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Micro Modeling of Retirement Decisions in Germany

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ABSTRACT

Early retirement in Germany is very costly and amplifies the burden which the German public pension system has to carry due to population aging. This paper shows that the German pension system provides strong incentives to retire early. The paper provides econometric estimates of these incentive effects on old age labor supply, using several specifications of the incentive variables and their covariates. These estimates are used to simulate the individual responses to three policy changes: (a) the adjustment factors for early retirement introduced by the 1992 pension reform will increase the retirement age of men by about 1.5 years; (b) this increase is almost the same as the effect of a shift in the "normal retirement" age from 65 to 67; (c) introducing close to actuarially fair adjustment factors (6% per year of delay) would increase the average retirement age by about 2 years and 2 months. The effects are about half the size for women.

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1 Introduction

Germans retire early. Average retirement age is about 59.5 years, half a year younger than the earliest eligibility age for old-age pensions and more than 5 years younger than the so called “normal” retirement age in Germany. Early retirement is a well appreciated social achievement among Germans, but it is costly. Since life expectancy at age 60 is about 17 years, a year of early retirement corresponds to more than 5% of pension expenditures.

This paper is part of a multi-stage research project on the causes for, and the effects of, early retirement.[1] Its significance stems from the mounting strain on the German public pension system. The German public pension, or as it is called in German, "public retirement insurance", was the first formal pension system when it was installed over 100 years ago, and has been a model for many social security systems in the world. It has been very successful in providing a high and reliable level of retirement income over the past 100 years. It has survived, although under severe modifications, through World Wars I and II, the Great Depression, and, most recently, the German unification.

However, times have changed. According to recent polls, most young people do not believe that they will receive a pension that will suffice for their old-age consumption, and the number of employees which are using the few existing loopholes to escape the otherwise mandatory retirement insurance system has increased dramatically. Adding to this nervousness, we have experienced two major pension reforms in 1992 and 2001, each of them dubbed „century reforms,“ and a constant flurry of minor changes between 1992 and 2001. The German public pension model is under siege, and there appear two main culprits for this: Negative incentive effects of the system, among them the incentives to retire early, which have reduced the number of contributors and increased

[1] See the country chapters in Gruber and Wise (1999) for the first stage.

the number of beneficiaries (the "system dependency ratio") since 1972, and population aging, which will increase the system dependency ratio from 2015 on even further, and this rather dramatically.

This paper is not the place to discuss population and its implications on the pension system.[2] Rather, we focus on the incentive effects to retire early. Figure 1 depicts the evolution of average retirement age among German men from 1960 through 1998, once disaggregated by old-age pensions and disability pensions, and once total.

Figure 1: Average age at first receipt of public pensions, 1960-1998.

Source: VDR (1999), male workers only.

The most obvious feature is the sudden change after 1972, when the retirement age drops sharply for both old-age and disability pensions. Within a few years, the average retirement age for old-age pensions dropped by about 3 years and has then stabilized. For disability pensions, we see a steady decline since 1972 that has not stopped yet. Composition effects – mainly caused by the tighter disability rules – have led to a consolidation of the total retirement age at about 59.5 years.

The year 1972 marks the first major pension reform after the current pay-as-you-go (PAYG) public pension system was installed in 1957. This reform introduced a "flexible" retirement age without actuarial adjustments of pension benefits. Without

[2] See Börsch-Supan (1998, 2000a) and Schnabel (1997a and b) for descriptions of the problems, and Birg and Börsch-Supan (1999) and Börsch-Supan (2001) for concrete reform proposals.

going further into details – see Börsch-Supan and Schnabel (1998) for a more detailed description and analysis – Figure 1 appears to be prima facie evidence for the incentives which pension rules create to retire early.[3]

Several formal econometric analyses based on micro data have studied the incentive effects of the non-actuarial adjustment on early retirement (Börsch-Supan, 1992; Schmidt, 1995; Siddiqui, 1997; Börsch-Supan, 1999 and 2000c). These studies employ variants of the microeconometric option value analysis developed by Stock and Wise (1990). Börsch-Supan (2000c) derives from the estimates that the 1992 reform will increase the average retirement age only by about half a year, and reduce retirement before age 60 from 32 percent to about 28 percent, while a switch to a system with actuarially fair adjustment factors would shift the retirement age by about two years. Indeed: these estimates are well in line with the drop in Figure 1. Börsch-Supan (1999) shows that in effect these estimates are robust even when much more sophisticated specifications are applied.

This paper departs from these econometric analyses. Its main purpose is to provide further econometric evidence for the strength of the incentive effects to retire early, based on micro data. It adds to the existing literature in at least four respects. First, this paper uses definitions and specifications that are comparable to the other countries in this volume. Second, the paper extends the comprehensive treatment of retirement as an option on several pathways in Börsch-Supan (1999) beyond the standard old-age and disability pension. Third, the paper exploits as much of the sample variation as possible; specifically, we include civil servants in our estimations. Fourth and finally, we apply a "family approach" to retirement options and compute the joint incentives for husband and spouse.[4]

The paper is structured as follows. Sections 2 and 3 describe the institutional background for private sector and civil servants' pensions. Section 4 present data and variable specifications. Section 5 contains our estimation results. Section 6 explores

[3] A competing explanation are labor demand effects due to rising unemployment. See Riphahn and Schmidt (1995) and Börsch-Supan (2000c) who show that there is no evidence in favor of this.

[4] See Coile (1999) for the significance of this extension.

what these estimates mean and simulates a set of pension reform steps. Section 7 concludes.

2 Private Sector Pensions

In this section we describe the German "public retirement insurance" ("Gesetzliche Rentenversicherung", GRV) which 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 percent of the workforce, have their own pension system, described in Section 3. The self-employed, about 9 percent of the work force, are mainly self-insured although some of them also participate in the public retirement insurance system. For the average worker, occupational pension do not play a major role in the German system of old-age provision, neither do individual retirement accounts, but there are important exceptions from this general picture. Broadly speaking, the German system is a monolith.

The following descriptions focus on the institutional rules that applied during our sample period 1984-1997 (dubbed "1972 legislation" although there have been several administrative adjustments since 1972). There have been two major pension reforms in 1992 and 2001. At several places, notably the last subsection, we briefly sketch their implications. The main provisions of the 1992 reform, however, did not affect the persons in our sample since generous grandfathering schemes applied.

2.1 Coverage and Contributions

The German pay-as-you-go public pension system features a very broad mandatory coverage of workers. Only the self-employed and, until 1998, workers with earnings below the official minimum earnings threshold („*Geringfügigkeitsgrenze*," 15 percent of average monthly gross wage; below this threshold are about 5.6 percent of all workers) are not subject to mandatory coverage.

Roughly 70 percent of the budget of the German public retirement insurance is financed by contributions that are administrated like a payroll tax, levied equally on employees and employers. Total contributions in 2000 are 19.3 percent of the first DM 8,600 of monthly gross income (upper earnings threshold, „*Beitragsbemessungsgrenze*," about

180 percent of average monthly gross wage).[5] Technically, contributions are split evenly between employees and employers. While the contribution rate has been fairly stable since 1970, the upper earnings threshold has been used as a financing instrument. It is anchored to the average wage and has increased considerably faster than inflation.

Private sector pension benefits are essentially tax free. Pension beneficiaries do not pay contributions to the pension system and to unemployment insurance. However, pensioners have to pay the equivalent of the employees' contribution to the mandatory medical insurance. The equivalent of the employers' contribution to health insurance is paid by the pension system.

The remaining approximately 30 percent of the social security budget are financed by earmarked indirect taxes (a fixed fraction of the value-added tax and the new "eco-tax" on fossil fuel) and a subsidy from the federal government. The subsidy is also used to fine-tune the pay-as-you-go budget constraint which has a minimal reserve of one month worth of benefits.

2.2 Benefit Types

The German public retirement insurance provides *old-age pensions* for workers aged 60 and older, *disability benefits* for workers below age 60 which are converted to old-age pensions latest at age 65, and *survivor benefits* for spouses and children. In addition, pre-retirement (i.e., retirement before age 60) is possible through several mechanisms using the public transfer system, mainly unemployment compensation. We begin by describing old-age pensions.

2.3 Eligibility for Benefits and Retirement Age for Old Age Pensions

Eligibility for benefits and the minimum retirement age depend on which type of pension the worker chooses. The German public retirement insurance distinguishes five types of old-age pensions, corresponding to normal retirement and four types of early retirement.

[5] West Germany only, DM 7,200 in East Germany. 1 DM has a purchasing power of approximately $0.50.

Table 1: Old-Age Pensions (1972 Legislation)

Pension type	Retire-ment age	Years of service	Additional conditions	Earnings test
A Normal	65	5		No
B: Long service life („flexible“)	63	35		Yes
C: Women	60	15	10 of those after age 40	Yes
D: Older disabled	60	35	Loss of at least 50% earnings capability	(yes)
E: Unemployed	60	15	1.5 to 3 years of unemployment (has changed several times)	Yes

Notes: This legislation was changed in the reform of 1992. It has been effective until the year 1998.

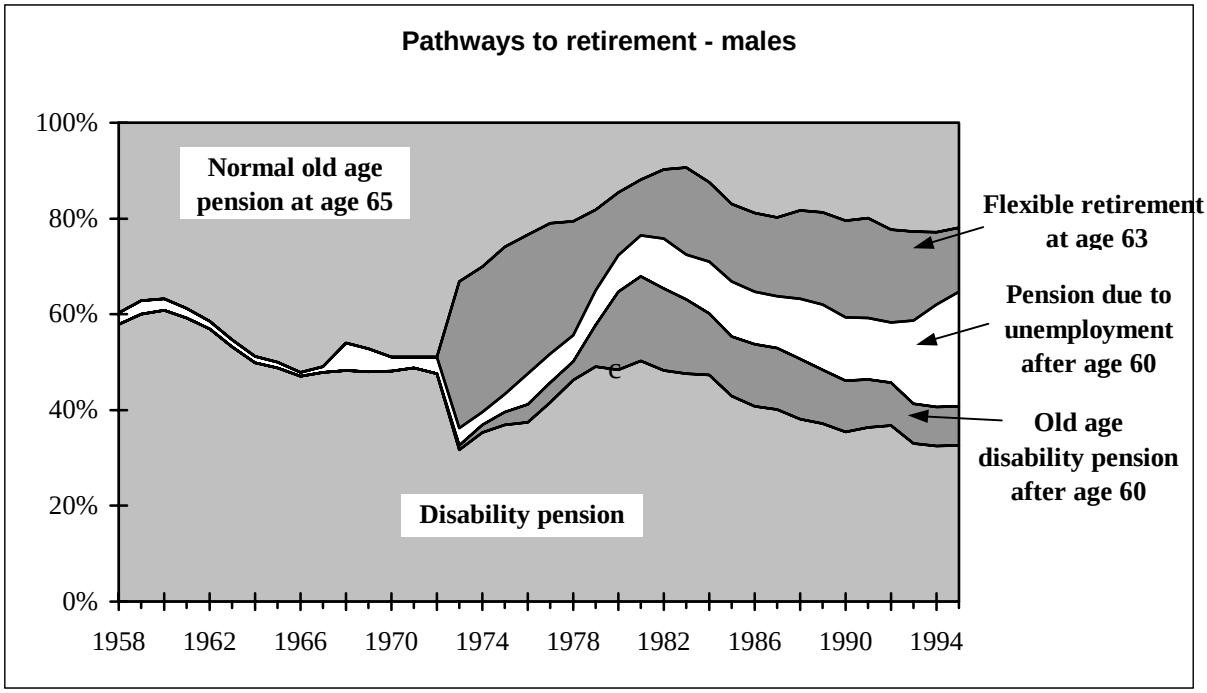
This complex system was introduced by the 1972 social security reform. One of the key provisions was the introduction of "flexible retirement" after age 63 with full benefits for workers with a long service history. In addition, retirement at age 60 with full benefits is possible for women, unemployed, and older disabled workers. "Older disabled workers" refers to those workers who cannot be appropriately employed for health or labor market reasons and are age 60 or older. There are three possibilities to claim old age disability benefits. One has to (1) be physically disabled to at least 50 percent, or (2) pass a strict earnings test, or (3) pass a much weaker earnings test. The strict earnings test is passed if the earnings capacity is reduced below the minimum earnings threshold for any *reasonable* occupation (about 15 percent of average gross wage) ("*erwerbsunfähig," EU*). The weaker earnings test is passed when no vacancies for the worker's *specific* job description are available and the worker has to face an earnings loss of at least 50 percent when changing to a different job ("*berufsunfähig," BU*). As opposed to the disability insurance for workers below age 60 (see below), full benefits are paid in all three cases.

Figure 2 shows the uptake of the various pathways,[6] including the disability pathway described below (adding to 100% on the vertical axis) and their changes over time (marked on the horizontal axis), mostly in response to reforms, benefit adjustments and administrative rule changes, in particularly the tightening of the disability screening

[6] See Jacobs, Kohli and Rein (1990) for this concept.

process. This figure shows the multitude of possible pathways. A major undertaking of this paper is to take account of this diversity.

Figure 2: Pathways to Retirement, 1960-1995.



Source: Börsch-Supan and Schnabel (1999)

The 1992 social security reform and its subsequent modifications, the age limits types of early retirement will gradually be raised to age 65. These changes will be fully be phased in by the year 2004. The only distinguishing feature of types B and C of "early retirement" will then be the possibility to retire up to five years earlier than age 65 if a sufficient number of service years (currently 35 years) has been accumulated. As opposed to the pre-1992 regulations, benefits will be adjusted to a retirement age below age 65 in a fashion that will be described below.

