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Erstgutachter:
Prof. Viktor Steiner, Freie Universität Berlin

Zweitgutachter:
Prof. Carsten Schröder, Christian-Albrechts-Universität zu Kiel

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Contents

1 Introduction

The German labour market has been characterised by high and persistent unemployment for decades. In East Germany, unemployment rose sharply after reunification and has remained high ever since. However, unemployment has steadily increased in West Germany as well. This development has important policy and welfare implications as the social insurance system has been considered to be not sustainable in the long run in view of the persistently high unemployment rates. Moreover, rapid demographic ageing constitutes a reinforcing factor which will put additional pressure on the welfare state. To respond to the challenges, Germany has been modifying the institutional settings of the welfare state, its labour market regulation and the social security systems in a series of gradual reforms since the 1990s. For example, the continuing reforms of the pension insurance were aimed at improving the system's financial sustainability, and one goal of the so-called "Hartz reforms" was to render the labour market more dynamic and reduce unemployment.

The question whether these reforms have led to a reduction in unemployment and have spurred economic growth is under constant debate. Particularly in the aftermath of the last financial crisis and the worldwide recession, the public and experts have been puzzled alike: Why has the labour market remained stable during the worst post-war recession? Advocates of the welfare reforms felt vindicated and claimed flexibility of its labour market in terms of employment, working conditions and pay to be an important factor of Germany's so-called "jobs miracle".

But what changes occurred at the level of the individual? The ongoing public debate on the consequences of labour market flexibilisation in Germany is also characterised by another critical perspective. Proponents of this view argue that flexibilisation has increased job insecurity, promoted the development of a low wage sector, and has not actually reduced unemployment. Indeed, it has to be kept in mind that unemployment rates have remained relatively high and have left their "traces" in employment biographies. Moreover, the increase in employment does not necessarily lead to individual job security. In fact, a steady erosion of the standard full-time employment relationship has been observed in Germany as in other European countries. New forms of employment have gained importance, as for example marginal employment and fixed-term contracts, and collective labour agreements have lost significance (see, e.g., Bispinck, 2007; Faik et al., 2001; Rische, 1999; SVR, 2008). Particularly in the manufacturing and service sector, we currently can observe an unprecedented boom of temporary agency work (Bundesagentur für Arbeit, 2011). And as noted above, the decline in standard employment relationships has been accompanied by a very modest wage development (e.g., Brenke, 2009).

A tentative interpretation of these developments is that they represent two sides of the same coin: the need for both flexibilisation of labour market institutions and the provision of suitable individual coping strategies. A fundamental future challenge to the welfare state will be to keep its institutions not only financially sustainable but, at the same time, socially sustainable. Therefore, further research is needed to identify particular problems and to suggest policy solutions.

Against the background of these social challenges, this cumulative doctoral thesis investigates economic risks on the level of the individual and household from different perspectives. The second chapter takes a broad view on how labour market changes transmit to individual employment biographies. Comparing birth cohorts born between 1937 and 1971, it focuses on the relationship between changing life-cycle employment and its probable impact on future pensions. One of the most important labour market risks is involuntary joblessness. Job loss immediately leads to income loss and has a negative long-term effect on employability and attainable wage rates. Moreover, the German public pension system is closely linked to labour earnings over the life cycle, so that periods of unemployment directly reduce the benefit entitlements a person collects compared to periods of employment. While the negative effect on wages can possibly be restored, periods of unemployment are saved in the individual pension insurance account. Labour market changes are likely to hav not only an influence on pension entitlements but also a differential effect for different birth cohorts.

For years, poverty rates among pensioners have been lower than the population average. However, researchers expect that recent pension reforms together with the poor labour market development will lead to a strong increase in old-age poverty in the future (e.g., Arent and Nagl, 2010; OECD, 2007). The debate on the sustainability of the system of public pensions in Germany is a good example how the focus changed from financial to social sustainability in recent years. At the end of the 80s, projections suggested a strong increase in the contribution rate to the pension insurance. Demographic ageing, poor labour market performance and generous early retirement schemes were among the reasons for this pessimistic outlook (Börsch-Supan, 2000). Since then reforms have led to a steady decrease in pension levels and have helped to improve the system's financial sustainability. At the same time the government increased subsidies ("Bundeszuschuss") for the German Pension Fund. However, given the fact that pension reforms interact with labour market development, the situation remains challenging. As noted above, the labour market situation has been characterised by persistent unemployment on a relatively high level, growing wage dispersion and a decline in standard employment relationships during the past two decades. In this second chapter, both the impact of changing employment patterns and of pension reforms on future pension benefits is analysed from a cohort perspective. Employment biographies are affected in different ways by reforms and changes of labour market institutions across birth cohorts. This particularly holds for the sustainability factor and the raising of the statutory retirement age to 67. German reunification is an example of how changes in labour market institutions affect employment risks and opportunities differently across birth cohorts.

The third chapter focuses more closely on short-term economic risks of the active population. It investigates the questions whether and to what extent individuals build up assets as a precaution to expected variance in net household income. As noted above, involuntary unemployment constitutes one of the most important economic risks during the pre-retirement period. A key determinant of unemployment is health status. In Germany, a universal and comprehensive health insurance system exists for the vast majority of the population, and sufficient health care provision is likely to be covered by public health insurance. Nevertheless, health shocks can also affect the income when reducing the earning capacity and increasing the risk of unemployment. A further possible consequence is a higher risk of poverty. To the extent that individuals perceive this economic risk as not insured by the welfare state, it seems straightforward to build up ressources as a precaution against it. In fact, surveys conducted in different welfare regimes suggest that the precautionary motive is important for savings behaviour (Alessie et al., 1997; Börsch-Supan and Essig, 2003; Kennickell and Lusardi, 2004; Schunk, 2009).

This idea has been formalized in the theory of precautionary savings (Leland, 1968). The model adds a savings motive to the theory of intertemporal allocation (Browning and Lusardi, 1996; Carroll and Kimball, 2008). The basic hypothesis states that a part of accumulated savings provides insurance against future contingencies. Whereas the theoretical concept is stringent and plausible, the empirical literature has not been able to set approximate limits to the amount of savings that can be attributed to the precautionary motive. A key question for the empirical literature is how to model economic uncertainty that gives rise to precautionary wealth. A large number of studies has considered ex-post measures of income uncertainty. In the present analysis, it is assumed that individuals perceive economic uncertainty as variation in income conditional on their expectation of the future realisation of certain risks. Therefore it is proposed to model uncertainty ex-ante as a step to improve on models that estimate the effect of the precautionary savings motive. The proposed ex-ante measure of net income risk takes into account the relation between health and unemployment risk. The uncertainty measure is then used as an explanatory variable in different savings models to test the significance and importance of the precautionary savings motive.

The fourth chapter examines how labour market restrictions interact with individual health resources. Many international studies report differences between desired and actual hours of work (e.g., Otterbach, 2010; Sousa-Poza and Henneberger, 2002). In fact, a majority of German men report to be “overworked”, i.e. to work more hours than they wish to work. The determinants of the prevailing “hours disequilibrium” have not yet been well researched, which is astonishing given the success story of Germany’s working hours flexibility. This chapter studies to what extent individuals in bad health are able to adjust working hours to their preferences. The model distinguishes between self-assessed health and legal disability status which allows to take into account different aspects of the individual health status. Moreover, it tests how persistent divergences between realised and preferred working hours are.

The relationship between health and working hours might gain importance due to rapid demographic ageing in the future. Individuals are expected to extend their working life. Until 2029, the statutory retirement age will be gradually increased up to 67 years of age. And, as is found in the second chapter, longer employment biographies are necessary to maintain a sufficient level of old-age income. An important related question is whether individuals aged 55 and older will be able to work longer. Otherwise the increase in statutory retirement age and the pension reforms will only lead to a further reduction in pension levels. One important condition for this to happen might be that working hours are flexible enough to meet the preferences of an older workforce. Moreover, difficulties to realise preferred working hours may have a direct impact on the effectiveness of policies that aim at changing labour supply behaviour.

Finally, the fifth chapter summarises the main results and conclusions that can be drawn from the preceding chapters. It illustrates the most important limitations of the three analyses and points to the direction of further research. The chapter closes with a discussion of implications for social policy.

1.1 Main findings and contribution

The main source of income in old age are public pensions. This particularly holds for East Germany where alternative insurance schemes have only been offered since 1990. Chapter 2 contributes to the debate about the rising risk of old-age poverty (e.g., Goebel and Grabka, 2011; Himmelreicher and Frommert, 2006; OECD, 2007) by a projection of future public pensions of cohorts born between 1937 and 1971. More precisely, the likely impact of changing employment patterns and pension reforms on the future level of public pensions across birth cohorts in Germany is quantified. To this end, a microsimulation model is developed which accounts for cohort effects in individual employment, unemployment and earnings over the life cycle as well as the differential impact of recent pension reforms on birth cohorts.

The empirical estimates and the simulated sample is based on data from the German Socio-Economic Panel Study from 1984 until 2006. Past pension entitlements of non-retirees are imputed by a statistical matching procedure from the insurance account sample of 2005 ("Versicherungskontenstichprobe", VSKT 2005) of the German Pension Fund. Cohort effects are identified by assuming that period effects are orthogonal to a linear trend and sum to zero over all observation periods (Deaton, 1997). Cohort effects are estimated for full-time employment, unemployment, part-time employment, and non-employment. Models for the latter two categories are only estimated for women. This is the first study estimating cohort effects in cumulated employment and unemployment durations. Separate tobit models are estimated for different samples distinguished by region, gender and education. Estimated cohort effects are significant for most groups and differ by gender, region, and the level of education. In East Germany, for example, the effects imply almost five years more unemployment relative to the oldest age cohort for the youngest cohort of men with a low or medium level of education, compared to about two years for those with higher education. For East German women the corresponding estimated cohort effects are about eight years and three years, respectively. Cohort effects in unemployment estimated for West German samples are lower and show an increase in unemployment for lower educated men (women) of about two (1.5) years for the youngest cohort.

On the basis of simulated life cycle employment and income profiles, the estimation of future public pensions reveals that public pensions of East German men and women will fall dramatically among younger birth cohorts. The negative trend is caused not only because of policy reforms but also by an increase in unemployment. For West German men, the small decline of average pension levels in 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 higher labour market participation among younger birth cohorts. This evidence refers to the "base scenario" which takes into account the demographic adjustment factor ("sustainability factor") and the recently introduced long-term increase in the statutory retirement age to stabilise the contribution rate to the public pension system.

Generally the uncertainty of a simulation increases with the duration of the projection period. In the present case, the largest effects are found for the youngest cohorts (in East Germany) for which the projection period is the longest. Therefore, to set an approximate limit if the labour market situation improves, an alternative scenario for East Germany was simulated. In this scenario, "positive labour market East Germany", East German employment biographies of men and women develop like the average employment biography in the estimation sample. That implies the assumption that employment biographies of younger cohorts improve significantly to make up for the higher unemployment experience – compared to older cohorts. Despite already accumulated unemployment in the past, results show a marked improvement compared to the "base scenario".

The third chapter contributes to the large empirical literature on precautionary savings by developing an ex-ante uncertainty measure that takes into account health and unemployment risks and their effect on wages. A further contribution is the consideration of health risks in a model of precautionary savings. Several simulations show that precautionary savings may account for a large share of more than 50 percent of total wealth (e.g., Caballero, 1991; Cagetti, 2003; Gourinchas and Parker, 2001, 2002; Skinner, 1988). However, empirical estimates could not replicate this result consistently. Instead, a large range of estimates can be found ranging from zero (e.g., Dynan, 1993; Fossen and Rostam-Afschar, 2009; Skinner, 1988) or very low levels (e.g., Arrondel, 2002; Guiso et al., 1992; Lusardi, 1997, 1998) of precautionary savings to a sizable share of total wealth (e.g., Bartzsch, 2008; Carroll and Samwick, 1998; Dardanoni, 1991; Fuchs-Schündeln and Schündeln, 2005; Hubbard et al., 1995).

One important conceptual factor of modelling precautionary savings is the empirical specification of expected income uncertainty. A large part of the literature uses variants of ex-post income variance measures to proxy perceived income uncertainty. The ex-post approach is restrictive because it considers only realised income fluctuations. Suppose an individual saves money for the potential risk of a negative income shock due to unemployment. The savings decision is made even if the transition never occurs. Instead, an alternative ex-ante risk measure is presented using a microsimulation model to generate counterfactual scenarios under the assumption of probabilities for the realisation of employment, health and wage risks. Probabilities for the realisation of these risks and the associated wages are estimated taking into account that prior unemployment and bad health may have negative effects on attainable wages. Net household income is simulated for these scenarios and an income variance is derived. The approach highlights the importance of including counterfactuals in a measure of income risk since future contingencies do not have to actually occur to spur precautionary savings. Household net income is simulated using the detailed tax-benefit microsimulation model.

The SOEP study allows to test the precautionary savings motive with two different dependent variables. In a first step, a standard buffer-stock model of wealth is estimated (Carroll et al., 1992; Deaton, 1991). Wealth data from 2002 and 2007 are transformed applying the inverse hyperbolic sine transformation. This is a log-like transformation, which allows to estimate the model based on all observations of the sample, including those with zero or negative wealth. The data also allow to control for risk preferences which should alleviate problems of self-selection. About 17 percent of financial wealth or 14 percent of net worth – which additionally includes real estate assets – can be attributed to precautionary behaviour. Thus, in contrast to other studies (e.g., Bartzsch, 2008; Carroll et al., 2003; Engen and Gruber, 2001), these results are robust to changes of the wealth aggregate. For East Germany, no significant results of income variance in the buffer-stock model can be found. And the point estimates result in implausible shares of precautionary assets in financial wealth. Potential reasons are sample size and low variability of the dependent variable. The results for net worth, albeit insignificant, show similar estimates as for West Germany. In a second step, a panel model of monthly savings flows is estimated. The comparison of models for stock and flow values can be seen as an informal test of the validity of both models, and they represent two independent tests of the theory of precautionary savings (Guiso et al., 1992). The advantage of using savings flows is that it enables to apply panel data methods and to control for fixed effects. A disadvantage is that negative flow savings cannot be observed in the data. The model is estimated in logs (dropping observations without monthly savings) and in levels (including observations without monthly savings). The simulated income variance turns out significant across all specifications in both East and West Germany. A conservative estimate is that about 14 percent of saving flows can be attributed to precautionary motives. The result is remarkably stable without any large differences between East and West Germany – although the absolute amount of savings flows is lower in East Germany. For West Germany, results resemble the estimates of the first model which is a very strong result. And the predicted share for East Germany is similar to the findings for the buffer-stock model with net worth.

Research into the determinants of the working hours disequilibrium, the difference between desired and actual working hours, is still developing. Chapter 4 contributes to the evolving literature by addressing the question how health and hours match are correlated. Moreover, it contributes to the literature by applying dynamic fixed effects models to test the persistence of the hours match. The data used allow to distinguish self-assessed health status and the legally recognised state of severe disability. While the former measure constitutes a standard instrument in health economics, the latter has some unique properties. Whereas severe disability status entails several legal privileges and is usually known to the employer, the self-assessed health measure can be assumed to reflect private knowledge that is not easily revealed. Conditional on being employed, disability status should have no effect on the hours match. On the other hand, self-assessed bad health is more likely to be correlated with the desire to reduce working hours.

The descriptive analysis reveals a relatively high persistence of the hours disequilibrium. However, when controlling for a broad set of covariates and fixed personal and job characteristics, the estimated coefficient of the lagged endogenous variable results only in small (West Germany) or insignificant (East Germany) state dependence. With regard to labour market flexibility, this result can be considered positive, as it implies that hours mismatches have no strong inherent state dependence. Differences between East and West Germany are also found with regard to personal and household characteristics. Age, education and other household income significantly influence the hours disequilibrium in West Germany, none of these variables shows a significant effect in East Germany. On the other hand, variables that control for job characteristics are significant and have the same sign in both regional samples.

The hypothesis that the disability status should have no effect on the hours match – conditional on being employed – cannot be rejected. On other hand, bad health negatively affects the hours match. In West Germany, individuals in bad health wish to reduce their weekly working hours by about 0.7 hours. This desired reduction is small but corresponds nearly to a full-time working week per year. By contrast, no significant health effects are found for East Germany, which shows the importance of regional differentiation when analysing the German labour market. The elasticity with respect to other household income is about 0.026. That means, if other household income increased by 100 percent, the hours disequilibrium would increase by 2.6 percent. This elasticity is almost five times larger for employees in bad health and amounts to 0.098.

2 Future public pensions and changing employment patterns across cohorts[1]

2.1 Introduction

The political debate about the future of the public pension system in Germany has shifted from the focus on its financial sustainability to the question whether it is able to prevent old-age poverty, particularly among the younger birth cohorts (OECD, 2007). Various factors affect the development of income maintenance in old age. While 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 relationship 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 without employees. A recent report commissioned by the German Pension Fund (DRV) and the Federal Ministry of Labour and Social Affairs (BMAS) suggests that these factors will lead to substantial reductions in the level of public pensions among younger birth cohorts, especially in East Germany (DRV, 2007).

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 life cycle 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 is important for at least two reasons.

1 This chapter is based on Geyer and Steiner (2010).

On the one hand, recently enacted pension reforms will affect younger birth cohorts to a much greater degree than cohorts that are already close to retirement. This argument refers to the demographic adjustment mechanism ("sustainability factor") which leads to pension growth lagging behind wage growth and to the raising 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 in previous reforms. Given the relatively long phase-in period, this will also have heterogeneous effects on older and younger birth cohorts.

On the other hand, the changes that have been taking place in the labour market for the past decades have affected cohorts quite differently. One of the most striking examples for the potential importance of cohort effects is the worsening of the labour 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 German Democratic Republic (GDR) where unemployment was virtually nonexistent and wages relatively equally distributed. These continuous employment profiles were integrated into the West German public pension scheme which led to relatively high and uniform pension entitlements of East German pensioners and of those already near retirement age. By contrast, East Germans in the middle of their career were affected quite differently by unification: during the first years of the transition process, large parts of the economy had to be rebuild under the conditions of the new market-based system. As a consequence, redundancies and closures of factories took place on a large scale. Endowed with human capital from the former GDR, the laid-off employees had to find new jobs in the unified labour market. However, this process turned out to evolve very slowly. Today, the average unemployment rate is still twice as high in East Germany as in the West. Furthermore, wage convergence almost came to a standstill in the mid-1990s, with a substantial wage differential remaining (Franz and Steiner, 2000; Orlowski and Riphahn, 2009). In West Germany, the younger birth cohorts may also have been affected by the worsening of general labour market conditions. Another development which might have contributed to differences across birth cohorts is the increasing labour force participation among women, in particular those with higher education.

Pension benefits strongly depend on the length of all (insured) employment spells over the life-cycle and on the earned income that is subject to pension contributions. Cohort effects in unemployment and employment thus have both a direct and an indirect effect on the individual pension benefit. The direct effect relates to the length of employment over the life-cycle, whereas the indirect effect works through lower (higher) wages due to previous unemployment (employment).

The relevance of these cohort effects is of course an empirical question, and the identification strategy that we chose is described in Section 2.4.2. Using a large and representative panel data set – (German Socio-Economic Panel Study, SOEP) – we are able to place emphasis on important socio-economic characteristics in addition to the effect of the birth cohort. We distinguish between East and West Germany as well as men and women. We also control for education since education has a well documented effect on both the employment probability and the wage level. We describe how estimated cohort effects are used to project individual employment biographies and earnings which both determine the individual pension level. Moreover, we also simulate pension outcomes on the household level.

The chapter is structured as follows. The first section presents the main features and recent reforms of the German pension system. Section 2.3 presents previous analyses on changing employment biographies and implications for individual pensions. The following section presents data, sample, estimation methods and the simulation model that we develop. Section 2.5 gives an overview of the estimated cohort effects and earnings profiles. The results of the simulation are detailed in Section 2.6. The chapter closes with a discussion and summary of our main findings.

2.2 The German PAYG pension system - basic structure and recent reforms

The public pension scheme in Germany is a pay-as-you-go (PAYG) system.[2] 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, low fertility rates (between 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 low effective retirement age.

Policy has responded to these developments by enacting a series of pension reforms.

2 For a more detailed account of the German public pension system and recent reforms see, e.g., Börsch-Supan and Schnabel (1999) and Börsch-Supan and Wilke (2005).

On the one hand, federal subsidies to the public pension system were extended.[3] On the other hand, the government reduced the generosity of the pension system. The 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. For each month of early retirement the benefit is lowered by 0.3 percent (3.6 percent per year). Currently, people retiring at 60 might loose a maximum of 18 percent of their pension benefit. Furthermore, in that year the phasing out of special early retirement options for the unemployed and women was enacted. In 2001, a 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 stepwise from 65 to 67 by 2029.

3 The current (data from 2010) budget of the statutory pension insurance is about 251 bn. euro, and federal subsidies amount to roughly 64 bn. euro or 25 percent of it. In 1991, their share was nearly eight percentage points lower (DRV, 2011).

Public pensions in Germany are closely linked to an individual's lifetime employment and wage income relative to average earnings in the economy, with relatively few redistributive elements (cf. Schröder, forthcoming). It is calculated according to the following formula:

$$PB_{T+s} = \left(\sum_{t=1}^{T} PP_t \right) \times PT \times EF_A \times CPV_{T+s}, \ s = 0,1,\ldots,S \tag{2.1}$$

PB	Monthly pension benefit
PP	Pension point
CPV	Current pension value
PT	Pension type factor
EF	Entry factor
s	Years after retirement until S (death)
T	Year of entering retirement
A	Retiremnet age

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.[4]

PP are mainly earned from social security contributions levied on own wage income 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 earnings position. If a person earns the average income in a given year, he/she receives one PP. Thus, the accumulation of PP depends mainly on an individual's earnings profile relative to the evolution of average earnings as well as the pattern of employment and unemployment over the life cycle. However, earnings are only subject to social security contributions in a certain income range. The thresholds restrict the feasible number of annual PP to a range between about 0.15 and two.

4 In Section 2.4.3, we provide some descriptive evidence on the significance of early retirement and how we treat the retirement decision in our simulation.

PP may also be acquired during spells of unemployment and non-employment due to child rearing or nursing care at home. For example, a mother receives three PP 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 percent of the former gross earnings. Since the recent labour market reform in 2005, long-term unemployed persons who receive the new means-tested unemployment assistance payment (ALG II) acquire very little pension entitlements – an equivalent to slightly more than two euro per month. This is another example of how the impact of reforms on future pensions may differ across birth cohorts, depending on the individual periods of unemployment (Potrafke, forthcoming).[5]

The CPV in the above formula is given by the following (simplified) adjustment rule:

$$CPV_t = CPV_{t-1} \times \frac{W_{t-1}}{W_{t-2}} \times \frac{100 - RP_{t-1} - CR_{t-1}}{100 - RP_{t-2} - CR_{t-2}} \times \overbrace{\left[\left(1 - \frac{PR_{t-1}}{PR_{t-2}}\right) \times \alpha + 1\right]}^{\text{sustainability factor}} \quad (2.2)$$

where W is the sum of gross earnings 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 insurance, PR is the ratio of retirees to contributors to the public pension system, and α is a weighting factor currently set to 0.25. In our base year 2005 the CPV amounted to 26.13 euro in West Germany and to 22.57 euro 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

5 The model refers to the legislation before 2011. Ever since then, the unemployed in the ALG II scheme do not acquire PP any longer.

6 The lower CPV in East Germany is intended to compensate for the higher pension points given to East Germans by increasing their individual wage income by an adjustment factor which should account for the still substantially lower level of average income in East Germany. This adjustment factor currently amounts to about 18 percent, whereas the regional divide of average wages amounts to 15 percent. 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 (for a discussion of the harmonisation of pension schemes in East and West Germany, see e.g., Nagl, 2009).

7 In this paper, we focus on pension benefits before taxes. 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).

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 four percent 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. The result will be a growth rate of pensions that is lagging behind the growth rate of wages. This implies lower individual replacement rates. Due to the complex rule for the adjustment of the CPV, its future trajectory has to be simulated making assumptions on the changes of all factors that enter the adjustment rule (see Section 2.4.3).

2.3 Evidence on changing work patterns across birth cohorts

Since reunification, Germany has had high and persistent unemployment with an extraordinary increase in long-term unemployment in East Germany. At the same time, the share of non-standard employment has been increasing significantly. The standard open-ended full-time employment has lost significance and has been partially substituted by part-time jobs and also by employment not covered by social security such as "marginal employment" or self-employment without employees (see, e.g., Faik et al., 2001; Rische, 1999; SVR, 2008). The structural change in employment relationships has been accompanied by growth of the low-wage sector (e.g., Brenke, 2006).

How will the decline of full-time employment and the increase of unemployment among younger birth cohorts affect future levels of public pensions? The German public pension system implies a fairly close relationship between an individual's lifetime earnings and the level of her/his own public pension. This relationship implies that unemployment may affect individual pension entitlements in two ways: first, by reducing the employment years counted for in the calculation of an individual's pension value 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 (2005) indicate that unemployment or non-employment spells have significant long-term effects on an individual's future earnings. These effects tend to be the stronger the longer these spells have lasted. The illustrative calculations presented in Wunder (2005) also show how the increasing importance of unemployment among younger age cohorts may affect their future pension levels.

A couple of studies analyse the impacts of unemployment and changing employment patterns on future pension benefits for Germany. Most of these studies were based on the AVID reports ("Altersvorsorge in Deutschland") of 1996 and 2005. The focus of AVID is on public and private pension provision of people aged between 40 and 60 years (DRV, 2000, 2007).[8] The studies based on AVID 1996 report a weak negative trend for pension entitlements of younger cohorts of men born between 1951-55 relative to those born between 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 labour market participation, in particular part-time 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 different data and methods, the studies by Arent and Nagl (2010) and Kumpmann et al. (2010) show very similar projections and conclude that old-age poverty is likely to rise in East Germany over the next decades. Arent and Nagl (2010) simulate expected PP of cohorts born between 1939-1941 and 1955-1957. They identify a large share of pensioners of the younger cohort in East Germany to be at risk of old-age poverty. The effect is particularly strong for low skilled individuals and for men. Although the decline of pension levels in East Germany develops slowly, a negative trend is already reported by studies using data on recent entry cohorts (see, e.g., Frommert and Himmelreicher, 2010; Goebel and Grabka, 2011; Himmelreicher and Mai, 2006).

2.4 Data and microsimulation methodology

2.4.1 Data

According to the pension formula (Section 2.2), the simulation of future pension benefits requires detailed information about current individual entitlement (the number of PP) as well as estimates of future pension accruals until retirement. The simulation of future pension entitlements has to account for cohort effects in labour market histories, future

8 These surveys are not available for scientific research outside the DRV and BMAS, the two institutions which have jointly commissioned these surveys. For a summary of studies based on AVID 1996, see Steiner (2003).

earnings, and the individual retirement age. Furthermore, we are also interested in the level of own public pensions of households. Since there is no data set publicly available in Germany which would include all required information, we have to combine various data sources to perform our simulation of individual pension benefits.[9] We combine data from the SOEP and administrative data of individual insurance records provided by the Research Data Center of the German Pension Fund (FDZ-RV). SOEP data are used to estimate cohort effects in individual labour market histories and earnings. The cohort effects indirectly affect life cycle earnings profiles. The administrative data are used to determine pension entitlement in the 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.

