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Public pensions, changing employment patterns, and the impact of pension reforms across birth cohorts: a microsimulation analysis for Germany

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March 2010

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
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ABSTRACT

Public Pensions, Changing Employment Patterns, and the Impact of Pension Reforms across Birth Cohorts: A Microsimulation Analysis for Germany*

We analyze the impact of changing employment patterns and pension reforms on the future level of public pensions across birth cohorts in Germany. The analysis is based on a rich dataset that combines household survey data from the German Socio-Economic Panel Study (SOEP) and process-produced microdata from the German pension insurance. A microsimulation model is developed which accounts for cohort effects in individual employment and unemployment and earnings over the lifecycle as well as the differential impact of recent pension reforms. Cohort effects for individuals born between 1937 and 1971 vary greatly by region, gender and education and strongly affect lifecycle wage profiles. The largest effects can be observed for younger cohorts in East Germany and for the low educated. Using simulated life cycle employment and income profiles, we project gross future pensions across cohorts taking into account changing demographics and recent pension reforms. Simulations show that pension levels for East German men and women will fall dramatically among younger birth cohorts, not only because of policy reforms but due to higher cumulated unemployment. For West German men, the small reduction of average pension levels among younger birth cohorts is mainly driven by the impact of pension reforms, while future pension levels of West German women are increasing or stable due to rising labor market participation of younger birth cohorts.

JEL Classification: H55, J26, J11

Keywords: public pensions, cohort effects, microsimulation

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1 Introduction

The political debate about the future of the public pension system in Germany has shifted from the issue of its financial sustainability to the question whether it will avoid old-age poverty, especially among the younger birth cohorts (see, e.g., OECD 2007). There are various factors affecting the development of income maintenance in old age. Although the pension reforms since 1992 have improved the long-term financial sustainability of the public pension system, they have substantially reduced income replacement rates. Furthermore, since reunification there has been rising and persistent unemployment particularly in East Germany. At the same time, there has been a trend away from the “standard” employment relationships covered by social security towards “flexible” work patterns typically not or only partially covered by social security, such as “marginal employment”, temporary employment, part-time jobs, and self-employment. A recent report commissioned by the Public Pension Insurance Fund and the Federal Ministry of Labor and Social Affairs (AVID 2005) suggests that these factors will lead to substantial reductions in the level of public pensions among younger birth cohorts, especially in East Germany.

The goal of the present study is to quantify the likely impact of these developments on the future level of public pensions across birth cohorts. To this end, we develop a microsimulation model which accounts for cohort effects in individual employment and unemployment and earnings over the lifecycle as well as the differential impact of recent pension reforms on birth cohorts. To account for cohort effects on the future level of public pensions across birth cohorts is important for at least two reasons.

On the one hand, the impact of the recently enacted pension reforms will affect younger birth cohorts to a much greater degree than cohorts already close to retirement. In particular, this concerns the demographic adjustment mechanism which determines the level of public pensions relative to current wages and the increase of the legal retirement age to 67 years by 2029. Furthermore, actuarial adjustments for early retirement and phasing out of special early retirement options for the unemployed and women were enacted which, given the relatively long phase-in period, also had heterogeneous effects on older and younger birth cohorts.

On the other hand, changes in the labor market that occurred during the past decades affected cohorts quite differently. One of the most obvious examples for the potential importance of cohort effects is the worsening of the labor market situation in East Germany in the aftermath of reunification. Birth cohorts in East Germany differ with respect to the share of their working life spent in the former GDR where open unemployment was virtually nonexistent and wages relatively equally distributed. Both factors as well as the politically mandated equalization of GDR pension entitlements to West German levels resulted in relatively high and uniform pension entitlements of East Germans already near the early

retirement age when they were integrated into the West German public pension scheme. East Germans in the middle of their career were affected quite differently by unification: In the first years of the transition, large parts of the economy had to be rebuild under the new market based system and caused redundancies and closure of factories on a large scale. Endowed with human capital from the former GDR they had to find new jobs in the unified labor market. This process, however, turned out to be a slow and the unemployment rate in East Germany, on average, is still double the West German level. Furthermore, wage convergence almost came to a standstill in the mid-1990s, with a substantial wage differential remaining (see Franz and Steiner 2000). In West Germany, the younger birth cohorts may also have been affected by the worsening of general labor market conditions. However, another cohort effect which might have contributed to differences across birth cohorts is the increasing labor force participation among women, especially those with higher education. In the German public pension system, cohort effects in employment histories have both a direct and indirect effect on the individual pension benefit. The direct effect relates to total employment over the life-cycle, the indirect effect works through lower wages due to previous unemployment.

The relevance of these cohort effects, if any, is of course an empirical question and depends on the chosen identification strategy which will be described in Section 3. Using a large and representative panel data set – the German Socio-Economic Panel (SOEP) – we are able to place emphasis on important socio-economic characteristics in addition to the birth cohort. We distinguish between East and West Germany and men and women throughout our analysis. Furthermore, we analyse the impact of education. Education has a well documented effect on both the employment probability and the wage level. In addition to the perspective of the individual pension, we simulate pension outcomes also on a household level. There we also describe how estimated cohort effects are used to project individual employment biographies and earnings which determine the individual pension level.

Our estimation results, summarized in Section 4, show that cohort effects vary greatly between region, gender, and education. The estimated cohort effects in individual employment patterns affect lifecycle wage profiles used to simulate future earnings for cohorts born between 1937 and 1971. Using simulated life cycle employment and income, we project gross future pensions across cohorts taking into account changing demographics and recent pension reforms. We look mainly at public pensions at the individual level from various perspectives. Simulation results show that pension levels for East German men and women will fall dramatically among younger birth cohorts, not only because of policy reforms but due to higher cumulated unemployment. For West German men, the small reduction of average pension levels among younger birth cohorts is mainly driven by the impact of

pension reforms, while future pension levels of West German women are increasing or stable due to a rising labor market participation of younger birth cohorts. As summarized in the conclusion, these results shed light on the adequacy of future public pensions among younger age cohorts which is of crucial importance for social policy.

2 Empirical and Institutional Background

2.1 Evidence on changing work patterns across birth cohorts

Since reunification Germany has seen high and persistent unemployment with an extraordinary increase in long-term unemployment in East Germany. At the same time, full-time employment has been partially substituted for by part-time jobs and "marginal employment" not covered by social security (see, e.g., Rische 1999, Faik et al. 2001, Sachverständigenrat 2008). These labor market developments are likely to reinforce the negative impact of recent pension reforms (see Section 2.2) on the level of public pensions especially of younger birth cohorts.

There are a few studies analyzing the impacts of unemployment and changing employment patterns on future pension benefits across cohorts for Germany. Most of these studies were based on the AVID reports ("*Altersvorsorge in Deutschland*") for the years 1996 and 2005 which investigate public and private pension provision of people aged between 40 and 60 (DRV 2000, 2007).[1] The studies based on AVID 1996 report a weak negative trend for pension entitlements of younger cohorts of men born 1951-55 relative to those born 1936-40, particularly in East Germany. While younger cohorts of women tend to work more than older cohorts in West Germany, a substantial decline in employment and increase in unemployment is observed among younger cohorts of women in East Germany. The AVID 2005 study shows that these trends have continued in recent years: West German women continue to increase their labor market participation, in particular part-employment, while employment of West German men remains fairly stable across cohorts. For East Germany, the trend is negative for both men and women, with a substantial increase in unemployment. Using administrative data of recent entry cohorts of pensioners, Himmelreicher and Frommert (2006) report similar but weaker trends. Table 1 confirms these developments on the basis of retrospective SOEP data on employment histories across birth cohorts by gender and region.[2]

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[1] The data are not available for scientific research outside the Public Pension Fund and the Federal Ministry of Labor and Social Affairs, the two institutions which have jointly commissioned these surveys. For a summary of studies based on AVID 1996 see Steiner (2003).

[2] For a description of the SOEP, see Section 3.1.

Table 1 Employment histories across birth cohorts by gender and region (average cumulated duration in years)

	Men		Women			
	FTE	UN	FTE	PTE	UN	NE
West Germany						
Age 30 – 34 : year						
Cohort 1951-55 : 1985	9.9	0.3	7.1	1.3	0.3	4.3
Cohort 1961-65 : 1995	8.6	0.5	6.5	1.5	0.7	2.5
Cohort 1971-75 : 2005	8.6	0.6	5.6	1.8	0.6	2.4
Total	9.0	0.5	6.4	1.5	0.5	3.0
Age 40 – 44 : year						
Cohort 1941-45 : 1985	20.3	0.3	10.4	2.8	0.2	10.2
Cohort 1951-55 : 1995	18.7	0.6	10.2	3.6	0.5	7.4
Cohort 1961-65 : 2005	18.0	0.8	10.4	3.9	0.8	5.1
Total	18.9	0.6	10.3	3.5	0.6	7.3
Age 50 – 54 : year						
Cohort 1931-35 : 1985	31.6	0.5	13.8	3.6	0.2	15.6
Cohort 1941-45 : 1995	29.2	0.7	14.0	4.7	0.5	13.4
Cohort 1951-55 : 2005	27.6	0.9	15.1	6.7	0.9	8.8
Total	29.4	0.7	14.3	5.0	0.6	12.5
East Germany						
Age 30 – 34 : year						
Cohort 1961-65 : 1995	10.0	0.4	8.7	1.2	0.9	0.7
Cohort 1966-70 : 2000	9.5	0.8	7.3	1.3	1.4	0.8
Cohort 1971-75 : 2005	8.5	1.4	6.2	2.1	1.4	0.7
Total	9.4	0.8	7.6	1.4	1.2	0.7
Age 40 – 44 : year						
Cohort 1951-55 : 1995	19.9	0.4	17.4	2.5	0.6	0.9
Cohort 1956-60 : 2000	19.0	1.2	17.0	2.0	1.2	1.1
Cohort 1961-65 : 2005	18.1	1.8	13.4	3.5	2.6	1.2
Total	18.9	1.1	15.9	2.7	1.5	1.1
Age 50 – 54 : year						
Cohort 1941-45 : 1995	31.0	0.6	24.5	5.3	0.8	1.9
Cohort 1946-50 : 2000	28.5	0.9	24.1	3.5	1.3	1.5
Cohort 1951-55 : 2005	28.2	1.8	24.2	3.1	2.5	1.2
Total	29.3	1.1	24.3	4.0	1.5	1.5

Notes: FTE = full-time employment, PTE = part-time employment, UN = unemployment, NE = non-employment. The first year observation for West Germany refers to 1985, for East Germany to 1995.

Source: SOEP 1984 – 2006, own calculations.

For each age group and given calendar year, the table shows the average cumulated duration of the respective labor market state, and how the duration has changed across birth cohorts. Note that the first year of observation for East Germany (1995) differs from that for West Germany (1985), and hence results for the two regions are strictly comparable for the years 1995 and 2005 only. Labor market states are differentiated by full-time employment

and unemployment for men and additionally by part-time employment and non-employment for women.

As a result of the employment system in the former GDR, employment patterns of older cohorts do not show large gender differences in East Germany. Furthermore, the evolution of employment patterns of East German men and women is very similar. We observe a particularly strong increase in unemployment in East Germany and a decrease in employment for men and women, both in absolute and relative terms. For example, in the age group 40-44 years the cumulated duration of unemployment increases, on average, from 0.4 to 1.8 years for men and from 0.6 to 2.6 for women. This is in stark contrast to West Germany, where we observe only a slight reduction in employment and a small increase in unemployment for men and even a positive development for women. Women increase their cumulated employment experience while times of non-employment decrease markedly over cohorts. For example, women aged 50-54 have cumulated about ten years of unemployment and non-employment by 2005, while in 1985 the same age group had cumulated about 16 years of non-employment and unemployment.