2.4 Benefits

Benefits are strictly work-related. The German system does not have benefits for spouses like in the U.S.[7] Benefits are computed on a life-time basis and adjusted according to the type of pension and retirement age. They are the product of four

[7] There are, of course, survivor benefits.

elements: (1) the employee's relative earnings position, (2) the years of service life, (3) adjustment factors for pension type and (since the 1992 reform) retirement age, and (4) the average pension. The first three factors make up the "personal pension base" while the fourth factor determines the income distribution between workers and pensioners in general.

The employee's relative contribution position is computed by averaging her or his annual relative contribution positions over the entire earnings history. In each year, the relative contribution position is expressed as a multiple of the average annual contribution (roughly speaking, the relative income position). A first element of redistribution was introduced in 1972 when this multiple could not fall below 75 percent for contributions before 1972 provided a worker had a service life of at least 35 years. A similar rule was introduced in the 1992 reform: for contributions between 1973 and 1992, multiples below 75 percent are multiplied by 1.5 up to the maximum of 75 percent, effectively reducing the redistribution for workers with income positions below 50 percent.

Years of service life are years of active contributions plus years of contribution on behalf of the employee and years that are counted as service years even when no contribution were made at all. These include, for instance, years of unemployment, years of military service, three years for each child's education for one of the parents, some allowance for advanced education etc., introducing a second element of redistribution. The official Government computations such as the official replacement rate („Rentenniveau") assume a 45-year contribution history for what is deemed a „normal earnings history" („Eckrentner"). In fact, the average number of years of contributions is about 38 years. Unlike to the U.S., there is neither an upper bound of years entering the benefit calculation, nor can workers choose certain years in their earnings history and drop others.

Since 1992, the average pension is determined by indexation to the average net labor income. This solved some of the problems that were created by indexation to gross wages between 1972 and 1992. Nevertheless, wage rather than cost of living indexation makes it impossible to finance the retirement burden by productivity gains.

The average pension has provided a generous benefit level for middle income earnings. The net replacement rate for a worker with a 45-year contribution history is 70.5% in 1998. For the average worker with 38 years of contributions, it is reduced in proportion to 59.5%. Unlike to the U.S., the German pension system has only little redistribution as

is obvious from the benefit computation.[8] The low replacement rates for high incomes result from the upper limit to which earnings are subject to social security contributions – they correspond to a proportionally lower effective contribution rate.

Before 1992, *adjustment of benefits to retirement age* was only implicit via years of service. Because benefits are proportional to the years of service, a worker with fewer years of service will get lower benefits. With a constant income profile and 40 years of service, each year of earlier retirement decreased pension benefits by 2.5 percent, and vice versa.

The 1992 social security reform will change this by the year 2004. Age 65 will then act as the "pivotal age" for benefit computations. For each year of earlier retirement, up to five years and if the appropriate conditions in Table 1 are met, benefits will be reduced by 3.6 percent (in addition to the effect of fewer service years). 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 6 percent in addition to the "natural" increase by the number of service years.

Table 2 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 (normalized to 100 percent) 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, the table also displays the corresponding adjustments in the United States and actuarially fair adjustments at a 3 % discount rate.[9]

[8] See Casmir (1989) for a comparison.

[9] The actuarially fair adjustments equalize the expected social security wealth for a worker with an earnings history starting at age S=20. A higher discount rate yields steeper adjustments.

Table 2: 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				
	Germany		United States		Actuarially
Age	pre-1992[a)]	post-1992[b)]	pre-1983[c)]	post-1983[d)]	fair[e)]
62	100.0	89.2	80.0	77.8	80,5
63	100.0	92.8	86.7	85.2	86,3
64	100.0	96.4	94.4	92.6	92,8
65	100.0	100.0	100.0	100.0	100,0
66	107.2	106.0	103.0	105.6	108,1
67	114.4	112.0	106.0	111.1	117,2
68	114.4	118.0	109.0	120.0	127,4
69	114.4	124.0	112.0	128.9	139,1

Notes: a) GRV 1972–1992. b) GRV after 1992 reform has fully phased in. c) US-Social Security (OASDHI) until 1983. d) US-Social Security after 1983 Social Security Reform has fully phased in. e) Evaluated at a 3% discount rate, 1992/94 mortality risks of West-German males and an annual increase in net pensions of 1%. *Sources*: Börsch-Supan and Schnabel (1999).

While neither the German nor the American system were actuarially fair prior to the reforms, the public retirement system in Germany as enacted in 1972 was particularly distortive. There was less economic incentive for Americans to retire before age 65 and only a small disincentive to retire later than at age 65 after the 1983 Reform, while the German social security system tilted the retirement decision heavily towards the earliest retirement age applicable. The 1992 Reform has diminished but not abolished this incentive effect.

2.5 Disability and Survivor Benefits

The contributions to the German retirement insurance also finance *disability benefits* to workers of all ages and *survivor benefits* to spouses and children. In order to be eligible for *disability benefits*, a worker must pass one of the two earnings tests mentioned earlier for the old-age disability pension. If the stricter earnings test is passed, full benefits are paid („*Erwerbsunfähigkeitsrente*," *EU*). If only the weaker earnings test is passed and some earnings capability remains, disability pensions before age 60 are only two-thirds of the applicable old age pension („*Berufsunfähigkeitsrente*," *BU*). In the 1970s and early 1980s, the German jurisdiction has interpreted both rules very broadly, in particular the applicability of the first rule. Moreover, jurisdiction also overruled the

earnings test (see below) for earnings during disability retirement. This lead to a share of *EU*-type disability pensions of more than 90 percent of all disability pensions. Because both rules were used as a device to keep unemployment rates down, their generous interpretation has only recently lead to stricter legislation.[10]

Survivor pensions are 60 percent 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 percent („*kleine Witwenrente*"). Survivor benefits are a large component of the public pension budget and of total pension wealth as will be shown in part III. 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 percent) share of widows. Only since recently, male and female survivors are treated symmetrically. As mentioned before, the German system does not have a married couple supplement for spouses of beneficiaries. However, most wives acquire their own pension by active and passive contribution (mostly years of advanced education and years of child education).

2.6 Pre-Retirement

In addition to benefits through the public pension system, transfer payments (mainly unemployment compensation) enable what is referred to as „pre-retirement".Labor force exit before age 60 is frequent: about 45 percent of all men call themselves „retired" at age 59. Only about half of them retire because of disability; the other 50 percent make use of one of the many official and unofficial pre-retirement schemes.

Unemployment compensation has been used as pre-retirement income in an unofficial scheme that induced very early retirement. Before workers could enter the public pension system at age 60, they were paid a negotiable combination of unemployment compensation and a supplement or severance pay. At age 60, a pension of type E (see table 1) could start. As the rules of pensions of type E and the duration of unemployment benefits changed, so did the "unofficial" retirement ages. Age 56 was particularly frequent in West Germany because unemployment compensation is paid up to three years for elderly workers; it is followed by the lower unemployment aid. Earlier retirement ages could be induced by paying the worker the difference between the last salary and unemployment compensation for three years; and further years the difference between the last salary and unemployment aid – it all depended on the so-called „social plan" which a firm would negotiate with the workers before restructuring the work force.

[10] See Riphahn (1995) for an analysis of disability rules.

In addition, early retirement at age 58 was made possible in an official pre-retirement scheme ("Vorruhestand"), in which the employer received a subsidy from the unemployment insurance if a younger employee was hired. While the first (and unofficial) pre-retirement scheme was very popular and a convenient way to overcome the strict German labor laws, few employers used the official second scheme.

2.7 Retirement Behavior

The retirement behavior of entrants into the German public retirement insurance system has been summarized by Figures 1 and 2. The average retirement age in 1998 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, see Figure 2, 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.

2.8 Pension Reform

During and since our sample period, there have been two major pension reforms, 1992 and 2001, and many smaller adjustments in between. The main changes in the 1992 reform were to anchor benefits to net rather than to gross wages. This implicitly has reduced benefits since taxes and social security contributions have increased, reducing net relative to gross wages. This mechanism is particularly important when the population aging will speed up. The other important change in 1992 was the introduction of adjustments to benefits in some (not all) cases of early retirement and a change in the "normal" retirement age for women. They have been described in subsection 2.4. They will be fully effective in 2004 and reduce the incentives to retiree early, however, they are still not actuarially fair even at very low discount rates.[11]

The 2001 reform is intended to change the monolithic German system of old-age provision to a genuine multi-pillar system. Benefits will gradually be reduced by about 10%, lowering the replacement rate with respect to the average net earnings from 72% in 1997 to 64% in 2030. The effective benefit cuts are even larger since the credit of earnings points for education and training will be greatly restricted. On the other hand, a redefinition of the "official" replacement rate minimizes the perception of these cuts because the so-defined new replacement rate will be 67% with respect to a smaller net

[11] Not even at zero.

earnings base. The resulting "pension gap" of slightly less than 20% of the current retirement income is supposed to be filled with occupational and individual pensions. This new pillar is not mandatory, but the required private savings will be subsidized or tax privileged. The 2001 reform does not change the "normal" retirement age or the adjustments factors with respect to early retirement age that provide the large incentives to retire early, the main subject of this paper.

3 Public Sector Pensions

There are two types of workers in the public sector: civil servants and other public sector workers. As already mentioned, the latter are part of the same system as the private sector workers described in the previous sector. In addition, they participate in a supplemental system, which resembles occupational pensions elsewhere and raises the pensions of public sector workers to the level of civil servants.

Civil Servants do not pay explicit contributions for their pensions as the other employees in the private and public sectors do.[12] Instead, the "gross" wage for civil servants is lower than the gross wage of other public sector employees with a comparable education. Civil servants acquire pension claims that are very generous compared to workers in the private sector.

3.1 Eligibility: Pathways to retirement for civil servants

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. Discount factors for early retirement are phasing 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 and substantially smaller than actuarially fair. Since our sample covers the years 1984 to 1997, these changes of rules do not play a role in our analysis.[13]

[12] 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.

[13] 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.

Filing for disability is a third pathway to retirement for civil servants. In the case of disability a civil servant receives a pension which is based on his or her previous salary. The replacement rate depends on the number of service years reached before disability retirement and the number of service years that could potentially have been accumulated to age 60. For those who did not reach the maximum replacement rate before disability, one additional year of service raises the replacement rate by only 1/3 percentage point per year.

3.2 Computation of pensions

The standard pension benefit for civil servants is the product of three elements: (1) the last gross earnings level, (2) the replacement rate as function of service years, and (3) the new adjustment factors to early retirement. As described above, this third component does not affect our sample persons. There are three crucial differences between civil servants pensions and private sector benefits. First, the benefit base is gross rather than net income. In turn, civil servants' pensions are taxed like any other income. Finally, the benefit base is the last salary rather than the life-time average.

In the following, we concentrate on describing how the system worked for the sample period 1984-97. Benefits are anchored to the earnings in the last position and then updated annually by the growth rate of the net earnings of active civil servants. If the last position was reached within the last two years before retirement, the pension is based on the previous, lower position. Due to the difference in the benefit base, gross pensions of civil servants are approximately 25 percent higher (other things being equal) than in the private sector.

The maximum replacement rate is 75 percent of *gross* earnings which is considerably higher than the official replacement rate of the private sector system which is around 70 percent of *net* earnings. The replacement rate depends on the years of service. High school and college education, military service, and other work in the public sector are also counted as service years. For retirement after June 1997 the college education credit is limited to 3 years.

Before 1992 the replacement rate was a non-linear function of service years. The replacement rate started at a value of 35 percent for all civil servants with at least 5 years of service. For each additional year of service between the 10^{th} and the 25^{th} year the increment was 2 percentage points. From the 25^{th} to the 35^{th} year the annual increment was one percent. Thus, the maximum replacement rate of 75 percent was

reached with 35 service years under the old rule. This is much more generous than the private sector replacement rate of 70 percent which requires 45 years of service.

For persons retiring after January 1, 1992 the replacement rate grows by 1.875 percentage points for each year of service. Thus, the maximum value is reached after 40 years of service. However, there are transitional modifications to that simple rule. First, civil servants who reach the standard retirement age (usually age 65) before January 1, 2002 are not affected at all. Second, for younger civil servants, all claims that have been acquired before 1992 are conserved. These persons gain one additional percentage point per year from 1992 on. All persons who have acquired 25 service years before 1992 have reached 65 percentage points and would also have gained only one additional point per year under the old rule. Only persons with less than 25 service years in 1991 can be made worse off by the reform. The new proportional rule only applies if it generates a higher replacement rate than the transitional rule. Our calculations of pension wealth use these institutional changes, but only a few special cases are affected.

The generosity of gross pensions received by civil servants vis-a-vis the private sector workers is only partially offset by the preferential tax treatment of private sector pensions. Since civil servants' pensions are taxed according to the German comprehensive income taxation, the net replacement rates of civil service pension recipients depends on their position in the highly progressive tax schedule. In general, the net replacement rate with respect to the pre-retirement net earnings is higher than 75 percent and thus considerably more generous than in the private sector.

3.3 Incentives to retire

In our sample, most civil servants have reached the maximum replacement rate by the age of 54. Persons who have started to work in the public sector before the age of 23 have reached a replacement rate of 75 percent when taking into account the disability rules. This also holds for civil servants, who – like professors – receive lifetime tenure late in their life-cycle. For those groups the starting age is usually set to age 21. Additional years of service beyond the age of 54 increase pensions only if the civil servant is promoted to a position with a higher salary. Retirement incentives therefore strongly depend on promotion expectations.