The SOEP is a representative longitudinal micro-database that provides a wide range of socio-economic information on private households in Germany. The data of the first wave were collected on about 12,200 randomly selected adult respondents (in 6,000 families) in West Germany in 1984. After German reunification, the SOEP was extended by about 4,500 persons (in 2,200 households) from the former GDR.[10] SOEP contains a detailed retrospective questionnaire from which we reconstruct individual employment histories to estimate cohort effects and earnings profiles. 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 a respondent joined the survey. Thus, individual pension entitlements of non-retirees for the base year 2005 simulated from retrospective work history data recorded in the SOEP are likely to contain substantial measurement error. For East Germany, this constitutes a problem as it does not seem feasible to estimate and predict past earnings in the former GDR based on market earnings 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.[11] Hence, individual pension entitlements in the base year for East Germans cannot be determined based on SOEP data alone. This is also true for West Germany, however,

9 Two major shortcomings of administrative data are the lack of information on household characteristics and on activities not relevant for the pension calculation.
10 A description of the SOEP is provided by Wagner et al. (2007).
11 Himmelreicher and Fachinger (2007) describe the integration of pension entitlements of former GDR citizens.

because of the complex pension legislation, to a much lesser extent .[12]

We therefore match administrative information on individual pension claims in 2005 to the SOEP data. For this purpose, we use the scientific use file of the so-called insurance account sample of 2005 ("Versicherungskontenstichprobe", VSKT 2005) which is a random sample of cleared individual insurance records and comprises about 60,000 observations of people aged between 30 and 67 years in 2005.[13] 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 observations with less than secondary education. We provide some information on the matching procedure and results in Appendix 2.A.[14] For each observations in the SOEP matched to a statistical twin in the VSKT data we replace the simulated amount of pension entitlements by that recorded in the latter dataset. For SOEP observations for which no statistical twin could be found the simulated amount is maintained.

The estimation of cohort effects in employment biographies (see equation (2.4) below) 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. This restriction excludes very low pensions resulting from short 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.

We estimate separate tobit models for each of the sub-groups defined by region (East and West Germany), gender, and by the level of education. The earnings model (see equation (2.5) below) is estimated on a sub-sample of observations also used for the estimation of cohort effects, i.e. those with a wage income subject to social security contributions. As in the estimation of cohort effects, we estimate separate relative earnings equations for each of the sub-groups defined by region, gender, and the level of education.

Finally, we use a ten percent random sample (about 90,000 observations) of all new

12 An example would be the splitting of pension entitlements between spouses after a divorce which occurred before the individual joined SOEP.

13 These data are provided as a scientific use file (SUFVSKT2005) by the FDZ-RV. Detailed descriptions of the data can be found in DRV (2008) and Himmelreicher and Stegmann (2008).

14 Further details can be found in Steiner and Geyer (2010).

retirees in 2006 for the simulation of the age of retirement.[15] After restricting the sample to old-age pensioners who retired between the age of 60 to 65 years we are left with about 68,000 observations.

2.4.2 Estimation of cohort effects and earnings equations

To link individual labour market histories to life cycle 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 labour market states. In a second step, we estimate relative earnings equations relating individual earnings to labour market histories and a number of other potential earnings determinants. Our maintained hypothesis is that cohort effects enter the earnings equation only indirectly through their impact on an individual's labour market history. We start with a brief description of the estimation of cohort effects in labour market histories and then describe the modeling of the earnings equation.

Cohort effects

We assume that the cumulated duration in a particular labour 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_t and a vector of other control variables, X_{it}:

$$Y_{it}^* = \alpha + \beta_1 K_{it} + \beta_2 A_{it} + \beta_3 P_t + \gamma' X_{it} + \varepsilon_{it} \tag{2.3}$$

where the labour market states are full-time employment and unemployment for men, and additionally part-time employment and non-employment for women. The control variables include the age of the youngest child, dummies for the presence of 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 is impossible. This specification requires a restriction on these effects. Here,

15 These data are provided as a scientific use file of the so-called "Rentenzugangsstichprobe" (SUFRTZN06XVSBB) by the FDZ-RV. The data are described in DRV (2006).

we follow Deaton (1997) and assume that period effects are orthogonal to a linear trend and sum to zero over all observation periods. The transformed time dummies are denoted as P_t^*.[16] This assumption allows one to decompose the effects in three different dimensions: the trend (cohort), the profile (age), and the business cycle (period). This assumption can be justified since we analyse cumulated durations of labour market activities. Thus, positive and negative year effects cancel each other out in this aggregated measure and lose significance with respect to the level of the aggregate.

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

$$
\begin{aligned}
Y_{it}^* &= \beta_0 + \beta_1 K_{it} + \beta_2 A_{it} + \beta_3 P_t^* + \gamma' X_{it} + \varepsilon_{it} \qquad (2.4)\\
Y_{it} &= max\,(0,Y_{it}^*)\\
\varepsilon_{it}|K_{it},A_{it},P_t^*,X_{it} &\sim N\left(0,\sigma^2\right)
\end{aligned}
$$

where the original period dummies have been transformed as described above.

Earnings equation

The dependent variable in the earnings equation is the log of the ratio of the individual monthly gross earnings in a given year to the average earnings of the insured population in that period.[17] Explanatory variables are age A_{it}, the cumulated duration of unemployment UE_{it} and (in case of women) non-employment NE_{it} and part-time employment PTE_{it}, all entered as polynomials of degree three. Since we include these as well as age, the duration of full-time employment cannot be identified separately. Cohort effects have an impact on individual relative earnings through their effects on the employment biography. The control variables contained in X_{it} include time dummies, dummies for industry, firm

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

17 We use this uncensored earnings measure in the estimation although we calculate expected earnings 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.

size, and nationality.[18] Unobserved earnings 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 earnings equation for men (the equation that is estimated for women includes NE_{it} as additional regressor) thus is:

$$\begin{aligned}\log\frac{w_{it}}{\overline{w}_t} &= \alpha_0+\alpha_1 A_{it}+\alpha_2 UE_{it}+\alpha_3 PTE_{it}+\lambda X_{it}+u_i+v_{it} \\ E[u_i|A_{it},UE_{it},PTE_{it},X_{it}] &= 0 \\ E[v_{it}|A_{it},UE_{it},PTE_{it},X_{it},u_i] &= 0,\ \forall t\end{aligned} \tag{2.5}$$

Where w_{it} denotes earnings of individual i in period t and $\overline{w}_t$ average earnings in that period.

2.4.3 Simulating future pension levels across birth cohorts

Together with individual pension entitlements in 2005, the estimates from the earnings and employment equations 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 the oldest cohort (1937-41) is already retired in 2005, and we know for a fact how high their pensions are, the youngest birth cohort (1967-71) is aged 34-38 in 2005 and up to 33 years of their future employment/unemployment spells and earnings have to be simulated. To begin with, we present the "base scenario" of the simulation model. Then we present the assumptions of an alternative scenario for East Germany where we find the strongest effects across cohorts.

Base scenario

The simulation involves five steps. First, we project future individual work patterns on the basis of estimated labour market histories, accounting for cohort effects. This projection is based on tobit model estimates to predict unconditional expected durations in labour

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

market state j at a certain age in period t for each individual in our sample 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 time t is then calculated as the difference of the expected values in period t and $t-1$ as

$$\max[0, y_{jt} = E(Y_{jt}|Z_{jt}) - E(Y_{j,t-1}|Z_{j,t-1})]. \tag{2.6}$$

Second, we simulate future relative earnings for each individual in our sample based on expected values (not conditional on employment) derived from our estimated earnings equations. These simulations are based on the simulated and cumulated durations derived in the first step. For example, an individual's expected cumulated duration of unemployment in period t determines, together with the other explanatory variables in the earnings equation evaluated at that point in time, the individual's expected relative earnings. In addition to the mean we also simulate the variance of projected earnings on the basis of the distribution of earnings observed in our estimation sample.[19]

Third, putting together simulated future employment/unemployment durations and earnings at age a, we calculate for each individual the number of PP until her/his retirement age. Adding these – adjusted by the number of PP acquired for non-employment spells and the retirement age – to the number of already acquired PP in the base year 2005 (imputed from VSKT) yields the expected total number of PP 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, we have to model the future evolution of the effective retirement age.[20]

We do this in a simplified way by extrapolating the distribution of the effective retirement age of people retiring in 2006 (see Figure 2.5 in Appendix 2.C) by a common factor that should reflect the recently enacted long-term increase of the statutory retirement age from

19 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 earnings.

20 For example, about 60% of all retirement entries in 2010 occured before the statutory retirement age of 65 (DRV, 2011).

65 to 67 years.[21] Since we focus on old-age pensions here, we apply the same factor to men and women and also to East and West Germany.[22] The average effective retirement age in 2006 was about 63 years. We assume a long-term increase to 65 years in the simulation. As shown by Figure 2.1, the expected increase in the effective retirement age is not linear. This is due to the abolishment of early retirement options for the unemployed and women, which implies a relatively strong increase in the expected retirement age of people in the birth cohorts from 1947-56.

Fourth, based on the simulated individual pension points and projections of the CPV we derive individual pension benefits. The CPV is determined by the growth rate of

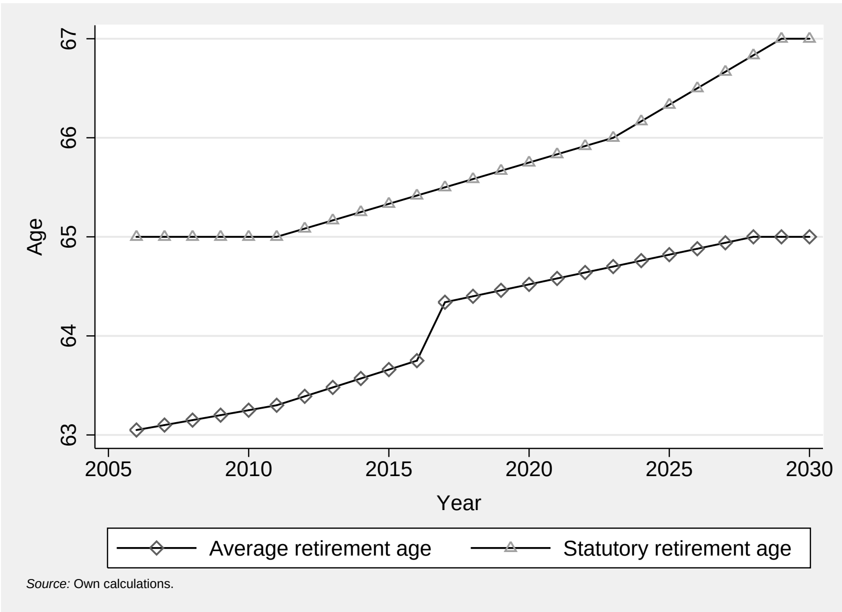

Figure 2.1: Average effective and statutory retirement age

21 It is difficult to quantify the effects of the recent pension reforms on the effective retirement 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.

22 In the more optimistic labour market scenario for East Germany discussed in Section 2.6.4 below, we assume that the effective retirement age converges between the two regions.

the average gross earnings in the economy and some adjusment factors (equation (2.2)). Following the Ageing Working Group (AWG), the average real gross wage income 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 2.2 shows the development of gross earnings 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 earnings 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 earnings 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 earnings by almost 20 percentage points compared to 2005.

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.,

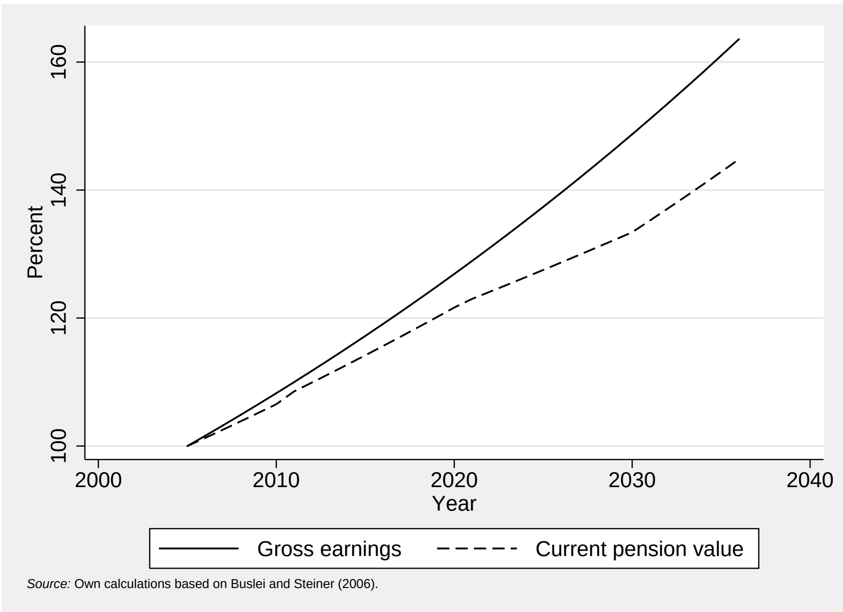

Figure 2.2: Development of the average gross earnings and the current pension value in the simulation period

2006, 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 algorithm developed by Merz (1983).[23]

Figure 2.3 summarises the model and shows all steps involved for the simulation in a stylised flow chart. The analysis is restricted to 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. As we do not model income taxation in this paper, all pension benefits are gross amounts. However, we do subtract pensioners' own contribution to the health and long-term care insurance. That is, we report the effective amount of pension payment before taxes ("Rentenzahlbetrag"). 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.[24] 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 earnings, the current pension value for younger birth cohorts will decline, although pension benefits will continue to grow in real terms.

In addition to pension levels, we report a replacement rate. The replacement rate is defined as the ratio of the amount of the pension benefit to the average gross earnings in East and West Germany, respectively. Average monthly gross earnings in 2005 were 2,433 euro in West Germany and 2,057 euro in East Germany.

Alternative scenario: positive labour market East Germany

The long projection period implies an increasing uncertainty in simulated outcomes the younger cohorts are. And, as shown below, we find the strongest effects for younger cohorts in East Germany. In the base scenario we assume that the cohort effects estimated over a period of high and increasing unemployment in East Germany determine future labour market behaviour across birth cohorts. Thus, the simulations imply a rather pessimistic outlook for the future development of the level of pension benefits of younger birth cohorts in East Germany. Since we have to simulate employment and earnings developments for up to 30 years in the future for the youngest birth cohort, these simulations very much depend on the question whether the estimated cohort effects can be used to project

23 We use the program "Adjust" to run the reweighting algorithm (Merz et al., 2004).

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

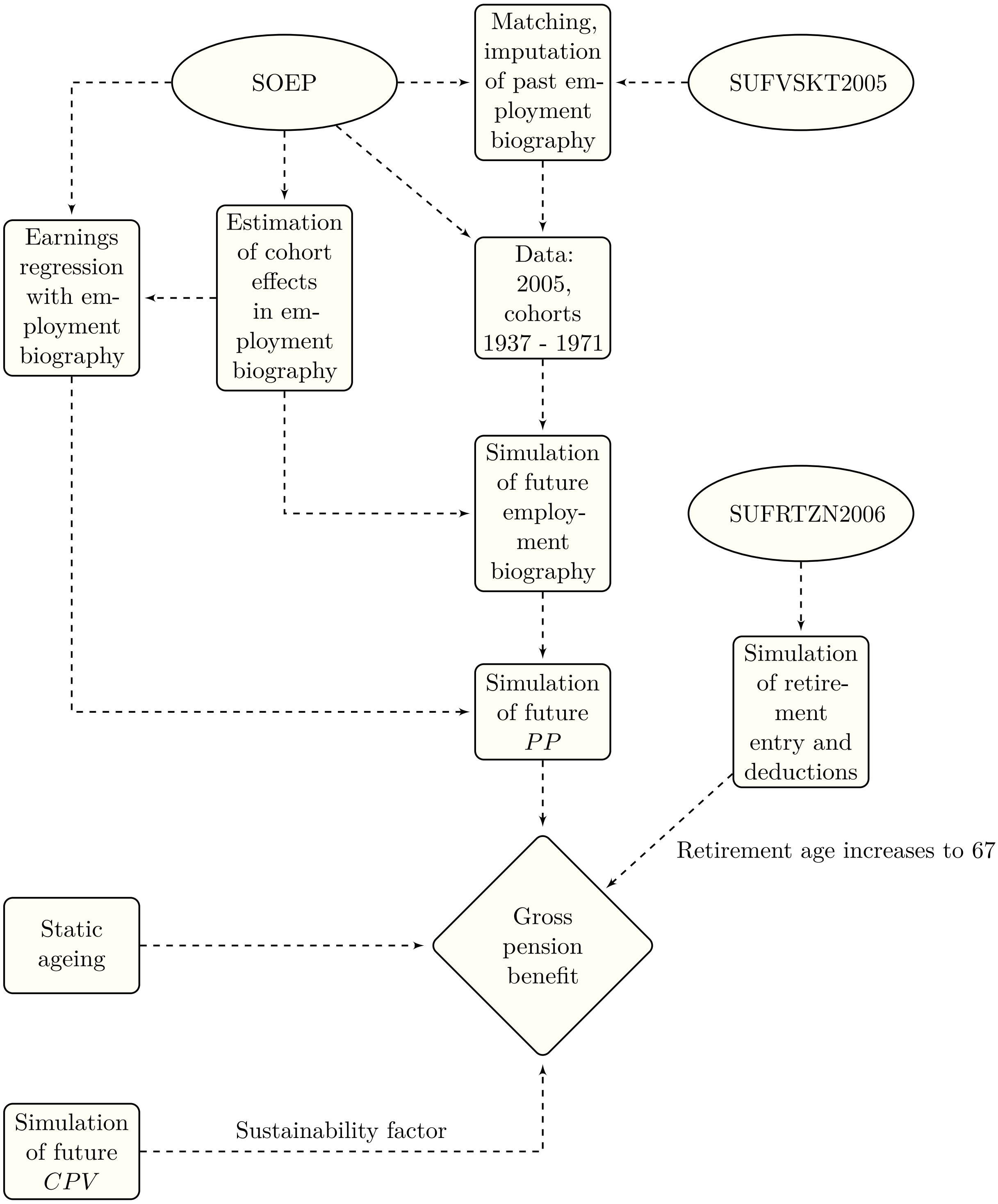

Figure 2.3: Stylised flow chart of the simulation of future pension benefits

labour 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. Therefore we refer to the so far described version of the simulation model as the "base scenario" and simulate an additional, less pessimistic scenario for East Germany called "positive labour 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 alternative scenario. Hence, the sharp increase in the future duration of unemployment among younger birth cohorts is diminished relative to the base scenario. Given the improvement in future labour 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.

2.5 Estimation results

2.5.1 Descriptive evidence on changing employment biographies

In a first step, we look at aggregated employment and non-employment periods of different cohorts on the basis of retrospective SOEP data. Table 2.1 shows employment histories across birth cohorts by gender, region and education. We use the same cohorts in our multivariate analysis. The table shows the average cumulated duration of the respective labour market state, and how the duration has changed across birth cohorts. Note that the two lowest educational categories had to be pooled for East Germany due to small sample size. This limits comparability, however, it also shows one important difference between regional samples. We did not want to pool the lowest two groups for West Germany because we expect differences between educational groups to be important.

Labour market states are differentiated by full-time employment and unemployment for men and, in addition to these two categories, also by part-time employment and non-employment for women. Note that we focus on employment subject to social security contributions to simulate public pensions. Other forms of employment are not included into the analysis. In particular, the cumulated employment durations reported in Table 2.1 do not comprise any periods when the individual was marginally employed, self-employed, or worked as a civil servant.

Table 2.1: Employment histories across birth cohorts by gender and region (average cumulated duration in years)

	West Germany						East Germany					
	Men		Women				Men		Women			
Cohort: Year	FT	UE	FT	PT	UE	NE	FT	UE	FT	PT	UE	NE
Age 34-38			Education level: Low									
1957–1961: 1995	10.5	1.2	7.0	2.9	0.7	7.5	.	.	.	.	.	.
1962–1966: 2000	11.4	1.5	7.1	2.5	0.9	7.1	.	.	.	.	.	.
1967–1971: 2005	10.5	2.3	4.7	2.2	1.3	8.5	.	.	.	.	.	.
Total	10.8	1.6	6.2	2.5	1.0	7.8	.	.	.	.	.	.
Age 44-48												
1947–1951: 1995	17.2	0.8	10.2	3.1	0.6	13.2	.	.	.	.	.	.
1952–1956: 2000	14.9	1.3	10.8	4.1	1.0	10.8	.	.	.	.	.	.
1957–1961: 2005	17.5	1.6	11.9	3.0	1.8	9.7	.	.	.	.	.	.
Total	16.7	1.2	10.9	3.3	1.1	11.4	.	.	.	.	.	.
Age 54-58												
1937–1941: 1995	29.3	1.7	13.6	5.6	0.5	17.0	.	.	.	.	.	.
1942–1946: 2000	27.6	1.7	15.1	5.7	1.0	16.7	.	.	.	.	.	.
1947–1951: 2005	23.5	1.0	11.0	5.8	1.6	18.7	.	.	.	.	.	.
Total	27.4	1.5	13.2	5.7	0.9	17.4	.	.	.	.	.	.
Age 34-38			Education level: Medium						Low/Medium			
1957–1961: 1995	13.6	0.9	8.6	2.7	0.5	4.6	13.8	0.6	11.9	2.0	1.0	1.6
1962–1966: 2000	13.7	0.5	8.0	2.8	0.6	4.5	14.1	0.8	10.6	2.1	1.7	1.7
1967–1971: 2005	12.7	1.3	8.7	2.3	0.6	3.3	12.9	1.3	8.4	2.4	2.4	1.5
Total	13.4	0.9	8.4	2.6	0.6	4.2	13.7	0.8	10.2	2.2	1.7	1.6
Age 44-48												
1947–1951: 1995	22.7	1.3	11.3	4.8	0.4	9.8	24.4	0.8	20.6	3.2	1.0	1.4
1952–1956: 2000	22.5	0.9	12.3	4.9	0.3	8.9	23.7	1.4	20.0	2.0	2.1	1.3
1957–1961: 2005	22.3	0.9	12.5	5.7	0.6	6.9	21.0	2.1	18.4	3.3	2.4	1.4
Total	22.5	1.0	12.0	5.2	0.4	8.5	22.8	1.5	19.6	2.9	1.8	1.4
Age 54-58												
1937–1941: 1995	32.6	0.8	13.3	5.4	0.7	17.0	34.3	0.5	26.6	6.1	1.0	4.2
1942–1946: 2000	31.2	1.2	15.3	6.6	0.6	13.0	33.1	1.1	27.2	4.1	2.6	3.1
1947–1951: 2005	30.1	1.6	15.1	7.7	0.6	12.1	31.6	1.9	25.1	3.8	3.0	1.8
Total	31.4	1.2	14.5	6.5	0.6	14.2	33.2	1.1	26.3	4.9	2.0	3.2
Age 34-38			Education level: High						High			
1957–1961: 1995	8.1	0.6	6.1	2.3	0.5	3.2	12.1	0.4	11.7	1.2	0.4	0.7
1962–1966: 2000	9.5	0.4	6.6	1.8	0.4	2.6	10.5	0.4	9.8	1.5	0.9	0.7
1967–1971: 2005	8.4	0.4	6.2	1.9	0.3	2.1	9.2	1.1	7.3	2.0	0.9	0.5
Total	8.7	0.5	6.3	2.0	0.4	2.6	10.9	0.5	9.9	1.5	0.7	0.7
Age 44-48												
1947–1951: 1995	15.0	0.5	10.8	2.3	0.6	5.6	20.9	0.4	21.2	2.0	0.3	0.6
1952–1956: 2000	15.4	0.8	9.9	3.1	0.7	4.6	19.9	0.3	19.4	2.0	0.7	0.9

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Table 2.1 – *continued from previous page*

	West Germany						East Germany					
	Men		Women				Men		Women			
Cohort: Year	FT	UE	FT	PT	UE	NE	FT	UE	FT	PT	UE	NE
1957–1961: 2005	16.5	0.7	10.7	3.8	0.6	4.9	18.8	1.0	17.5	3.0	0.9	1.0
Total	15.6	0.7	10.5	3.1	0.6	5.0	19.8	0.6	19.1	2.4	0.7	0.9
Age 54-58												
1937–1941: 1995	22.3	0.2	12.6	4.1	0.3	11.0	32.0	0.4	28.3	3.4	0.3	1.6
1942–1946: 2000	21.2	0.9	13.9	4.9	0.5	9.1	30.1	0.8	27.6	4.0	0.9	1.0
1947–1951: 2005	20.7	1.2	13.6	4.2	0.7	7.7	24.8	0.9	25.5	3.8	1.5	0.7
Total	21.4	0.7	13.4	4.4	0.5	9.1	29.4	0.6	27.2	3.7	0.8	1.1

Notes: Activities since 15^{th} birthday (in years). Cumulated experience: FT := full-time employment; PT := part-time employment; UE := unemployment; NE := non-employment. For example, take the value “0.8” in column “West Germany, men, UE”, row “age 54-58, 1937-1941: 1995”, it means that men born between 1937 and 1941 were between 54 and 58 years of age in 1995 and spent on average 0.8 years in unemployment since their 17^{th} birthday. The next row refers to the level of unemployment of the same age group five years later, i.e. born between 1942 and 1946.
Source: SOEP, own calculations

The results allow for many comparisons. For example, we find differences in aggregated employment and unemployment between educational groups. Men between 54 and 58 years of age with a lower education level have on average been 27.4 years in full-time employment, i.e. six years more than the higher educated. They have spent 1.5 years in unemployment which is more than twice as long as the higher educated. We can also document the huge differences between genders with respect to time spent in full-time employment in West Germany. However, the following considerations focus on differences between cohorts and trends. For West Germany, we do not find many stable trends that characterise changes in careers of different cohorts. We find an increase in time spent in unemployment for low educated women for all age-groups. For the two older age-groups, unemployment tripled between 1995 and 2005. The cohort born between 1957-1961 has been spending on average 1.8 years in unemployment (even more than the older cohort born between 1947-1951 in 2005). However, trends turn out to be different for the other groups. For example, when looking at low educated men, we find that the average duration of unemployment has been increasing only for the two younger age-groups. Moreover, no clear pattern can be found for these two cohorts regarding the time spent in employment.

As a result of the economic system in the former GDR, employment patterns of older cohorts do not show any large gender differences in East Germany. Furthermore, the evolution of employment patterns of East German men and women is very similar.

In contrast to West Germany, we find stable trends in aggregated employment and unemployment. 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 of 44-48 years with low or medium educational level the cumulated duration of unemployment increases, on average, from 0.6 to 1.3 years for men and from one to 2.4 years for women. For the same group, full-time employment decreases from 24.4 to 21 years and from 20.6 to 18.4 years for men and women, respectively.