How will the weakening of full-time employment and increasing unemployment among younger birth cohorts affect future levels of public pensions? As described in the next section, the German public pension system implies a fairly close relationship between an individual's lifetime earnings and the level of her own public pension. This relationship implies that unemployment may affect individual pension entitlements in two ways: First, by reducing the employment years counted towards individual pension entitlements and, secondly, by negatively affecting the life-cycle wage profile. Regarding this latter effect, empirical studies by Licht and Steiner (1992), Beblo and Wolf (2002), and Wunder (2006) indicate that unemployment or non-employment spells have significant long-term effects on an individual's future earnings, and that these effects tend to be the stronger, the longer these spells have lasted. The illustrative calculations presented in Wunder (2006) also show how the increasing importance of unemployment among younger age cohorts may affect their future pension levels.

2.2 The German PAYG pension system – structure and reforms

The public pension scheme in Germany is a pay-as-you-go (PAYG) system.[3] As such, population ageing is expected to put pressure on its financial sustainability in the coming decades, mainly due to three factors: rising life expectancy, very low fertility rates (between

[3] For a more detailed account of the German public pension system and recent reforms, see, e.g., Börsch-Supan and Schnabel (1999).

1.3 and 1.4), and a baby boomer generation reaching the retirement age in the coming years. As reinforcing negative factors, Germany has experienced a long-term increase in unemployment and a very low effective retirement age.

Policy has responded to these developments by enacting a series of pension reforms. These reforms go mainly in two directions: first, the extension of the working life, and second, the gradual lowering of the pension level. Starting in 1992, actuarial adjustments for early retirement were introduced with a relatively long phase-in period. Furthermore, the phasing out of special early retirement options for the unemployed and women was enacted. In 2001, a small subsidized pre-funded pillar of private pensions was introduced ("Riester pension"). In 2004, the benefit indexation was changed by introducing a so called sustainability factor that takes into account the development of the ratio of contributors to the pension system and its recipients. According to the new benefit indexation rule, pensions will grow at a lower rate than wages as long as this ratio declines. In 2007, a law came into effect that increases the statutory retirement age from 65 to 67 until 2029.

Public pension benefits in Germany are closely linked to an individual's lifetime employment and wage income relative to average wages in the economy, with relatively few redistributive elements. The *Pension Benefit* (*PB*) payment in year *s* after retirement is the product of four factors: the sum of *Pension Points* (*PP*) acquired at retirement age *T*, a *Pension Type* factor (*PT*), an *Entry Factor* (*EF*) and the *Current Pension Value* (*CPV*). It is calculated according to the following formula:

$$PB_{T+s} = \left(\sum_{t=1}^{T} PP_t \right) \times PT_T \times EF_T \times CPV, \quad s = 0,1,\ldots,S$$

For old-age pensions *PT*=1, and it is less than unity for other pension types, e.g., a widow's pension. In the following, we will only analyze old-age pensions. EF is equal to one if the age at retirement equals the statutory retirement age and lower for early retirement. For each month (year) of early retirement the benefit is lowered by 0.3% (3.6%).[4]

The most important component in the above formula is the sum of individual PP which mainly accrue from social security contributions levied on own wage income. Individual PP in a given year are calculated as the ratio of individual annual earnings and this year's average of annual earnings in the whole economy, i.e. the person's relative wage position. Thus, if a person earns the average wage in a given year she receives one PP. Earnings are only subject to social security contributions if they exceed a lower limit and contributions have to be paid only up to a higher limit. Both limits restrict the feasible number of PP to lie roughly in

[4] In Section 3.3, we provide some descriptive evidence on the significance of early retirement and how we treat the retirement decision in our simulation.

the range between 0.15 and 2. Thus, the accumulation of PP depends on an individual' wage profile relative to the evolution of average wages as well as the pattern of employment and unemployment over the life cycle.

PP may also be acquired during spells of unemployment and non-employment due to child rearing activities. For example, a mother receives one pension point for the first three years of a child born after 1992. The treatment of periods of unemployment has changed over time. Currently, short-term unemployed persons receiving the unemployment benefit (ALG I, which is insurance based and related to previous earnings) acquire PP as if earning 80% of the former gross wage. In contrast, since the recent reform in 2005 long-term unemployed receiving the new means-tested unemployment assistance payment (ALG II) acquire very little pension entitlements equivalent to a bit more than 2 € per month. This is another example of how the impact of reforms on future pensions may differ across birth cohorts.[5]

The Current Pension Value (CPV) in the above formula is given by:

$$CPV_t = CPV_{t-1} \times \frac{W_{t-1}}{W_{t-2}} \times \frac{100 - RP_{t-1} - CR_{t-1}}{100 - RP_{t-2} - CR_{t-2}} \times \left(\underbrace{\left(1 - \frac{PR_{t-1}}{PR_{t-2}}\right)}_{\text{"sustainability factor"}} \times \alpha + 1 \right),$$

where *W* is the sum for gross wages in the economy, *RP* is the contribution rate to subsidized private and/or occupational pension schemes, *CR* is the contribution rate to the public pension fund, *PR* is the ratio of retirees to contributors to the public pension fund, and α is a weighting factor currently set to 0.25. In our base year 2005 the CPV amounted to 26.13 € in West Germany and to 22.57 €in East Germany.[6]

The determination of the *CPV* has been subject to a couple of reforms.[7] The introduction of the subsidy of contributions to private pension plans ("Riester pension") is reflected by the factor *RP*. This factor lowers the benefit indexation, even though the supplementary private pension is not mandatory. The contribution rate is set to increase to

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[5] Between 2000 and 2004, PP acquired while receiving means-tested unemployment benefits were caculated on the basis of the benefit amount and not on the prior income.

[6] The lower CPV in East Germany is intended to compensate for the higher pension points given to East Germans by increasing their individual wages by an "adjustment factor" which should account for the still substantially lower level of the *average* wage in East Germany. Currently this adjustment factor amounts to about 18%, whereas the regional differential of average wages is about 15%. Thus, despite the lower CPV, individual pension contributions in East Germany are actually treated more generously in the pension formula than in West Germany. In our simulations we keep these regional differences in the CPV and the mentioned adjustment factor constant.

[7] In this paper, we only focus on gross pensions and ignore taxation. Therefore we do not model the long-term reform of the tax treatment of pensions in 2004. An analysis of that reform can be found in Buslei and Steiner (2006).

4% of gross earnings until 2011 and remains constant thereafter. The 2004 reform introduced the sustainability factor which links pension growth to demographic ageing. Demographic ageing will most likely reach its peak in the 2030s which results in a growth rate of pensions that is lagging behind the growth rate of wages. This implies lower individual replacement rates on average. Due to the complex rule for the adjustment of the *CPV*, it's future trajectory has to be simulated making assumptions on the changes of all factors that enter the adjustment rule (see Section 3.3).

3 Data and Microsimulation Methodology

3.1 Data

According to the pension formula discussed in the previous section, the simulation of future pension benefits requires detailed information of current individual entitlement (the number of pension points) as well as estimates of future pension accruals until retirement. The estimation of future pension entitlement would have to account for cohort effects in labor market histories, future earnings, and the individual retirement age. Since there is no data set publicly available in Germany that includes all the required information, we have to combine various data sources for the simulation of individual pension benefits. We combine data from the SOEP and administrative data of individual insurance records provided by the Research Data Center of the Public Pension Fund. SOEP data is used to estimate cohort effects in individual labor market histories which indirectly affect lifecycle wage profiles. The administrative data are used to determine pension entitlement in our base year (2005) for those individuals who can be matched to "statistical twins" observed in the SOEP data and to simulate the effective retirement age across birth cohorts.

The SOEP is a representative longitudinal micro-database that provides a wide range of socio-economic information on private households in Germany. Data were first collected on about 12,200 randomly selected adult respondents (in 6,000 families) in West Germany in 1984. After German reunification in 1989, the SOEP was extended by about 4,500 persons (in 2,200 households) from the former GDR.[8] SOEP contains a detailed retrospective questionaire from which we reconstruct individual employment histories to estimate cohort effects. The data we use range from 1984-2006 for West Germany and 1990-2006 for East Germany.

SOEP data do not provide information on wages of the time before the individual joined the survey. Thus, individual pension entitlements of non-retirees for the base year 2005

[8] A description of the SOEP is provided by Wagner et al. (2007).

simulated from retrospective work history data recorded in the SOEP are likely to contain substantial measurement error. This is a particular problem for East Germany because it does not seem feasible to back-cast wages in the former GDR based on market wages after reunification. The calculation of individual pensions in East Germany is also rendered extremely difficult due to complex regulations concerning the integration of pension entitlements from the former GDR into the unified pension system in Germany.[9] Thus, the determination of individual pension entitlements in the base year for East Germans is not feasible based on SOEP data alone. Because of the complex pension legislation, to a much lesser extent this is also true for West Germany.[10]

We therefore match administrative information on individual pension claims in 2005 to the SOEP data. For this purpose we use the so-called insurance account sample of 2005 ("*Versichertenkontenstichprobe*", VSKT 2005) of the Public Pension Fund which is a random sample of cleared individual insurance records that comprises about 60,000 observations of people aged between 30 and 67 years in 2005.[11] To this end, we applied a propensity-score matching procedure ("nearest-neighbor" matching) to combine the data sets of SOEP and VSKT for 2005. The data were matched within small cells defined by age-groups, gender, region, and education. While the level of education is represented by three categories for West Germany, there are only two categories for East Germany since there are only very few people with less than secondary education. We provide some information on the matching procedure in the appendix. For each observations in the SOEP matched to a statistical twin in the VSKT data we replace the simulated amount of pension entitlement by that recorded in the latter data base. For SOEP observations for which no statistical twin could be found the simulated amount is maintained.

Finally, we use a 10% random sample (about 90,000 observations) of all new retirees in 2006 for the simulation of the age of retirement (see Section 3.3).[12] After restricting the sample to old-age pensioners who retired between 60 and 65 years we are left with about 68,000 observations.

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[9] Himmelreicher et al. (2007) describe the integration of pension entitlements of former GDR citizens.

[10] An example would be the pension rights adjustment after a divorce which occurred before the individual joined SOEP.

[11] These data are provided as a scientific use file (SUFVSKT2005) by the Research Data Center of the Public Pension Fund. Detailed descriptions of the data are contained in DRV (2008) and Himmelreicher and Stegmann (2008).

[12] These data are provided as a scientific use file of the so-called "*Versichertenzugangstichprobe*" (SUFRTZN06XVSBB) by the Research Data Center of the Public Pension Fund. The data are described in DRV (2006).

3.2 Estimation of cohort effects and wage equations

To link individual labor market histories to lifecycle earnings profiles, which determine the level of an individual's future pension, we first estimate the impact of cohort effects on the cumulated duration of the various labor market states. In a second step, we estimate relative wage equations relating individual wages to labor market histories and a number of other potential wage determinants. Our maintained hypothesis is that cohort effects enter the wage equation only indirectly through their impact on an individual's labor market history. We start with a brief description of the estimation of cohort effects in labor market histories and then describe the modeling of the wage equation.

Cohort effects

We assume that the cumulated duration in a particular labor market state, Y_{it}*, can be modeled as a linear function of the birth cohort K_{it}, the individual's age A_{it}, period (year) dummies P_{it} and a vector of other control variables, X_{it}:

$$Y_{it}^* = \alpha + \beta_1 K_{it} + \beta_2 A_{it} + \beta_3 P_t + \gamma' X_{it} + \varepsilon_{it},$$

where the labor market states are full-time employment and unemployment for men, and additionally part-time employment and non-employment for women. The control variables include age of the oldest child, dummies for other children, marital status, nationality, and education. The error term ε is assumed to be uncorrelated with these variables.

Because of the linear dependence of age, period, and cohort the identification of linear cohort effects this specification requires a restriction on these effects. Here, we follow Deaton (1997) and assume that period effects are orthogonal to a linear trend and sum to zero over all observation periods.[13] This assumption allows to decompose the effects in three different dimensions: the trend (cohort), the profile (age), and the business cycle (period).