For persons who cannot expect to be promoted after age 54 the pension accrual is zero or very small. For those who have already reached the replacement rate of 75 percent, the accrual of the present discounted pension wealth is negative. Since the replacement rate is 75 percent of the gross earnings in the last position before retirement, the

negative accrual of postponing retirement by one year is simply 75 percent of the last gross earnings. This is equivalent to a 75 percent tax on earnings.

For persons who expect to climb another step in the hierarchy the gross wage increase is on average 10.5 percent. This raises the pension by approximately 10 percent. In order to cash in the higher pension, the civil servant has to defer retirement by at least one year.[14] In this extreme case the social security wealth increases 10 percent through the effect of higher pensions and decreases by 5 percent through the effect of pension deferral. In this extreme case the pension accrual is positive. If the civil servant has to wait several years for the next promotion (or for the promotion to have an effect on pension claims) the accrual of working becomes negative.

The dependency on promotion expectations makes modeling the incentive effects for civil servants very hard, since the researcher needs information on the career prospects of the respondent. We do not have such information in our data and must therefore ignore the effect of potential promotions.

3.4 Retirement behavior

The retirement behavior of civil servants reflects the very generous disability and early retirement rules. The average retirement age for civil servants in the year 1993 was age 58.9 and thus about one year lower than in the private sector, see Section 2.7. Disability is the most important pathway to retirement for civil servants: 40 percent of those who retired in the year 1993 used disability retirement. Almost one third used the early retirement option at the age of 62. Only about 20 percent of civil servants retired at the regular retirement age of 65.

[14] For the higher earnings to take effect on pensions it is usually required to work several years after the promotion.

4 Data and Variable Specification

Our main data source is the German Socio-Economic Panel (GSOEP), described below. The remaining subsections are devoted to the variable construction, notably the definition of retirement status, which acts as our dependent variable, and the incentive variables, which act as our main explanatory variables. Aggregate information is provided by the German retirement insurance organization ("Verband deutscher Versicherungträger", VDR) who publishes annual statistics on average earnings, system entries, retirement age, etc. ("Rentenversicherung in Zeitreihen"), and by the Labor Ministry (BMA, 1999).

4.1 The German Socio-Economic Panel

The German Socio-Economic Panel (GSOEP) is an annual panel study of some 6000 households and some 15000 individuals. The data are gathered by the *German Institute for Economic Research* (DIW). The GSOEP is a panel survey of private households. Its design closely corresponds to the U.S. Panel Study of Income Dynamics (PSID).[15] The GSOEP includes carefully designed household weights that match the data with the German *Mikrozensus*. The panel started in 1984. We use 14 annual waves through 1997.

In 1997, the GSOEP had four subsamples: (A) West German citizens (9000 persons in 1984); (B) Foreign workers from Spain, Italy, Greece, Turkey and former Yugoslavia residing in West Germany (3000 persons in 1984, oversampled); (C) East German citizens (4000 persons sampled from 1991 on); and (D) Germans who have re-migrated (mainly from Romania and the former USSR) (1000 persons sampled in 1995). We draw our working sample from samples A and B since the labor supply patterns of East Germans and re-migrants are substantially different from residents in West Germany such that pooling these samples is not warranted.[16]

[15] 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.

[16] Schmähl (1991) provides a narrative of the transition.

We constructed a both-sided unbalanced panel of all persons aged 55 through 70 from subsamples A and B for which earnings data is available.[17] This panel includes 2223 individuals with 14401 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. There is only little right censoring due to missing interviews. Specifically, foreign workers often leave Germany after retirement. However, since this affects only a few cases, we did not model this censoring. The sample contains private sector workers, civil servants and other public sector workers, and self-employed.

The GSOEP data provide a detailed account of income and employment status. Since the GSOEP performs personal interviews with each member aged 17+ in the household, we have the same information on husbands and spouses. The personal information includes labor market status, gross and net income, hours worked, education, marital status but only a subjective indicator of health (plus disability status, and number of doctor and hospital visits). The GSOEP also has a very detailed "labor market calendar" that provides monthly information on the labor market status (full time, part time, retired, unemployed, education) and its corresponding income for each sample person. This detailed information during the sample period is augmented by a retrospective history of labor force participation that starts with age 15. It carries the annual labor market status (full time, part time, unemployed, out-of-labor force, etc.) but has no retrospect earnings information.

Table 3 presents the descriptive statistics of the most common socio-economic variables in our working sample.

[17] 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.

Table 3: Descriptive Statistics of Main Variables

Variable	Valid observations	Mean	Standard Deviation	Minimum	Maximum
Age	14401	59.77	4.88	53	70
Health	14401	8.09	3.05	0	10
Married	14401	86%	34%	0	1
College	14401	11%	31%	0	1
Skilled	14401	86%	58%	0	2
Homeown	14398	52%	50%	0	1
No wealth	14312	11%	31%	0	1
Financial assets	14401	22%	42%	0	1
Experience	14401	450.29	96.01	0	646
Former self-empl.	14401	9%	29%	0	1
Former civil serv.	14359	8%	27%	0	1
Children in hh.	14401	33%	47%	0	1

Source: GSOEP, working sample of males, 1984-1997

4.2 Construction of Earnings Histories

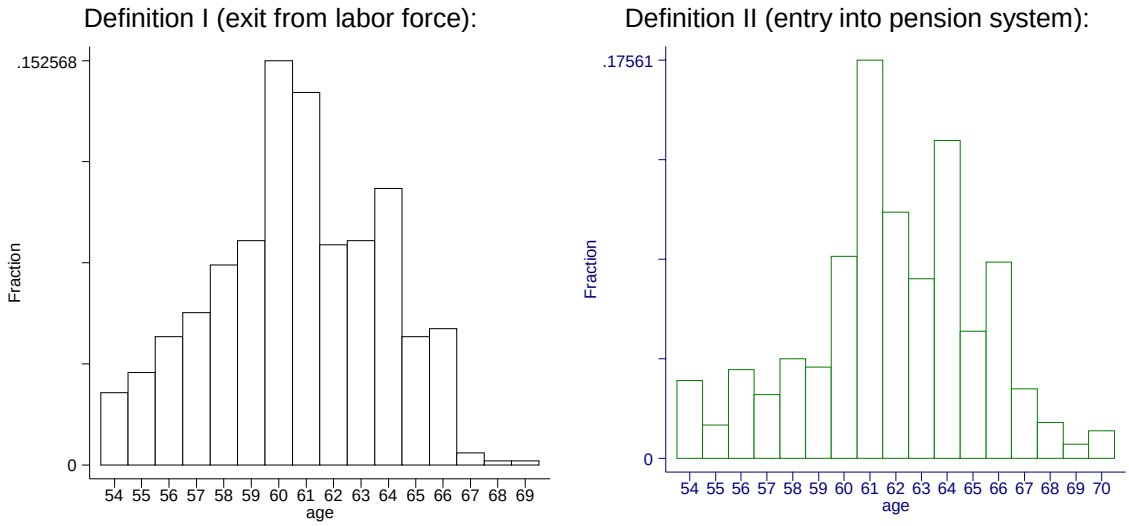
Since the benefit formula for private sector pensions depends on earnings points computed from relative income positions, and since civil servants' pensions depend on the last salary, we do not need a complete earnings history of our sample persons. Information on the earnings position in each year relative to the aggregate average of that year is sufficient. We have this information for the sample period but not for earlier years. We therefore estimate the average relative earnings position (EP) using all non-retired, full or part time workers in the sample who have a positive wage. We fit a fixed effects model for EP. The fixed effects absorb the constant covariates (e.g., education, marital status, race). All aggregate year specific covariates drop out since we estimate the relative earnings position. This procedure makes the most efficient use of our earnings data.

In the forward projection, we need a forecast of the absolute earnings level. In retrospect, we recover this by multiplying EP, the average relative earnings position, with the aggregate level of earnings which we take from the VDR statistics. For future years, we assume a 1 percent real wage growth, corresponding to the average over the last 25 years.

4.3 Definition of Retirement Status

The definition of the retirement status is problematic. Retirement definitions commonly employed in the literature include 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. In many countries (e.g., the U.S., see Rust, 1990) these definitions do not coincide for a large fraction of old-age workers. The problem is somewhat less severe in Germany, although there are some differences such as the more distinct "spikes" at the legal ages (described in Table 1) as can be seen from Figure 3:

Figure 3: Retirement Status by Alternative Definitions



Source: GSOEP, working sample of males, 1984-1997

The persons in our sample appear to have a very general notion of retirement since, when asked about their labor market status, they consider the receipt of benefits from pre-retirement schemes as well as from the formal retirement programs as "retirement". It seems as if they consider different programs as close substitutes. For instance, persons who receive severance pay from their former employers plus unemployment compensation generally claim to be "retired". Moreover, our sample persons rarely report significant hours worked after the receipt of pension benefits.

Our first measure of retirement (definition I) is thus the self-assessment as "retired" and our results presented below are based on this definition. One additional reason for

treating this as retirement is the fact that, after giving up the career job, there is no choice left. For instance, persons in pre-retirement schemes are automatically shifted from unemployment benefits to old-age pensions of type E (see Table 1) at age 60.

We also tried out other definitions.[18] For instance, we know whether persons received formal pension benefits. A definition based on this excludes some forms of early retirement (definition II). We then add persons to definition I who receive formal pensions but do not consider themselves as being retired, e.g. many self-employed. This definition III (the joint set of I and II) is the broadest definition.

4.4 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.

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 2. We refer to these choices as "pathways" as we have done in Figure 2. It is important to notice that all of these pathways pay the same benefit, once a person is eligible.[19]

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, notably the determination of a workers' disability status.[20]

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. We

[18] Using one of the other measures does not change the qualitative results. We find that the first measure of retirement works best.

[19] 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.

[20] "Disability" depends on health as well as labor market characteristics.

used two methods. The first method considers only strict eligibility, thus implicitly assumes that every individual who wants to obtain a disability pension will eventually be granted one. Hence expected benefits at a given age are zero, if the person is not eligible to any of the pathways, otherwise the (common) benefit for that given age. For example, those self-employed who pay voluntary contributions are only eligible for early retirement – namely disability – if they have contributed continuously since 1984 (the date of a major reform of voluntary participation), otherwise they can retire at the age of 63 at the earliest.[21] In the latter case the pension will be zero for all retirement ages below 63.

The second method weights the benefits by its observed frequency. 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. Börsch-Supan (1999) explores the sensitivity of estimation results to these two methods, and provides an instrumental variables interpretation of the second method. This second method is our method of choice and the only one reported in this paper.

4.5 Construction of Social Security Wealth

A key statistic to measure the incentives to retire early is the change in the net present value of all future benefits when retirement is postponed. In a slight misuse of terminology, we call the net present value of all future benefits "social security wealth" (SSW) for both private sector and civil servants' pensions. If social security wealth declines because the increase in the annual pension due to postponement of retirement is not large enough to offset the shorter time of pension receipt, workers have a financial incentive to retire earlier.

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

[21] See Schnabel (1999) for details.

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

with:

SSW	net present discounted value of retirement benefits
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. 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 Börsch-Supan (1995). This internal consistency is important. Assume a policy proposal, which reduces the replacement rate by 20 percent. This immediately lowers the contribution rates by 20 percent if the system is PAYG and financed through contributions. The effect on SSW is ambiguous and varies by cohort.

Table 4 shows the average social security wealth in our sample and its change for each individual, the accrual of social security when retirement is postponed by one year. Note that the averages in the right panel are not the first differences of the average SSW in the left panel since the aggregate figures relate to different individuals in our unbalanced panel.

Table 4: Social Security Wealth and its Accrual

	SSW			Accrual		
Age	**Mean**	**Stddev**	**Nobs**	**Mean**	**Stddev**	**Nobs**
54	167.209	82.603	913	-10.084	5.083	913
55	169.280	80.628	948	-10.494	5.175	948
56	166.391	80.242	930	-8.327	4.356	930
57	168.211	80.550	885	-8.730	4.651	885
58	171.161	81.672	812	-8.991	4.612	812
59	170.002	81.828	736	-9.360	4.713	736
60	172.426	80.792	656	-8.565	4.565	656
61	175.892	81.324	572	-8.929	4.690	572
62	182.616	77.848	507	-9.064	4.780	507
63	191.603	75.784	434	-10.997	4.302	434
64	194.370	76.811	375	-11.643	4.512	375
65	194.654	76.697	325	-12.149	4.652	325
66	197.866	76.820	275	-12.855	4.846	275
67	197.180	76.052	225	-13.374	5.038	225
68	196.372	77.633	182	-13.869	5.330	182
69	196.469	78.187	144	-14.424	5.637	144
Total	**175.948**	**80.691**	**8919**	**-9.908**	**4.995**	**8919**

Note: All figures in 1995 Euro. 1 Euro has a purchasing power of about $1.00.

4.6 Specification of Incentive Variables

We computed five different incentives measures:

- ACCRUAL: the accrual of social security wealth if retirement is postponed by 1 year,
- ACCRUALRATE: the accrual divided by the level of social security wealth,
- TAXRATE: the accrual divided by the (potential) gross earnings during the year of postponement,
- PEAKVAL: the maximum of future SSW over all possible retirement ages minus the SSW for immediate retirement, and
- OPTVAL: the option value of postponing retirement by 1 year.