2.5.2 Cohort effects and earnings

Tables 2.12 and 2.13 in the Appendix report estimated marginal effects of the cohort dummies for each of the educational groups from Table 2.1 on the cumulated duration in the various labour market states. These effects are evaluated at sample means of the explanatory variables in the model including age. Thus, they represent the pure cohort effects on the cumulated duration of, e.g., unemployment at a given age. For example, for West German men with a low level of education, the estimated effect for the youngest cohort (1967-71) implies that, evaluated at sample means, the cumulated unemployment duration of this group exceeds that of the oldest cohort by about two years. Estimated cohort effects differ significantly by gender, region, and the level of education. For the youngest cohort of men with a low or medium level of education in East Germany, for example, estimated effects imply almost five years more unemployment relative to the oldest age cohort; this compares to a difference of about two years for those with higher education. For East German women, the corresponding estimated cohort effects are about eight years and three years, respectively. Tables 2.12 and 2.13 also show large differences in estimated cohort effects across gender, region and level of education regarding the cumulated labour market states. The implications of estimated cohort effects for employment and unemployment over the life-cycle will be discussed in Section 2.6.

As shown by Figure 2.4 in the Appendix, the empirical age-earnings profiles derived from our estimated relative earnings equations differ substantially by education.[25] The higher its level, the higher the individual earnings relative to the average earnings in the economy, and hence, the higher the acquired number of PP. Although this relationship holds for men and women in East and West Germany throughout the life-cycle after the

25 Detailed estimation results for the relative earnings equations can be found in Steiner and Geyer (2010).

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, especially for people with higher education. In West Germany, relative earnings 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 earnings increase until their early thirties, followed by a reduction and a subsequent rebound in their relative earnings. This pattern can be explained by the relatively weak labour 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 earnings remain flat or even decrease with age, and slightly increase for men with a medium level of education. In East Germany, relative earnings 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 no long-term effects on future earnings and thus the level of the public pension.

2.6 Simulation results

2.6.1 Employment and unemployment until retirement

Table 2.2 summarizes our simulation results for full-time employment and unemployment by region, gender and the level of education.[26] 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 2.4.3). Differences in simulation results across birth cohorts thus not only represent pure cohort

26 Simulation results for part-time employment and non-employment of women are reported and discussed in Steiner and Geyer (2010).

effects but also structural changes in the population across cohorts.[27]

Simulation results for West German men show that the cumulated duration of employment in the younger birth cohorts declines by about three years relative to the oldest cohort, and that this 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 individuals 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 accumulates only about three years, those with higher education two years of 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 of non-employment spells, often related to childrearing periods.[28]

In East Germany, younger male birth cohorts experience a dramatic decline in employment and an 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, the simulated duration of unemployment ranges from about 37 to 31 years. Correspondingly, the simulated duration of unemployment in the group of persons with low or medium education soars

27 Changes in the simulated cumulated employment and unemployment durations between cohorts therefore differ from estimated cohort effects as reported in Tables 2.12 and 2.13 in the Appendix to this chapter.

28 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, 2010, Chapter 4.3.1).

Table 2.2: Simulated years of cumulated employment/unemployment durations until retirement by region, gender and education

	West Germany						East Germany			
	Full-time			Unemployment			Full-time		Unemployment	
Eudcation:	Low	Medium	High	Low	Medium	High	Low/Medium	High	Low/Medium	High
Cohort						Men				
1937-41	39.1	40.9	35.2	3.7	1.7	0.8	40.4	37.2	2.3	1.4
1942-46	38.6	39.4	34.3	4.0	2.1	1.3	39.4	36.5	3.6	2.1
1947-51	36.4	38.9	33.6	4.6	2.6	1.5	38.7	34.5	4.6	2.9
1952-56	37.4	39.0	33.4	5.4	2.7	1.8	37.9	33.7	6.1	3.0
1957-61	36.4	37.4	32.8	6.6	3.2	2.2	36.2	33.2	7.9	3.9
1962-66	35.3	36.4	33.7	8.2	3.1	2.0	36.1	32.3	8.0	4.1
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				
1937-41	15.5	15.5	17.4	1.0	0.7	0.5	30.6	34.8	3.1	1.8
1942-46	14.9	16.5	18.7	1.2	0.9	0.7	31.2	32.9	5.4	3.0
1947-51	16.0	17.0	19.7	1.7	0.9	1.0	30.5	33.1	6.9	3.8
1952-56	16.1	16.5	19.1	2.2	1.1	1.4	29.1	32.4	8.9	4.4
1957-61	15.5	16.2	18.7	2.6	1.2	1.3	28.4	31.5	9.9	4.8
1962-66	14.5	16.0	19.1	2.9	1.5	1.3	26.3	28.8	11.5	6.4
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 weighting factors and static aging to forecast future population structure.
Source: SOEP, SUFVSKT2005, own calculations

from about two years in the oldest to more than nine years in the youngest birth cohort. Unemployment also rises sharply for East German men with higher education, from 1.4 years in the oldest to more than five years in the youngest birth cohort. This clearly shows the long-term consequences of the catastrophic labour market situation in East Germany.

The predictions for the employment situation of younger birth cohorts of East German women are even worse than for men. The simulated duration of full-time employment falls from more than 30 years in the oldest to 24 years in the youngest cohort for women with low or medium 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 medium education more than quadruples from about three 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 seven 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.

2.6.2 Effects of pension reforms on the average pension level

To get an impression of the relative impact of the sustainability factor and the increase of the retirement age to 67, Table 2.3 presents simulated pension benefits for four alternative scenarios for West German men: In the first two scenarios the statutory retirement age is kept at 65 while the sustainability factor is introduced in Scenario I but not in Scenario II. This latter difference also distinguishes Scenario III and Scenario IV which also includes the increase in the statutory retirement age. We present these calculations for West German men, for whom we do not find any 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 2.16 in the Appendix to this chapter.

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 1,000 euro per month for all cohorts. This changes when the slower growth rate of the current pension value due to the 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 eight percent.

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 2.3, the extension of the working life reduces the effect of the lower pension growth for the two youngest birth cohorts by almost five percent.

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.

Table 2.3: Impact of pension reforms on the average pension benefit by birth cohort – West German men

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

Notes: Scenario I: Retirement age = 65, without adjustment of current pension value (CPV); Scenario II: Retirement age = 65, with adjustment of CPV; Scenario III: Retirement age = 67, without adjustment of CPV; Scenario IV: Retirement age = 67, with adjustment of CPV (base scenario).
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations

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 ten percent for the youngest birth cohort, compared to an average reduction of only about five percent across all cohorts.

2.6.3 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 the base scenario (Scenario IV in Table 2.3), which includes the already legislated changes concerning the sustainability factor and the increase of the statutory retirement age.

Average pension levels and replacement rates

Table 2.4 shows remarkable differences in the amount and the replacement rate of individual gross pension benefits stratified by cohort, gender, and region.

Compared to all other groups, West German males across all birth cohorts can expect to receive the highest pension benefits. The slightly negative trend in this group's pension benefit is, as analyzed in the previous section, mainly driven by the lower CPV growth rate due to the sustainability 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 in the youngest birth cohort still reaches about 45 percent and is only two percentage points less than the replacement rate of the oldest cohort.[29]

Women's pensions are, on average across all birth cohorts, less than half as high as those of West German men. On average, their pension benefits are less than those 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 labour market attachment of younger women in West Germany. Still, the youngest cohort of West German women reaches a replacement rate of only 24 percent.

Looking at simulation results for East Germany, the evolution of pension benefits across birth cohorts is very different. Whereas the average pension benefit of East German women is almost 700 euro per month, and thus more than 100 euro above the amount obtained by women in West Germany, it is only 466 euro 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 ten percentage points are due to the net effect of the sustainability factor and the increase in the retirement age. Thus, about 20 percentage points of the reduction of the pension benefit in the youngest age cohort of East German women would be related to increased unemployment and lower earnings.

For East German males the development is even more pronounced. Whereas East German men in the oldest birth cohort reach a pension benefit of about 900 euro, birth cohorts 1952-56 and younger can only expect a substantially smaller amount. The pension benefit of the youngest birth cohort of a bit less than 600 euro 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 labour market when the wall came down and was exceptionally affected by the poor economic development of East Germany.

29 Note that this replacement rate links the individual pension amount and the average monthly gross earnings.

Table 2.4: Simulated years of cumulated employment/unemployment durations until retirement by region, gender and education

		West Germany		East Germany	
Cohort	Average	Men	Women	Men	Women
		Pension benefit (euro 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

The distribution of individual pension benefits

Table 2.5 illustrates how individual pension benefits are distributed across birth cohorts. To have a sufficient number of observations in each income class, which we group by intervals of 300 euro, birth cohorts were pooled. 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.

On average across all cohorts, more than 40 percent of all pension benefits of West German men fall in the income category of 901-1200 euro, 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 negligible for women. For men in East Germany, the share of pensions exceeding 1200 euro drops form about ten 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 hardly changes between the older and younger age cohorts.

From a policy perspective, the share of pension benefits below 600 euro is important because this amount is close to the average means-tested minimum pension for single pensioners ("Grundsicherung im Alter").[30] 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 income, 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 three percent even among younger age cohorts, one out of three East German men in the younger birth cohorts will receive a pension below this level. While this share will change little in West Germany, it will increase dramatically from about four 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 in the level of education, which is one of the major factors shaping life-time earnings. To shed some light on these differences, Table 2.6 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 these cohorts are likely to show a high share of low

30 The Federal Statistical Office reports an average gross amount of 627 euro in 2006 for individuals aged 65 and older (Destatis et al., 2008).

Table 2.5: Distribution of pension benefits across birth cohorts by region and gender, shares in percent

	Total	West Germany		East Germany	
Income class (in euro)		Men	Women	Men	Women
Cohort 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
Cohort 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
Cohort 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

pensions, particularly in East Germany.[31]

Looking first at the simulation results for West German men, the group with relatively high average pensions, Table 2.6 reveals that for about a fourth of all people in the group

31 As mentioned in Section 2.4.1, 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.

with a low level of education the expected pension benefit is below 660 euro, and thus only marginally higher than the average minimum pension. Even the median pension of 740 euro for this group is only 100 euro above the minimum pension. The distribution of pension benefits among East German men with low or medium education is similar to 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 for any percentile of the distribution.

As shown by Table 2.6, 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 euro, and even the 95 percentile is only a modest amount of 640 euro. These very low pensions result partly from the low earnings of women with low education, partly from this group's low attachment to the labour 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 euro. 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 labour 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 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 calculate the average of the amounts of old-age pension benefits received in couple households to represent the individualized pension at the household level. We present both average pension benefits (Table 2.7) and their distribution (Table 2.8) across birth cohorts.

Table 2.7 shows that for West German couples the average pension benefit per person remains fairly stable at about 850 euro across birth cohorts. This corresponds to the evolution of individual pension benefits in West Germany described above: their slight

Table 2.6: Distribution of pension benefits by level of eduction, cohorts 1952-71 (means and percentiles in euro per month)

		Percentile					
Education level	Mean	5	10	25	50	75	95
Men, West Germany							
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
Average	1,121	688	784	930	1,089	1,290	1,652
Men, East Germany							
Low/Medium	746	477	514	600	719	881	1,062
High	908	550	596	716	886	1,073	1,315
Average	801	489	535	626	784	940	1,206
Women, West Germany							
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
Average	554	223	261	348	527	709	1,020
Women, East Germany							
Low/Medium	608	319	398	503	603	700	902
High	790	478	527	604	751	955	1,182
Average	680	362	443	549	640	792	1,105
Overall	804	268	332	533	767	1,044	1,481

Notes: Percentiles refer to the individual pension benefit.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations

Table 2.7: Average pension benefits (per capita, euro per month) at the household level across birth cohorts

	Couples		Singles			
	West	East	West		East	
Cohort			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

reduction for men is compensated by increases for women. In contrast, for East German couples there is a decreasing 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 euro to less than 600 euro 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 was found at the individual level.

Table 2.8 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 ten percent of couples in both East and West Germany have a pension of less than 600 euro per person, compared to almost 60 percent of single women in West Germany and more than 30 percent of this group in East Germany. In West Germany in particular, relatively high pensions of between 900 and 1200 euro per person are much more common among couples than among single women.

Looking at changes across birth cohorts, Table 2.8 displays a sharply increasing share of

Table 2.8: Distribution of pension benefits by income class across birth cohorts scenario "positive labour market East Germany"

	Couples		Singles			
	West	East	West		East	
Income class (in 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

low pensions in East German couple households: Among the younger birth cohorts, 15 percent receive a pension of less than 600 euro, compared to only five percent among the older cohorts. The share of relatively high pension benefits exceeding 900 euro 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 decrease of relatively high pension in the younger birth cohorts.

2.6.4 Alternative scenario: "positive labour market East Germany"

The left part of Table 2.9 shows the simulation results for the individual pension benefit and the replacement rate in the scenario "positive labour market East Germany", the right part shows the changes relative to the base scenario. Across all birth cohorts, the pension benefits increase by about eight percent, on average, with a somewhat stronger increase for women. The replacement rate 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, eleven percent less than in the base scenario, and the decline in the replacement rate is reduced by six percentage points. Somewhat weaker effects of a positive labour 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.

The comparison of the distribution of pension benefits across birth cohorts in our base and alternative scenario in Table 2.10 reveals a relatively strong reduction in the share of very small pension benefits. In the younger age cohorts, the share of pensions below 600 euro drops by 19 percentage points for men and 16 percentage points for women. This strong reduction is be accompanied by an increase in the share of monthly pensions of more than 900 euro by almost ten percentage points for men and five percentage points for women.

The large differences in simulations results between the two scenarios illustrate the importance of future labour 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, e.g., 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 entitlements that result from long-term unemployment since 2005. Labour market developments in East Germany give little reason to be optimistic in this respect. Thus, our alternative scenario probably lies near the upper bound of likely outcomes of the development of pension benefits in East Germany.

Table 2.9: Pension benefits and replacement rates across birth cohorts, scenario "positive labour market East Germany"

	Pension benefit (euro per month)			*Delta* relative to base scenario (in percent)		
Cohort	Total	Men	Women	Total	Men	Women
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)			*Delta* 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 level of pension benefits and replacement rates in the base scenario are documented in Table 2.4.

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations

Table 2.10: Distribution of pension benefits by income class across birth cohorts, scenario "positive labour market East Germany"

	Share (in percent)			Δ relative to base scenario (in percentage points)		
Income class (in 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 2.5.
Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations

2.7 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 life cycle as well as the differential impact of recent pension reforms on birth cohorts. The base scenario takes into account the sustainability factor and the long-term increase in the statutory retirement age, which was recently introduced to stabilize the contribution rate to the public pension system. In this scenario, 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 labour market participation among younger birth cohorts.

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 average minimum pension recently introduced to avoid poverty among pensioners. Furthermore, the distribution of pension benefits in the total population disguises important differences in 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 still relatively high 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. 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 labour market developments that have been observed in the past into the distant future for younger birth cohorts, which by necessity has to rely on uncertain assumptions especially for East Germany, we have also simulated the evolution of future pensions across birth cohorts under a more optimistic labour 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 is not reversed, although it becomes substantially weaker.

Appendix

2.A Statistical Matching of SOEP and VSKT

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 (D'Orazio et al., 2006; O'Hare, 2000). We apply a nearest-neighbor propensity score matching with replacement (see, e.g., Cameron and Trivedi, 2005). 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 observations by individual labour 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 sets before and after matching. 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 Steiner and Geyer, 2010, Tables A3-3 and A3-4). 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 2.11 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 PP after matching is significantly larger in the VSKT than in the SOEP in all groups, varying between 2.6 PP for East German women and almost four PP 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 entitlements acquired in the GDR were counted after their integration in the West German pension system.

Since pension entitlements in the VSKT 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 VSKT data set.

2.B Tables

Table 2.11: Employment and unemployment durations (months) and pension points in 2005 in SOEP and the VSKT before and after matching

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

Table 2.12: Marginal cohort effects in employment and unemployment histories from tobit estimates by region and level of education, men

Cohort	Full-time experience		Unemployment experience	
West Germany		Low level of education		
1942-1946	-1.07	(0.68)	0.11	(0.24)
1947-1951	-1.63	(0.75)	0.29	(0.25)
1952-1956	-1.28	(0.69)	0.84	(0.36)
1957-1961	-2.26	(0.68)	1.42	(0.38)
1962-1966	-3.13	(0.68)	2.19	(0.41)
1967-1971	-3.23	(0.66)	1.85	(0.36)
		Medium level of education		
1942-1946	-1.24	(0.67)	0.20	(0.13)
1947-1951	-1.11	(0.59)	0.34	(0.12)
1952-1956	-1.06	(0.61)	0.37	(0.13)
1957-1961	-1.40	(0.54)	0.61	(0.14)
1962-1966	-1.37	(0.59)	0.52	(0.13)
1967-1971	-1.59	(0.58)	0.70	(0.15)
		High level of education		
1942-1946	-0.71	(0.64)	0.51	(0.16)
1947-1951	-0.93	(0.52)	0.54	(0.16)
1952-1956	-1.09	(0.50)	0.67	(0.16)
1957-1961	-1.03	(0.48)	0.83	(0.17)
1962-1966	-0.96	(0.48)	0.68	(0.16)
1967-1971	-1.31	(0.49)	0.70	(0.17)
East Germany		Low/medium level of education		
1942-1946	-0.29	(0.60)	0.65	(0.20)
1947-1951	-1.18	(0.57)	1.49	(0.30)
1952-1956	-1.94	(0.56)	2.52	(0.33)
1957-1961	-3.05	(0.58)	3.54	(0.37)
1962-1966	-3.19	(0.58)	3.89	(0.40)
1967-1971	-3.38	(0.59)	4.62	(0.42)
		High level of education		
1942-1946	-0.35	(0.51)	0.22	(0.13)
1947-1951	-1.95	(0.70)	0.64	(0.18)
1952-1956	-2.64	(0.62)	0.72	(0.20)
1957-1961	-3.17	(0.65)	1.19	(0.26)
1962-1966	-3.64	(0.69)	1.44	(0.30)
1967-1971	-5.08	(0.74)	2.20	(0.41)

Notes: Standard errors in parentheses.

Source: SOEP, own calculations

Table 2.13: Marginal cohort effects in employment and unemployment histories from tobit estimates by region and level of education, women

Cohort	Full-time experience		Part-time experience		Unemployment experience		Homework	
West Germany				Low level of education				
1942-46	−0.75	(0.83)	0.40	(0.50)	0.24	(0.16)	−0.36	(0.84)
1947-51	−0.49	(0.77)	0.17	(0.41)	0.52	(0.16)	−0.85	(0.75)
1952-56	−0.27	(0.79)	0.93	(0.46)	0.89	(0.20)	−1.81	(0.70)
1957-61	−1.18	(0.74)	2.31	(0.56)	1.19	(0.24)	−2.07	(0.72)
1962-66	−1.75	(0.70)	2.70	(0.53)	1.41	(0.25)	−1.63	(0.67)
1967-71	−2.06	(0.69)	2.84	(0.54)	1.56	(0.25)	−1.79	(0.68)
				Medium level of education				
1942-46	0.82	(0.72)	0.81	(0.47)	0.10	(0.11)	−1.46	(0.58)
1947-51	1.17	(0.65)	1.73	(0.48)	0.12	(0.10)	−2.33	(0.51)
1952-56	1.08	(0.62)	1.97	(0.49)	0.23	(0.11)	−2.75	(0.47)
1957-61	0.76	(0.59)	2.83	(0.51)	0.27	(0.11)	−3.02	(0.45)
1962-66	0.47	(0.59)	3.35	(0.50)	0.45	(0.12)	−3.04	(0.46)
1967-71	0.58	(0.59)	3.54	(0.54)	0.17	(0.11)	−3.33	(0.44)
				High level of education				
1942-46	1.16	(1.53)	−0.20	(0.76)	0.20	(0.22)	−0.56	(1.15)
1947-51	2.21	(1.48)	0.06	(0.79)	0.55	(0.28)	−1.10	(1.02)
1952-56	1.52	(1.40)	1.08	(0.90)	0.86	(0.31)	−1.86	(0.92)
1957-61	1.42	(1.38)	1.77	(0.93)	0.73	(0.27)	−1.67	(0.95)
1962-66	1.46	(1.37)	1.75	(0.90)	0.67	(0.26)	−1.82	(0.95)
1967-71	1.28	(1.36)	1.94	(0.96)	0.41	(0.25)	−1.46	(0.94)
East Germany				Low/Medium level of education				
1942-46	0.57	(1.18)	−0.89	(0.56)	1.42	(0.29)	−0.60	(0.35)
1947-51	0.17	(1.15)	−0.88	(0.55)	2.80	(0.35)	−1.08	(0.29)
1952-56	−1.01	(1.13)	−1.37	(0.51)	4.47	(0.40)	−0.92	(0.30)
1957-61	−1.78	(1.13)	−1.16	(0.55)	5.38	(0.43)	−0.95	(0.31)
1962-66	−3.78	(1.12)	−0.49	(0.62)	6.82	(0.47)	−0.58	(0.35)
1967-71	−5.74	(1.10)	−0.46	(0.63)	8.20	(0.47)	0.17	(0.42)
				High level of education				
1942-46	−1.69	(1.36)	0.67	(0.79)	0.41	(0.22)	0.19	(0.47)
1947-51	−1.53	(1.25)	1.20	(0.78)	0.91	(0.28)	0.03	(0.38)
1952-56	−2.14	(1.21)	1.00	(0.74)	1.20	(0.29)	0.14	(0.38)
1957-61	−3.32	(1.21)	1.91	(0.82)	1.47	(0.30)	0.37	(0.41)
1962-66	−5.53	(1.20)	3.25	(0.96)	2.46	(0.41)	0.99	(0.50)
1967-71	−6.94	(1.22)	4.65	(1.15)	3.05	(0.52)	1.60	(0.63)

Notes: Standard errors in parentheses.
Source: SOEP, own calculations

Table 2.14: Random-effects relative earnings regressions, men

	West Germany			East Germany	
Education level	Low	Medium	High	Low/Medium	High
Non-employment	−0.09**	−0.13**	−0.32**	−0.21**	−0.56**
	(0.01)	(0.01)	(0.02)	(0.02)	(0.04)
Non-employment^2/100	1.08**	0.69*	5.09**	2.71**	20.73**
	(0.37)	(0.31)	(0.68)	(0.58)	(2.79)
Non-employment^3/100	−0.59**	−0.15	−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 controls	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 2.15: Random-effects relative earnings regressions, women

	West Germany			East Germany	
Education level	Low	Medium	High	Low/Medium	High
Part-time experience	−0.09**	−0.11**	−0.15**	−0.11**	−0.10**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part-time experience^2/100	1.10**	1.29**	2.07**	1.32**	1.27**
	(0.10)	(0.07)	(0.16)	(0.14)	(0.18)
Part-time experience^3/100	−0.48**	−0.54**	−1.06**	−0.57**	−0.66**
	(0.05)	(0.04)	(0.10)	(0.08)	(0.12)
Part-time experience^4/100	0.00**	0.00**	0.00**	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Part-time employed	−0.89**	−0.84**	−0.83**	−1.04**	−0.80**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)
Non-employment	−0.05**	−0.14**	−0.14**	−0.07**	−0.09**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Non-employment^2/100	0.20**	1.40**	1.28**	0.19†	−0.39
	(0.05)	(0.09)	(0.24)	(0.10)	(0.39)
Non-employment^3/100	−0.04**	−0.59**	−0.53**	−0.01	0.57*
	(0.01)	(0.05)	(0.15)	(0.03)	(0.24)
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)			
Other controls	yes	yes	yes	yes	yes
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.