Since the cumulated duration in most labor market states is zero for a non-neglible share of people, we estimate tobit models of the form:

$$\begin{aligned} Y_{it}^* &= \alpha + \beta_1 K_{it} + \beta_2 A_{it} + \beta_3 P_t^* + \gamma' X_{it} + \varepsilon_{it} \\ Y_{it} &= \max(0, Y_{it}^*) \\ \varepsilon_{it} &\left| K_{it}, A_{it}, P_t^*, X_{it} \sim N(0, \sigma^2) \right. \end{aligned}$$

[13] This implies the following linear transformation of the period dummies: $P_t^* = P_t - (t\text{-}1)P_2 + (t\text{-}2)P_1$, with $P_t = 1$ in period t, and zero otherwise. Alternative ways to identify cohort effecst using panel data are discussed in Heckman and Robb (1985), Beaudry and Green (2000), Fitzenberger et al. (2004), Alessie et al. (2005), and Boockmann and Steiner (2006).

where the original period dummies have been transformed as described above. Estimation of this equation is based on 21 waves of the SOEP for West Germany and 15 waves for East Germany spanning the period 1984-2005 and 1990-2005, respectively. People in education or already retired as well as civil servants and the self-employed are not included in the analysis. We estimate separate tobit models for each of the sub-groups defined by region (East and West German), gender, and by the level of education.

Tables A2 and A3 in the Appendix report for each of these groups estimated marginal effects of the cohort dummies on the cumulated duration in the various labor market states: These effects are evaluated at sample means of the explanatory variables in the model including age. Thus, these effects give the pure cohort effects on the cumulated duration of, e.g., unemployment at a given age. For example, for West German men with low level of education the estimated effect for the youngest cohort (1967-71) implies that, evaluated a sample means, the cumulated unemployment duration of this group exceeds that of the oldest cohort by about 2 years. Estimated cohort effects differ significantly by gender, region, and the level of education. In East Germany, for example, estimated effects imply almost 5 years more unemployment relative to the oldest age cohort for the youngest cohort of men with low or medium level of education, compared to about 2 years for those with higher education. For East German women the corresponding estimated cohort effects are about 8 years and 3 years respectively. Tables A2 and A3 also show large differences in estimated cohort effects across gender, region and level of education regarding the cumulated labor market states. The implications of estimated cohort effects for employment and unemployment over the life-cycle will be discussed in Section 4.1.

Wage equations

The dependent variable in the wage equation is the log of the ratio of the individual monthly gross wage in a given year to the average wage of the insured population in that period.[14] Explanatory variables are age, the cumulated duration of unemployment and (in case of women) non-employment and part-time employment, all entered as polynomials of degree three. Since we include these as well as age the duration of full-time cannot be identified separately. Cohort effects impact on individual relative wages through their effects on the duration variables. The control variables contained in X_{it} include time dummies, dummies for

[14] We use this uncensored wage measure in the estimation although we calculate the expected wage accounting for the censoring at the lower and upper social security thresholds in the simulations below. Using all observations avoids estimating a double-censored regression model and takes advantage of all available information in the estimation.

industry, firm size, and nationality.[15] Unobserved wage determinants are modeled by the two error components u_i and v_{it} which are assumed to be independently normally distributed. The specification of the wage equation thus is:

$$\log\left(\frac{w_{it}}{\overline{w}_t}\right) = \alpha_0 + \alpha_1 A_{it} + \alpha_2 U_{it} + \alpha_3 TZ_{it} + \lambda X_{it} + u_i + v_{it}$$
$$E\left[u_i \middle| A_{it}, U_{it}, TZ_{it}, X_{it}\right] = 0$$
$$E\left[v_{it} \middle| \varepsilon_i, A_{it}, U_{it}, TZ_{it}, X_{it}\right] = 0, \quad \forall\, t.$$

This equation is estimated on a sub-sample of observations also used for the estimation of cohort effects, i.e. those people for whom we observe a wage subject to social security contributions. Civil servants and the self-employed are not included. As in the estimation of cohort effects, we estimate separate relative wage equations for each of the sub-groups defined by region, gender, and the level of education.

As shown by Figure A1 in the appendix, the empirical age-earnings profiles derived from our estimated relative wage equations differ substantially by education.[16] The higher its level, the higher the individual wage relative to the average wage in the economy and, hence, the higher the acquired number of pension points. Although this relationship holds for men and women in East and West Germany throughout the life-cycle after the first few years of employment, the slope of the age-earnings profile differs markedly between these groups. Age-earnings profiles are relatively flat for persons with low or medium education and fairly steep for higher educated people. These profiles differ substantially by gender and region, however, especially for people with higher education. In West Germany, relative wages of men in this group continuously increase with age until the age of sixty and will have almost doubled by then. In contrast, higher educated women experience a steep wage increase until their early thirties followed by a reduction and a subsequent rebound in their relative wage. This pattern can be explained by the relatively weak labor force participation and a high share of part-time employed West German women in their thirties and early forties due to child-care responsibilities. Since this used to be, and still is, much less true for women in East Germany, their age-earnings profiles are, on average, similar to those of East German men. For West German men and women with low education, relative wages remain flat or

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[15] Industry and firm-size dummies are normalized ("orthogonalized") so that setting them all equal to zero yields their average effect on the relative wage. This normalization is used in the simulations below to predict wages of individuals for whom we currently do not observe wages, i.e. we assume that their expected wage equals the average wage with respect to these characteristics.

[16] Detailed estimation results for the relative wage equations are available from the authors upon request.

even decrease with age, and slightly increase for men with a medium level of education. In East Germany, relative wages of both men and women with low or medium education also change relatively little over the life-cycle.

On the one hand, these differences in empirical age-earnings profiles imply that people with low level of education accumulate little earnings potential over their life-cycle, in contrast to higher educated people. On the other hand, flat age-earnings profiles also imply that employment interruptions have relatively small effects on future earnings and thus the level of the public pension.

3.3 Simulating future pension levels across birth cohorts

Together with individual pension entitlements in 2005, the estimates from the previous section are used to simulate the level of individual pensions at retirement age. Note that the simulation horizon varies greatly between birth cohorts. Whereas the majority of our oldest cohort (1937-41) is already retired in 2005, and their pensions can be observed, the youngest birth cohort (1967-71) is aged 34-38 in that year and up to 33 years of their future employment/unemployment spells and earnings have to be simulated. This simulation involves various steps.

First, we project future individual work patterns on the basis of estimated labor market histories accounting for cohort effects. This projection is based on our estimated tobit models to predict for each individual in our sample unconditional expected durations in labor market state j at age t until retirement age, conditional on a set of explanatory variables Z which include cohort effects. Let this expected value be denoted by $E(Y_{jt}|Z_{jt})$. The time spent in a particular state at age t is then calculated as the difference of the expected values at age t and (t -1) as $\max[0, y_{jt}=E(Y_{jt}|Z_{jt})-E(Y_{ji,t-1}|Z_{j,t-1})]$.

Second, we simulate future relative earnings for each individual in our sample based on expected values (not conditionally on employment) derived from our estimated wage equations. These simulations are based on the simulated cumulated durations derived in the previous step. For example, an individual's expected cumulated duration of unemployment at age t determines, together with the other explanatory variables in the wage equation evaluated at that age, the individual's expected relative wage. In addition to the mean we also simulate the variance of projected wages on the basis of the distribution of wages observed in our estimation sample.[17]

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[17] This is done by randomly drawing residuals from the distributions of the error terms u_i and v_{it} and adding them to the simulated wages.

Third, putting together simulated future employment/unemployment durations and earnings at age *t* we calculate for each individual the number of pension points until her retirement age. Adding these – adjusted by the number of pension points acquired for non-employment spells – to the number of already acquired pension points in the base year 2005 yields the expected total number of pension points an individual is expected to earn until retirement. Since early retirement is still the rule rather than the exception in Germany, despite the associated substantial reduction of the pension entitlement (see Section 2.2), we have to model the future evolution of the effective retirement age.

We do this in a simplified way by extrapolating the distribution of the effective retirement age of people retiring in 2006 (see Figure A2 in the Appendix) by a common factor that should reflect the recently enacted long-term increase of the statutory retirement age from 65 to 67 years (see Section 2.2).[18] Since we focus on old-age pensions here, we apply the same factor to men and women and – in our base scenario – also to East and West Germany.[19] Since the average effective retirement age in 2006 was about 63 years, this implies a long-term increase to 65 years in the simulation. As shown by Figure 1, the expected increase in the effective retirement age is not linear. This is due to the abolishment of early retirement options for unemployed and women, which implies a relatively strong increase in the expected retirement age of people in the birth cohorts 1947-56.

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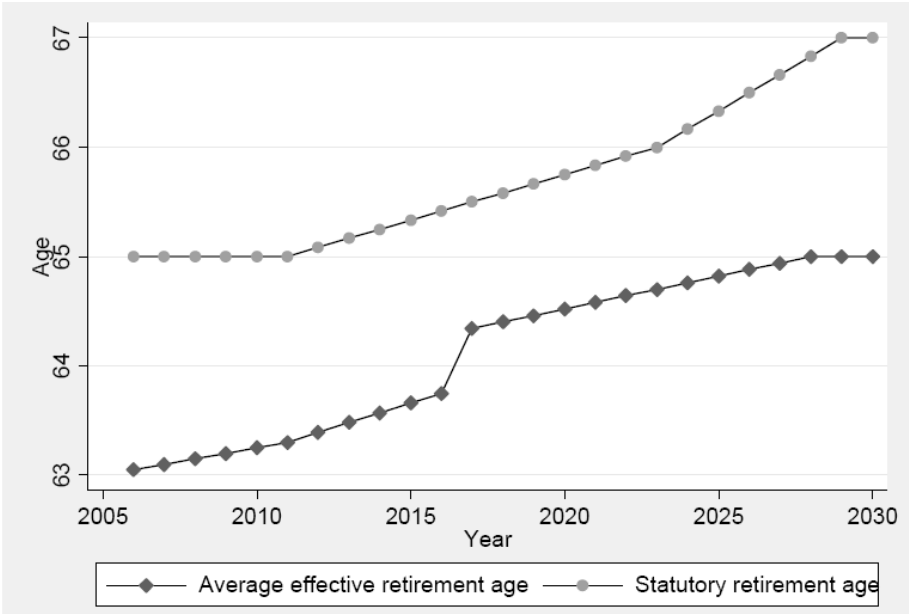
[18] It is difficult to quantify the effects of the recent pension reforms effective retirment age in the distant future. Berkel and Börsch-Supan (2004) estimate that the pension reforms in 1992 and 1999 which enacted the adjustment factors for early retirement pensions have increased the average retirement age by two years for men and less than one year for women. In 2006, the average retirement age of women was actually above and that for men below the values implied by these estimates. Gender differences in changes of the retirement age could be related to the inclusion of disability pensions in these estimates. For old-age pensions, there is a clear positive trend in the effective retirement age for both men and women.

[19] In the more optimistic labor market scenario for East Germany discussed in Section 4.4 below we assume that the effective retirement age converges between the two regions.

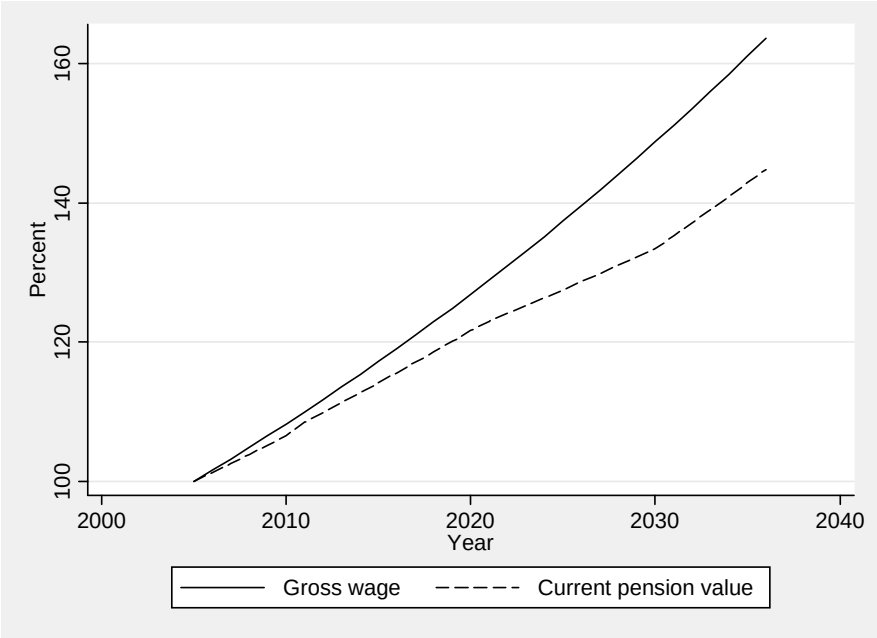
Figure 1 Adjustment of the effective to changes in the legal retirment age



Fourth, based on the simulated individual pension points and projections of the current pension value we derive individual pension benefits. As discussed in Section 2.2, the current pension value (CPV) is determined by the growth rate of the average gross wage in the economy and some adjustment factors to the pension formula. Following the Ageing Working Group (AWG), the average real gross wage in the economy is projected to grow at an annual rate of 1.6 % (European Commission 2005). Given this projection, the CPV is calculated using the formula in Section 2.2.