The pension wealth accrual function, a function of the retirement age R, is the change in social security wealth when retirement is postponed from age R-1 to age R. We have seen this first incentive variable already in Table 4. We convert this variable in a rate by defining

$$ACCR_S(R) = [SSW_S(R) - SSW_S(R\text{-}1)] / SSW_S(R\text{-}1).$$

It is displayed in Table 5. The lack of actuarial fairness of the German public pension system creates a negative accrual of pension wealth during the early retirement window between 5 and 8% when retirement is postponed by one year. The average loss in our sample is about DM 10,000 (roughly US $ 5,000 at purchasing power parity).

A negative accrual can be interpreted as a tax on further labor force participation. We therefore compute as implicit tax rate the ratio of the (negative) social security wealth accrual to the gross wage (*YLAB*) that workers would earn if they would postpone retirement to age *R*:

$$TAXR_S(R) = - [SSW_S(R) - SSW_S(R\text{-}1)] / YLAB_R.$$

This implicit tax rate can be rewritten as the product of two terms. The first term represents the effect of postponing retirement through mortality, discounting, and the adjustment of benefits to retirement age, while the second term is the net replacement rate $YRET_R/YLAB_R^{NET}$

$$TAXR_S(R) = [\, a_R \cdot \delta \cdot (\psi\text{-}1) - 1 \,] \cdot REPL_R$$

If benefits are actuarially fair in a financial sense, $\psi = 1 + 1/a_R \cdot \delta$, and the resulting tax rate is zero. This is not the case in Germany, see Table 5. It shows that the early retirement incentives in Germany have been strong. The tax rate at age 60 was about 30%, increased with the retirement age and exceeded 40% at age 65. These numbers refer to the pre-1992 legislation applicable to our sample. Today's implicit tax rates are about half of those in Table 5, see Börsch-Supan and Schnabel (1999).

Table 5: Accrual Rates and Implicit Tax Rates

	Accrual rate			Implicit Tax Rate		
Age	**Mean**	**Stddev**	**Nobs**	**Mean**	**Stddev**	**Nobs**
54	-7.7%	15.1%	885	34.4%	13.5%	886
55	-8.3%	16.6%	927	35.7%	13.0%	923
56	-6.9%	14.4%	904	28.6%	11.6%	908
57	-7.7%	17.3%	862	29.6%	11.8%	866
58	-7.2%	14.3%	788	30.4%	11.4%	798
59	-8.2%	18.2%	711	31.9%	11.6%	726
60	-8.0%	20.3%	637	29.4%	11.4%	648
61	-7.6%	20.2%	553	30.6%	11.0%	568
62	-5.0%	1.7%	493	31.8%	11.7%	502
63	-5.8%	0.4%	432	37.9%	6.8%	431
64	-6.0%	0.4%	374	40.1%	7.0%	374
65	-6.3%	0.4%	325	42.2%	6.6%	325
66	-6.5%	0.5%	275	44.5%	6.7%	275
67	-6.8%	0.5%	225	47.0%	7.0%	225
68	-7.1%	0.5%	182	49.6%	7.5%	182
69	-7.4%	0.5%	144	51.8%	7.1%	143
Total	**-7.2%**	**14.3%**	**8717**	**34.1%**	**12.4%**	**8780**

These first three measures of one-year accrual only account for the immediate benefit to working an additional year. But an additional year of work also sustains the option of retiring at an even later date. The value of this choice can be important if there are large non-linearities in the accrual profile. For example, if there is a small negative accrual at age 59, but a large positive accrual at age 60, it would be misleading to say that the system induces retirement at age 59; the disincentive to work at that age is dominated by incentives to work at age 60.

One way of capturing this possibility is to use the "peak value" calculation suggested by Coile and Gruber (1999). Rather than taking the difference between SSW today and next year, peak value takes the difference between SSW today and in the year in which the expected value of SSW is maximized:

$PEAKVAL_S(R) = SSW_S(R) - \max_{T>R}[SSW_S(T)]$.

This measure therefore captures the tradeoff between retiring today and working until a year with a much higher SSW. In years beyond the year in which SSW peaks, this calculation collapses to the simple one-year accrual variable. In fact, PEAKVAL turns

out to be virtually identical to ACCRUAL since pension accrual is negative in most cases for the whole sequence of retirement ages, see the averages in Table 6.

All these measures include the financial aspects of the retirement decision only. Alternatively, one might consider the consumption utility of net earnings and pension benefits and also account for the utility aspects of the labor-leisure tradeoff. To this end, we employ as the fifth and final incentive variable 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 utility that depends on this retirement age) and keeping all options open for some later retirement date (with associated streams of utility for all possible later retirement ages).

Let $V_t(R)$ denote the expected discounted future utility at age t if the worker retires at age R, specified as follows:

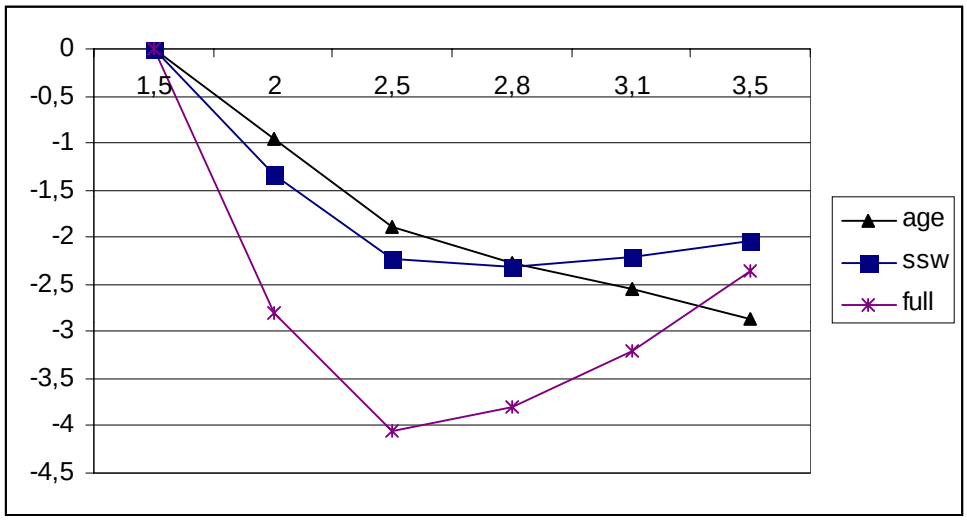
$$V_t(R) = \sum_{s=t}^{R-1} \mathrm{u}(YLAB_s^{NET}) \cdot a_s \cdot \delta^{s-t} + \alpha \sum_{s=R}^{\infty} \mathrm{u}(YRET_s(R)) \cdot a_s \cdot \delta^{s-t}$$

with	$YLAB_s^{NET}$	after–tax labor income at age s, s=t...R-1,
	$YRET_s(R)$	pension income at age s, s>R,
	R	retirement age,
	α	marginal utility of leisure, to be estimated,
	a	probability to survive at least until age s,
	δ	discount factor = 1/(1+r).

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

We employed a grid search for the parameter α, applied to three specifications, see Figure 4 below. The parameter gets smaller the more covariates are used: it is larger than 4 if only a second-order age polynomial is included (plus option value), 2.8 if initial social security wealth is added, and 2.5 if a large set of regressors including a full set of age dummies is added, see Table 7.

Figure 4: Grid Search for Three Estimation Variants



Source: Own estimates based on GSOEP panel, males. See text for explanation of legend.

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 $R^*(t)$ denote the optimal retirement age if the worker postpones retirement past age t, i.e., $\max(V_t(r))$ for $r>t$. With this notation, the option value is

$$G(t) = V_t(R^*(t)) - V_t(t).$$

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 $YRET_s(R)$ depends on retirement age according to the adjustment factors and on previous labor income by the benefit rules summarized in Sections 2 and 3. The option value is also closely linked to the pension accrual. This is most easily seen in a simple two-period comparison and for $\gamma=1$. In this crude approximation, a worker of age R in the first period will retire early if

$$\alpha \cdot W(R) > YLAB^{NET} + \alpha \cdot W(R+1)$$

where $W(t)$ denotes the present discounted value of pension benefits when retiring at age t. Using the definition of $TAXR(R)$, it follows that a worker will retire in the first

period if $TAXR(R) > 1/\alpha$. Hence, according to this crude approximation, the tax rates well above 50% exerted by the current public pension system in Germany will lead to early retirement.

We compute the option value for every person in our sample, using the applicable pension regulations and the imputed earning histories. The parameters chosen are a discount rate δ of 3%, a curvature parameter γ of 1.0, and a relative utility parameter α of 2.8. Additional private pension income is ignored because it represents only a very small proportion of retirement income as described before. Table 6 shows the sample averages.

Table 6: Peak Value and Option Value

	Peak Value			**Option Value**		
Age	**Mean**	**Stddev**	**Nobs**	**Mean**	**Stddev**	**Nobs**
54	-10.084	5.085	913	66.414	111.233	913
55	-10.493	5.176	948	61.179	101.163	948
56	-8.326	4.357	930	59.015	93.312	930
57	-8.728	4.652	885	55.770	118.974	885
58	-8.986	4.622	812	49.709	115.357	812
59	-9.320	4.764	736	42.628	98.487	736
60	-8.531	4.612	656	33.888	51.254	656
61	-8.904	4.717	572	25.936	44.513	572
62	-9.064	4.780	507	15.646	33.281	507
63	-10.997	4.302	434	5.900	16.255	434
64	-11.643	4.512	375	2.806	12.175	375
65	-12.149	4.652	325	0.428	7.975	325
66	-12.855	4.846	275	-1.341	6.873	275
67	-13.374	5.038	225	-3.188	5.724	225
68	-13.869	5.330	182	-4.984	4.855	182
69	-14.424	5.637	144	-6.642	4.029	144
Total	**-9.900**	**5.007**	**8919**	**38.167**	**87.540**	**8919**

Note: All figures in 1995 Euro. 1 Euro has a purchasing power of about $1.00.

5 Regression results

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 – unlike the competing risk analysis of Sueyoshi (1989). We use definition I for being "retired" based on the self-assessed labor force status (see Section 4.3).

In each of the following regressions, our main explanatory variable is one four of the incentive variables described in the previous section: accrual rate, implicit tax rate, peak value (which is essentially identical to the accrual of social security wealth) and option value. The other explanatory variables are the usual suspects: an array of socio-economic variables such as gender, marital status, wealth (indicator variables of several financial and real wealth categories) and a self-assessed health measure ranging from 0 for poor to 10 for excellent health. 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.

Table 7: Definitions of Other Explanatory Variables

Age	Age of person
Married	Marital status: 1=married, 0=not married
Health	0=poor, ..., 10=excellent
College	1=college degree, 0=else
Medium skilled	1=medium skilled (only vocational training or high school)
Homeowner	1=homeowner
No assets	1="no wealth"
Financial assets	1=owner of financial assets
Exp	work experience
Yhat	estimated labor income
Former self-employed	self employed before retirement
Former civil servant	civil servant before retirement
Kids	children in the household

We link the explanatory variables to the dependent variable by a binary probit model. This does some injustice to the panel nature of our data and probably underestimates the

true effect, see Börsch-Supan (1999) who experiments with several specifications of panel probit models with parametrized correlation patterns over time. This more complicated models can be interpreted as semi-nonparametric hazard models for multiple spell data, permitting unobserved heterogeneity and state dependence without imposing a functional form on the duration in a given state, while the simple probit model ignores these temporal effects.[22] We conducted several random effect estimates that correct for some of the intertemporal correlations. The effects of the incentive variables were slightly strengthened, however, the results did not change significantly. Note that our estimation sample includes repeated observations of the same person only while this person is employed. Once the person retires, we assume that this is an absorbing state and include only the first observation in retirement. Hence, our dependent variable is in fact the probability to retire, given that the sample person has worked during the year before, p_t=Prob(retired in t | worked in t-1). We then compute the survivor function $S(t)$ conditional on working until the beginning of our window period (age 53) as the product of $(1-p_t)$ from age 53 to t. The probability of choosing a retirement age a is then $p_a \cdot S(a)$ and the expected retirement age is $\Sigma\, p_a \cdot S(a) \cdot a$.

Inserting the option value in this type of a regression model is a practical estimation procedure which can be interpreted as a flexible discrete-time duration model explaining the timing of retirement entry. It ignores, however, the structure of the dynamic optimization that underlies the workers decision when to retire.[23] Nevertheless, previous experimentation has shown that this pragmatic approach generates robust estimates of the average effects of the incentive variables on retirement, although it is likely to fail the individual variation as precisely as the true dynamic optimization model.[24]

Identification of the incentive variables is possible only if we have meaningful variation in these variables. Sources of variation are

[22] Flexible hazard rate models of retirement have been estimated by Sueyoshi (1989) and Meghir and Whitehouse (1997), parametric hazard rate models for German data by Schmidt (1995) and Börsch-Supan and Schmidt (1996).

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

[24] See Lumbsdaine, Stock and Wise (1992).

- the level of SSW reached at the earliest retirement age, mainly generated by variation in labor force histories;
- the upper threshold for the social security contributions, mainly generated by their changes over time and the different earnings levels;
- differences in the pension rules between single workers and couples;
- widely varying age differences between husband and spouse;
- restricted eligibility of self-employed;
- restricted eligibility of women with less than 15 years of service;
- differences in the pension formula between private sector employees and civil servants;
- differences in the ratio between contribution rates and pension benefits across cohorts: younger cohorts have a substantially lower internal rate of return; and
- several minor rule changes during our the sample period.

We estimated 24 different models: We use four different incentive variables as our main regressors (accrual rate, tax rate, option value and peak value, see Section 4.6). For each of these incentive variables, we run probit regressions with three age specifications (linear, quadratic, and a full set of age dummies) and with and without including social security wealth (SSW). We pool public and private workers, but have separate regressions for males and females.