Source: SOEP, own calculations

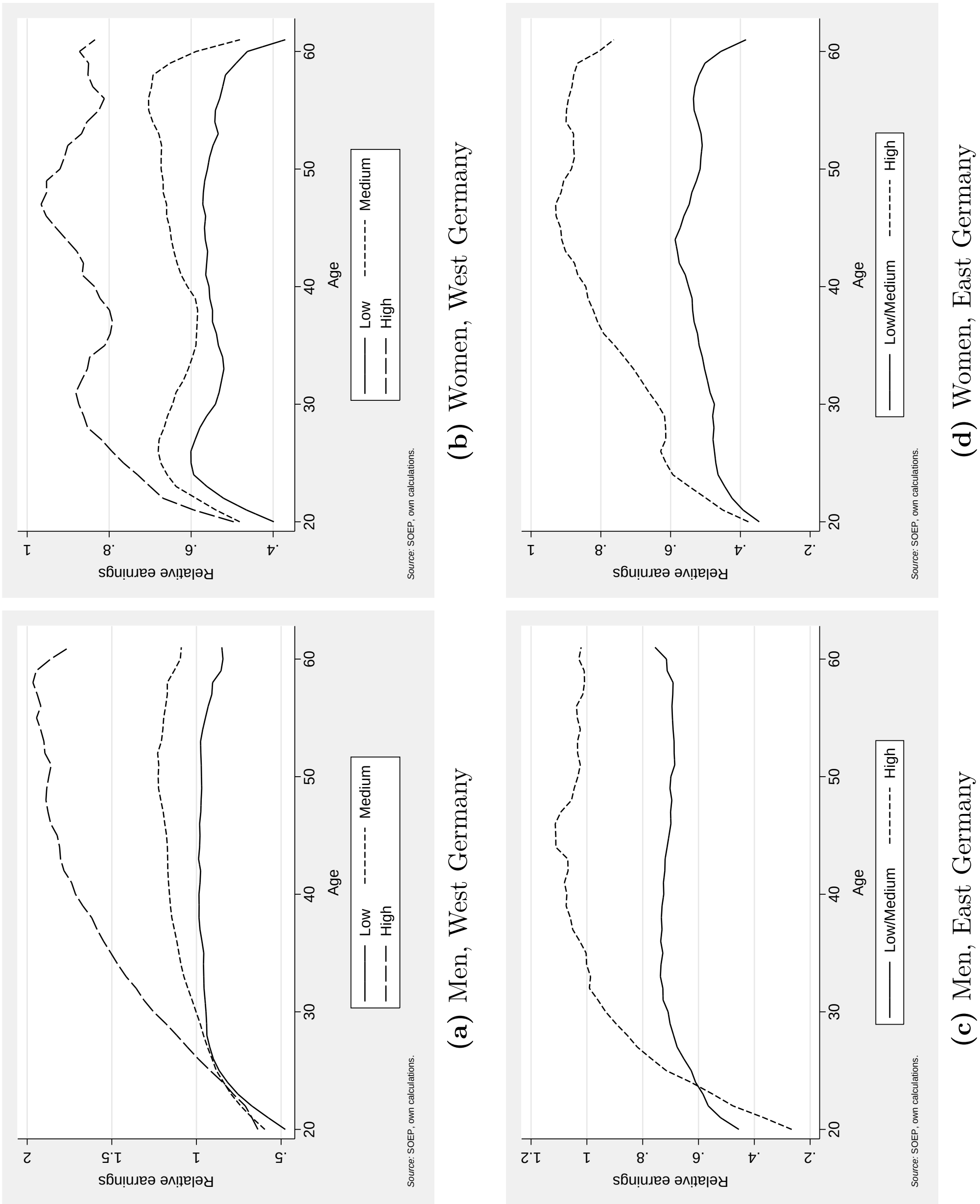
Table 2.16: Impact of pension reforms on the average pension benefit by birth cohort – women in West Germany, men and women in East Germany

	Pension benefit (euro per month)				Percentage change		
Cohort/Scenario	I	II	III	IV	II/I	III/I	IV/I
Women. West Germany							
1937-41	451	449	451	449	−0.3	0.1	−0.3
1942-46	552	538	554	540	−2.6	0.4	−2.2
1947-51	570	538	577	544	−6.1	1.2	−4.8
1952-56	588	543	606	560	−8.3	3.0	−5.1
1957-61	581	522	603	542	−11.3	3.7	−7.2
1962-66	666	581	694	606	−14.5	4.0	−9.9
1967-71	659	566	688	591	−16.4	4.3	−11.5
Average	590	540	606	554	−9.2	2.6	−6.4
Men. East Germany							
1937-41	887	886	887	886	−0.1	0.0	−0.1
1942-46	1.017	993	1.020	996	−2.5	0.3	−2.2
1947-51	943	890	953	898	−6.0	1.0	−5.0
1952-56	849	784	870	804	−8.2	2.5	−5.5
1957-61	730	657	756	680	−11.1	3.4	−7.4
1962-66	723	635	756	663	−14.0	4.3	−9.1
1967-71	658	566	690	594	−16.2	4.7	−10.7
Average	843	786	860	801	−7.3	2.0	−5.2
Women. East Germany							
1937-41	646	646	646	646	0.0	0.0	0.0
1942-46	727	718	729	720	−1.2	0.3	−0.9
1947-51	827	786	834	792	−5.3	0.8	−4.5
1952-56	745	691	763	708	−7.8	2.4	−5.2
1957-61	755	685	779	706	−10.3	3.0	−7.0
1962-66	647	570	672	592	−13.5	3.7	−9.2
1967-71	516	447	538	466	−15.5	4.0	−10.9
Average	715	667	729	680	−7.2	2.0	−5.1

Notes: Scenario I: Retirement age = 65. without adjustment of CPV; Scenario II: Retirement age = 65. with adjustment of CPV; Scenario III: Retirement age = 67, without adjustment of CPV; Scenario IV: Retirement age = 67, with adjustment of CPV (base scenario)

Source: SOEP, SUFVSKT2005, SUFRTZN06XVSBB, own calculations

2.C Figures



(a) Men, West Germany

(b) Women, West Germany

(c) Men, East Germany

(d) Women, East Germany

Figure 2.4: Relative earnings-experience profiles by gender, region and education

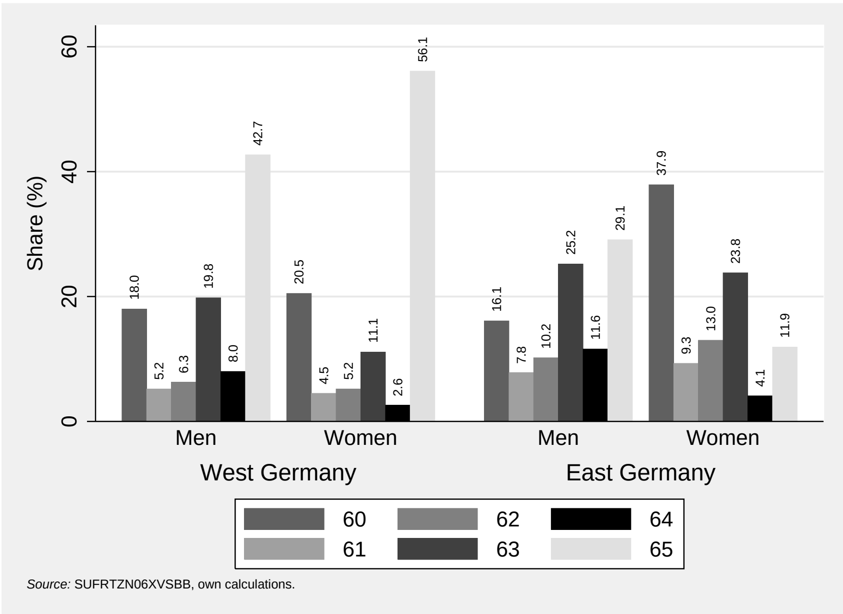


Figure 2.5: Retirement age of the 2006 entry cohort by gender and region (shares in percent)

3 The effect of health and employment risks on savings[1]

3.1 Introduction

The idea that individuals build up precautionary wealth because future income is random and not determinate was formally analysed by Leland (1968) for the first time and extended by the works of Sandmo (1970) and Dreze and Modigliani (1972). The theory predicts that individuals accumulate precautionary wealth to insure themselves against potential future income shocks. It gained importance in the context of the life-cycle hypothesis of consumption (Modigliani and Brumberg, 1954). The precautionary motive for accumulating wealth may be able to explain several so-called "consumption puzzles" that cannot be explained by traditional certainty or certainty-equivalence models (Zeldes, 1989). For example, it offers an explanation for the excess sensitivity of consumption to anticipated income fluctuations, the growth of consumption in the presence of a low real interest rate, and low spending of the elderly (Zeldes, 1989). Hubbard et al. (1995) argue that low wealth accumulation of many US households is not consistent with the traditional life-cycle model. They show that introducing uncertainty or precautionary savings can solve this puzzle. A large number of studies has been devoted to analyse the impact of income uncertainty[2] on savings (a survey of the life-cycle model can be found in Browning and Crossley, 2001). The magnitude of individuals' reaction to income uncertainty by accumulating precautionary savings is expected to be higher the more risk averse individuals are. If this holds true for the economy in general, the quantitative

1 This chapter is based on Geyer (2011).
2 The literature on precautionary savings does no distinguish between (measurable) risk and (immeasurable) uncertainty in a Knightian sense (Knight, 1921). In line with the literature, I use both concepts interchangeably and assume that both economic uncertainty and economic risk can be measured and operationalised with a probability distribution that is known to the individual.

relevance of the precautionary motive has important implications for government policies that affect income uncertainty (Aiyagari, 1994; Femminis, 2001; Kimball and Mankiw, 1989).

Although the theoretical concept appears to closely reflect everyday ideas of savings behaviour, empirical estimates of precautionary wealth are exceptionally diverse. The findings range from high shares of precautionary wealth in total wealth (e.g., Carroll and Samwick, 1997; Dardanoni, 1991; Engen and Gruber, 2001; Lusardi, 1998) to little or no precautionary wealth at all (e.g., Dynan, 1993; Guiso et al., 1992; Skinner, 1988). However, applied studies on the existence and significance of precautionary savings are confronted with a lot of conceptual and methodological problems, which might have contributed to the plurality of results (Browning and Lusardi, 1996; Kennickell and Lusardi, 2004).

The fundamental assumption underlying this model is that individuals assess the need for precautionary savings conditional on their expectations of future income risks. As a consequence, empirical studies applying this model have to find a reliable empirical risk measure that actually corresponds to households' risk expectations at the time savings decisions are made. Although the concept of precautionary savings relates current wealth to future income levels and shocks, and is thus related to individual expectations, the standard approach to model income risks in the literature is based on ex-post measures of household specific income variation. A likely reason for this restriction is the lack of good data on ex-ante risk expectations. Ex-post measures are likely to capture part of the expected income path. However, these income changes may also reflect choices, and only income fluctuations that have actually occurred contribute to it. The focus on observed income fluctuations is restrictive because the scenarios that trigger precautionary saving will not inevitably occur. For example, it is plausible to assume that an employed individual saves money as a precaution against the risk of becoming unemployed. Usually, however, these kinds of savings decisions remain unobserved in survey data. Surveys that ask for saving motives normally find that the precautionary motive is important for savings (Alessie et al., 1997; Börsch-Supan and Essig, 2003; Kennickell and Lusardi, 2004; Schunk, 2009). The ideal ex-ante risk measure would have to comprise this counterfactual information as well.

Only a few studies have considered ex-ante measures of economic risk. The most obvious indicators, which reflect expectations, probably are subjective assessments of economic risks. Unfortunately, these indicators often lack enough variation to identify an effect of income uncertainty on savings. However, some studies take advantage of detailed income risk assessments and simulate the corresponding ex-ante income variances (e.g., Arrondel, 2002; Guiso et al., 1992; Lusardi, 1997, 1998). Still, such detailed subjective data are rarely collected. Moreover, the more realistic the respective set of questions is, the more complex and difficult to understand the questions get. A more flexible alternative is to simulate ex-ante risk scenarios and the corresponding income variance based on empirical estimates. This has been done using predicted unemployment risk – which is certainly one of the most important economic risks before retirement – in a model of precautionary savings (e.g., Benito, 2006; Carroll et al., 2003). In a similar study, Engen and Gruber (2001) use simulated unemployment benefits to calculate replacement rates and show that the generosity of the unemployment insurance has an impact on savings for the group of employed individuals.

This chapter extends the idea of using future unemployment risk in a model of precautionary savings in several ways. First, the simulation comprises three future periods to calculate the uncertainty measure. This way I account for dynamic effects of unemployment in two ways: the model for unemployment controls for true state dependence in the employment status, and the expected future wage is modelled dependent on the previous labour market status. A second contribution of my model is that I explicitly include health as a risk into a model of precautionary savings. Health constitutes an important factor for several reasons. To begin with, health plays a major role in determining labour market activity. As a consequence, the financial situation of the individual and the household are also determined by health. In addition, poor health is a risk about which individuals may have a lot of private information, and it seems straightforward to account for it in the analysis of precautionary savings. As labour market risks are affected by poor health and vice-versa, I also have to consider that health and employment may be endogenously determined (e.g. Haan and Myck, 2009). Thus, to account for health risks will improve the identification of labour market related uncertainty. Third, a detailed tax-benefit microsimulation model is applied to calculate the expected income in each scenario, i.e. combinations of being in employment/unemployment and good health/bad health, which constitute the basis to calculate an ex-ante income variance.

Further contributions of this chapter to the literature on savings behaviour are the following: the empirical analysis is conducted using a measure for saving stocks and saving flows. The latter model allows to control for individual specific effects. Moreover, I apply the inverse hyperbolic sine transformation to the wealth aggregate used in the estimation. This is a log-like transformation that allows to keep zero and negative wealth observations in the data.[3]

The next section provides an overview of previous research with a focus on different measures of uncertainty. The following section introduces the estimation models and my approach to model the ex-ante income risk measure. Section 3.4 presents data, sample and variables. Section 3.5 shows the results of the simulated uncertainty measure, and Section 3.6 presents the buffer-stock model and the monthly savings regression. The following section discusses the results and draws several conclusions from the empirical evidence.

3.2 Previous research

Precautionary savings can be interpreted as a reaction of individuals to insure themselves against ("uninsurable") future uncertainty. The resulting precautionary wealth stock is defined as the difference of total wealth holdings to the wealth stock that would be observed if there was no uncertainty (Kimball, 1990). Simulations based on intertemporal models of optimal consumption-savings decisions with income uncertainty show that precautionary wealth may explain a sizeable share of total wealth. For example, Skinner (1988) argues that half of total wealth can be explained by precautionary motives. The studies by Caballero (1991), Gourinchas and Parker (2002), Cagetti (2003) estimate similarly high or

3 I discuss health within this chapter in its relation to the employment status. Another interesting research question would be to particularly analyse the relationship of health shocks and precautionary savings. However, this would exceed the scope of my study here and extend its focus to include older individuals as well. The literature on health risk in the context of precautionary savings is much more focused on the health insurance than on the relation between health, employment and wages. Thus, the focus is on uncertainties about future health care expenditures, which give rise to household savings. In an early simulation, Kotlikoff (1989) showed for the life-cycle model that savings increase if there is uncertainty about medical expenditures (cf. Palumbo, 1999). Hubbard et al. (1995) argues that asset-means tested social insurance programs can prevent low income households from building up assets. Gruber and Yelowitz (1999) test this hypothesis empirically using US data on reforms of the Medicaid program. They exploit exogenous variations in Medicaid eligibility over time for identification. They find that Medicaid eligibility has a significant negative effect on wealth. In a study for Italy, Jappelli et al. (2007) exploit regional variation in health care quality and show that low quality has a positive effect on precautionary wealth. They conclude that uncertainty about medical expenditures may explain the low dissaving rate of retirees. In a study for Germany, Schunk (2009) uses the same arguments to explain his result that the precautionary motive for savings gets more important among the elderly.

even higher shares of precautionary wealth.[4] However, empirical studies using micro data yield exceptionally diverse results that range from no precautionary wealth (e.g., Dynan, 1993; Skinner, 1988) to large shares of 50 percent and more (e.g., Carroll and Samwick, 1997, 1998; Dardanoni, 1991).

Several methodological and conceptual factors may have contributed to the heterogeneity of empirical results. One of the most challenging factors is to model the uncertainty relevant for the study of precautionary savings (Kennickell and Lusardi, 2004). A large number of studies focuses solely on income risk in order to model uncertainty. A common approach is to use some stochastic panel data model of net household income and to derive ex-post variance measures based on this income model (Carroll and Samwick, 1998; Fossen and Rostam-Afschar, 2009; Hubbard et al., 1995; Kazarosian, 1997). Others use the variability of expenditures (Dynan, 1993). However, when using this proxy, it may be difficult to distinguish between transitory income and measurement error (Kennickell and Lusardi, 2004). Another aspect is that individuals may already be insured against the estimated income uncertainty (Browning and Lusardi, 1996; Caballero, 1991). Furthermore, these proxies may contain large adjustable elements which increase the variance of earnings but rather reflect choices than uncertainty (Carroll et al., 2003; Guiso et al., 1992; Low et al., 2010).

Important for the present study is a part of the research literature that uses ex-ante risk measures. Some studies use subjective uncertainty indicators in combination with an income simulation. Often these measures show a small variance of income risks, which renders identification difficult. Self-assessed income or employment risks is often measured by categorical variables with few categories. The studies by Guiso et al. (1992) for Italy and Arrondel (2002) for France rely on a very detailed subjective risk assessment of future real household income development. The corresponding income is simulated to construct an income uncertainty measure. Both studies find only small, but significant shares of precautionary wealth – roughly between two and five percent. Lusardi (1997) reestimates

4 As Carroll and Kimball (2008) note, the results of Gourinchas and Parker (2002) and Cagetti (2003) should be approached with caution. Both studies calibrate a life cycle optimization problem using empirical estimates of income variance and the coefficient of relative risk aversion (CRRA) by Carroll and Samwick (1997). The estimated CRRA depends on the model's assumptions about income uncertainty as faced by the household at the time of the savings decision. Low et al. (2010) show that the estimates by Carroll and Samwick (1997) may overstate the magnitude of shocks to permanent income by as much as 50 percent. They argue that endogenous job mobility choices account for a large proportion of wage fluctuations in Carroll and Samwick (1997).

the data used in Guiso et al. (1992) with an IV approach and finds a much higher share of precautionary wealth of about 20 to 24 percent.

Using US data, Lusardi (1998) conducts a similar exercise with self-assessed unemployment probabilities, although without simulating household specific replacement rates for this uncertainty measure. Her findings on the share of precautionary wealth are similar to Guiso et al. (1992) and Arrondel (2002) and range from one to 3.5 percent. For Germany, Essig (2005) applies the same uncertainty measure and simulates the respective unemployment replacement rate as if the household received ALG I. However, effects are insignificant.

Another related strand of the literature uses estimated ex-ante indicators. Carroll et al. (2003) simulate unemployment benefits for employed individuals in the US and exploit individual and regional variation in unemployment benefit entitlements. Results are mixed and suggest that precautionary savings are income dependent. Whereas low income households do not engage in precautionary savings, evidence can be found for precautionary savings behaviour in higher income groups. However, when housing is excluded from the measure of wealth, the effect of unemployment risk turns insignificant. Although it is plausible to assume that housing equity is part of precautionary wealth, the authors cannot answer the question why no precautionary wealth effect can be found regarding more liquid assets.

Using US data, Engen and Gruber (2001) show that small savings of low income households may be explained by the provision and generosity of unemployment transfers. They regress gross financial wealth on the individual unemployment insurance replacement rate and unemployment risk. One of their findings is that the generosity of the unemployment insurance decreases savings: a ten percent increase in replacement rate would lower savings by 2.8 percent. Benito (2006) uses the probability to become unemployed in the next period to proxy uncertainty with UK data. He uses weekly food consumption as the dependent variable which might influence the comparability of his model with other cited studies. He models uncertainty with an estimated and a subjective measure of future unemployment probability. His results show that a one standard deviation increase in unemployment risk lowers weekly food consumption by 2.7 percent. And he shows that this effect is stronger for younger households. He interprets this result as evidence for a precautionary savings motive.[5]

Some studies proxy uncertainty with the occupational status because certain jobs entail higher/lower earnings variance or higher/lower risk of job loss (Fuchs-Schündeln and Schündeln, 2005; Skinner, 1988). Using US data, Skinner (1988) proxies the degree of earnings risks by including dummies for self-employed and farmers in a savings regression. He finds no evidence for precautionary savings. On the contrary, the self-employed as well as farmers appear to save even less than other occupational groups. Lusardi (1997) reports similar findings for Italy. A potential reason is that individuals with different tastes for risk choose different occupations. This would induce a selection effect and bias the estimates downwards. However, it could also be the case that data on saving flows of the self-employed suffer from large measurement error because it may be difficult to distinguish between business expenditures and personal consumption (Carroll and Samwick, 1998). Another selection effect results from the fact that we do not observe the self-employed who experienced a negative wealth shock and changed occupation, which would result in a positive bias. Carroll and Samwick (1997, 1998) report that high levels of precautionary savings disappear if the self-employed are excluded from the sample. As Hurst et al. (2010) and Fossen and Rostam-Afschar (2009) point out, this constitutes a problem because the self-employed show higher income uncertainty and higher levels of wealth for other reasons than precautionary motives. Therefore, when including the self-employed in the sample, it is of key importance to properly account for this group.

Using data for Germany, Fuchs-Schündeln and Schündeln (2005) solve the problem of self-selection by exploiting a natural experiment in which selection into risk-less occupations is exogenous. They define a risk-less occupation as having a civil servant status (life-time tenure). Using SOEP they find that about 20 percent of all gross financial and housing

5 My own results suggest that using the unemployment probability as a measure of income risk might be problematic. Individuals with a high risk of becoming unemployed may also have below average incomes and – with respect to labour market success – disadvantageous characteristics that might drive the results using unemployment risk alone. Instead, it seems important to control whether results change when the same probabilities are used together with a simulation of income in each state.I check the simulated income variance using it as a regressor for subjectively assessed job risks. It turns out that simulated unemployment probabilities are positively correlated with self-assessed job risks but income variance has a negative sign (Section 3.5.1).

wealth in East Germany and 12 percent in West Germany follow a precautionary motive.[6]

For Germany, only a few studies have yet analysed the precautionary savings model and none of these used estimated unemployment probabilities or health risks as a proxy for future uncertainty. Using SOEP data from 2002, Bartzsch (2006, 2008) estimates a buffer-stock savings model and applies different measures of income variance to proxy uncertainty. He finds that roughly 20 percent of net financial wealth traces back to the precautionary savings motive. His results suggest that housing equity is not used as a buffer against income shocks. As mentioned above, Fuchs-Schündeln and Schündeln (2005) proxy uncertainty with occupation and find evidence for precautionary savings particularly in East Germany. Using the same data for the years 2002 and 2007, the study by Fossen and Rostam-Afschar (2009) does not find any evidence for precautionary savings. They explicitly account for heterogeneity between entrepreneurial and non-entrepreneurial households and show that the higher savings rate of the self-employed can not be attributed to the precautionary savings motive. They argue that the effect of precautionary savings vanishes once net worth is used as a measure of wealth and that the significant effect on liquid assets could rather reflect portfolio decisions.

Using an error components model, Beznoska and Ochmann (2010) find significant effects of income uncertainty on precautionary savings. In their model, a doubling of transitory income uncertainty increases savings by 4.4 percent or 43 euro for an average household, which is similar to the results of the savings flows regression in this chapter. Giavazzi and McMahon (forthcoming) use the pension reform in Germany in 1997 as a quasi-experiment because it was revoked after the elections in 1998 and never came into force. Their results suggest that the implied increase in income uncertainty increased savings.[7] Essig (2005) conducted one of the few studies for Germany that is not using SOEP data. Using SAVE, he shows that individuals with negative expectations about the future tend to save less. And he does not find an effect of subjective unemployment probabilities on savings. However, using these expectations might be misleading in the context of precautionary

6 Their study also reflects the above mentioned large diversity of results. The baseline specification is a linear model with log of gross financial and housing wealth as dependent variable. The model excludes zero or negative wealth observations. As a robustness check, the authors also estimate a tobit specification, in which zero wealth observations were included. From this specification they do not find any precautionary wealth in West Germany and even 68 percent in East Germany.

7 They also analyse the labour supply decision and find that household heads who work part-time increase their labour supply in response to the reform.

savings. It is very likely that households with negative expectations about the future have also low income and low income variance (see also Section 3.5.1).

This section has illustrated the diversity of measures of economic uncertainty and has shown how heterogeneous the outcomes of these studies are. [8] In the following, I contribute to the evolving literature by developing an ex-ante measure of economic risks that combines two interdependent labour market risks: future health and unemployment status. My analysis further contributes to the literature by using a detailed microsimulation model to simulate the respective net household income for each potential risk scenario. Moreover, I estimate panel models, whereas most of the aforementioned studies are based on cross-sectional models.

3.3 Modelling precautionary savings

3.3.1 Buffer-stock wealth and savings flows model

The primary estimation equation follows the literature and models precautionary savings in a buffer-stock wealth model, as suggested by Deaton (1991) and Carroll et al. (1992). The model is centered around a target wealth-to-income ratio $\frac{W}{P}$. Where W denotes the relevant wealth measure and P the level of permanent income. $\frac{W}{P}$ positively depends on uncertainty, σ, as faced by the individual. In the steady state, when the target is reached, income uncertainty should have no effect on the savings rate (Carroll and Samwick, 1997). If wealth exceeds or falls below the target, the wealth is expected to fall (dissaving) and to increase (saving), respectively. The importance of the precautionary motive depends on the degree to which wealth increases with uncertainty. In addition, the target ratio may depend on household characteristics X and unobserved factors ε:

$$\frac{W}{P} = f(\sigma, X) + \varepsilon \tag{3.1}$$

8 Table 3.13 in the Appendix provides a summary of the discussed empirical studies and further analyses on precautionary savings. It shows that comparison of results may be difficult because samples, dependent variables, and risk measures vary strongly across studies.

Carroll and Samwick (1998) show that the buffer-stock model predicts an approximately linear relationship between the log[9] of target wealth ratio and the measure of income uncertainty. The estimation equation includes permanent income as a right hand side variable to allow for non-homothetic preferences (King and Dicks-Mireaux, 1982).

The following model shall be estimated:

$$log\,(W_{it}) = \alpha + \theta^{w} log(\sigma^{2}_{it}) + \lambda^{w} log\,(P_{it}) + \beta^{w\prime} X_{it} + \varepsilon_{it} \tag{3.2}$$

Identification of the relationship in equation (3.2) is closely related to the chosen measures of wealth, permanent income, and uncertainty. To find an appropriate aggregated wealth measure for the model is difficult. In general, the portfolio elements will differ with respect to their risk and liquidity characteristics (Kennickell and Lusardi, 2004). An illiquid asset cannot serve as a precaution against income shocks. However, it is not obvious what an illiquid asset actually is. Some studies, such as Kazarosian (1997) or Engen and Gruber (2001) have only considered financial wealth, which may however be too restrictive. For example, housing wealth could be pledged as collateral, increasing the degree of liquidity of this asset. I estimate equation (3.2) using two different wealth measures, net worth (NW) and financial wealth (FW). NW includes all wealth components except for business assets, whereas FW is a subset of NW and consists of liquid assets. In particular FW does not include housing equity. If there is a precautionary savings motive, which does not only reflect a portfolio decision, I expect the effect of income uncertainty to be higher for liquid assets but still significant for NW. Moreover, it is interesting to consider real estate assets in the wealth measure since previous studies reported strong sensitivity of results if it was included.[10]

If uncertainty has a positive impact on the stock of wealth, it should also increase saving flows. As Guiso et al. (1992) argue, to estimate whether income uncertainty has an effect on both asset accumulation and saving flows can be interpreted as a test of the validity of both models, and as two independent tests of the theory of precautionary

9 The disadvantage of using logs is that households who have zero or negative wealth have to be excluded from the sample. Section 3.6.1 presents a log-like transformation that allows to keep the otherwise excluded observations in the sample.

10 For example, the results in Carroll et al. (2003) and Bartzsch (2008) change completely when housing is included in the measure of wealth.

savings. Therefore, in addition to the buffer-stock model with FW and NW, I estimate a second model using the monthly flow of savings as dependent variable. The ad-hoc savings model regresses the log of monthly savings flows s_{it} on the uncertainty measure σ_{it}, permanent income P_{it}, and household characteristics X_{it}. In addition, the model includes an idiosyncratic time-varying error e_{it} and a constant individual effect u_i:

$$log(s_{it}) = \theta^s log(\sigma_{it}^2) + \lambda^s log(P_{it}) + \beta^{s\prime} X_{it} + u_i + e_{it} \tag{3.3}$$

With respect to the measure of permanent income, I use an approach proposed by Fuchs-Schündeln and Schündeln (2005). In a given year, net household income is detrended by dividing it through the average net household income. In a second step, the average detrended net household income for each household is calculated. The product of average annual net household income and the detrended average net household income gives the measure of permanent income.[11]

Quantify precautionary savings

To approximately quantify the amount of precautionary savings based on the estimated coefficients, a counterfactual simulation is conducted (Carroll and Samwick, 1998). I compare the current savings flows with a situation, in which each household faces the same small income risk σ_{low}. The same simulation is done for the buffer-stock wealth model. Estimates of equation (3.3) are used to predict $\widehat{log(s_{it})}$:

$$\widehat{log(s_{it})} = \widehat{\theta^s} log(\sigma_{it}^2) + \widehat{\lambda^s} log(P_{it}) + \widehat{\beta^s}' X_{it} \tag{3.4}$$

In the next step, $log(\sigma_{it}^2)$ is replaced by $log(\sigma_{low}^2)$ and used to predict $\widehat{log(s_{it})}^*$:

$$\widehat{log(s_{it})}^* = \widehat{\theta^s} log(\sigma_{low}^2) + \widehat{\lambda^s} log(P_{it}) + \widehat{\beta^s}' X_{it} \tag{3.5}$$

Then $\widehat{s_{it}}^*$ is subtracted from $\widehat{s_{it}}$ and divided by $\widehat{s_{it}}$ to obtain a measure of relative change

11 As a robustness check, I calculated a different measure of permanent income as in Bartzsch (2008). The results do not change significantly.

in saving flows if the household faced the (counterfactual) low risk σ_{low}. The share of precautionary saving flows in the sample, denoted as $\overline{PS}^*$, is simply the average of this relative difference over all observations N:

$$\overline{PS}^* = \frac{\frac{1}{N}\sum_{i=1}^{N}\widehat{s}_i - \frac{1}{N}\sum_{i=1}^{N}\widehat{s}_i^{\,*}}{\frac{1}{N}\sum_{i=1}^{N}\widehat{s}_i} \tag{3.6}$$

Previous studies suggested to choose the minimum value of σ in the regression sample for σ_{low} (e.g., Carroll and Samwick, 1998). However, the choice is rather arbitrary and the minimum could strongly depend on outliers. Thus, in addition to the minimum, equation (3.6) is also evaluated for the first percentile of σ.[12]

3.3.2 An ex-ante measure of income uncertainty

The main contribution of this study is the simulation of the ex-ante uncertainty measure σ^2_{it}, the central explanatory variable in equations (3.2) and (3.3). As described above, many studies on precautionary savings use ex-post income variance measures to proxy uncertainty. This approach implies an important assumption: Realized income variations are equivalent to the perceived risk which gives rise to precautionary savings. The advantage of using ex-post data is of course that it can be observed. Moreover, the calculation of different variance measures is straightforward in this case. The disadvantage is however also obvious: this approach uses only realized outcomes to identify the effect of risk expectations on savings behaviour. As precautionary savings are triggered by potential risks that do not have to actually occur, or, as Carroll and Kimball (2008) put it, "precautionary saving result from the knowledge that the future is uncertain", it is straightforward to use counterfactual or different potential outcomes to construct a measure of uncertainty. As a natural alternative to ex-post measured (observed) variance, I propose to use an ex-ante measure of income risk that is constructed from hypothetical (simulated) risk scenarios to explain precautionary savings behaviour.