Figure 2 shows the development of gross wages and the CPV in the simulation period. Due to the adjustment factors in the pension formula, there is an increasing divergence between the average gross wage and the CPV. Since population aging will peak during the 2030s, and this is accounted for in the „sustainability factor“ included in the CPV formula, the difference between gross wages and the CPV will reach a maximum towards the end of the simulation period. By then, the CPV will fall short of the average gross wage by almost 20 percentage points.

Figure 2 Development of the average gross wage and the current pension value in the simulation period



The final step in the calculation of future public pensions is to project the population structure over the whole simulation period. Starting with a representative sample of the German population born between 1937 and 1971 we apply a “static ageing” procedure which adjusts the SOEP weighting factors to the marginal distributions of a few demographic variables derived from a household projection of DIW Berlin (see Buslei et al. 2007, pp. 29-33). These variables include the age, gender and education of the household head, region of residence, and type of household (couples/singles, with/without children). The static aging procedure uses a reweighting procedure developed by Merz et al. (2004).

4 Simulation Results

4.1 Employment and unemployment until retirement

As described in Section 3.3, for the younger birth cohorts we have to simulate a large part of their labor market behavior until retirement. Starting from our base year 2005 and using the estimated cohort effects we simulate for each individual the cumulated employment and unemployment durations until the expected individual retirement age. In our base scenario we assume that these cohort effects estimated over a period of high and increasing unemployment, especially in East Germany, also determine future labor market behavior across birth cohorts. In the following simulation of the cumulated employment and unemployment durations the individual retirement age differs across age cohorts but is

assumed to be determined by the current legal retirement age of 65 years. This assumption will be relaxed when we simulate the level of pension benefits below.

Table 2 summarizes our simulation results for full-time employment and unemployment by region, gender and the level of education.[20] Simulation results for cohorts refer to future populations in the year of retirement. They are derived using the method of static aging to adjust SOEP weighting factors to account for demographic change (Section 3.3). Differences in simulation results across birth cohorts thus not only represent pure cohort effects but also structural changes in the population across cohorts.[21]

Table 2 Simulated years of cumulated employment/unemployment durations until retirement

	West Germany						East Germany			
	Full-time employment			Unemployment			Full-time employment		Unemployment	
Education level:	Low	Medium	High	Low	Medium	High	Low/Medium	High	Low/Medium	High
Men										
Cohort 1937-41	39.1	40.9	35.2	3.7	1.7	0.8	40.4	37.2	2.3	1.4
Cohort 1942-46	38.6	39.4	34.3	4.0	2.1	1.3	39.4	36.5	3.6	2.1
Cohort 1947-51	36.4	38.9	33.6	4.6	2.6	1.5	38.7	34.5	4.6	2.9
Cohort 1952-56	37.4	39.0	33.4	5.4	2.7	1.8	37.9	33.7	6.1	3.0
Cohort 1957-61	36.4	37.4	32.8	6.6	3.2	2.2	36.2	33.2	7.9	3.9
Cohort 1962-66	35.3	36.4	33.7	8.2	3.1	2.0	36.1	32.3	8.0	4.1
Cohort 1967-71	36.5	37.6	32.2	7.2	3.4	2.0	35.7	31.3	9.4	5.2
Average	37.3	38.9	33.5	5.2	2.6	1.7	37.6	34.3	6.2	3.1
Women										
Cohort 1937-41	15.5	15.5	17.4	1.0	0.7	0.5	30.6	34.8	3.1	1.8
Cohort 1942-46	14.9	16.5	18.7	1.2	0.9	0.7	31.2	32.9	5.4	3.0
Cohort 1947-51	16.0	17.0	19.7	1.7	0.9	1.0	30.5	33.1	6.9	3.8
Cohort 1952-56	16.1	16.5	19.1	2.2	1.1	1.4	29.1	32.4	8.9	4.4
Cohort 1957-61	15.5	16.2	18.7	2.6	1.2	1.3	28.4	31.5	9.9	4.8
Cohort 1962-66	14.5	16.0	19.1	2.9	1.5	1.3	26.3	28.8	11.5	6.4
Cohort 1967-71	14.0	16.6	19.8	3.2	1.1	1.0	24.0	26.6	13.3	7.0
Average	15.2	16.4	19.1	2.1	1.1	1.1	28.4	31.3	8.9	4.7

Notes: Cumulated durations at the time of retirement under the assumption the legal retirement age is 65 years. Simulation results derived using SOEP weighing factors and static aging to forecast future population structure.

Source: SOEP, SUFVSKT2005, own calculations.

Simulation results for West German men show that the cumulated duration of employment in the younger birth cohorts declines by about 3 years relative to the oldest cohort, and that this

[20] To save space, we focus on these two states here. Simulation results for part-time employment and non-employment of women are reported and discussed in Steiner and Geyer (2009).

decline is similar for all education groups. Differences related to the level of education are more pronounced regarding changes in the cumulated duration of unemployment across birth cohorts: For people with low education it almost doubles from about 3.7 years in the oldest birth cohort to 7.2 years in the youngest cohort. Although the relative change across birth cohorts is similar for the other two education groups, the youngest birth cohort of West German men with medium education accumulate only about 3 years, those with higher education 2 years unemployment until retirement.

For West German women, changes in the cumulated duration of full-time employment across birth cohorts differ by the level of education. In the low education group it falls from 15.5 years in the oldest cohort to 14 years in the youngest, for women with medium or higher education full-time employment increases in the younger birth cohorts. Changes in the cumulated duration of unemployment across cohorts also differ by the level of education, although the younger cohorts accumulate somewhat more unemployment over their life-cycle than the older cohorts in all education groups. Note that the low average level of unemployment, relative to both West German men and especially East German women, is related to the much greater importance non-employment spells, often related to child-rearing activities, have for West German women.[22]

In East Germany, younger male birth cohorts experience a dramatic decline in employment and increase in unemployment durations. In the group with low or median education, the simulated duration in full-time employment from about 40 in the oldest to less than 36 years in the youngest cohort, in the high education group from about 37 to 31 years. Correspondingly, the simulated duration of unemployment in the group of persons with low or medium education soars from about 2 years in the oldest to more than 9 years in the youngest birth cohort. Unemployment also rises sharply for East German men with higher education, 1.4 years in the oldest to more than 5 years in the youngest birth cohort. This clearly shows the long-term consequences of the catastrophic labor market situation in East Germany.

Even worse seems the likely evolution of employment and unemployment for younger birth cohorts of East German women. The simulated duration of full-time employment falls

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[21] Changes in the simulated cumulated employment and unemployment durations between cohorts therefore differ from estimated cohort effects as reported in Tables A2 and A3 in the Appendix.

[22] The cumulated duration of non-employment of West German women has declined across birth cohorts in all education groups. For example, in the high education group non-employment duration is estimated to decline from 14 years to about 11 years. In contrast, non-employment of East German women in the high education group is expected to increase slightly across cohorts, although starting from a very low level of less than 2 years (see Steiner and Geyer 2009, Chapter 4.3.1).

from more than 30 years in the oldest to 24 years in the youngest cohort for women with low or median education, and from almost 35 years to less than 27 years in the high education group. The cumulated duration of unemployment of East German women with low or median education more than quadruples from about 3 years in the oldest to about 13 years in the youngest cohort. The increase in unemployment across birth cohorts is also substantial for the high education group for whom the simulated duration increases to 7 years in the youngest cohort. This dramatic increase of female unemployment can only partly be related to differences in non-employment between East and West Germany.

4.2 The effects of pension reforms on the average pension level

The introduction of the demographic adjustment factor in the pension formula and the phasing-in of a higher statutory retirement age described in Section 2.2 will have heterogeneous effects on individual pension levels across birth cohorts. While the pension reductions due to the adjustment factor will be larger for younger birth cohorts, the effects of the increase of the statutory retirement age will depend on the adjustment of the effective retirement age across birth cohorts. In the following we assume that the effective retirement age adjusts to the increase in the statutory retirement age from 65 to 67 years as described in Section 2.2, i.e. will also increase by two years over the phase-in period. To get an impression on the relative impact of these two policy reforms, Table 3 presents simulated pension benefits[23] for four alternative scenarios for West German men. In the first two scenarios the statutory retirement age is kept at 65 while the adjustment factor is introduced in *Scenario I* but not in *Scenario II*. This latter difference also distinguishes *Scenario III* and *Scenario IV* which also allow for the legislated increase in the statutory retirement age. We present these calculations for West German men, for whom we do not find large cohort effects in employment and unemployment durations. This allows us to abstract from cohort effects in employment histories and disentangle the reform effects in a simple way. For the other groups we document simulation results in Table A6 in the appendix.

The relative stability of employment histories across cohorts is reflected by the stability of pension benefits across cohorts under the Scenario I. In the absence of reforms, the pension benefit remains well above 1000 € per month for all cohorts. This changes when the legislated slower growth rate of the current pension value due to the demographic

[23] As we do not model income taxation in this paper, all pension benefits are gross amounts. However, we do substract pensioners' own contribution to the health and long-term care insurance. That is, here and in the following we report the effective amount of pension payment ("*Rentenzahlbetrag*") in the terminology of the German pension insurance.

sustainability factor is allowed for. In Scenario II, the pension level of younger cohorts declines relative to the oldest cohort. As expected and shown by the relative change in the pension benefit under Scenario I and Scenario II, the negative impact of the introduction of the adjustment factor is the bigger, the younger the age cohort. The youngest two age cohorts have to bear a reduction in the pension benefit of 13-14 percent due to this adjustment factor, compared to an average reduction across all cohorts of less than 8 percent.

Table 3 Impact of pension reforms on the average pension benefit by birth cohort – West German men

Scenario	I	II	III	IV	II / I	III / I	IV / I
	pension benefit (euro per month)				percentage change		
Cohort 1937-41	1,141	1,139	1,141	1,140	-0.2	0.0	-0.1
Cohort 1942-46	1,126	1,099	1,131	1,104	-2.4	0.4	-2.0
Cohort 1947-51	1,178	1,111	1,192	1,124	-5.7	1.2	-4.6
Cohort 1952-56	1,251	1,155	1,288	1,189	-7.7	3.0	-5.0
Cohort 1957-61	1,170	1,051	1,215	1,091	-10.2	3.8	-6.8
Cohort 1962-66	1,208	1,054	1,264	1,102	-12.7	4.6	-8.8
Cohort 1967-71	1,210	1,039	1,269	1,090	-14.1	4.9	-9.9
Total	1,184	1,094	1,214	1,121	-7.6	2.5	-5.3

Szenario I – Retirement age = 65, without adjustment of current pension value (CPV)
Szenario II – Retirement age = 65, with adjustment of CPV
Szenario III – Retirement age = 67, without adjustment of CPV
Szenario IV – Retirement age = 67, with adjustment of CPV (*base scenario*)
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations, see text.

Due to the slow phase-in of the statutory retirement age, which reaches 67 years only in 2029, the largest effects of this policy change occur for the two youngest birth cohorts. As shown by the relative change in the pension value under Scenario III and Scenario I in Table 3, the extension of the working life reduces the effect of the lower pension growth for the two youngest birth cohorts by almost 5.