We first summarize our main results, separate for men and women. Tables 8 and 10 report the goodness of fit, and Tables 9 and 11 the impact of the incentive variables, measured as the change in the probability of being retired when the incentive variable is changed infinitesimally. Tables 12 and 13 show full regression results for our favorite specification (option value with SSW and with a full set of age dummies). The other specifications produce very similar results in terms of significance and signs.

Table 8: Goodness of Fit: Males

	Accrual Rate			Tax Rate		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-1530,1362	-1524,0716	-1492,562	-1532,5654	-1529,0165	-1481,4323
	18,2%	*18,6%*	*20,2%*	*18,1%*	*18,3%*	*20,8%*
With SSW	-1528,6764	-1522,7746	-1491,2561	-1532,5653	-1529,0016	-1481,3642
	18,3%	*18,6%*	*20,3%*	*18,1%*	*18,3%*	*20,8%*

	Option Value			Peak Value		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-1527,4082	-1525,2906	-1490,2695	-1536,2424	-1533,1139	-1488,696
	18,4%	*18,5%*	*20,3%*	*17,9%*	*18,1%*	*20,4%*
With SSW	-1522,938	-1521,7785	-1485,3395	-1536,2335	-1533,0664	-1488,6922
	18,6%	*18,7%*	*20,6%*	*17,9%*	*18,1%*	*20,4%*

Source: GSOEP, working sample of men, 1984-1997.
Note: Loglikelihood values and Pseudo-R^2 (*in italics*)

The fit is rather similar across all four incentive variables. Tax rate and option value yield significantly better fits than accrual rate and peak value in almost all specifications. There is little difference between including the social security wealth (SSW) or not, while introducing age dummies makes a large difference. Judging from the goodness of fit, the regressions with age dummies and SSW is our favorite specification. The pseudo-R^2 s are just about 20%, a satisfactory value.

Table 9: Marginal Effect of Incentive Variables: Males

	Accrual Rate			Tax Rate		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	0,0001396	0,0001381	0,0001356	-0,08456341	-0,07667369	-0,17190381
	3,5	*3,6*	*3,6*	*-4,7*	*-4,4*	*-7,2*
With SSW	0,0001509	0,0001481	0,0001460	-0,08454737	-0,07632455	-0,17314054
	3,9	*3,9*	*3,9*	*-4,6*	*-4,3*	*-7,1*

	Option Value			Peak Value		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-0,00023237	-0,00020934	-0,00024276	-0,0012644	-0,00107072	-0,00292954
	-5,5	*-5,0*	*-5,5*	*-3,8*	*-3,2*	*-5,7*
With SSW	-0,00030332	-0,00027806	-0,0003286	-0,00126031	-0,00105993	-0,00293449
	-6,1	*-5,6*	*-6,2*	*-3,7*	*-3,2*	*-5,7*

Source: GSOEP, working sample of men, 1984-1997. *Note*: ∂P/∂x and t-statistic (*in italics*).

All incentive variables have the correct sign and are highly significant. The significance is very robust across all specifications, including inclusion of other covariates, sample selection, and definition of retirement (not shown in table). Including age dummies generally yields larger marginal effects and better precision. Including SSW also strengthens the estimated effects (with the exception of the peak value regressions).

The quantities of the marginal effects have to be evaluated with the dimension of the incentive variables and their average size in mind (tax rate and accrual rate as decimals, e.g. 0.5 for a 50% tax rate; option and peak value in 1000 DM, about 500$). Hence, the marginal effects of option value and peak value are relatively large, tax rate considerably smaller, and accrual rate very small, actually economically not different from zero while statistically significant. We will visualize these magnitudes in our policy simulations in Section 6.

Given the comparability of the goodness-of-fit measures in Table 8, we choose the option value model as our favorite specification because it delivers the most precise estimate of the incentive variable.

Our GSOEP estimation sample also includes civil servants. We have programmed the incentive variables for civil servants using the pension rules for civil servants which should lead to stronger incentives for early retirement. However, estimates for a sample of civil servants only are disappointing. The most probable reason is that we do not capture the incentives created by promotion possibilities, the main reason for civil servants to retire later than measured by our incentive variables.

We now turn to the female sample. While the overall fit is comparable and (for the regressions with a full set of age dummies) even better, the incentive variables are weaker, with the exception of peak value. Only option value and peak value are strongly significant, and accrual rate is completely insignificant.

Table 10: Goodness of Fit: Females

	Accrual Rate			Tax Rate		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-691,58206	-684,4851	-632,7585	-687,97887	-681,87265	-631,03328
	18,0%	*18,9%*	*24,9%*	*18,4%*	*19,2%*	*25,1%*
With SSW	-691,28715	-684,2648	-632,60559	-687,95991	-681,86189	-631,01395
	18,1%	*18,9%*	*25,0%*	*18,4%*	*19,2%*	*25,1%*

	Option Value			Peak Value		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-685,97528	-679,93327	-627,72675	-678,58724	-672,18414	-623,80517
	18,7%	*19,4%*	*25,5%*	*19,6%*	*20,3%*	*26,0%*
With SSW	-684,17131	-678,30671	-625,19017	-677,54142	-671,08436	-621,56825
	18,9%	*19,6%*	*25,8%*	*19,7%*	*20,4%*	*26,3%*

Source: GSOEP, working sample of women, 1984-1997.
Note: Loglikelihood values and Pseudo-R^2 (*in italics*)

The marginal effects of the incentive variables, see Table 11, are also smaller for women compared to men. Again, we will visualize them in our policy simulations in Section 6.

Table 11: Marginal Effect of Incentive Variables: Females

	Accrual Rate			Tax Rate		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	0,0000087	0,0000115	0,0000046	-0,01152618	-0,01250953	-0,01550037
	0,7	*0,8*	*0,3*	*-2,8*	*-2,4*	*-1,9*
With SSW	0,0000074	0,0000102	0,0000037	-0,01180793	-0,01278009	-0,01608508
	0,6	*0,7*	*0,2*	*-2,7*	*-2,3*	*-1,8*

	Option Value			Peak Value		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Without SSW	-0,00005129	-0,00006159	-0,00010106	-0,00133364	-0,00159996	-0,00270272
	-3,4	*-3,1*	*-3,1*	*-5,1*	*-5,0*	*-4,2*
With SSW	-0,00005499	-0,00006957	-0,00013015	-0,00155703	-0,00189241	-0,00384073
	-3,7	*-3,4*	*-3,7*	*-5,2*	*-5,1*	*-4,6*

Source: GSOEP, working sample of women, 1984-1997. *Note*: ∂P/∂x and t-statistics (*in italics*).

We now turn to the full regression results for our favorite specification: option value, SSW included as well as a full set of age dummies in the full sample. Table 12, discussed first, reports the marginal effects of all included variables for men. Table 13 follows with our results for women.

Table 12: Probit estimates for male subsample – incentive variable OPTION VALUE

```
Probit estimates                                  Number of obs =   6615
                                                  LR chi2(30)   = 769.96
                                                  Prob > chi2   = 0.0000
Log likelihood = -1485.3395                       Pseudo R2     = 0.2058

------------------------------------------------------------------------------
   rente |      dF/dx   Std. Err.      z    P>|z|     x-bar  [    95% C.I.   ]
---------+--------------------------------------------------------------------
  optval |  -.0003286   .0000505    -6.21   0.000   242.042  -.000427  -.00023
    fssw |  -.0000989   .0000307    -3.19   0.001   315.658  -.000159 -.000039
agedum55*|  -.0036754   .0151666    -0.24   0.813   .135147  -.033401  .026051
agedum56*|   .0201558   .0181694     1.23   0.217   .131973  -.015456  .055767
agedum57*|    .026436   .0192524     1.57   0.116   .122147  -.011298   .06417
agedum58*|   .0321028   .0207181     1.82   0.068   .110355  -.008504   .07271
agedum59*|   .0324319    .021896     1.75   0.079   .095994  -.010483  .075347
agedum60*|   .0933354   .0334312     3.89   0.000   .081028   .027812  .158859
agedum61*|   .1135756   .0384359     4.28   0.000   .062585   .038243  .188909
agedum62*|   .0832613    .036049     3.21   0.001   .046259   .012606  .153916
agedum63*|   .1466757   .0484479     4.58   0.000   .034618    .05172  .241632
agedum64*|   .3298128   .0699013     7.40   0.000   .024187   .192809  .466817
agedum65*|   .2247953   .0707141     5.03   0.000   .013303   .086198  .363393
agedum66*|   .4212799   .0989167     6.49   0.000   .007861   .227407  .615153
agedum67*|   .0734052    .083187     1.23   0.219   .002268  -.089638  .236449
agedum68*|  -.0171134   .0334167    -0.41   0.680   .001965  -.082609  .048382
  health |  -.0085313   .0009192    -9.84   0.000   9.02902  -.010333  -.00673
 married*|  -.0040946   .0113837    -0.37   0.710   .950718  -.026406  .018217
     uni*|  -.0194595   .0087792    -1.88   0.060   .127589  -.036666 -.002253
   skill |    .001199   .0058786     0.20   0.838   .866667  -.010323  .012721
  veigen*|   .0067526    .005148     1.31   0.191   .530159  -.003337  .016843
   vnull*|  -.0048485   .0079716    -0.58   0.559   .088587  -.020473  .010776
     vwp*|   .0137891   .0066855     2.20   0.028   .228571   .000686  .026893
 vpdauer |  -.0014149   .0014837    -0.96   0.339   38.3178  -.004323  .001493
vpdauer2 |   .0000237    .000025     0.95   0.342   1522.89  -.000025  .000073
    yhat |   .0010094   .0003056     3.27   0.001   59.7497    .00041  .001608
   yhat2 |   2.55e-06   5.03e-07     4.92   0.000   4490.93   1.6e-06  3.5e-06
      ds*|     -.0204   .0061492    -2.76   0.006   .107029  -.032452 -.008348
      db*|   .0385151   .0132965     3.54   0.000   .093575   .012454  .064576
    kids*|  -.0087559   .0048989    -1.77   0.077   .417234  -.018358  .000846
---------+--------------------------------------------------------------------
  obs. P |   .0816327
 pred. P |    .043401  (at x-bar)
```

Source: GSOEP, working sample of men, 1984-1997.

The option value is highly significant as pointed out before. The set of age dummies elevates the probabilities to retire after ages 60, 63 and 65 significantly, the earliest retirement ages under the various pathways (see Table 1). There clearly are independent effects of age and the incentive variable on retirement: the option value does not fully account for the "spikes" in the retirement pattern that have been shown in Figure 3. 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. Retirement is more likely to be deferred if there is (still) a child in the household. There is a weak retarding effect of a college degree on retirement age although we have an income measure as an additional control (predicted earnings "yhat" and its square). The wealth variables indicate that there is a wealth effect, although weak and barely significant: persons with higher wealth

(homeownership, financial assets) afford an earlier retirement. Also higher labor income weakens labor force attachment. The same holds (significantly and progressively) for earnings. Note that the higher opportunity costs of retirement have already been accounted for in the option value variable. Hence, this income effect is over and above this plus the wealth effect. It is interesting to observe that the accrual and tax value regressions produce a negative income effect. In these regressions, a higher labor income is ceteris paribus (given the wealth and the accrual variables) strengthening the labor force attachment. This makes perfectly sense, since higher labor income means higher opportunity costs of retirement, which – in these latter specifications – are not measured with the incentive variables. Two dummy variables are indicating the former labor force status. These variables take the value one if the person is actually or used to be a self employed or a civil servant. The model indicates that self employed tend to work longer, while civil servants retire earlier. Both results are significant and confirm our expectations.

We now turn to the full regression results for women, see Table 13.