One of the most important labour market risks for prime age men is unemployment. Many studies suggest that unemployment is also one of the primary reasons for larger

12 As Carroll and Samwick (1998) emphasize, this is a ceteris-paribus simulation. In reality, one would expect general equilibrium effects, particularly on the interest rate.

income fluctuations of the active population (e.g., Carroll et al., 1992; Engen and Gruber, 2001; Lusardi, 1997). And the health status is highly related to the employment status.

Unemployment has not only an instantaneous effect on income but also a negative impact on reemployment probabilities and future wages. And bad health is strongly associated with unemployment and is likely to affect wages and work capacity negatively. In the precautionary savings model, I follow most of the literature and interpret the labour market risks as exogenous constraints for the individual savings decision.[13]

Both risks are modeled as binary variables. A simulation model is used to assign probabilities to these labour market risks and to simulate respective net household income in each possible state. This approach implies the assumption that individuals perceive uncertainty as income variation conditional on the likelihood that certain income risks may occur. To use the simulation of net household income to build the income variance has the further advantage to enable the simulation of reforms in the tax-benefit system and their impact on precautionary savings.

The combination of health, h_{it}, and labour market status, l_{it}, results in four possible scenarios s_{it} with:

$$s_{it} = \begin{cases} 1 & h_{it} = 0, l_{it} = 0 \\ 2 & h_{it} = 1, l_{it} = 0 \\ 3 & h_{it} = 0, l_{it} = 1 \\ 4 & h_{it} = 1, l_{it} = 1 \end{cases} \quad \text{with} \quad \begin{array}{l} h_{it} = \begin{cases} 0 & \text{good health} \\ 1 & \text{bad health} \end{cases} \\ \\ l_{it} = \begin{cases} 0 & \text{employed} \\ 1 & \text{unemployed} \end{cases} \end{array}$$

For each scenario s_{it} I simulate the related income y^s_{it}. If $l_{it} = 1$, net income for the scenario when unemployed is calculated, which depends on individual and household characteristics X_{it} and the tax-benefit function $\gamma_t(.)$. If $l_{it} = 0$, net income depends on the wage rate w_{it}, hours worked h_{it}, X_{it} and $\gamma_t(.)$:

13 Usually, this assumption is not stated explicitly but of course individuals could react to a change in income variance by changing the employment behaviour as well as the savings behaviour.

$$y_{it}^{s} = \begin{cases} \int \gamma_t \left(w_{it}, h_{it}, X_{it}\right) dh_{it} & \text{if } s = 1,2 \\ \gamma_t \left(X_{it}\right) & \text{if } s = 3,4 \end{cases} \tag{3.7}$$

The scenarios are treated as the outcome of a discrete random variable with probability p_{it}^{s}. The expected income over all possible states in period t is the probability weighted predicted income Y_{it}:

$$\mathbf{E}\left[y_{it}\right] = Y_{it} = p_{it}^{1} y_{it}^{1} + p_{it}^{2} y_{it}^{2} + p_{it}^{3} y_{it}^{3} + p_{it}^{4} y_{it}^{4} \tag{3.8}$$

And the variance of y_{it} is given by

$$\mathbf{Var}\left[y_{it}\right] = \sigma_{it}^{2} = p_{it}^{1}\left(y_{it}^{1}\right)^{2} + p_{it}^{2}\left(y_{it}^{2}\right)^{2} + p_{it}^{3}\left(y_{it}^{3}\right)^{2} + p_{it}^{4}\left(y_{it}^{4}\right)^{2} - Y_{it}^{2} \tag{3.9}$$

One important feature of the model is that it accounts for path dependency in l_{it} and h_{it} by making them dependent on their own lag and the lag of the other variable. Thus, the expected probabilities in t are conditional on being in state s in period $t-1$. For the first period, the state in $t-1$ is known to the individual, whereas it has to be replaced by an expected probability in $t+1$ and $t+2$. Equation (3.8) for period $t+1$ would contain 16 elements and 64 elements for period $t+2$. The variance is calculated over each possible income path and its probability.

Moreover, wages also dependent on the lagged labour market and health status. I treat working hours as exogenous and use their observed distribution, differentiated by socio-economic characteristics, to simulate working hours in future periods.

In the following, I explain the steps necessary to construct the uncertainty measure and present the empirical results.

3.3.3 Simulation of the ex-ante uncertainty measure

Health and employment

I model health and employment status jointly in a dynamic framework like Haan and Myck (2009). That allows to control for true state dependence and takes into account that unobservable characteristics can have a joint effect on both outcomes. Haan and Myck (2009) find a significant correlation between the two processes and show that it is important to control for state dependence and unobserved heterogeneity. In a similar approach, I specify a bivariate dynamic probit model suggested by Alessie et al. (2004) and control for the initial conditions as in Wooldridge (2005).

The model is not a simultaneous but rather a sequential intertemporal model. That implies the assumption that the health status in t does not affect the employment status in t and vice versa. The approach avoids the problem of finding exclusion restrictions to identify a simultaneous relationship. Thus, it is not necessary to impose a coherency condition to ensure consistency. For example, it would be necessary to restrict one of γ_h and γ_e or both to zero to estimate equation (3.10) as a simultaneous model (Ronning, 1991). Both the intertemporal and the simultaneous model require strong assumptions for identification. My strategy can be justified by three arguments: As Haan and Myck (2009) argue, I observe both dependent variables only at the time of the interview, which renders it impossible to determine the exact chronological order of both processes. In addition, due to the inherent state dependence in both employment and health status, the lagged indicators can be interpreted as good proxies of their current status. And third, the intertemporal model allows to model the mutual dependence of health status and employment status.

The following specification will be estimated:[14]

$$h_{it}^* = h_{it-1}\gamma_h + l_{it-1}\alpha_e + h_{i0}\delta_h + x_{1it}\beta_h + c_i^h + \varepsilon_{1it} \tag{3.10a}$$

$$l_{it}^* = l_{it-1}\gamma_e + h_{it-1}\alpha_h + l_{i0}\delta_e + x_{2it}\beta_e + c_i^l + \varepsilon_{2it} \tag{3.10b}$$

$$\text{with } m_{it}^* = \begin{cases} 1 & \text{if } m_{it}^* > 0 \\ 0 & else \end{cases} \quad , \quad m := (l,h)$$

Health and employment status (h_{it} and l_{it}) depend on their own lag, their initial state (h_{i0} and l_{i0}), the lagged indicator of the respective other variable and a set of independent explanatory variables (x_{1it} and x_{2it}) which are assumed to be strictly exogenous. The employment equation comprises some independent variables that are not elements of x_{1it},

14 I use the Stata program GLLAMM to estimate the model.

the regional unemployment rate, other household income and nationality. All variables in x_{1it} are elements of x_{2it}. In addition, I assume random individual effects c_i^h and c_i^l which have a bivariate normal distribution with variances σ_h^2 and σ_l^2 and covariance $\sigma_h^2\sigma_l^2\rho_c$. The idiosyncratic error terms ε_{1it} and ε_{2it} are assumed to be independent over time and bivariate standard normal with covariance ρ_c.

Hourly wages

The simulation of health and employment status results in conditional probabilities of combinations of both states, scenarios s_{it}. The first step to associate these scenarios with income from labour is to model hourly wages. However, the wage itself may depend on previous unemployment and health status. Thus, wages are estimated conditional on the lagged employment and health status. A simplifying assumption of my simulation is that wages only depend on previous unemployment and health.

As these effects, in addition to the probabilities, will mainly drive the simulation of income uncertainty, it is important for a valid simulation to estimate the effects of bad health and unemployment on wages consistently. I choose a panel data model suggested by Wooldridge (1995), which simultaneously allows for fixed effects in both the main and the selection equation. Using a within (fixed effects) estimator is particularly useful for my application since unobserved heterogeneity is expected to have an important influence on the wage regression. As long as selection is related to time constant unobserved factors, possible sources for bias due to non-random selection are reduced by using the fixed effects approach. However, selection through time-varying variables could still play a major role. Therefore, I also specify a general selection mechanism that allows for fixed effects. For the wage and the selection equation, the following model is estimated:

$$w_{it} = x_{1it}\beta_{x1} + x_{2it}\beta_{x2} + \mu_i + u_{it} \tag{3.11}$$

$$l_{it} = \mathbf{1}\left[z_{it}\gamma + \kappa_i + e_{it} > 0\right] \tag{3.12}$$

$$l_{it}|\left(z_{it},\kappa_i,\mu_i\right) \sim N(0,\sigma_l^2)$$

In equation (3.11), w_{it} denotes the hourly wage rate, the vector of explanatory variables x_{1it} refers to characteristics observed regardless of whether being employed or unemployed, while x_{2it} is only observed for the employed. μ_i is an unobserved time-constant individual specific effect, u_{it} is a time-varying idiosyncratic error. l_{it} in equation (3.12) is a selection indicator which equals unity if the expression in the indicator function $\mathbf{1}\left[.\right]$ is true. In this application, x_{1it} is a subset of z_{it}, which implies that the model is not only identified by functional form. To improve identification, I choose a set of variables that is assumed to influence participation and not the wage rate. The selection equation also contains an individual specific error, κ_i, and a strictly exogenous[15] normally distributed time varying error e_{it}. Estimating equation (3.11) by OLS would result in inconsistent estimates if selection is nonrandom or if μ_i is correlated with the explanatory variables or if both applies.

The presence of κ_i in the non-linear selection equation renders estimation of this selection model difficult. Wooldridge (1995, 2004) suggests to use a Mundlak version of Chamberlain's random effects probit model in this case (Chamberlain, 1984; Mundlak, 1978). Let $\overline{z}_i$ denote the time average of z_{it}, then κ_i can be replaced by $\overline{z}_i\theta + \omega_i$ where ω_i is a random component independent of everything else:

$$\begin{aligned} l_{it} &= \mathbf{1}\left[\overline{z}_i\theta + z_{it}\gamma + \upsilon_{it} > 0\right], \quad \upsilon_{it} = \omega_i + e_{it} \\ E(\omega_i|z_i) &= 0 \qquad \text{with} \quad z_i = (z_{1i}, z_{2i}, \ldots, z_{Ti}) \end{aligned} \tag{3.13}$$

A valid correction procedure requires two additional linearity assumptions (Wooldridge, 2004). First, I assume that u_{it} is mean independent of $\overline{z}_i$ conditional on υ_{it} and can be expressed as linear projection onto υ_{it}, i.e., $E\left(u_{it}|\overline{z}_i,\upsilon_{it}\right) = E\left(u_{it}|\upsilon_{it}\right) = \rho_t\upsilon_{it}$. Second, I specify the conditional mean of the fixed effect, μ_i, in the wage model as a linear projection onto $(\overline{x}_{1i}, \overline{x}_{2i}, \upsilon_{it})$ and an error c_i. Wooldridge's estimator does not impose distributional assumptions about the error terms and the individual effect in the main equation. It allows for dependence between the error of the selection equation, υ_{it}, and the errors of the main equation, u_{it} and μ_i. Therefore, selection effects may depend on both error components of the wage equation. I estimate the following final specification:

$$w_{it} = \overline{x}_{1i}\xi_{x1} + x_{1it}\beta_{x1} + \overline{x}_{2i}\xi_{x2} + x_{2it}\beta_{x2} + \zeta_t\lambda_{it} + \nu_{it} \tag{3.14}$$

15 Strictly exogenous means that l_{it} is neither correlated with κ_i nor with z_{it} $\forall t$.

The inverse Mills ratios (IMR), λ_t, are obtained from t cross sectional probit estimations of equation (3.13). Equation (3.14) can then be estimated by pooled OLS. A variance that is robust to serial correlation and heteroskedasticity is estimated by a "panel bootstrap" (Semykina and Wooldridge, 2010).

Working hours

The next step to simulate gross labour income is to generate a distribution of working hours. I simplify the simulation model by assigning the distribution of working hours in period t to the simulated scenarios. To this end, I divide the distribution of working hours into quintiles and generate the corresponding discrete categories. I estimate a multinomial logit that depends on the same set of job characteristics and household variables as hourly wages. Again, the model is estimated separately for East and West Germany. The results are used to predict probabilities for each hours category. Expected hours are calculated by multiplying these probabilities with mean hours of each category and adding them up (results not reported).

Simulation of net household income and income variance

Net household income is simulated using the Tax-Benefit Microsimulation Model (STSM). This detailed tax-benefit model comprises the main features of the German tax and transfer system.[16] Net household income is calculated by deducting income tax and social security contributions and by adding individual or household transfers (e.g. child benefits, unemployment benefits and housing benefits).

I use the simulated information (probabilities) on labour market status (employed or unemployed), health status (good and bad health), and the respective labour earnings (zero or positive) and keep other household income constant. It is further assumed that the estimated coefficients remain stable and that household composition does not change over the next periods. The year effects are orthogonalised to the mean value and are set to zero for the prediction. Other household income is assumed to grow at a rate of two percent.[17] As described above, I simulate the incomes for different combinations of health

16 A detailed description of the STSM can be found in Steiner et al. (2008).

17 This is a gross value and not affected by the simulation if I assume constant behaviour of the other household members.

and employment status. For the current application, the model simulates net household income three periods ahead.

For each possible future income path j a net income y^j is simulated. To simplify notation, I drop the panel and time indices (i,t). Instead, let $p^{s,r}_{t+1}$ denote the probability of state s in $t+1$, given state r in period t. In addition I assume a discount factor π of two percent per year. Any net income y^j is then calculated as:

$$y^j = \underbrace{p^{s,r}_{t+1} \times p^{f,s}_{t+2} \times p^{k,f}_{t+3}}_{p^j} \times \underbrace{\left(\pi y^{s,r}_{t+1} + \pi^2 y^{f,s}_{t+2} + \pi^3 y^{k,f}_{t+3}\right)}_{y^j} \tag{3.15}$$

$r,s,f,k = 1,2,3,4; \quad j = 1,\ldots,64$

The expected income is then given by:

$$\mathbf{E}[y] = Y = \sum_{j=1}^{64} p^j \times y^j \tag{3.16}$$

Since the state r in period t is known, 64 $(s \times f \times k)$ possible combinations remain for the calculation of the variance:

$$\mathbf{Var}[y] = \sigma^2 = \sum_{j=1}^{64} p^j \times \left(y^j\right)^2 - Y^2 \tag{3.17}$$

The simulated measure for σ^2 is then used in the estimation of equations (3.2) and (3.3) and to quantify the share of precautionary savings in total wealth and monthly savings, respectively.

3.4 Data and variables

The first part of this section briefly describes the estimation sample and variables used in the simulation of σ^2_{it}. The second part discusses the samples and variables of the main estimation equations in more detail. In addition, using different subjective ex-ante risk assessments, this section includes an informal test of the simulated income uncertainty measure.

My analysis is based on data from the SOEP.[18] To estimate health and employment probabilities and wages, I use unbalanced panel data covering the period from 1997 until 2009. The sample is restricted to men between 29 and 59 years of age who are not self-employed, not retired, and not in education. To account for the large regional differences in labour market situations, I estimate the models separately for East and West Germany. Table 3.14 in Appendix 3.C provides pooled descriptive statistics for the regression samples of the bivariate probit. The samples consist of 32,719 and 10,485 observations for West and East Germany, respectively. The selection equation for the wage model is based on the same samples. For the estimation of wages a subset of working individuals is used: 30,110 and 8,952 observations remain in the sample for West and East Germany, respectively. (see Table 3.15).[19]

The analysis of savings is conducted at the household level. Since the development of the uncertainty measure was restricted to prime age males, I assume the respective individuals to be the household heads. Self-employed respondents are excluded from the analysis since the risks model has only been developed for a sample of dependent employees.

The models on saving flows and buffer stock wealth are estimated for different samples. While data on monthly savings is collected annually in the SOEP, data on household's financial and non-financial assets was collected only in 2002 and 2007, and the STSM is available for the years 2001 through 2010. Given that the uncertainty measure is built from three future periods, the years 2001 to 2007 remain available for estimation.

Table 3.1 shows the descriptive statistics for the buffer-stock model. I use the same variables as for the saving flows model in the buffer-stock wealth model. In addition, I control for risk attitudes. This information is available for the years 2004 and 2006. The value of 2004 is used for the data in 2002 and 2006 for 2007. This is particularly important, since self-selection might be important for the estimated savings reaction to income risk (see Section 3.2).[20] Individuals were asked to specify their attitude towards general risk

18 See Wagner et al. (2007) for more information on SOEP.

19 For the simulation I have to predict wages for individuals whose job characteristics are not observed. I apply the same procedure as described in Geyer and Steiner (2010) and normalise ("orthogonalise") the respective dummies so that setting them equal to zero yields their average effect. The same is done for time dummies.

20 For the saving flows model I have enough data to estimate a fixed effects model. For the buffer stock model, the samples are smaller and estimation in first differences resulted in very large standard errors.

on an eleven-point scale. A higher willingness to take risks corresponds to a higher value of the variable. The items were aggregated to five dummy variables for the estimation. The buffer-stock model is estimated using all observations since the inverse hyperbolic sine transformation (IHS) is applied (see Appendix 3.A) – a log-like transformation that allows to include observations with zero or negative wealth.

Table 3.1: Buffer-stock model: Descriptive statistics by region

	West Germany	East Germany
$log(\sigma^2)$	13.311	12.571
Log permanent income	10.576	10.314
Permanent income	43,399.535	34,053.668
Risk propensity:		
Very low	0.087	0.072
Low	0.200	0.186
Medium	0.192	0.199
High	0.256	0.271
Very high	0.113	0.089
Age	46.287	46.425
Type of household:		
Single, no children	0.144	0.177
Single, children	0.014	0.034
Couple, no children	0.271	0.271
Couple, children	0.515	0.492
Other	0.057	0.026
Unemployment experience	0.567	1.101
Years of education:		
7-10.5	0.357	0.144
11-12	0.295	0.504
12.5+	0.348	0.351
Regional unemployment rate	8.706	18.292
Obs.	4,754	1,253

Notes: Pooled data for years 2002 and 2007. All euro amounts are deflated by the consumer price index (2007).
Source: SOEP, own calculations

SOEP includes a set of detailed questions on private wealth holdings in the years 2002 and 2007. Frick et al. (2007) provide an overview of the wealth data for 2002 and describe how missing information was imputed using regression based imputation methods in the case of item nonresponse or partial unit non-response. Data are available as five multiple imputed datasets. The subsequent analysis uses the imputed data and applies "Rubin's rule" (Rubin, 1987, see Appendix 3.B) to all estimated statistics and predictions.

The wealth module consists of questions on seven components of wealth. These include information on owner-occupied housing (including mortgage debt), other property (including mortgage debt), financial assets, business assets, tangible assets, private pensions (including life insurance) and consumer credits.[21] The wealth information was collected at the level of the individual. For the subsequent analysis, the wealth components were aggregated to the household level. As explained above, I create two aggregated measures of net wealth that are commonly used in the literature. The first measure, NW, consists of all wealth components that are available in the SOEP data except for business assets. The second measure is a subset of NW and refers to liquid assets (FW). Here, I aggregate the information on financial assets, tangible assets, private pensions and consumer credits.

Table 3.2 shows statistics on FW and NW. The amount of assets is considerably lower in East Germany, which holds for both FW and NW. Mean FW is about 37,000 euro in the West and 16,000 euro in East Germany. The definition of NW adds real estate property (owner-occupied housing and other property) to the FW measure. Average NW is more than three times higher than FW. The distribution of wealth is highly skewed. For example, the mean is about twice as high as the median for both wealth aggregates and samples. Note that a considerable share of households in the sample does not report to hold positive net FW (>20 percent) or positive NW (>15 percent). About half of these households are in debt.[22]

For the precautionary savings motive it is interesting to compare wealth holdings with data on income. The median ratio of net liquid assets to permanent income is 0.41 in West and 0.25 in East Germany. Accordingly, the median West (East) German household possesses roughly 41 (25) percent of its permanent annual income in net liquid assets. This relation increases markedly when housing equity is included. The low median ratio of liquid assets to permanent income corresponds to the relatively high share of 26 and 33 percent of households which hold liquid assets of less than one month's income in West and East Germany, respectively. This number is strongly reduced when housing equity is

21 The data lack information on pension entitlements for workers (statutory pension insurance and company pension plans) and civil servants.

22 Only a negligible fraction of these households holds business assets.

Table 3.2: Buffer-stock model: Descriptive statistics on financial wealth and net worth by region

	West Germany		East Germany	
	FW	NW	FW	NW
Mean wealth	36,923	113,794	16,373	50,741
	(1,799)	(3,437)	(1,234)	(2,646)
Median wealth	15,969	63,350	8,000	25,456
	(636)	(2,408)	(730)	(2,620)
Wealth p90	90,272	274,400	47,722	133,100
	(3,035)	(6,888)	(2,843)	(6,525)
Wealth >0	0.782	0.847	0.758	0.827
	(0.007)	(0.006)	(0.013)	(0.012)
Wealth = 0	0.122	0.078	0.123	0.087
	(0.005)	(0.004)	(0.010)	(0.008)
Wealth <0	0.096	0.075	0.119	0.086
	(0.005)	(0.004)	(0.010)	(0.009)
Median ratio: wealth/permanent income	0.408	1.496	0.247	0.765
	(0.011)	(0.043)	(0.016)	(0.054)
Wealth <one month's income	0.268	0.184	0.325	0.226
	(0.007)	(0.006)	(0.014)	(0.012)
Obs.	4,882	4,882	1,267	1,267

Notes: Standard errors in parentheses. All euro amounts are deflated by the consumer price index (2007). Means and percentiles are estimated using "Rubin's rule".
Source: SOEP, own calculation

included but still characterises about one fifth of the samples.

The pooled sample statistics for the estimation of saving flows are presented in Table 3.3. All euro amounts are deflated by the consumer price index (base 2007). In addition to permanent income and income variance, the model includes age, type of household, unemployment experience, education and regional unemployment. I include unemployment experience to have an additional control variable for past earnings history.

The first model is estimated using log savings as dependent variable and only includes observations with positive savings. As a robustness check I run panel tobit models on the samples, including zero savings observations. About 66 percent of the samples in both East and West Germany report positive monthly savings. In West Germany the average amount of savings is about 360 euro for all observations and 540 euro conditional on positive savings. Savings are about 40 euro lower in East Germany. In the samples of respondents with positive savings, we can find a higher share of higher educated individuals as well as a higher average permanent income and income variance. Moreover, the average unemployment experience is lower in these samples.

Table 3.3: Descriptive statistics for flow savings model

	West Germany		East Germany	
	sav. >0	all	sav. >0	all
Positive savings	1.000	0.665	1.000	0.656
Average savings (monthly)	538.387	358.249	496.845	325.752
$log(\sigma^2)$	13.443	13.255	12.834	12.535
Log permanent income	10.584	10.516	10.368	10.261
Permanent income	43,340.633	40,754.090	35,244.039	32,128.337
Age	46.218	46.133	46.478	46.461
Type of household:				
Single, no children	0.139	0.141	0.148	0.173
Single, children	0.014	0.016	0.024	0.030
Couple, no children	0.289	0.269	0.301	0.268
Couple, children	0.505	0.517	0.504	0.501
Other	0.053	0.058	0.024	0.029
Unemployment experience (yrs.)	0.364	0.568	0.623	0.984
Years of education:				
7-10.5	0.332	0.382	0.114	0.150
11-12	0.299	0.297	0.485	0.517
12.5+	0.369	0.320	0.402	0.334
Regional unemployment rate	9.286	9.321	18.952	18.979
Obs.	12,557	18,871	3,231	4,928

Notes: Pooled statistics for years 2001 to 2007. All euro amounts are deflated by the consumer price index (2007).
Source: SOEP, own calculations

The permanent income measure is based on annual net household income which includes, in addition to regular monthly income, components that are paid only once a year or irregularly, like bonuses or vacation pay. Since our sample consists of prime age males, the average permanent income is relatively high and amounts to 43,340 euro in West Germany and to 35,244 euro in East Germany (sample with positive savings).

The next two sections present estimation results. At first, the empirical estimates for the construction of σ_{it}^2 are presented and, in Section 3.6, applied in the precautionary savings models.

3.5 Simulated ex-ante income uncertainty

Health and employment

Table 3.4 shows the estimated coefficients of equation (3.10). There is a strong dependence between both processes. On the one hand, I can find significant effects of the lagged variables of the respective other process, and, on the other hand, I can also find a significant correlation between the random effects. Lagged poor health increases the risk of becoming unemployed and lagged unemployment has a negative effect for health. In addition, results provide strong support for state dependence in health and employment status.

The other covariates have the expected signs. With the exception of the age profile, the effects of all other covariates that appear in both equations have the same sign. For example, higher education reduces the risk of both unemployment and poor health.[23]

In order to assess the magnitude of the effects and to compare them between both regional subsamples, Table 3.5 presents simulated probabilities for an individual with average characteristics. The results are simulated for different values of the lagged health and employment status. The table shows the respective transition probabilities. For example, the probability for an average individual to be employed and in good health in period $t-1$ and unemployed and in bad health in period t is 0.5 percent in West Germany and one percent in East Germany, respectively.

The main diagonal can be interpreted as the degree of state dependence. The largest state dependence is found for being in good health and employment ($s_{it} = 1$). It amounts to 90 percent in West Germany and to a lower 86 percent in East Germany. For this

23 In general, I find similar qualitative results as Haan and Myck (2009). In contrast to Haan and Myck (2009), I only find a low effect of the regional unemployment rate. This can be explained by two factors: first, I include time dummies. The regional unemployment rate in the model of Haan and Myck (2009) is in fact an interaction with a time dummy. Second, Haan and Myck (2009) do not distinguish between East and West Germany. Thus, the regional unemployment rate also contains information about the differences in the level of unemployment between East and West Germany.