Comparing the evolution of pension benefits across birth cohorts under Scenario III and Scenario IV shows that the assumed adjustment of the effective retirement age to the increased statutory retirement age partly compensates for the slower CPV growth rate. As shown by the column referring to Scenario IV, the net effect of these two policy changes is a fairly stable level of pension benefits of West German men across birth cohorts. However comparing this scenario to the one without adjustment of the pension formula and increase of the retirement age (Scenario I) reveals that the pension benefit is reduced by almost 10 percent for the youngest birth cohort, compared to an average reduction of only about 5 percent across all cohorts.

4.3 The level and distribution of pension benefits in the base scenario

Our simulation results on the level and distribution of pension benefits across birth cohorts presented in this section refer to Scenario I which includes the already legislated changes concerning the adjustment factor and the increase of the statutory retirement age. In general, we report pension benefits at the individual retirement age. In the case of two-person households, the simulations refer to the date when both spouses are retired. All pension benefits are discounted by the growth rate of real wages to make them comparable across birth cohorts. Due to the lower growth rate of pension benefits relative to wages the current pension value for younger birth cohorts will decline, although pension benefits will continue to grow in real terms. The sample is restricted to persons who were not civil servants or self-employed in the base year 2005. This restriction excludes very low pensions resulting from brief employment spells under the social security system, e.g. of persons who acquired pension entitlements at the beginning of their career but subsequently became civil servants. The analysis is restricted to own pensions derived from the public pension scheme which are by far the most important source of income in old age for the great majority of the population.

Average pension levels and replacement rates

Table 4 shows remarkable differences in the amount and the replacement rate of individual gross pension benefits stratified by cohort, gender, and region. The replacement rate is defined as the ratio of the amount of the pension benefit to the average gross wage in East and West Germany, respectively.[24]

Compared to all other groups, West German males across all birth cohorts can expect to receive the highest pension benefits. The slight negative trend in this group's pension benefit across birth cohorts is, as analyzed in the previous section, mainly driven by the lower CPV growth rate due to the demographic adjustment factor. The youngest cohorts receive a pension that is still about 95 percent of the pension of the oldest cohort. The gross replacement rate of West German men hovers in the youngest birth cohort still reaches about 45 percent and is only 2 percentage points less than the replacement rate of the oldest cohort.[25]

The own pension received by women is, on average across all birth cohorts, less than half the amount received by men in West Germany. On average, their pension benefit is less

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[24] The average monthly gross wage in 2005 was 2,433 € in West Germany and 2,057 € in East Germany. We use regional wages to account for differences in the cost of living the economy.

[25] Note that this replacement rate links the individual pension amount and the average monthly gross wage.

than the one received by women in East Germany. In contrast to all other groups, however, the pension benefit received by younger cohorts of West German women is substantially higher than that obtained by the older cohorts. This is the more remarkable as the older cohorts are not affected by the demographic CPV adjustment and shows the importance of the increasing labor market attachment of younger women in West Germany. Still, the youngest cohort of West German women reaches a replacement rate of only 24 percent.

Table 4 Pension benefits and replacement rates across birth cohorts by region and gender

		West Germany		East Germany	
Cohort	Average	Men	Women	Men	Women
		Pension benefit (€ per month)			
1937-41	863	1,140	449	886	646
1942-46	810	1,104	540	996	720
1947-51	808	1,124	544	898	792
1952-56	812	1,189	560	804	708
1957-61	765	1,091	542	680	706
1962-66	804	1,102	606	663	592
1967-71	770	1,090	591	594	466
Average	804	1,121	554	801	680
		Replacement rate (in percent)			
1937-41	36.4	46.8	43.1	18.5	31.4
1942-46	34.8	45.4	48.4	22.2	35.0
1947-51	34.5	46.2	43.7	22.4	38.5
1952-56	34.8	48.9	39.1	23.0	34.4
1957-61	32.7	44.8	33.1	22.3	34.3
1962-66	34.0	45.3	32.2	24.9	28.8
1967-71	32.3	44.8	28.9	24.3	22.6
Average	34.2	46.1	39.0	22.8	33.0

Notes: The sample is restricted to persons who were not civil servants or self-employed in the base year 2005. The replacement rate is the ratio of the monthly pension benefit to the average monthly gross wage in East and West Germany, respectively.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Looking at simulation results for East Germany, the evolution of pension benefits across birth cohorts looks much different. Whereas the average pension benefit of East German women is almost 700 € per month, and thus more than 100 € above the amount obtained by women in West Germany, it is only 466 € for the youngest birth cohort. This is only about 70 percent of the pension benefit received by the oldest cohort of women in East Germany. As shown in the previous section, about 10 percentage points are due to the net effect of the demographic adjustment factor and the increase in the retirement age. Thus, about 20 percent of the reduction of the pension benefit in the youngest age cohort of East German women would be related to increased unemployment and lower wages.

For East German males the development is even more dramatic. Whereas East German men in the oldest birth cohort reach a pension benefit of about 900 €, birth cohorts 1952-6 and younger have to expect a substantially smaller amount. The pension benefit of the youngest birth cohort of a bit less than 600 € is only two third of the amount received by the oldest cohort of East German men. The youngest birth cohort was about to enter the labor market when the wall came down and was especially hard hit by the catastrophic development of the East German labor market.

The distribution of individual pension benefits

Table 5 shows how individual pension benefits are distributed across birth cohorts. To have a sufficient number of people in each income class, which we group by intervals of 300 €, we have pooled birth cohorts. The upper part of the table contains the distribution of pension benefits across all birth cohorts, the middle part for cohorts born 1937-1951, and the lower part for cohorts born 1952-1971.

Table 5 Distribution of pension benefits across birth cohorts by region and gender, shares in percent

		West Germany		East Germany	
Income class (in €)	Total	Men	Women	Men	Women
			Cohorts 1937-71		
0-300	7.8	0.1	18.0	0.2	1.9
301-600	23.6	2.3	40.1	19.6	36.7
601-900	30.7	19.4	32.4	49.1	46.2
901-1200	23.4	42.9	8.0	25.9	13.5
1201-1500	9.9	23.2	1.5	4.6	1.6
1501+	4.6	12.1	0.1	0.6	0.0
			Cohorts 1937-51		
0-300	11.5	0.3	27.7	0.4	2.6
301-600	18.4	2.4	36.5	3.5	22.7
601-900	27.8	20.9	23.2	45.5	54.1
901-1200	25.6	40.3	9.6	39.7	18.8
1201-1500	11.3	23.2	2.7	9.5	1.8
1501+	5.3	12.9	0.3	1.4	0.0
			Cohorts 1952-71		
0-300	5.0	0.0	11.2	0.0	1.4
301-600	27.5	2.3	42.6	31.4	46.6
601-900	32.9	18.1	38.8	51.8	40.7
901-1200	21.7	45.0	6.8	15.7	9.8
1201-1500	8.9	23.2	0.7	1.0	1.5
1501+	4.1	11.4	0.0	0.0	0.0

Notes: Income class refers to the individual pension benefit.
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

On average across all cohorts, more than 40 percent of all pension benefits of West German men are in the income category 901-1200 €, while almost 50 percent of all men in East Germany obtain pensions between 601 and 900 Euro. The share of pensions exceeding 1200 Euro per month is neglible for women. For men in East Germany, the share of pensions exceeding 1200 Euro drops form about 10 percent among the older to almost zero in the younger cohorts. In contrast, about a third of all men in West Germany obtain relatively high pensions, and this share changes little between the older and younger age cohorts.

From a policy perspective, the share of pension benefits below 600 € is important because this amount is close to the average means-tested subsistence level for single pensioners ("Grundsicherung im Alter").[26] A single pensioner with an income below that threshold would be entitled to receive social assistance up to that limit by the state. Since we focus on individual pensions and do not take into account other household incomes we can, of course, make no strong statements concerning poverty issues. Still, the extent to which own old-age pensions lift the retired out of poverty is of substantial interest for social policy.

Whereas the share of West German men receiving pensions below 600 Euro is less than 3 percent even among younger age cohorts, one out of three East German men in the younger birth cohorts will receive a pension below this amount. While this share will change little in West Germany, it will increase dramatically from about 4 to more than 30 percent in East Germany. The already high share of low pensions among East German women will roughly double, from about 25 percent in the older to almost 50 percent in the younger cohorts. The share of low pensions is even higher among West German women, although it is expected to fall slightly from about 60 in the older to 55 percent in the younger cohorts.

The distribution of pension benefits by the level of education

The distribution of pension benefits in the total population disguises important differences by the level of education which is one of the major factors shaping life-time earnings. Thus, to shed some light on these differences, Table 6 reports means and percentiles of pension benefits for the birth cohorts 1952-71. We focus on the younger cohorts here to save space and, more importantly, because in these cohorts the share of people with low pensions is expected to be extremely high, especially in East Germany.[27]

Looking first at the simulation results for West German men, the group with relatively high average pensions, Table 6 reveals that for about a fourth of all people in the group with

[26] The Federal Statistical Office reports an average gross amount of 627 € in 2006 for individuals aged 65 and older (DESTATIS 2008).

a low level of education the expected pension benefit is below 660 €, and thus only marginally higher than the minimum pension. Even the median pension of 740 Euro for this group is only 100 € above the minimum pension. The distribution of pension benefits among East German men with low or medium education is similar as for West German men with low education, although the median is even a bit smaller. Compared to West German men with medium education, pension benefits in East Germany are substantially smaller at all percentiles of the distribution.

Table 6 Distribution of pension benefits by level of eduction, cohorts 1952-71 means and percentiles (in € per month)

		Percentile					
Education level	Mean	5	10	25	50	75	95
				Men West			
Low	761	526	571	657	742	821	1,091
Medium	1,079	765	826	935	1,046	1,207	1,506
High	1,281	833	956	1,073	1,253	1,504	1,747
Total	1,121	688	784	930	1,089	1,290	1,652
				Men East			
Low/Medium	746	477	514	600	719	881	1,062
High	908	550	596	716	886	1,073	1,315
Total	801	489	535	626	784	940	1,206
				Women West			
Low	350	211	230	268	309	376	638
Medium	569	230	266	387	571	707	987
High	640	244	328	444	636	808	1,101
Total	554	223	261	348	527	709	1,020
				Women East			
Low/Medium	608	319	398	503	603	700	902
High	790	478	527	604	751	955	1,182
Total	680	362	443	549	640	792	1,105
Overall total	804	268	332	533	767	1,044	1,481

Notes: Percentiles refer to the individual pension benefit.
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

As shown by Table 6, the picture is much different for women. Pension benefits of West German women with low education are very small: The median in the younger age cohorts is only a little more than 300 €, and even the 95 percentile is only a modest amount of 640 Euro, which exactly amounts to the current value of the minimum pension. These very

[27] As already mentioned in Section 3.1, we had to aggregate low and medium levels of education levels into one in East Germany because of the small number of people with low education.

low pensions result partly from the low wage of women with low education, partly from this group's low attachment to the labor market. This latter factor may also explain the relatively low level of pension benefits among West German women with higher education, for whom the median is only about 640 €. Pension benefits of East German women with high education exceed those of women in West Germany at each percentile of the distribution. Also, East German women with low or medium education obtain higher pension benefits than West German women with medium education at each percentile in the lower half of the distribution. These differences result from the stronger labor market attachment of women in East Germany, in particular their higher share of full-time employment.

Pensions at the household level

From a policy perspective, the low level of pension benefits of women has to be assessed by taking into account other household incomes as well. Small own old-age pensions of women need not imply a low living standard. Here, we focus on pension income from the spouse and analyze the distribution of pensions benefits at the household level. To this end, we simply average the amounts of old-age pension benefits received in couple households to represent the individualized pension at the household level.[28] We present both average pension benefits (Table 7) and their distribution (Table 8) across birth cohorts.

Table 7 Average pension benefits (€ per month) at the household level across birth cohorts

	Couples		Singles			
	West	East	West		East	
Cohorts			Men	Women	Men	Women
1937-41	816	770	1,112	452	908	653
1942-46	849	847	1,092	524	951	739
1947-51	853	853	1,070	533	828	792
1952-56	861	773	1,143	601	784	666
1957-61	841	714	1,042	556	660	702
1962-66	854	631	1,033	589	638	631
1967-71	839	588	1,091	616	591	429
Average	847	763	1,086	556	742	662

Notes: For couple households pension benefits are averaged. The cohort is defined with respect to the age of the older spouse.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

[28] Since we do not interpret pension levels in welfare terms, we refrain from calculating "equivalized" pension incomes using one of the usual scales.