Table 13: Probit estimates for female subsample – Incentives: OPTION VALUE

```
Probit estimates                                  Number of obs =   3176
                                                  LR chi2(30)   = 435.66
                                                  Prob > chi2   = 0.0000
Log likelihood = -625.19017                       Pseudo R2     = 0.2584

------------------------------------------------------------------------------
   rente |      dF/dx   Std. Err.      z    P>|z|     x-bar  [    95% C.I.   ]
---------+--------------------------------------------------------------------
  optval |  -.0001301   .0000795    -3.70   0.000   157.733  -.000286  .000026
    fssw |  -.0000573   .0000411    -2.22   0.027   115.157  -.000138  .000023
agedum55*|  -.0005269    .005822    -0.09   0.929   .150504  -.011938  .010884
agedum56*|   .0008589   .0062094     0.14   0.886    .13728  -.011311  .013029
agedum57*|  -.0008986    .005703    -0.15   0.878   .127204  -.012076  .010279
agedum58*|  -.0003483   .0059067    -0.06   0.954   .114295  -.011925  .011229
agedum59*|    .004319    .008509     0.63   0.527   .099811  -.012358  .020996
agedum60*|     .06787   .0476489     4.67   0.000   .079345   -.02552   .16126
agedum61*|   .1477394   .0852918     6.42   0.000   .051322  -.019429  .314908
agedum62*|    .040942   .0372656     2.68   0.007   .028652  -.032097  .113981
agedum63*|   .0209614   .0254712     1.54   0.125   .021725  -.028961  .070884
agedum64*|    .062657   .0545628     2.98   0.003   .016688  -.044284  .169598
agedum65*|   .2216001   .1224648     5.81   0.000   .013539  -.018427  .461627
agedum66*|   .2444922   .1527208     4.57   0.000   .005982  -.054835   .54382
agedum67*|   .0279499   .0514893     0.92   0.358   .002519  -.072967  .128867
agedum69*|  -.0072742   .0096887    -0.53   0.596   .002519  -.026264  .011715
  health |  -.0021441   .0015575    -4.07   0.000   9.40334  -.005197  .000909
 married*|  -.0336676   .0216777    -4.40   0.000   .948992  -.076155   .00882
     uni*|  -.0088107   .0072693    -1.65   0.099   .035579  -.023058  .005437
   skill |    -.00626   .0047299    -2.48   0.013   .474496   -.01553  .003011
  veigen*|  -.0003875   .0024397    -0.16   0.872   .514484  -.005169  .004394
   vnull*|  -.0036202   .0039021    -1.06   0.291   .109887  -.011268  .004028
     vwp*|   .0025916   .0036489     0.82   0.410   .201826   -.00456  .009743
 vpdauer |   .0002687   .0004437     0.70   0.481   20.0961  -.000601  .001138
vpdauer2 |  -4.86e-06   8.55e-06    -0.64   0.525   557.848  -.000022  .000012
    yhat |   .0011964   .0006353     4.05   0.000   28.7568  -.000049  .002442
   yhat2 |  -2.73e-06   4.15e-07    -1.78   0.075   6526.87  -3.5e-06 -1.9e-06
      ds*|  -.0086641   .0065533    -2.76   0.006   .089736  -.021508   .00418
      db*|   .0485268   .0615143     1.59   0.112   .007872  -.072039  .169093
    kids*|   .0003547   .0026247     0.14   0.892   .345088   -.00479  .005499
---------+--------------------------------------------------------------------
  obs. P |   .0746222
 pred. P |    .010959  (at x-bar)
------------------------------------------------------------------------------
(*) dF/dx is for discrete change of dummy variable from 0 to 1
           z and P>|z| are the test of the underlying coefficient being 0
```

Source: GSOEP, working sample of women, 1984-1997.

The peaks of the age dummies are now much more pronounced at age 60 and 65, in accordance with the different rules for women. Most socio-economic variables have directionally identical, but weaker effects compared to the male subsample. Different, however, is 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.

6 Simulation results and policy conclusions

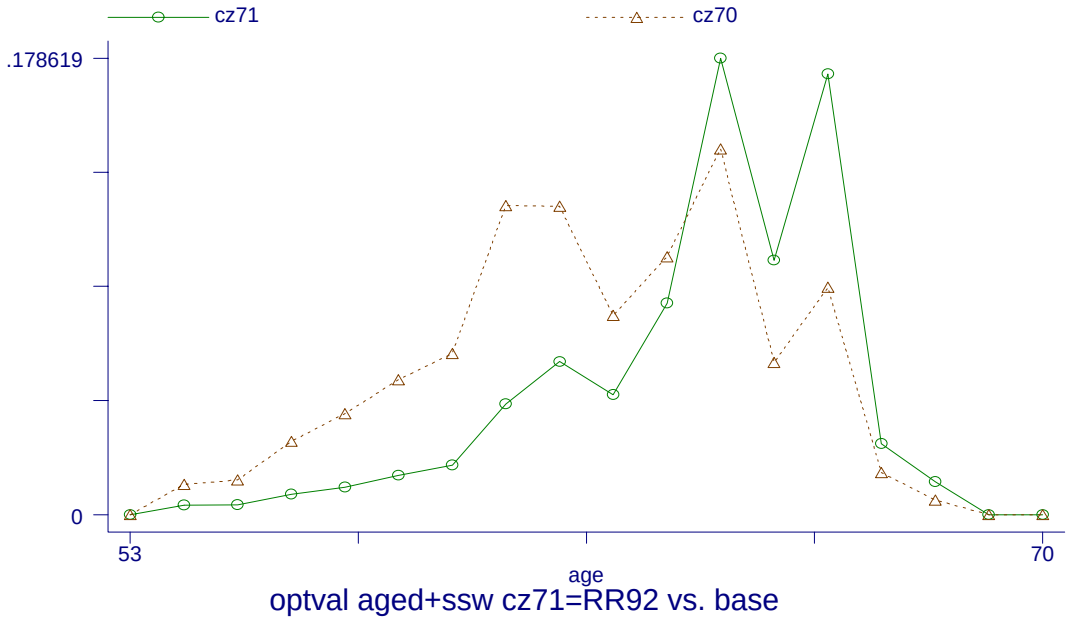
We now apply the estimated coefficients to three simulation experiments:

- The first experiment (Simulation A) uses the adjustment factors for early retirement that have been introduced by the pension reform 1992 (3.6% per year of early retirement). These adjustment factors have been phased in after our sample period and will take full force from the year 2004 on. They are not actuarial fair, and they are not effective before age 60 because they are overruled by the special earnings point credited under the disability insurance rules.
- The second experiment (Simulation B) uses a geometric adjustment of six percent per year that comes closer to a actuarially fair adjustment. It is applied to all ages in the window period (ages 54-69), anchored at the pivotal retirement age of 65. Hence, a worker retiring at age 64 receives a pension with 6% lower benefits per year. The reduction is 12.36% for a worker retiring at age 63, while a worker retiring at age 68 would receive 19.1% higher benefits.
- The third experiment (Simulation C) shifts the“normal” – better: pivotal – retirement age by 2 years.

For each policy scenario we use the estimated parameter values of the incentive variables to compute the probability to retire at age x given that the worker has worked until age 53. In all figures, we display the baseline probabilities (i.e., predicted under the pension rules of 1972 valid in our sample period) as dotted lines with trinagles, while we plot the predicted probabilities under the hypothetical new rules as solid lines with circles. We report the simulations based on the entire set of regression variants as Figures 5 through 12, set up in the same fashion as the panels in Tables 8 through 11.

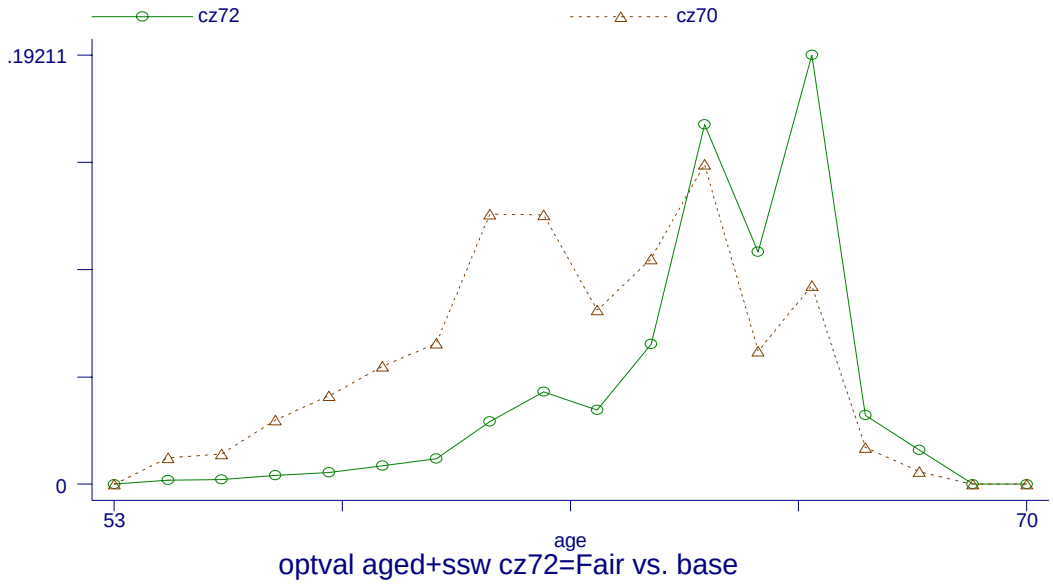
Figures 13, 14 and 15 show our favorite specification in detail for the subsample of men (option value with SSW and a full set of age dummies). The figures show a distinct right shift of the distribution, resulting in an increase of the average retirement age. This increase is about 9 months for the 1992 reform, 14 months for a system that is almost actuarially fair, and 8.5 months if the pivotal retirement age is changed by 2 years.

Figure 13: Baseline and Predicted Distribution of Retirement Ages (Reform 1992)



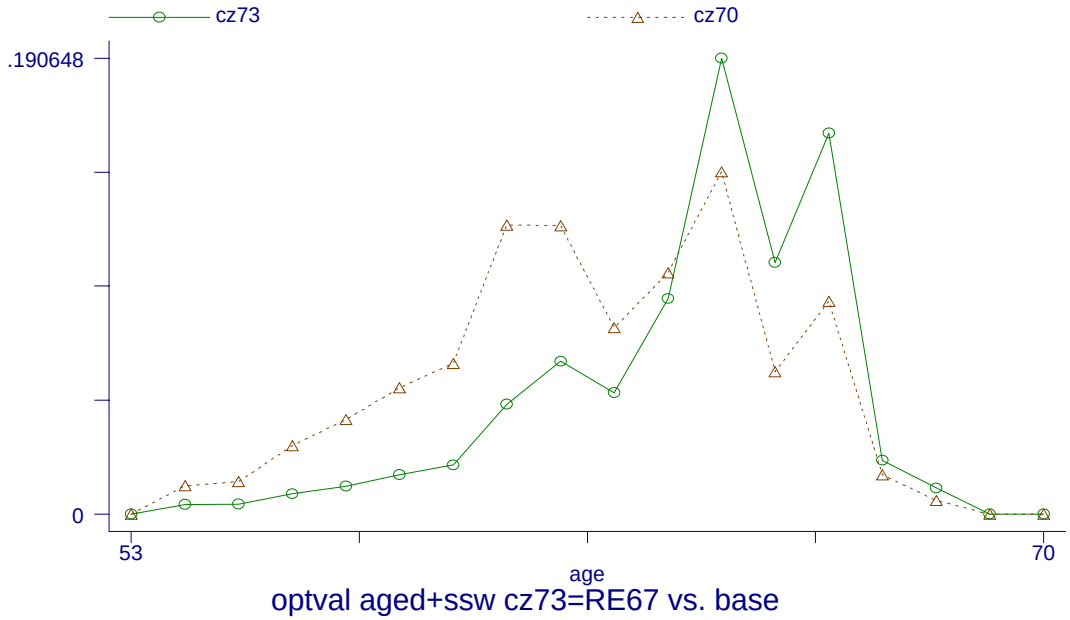
Source: GSOEP, working sample of men, 1984-1997.

Figure 14: Baseline and Predicted Distribution of Retirement Ages ("Fair System")



Source: GSOEP, working sample of men, 1984-1997.

Figure 15: Baseline and Predicted Distribution of Retirement Ages ("Fair System")



Source: GSOEP, working sample of men, 1984-1997.

The average effects are substantially stronger for the peak value regressions, se Table 15 which reports the induced change in the expected retirement age by the three policy experiments. This increase in retirement age predicted by the peak value model is more than 14 months (rather than 9 in the option value specification) for the 1992 reform, 19.5 (rather than 14 months) for a system that is almost actuarially fair, and 13 (rather than 8.5 months) if the pivotal retirement age is changed by 2 years.

Even when we use the smaller effects measured by the option value model, the effects on the budget of the German public pension system are considerable. Adjustment factors of 6 percent imply an increase of the retirement age of male workers to 61.1 years. Given that the average duration of pension receipts was 16 years prior to the reform, expenditure would decrease by roughly 7 percent through this effect. A second effect works through the extended working life, which leads to higher contributions. An additional year relative to 40 service years increase the contributions to the PAYG-system by 2.5 percent – provided that deferred take-up of pensions implies additional employment. Moreover, there is a third budgetary effect (compared to the no-reform case), since pension benefits are now lower for all who retire early. This would save

another 12 percent. Hence, the second policy reform – making the adjustments of benefits to retirement age close to actuarially fair – would relief the budget of the German public pension system by more than 20%.

Table 14: Effects of Policy Reforms on Expected Retirement Age (Men)

	Simulation A (Reform 1992)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,10	-0,10	-0,09	0,41	0,34	0,72
Tax Rate	-0,12	-0,12	-0,11	0,41	0,34	0,73
Option Value	1,90	1,74	1,55	0,39	0,32	0,73
Peak Value	2,31	2,16	1,86	0,39	0,31	0,73

	Simulation B (6% Geometric Adjustment Factors)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,10	-0,10	-0,09	0,91	0,79	1,57
Tax Rate	-0,12	-0,12	-0,11	0,91	0,79	1,58
Option Value	2,63	2,45	2,12	1,11	0,93	1,85
Peak Value	3,06	2,91	2,39	1,11	0,93	1,85

	Simulation C (Shift in "Normal" Retirement Age by 2 Years)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,10	-0,10	-0,09	0,38	0,32	0,81
Tax Rate	-0,12	-0,12	-0,11	0,38	0,32	0,82
Option Value	1,75	1,60	1,44	0,36	0,30	0,80
Peak Value	2,12	1,98	1,73	0,36	0,30	0,80

Source: GSOEP, working sample of women, 1984-1997.