Table 3.4: Regression results for the bivariate random effects probit by region

	West Germany				East Germany			
	Bad health		Unemployment		Bad health		Unemployment	
Lagged health status	1.281**	(0.026)	0.403**	(0.038)	1.383**	(0.046)	0.346**	(0.057)
Lagged employment status	0.218**	(0.031)	1.680**	(0.037)	0.282**	(0.046)	1.371**	(0.045)
Age	−0.182	(0.113)	0.660**	(0.142)	−0.113	(0.213)	0.614**	(0.201)
$Age^2/100$	0.491†	(0.254)	−1.690**	(0.320)	0.343	(0.475)	−1.500**	(0.455)
$Age^3/100$	−0.004*	(0.002)	0.014**	(0.002)	−0.003	(0.003)	0.012**	(0.003)
Years of education (ref. 11-12):								
7-10.5	0.076**	(0.024)	0.211**	(0.033)	0.046	(0.048)	0.189**	(0.047)
12.5+	−0.145**	(0.029)	−0.131**	(0.041)	−0.149**	(0.047)	−0.324**	(0.049)
Initial health status	0.636**	(0.030)	0.173**	(0.044)	0.551**	(0.053)	0.126†	(0.065)
Initial employment experience	−0.007*	(0.003)	−0.010**	(0.004)	−0.002	(0.006)	−0.004	(0.006)
Initial employment status	0.028**	(0.007)	0.068**	(0.008)	0.033*	(0.016)	0.183**	(0.016)
Person in HH needs care	0.160**	(0.061)	0.342**	(0.076)	0.096	(0.094)	0.210†	(0.110)
Foreign nationality			0.198**	(0.037)			0.067	(0.274)
Type of household (ref. Single):								
Single, children			−0.337**	(0.081)			−0.116	(0.111)
Couple, no children			−0.561**	(0.050)			−0.444**	(0.069)
Couple, children			−0.542**	(0.046)			−0.546**	(0.063)
Other			−0.329**	(0.068)			−0.388**	(0.116)
Regional unemployment rate			0.029**	(0.004)			0.016†	(0.008)
Other HH income			−1.480**	(0.051)			−1.260**	(0.069)
Constant	0.329	(1.650)	−9.238**	(2.056)	−0.900	(3.113)	−8.856**	(2.917)
Year dummies	Yes		Yes		Yes		Yes	
σ	1.437	(0.121)	1.312	(0.209)	1.253	(0.113)	1.192	(0.092)
ρ_c	0.528	(0.041)			0.612	(0.042)		
ρ_ε	0.183	(0.030)			0.172	(0.024)		
Obs.	32,719				10,485			

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01
Source: SOEP, own calculations

category, the probability to become unemployed in period t is nearly ten percent in East Germany and only 3.5 percent in West Germany. Lagged poor health increases the probability to become unemployed for West Germany to more than seven percent and to about 15 percent in East Germany. The state dependence in unemployment for healthy individuals is higher in East Germany (roughly 50 percent compared to 40 percent in West Germany). The least regional differences are found for the status being in poor health and unemployment. These results clearly show the importance of health for the risk of unemployment.

Table 3.5: Transition probabilities of employment and health status by region

	West Germany				East Germany			
	$s_{i,t}=1$	$s_{i,t}=2$	$s_{i,t}=3$	$s_{i,t-1}=4$	$s_{i,t}=1$	$s_{i,t}=2$	$s_{i,t}=3$	$s_{i,t-1}=4$
$s_{i,t-1}=1$	90.1	6.4	3.0	0.5	85.7	4.9	8.4	1.0
$s_{i,t-1}=2$	56.1	36.4	3.2	4.2	51.1	32.7	7.6	8.6
$s_{i,t-1}=3$	55.5	4.7	34.3	5.6	46.3	3.6	43.9	6.3
$s_{i,t-1}=4$	26.4	19.0	24.4	30.1	20.7	16.4	27.3	35.7

Notes: The probabilities are simulated for an average individual in the regression sample. Rows sum up to 100 percent, deviations are due to rounding erros. See page 71 for the definition of s_{it}.
Source: SOEP, own calculations

Hourly wages

Table 3.6 shows the estimated coefficients of the wage regression using three different estimation methods (OLS, FE, FEsel) for West and East Germany. “FEsel” denotes Wooldridge’s 1995 estimator.

I check the validity of the simple FE model against OLS using a Hausman test. The test rejects the null hypothesis of no correlation with individual fixed effects at any conventional significance level for both samples. The next step is to test whether nonrandom selection is present. In fact, the IMRs are jointly significant for both samples.[24] Thus, the preferred specification is FEsel.[25]

For the simulation, I focus on the effects of lagged health and employment status. Lagged poor health reduces wages by five percent in the OLS model for West Germany. Controlling for fixed effects, the point estimate remains negative but becomes smaller and insignificant. The effect is small and insignificant across all specifications for East Germany. Thus, there is only a negligible negative direct[26] health effect on hourly wages.[27]

24 A preliminary test with a simple selection indicator (Wooldridge, 2004) rejected the null hypothesis that no selection bias is present (not reported).
25 I report standard OLS and FE results for comparison.
26 There is an additional indirect effect through λ_{it}. The total effect is simulated in Table 3.7 for lagged health and employment status for an average individual.
27 This result differs from the findings in Jäckle and Himmler (2010). Using the SOEP, Jäckle and Himmler (2010) estimate a similar wage model with health satisfaction instead of general health status. They find a negative effect of deteriorated health for men but do not focus on the effects of previous unemployment in their model. They estimate a small significant effect of health on wages using the same estimator. However, the models are not strictly comparable since samples, time window and regressors, in particular the used health measure, are different.

Lagged unemployment also has a negative effect on wages but its magnitude is larger and, at least for the West German sample, remains significant in all specifications. The OLS model suggests a reduction of hourly wages by about 29 percent in the West and 17 percent in East Germany. This very large estimate is likely to be upward biased. Using the fixed effects model, it is still significant but reduced to twelve (West) and five (East) percent, respectively. In addition, when selection is accounted for, the effect is further reduced to two percent and gets insignificant in East Germany. In West Germany, it has a significant negative effect of 7.3 percent.

In order to illustrate the economic significance of the findings in Table 3.6 and to account for the indirect health and unemployment effects via λ_{it}, I simulate wages for an individual with average characteristics.[28] Similar to the simulation for health and employment status, I vary the simulation by lagged health and employment status. Table 3.7 shows the simulated wage levels.

For an average man who was employed and in good health in the previous period ($s_{i,t-1} = 1$), the average hourly wage rate is nearly five euro higher compared to someone who was unemployed and in bad health ($s_{i,t-1} = 4$) in the West German sample. This difference turns out to be smaller in East Germany and amounts to less than two euro. The coefficients are smaller when fixed effects are taken into account. For West Germany, the difference decreases to about two euro and to less than one euro in East Germany. The difference is only significant for the West German sample. A selection correction reduces the effect even further, to about 1.3 euro in the West and 0.2 euro in East Germany. Again, the difference is significant for West Germany. The differences in wages between ($s_{i,t-1} = 1$) and ($s_{i,t-1} = 2$) and between ($s_{i,t-1} = 3$) and ($s_{i,t-1} = 4$) are negligible due to the low estimated coefficient of lagged health status.

Simulated ex-ante income uncertainty

Distributions of the ex-ante variances, σ^2_{it}, by health status and region are depicted in Figure 3.1. The vertical lines represent the mean variance. Figure 3.1a shows a higher income variance in West Germany as compared to East Germany, which is presumably related to the higher income level. However, differences between East and West Germany

28 Year effects, industry, occupation and firm size dummies are orthogonalized to their mean effect. I set these categorical dummies to zero in the simulation of future wages of currently unemployed individuals.

Table 3.6: Wage regression

	West Germany			East Germany		
	OLS	FE	FEsel	OLS	FE	FEsel
Lagged health status	-0.050^{**}	-0.009	-0.002	-0.016	-0.006	-0.005
	(0.006)	(0.006)	(0.006)	(0.016)	(0.016)	(0.023)
Lagged employment status	-0.286^{**}	-0.123^{**}	-0.073^{**}	-0.165^{**}	-0.050^{*}	-0.019
	(0.021)	(0.020)	(0.010)	(0.024)	(0.023)	(0.013)
Age	0.049^{**}			0.174^{**}		
	(0.019)			(0.036)		
$\text{Age}^2/100$	-0.065	-0.022	-0.192^{**}	-0.358^{**}	-0.217^{*}	-0.329^{**}
	(0.042)	(0.055)	(0.024)	(0.081)	(0.107)	(0.077)
$\text{Age}^3/100$	0.000	-0.000	0.001^{**}	0.002^{**}	$0.001^{\dagger}$	0.002^{**}
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Years of education (ref. 11-12):						
7-10.5	-0.020^{**}	-0.005	-0.000	-0.014	-0.005	0.004
	(0.005)	(0.013)	(0.020)	(0.012)	(0.032)	(0.048)
12.5+	0.116^{**}	0.022	0.021	0.100^{**}	0.027	0.036
	(0.006)	(0.026)	(0.033)	(0.013)	(0.053)	(0.031)
Regional unemployment rate	-0.008^{**}	-0.003	0.008^{*}	-0.001	-0.001	0.017
	(0.001)	(0.003)	(0.004)	(0.002)	(0.006)	(0.011)
IMR	No	No	Yes	No	No	Yes
χ^2_{11}			96.04^{**}			47.92^{**}
Mundlak terms	No	No	Yes	No	No	Yes
χ^2_{39}			$1{,}559.38^{**}$			575.36^{**}
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Occupation dummies	Yes	Yes	Yes	Yes	Yes	Yes
Firm size dummies	Yes	Yes	Yes	Yes	Yes	Yes
Hausman test (p-value)		0.00			0.00	
No. of groups		5,699			1,669	
Obs.	30,155	30,155	30,155	8,620	8,620	8,620

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: SOEP, own calculations

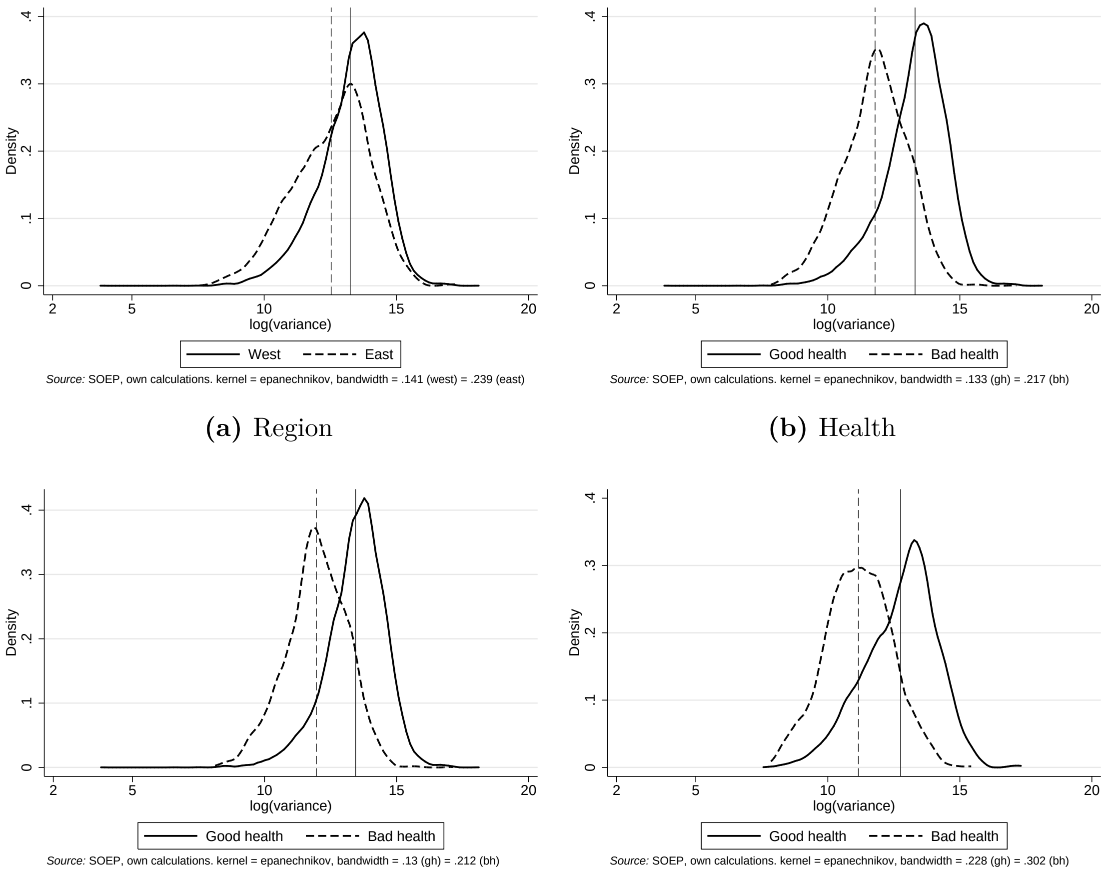
Table 3.7: Wage level predictions by lagged employment and health status and region (different regression models)

	West Germany			East Germany		
$s_{i,t-1}$	OLS	FE	FEselect	OLS	FE	FEselect
$s_{i,t-1} = 1$	17.36	16.62	16.51	11.76	11.21	11.29
	(17.27;17.46)	(16.58;16.66)	(16.39;16.64)	(11.61;11.91)	(11.13;11.27)	(11.22;11.36)
$s_{i,t-1} = 2$	16.51	16.47	16.49	11.58	11.14	11.29
	(16.24;16.96)	(16.17;16.73)	(16.36;16.76)	(11.05;12.23)	(10.58;11.68)	(11.09;11.62)
$s_{i,t-1} = 3$	13.04	14.69	15.25	9.96	10.66	11.06
	(12.11;13.84)	(13.85;15.81)	(14.95;15.65)	(9.20;10.65)	(9.87;11.37)	(10.66;11.37)
$s_{i,t-1} = 4$	12.41	14.56	15.23	9.82	10.59	11.05
	(11.43;13.20)	(13.65;15.63)	(15.13;15.41)	(8.83;10.87)	(9.67;11.59)	(10.90;11.19)

Notes: Wages are evaluated for an individual with average characteristics. Bootstrapped confidence intervals in parentheses. See page 71 for the definition of s_{it}.

Source: SOEP, own calculation

are smaller than between individuals in bad and good health. Figure 3.1b shows that the simulated variance for individuals in good health is higher than for those in bad health. It is similar to the difference between East and West Germany. The sample consists of households in poor health that face a lower income risk because their income level is already lower. Figures 3.1c and 3.1d demonstrate that this difference is similar in East and West Germany.



(a) Region

(b) Health

(c) West Germany

(d) East Germany

Figure 3.1: Kernel densities of net income variance by region and health status

As expected, individuals with higher incomes or lower economic risks (good health vs. bad health or West vs. East Germany) have a higher income variance. This is important to keep in mind when I now turn to the precautionary savings models. Precautionary savings should not be simply identified with low income households. In fact, the motive seems particularly relevant for household which can loose much – in a relative sense – but with a low probability of occurrence.

3.5.1 Ex-ante income uncertainty and subjective risk assessment

A simple empirical test of the simulated uncertainty measure is to relate it to subjective risk assessments in order to test whether both measures are significantly correlated and in what direction. Two variables from SOEP are chosen: (1) worries about job security (three-point scale) and (2) how likely it is for the respondent to lose his/her job within the next two years (in percent).

The first item is available for all years, whereas the second is asked only every other year. The three-point scale is dichotomized to "1 = has worries" and "0 = no worries". The model is estimated using a probit. The second variable has a continuous scale and is estimated using OLS. The subjective indicators are regressed on the same set of variables as in the savings regression (Table 3.11). The only exception is that, in addition to income variance, I regress the indicators on simulated employment and health probabilities (only for period t+1). The probabilities add up to one, and a reference category has to be defined. Here it is the probability to be in good health and employed in the next period.

Table 3.8 shows the regression results. The probabilities and income uncertainty are significant in nearly all models. The estimates reveal an interesting differentiation of the uncertainty measure. Note that the questions about job security and worries are asked conditional on being employed. First of all, negative expectations about job security in the probit and OLS models are negatively correlated with simulated income variance and permanent income. Secondly, the set of probabilities has positive signs. For example, an estimated coefficient of 28.8 in the OLS model (2) for West Germany implies c.p. that an increase of one percentage point in the simulated probability to be unemployed in the next period increases the subjective probability to become unemployed within the next two years by 0.3 percentage points.[29]

This result shows that uncertainty measured by unemployment probabilities and measured by income variance cannot simply be interpreted in the same way, as if measuring

29 Note that this effect has to be interpreted with respect to the reference category. Thus, the increase of one percentage point is c.p. equivalent to a decrease of one percentage point in the reference category.

Table 3.8: Probit regression: Worries about job loss and income uncertainty

	West Germany				East Germany			
	Worries (Probit) (job security)		Job loss (OLS) (pr in %)		Worries (Probit) (job security)		Job loss (OLS) (pr in %)	
	1	2	1	2	1	2	1	2
$log(\sigma^2)$	−0.116**		−3.466**		−0.055†		−1.641†	
	(0.016)		(0.505)		(0.033)		(0.869)	
Permanent income	−0.227**	−0.385**	−1.592	−6.460**	−0.741**	−0.836**	−13.412**	−15.469**
	(0.041)	(0.034)	(1.265)	(1.051)	(0.093)	(0.076)	(2.414)	(2.052)
Unemployment probability (ref. $p_t(s_{t+1}=1)$):								
$p_t(s_{t+1}=2)$		0.025		11.536		−1.147*		17.477
		(0.288)		(16.225)		(0.519)		(41.644)
$p_t(s_{t+1}=3)$		0.583*		28.845*		0.446		1.181
		(0.231)		(11.846)		(0.373)		(15.385)
$p_t(s_{t+1}=4)$		0.629**		14.884**		0.325		15.711
		(0.096)		(3.300)		(0.251)		(10.065)
joint sig.		0.00		0.00		0.15		0.01
Pseude R2	0.07	0.07			0.10	0.10		
R2			0.04	0.04			0.11	0.11
Obs.	16,356	16,356	4,381	4,381	3,874	3,874	1,446	1,446

Notes: $p_t(s_{t+1}=i)$ denotes the simulated probability to be in scenario i in the next period. For the definition of s, see page 71. Other control variables are age, type of household, local unemployment rate, year dummies, past unemployment experience and education. Worries about job security are asked every year. The probability of a job loss within the next two years is asked every other year. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.

Source: SOEP, own calculations

the same concept of uncertainty. In general, higher income is associated with more stable employment biographies and vice versa. Thus, it is not surprising that studies on precautionary savings often find that negative subjective expectations are negatively correlated with savings (e.g., Essig, 2005). However, this is no evidence against the precautionary savings motive but rather shows that individuals who assess their future negatively often have no resources or motivation to save. Thus, for a precautionary savings model, it is important to associate the unemployment/employment probabilities with income. Individuals who face a low risk of becoming unemployed may have a good reason and resources to save as a precaution for this unlikely event.

3.6 Multivariate analysis of precautionary savings

In the first part of this section, the estimates for the buffer-stock model according to equation (3.2) are presented. Results for the flow savings model, equation (3.3), are shown in the second part.

3.6.1 Buffer-stock wealth

Tables 3.9 and 3.10 report estimated marginal effects of the buffer-stock model (FW and NW) for West Germany and East Germany, respectively. The estimated coefficients are reported in Appendix 3.C. As described above, a considerable share of the sample shows no or negative wealth accumulation. In order to keep these observations and their information in the sample, the IHS transformation is applied to the wealth aggregates. Appendix 3.A provides more details on the transformation, for example, how marginal effects can be calculated. Marginal effects are evaluated at the median wealth level. The column that reports percentage-changes is an approximation for larger values of the dependent variable.

For West Germany, the first important finding is the significantly positive effect of income uncertainty for both FW and NW. A doubling of log variance increases FW by 965 euro or roughly five percent. The magnitude of the absolute effect increases to 3,734 euro when NW is the dependent variable but the relative effect of 5.7 percent remains similar. The estimation is robust to the chosen wealth aggregate. This is the second important finding, since, as noted above, many studies report unstable results for different definitions of wealth (e.g., Bartzsch, 2008; Carroll et al., 2003). This is also visible when the share of precautionary wealth is considered. Evaluated at the minimum risk, it amounts to 30 and

25 percent for FW and NW, respectively. The share of precautionary savings, compared to FW, decreases in NW but represents a much higher stock of assets. The median level of NW amounts to about 63,000 euro and is nearly four times larger than the median value of FW in the West German sample. If the share of precautionary savings is evaluated at the first percentile, the estimates drop to 17 and 14 percent for FW and NW, respectively. Since the share does not decrease proportionally in NW, a part of housing equity must serve a precautionary purpose.

Findings are less consistent for East Germany than for the West German sample. The estimated coefficients of income risk are positive but not significant. The coefficient is also larger in the model with NW as dependent variable. Consequently, I can find a higher share of precautionary wealth when housing equity is included in the wealth aggregate. This means that East Germans have relatively more precautionary wealth in real estate assets than in FW. This is a counterintuitive finding, which requires further analysis. A potential reason is the small sample. In particular the results for FW seem to be inconsistent with the findings on precautionary flow savings in the following section and the model for NW. Although not significant, the magnitude of the point estimate is 1,341 euro or 5.2 percent with respect to NW. The estimated share of precautionary savings lies between about 16 (minimum risk) and 12 (first percentile) percent. This result is consistent (if it was significant) with the effects found for West Germany and comparable to the findings below.

The coefficient of permanent income is significantly positive across specifications for East and West Germany. The higher permanent income, the higher is the stock of wealth. Its relative effect is similar in East and West. Approximately, a one percent increase in permanent income increases wealth by one percent.

3.6.2 Savings flows

Table 3.11 shows the results for the savings regressions using the log of the variance σ^2 as uncertainty measure and log of monthly savings as dependent variable. The coefficient of income uncertainty is positive and significantly different from zero in nearly all models. The only exception is the fixed effects model for East Germany, in which the coefficient is positive but not significant. The coefficients differ between OLS, random effects and fixed effects, and the Hausman test rejects the null hypothesis that the explanatory variables are uncorrelated with the unobserved fixed effects at any conventional significance level.

Table 3.9: Wealth regression, West Germany - marginal effects

	Financial wealth (FW)		Net worth NW	
	Marginal effect	%-change	Marginal effect	%-change
$log(\sigma^2)$	965.297*	0.053*	3,734.480*	0.057*
	(475.423)	(0.026)	(1,590.736)	(0.024)
Log permanent income	17,314.563**	0.956**	68,520.283**	1.039**
	(1,425.630)	(0.079)	(4,615.948)	(0.070)
Age	2,808.429	0.155	26,169.784**	0.397**
	(2,784.322)	(0.154)	(9,513.399)	(0.144)
$Age^2/100$	−4,531.201	−0.250	−49,185.020*	−0.746*
	(6,215.466)	(0.343)	(21,282.938)	(0.323)
$Age^3/100$	27.833	0.002	337.908*	0.005*
	(45.238)	(0.002)	(155.223)	(0.002)
Type of household (ref. Single):				
Single, children	−15,346.669**	−0.847**	−38,998.420**	−0.591**
	(3,645.737)	(0.202)	(12,928.130)	(0.196)
Couple, no children	−7,164.548**	−0.396**	−19,485.114**	−0.295**
	(1,262.459)	(0.069)	(4,227.795)	(0.064)
Couple, children	−11,184.692**	−0.618**	−20,329.480**	−0.308**
	(1,205.271)	(0.067)	(4092.110)	(0.062)
Other	−12,144.603**	−0.671**	−11,736.813†	−0.178†
	(1,882.590)	(0.104)	(6,113.453)	(0.093)
Unemployment experience	−1,134.177**	−0.063**	−6511.192**	−0.099**
	(208.270)	(0.012)	(752.720)	(0.011)
Years of education (ref. 11-12):				
7-10.5	−1,664.026*	−0.092*	−8,095.792**	−0.123**
	(844.515)	(0.047)	(3,033.661)	(0.046)
12.5+	4,217.542**	0.233**	5,865.468*	0.089*
	(919.023)	(0.051)	(2,970.550)	(0.045)
Regional unemployment rate	−460.623**	−0.025**	−3,049.386**	−0.046**
	(120.904)	(0.007)	(405.021)	(0.006)
Risk preference (ref. Medium):				
Very low	1,499.648	0.083	3,960.432	0.060
	(1,211.658)	(0.067)	(4,224.625)	(0.064)
Low	2,336.474*	0.129*	6,057.598†	0.092†
	(907.797)	(0.050)	(3,132.140)	(0.047)
High	2,338.223**	0.129**	4,387.716	0.067
	(898.719)	(0.049)	(2,976.959)	(0.045)
Very high	336.067	0.019	−7,008.633†	−0.106†
	(1,254.916)	(0.069)	(4,050.575)	(0.061)
Obs.	4,754	4,754	4,754	4,754
IHS: Γ ^{a}	0.000116		0.000055	
Median	15,969		63,350	
$\sigma_{minimum}$ $^{(b)}$	30.07		25.38	
$\sigma_{1^{st} percentile}$ $^{(b)}$	17.01		14.07	

Notes: Estimated standard errors are corrected for multiple imputed datasets. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. Marginal effects evaluated at the median wealth. (a) Γ is estimated separately for each imputed dataset. Reported is the mean value. See Appendix 3.A for more information. (b) This value shows the share of savings that can be attributed to income uncertainty. The simulation of $\overline{PS}^*$ in equation 3.6 is evaluated at the minimum and the 1^{st} percentile of $log(\sigma^2)$.
Source: SOEP, own calculations

Table 3.10: Wealth regression, East Germany - marginal effects

	Financial wealth (FW)		Net worth (NW)	
	Marginal effect	%-change	Marginal effect	%-change
$log(\sigma^2)$	206.627	0.022	1,341.879	0.051
	(436.470)	(0.046)	(1,405.594)	(0.053)
Permanent income	10,598.212**	1.112**	31,431.552**	1.192**
	(1,216.054)	(0.127)	(3,933.071)	(0.149)
Age	−1,994.818	−0.209	3,297.789	0.125
	(2,792.735)	(0.293)	(8,416.964)	(0.319)
$Age^2/100$	4,597.079	0.482	−3,622.966	−0.138
	(6,250.528)	(0.656)	(18,872.979)	(0.716)
$Age^3/100$	−31.474	−0.003	13.699	0.001
	(45.490)	(0.005)	(137.585)	(0.005)
Type of household (ref. Single):				
Single, children	−7,289.606**	−0.765**	−7,572.007	−0.287
	(1,861.403)	(0.195)	(6,683.797)	(0.254)
Couple, no children	−6982.383**	−0.733**	−13,924.989**	−0.528**
	(1,340.049)	(0.140)	(4,093.954)	(0.155)
Couple, children	−7,936.092**	−0.833**	−12,675.752**	−0.481**
	(1,301.137)	(0.137)	(4,029.026)	(0.153)
Other	−11,883.870**	−1.247**	−15,637.683†	−0.593†
	(2,881.400)	(0.301)	(8,529.524)	(0.323)
Experience UE	−342.326*	−0.036*	−891.670	−0.034
	(157.618)	(0.017)	(554.981)	(0.021)
Years of education (ref. 11-12):				
7-10.5	−30.861	−0.003	−2,234.525	−0.085
	(1,036.094)	(0.109)	(3,224.547)	(0.122)
12.5+	3,743.317**	0.393**	1,932.097	0.073
	(849.669)	(0.089)	(2,697.777)	(0.102)
Regional unemployment rate	−66.258	−0.007	393.253	0.015
	(149.508)	(0.016)	(476.284)	(0.018)
Risk preference (ref. Medium):				
Very low	−522.243	−0.055	−5,159.919	−0.196
	(1,499.155)	(0.157)	(4,308.855)	(0.163)
Low	−656.137	−0.069	−984.256	−0.037
	(936.498)	(0.098)	(3,027.787)	(0.115)
High	−367.998	−0.039	−1,212.161	−0.046
	(818.200)	(0.086)	(2,642.305)	(0.100)
Very high	−1,432.257	−0.150	3,677.980	0.139
	(1,472.147)	(0.155)	(4,331.052)	(0.164)
Obs.	1,253	1,253	1,253	1,253
IHS: Γ ^{a}	0.000193		0.000144	
Median	8,000		25,456	
$\sigma_{minimum}$ $^{(b)}$	11.83		15.67	
$\sigma_{1^{st} percentile}$ $^{(b)}$	9.24		12.24	

Notes: Estimated standard errors are corrected for multiple imputed datasets. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. Marginal effects evaluated at the median wealth. (a) Γ is estimated separately for each imputed dataset. Reported is the mean value. See Appendix 3.A for more information. (b) This value shows the share of savings that can be attributed to income uncertainty. The simulation of $\overline{PS}^*$ in equation 3.6 is evaluated at the minimum and the 1^{st} percentile of $log(\sigma^2)$.
Source: SOEP, own calculations

Therefore, the fixed effects model is the preferred specification.