For West German couples the average pension benefit per person remains fairly stable at about 850 € across birth cohorts. This corresponds to the evolution of individual pension benefits in West Germany described above: Its slight reduction for men is more or less compensated by its increase for women. In contrast, for East German couples there is a very strong negative trend in the level of average pensions across birth cohorts. Due to the relatively high pension benefits received by women, the level of the average pension benefit received by older birth cohorts of East German couples is similar to the level of West German couples in the same cohorts. The substantial decline of the average pension benefit of couples in East Germany from about 800 € to less than 600 € is the result of the drop of individual pensions among men and women in the younger birth cohorts. The evolution of pensions of singles, both in East and West Germany, is similar to what has been described above at the individual level. Hence, marital status of pensioners as such does not seem to effect pension benefits much.

Table 8 Average pension benefits (€ per month) at the household level across birth cohorts

	Couples		Singles			
	West	East	West		East	
Euro			Men	Women	Men	Women
			Cohorts 1937-71			
0-300	0.5	0.0	0.2	21.8	0.7	0.6
301-600	12.6	10.2	4.0	35.6	20.0	31.6
601-900	46.5	62.2	23.2	31.4	47.7	48.5
901-1200	33.9	26.9	38.7	9.3	26.9	17.5
1201-1500	6.0	0.7	24.4	1.6	3.8	1.8
1501+	0.4	0.0	9.6	0.4	0.8	0.0
			Cohorts 1937-51			
0-300	1.0	0.0	0.4	29.8	1.6	1.4
301-600	14.4	5.4	3.4	31.7	5.7	26.5
601-900	43.1	56.1	24.6	25.6	50.5	46.5
901-1200	34.5	37.1	42.0	9.8	33.5	21.7
1201-1500	6.5	1.4	21.9	2.5	7.0	3.9
1501+	0.6	0.0	7.8	0.6	1.8	0.0
			Cohorts 1952-71			
0-300	0.0	0.0	0.0	11.0	0.0	0.0
301-600	10.6	14.9	4.5	40.8	32.9	36.0
601-900	50.3	68.2	21.8	39.1	45.2	50.2
901-1200	33.3	16.8	35.4	8.7	21.0	13.9
1201-1500	0.3	0.0	27.0	0.4	0.9	0.0
1501+	0.3	0.0	11.3	0.0	0.0	0.0

Notes: For couple households pension benefits are averaged. The cohort is defined with respect to the age of the older spouse.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Table 8 shows the distribution of pension benefits at the household level. Across all cohorts, the share of low pensions among couples is small compared to single women. Only about 10 percent of couples in both East and West Germany have a pension of less than 600 € per person, compared to almost 60 percent of single women in West German and more than 30 percent of this group in East Germany. In West Germany in particular, relatively high pensions of between 900 and 1200 € per person are much more common among couples than among single women.

Looking at changes across birth cohorts, Table 8 displays a sharply increasing share of low pensions in East German couple households: among the younger birth cohorts, 15 percent receive a pension of less than 600 €, compared to only 5 percent among the older cohorts. The share of relatively high pension benefits exceeding 900 € received by this group also falls substantially in the younger cohorts, from 38.5 to 16.8 percent. In contrast, the slight decline in the share of very low pensions among couples in West Germany is accompanied by a marked of relatively high pension in the younger birth cohorts.

4.4 A more optimistic labor market scenario

The simulations from the previous sections are based on estimated cohort effects which imply a rather pessimistic outlook for the future level of pension benefits of younger birth cohorts in East Germany. These cohort effects in employment patterns and relative wages are estimated on data from the period 1990-2005, which saw a dramatic increase in registered long-term unemployment in East Germany. Since we have to simulate employment and wage developments for up to 30 years in the future for the youngest birth cohort, these simulations very much depend on the question whether these cohort effects can be used to project labor market outcomes in the distant future. The effects of past unemployment on future pension benefits cannot be made disappear but future employment may not decline and unemployment increase as strongly as observed in the past in East Germany.

Given the long projection period for the youngest cohorts and the uncertainty surrounding these projections, in the following we present simulation results derived under the scenario "*positive labor market East Germany*". Instead of simulating future employment and unemployment durations using estimated cohort effects, we average these effects across all birth cohorts in this scenario. Hence, the sharp increase in the future duration of unemployment among younger birth cohorts is diminished relative to the baseline scenario. Given the improvement in future labor market conditions in this alternative scenario, we also assume that the effective retirement age of East Germans increases to the West German level, which implies a long-term increase of about one more year in East Germany.

The left part of Table 9 shows the simulation results for the individual pension benefit and the replacement rate in this scenario, the right part the changes relative to our base scenario. Across all birth cohorts, the pension benefit increases by about 8 percent, on average, in the scenario with a more positive labor market development in East Germany, with a somewhat stronger increase for women. The replacement ratio increases by about three percentage points, on average, to about 44 percent for men and 37 percent for women. Although the overall negative trend in the evolution of pension benefits across birth cohorts is not reversed, it becomes substantially weaker in this scenario. The reduction of the pension benefit in the youngest cohort is, on average, 11 percent less than in the base scenario, and the decline in the replacement rate is reduced by 6 percentage points. Somewhat weaker effects of a positive labor market on pension benefits and replacement rates in East Germany can be observed for the birth cohort 1962-66 and, still somewhat diminished, for the cohort 1957-61.

Table 9 Pension benefits and replacement rates across birth cohorts scenario "positive labor market East Germany"

Cohort	Total	Men	Women	Total	Men	Women
	Pension benefit (€ / month)			*Change relative to base scenario* (in percent)		
1937-41	768	869	668	0.24	-2.07	3.40
1942-46	872	1000	738	-0.41	-1.73	1.54
1947-51	865	929	818	-1.31	-1.47	-1.17
1952-56	802	863	752	1.33	1.70	0.98
1957-61	771	765	776	3.71	4.77	2.77
1962-66	728	772	692	6.90	6.78	7.01
1967-71	646	733	570	11.00	11.52	10.42
Average	791	858	732	8.49	7.84	9.52
	Replacement rate (in percent)			*Change relative to base scenario* (in percentage points)		
1937-41	37.3	42.2	32.5	0.1	-0.9	1.1
1942-46	42.4	48.6	35.9	0.5	0.2	0.9
1947-51	42.0	45.2	39.7	1.4	1.5	1.3
1952-56	39.0	42.0	36.6	2.5	2.8	2.1
1957-61	37.5	37.2	37.7	3.8	4.1	3.4
1962-66	35.4	37.6	33.7	5.1	5.3	4.9
1967-71	31.4	35.7	27.7	5.9	6.8	5.1
Average	38.4	41.7	35.6	2.7	2.8	2.6

Notes: The replacement rate is the ratio of the monthly pension benefit to the average monthly gross wage in East and West Germany, respectively. The distribution of pension benefits in the base scenario is documented in Table 5.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

The comparison of the distribution of pension benefits across birth cohorts in our base and alternative scenario in Table 10 reveals a relatively strong reduction in the share of very

small pension benefits. In the younger age cohorts, the share of pensions below 600 € drops by 19 percentage points for men and 16 percentage points for women. This strong reduction would be accompanied by an increase in the share of monthly pensions of more than 900 € by almost 10 percentage points for men and 5 percentage points for women.

Table 10 Distribution of pension benefits by income class across birth cohorts scenario "positive labor market East Germany"

	Share (in percent)			Changes relative to base scenario (in percentage points)		
Euro	Total	Men	Women	Total	Men	Women
			Cohorts 1937-71			
0-300	0.6	0.2	1.1	-0.5	0.0	-0.8
301-600	17.8	8.0	26.4	-10.9	-11.6	-10.4
601-900	53.9	54.3	53.6	6.3	5.2	7.3
901-1200	22.5	30.5	15.6	3.3	4.6	2.1
1201-1500	4.7	6.4	3.2	1.7	1.8	1.6
1501+	0.0	0.0	0.0	-0.3	-0.6	0.0
			Cohorts 1937-51			
0-300	1.2	0.4	1.9	-0.4	0.0	-0.7
301-600	11.9	2.2	20.5	-1.8	-1.3	-2.2
601-900	50.1	45.1	54.5	0.0	-0.4	0.4
901-1200	29.0	40.3	18.8	0.3	0.6	0.0
1201-1500	7.0	10.6	3.8	1.6	1.1	2.1
1501+	0.0	0.0	0.0	-0.7	-1.4	0.0
			Cohorts 1952-71			
0-300	0.3	0.0	0.5	-0.5	0.0	-0.9
301-600	22.1	12.2	30.5	-17.5	-19.2	-16.1
601-900	56.7	61.1	52.9	10.9	9.3	12.2
901-1200	17.9	23.3	13.4	5.4	7.6	3.5
1201-1500	3.0	3.3	2.8	1.8	2.4	1.3
1501+	0.0	0.0	0.0	0.0	0.0	0.0

Notes: The distribution of pension benefits in the base scenario is documented in Table 5.
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

The large differences in simulations results between the two scenario illustrate the importance of future labor market developments for the level and distribution of pension benefits of younger birth cohorts in East Germany. In our view, the alternative scenario seems rather optimistic since, at the individual level, it implies relatively weak effects of long-term unemployment cumulated in early years on future employment patterns. Thus, younger birth cohorts will have to experience less unemployment between, say, age 40 and the retirement age than older cohorts in order to partially compensate for the much longer unemployment durations experienced by these cohorts in younger ages and the low pension rights that result from long-term unemployment since 2005. Labor market developments in

East Germany give little reason to be overly optimistic in this respect. Thus, our alternative scenario probably lies near to the upper bound of likely outcomes of the development of pension benefits in East Germany.

5 Conclusion

Our goal has been to quantify the likely impact of changing employment patterns and pension reforms on the future level of public pensions across birth cohorts in Germany. To this end, we have developed a microsimulation model which accounts for cohort effects in individual employment and unemployment and earnings over the lifecycle as well as the differential impact of recent pension reforms on birth cohorts. Using simulated life cycle employment and income profiles, we have shown that public pensions of East German men and women will fall dramatically among younger birth cohorts, not only because of policy reforms but due to higher cumulated unemployment. For West German men, the small reduction of average pension levels among younger birth cohorts is mainly driven by the impact of pension reforms, while future pension levels of West German women are increasing or stable due to increasing labor market participation among younger birth cohorts. These simulation results refer to our “base scenario” which takes into account the demographic adjustment factor and the long-term increase in the statutory retirement age introduced recently to stabilize the contribution rate to the public pension system.

Regarding the distribution of individual pension benefits, for the younger birth cohorts of East German men and women our simulation results imply high shares of pensions below the minimum pension recently introduced to avoid poverty among pensioners. Furthermore, the distribution of pension benefits in the total population disguises important differences by the level of education which is one of the major factors shaping life-time earnings. Even in the group of West German men whose average pension level is relatively high also among younger age cohorts, a large share of those with a low level of education will obtain public pensions which are very close to the minimum pension, and that even the median pension of this group is only marginally above that level. While the very high share of individual pensions below the level of the social minimum among West German women will decline somewhat in the younger birth cohorts, it will increase dramatically for both men and women in East Germany. Also at the household level, the share of low pensions among married women will increase dramatically in younger birth cohorts in East Germany.

Since these simulation results are based on projecting labor market developments observed in the past into the distant future for younger birth cohorts, which by necessity has to rely on highly uncertain assumptions especially for East Germany, we have also simulated the evolution of future pensions across birth cohorts under a more optimistic labor market scenario. This scenario implies that future employment patterns of younger birth cohorts will

resemble the average development over all cohorts since German reunification and that the effective retirement age of East Germans increases to the West German level. Even under this optimistic scenario, the overall negative trend in the evolution of pension benefits and the increasing share of low pensions across birth cohorts are not reversed, although it becomes substantially weaker. However, this latter scenario is probably too optimistic regarding the development of future pension benefits in East Germany.