Table 15: Effects of Policy Reforms on Expected Retirement Age (Women)

	Simulation A (Reform 1992)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,02	-0,02	-0,01	0,12	0,08	0,08
Tax Rate	-0,02	-0,02	0,00	0,12	0,08	0,09
Option Value	1,01	0,89	0,77	0,42	0,26	0,40
Peak Value	1,42	1,28	1,18	0,46	0,27	0,52

	Simulation B (6% Geometric Adjustment Factors)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,02	-0,02	-0,01	0,33	0,25	0,19
Tax Rate	-0,02	-0,02	0,00	0,34	0,26	0,20
Option Value	1,48	1,32	1,14	1,32	1,05	1,13
Peak Value	1,98	1,80	1,62	1,41	1,10	1,36

	Simulation C (Shift in "Normal" Retirement Age by 2 Years)					
	With SSW			Without SSW		
	Linear	Age Quadratic	Dummies	Linear	Age Quadratic	Dummies
Accrual Rate	-0,02	-0,02	-0,01	0,11	0,07	0,09
Tax Rate	-0,02	-0,02	0,00	0,11	0,07	0,09
Option Value	0,93	0,81	0,71	0,37	0,23	0,44
Peak Value	1,31	1,17	1,08	0,41	0,23	0,59

Source: GSOEP, working sample of women, 1984-1997.

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Attached Figures:

Figures [Version 17.4.2001]:

Four panels of 4x(2x3) Graphs:

Panel 1: Baseline prediction versus actual sample frequency (ZBASE.GPH)

Panel 2: Simulation A “RR92” (3.6% p.a. adjustments for age 60-70 as in 1992 reform) versus baseline (ZSIMA.GPH)

Panel 3: Simulation B “Fair” (6% p.a. geometric adjustments) versus baseline (ZSIMB.GPH)

Panel 4: Simulation C “RE67” (as RR92, but shift normal retirement age to 67) versus baseline (ZSIMC.GPH)

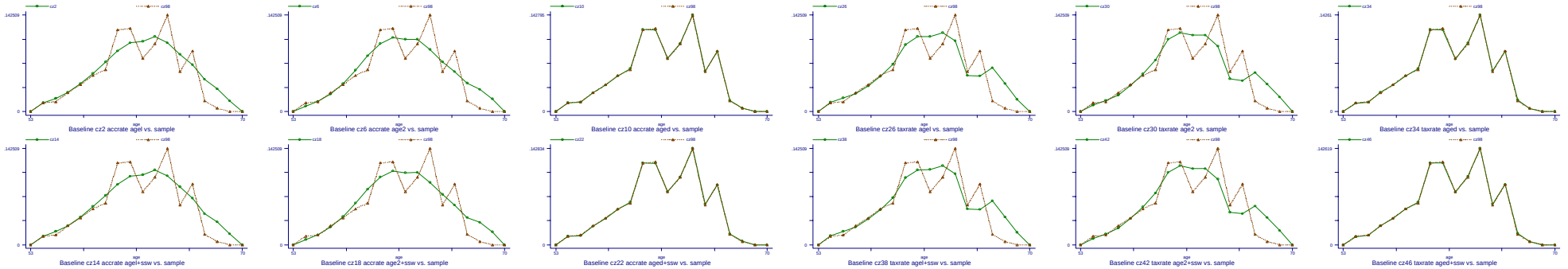
Note: All panels are set up as follows with six estimation specifications:

Age linear - without SSW	Age quadratic - without SSW	Full set of age dummies - without SSW
Age linear - with SSW	Age quadratic - with SSW	Full set of age dummies - with SSW

type (e.g. base) incentive (e.g. accrate)

The first set of figures is for the male subsample, the second set for the female subsample.

Figure 5: Baseline Prediction versus Sample Distribution of Retirment Ages (Males)



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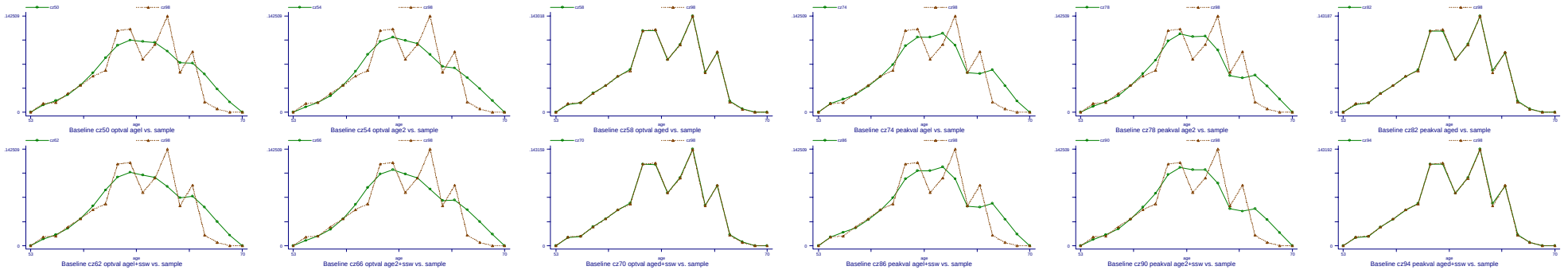
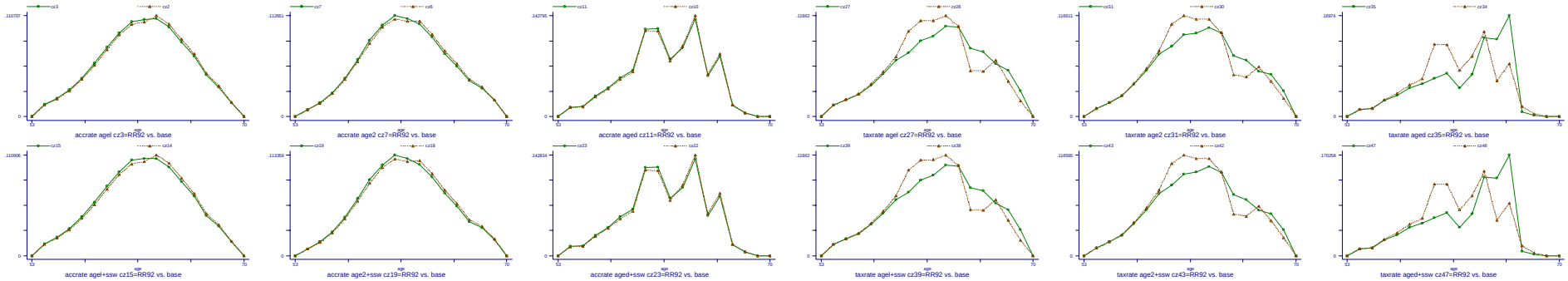
base taxrate



base optval

base peakval

Figure 6: Simulation A (Effects of Reform 1992) versus Baseline Prediction (Males)



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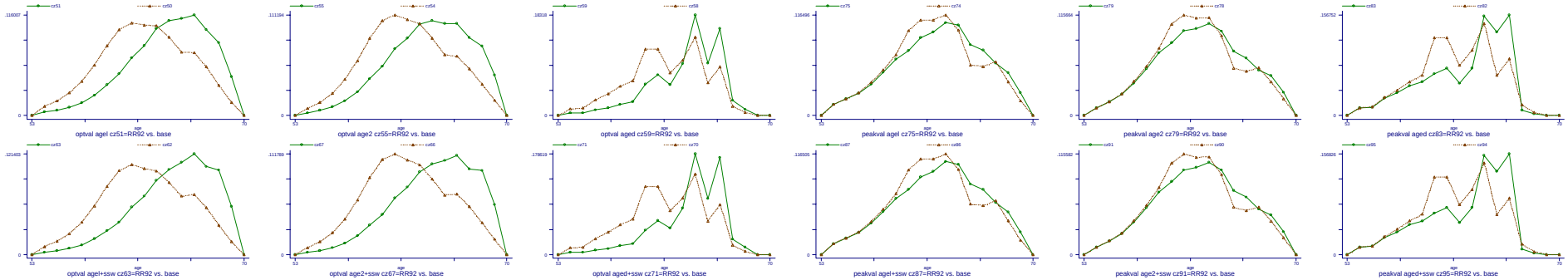

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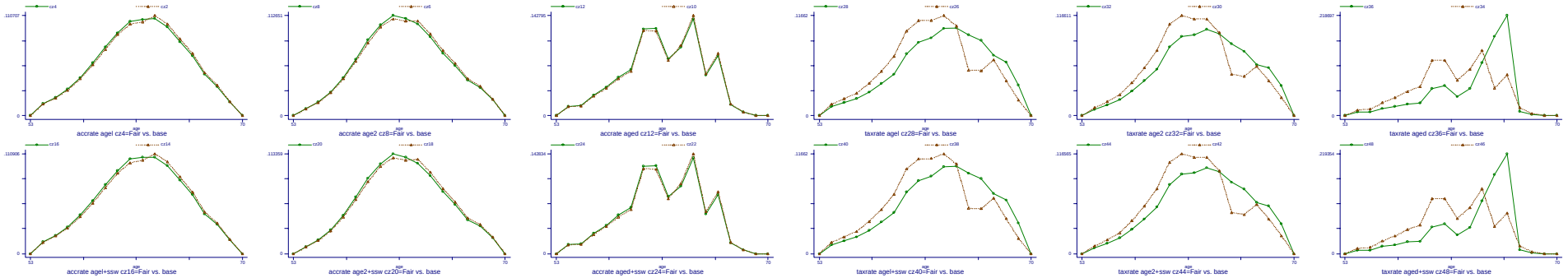
Figure 7: Simulation B (Effects of Introducing 6% Geometric Adjustment Factors) versus Baseline Prediction (Males)



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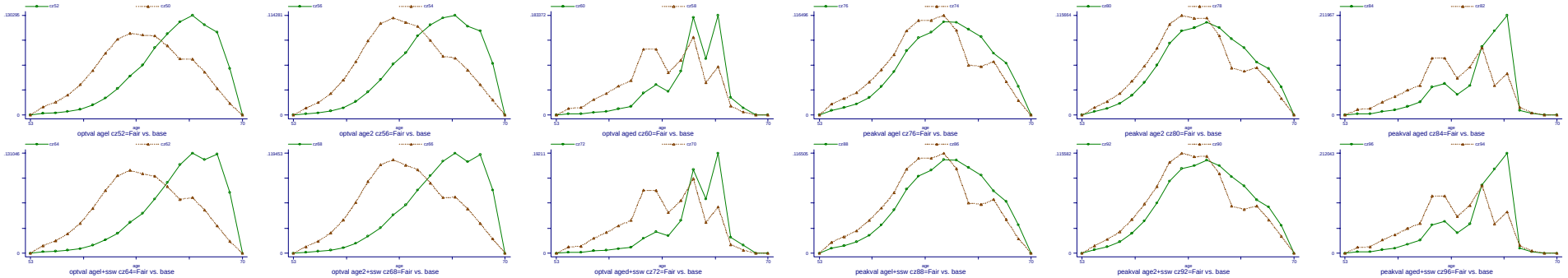

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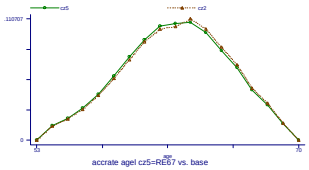
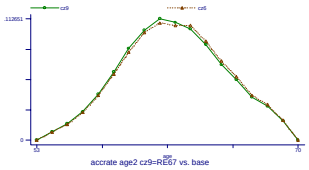
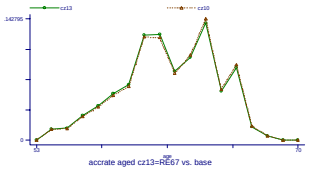
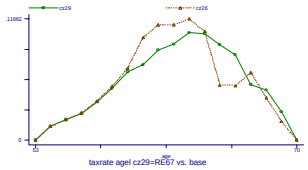
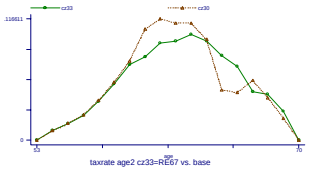
Figure 8: Simulation C (Effects of Shifting "Normal" Retirment Age by 2 Years) versus Baseline Prediction (Males)

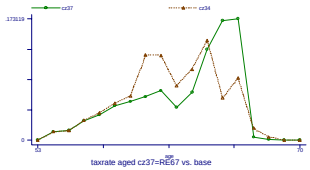


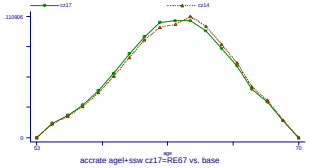


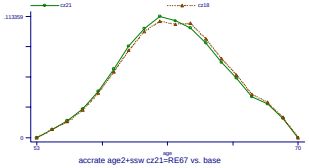


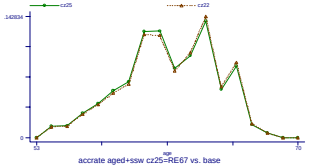


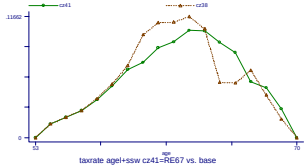


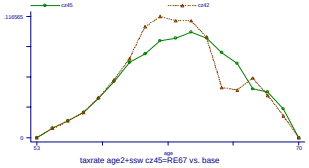


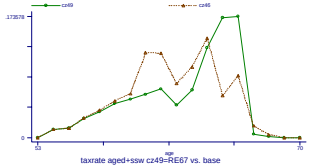












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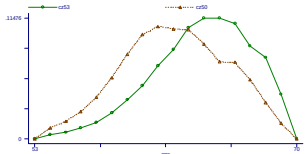