Due to larger standard errors, the confidence interval of the fixed effects estimates include the point-estimates of the coefficient for σ^2 of both other estimators. The fixed effects estimates amount to 0.054 and 0.042 for West and East Germany, respectively. Since both the dependent and independent variable are in logs, the effect can be interpreted as an elasticity: Doubling σ^2 leads to an increase of savings by 5.4 percent in the West and by 4.2 percent in East Germany. This result is very similar to the findings in Table 3.9 for West Germany where the same change in σ^2 leads to an increase of wealth (NW and FW) of about five percent.

Given a mean amount of monthly savings of 538 and 496 euro in West and East Germany the percentage increase is equivalent to about 29 and 21 euro, respectively. At the bottom of Table 3.11 it is shown that an increase of $log(\sigma^2)$ by one standard deviation increases monthly savings by roughly six percent in both West and East Germany.

Similar to the buffer-stock model, the estimation of average precautionary saving is relatively sensitive to the chosen reference value of σ_{low}. In the fixed effects model, the share ranges between 27.6 and 16 percent or between 149 and 85 euro for West Germany. For East Germany it lies between 19.6 and 13.9 percent or between 97 and 69 euro. Again, this estimate is similar to the previous results for buffer-stock wealth.

With respect to the other covariates, I find that permanent income has a significant and positive effect on saving in the OLS and random effects model. Its magnitude is comparable to the findings for the buffer-stock model. However, due to its construction, I cannot estimate a coefficient for permanent income in the fixed effects model since it is collinear. Interestingly, the dummies controlling for the type of household switch sign when we control for fixed effects. Note that the reference category is a single household without children. At first sight, this is surprising because the negative sign in the other two models could be explained by controlling for permanent income. This can also be seen in Tables 3.9 and 3.10 for the buffer-stock model. Since permanent household income is not weighted, it captures part of the effect of household size. It is different, however, in the fixed effects model: these household characteristics capture part of the effect of household income in this model specification. When I include the current net household income in this regression (estimation not shown), the significant coefficients disappear with the exception of a higher saving rate of couple households without children. Economies of

Table 3.11: Savings flows regression by region (log savings, different models)

	West Germany			East Germany		
	OLS	RE	FE	OLS	RE	FE
$log(\sigma^2)$	0.033**	0.048**	0.054**	0.069**	0.050*	0.042
	(0.010)	(0.011)	(0.015)	(0.017)	(0.022)	(0.029)
Permanent income	1.194**	0.979**		1.125**	0.847**	
	(0.029)	(0.042)		(0.056)	(0.085)	
Age	0.036	-0.036		-0.384**	−0.217	
	(0.060)	(0.077)		(0.113)	(0.153)	
$Age^2/100$	−0.106	0.052	0.160	0.807**	0.438	0.462
	(0.133)	(0.170)	(0.230)	(0.250)	(0.339)	(0.485)
$Age^3/100$	0.001	-0.000	−0.001	-0.005**	−0.003	-0.003
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)
Type of household (ref. Single):						
Single, children	−0.179**	-0.048	0.108	-0.175*	0.049	0.237
	(0.058)	(0.082)	(0.095)	(0.084)	(0.134)	(0.212)
Couple, no children	−0.094**	0.132**	0.378**	-0.203**	0.087	0.449**
	(0.024)	(0.040)	(0.056)	(0.052)	(0.080)	(0.105)
Couple, children	−0.465**	-0.142**	0.233**	-0.511**	−0.085	0.384**
	(0.023)	(0.039)	(0.057)	(0.054)	(0.082)	(0.113)
Other	−0.435**	-0.127**	0.271**	-0.574**	−0.026	0.496**
	(0.037)	(0.046)	(0.062)	(0.096)	(0.108)	(0.135)
Unemployment experience	−0.019**	-0.021*	−0.080*	-0.011	−0.047**	-0.112**
	(0.007)	(0.009)	(0.032)	(0.012)	(0.016)	(0.040)
Years of education (ref. 11-12):						
7-10.5	−0.003	-0.041	0.014	-0.069	−0.079	
	(0.017)	(0.029)	(0.168)	(0.046)	(0.075)	
12.5+	0.151**	0.194**	0.183	0.068*	0.180**	
	(0.017)	(0.029)	(0.123)	(0.032)	(0.052)	
Regional unemployment rate	−0.011**	-0.010*	0.009	-0.005	−0.010	-0.020
	(0.002)	(0.004)	(0.016)	(0.006)	(0.009)	(0.024)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of groups		3,215	3,215		850	850
Obs.	12,557	12,557	12,557	3,231	3,231	3,231
R^2	0.38		0.22	0.38		0.29
Hausman test (p-value)			0.00			0.00
Mean savings	538			496		
Change of one sd. $^{(a)}$	3.88	5.59	6.39	9.84	7.05	5.86
$\sigma_{minimum}$ $^{(b)}$	18.09	24.76	27.66	30.05	22.90	19.59
$\sigma_{1^{st} percentile}$ $^{(b)}$	10.19	14.18	15.97	21.70	16.33	13.89

Notes: Standard errors in parentheses; Significance levels: † p <0.10, * p <0.05, ** p <0.01. (a) This value shows the percentage change of monthly savings if the uncertainty measure increases by one standard deviation. (b) This value shows the share of savings that can be attributed to income uncertainty. The simulation of $\overline{PS}^*$ in equation 3.6 is evaluated at the minimum and the 1^{st} percentile of $log(\sigma^2)$.

Source: SOEP, own calculation

household size would offer a reasonable explanation of this finding.[30]

How robust are these findings to the exclusion of observations with zero monthly savings? To answer this question, a random effects tobit model is estimated using all observations. Savings amounts enter the model in levels.[31] Table 3.12 shows the estimated marginal effects. Following McDonald and Moffitt (1980), the marginal effects are decomposed: The first column for each set of estimates presents the unconditional marginal effect, the second column the conditional marginal effect, and the third column the probability of being uncensored.

The coefficient of income uncertainty is significant in both samples. A straightforward way to compare the results between models is to look at the estimated conditional share of precautionary saving. The tobit model results in very similar amounts of precautionary saving as the fixed effects regression of log savings flows. Evaluated at the first percentile, its share is about 14 percent in the tobit model compared to 16 (West Germany) and 14 (East Germany) percent in the fixed effects model.

A doubling of income uncertainty would increase the conditional mean value by about 28 euro or 5.2 percent in West Germany. And for East Germany, it would increase by 23 euro or 4.6 percent. Both estimates are close to the coefficients of the fixed effects model. The effect can also be calculated in terms of the savings rate. For example, using permanent income and the average conditional amount of monthly savings the savings rate is 14.9 percent in West Germany. An increase of 28 euro increases the conditional savings rate by about 0.8 percentage points.

This model also shows that the uncertainty measure has a positive and significant impact on the probability to save. In both regions the effect of doubling income uncertainty amounts to roughly three percentage points. Given the share of 66 percent observations with positive monthly savings, this is equivalent to an increase of about 4.5 percent.

30 The finding that singles save more than other households when permanent income is controlled for is also found in other studies, e.g., in the papers by Fuchs-Schündeln and Schündeln (2005), Bartzsch (2008), and Fossen and Rostam-Afschar (2009).

31 A common practice is to add a constant, often unity, to flow savings and to apply the log-transformation. However, the choice of the added constant is arbitrary and results may be sensitive to the value of the chosen constant.

Table 3.12: Savings flows regression including all observations, marginal effects of random effects tobit models by region (estimation in levels)

	West Germany			East Germany		
	Uncond.	Cond.	Prob.	Uncond.	Cond.	Prob.
$log(\sigma^2)$	37.152**	27.624**	0.032**	30.703**	23.158**	0.029**
	(4.488)	(3.343)	(0.004)	(6.761)	(5.109)	(0.006)
Log permanent income	367.173**	273.007**	0.313**	279.253**	210.630**	0.268**
	(16.748)	(12.730)	(0.014)	(27.220)	(20.944)	(0.025)
Type of household (ref. Single):						
Single, children	−37.222	−27.676	−0.032	−73.531†	−55.462†	−0.071†
	(27.581)	(20.510)	(0.024)	(40.685)	(30.706)	(0.039)
Couple, no children	48.810**	36.292**	0.042**	74.416**	56.129**	0.071**
	(13.318)	(9.901)	(0.011)	(23.616)	(17.799)	(0.022)
Couple, children	−52.578**	−39.094**	−0.045**	−16.512	−12.455	−0.016
	(13.431)	(9.996)	(0.012)	(24.265)	(18.310)	(0.023)
Other	−67.769**	−50.389**	−0.058**	−28.114	−21.206	−0.027
	(17.921)	(13.336)	(0.015)	(37.452)	(28.259)	(0.036)
Unemployment experience	−12.882**	−9.578**	−0.011**	−11.667*	−8.800*	−0.011*
	(3.394)	(2.523)	(0.003)	(5.136)	(3.873)	(0.005)
Years of education (ref. 11-12):						
7-10.5	−2.264	−1.683	−0.002	−64.717*	−48.813*	−0.062*
	(13.848)	(10.297)	(0.012)	(27.597)	(20.823)	(0.026)
12.5+	92.616**	68.864**	0.079**	93.378**	70.432**	0.090**
	(14.238)	(10.628)	(0.012)	(21.245)	(16.129)	(0.020)
No. of groups	3,852	3,852	3,852	1,046	1,046	1,046
Obs.	18,870	18,870	18,870	4,928	4,928	4,928
Positive savings			0.67			0.66
Conditional mean		538			497	
Unconditional mean	358			326		
$\sigma_{minimum}$ $^{(a)}$	69.28	31.93		41.05	18.03	
σ_{p1} $^{(a)}$	30.59	13.59		31.28	14.08	

Notes: (a) This value shows the share of savings that can be attributed to income uncertainty. The simulation of $\overline{PS}^*$ in equation 3.6 is evaluated at the minimum and the 1^{st} percentile of $log(\sigma^2)$. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01
Source: SOEP, own calculations

3.7 Conclusion

The theory of precautionary savings predicts that individuals accumulate precautionary wealth to insure themselves against expected (uninsured) future income shocks. Empirical evidence on precautionary savings might be important for government policies that have an impact on income uncertainty. The concept has a strong theoretical foundation and according to household surveys, the precautionary motive is one of the most important motives to save. However, the empirical results show an exceptionally rich diversity ranging from zero precautionary savings to more than half of all wealth. The few studies for Germany are no exception, and results vary considerably.

A potential reason for this diversity are the methodological problems associated with the precautionary savings model. I suggest that the prevalence of ex-post measures of economic risks is likely to neglect important aspects of the precautionary motive. As an alternative I propose an ex-ante risk measure. The innovation of this study is the way net household income variance is simulated and used in a model of precautionary savings. Starting from the fact that unemployment is one of the most important economic risks and has a strong linkage with health, the simulation model is built around a joint estimation of health and unemployment risks. In addition to employment risks, wages in the model depend on previous unemployment and health. The inherent path dependence is exploited by simulating three future periods. To generate net household incomes, a detailed tax benefit microsimulation model is applied. This will allow to simulate changes in the tax-benefit system and their likely impact on precautionary savings in future analyses.

All models are estimated separately for East and West Germany. The results underline that the regional differentiation of labour markets indeed matters. The estimates show that unemployment risks are not only higher in East Germany but also react more strongly to deteriorated health. On the other hand, I do not find any significantly negative effect of previous unemployment on wages in East Germany whereas a large effect of 7.3 percent can be found in West Germany. I do not find any significant direct effect of health on wages.

I find evidence for precautionary savings in response to the simulated uncertainty measure. This result holds for various specifications of the buffer-stock wealth model and a savings flows regression.

First, a standard buffer-stock wealth model is specified. The buffer-stock wealth model is estimated for two different wealth aggregates, FW and NW. In contrast to Bartzsch (2008) who uses SOEP data from 2002 the results are robust to the chosen wealth aggregate – at least for West Germany. Income uncertainty has a significantly positive effect. An increase by 100 percent leads to a five percent increase in precautionary wealth. Simulations suggest that about 17 percent of financial assets and 14 percent of NW has been accumulated due to the precautionary motive. The lower value for NW suggests that a part of housing equity serves as precautionary savings but not to the same degree as FW. The results for East Germany are less consistent. The model for NW shows comparable but insignificant effects of income uncertainty as compared to the results for West Germany.

The estimated shares of precautionary savings for West Germany are similar to the findings in Fuchs-Schündeln and Schündeln (2005), who calculate a share of 12.9 percent of NW for West Germany. In contrast to the findings in this chapter, they estimate no precautionary savings if zero-wealth observations are included. Furthermore, they find higher shares of precautionary savings, 22.1 percent, for East Germany. For the total sample – including zero wealth observations – they find even a share of 68 percent of overall wealth holdings. The volatility is not reproduced in my results. Among other differences, they add unity to zero-wealth observations and take the logarithm to include these observations in the estimation. It would be interesiting to reestimate their model applying the IHS transformation to the wealth aggregate. Bartzsch (2008) estimates a share of about 20 percent of FW but does not distinguish between East and West Germany.

The results in this chapter are further validated by using a different model for flow savings. To this end, an ad-hoc savings regression is specified. The data on savings flows allow to apply panel estimators and are used to compare the magnitude of the effects of the first model. In particular, fixed effects models can be estimated. Income uncertainty has a significant positive effect on savings flows in both East and West Germany. The effect is marginally insignificant in East Germany. The relative effect is similar between regions although absolute savings are higher in West Germany. If income uncertainty doubles, monthly savings increase by about five percent. Although not strictly comparable, this result is similar to the findings in Beznoska and Ochmann (2010). They estimate that a doubling of transitory income uncertainty increases savings by about 4.4 percent.

A counterfactual simulation shows that about 16 percent of savings flows can be attributed to the precautionary motive in West Germany. The share is slightly lower in the East and amounts to 14 percent. These results were estimated using log-savings as dependent variable. However, the estimation is robust to the inclusion of zero-savings observations. The results of a random effects tobit show also significant effects for East

Germany.

In general, and in contrast to a number of empirical studies on precautionary savings, my results are robust and stable across various specifications. Thus, they can be considered strong evidence for a share of precautionary wealth of about 14 to 17 percent. These estimates are conservative in the sense that they are not evaluated at the minimum risk but at the first percentile in order to avoid extreme outliers. In sum, I can show that a neither non-negligible nor extremely large part of savings flows and stocks results from the precautionary motive, and that the proposed measure of income uncertainty is a promising approach to the modelling of income risks.

Appendix

3.A Wealth transformation

The IHS function $\sinh^{-1}$ offers a solution to the problem of zero or negative values of the dependent variable. Burbidge et al. (1988) suggest a general version of the inverse hyperbolic sine, defined as:

$$f^{IHS}(w,\Gamma) = \frac{\ln\left[\Gamma w + (\Gamma^2 w^2 + 1)^{\frac{1}{2}}\right]}{\Gamma^{-1}} = \frac{\sinh^{-1}(\Gamma w)}{\Gamma} \tag{3.18}$$

where w is the observed wealth variable and Γ is a scaling parameter that allows the distribution to be leptokurtic.[32]

The function is linear around the origin and symmetric. For large w, the function is approximately a parallel shift of the logarithm: $\ln\left[\Gamma w + (\Gamma^2 w^2 + 1)^{\frac{1}{2}}\right] \approx \ln 2\Gamma + \ln w$.

Pence (2006) shows how to calculate the marginal effects with an IHS-transformed dependent variable. Assume the following model:

$$y = f^{IHS}(\Gamma,w) = f(\Gamma) = x\beta + \varepsilon \tag{3.19}$$

The marginal effect of a change in x is then given by $0.5\left(e^{\Gamma y} + e^{-\Gamma y}\right)\beta$. It is also possible to use the approximation $\beta\Gamma$ for large w; it approximates the percentage change in w for a unit change in x. Both types of marginal effects are reported in Tables 3.9 and 3.10. The marginal effects are calculated at the median wealth of the regression sample.

Burbidge et al. (1988) derive a likelihood function to determine the optimal Γ in the case of an OLS estimator. Assuming normally distributed errors, the concentrated log-likelihood for Γ in (3.19) is

$$l^c(\Gamma) = (constant) - \frac{n}{2}\ln f(\Gamma)' M f(\Gamma) - \frac{1}{2}\sum \ln(1 + \Gamma^2 w^2) \tag{3.20}$$

32 Ramirez et al. (1994) show that the normal distribution is only a special case as Γ approaches zero.

where $M = I - x(x'x)^{-1}x'$. To estimate the optimal Γ a grid search over $\Gamma \geqq 0$ is performed to maximize (3.20).[33] The grid search was performed for each of the imputed datasets.

3.B Combing results across multiple imputed datasets: "Rubin's rule"

As described in Frick et al. (2007), missing wealth information in the SOEP data (2002,2007) were imputed using a multiple imputation procedure. The idea behind this approach is to generate a number of different complete datasets by imputing missing values and to conduct separate statistical analyses on each of the imputed datasets. The different results are then combined according to "Rubin's rule" (Rubin, 1987). This procedure takes into account the variation between results obtained in each of the imputed datasets and allows to account for the uncertainty involved with imputing missing values.

Suppose we are interested in a scalar quantity Q, for example the coefficients or marginal effects of the buffer-stock model. Let $\hat{Q}_j$ and $\hat{V}_j$ be parameter and variance estimates from imputed dataset j with $j = 1, \ldots, m$. The overall point estimate $\hat{Q}$ is the mean of the m estimates:[34]

$$\hat{Q} = \frac{1}{m}\sum_{j=1}^{m}\hat{Q}_j \tag{3.21}$$

A valid standard error of the estimated $\hat{Q}$ is obtained by combining within and between variation of the imputations:

$$\hat{V}^w = \frac{1}{m}\sum_{j=1}^{m}\hat{V}_j \qquad \text{(wihtin variance)} \tag{3.22}$$

$$\hat{V}^b = \frac{1}{m-1}\sum_{j=1}^{m}(\hat{V}_j - \hat{V}^w)^2 \qquad \text{(between variance)} \tag{3.23}$$

$$\hat{V} = \hat{V}^w + \left(1 + \frac{1}{m}\right)\hat{V}^b \qquad \text{(total variance)} \tag{3.24}$$

33 Pence (2006) derives a similar likelihood function for a quantile regression.
34 The exposition is based on Carlin et al. (2003).

Rubin (1987) shows that approximately,

$$\hat{V}^{-\frac{1}{2}}(Q - \hat{Q}) \sim t_{df} \tag{3.25}$$

where the degrees of freedom df are given by

$$df = (m-1) + \left(1 + \frac{\hat{V}^w}{\left(1 + \frac{1}{m}\right)\hat{V}^b}\right)^2 \tag{3.26}$$

A $100(1-\alpha)\%$ confidence interval for $\hat{Q}$ is

$$\hat{Q} \pm t_{df,1-\frac{\alpha}{2}}\sqrt{\hat{V}} \tag{3.27}$$

3.C Tables

Table 3.13: Overview of selected empirical papers on precautionary savings

Paper	Data	Sample	Dependent variable	Risk measure	Results
Skinner (1988)	CE	1972/1973, Couple households with household heads aged between 20 and 50, savings rates lower than 50%, income between 2,000 and 35,000 dollars	Difference between net income and consumption (with and without consumption durables)	Occupational status	Derives a share of more than 50% of precautionary savings in a theoretical model of consumption. The empirical estimates do not show evidence for precautionary savings. Individuals in supposedly riskier occupations save less.
Guiso et al. (1992)	SHIW	1989, Household head dependently employed and younger than 65, households with negative net worth were excluded	Net worth	Self-reported measure of uncertainty of future earnings and inflation (one year ahead)	Precautionary savings account for 2% of total net worth.
Dynan (1993)	CE	1985	Consumption growth (non-durables)	Squared consumption growth	Estimates the coefficient of relative prudence as defined in Kimball (1990). The coefficient is not significant, i.e. no indication of precautionary savings.
Dardanoni (1991)	FES	1984 Households whose head is single earner and dependently employed	Total expenditures	Occupation specific earnings variance	Estimates an equation for optimal consumption derived from an intertemporal maximization problem. About 60% of all savings in the sample arise from precautionary motives.
Kuehlwein (1991)	PSID	1971, 1972, 1975-1982 Full sample	Food expenditures	Expectational errors of the consumption Euler equation	Larger consumption uncertainty decrease savings.

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Table 3.13 – *continued from previous page*

Paper	Data	Sample	Dependent variable	Risk measure	Results
Carroll (1994)	CE/ PSID	1960/1961 Households whose head is between 25 and 65 years of age	Current consumption	Imputed variance measures, estimated on future waves of PSID	A one standard deviation increase in the "equivalent precautionary premium" (EPP) (Kimball, 1990) increases savings rates by more than three percent.
Hubbard et al. (1995)	PSID	1984 Full sample	Net worth	life-span uncertainty, earnings uncertainty (permanent variance), and uncertainty about out-of-pocket medical expenditures	Estimate a multi period dynamic programming model and find that differences in wealth of different groups can be explained by the interaction of uncertainty and means tested social insurance programs.
Carroll and Samwick (1997)	PSID	1984 Households aged 50 and younger	Wealth: (1) liquid financial wealth, (2) Non-housing, non-business wealth, (3) total net worth	Permanent and transitory variance of total gross household income based, estimated on PSID waves 1981–1987	Significant effects of transitory and permanent income variance; No significant effects if self-employed and farmers are excluded.
Kazarosian (1997)	NLS	1965–1980 Male household heads between 45 and 59 in 1966	Total net worth including business assets	Decomposed variance	A doubling of uncertainty increases savings by 29%.
Lusardi (1997)	SHIW	Same sample as in Guiso et al. (1992)	Net worth	Self-reported measure of uncertainty of future earnings and inflation (one year ahead)	OLS estimates replicate the results in Guiso et al. (1992); but IV methods lead to much higher shares of precautionary savings of about 20% to 24% of total net worth.

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Table 3.13 – *continued from previous page*

Paper	Data	Sample	Dependent variable	Risk measure	Results
Carroll and Samwick (1998)	PSID	1984 Households whose head is younger than 50	same measures as in Carroll and Samwick (1997)	Log of a noramlised version of EPP	Precautionary savings account for about one third of liquid wealth, half of non-housing, non-business wealth, and 45% of total net worth. No significant effects if self-employed and farmers are excluded.
Lusardi (1998)	HRS	Households with dependently employed household head, aged between 51 and 61 (wave(s) not indicated)	Financial net wealth and total net worth (including business and home equity)	Self-assessed unemployment risk (p) and current income (Y): variance measure equals $p(1-p)Y^2$. i.e. unemployment insurance replacement rate is zero	Precautionary wealth accounts for 1 to 3.5% of net worth and 2 to 4.5% of financial wealth.
Engen and Gruber (2001)	SIPP	1984–1990 Household head between 25 and 64; must have wage earnings from a non-self employment job	Gross financial assets	Unemployment insurance replacement rate; unemployment risk	Reducing the generosity of unemployment benefits by 50% would raise financial assets by 14%.
Arrondel (2002)	INSEE	1997 Full sample of households whose income is greater than their current consumption ("non-constrained")	Financial wealth, total net worth	Self-assessed earnings variance over the next 5 years	Precautionary savings account for 4.9 to 5.6% of financial wealth and for 3.9 to 4.6% of net worth.
Carroll et al. (2003)	CPS/ SCF	1983,1989,1992 Household heads between 20 and 65 years of age	Net worth	Probability of job loss next year	Significant effects for households in higher permanent income groups. The effects vanish if housing wealth is excluded from the wealth aggregate.

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Table 3.13 – *continued from previous page*

Paper	Data	Sample	Dependent variable	Risk measure	Results
Murata (2003)	JPSC	1994, 1996 Couple households whose reference person is aged between 27 and 37, in which the wive does not work full-time. Self-employed and business owners are excluded.	Net worth, financial assets	Japan's economic outlook (self-assessed), self-assessed uncertainty with respect to Japan's public pension system	Uncertainty about public pensions leads nuclear families but not extended families to increase precautionary wealth. Using economic prospects as proxy for uncertainty gives no significant results.
Kennickell and Lusardi (2004)	SCF	1995, 1998 Three samples of households whose head is (1) dependently employed and aged between 21 and 60, (2) not self-employed and older than 62, and (3) business owner	Desired amount of precautionary wealth	Regional level of unemployment, expectations about income development (also: health and longevity risk)	The descriptive analysis shows a share of precautionary wealth of 8% of net worth and 20% of liquid wealth. Significance and importance of risk measures differ by estimation samples.
Essig (2005)	SAVE	2003 Full sample	Saving rate, financial wealth, net worth	Several subjective measures, variance of net income as in Lusardi (1998) but uses an individual unemployment replacement rate for the calculation	The more volatile the past income development the lower the saving rate. Variance of net income is insignificant.
Fuchs-Schündeln and Schündeln (2005)	SOEP	1998–2000 Main income earner of the household is younger than 56 and labour force participant, not self-employed; subsamples that focus on migrants are dropped from the analysis	Imputed gross wealth measure using information on interest and dividend income and housing wealth	Occupational status	Precautionary savings: 20% in East and 12% in West Germany; 60% in East and no precautionary savings if zero-wealth observations are included (tobit)
Ventura and Eisenhauer (2005)	SHIW	1995, 2000 Households with positive savings and those that are – according to an experiment and a theoretical model – risk neutral or risk averse	Annual saving	Direct Leland-Kimball measure of prudence and household income variance (based on two waves of SHIW)	About 20% of total saving can be attributed to precautionary motives.