Appendix

Statistical Matching of SOEP and Pension Insurance Accounts

The merging of SOEP and VSKT is performed by a statistical matching procedure to identify statistical twins. This is a common microsimulation method to combine data sets statistically when no unique identifier in two or more data sets is available (O'Hare 2000; D'Orazio et al. 2006). We apply a nearest-neighbor propensity score matching with replacement (see, e.g., Cameron and Trivedi, Ch. 25.4). That is, cases are matched for which the absolute difference in terms of the propensity score is minimized within 54 subsets of the data ("cells") defined by age-groups, gender, region, education and insurance status. Within these cells, we further match on individual labor market characteristics and – for women – the number of children. Since education is a very important matching variable, which is missing for more than 40 percent of all observations in the VSKT, we can only use a sub-sample of about 25,500 observations to match statistical twins to the about 12,800 observations in the SOEP data. We cannot include persons with foreign citizenship because they are not part of the VSKT. For them, pension benefits are simulated using the SOEP.

The effectiveness of the matching procedure can be checked by testing the differences in the means of matching variables in the matched data set. Results of standard *t*-tests of the difference in means from two independent samples show that no statistically significant differences remain in any of the matching variables (see Geyer and Steiner 2010, Table A3-3). More interesting are any remaining differences in employment patterns in the base year 2005 and pension points that are not used as matching variables. As described in the text, pension points are simulated in the SOEP on the basis of retrospective data and directly available in the VSKT from cleared insurance accounts.

Table A1 shows large differences in the means of these variables in the two data sets before matching, and differences remain statistically significant after matching in most cases. The average number of pension points after matching is significantly larger in the VSKT than in the SOEP in all groups, varying between 2.6 percentage points for East German women and almost 4 percentage points for women in West Germany. These relatively large differences result from both the longer cumulated employment durations of women recorded in the VSKT and the much more precise recording of individual entitlement periods obtained during non-employment spells in the VSKT relative to those simulated on the basis of SOEP. data. This in particular concerns entitlement periods related to child-rearing activities of women, but also more generally to the way pension entitlement acquired in the GDR were counted after their integration in the West German pension system.

Additional Tables and Figures

Table A1 Employment and unemployment durations (months) and pension points in 2005 in SOEP and the Pension Insurance Accounts (VSKT) before and after matching

	SOEP	VSKT	*t*	*p*
West Germany		Men		
Employment	227.5	259.2	-12.3	0.00
	227.5	244.0	-5.3	0.00
Unemployment	8.7	9.0	-0.8	0.44
	8.7	6.7	4.2	0.00
Pension points	25.3	29.2	-11.5	0.00
	25.3	29.1	-8.8	0.00
		Women		
Employment	181.7	205.3	-10.7	0.00
	181.7	197.5	-6.1	0.00
Unemployment	9.1	10.8	-4.6	0.00
	9.1	8.6	1.2	0.23
Pension points	12.6	17.0	-22.6	0.00
	12.6	16.5	-18.8	0.00
East Germany		Men		
Employment	249.4	276.5	-5.9	0.00
	249.4	274.4	-4.9	0.00
Unemployment	17.4	13.7	3.9	0.00
	17.4	17.5	-0.1	0.94
Pension points	24.7	28.0	-6.8	0.00
	24.7	27.3	-5.2	0.00
		Women		
Employment	244.9	250.4	-1.3	0.18
	244.9	236.7	1.7	0.08
Unemployment	24.9	23.5	1.1	0.26
	24.9	25.1	-0.1	0.89
Pension points	24.7	28.0	-6.8	0.00
	24.7	27.3	-5.2	0.00

Notes: For each variable, the first row shows its means in the SOEP and the VSKT before, the second row after the statistical matching. *t* is the statistic for the test of statististical significance of the difference of the two means, *p* the probability value for this test.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Since pension entitlements in the PSIA are measured much more precisely than those derived from the SOEP, we substitute the latter by the former for all observations for which a statistical twin could be found in the matched data set in the base year 2005. We use simulated pension benefits derived from retrospective SOEP data only for those persons for whom no statistical twin could be found. In particular, this concerns people with foreign nationality who are not included in the PSIA data set,

Table A2 Marginal cohort effects in employment and unemployment histories from tobit estimates by region and level of education, men

	Full-time employment		Unemployment	
	ME	s.e.	ME	s.e.
West Germany		Low level of education		
Cohort 1942-46	-1.11	0.17	0.11	0.06
Cohort 1947-51	-1.48	0.18	0.33	0.06
Cohort 1952-56	-0.99	0.21	0.94	0.07
Cohort 1957-61	-1.87	0.22	1.57	0.08
Cohort 1962-66	-2.69	0.24	2.37	0.08
Cohort 1967-71	-2.81	0.26	2.02	0.09
		Medium level of education		
Cohort 1942-46	-1.27	0.10	0.20	0.03
Cohort 1947-51	-1.16	0.10	0.39	0.03
Cohort 1952-56	-1.14	0.11	0.48	0.03
Cohort 1957-61	-1.49	0.11	0.74	0.03
Cohort 1962-66	-1.45	0.12	0.62	0.04
Cohort 1967-71	-1.66	0.13	0.82	0.04
		High level of education		
Cohort 1942-46	-0.75	0.16	0.55	0.03
Cohort 1947-51	-0.97	0.16	0.63	0.03
Cohort 1952-56	-1.16	0.17	0.83	0.04
Cohort 1957-61	-1.10	0.18	1.02	0.04
Cohort 1962-66	-1.04	0.18	0.86	0.04
Cohort 1967-71	-1.42	0.20	0.96	0.04
East Germany		Low/medium level of education		
Cohort 1942-46	-0.28	0.15	0.65	0.06
Cohort 1947-51	-1.16	0.17	1.51	0.07
Cohort 1952-56	-1.92	0.18	2.57	0.07
Cohort 1957-61	-3.03	0.19	3.60	0.08
Cohort 1962-66	-3.16	0.21	3.96	0.09
Cohort 1967-71	-3.34	0.22	4.74	0.09
		High level of education		
Cohort 1942-46	-0.35	0.17	0.22	0.04
Cohort 1947-51	-1.95	0.20	0.64	0.04
Cohort 1952-56	-2.64	0.22	0.72	0.05
Cohort 1957-61	-3.17	0.25	1.19	0.06
Cohort 1962-66	-3.64	0.29	1.44	0.06
Cohort 1967-71	-5.08	0.34	2.20	0.07

Notes: ME := Marginal Effect = difference of the average cumulated duration of the respective cohort and the cohort 1937-41 (base category). s.e. := estimated standard error of cohort effect. All estimated marginal effects are statistically significantly different from zero at the 1%-level. Marginal effects are evaluated at sample means of explanatory variables in the tobit models.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Table A3 Cohort effects in employment and unemployment histories from tobit estimates by region and level of education, women

	Full-time employment		Part-time employment		Unemployment		Non-employment	
	ME	s.e.	ME	s.e.	ME	s.e.	ME	s.e.
West Germany			*Low level of education*					
Cohort 1942-46	-0.89	0.19	0.43	0.10	0.22	0.03	-0.27	0.19
Cohort 1947-51	-0.59	0.19	0.19	0.11	0.51	0.04	-0.80	0.19
Cohort 1952-56	-0.17	0.22	0.90	0.12	0.91	0.04	-1.86	0.22
Cohort 1957-61	-0.75	0.24	2.16	0.13	1.29	0.04	-2.31	0.24
Cohort 1962-66	-1.38	0.26	2.55	0.15	1.51	0.05	-1.92	0.26
Cohort 1967-71	-1.73	0.28	2.70	0.16	1.65	0.05	-2.05	0.28
			Medium level of education					
Cohort 1942-46	0.81	0.15	0.78	0.10	0.11	0.02	-1.41	0.14
Cohort 1947-51	1.14	0.15	1.69	0.10	0.13	0.02	-2.24	0.14
Cohort 1952-56	1.11	0.16	1.87	0.10	0.28	0.03	-2.67	0.15
Cohort 1957-61	0.89	0.16	2.64	0.11	0.36	0.03	-2.94	0.15
Cohort 1962-66	0.57	0.17	3.15	0.12	0.55	0.03	-2.95	0.16
Cohort 1967-71	0.67	0.19	3.35	0.13	0.24	0.03	-3.25	0.18
			High level of education					
Cohort 1942-46	1.11	0.28	-0.15	0.17	0.21	0.05	-0.60	0.23
Cohort 1947-51	2.27	0.29	0.06	0.17	0.57	0.05	-1.14	0.23
Cohort 1952-56	1.74	0.29	1.01	0.17	0.90	0.05	-1.91	0.24
Cohort 1957-61	1.68	0.30	1.69	0.18	0.77	0.05	-1.73	0.24
Cohort 1962-66	1.77	0.31	1.66	0.19	0.73	0.05	-1.90	0.25
Cohort 1967-71	1.57	0.33	1.87	0.20	0.47	0.06	-1.56	0.27
East Germany			*Low/medium level of education*					
Cohort 1942-46	0.58	0.26	-0.89	0.17	1.41	0.07	-0.61	0.10
Cohort 1947-51	0.23	0.29	-0.90	0.18	2.74	0.08	-1.10	0.11
Cohort 1952-56	-1.00	0.32	-1.38	0.21	4.43	0.09	-0.93	0.13
Cohort 1957-61	-1.74	0.35	-1.17	0.23	5.32	0.10	-0.97	0.14
Cohort 1962-66	-3.78	0.39	-0.49	0.25	6.79	0.12	-0.59	0.15
Cohort 1967-71	-5.79	0.42	-0.44	0.27	8.21	0.12	0.19	0.17
			High level of education					
Cohort 1942-46	-1.69	0.32	0.67	0.19	0.41	0.06	0.19	0.10
Cohort 1947-51	-1.53	0.34	1.20	0.20	0.91	0.07	0.03	0.11
Cohort 1952-56	-2.14	0.36	1.00	0.22	1.20	0.08	0.14	0.12
Cohort 1957-61	-3.32	0.38	1.91	0.23	1.47	0.08	0.37	0.13
Cohort 1962-66	-5.53	0.42	3.25	0.25	2.46	0.09	0.99	0.13
Cohort 1967-71	-6.94	0.47	4.65	0.28	3.05	0.10	1.60	0.15

Notes: ME := Marginal Effect = difference of the average cumulated duration of the respective cohort and the cohort 1937-41 (base category). s.e. := estimated standard error of cohort effect. All estimated marginal effects are statistically significantly different from zero at the 1%-level. Marginal effects are evaluated at sample means of explanatory variables in the tobit models.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Table A4 Random-effects relative wage regressions, men

	West Germany			East Germany	
Education level	Low	Medium	High	Low/Medium	High
non-employment duration	-0.09***	-0.13***	-0.32***	-0.21***	-0.56***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.04)
(non-employment duration)^2/100	1.08***	0.69**	5.09***	2.71***	20.73***
	(0.37)	(0.31)	(0.68)	(0.58)	(2.79)
(non-employment duration)^3/100	-0.60***	-0.13	-2.38***	-1.43***	-25.26***
	(0.22)	(0.21)	(0.49)	(0.49)	(4.36)
age	5.41***	6.25***	-0.95***	0.13**	3.09
	(0.46)	(0.37)	(0.26)	(0.06)	(2.40)
age^2/100	-30.48***	-38.55***	6.12***	-0.37	-21.57
	(3.31)	(2.54)	(1.32)	(0.25)	(14.77)
age^3/100	0.90***	1.26***	-0.17***	0.00	0.79*
	(0.12)	(0.09)	(0.03)	(0.00)	(0.48)
age^4/1000	-0.15***	-0.23***	0.02***	-0.00	-0.16*
	(0.02)	(0.02)	(0.00)	(0.00)	(0.08)
Age^5/1000	0.00***	0.00***	-0.00***		0.00**
	(0.00)	(0.00)	(0.00)		(0.00)
Age^6/10000	-0.00***	-0.00***			-0.00**
	(0.00)	(0.00)			(0.00)
Other control variables included	yes	yes	yes	yes	yes
σ_u	0.39	0.40	0.44	0.34	0.40
σ_e	0.24	0.20	0.22	0.21	0.22
Number of observations	9.958	24.884	13.840	7.844	4.780
Number of individuals	1.622	3.864	2.376	1.252	751

Notes: Random-effects estimation, with σ_u, σ_e estimated error components; s. e. in parentheses;
* / ** / ***: statistically significantly different from zero at the 10%- / 5%- / 1%-level. All estimations include a constant and time effects; control variables are a dummies for German nationality and orthogonolized dummies for firm size and industry.