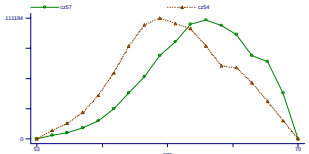

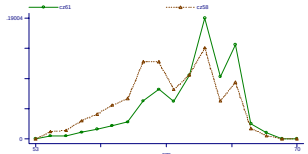

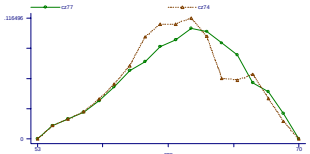

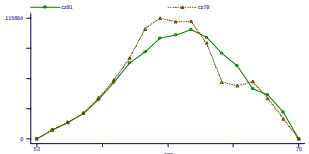

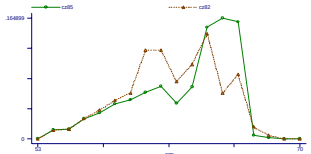

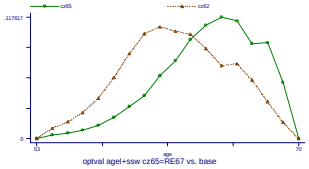

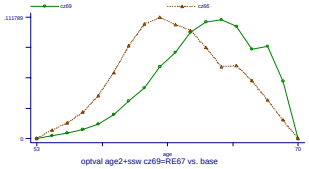

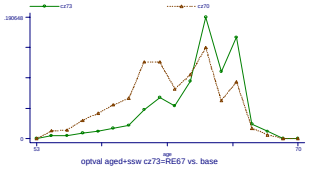

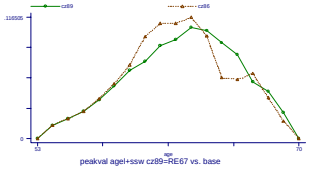

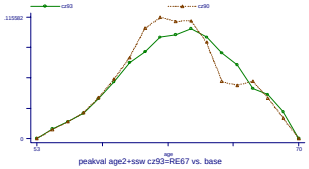

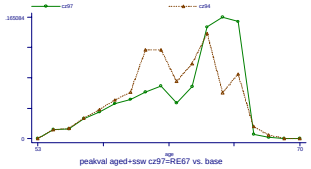

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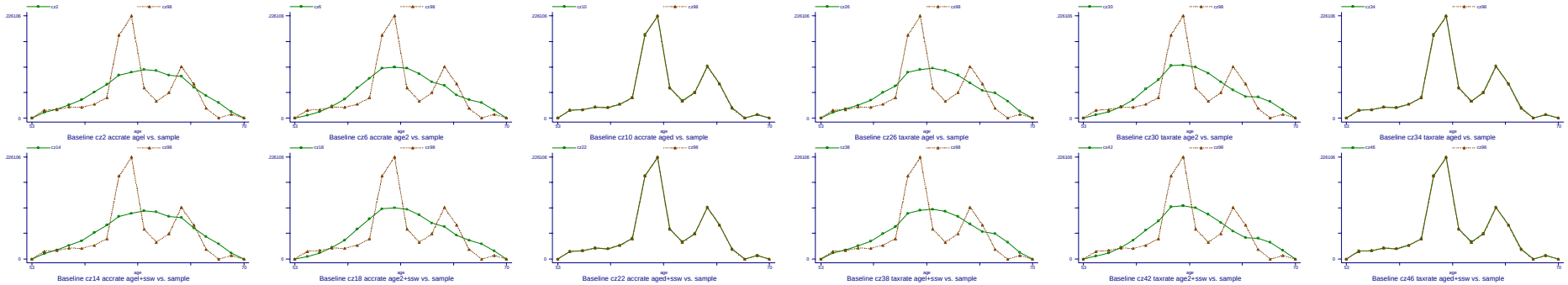
Figure 9: Baseline Prediction versus Sample Distribution of Retirment Ages (Females)



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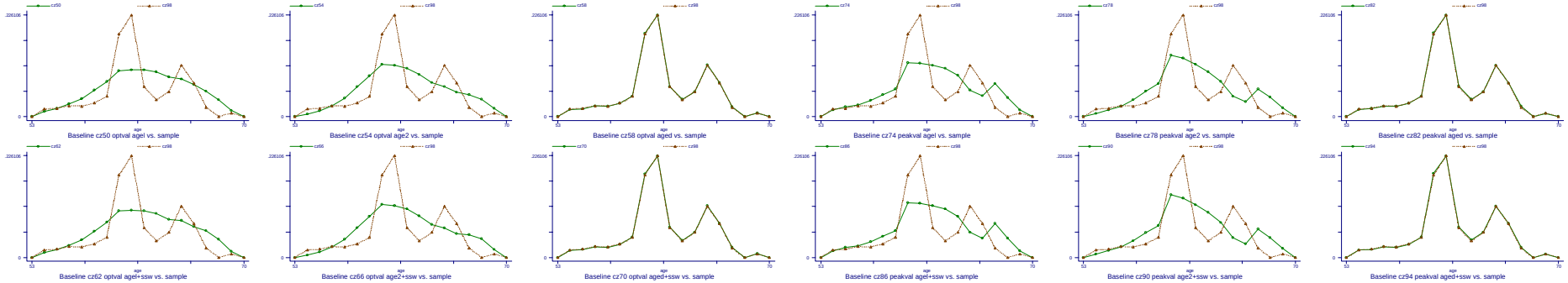

base optval

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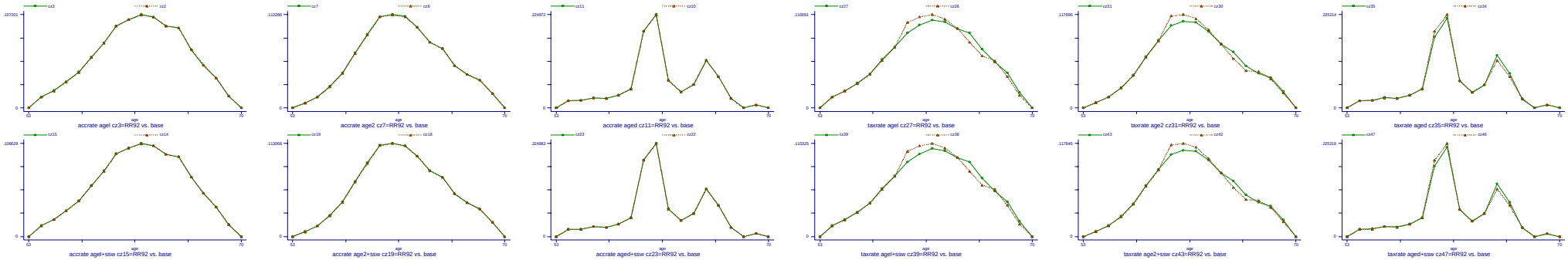
Figure 10: Simulation A (Effects of Reform 1992) versus Baseline Prediction (Females)



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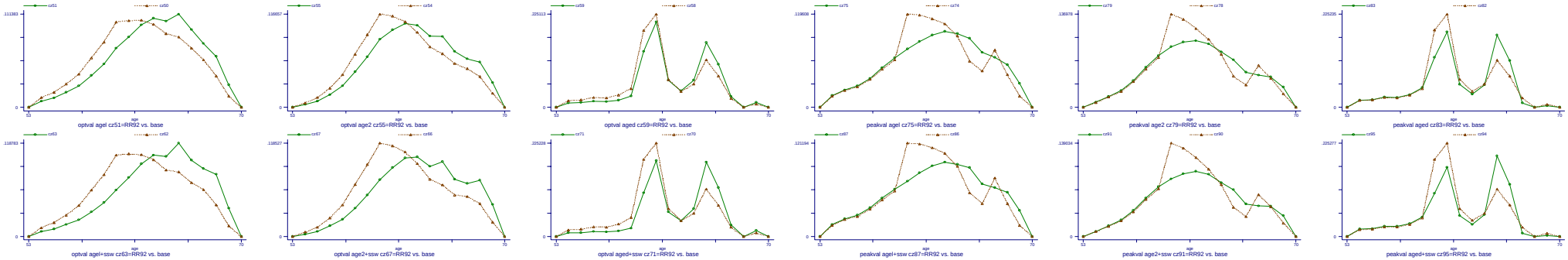

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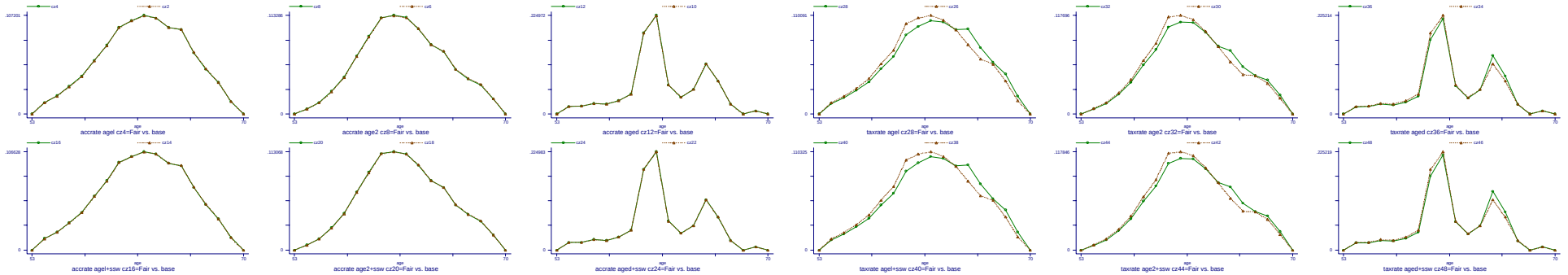
Figure 11: Simulation B (Effects of Introducing 6% Geometric Adjustment Factors) versus Baseline Prediction (Females)



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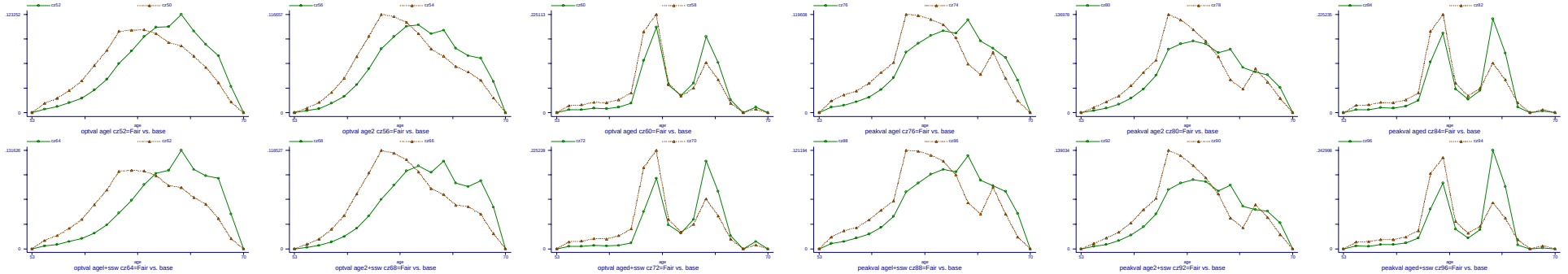

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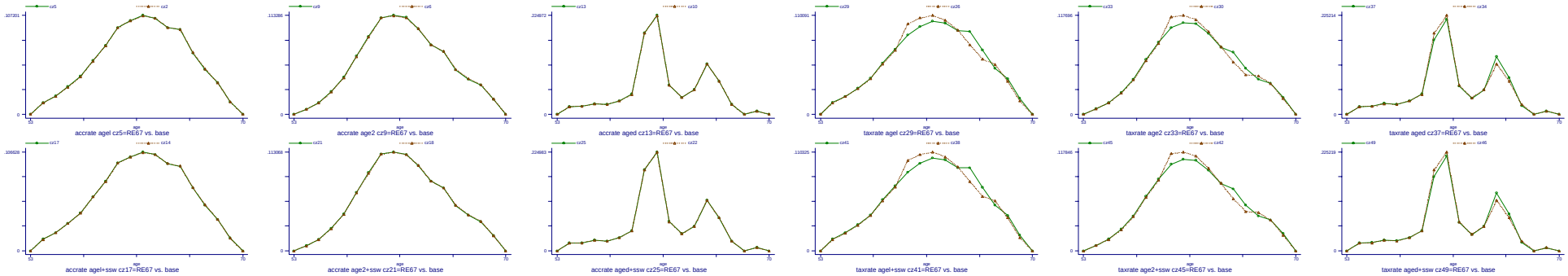
Figure 12: Simulation C (Effects of Shifting "Normal" Retirment Age by 2 Years) versus Baseline Prediction (Females)



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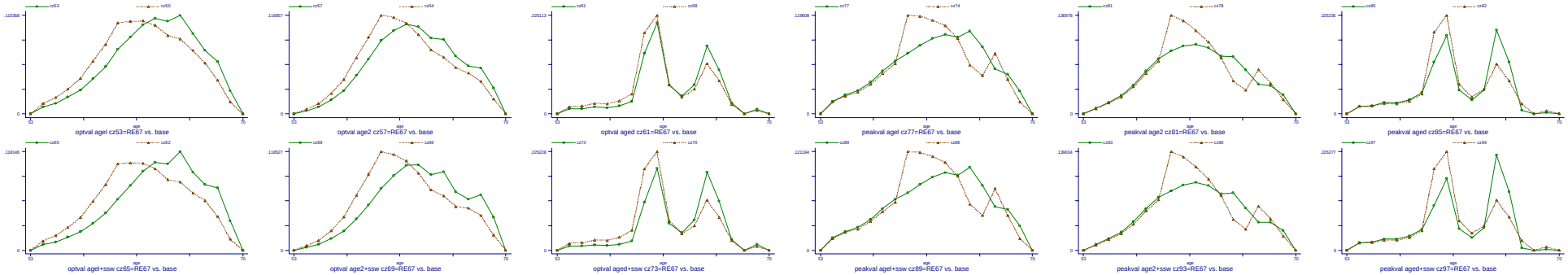

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