Source: SOEP, own calculations

Table A5 Random-effects relative wage regressions, women

	West Germany			East Germany	
Education level	Low	Medium	High	Low/Medium	High
non-employment duration	-0.05***	-0,14***	-0,14***	-0,07***	-0,09***
	(0.01)	(0,01)	(0,01)	(0,01)	(0,02)
(non-employment duration)^2/100	0.20***	1,40***	1,28***	0,19*	-0,39
	(0.05)	(0,09)	(0,24)	(0,10)	(0,39)
(non-employment duration)^3/100	-0.04***	-0,59***	-0,53***	-0,01	0,57**
	(0.01)	(0,05)	(0,15)	(0,03)	(0,24)
(non-employment duration)^4/100		0,00***	0,00**		
		(0,00)	(0,00)		
part-time employment duration	-0.09***	-0,11***	-0,15***	-0,11***	-0,10***
	(0.01)	(0,01)	(0,01)	(0,01)	(0,01)
(part-time employment duration)^2/100	1.10***	1,29***	2,07***	1,32***	1,27***
	(0.10)	(0,07)	(0,16)	(0,14)	(0,18)
(part-time employment duration)^3/100	-0.48***	-0,54***	-1,06***	-0,57***	-0,66***
	(0.05)	(0,04)	(0,10)	(0,08)	(0,12)
(part-time employment duration)^4/100	0.00***	0,00***	0,00***	0,00***	0,00***
	(0.00)	(0,00)	(0,00)	(0,00)	(0,00)
Currently part-time employed	-0.89***	-0,84***	-0,83***	-1,04***	-0,80***
	(0.01)	(0,01)	(0,01)	(0,02)	(0,03)
age	6.81***	8,53***	1,60***	0,10	-1,43***
	(0.57)	(0,56)	(0,42)	(0,09)	(0,45)
age^2/100	-41.88***	-54,49***	-7,74***	-0,31	7,85***
	(4.06)	(3,83)	(2,21)	(0,35)	(2,26)
age^3/100	1.35***	1,82***	0,19***	0,00	-0,20***
	(0.15)	(0,14)	(0,06)	(0,01)	(0,06)
age^4/1000	-0.24***	-0,33***	-0,02***	-0,00	0,03***
	(0.03)	(0,03)	(0,01)	(0,00)	(0,01)
age^5/1000	0.00***	0,00***	0,00***		-0,00***
	(0.00)	(0,00)	(0,00)		(0,00)
age^6/10000	-0.00***	-0,00***			
	(0.00)	(0,00)			
σ_u	0.38	0,37	0,42	0,30	0,29
σ_e	0.28	0,28	0,30	0,25	0,22
Number of observations	9.482	19.648	8.190	6.544	5.528
Number of individuals	1.696	3.420	1.619	1.191	808

Notes: Random-effects estimation, with σ_u, σ_e estimated error components; s. e. in parentheses;
* / ** / ***: statistically significantly different from zero at the 10%- / 5%- / 1%-level. All estimations include a constant and time effects; control variables are a dummies for German nationality and orthogonolized dummies for firm size and industry. G = Geringe Bildung, M = Mittlere Bildung, H = Höhere Bildung.

Source: SOEP, own calculations

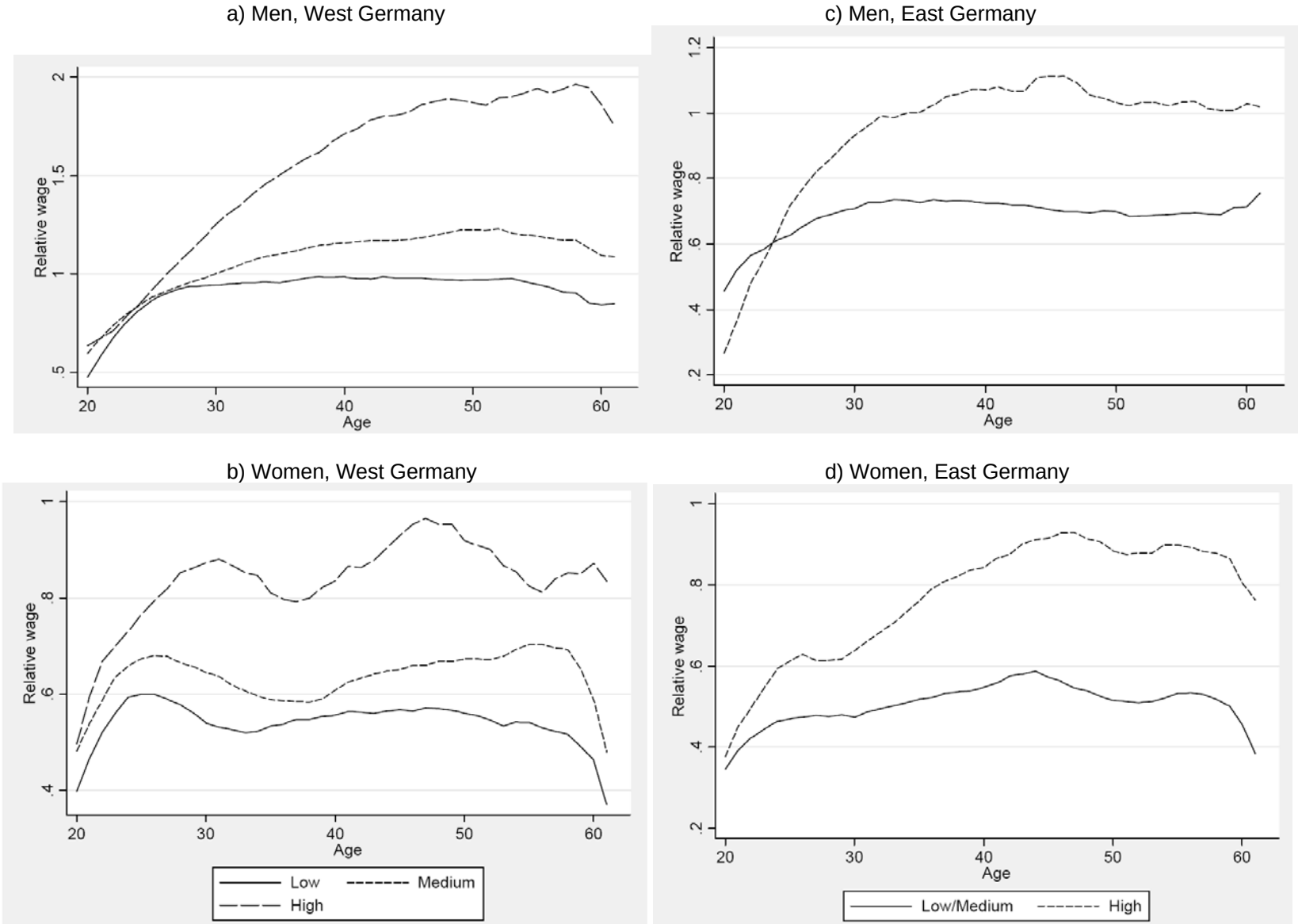
Table A6 Impact of pension reforms on the average pension benefit by birth cohort – women in West Germany, men and women in East Germany

Szenario	I	II	III	IV	II/I	III/I	IV/I
	pension benefit (euro per month)				percentage change		
Women, West G.							
Cohort 1937-41	451	449	451	449	-0,3	0,1	-0,3
Cohort 1942-46	552	538	554	540	-2,6	0,4	-2,2
Cohort 1947-51	570	538	577	544	-6,1	1,2	-4,8
Cohort 1952-56	588	543	606	560	-8,3	3,0	-5,1
Cohort 1957-61	581	522	603	542	-11,3	3,7	-7,2
Cohort 1962-66	666	581	694	606	-14,5	4,0	-9,9
Cohort 1967-71	659	566	688	591	-16,4	4,3	-11,5
Total	590	540	606	554	-9,2	2,6	-6,4
Men, East G.							
Cohort 1937-41	887	886	887	886	-0,1	0,0	-0,1
Cohort 1942-46	1.017	993	1.020	996	-2,5	0,3	-2,2
Cohort 1947-51	943	890	953	898	-6,0	1,0	-5,0
Cohort 1952-56	849	784	870	804	-8,2	2,5	-5,5
Cohort 1957-61	730	657	756	680	-11,1	3,4	-7,4
Cohort 1962-66	723	635	756	663	-14,0	4,3	-9,1
Cohort 1967-71	658	566	690	594	-16,2	4,7	-10,7
Total	843	786	860	801	-7,3	2,0	-5,2
Women, East G.							
Cohort 1937-41	646	646	646	646	0,0	0,0	0,0
Cohort 1942-46	727	718	729	720	-1,2	0,3	-0,9
Cohort 1947-51	827	786	834	792	-5,3	0,8	-4,5
Cohort 1952-56	745	691	763	708	-7,8	2,4	-5,2
Cohort 1957-61	755	685	779	706	-10,3	3,0	-7,0
Cohort 1962-66	647	570	672	592	-13,5	3,7	-9,2
Cohort 1967-71	516	447	538	466	-15,5	4,0	-10,9
Total	715	667	729	680	-7,2	2,0	-5,1

Szenario I – Retirement age = 65, without adjustment of current pension value (CPV)
Szenario II – Retirement age = 65, with adjustment of CPV
Szenario III – Retirement age = 67, without adjustment of CPV
Szenario IV – Retirement age = 67, with adjustment of CPV (*base scenario*)

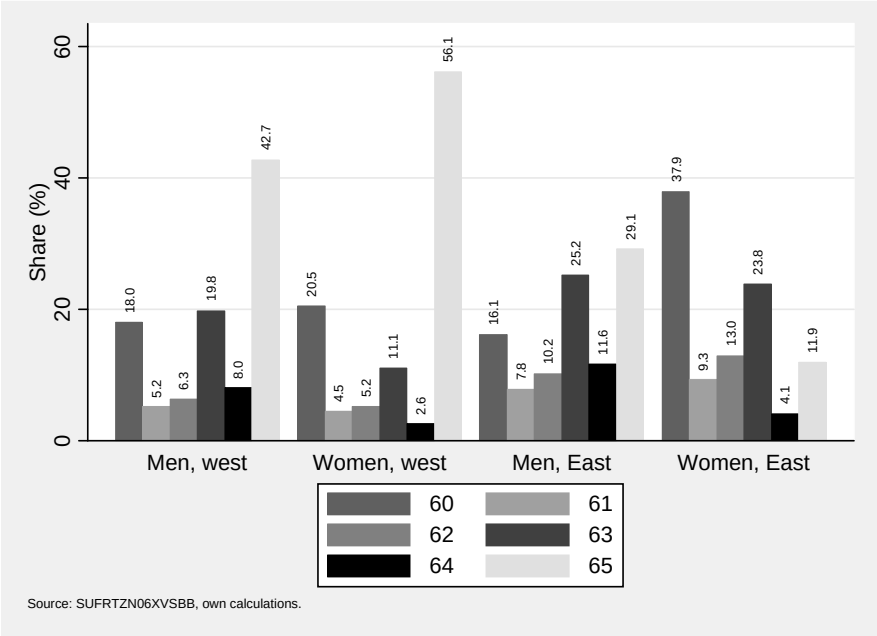
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations.

Figure A1 Relative earnings-experience profiles by level of education



Source: Own calculations based on estimated cohorts effects in Tables A2 and 3 and relative wage regressions in Tables A4 and A5.

Figure A2 Retirement age of the 2006 entry cohort by gender and region (shares in %)



Source: SUFRTZN06XVSBB, own calculations.

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