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Table 3.13 – *continued from previous page*

Paper	Data	Sample	Dependent variable	Risk measure	Results
Bartzsch (2006, 2008)	SOEP	2002 Households whose head is younger than 55, not self-employed, not in education or military service, not retired, German citizen, has always participated in SOEP between 1998 and 2004	Wealth: (1) net financial wealth (2) net financial wealth and housing wealth	Different variance measures based on net total household income 1998–2002	Positive and significant effects with respect to financial wealth, estimates of the share of precautionary savings range between 14.6% and 26.7%. Negative or insignificant effects if housing wealth is included.
Benito (2006)	BHPS	1992–1998 Households whose head is aged between 21 and 65	Weekly expenditures on food and groceries	Predicted probability of unemployment; self-assessed job insecurity	A one standard deviation increase in predicted unemployment probability decreases consumption by 2.7%; No significant effect of self-assessed job insecurity.
Fossen and Rostam-Afschar (2009)	SOEP	2002, 2007 Households with household heads between 18 and 55 who are employed	Net worth	Different income variance measures	Positive shares of precautionary savings disappear when accounting for entrepreneurs.
Schunk (2009)	SAVE	2003 Full sample	Savings rates	Savings motives	The precautionary motive is an important reason to save. Its importance increases with age.
Beznoska and Ochmann (2010)	SOEP/ LWR	2002–2007 Households excluding the self-employed	Savings rates	Permanent and transitory net income variance	Doubling of average transitory income uncertainty increases savings by 4.4% or about 43 euro for an average household. Effects vary with type of household.
Hurst et al. (2010)	PSID	1984, 1994 Households whose head is aged between 26 and 50, has positive net worth	Net worth	Decomposed income variance	The share of precautionary savings in total wealth drops from 50% to less than 10% when accounting for differences between self-employed and other groups.

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Table 3.13 – *continued from previous page*

Paper	Data	Sample	Dependent variable	Risk measure	Results
Giavazzi and McMahon (forthcoming)	SOEP	1995–2000 Balanced sample of households.	Savings rates	Quasi-natural experiment, dummy controlling for policy change that increased future income uncertainty	The increase in uncertainty of the future income path leads to an annual increase in savings rates of 3%-points. It has also a large positive effect on hours worked of part-time working heads of households.

Abbreviations: BHPS - British Panel Household Survey (UK); CE - Consumer Expenditure Survey (US); CPS - Current Population Survey (US); FES - Family Expenditure Survey (UK); HRS - Health and Retirement Study (US); INSEE - INSEE Survey on wealth ‘Patrimoine 97’ (FR); JPSC - Japanese Panel Survey of Consumers (JP); LWR - Laufende Wirtschaftsrechnung “Continuous Household Budget Survey” (DE); NLS - National Longitudinal Survey (CA); PSID - Panel Study of Income Dynamics (US); SAVE - Sparen und Altersvorsorge in Deutschland “Savings and old-age provisions in Germany” (DE); SCF - Survey of Consumer Finances (US); SHIW - Survey of Household Income and Wealth (IT); SIPP - Survey of Income and Program Participation (US); SOEP - Socio-economic Panel Study (DE)

Source: Own compilation

Table 3.14: Descriptive statistics for the bivariate random effects probit model

	West Germany		East Germany	
	mean	sd.	mean	sd.
$h_{it} = 1$	0.131	0.338	0.134	0.341
$l_{it} = 1$	0.109	0.312	0.201	0.401
$s_{it} = 1$	0.798	0.402	0.726	0.446
$s_{it} = 2$	0.093	0.290	0.073	0.259
$s_{it} = 3$	0.071	0.257	0.139	0.346
$s_{it} = 4$	0.038	0.192	0.062	0.241
Age	44.334	8.624	45.232	8.521
Foreign nationality	0.123	0.328	0.003	0.053
Years of education:				
7-10.5	0.396	0.489	0.176	0.381
edu. 11-12	0.297	0.457	0.528	0.499
12.5+	0.306	0.461	0.296	0.456
Person in HH needs care	0.023	0.148	0.030	0.170
Type of household:				
Single, no children	0.113	0.317	0.118	0.322
Single, children	0.028	0.164	0.032	0.177
Couple, no children	0.238	0.426	0.242	0.428
Couple, children	0.555	0.497	0.573	0.495
Other	0.066	0.249	0.035	0.185
Regional unemployment rate	9.452	3.005	18.866	2.393
Log other HH income	0.708	0.284	0.587	0.308
Obs.	32,719		10,485	

Notes: See page 71 for the definition of s_{it}, h_{it}, and l_{it}.
Source: SOEP, own calculations

Table 3.15: Sample statistics for the wage model by region

	West Germany		East Germany	
	mean	sd	mean	sd
Log hourly wage	2.787	0.423	2.384	0.459
$h_{it} = 1$	0.105	0.307	0.091	0.288
Lagged employment status	0.022	0.146	0.054	0.225
Lagged health status	0.095	0.293	0.085	0.278
Age	44.592	8.992	45.200	8.863
Foreign nationality	0.110	0.313	0.002	0.048
Years of education:				
7-10.5	0.368	0.482	0.138	0.345
11-12	0.303	0.460	0.525	0.499
12.5+	0.329	0.470	0.336	0.473
Person in HH needs care	0.019	0.135	0.021	0.143
Type of household:				
Single, no children	0.112	0.315	0.106	0.307
Single, children	0.025	0.156	0.028	0.165
Couple, no children	0.245	0.430	0.246	0.431
Couple, children	0.553	0.497	0.584	0.493
Other	0.066	0.248	0.036	0.187
Regional unemployment rate	9.376	2.977	18.810	2.349
Log other HH income	0.763	0.214	0.660	0.241
Obs.	30,110		8,592	

Notes: See page 71 for the definition of h_{it}.
Source: SOEP, own calculations

Table 3.16: Wealth regression - coefficients

	West Germany		East Germany	
	FW	NW	FW	NW
$log(\sigma^2)$	456.415*	1,051.829*	112.293	347.737
	(224.848)	(446.147)	(237.309)	(364.055)
Log permanent income	8,187.358**	19,311.650**	5,759.405**	8,180.414**
	(690.238)	(1343.458)	(682.159)	(1,105.676)
Age	1,325.700	7,372.330**	−1,084.654	851.791
	(1,313.057)	(2,670.714)	(1,519.652)	(2189.070)
$Age^2/100$	−2,138.153	−13,854.865*	2,499.572	−929.090
	(2,933.844)	(5,977.925)	(3,401.263)	(4912.241)
$Age^3/100$	13.133	95.181*	−17.115	3.466
	(21.363)	(43.603)	(24.753)	(35.823)
Single, children	−7,255.460**	−10,989.890**	−3,961.938**	−1,971.811
	(1,720.881)	(3,642.016)	(1,020.630)	(1743.121)
Couple, no children	−3,388.860**	−5,491.496**	−3,794.762**	−3,622.526**
	(609.079)	(1,194.476)	(738.827)	(1073.276)
Couple, children	−5,288.787**	−5,729.595**	−4,312.336**	−3,295.413**
	(578.399)	(1157.653)	(715.132)	(1,045.716)
Other	−5,743.724**	−3,308.739†	−6,461.505**	−4,090.210†
	(905.934)	(1,726.127)	(1,596.440)	(2,297.501)
Experience UE (yrs.)	−536.117**	−1,835.078**	−185.907*	−231.182
	(97.401)	(214.197)	(85.487)	(143.545)
edu. 7-10.5	−787.439†	−2,282.045**	−14.555	−577.448
	(401.320)	(857.443)	(563.010)	(834.562)
edu. 12.5+	1,993.837**	1,652.408*	2,034.795**	505.161
	(433.070)	(835.344)	(469.023)	(704.031)
Regional unemployment rate	−217.749**	−859.461**	−35.923	102.762
	(56.964)	(115.460)	(81.202)	(124.978)
Very low	709.413	1,115.859	−282.518	−1,347.343
	(573.870)	(1,191.018)	(817.192)	(1132.495)
Low	1,104.135*	1,706.467†	−356.263	−258.432
	(427.016)	(880.480)	(508.881)	(789.231)
High	1,107.076*	1,236.212	−200.210	−316.970
	(430.908)	(838.579)	(444.915)	(689.013)
Very high	160.491	−1,973.918†	−777.765	958.602
	(594.587)	(1,139.823)	(799.513)	(1,129.739)
Obs.	4,754	4,754	1,253	1,253
IHS: $\Gamma^{(a)}$	0.000116	0.000055	0.000193	0.000144

Notes: Estimation of standard errors takes into account multiple imputed datasets. Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01. (a) Γ is estimated separately for each imputed dataset. Reported is the mean value. See Appendix 3.A for more information.
Source: SOEP, own calculations

4 The mismatch between actual and desired working hours: dynamic effects of health[1]

4.1 Introduction

One of the key determining factors of individual economic status in the pre-retirement period is health. A negative health shock often entails direct individual welfare losses if it reduces physical abilities and quality of life. To the extent that it constrains labour market activity, it is likely to negatively affect the income level. It is well documented in the literature that poor health and labour market participation are negatively correlated and that poor health increases the risk of involuntary job loss (e.g., Blundell et al., 2002; Bound et al., 1999; Kalwij and Vermeulen, 2008; Pelkowski and Berger, 2004; Riphahn, 1999). Moreover, deteriorating health also influences the economic outcomes of those individuals who remain employed. Poor health may reduce productivity and thus also wages and future career prospects. It may also affect the number of hours an individual works (e.g., Cai et al., 2008; Jäckle and Himmler, 2010).[2] Finally, a negative health shock may force employees to change their occupation. Due to its income and substitution effects, the direction of the total effect that deteriorating health exerts on labour market participation is a priori indeterminate. On the one hand, employees may want to increase working hours to compensate for a lower wage rate. On the other hand, poor health is very likely to increase the disutility of labour, and hence the desire to reduce working hours.

This theoretical framework assumes that individuals trade off leisure and income and freely choose their preferred spot on the labour supply curve. However, whereas studies on the determinants of labour market intensity usually expect individuals to have a high degree of flexibility in bargaining their preferred work week length, it has also been

1 This chapter is based on Geyer and Myck (2010).
2 For a review of earlier studies, see Currie and Madrian (1999).

recognised for a long time that simple hours choice models are not suited for modelling the highly concentrated hours distribution we normally observe (Dickens and Lundberg, 1993; Kahn and Lang, 1991). Many studies report a significant degree of dissatisfaction for employees with the commonly required hours of work. Kahn and Lang (1992, 1995) present and empirically test theoretical models that allow for hours constraints. International comparisons show that hours constraints are omnipresent and affect at least a non-negligible minority (one third or more) of the workforce in many countries (Otterbach, 2010; Sousa-Poza and Henneberger, 2002).

Studies on the US-American and Canadian labour market find that usually about 30 percent of men would not want to work longer hours, while about 10 percent would prefer to reduce hours of work (e.g., Altonji and Paxson, 1988; Dickens and Lundberg, 1993; Kahn and Lang, 1991). In contrast, studies on European labour markets rather reveal a general preference to work less. Stewart and Swaffield (1997), Böheim and Taylor (2004) and Bryan (2007) show for the UK that about a third of all men want to reduce hours of work while five to ten percent would like to work more. Euwals et al. (1998) report similar findings for the Netherlands, Wolf (2000) and Holst (2009) for Germany. Overall, many studies suggest that even in countries with rather liberal labour market institutions disequilibria between preferred and desired hours prevail.[3] Moreover, adjustment to desired hours of work can be costly. As Altonji and Paxson (1986, 1988) and Martinez-Granado (2005) show for the US, changes in average working hours are more likely to occur when employees change jobs. Blundell et al. (2008) and Böheim and Taylor (2004) report the same finding for the UK.

Persistent hours disequilibria may lead to substantial welfare losses and have a direct impact on the effectiveness of policies that aim at changing labour supply behaviour. However, research into the determinants of the hours disequilibrium is still developing. From a social policy point of view, it is important, first, how individual resources and the household context influence the hours match and, second, how persistent the potentially resulting disequilibrium is. As mentioned before, the individual health status constitutes a key determinant of labour market activity – and a factor of growing importance, given the continuing demographic change in the labour market. Therefore, our own analysis

3 The discrepancy between actual and desired hours, what we define as “individual hours disequilibrium”, is sometimes referred to as “hour tension” (see e.g., Merz, 2002). Or, as Böheim and Taylor (2004) put it, employees can be considered “over-” or “underemployed”.

focuses on the hours disequilibrium of individuals in deteriorated health status and their ability to adjust actual working hours to the desired level.

The SOEP data we use allow to distinguish between the legally recognised state of severe disability and subjectively assessed health status. While the former measure is a standard instrument in health economics, the latter has some unique properties: Severe disability status entails several legal privileges on the job and is in general known to the employer. The general self-assessed health measure can be assumed to be private knowledge that is not easily revealed.[4] Contrary to previous studies, we apply dynamic fixed effects models to test the persistence of the hours match.

The empirical analysis of the effect of health on labour market outcomes entails several important identification problems that result from the complex relationship between health, on the one hand, and employment, wages and hours of work, on the other hand. We assume health to affect the probability of employment, work intensity and productivity. At the same time, however, health may itself be affected by the intensity of work and the level of income. Moreover, in the model of Grossman (1972) deteriorated health results in reduced total labour input. That effect may be reinforced by the endogeneity of health if individuals treat it as investment in human capital (Jäckle and Himmler, 2010; Lee, 1982).[5] However, with the data at hand it is in our view impossible to estimate a model which not only accounts for the endogeneity of employment status, hours of work and wages with respect to health, but also analyses the hours mismatches. Hence, we investigate the relationship between hours and health from a different angle and focus on the identification of determinants of individual labour market disequilibrium. The applied dynamic GMM estimator does not rule out feedback effects of health and the hours match but allows to relax the strict exogeneity assumption and to treat the health status as a predetermined variable.

We use data on prime-age males for the years 1996-2007 from the SOEP study. The reason for restricting the sample to this group is to avoid problems of non-random selection

4 Even if a person starts a new job, in general he/she does not have to report his/her health status unless it is – in a narrower sense – job-related.

5 There is also growing literature on the consequences of non-employment on health (e.g., Bockerman and Ilmakunnas, 2009; Clark and Oswald, 1994; Haan and Myck, 2009).

into the labour market.[6] The rich SOEP data set allows for a detailed analysis of the aspects that we are interested in. Its longitudinal design and the consistency of survey questions across waves enables us to apply dynamic panel methods. We run all models separately for East and West Germany in order to account for the large regional differences in labour market conditions.

Results reveal substantial differences between actual and desired hours of work. As was to be expected, part time work practices are of marginal importance among men in the German labour market. The share of overemployed men amounts to more than 60 percent with a mean difference of about -4.6 hours per week. Conditional on being overemployed, the deviation is more than eight hours per week. It is about one hour per week higher in East Germany than in the West. By contrast, average working hours are about 1.5 hours higher in East Germany. The descriptive analysis suggests a relatively strong persistence in the hours disequilibrium. However, our multivariate analysis reveals only a small degree of persistence in the hours mismatch. The effect is driven by the West German subsample, for which the effect is significant, whereas it remains insignificant in East Germany.

This finding indicates that the state dependence we found in the descriptive analysis is likely to be caused by other factors than the disequilibrium itself, i.e., observable or unobservable personal or job characteristics. We find consistent evidence that health constitutes an important determinant of the hours disequilibrium in West Germany, but not in the East. In West Germany, its short-term effect amounts to 0.7 hours or 16 percent of the mean difference and increases only slightly in the long-run. We do not find any effect of the legal disability status, which is in line with our expectation. Finally, we also observe a small positive elasticity for other household income, which implies a tendency to be overemployed if other income increases. This elasticity turns out to be almost five times larger for men in bad health.

Section 4.2 describes the data and includes a discussion of the health variable we use, the hours mismatch and several descriptive findings. Section 4.3 discusses the multivariate approach we take to model the observed disequilibrium between desired and actual hours of work. The results of our multivariate analysis are presented in section 4.4. The chapter

6 To exclude women from the analysis is not satisfactory since they are also affected by hours constraints. Due to child care and household responsibilities, hours constraints may even be more relevant for women than for men. However, to set up a convincing model of hours constraints for women, we would need to include hours restrictions in the participation decision as well, which is beyond the scope of this chapter.

concludes with an overall discussion of our key findings.

4.2 Data and descriptive statistics

The SOEP study provides information on respondents' average weekly working hours, desired hours of work as well as several health indicators.[7] For three reasons, we restrict our sample to male employees aged between 30-59. (1) To begin with, the workload of the self-employed is subject to stronger fluctuations. As Merz (2002) shows, the self-employed also have higher time sovereignty and differ systematically from employees with respect to the working time regime. Therefore, we would have to apply a different explanatory model for this subgroup of the workforce. (2) Women are still more likely to bear the main responsibility for caring activities in the household. As a consequence, we assume the disequilibrium between actual and desired working hours to exert a systematic influence on women's decision to participate in the labour market. Any possible exclusion restriction, which controls for selection into the workforce, would need to have an impact on the participation decision without being directly correlated with actual or preferred working hours. Since our data do not provide such an instrument, we restrict the analysis to male employees. (3) Finally, to avoid non-random selection for the group of male employees, we focus on employees between 30 and 59 years of age, i.e. on men who have most likely already finished their education and, at the same time, are not yet eligible for early or normal retirement. To control for sample selection and panel attrition in our final sample, we control for fixed effects so that non-random selection affects our results only if it is related to the time-varying error component.

4.2.1 Individual disequilibrium in hours of work

The aim of our analysis is to estimate the determinants of the disequilibrium between realised and desired hours of work, denoted as κ, and its dynamics. In particular, we focus on the impact of health on the disequilibrium. To generate our dependent variable, we rely on the following survey questions:

> And how many hours do your actual working-hours consist of including possible over-time?

7 See, e.g., Wagner et al. (2007) for more information on the SOEP data.

> If you could choose your own number of working hours, taking into account that your income would change according to the number of hours: How many hours would you want to work?

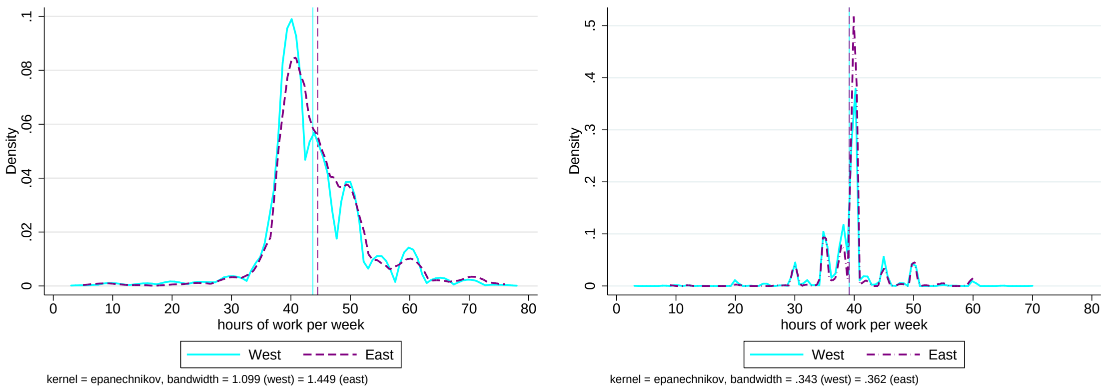
Both questions refer to weekly hours of work. The second question not just asks respondents to specify their preferred number of working hours, but also takes into account the income change that would result from the desired change in working hours. Therefore, the answer can be interpreted as the preferred change in work intensity under a given wage rate taking into account income and substitution effect, and thus as the preferred individual point on the labour supply curve (given the budget constraint), unrestricted by labour demand. Another implication is that if labour market demand were perfectly flexible, no systematic deviation would occur between realised and desired working hours.

Figure 4.1 shows the distribution of actual (a) and desired (b) working hours by region for the year 2006.[8] As Figure 4.1 illustrates, distributions of actual hours were similar for East and West Germany in 2006 with the typical spikes at 40, 45, and 50 hours per week. Mean working hours were nearly one hour higher in East Germany in 2006. Table 4.8 shows that employees on average worked 43.7 hours in West Germany and 44.5 hours in the East in 2006, compared to 42.6 and 46 hours in 1998. Although employees in East Germany still work more, the difference has declined from 3.4 to 0.8 hours per week. Nevertheless, the remaining difference of 0.8 hours per week amounts to about 41 hours per year, which corresponds to a whole work week. The regional difference can partly be explained by differences in working hours set by collective agreements. The average weekly working time, agreed upon in collective agreements, was 37.4 and 38.9 hours, respectively, in West and East Germany in 2006. However, actual working hours are normally higher than the collectively agreed working time, and the difference is larger in West Germany (Bosch, 2009). Moreover, the share of companies that take part in a collective agreement is lower in East Germany than in the West, and working hours are on average higher in companies without collective agreements (Lehndorff, 2003; Wagner, 2006). However, regional differences have decreased over time.

When comparing actual and preferred working hours, two findings are worth mentioning: first, the distribution of preferred working hours is clearly more concentrated. The spike

8 Tables 4.8 (actual working hours) and 4.9 (desired working hours) in the Appendix to this chapter provide detailed descriptive statistics for the whole sample and differentiated by health status for the period 1998-2006.

at about 40 hours in Figure 4.1b comprises about 40 percent of all observations in the West German and more than 50 percent in the East German sample. In 2006, average desired weekly work hours amounted to 39.2 hours in West Germany and 39.8 in the East. Second, the share of employees who actually work long hours clearly exceeds the share of employees who would prefer to work more than 40 hours per week. Figure 4.1b depicts the hours disequilibrium by region for 2006. In sum, the vast majority (66 percent) desires to work less. On average, men would have preferred to reduce working hours by 4.5 hours in 2006, and only 22 percent reported to work the hours they would have wished to work. Moreover, Table 4.10 shows that, conditional on a negative disequilibrium, the desire to reduce working time is even stronger and amounts to about 8 hours.



(a) Actual working hours **(b)** Desired working hours

Figure 4.1: Kernel densities of weekly working hours by region (2006)

4.2.2 Health status

We use self-assessed general health (SAH) as health measure. Several studies have pointed out that self assessed health status is likely to be biased by the actual labour market status and hence only imperfectly reflects respondents' "true" state of health (e.g., Bound, 1991; Bound et al., 1999). Other studies, however, demonstrate that SAH measures strongly correlate with "objective" health (e.g., Idler and Benyamini, 1997; Larsson et al., 2002; Wannamethe and Shaper, 1991). Thus, at least within homogeneous age and gender groups, SAH can be considered a valid indicator of current health status (Lindeboom and van Doorslaer, 2004).

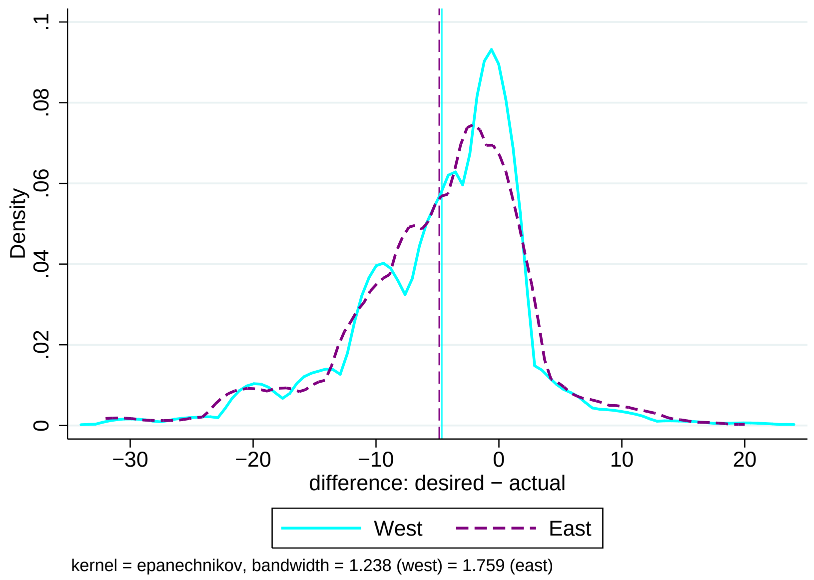


Figure 4.2: Kernel densities of hours disequilibrium by region (2006)

The so-called "justification bias", which means that respondents justify the fact that they do not work by rating their health status worse than employed respondents, can be considered irrelevant in our case since we focus on a relatively homogeneous group of employees. Moreover, part-time employment plays almost no role in the sample.

The question formulation we rely on is "How would you describe your current health?" Respondents could choose between the categories "very good", "good", "satisfactory", "not so good", and "bad" to answer the question. We dichotomise the variable into the category "good health" (GH), which includes the top three answering categories, and "poor health" (PH), which includes the bottom two. In order to test the robustness of the SAH effect, we estimate several regression models using different specifications of the health variable.

First, we disaggregate the five-scale measure of SAH and include four dummy variables into the equation. Second, we use a 11-point scale of health satisfaction, which is also provided in the SOEP data over the whole observation period, as an alternative health measure. We estimate three different models, using health satisfaction as

- (a) a linear variable (higher values imply lower health satisfaction),

- (b) a non-linear set of dummy variables,[9]
- and (c) a log-transformed variable.[10]

To differentiate the information on health status, we also take into account respondents' legal disability status and the degree of disability they report. Respondents were asked: "Are you legally classified as handicapped or capable of gainful employment only to a reduced extent due to medical reasons?" and "What is the extent of this capability reduction or handicap according to the most recent diagnosis?" (in percent). The indicator comprises two different legal categories, namely severe disability and reduced earnings capacity (REC). The legal status of "severe disability" applies when individuals' disability rating exceeds 49 percent. Although it does not define any working time limit, it implies several particular protective rights. On the one hand, individuals with severe disability status are entitled to extended dismissal protection, longer annual leave, favourable tax treatment and an early retirement option. On the other hand, employers having more than 19 employees are legally obliged either to employ at least five percent severely disabled or to make a certain monthly contribution to the pension scheme for the handicapped. In contrast to the subjective health measure, the disability status is generally known to the employer.[11]

In contrast to severe disability, the REC status legally protects individuals who are incapable of working in a "normal" employment relationship. Prior to 2001, the regulation applied to employees incapable of earning more than 1/7 of average monthly earnings over a longer period. Since then, the threshold is defined on the basis of working hours: individuals who are incapable of working more than 3 hours per day are now eligible for full REC (the threshold for partial REC is set at 6 hours). Employees with reduced earnings capacity are also eligible for disability pensions. On the basis of the SOEP data, we are unable to distinguish both legal forms of disability. However, given the incentives that the REC status provides, we expect only a negligible minority of individuals with

9 We define six dummy variables ranging from "excellent" to "bad": Categories = $\underbrace{(0-1)}_{\text{“}excellent''}$,(2),(3),(4),(5), $\underbrace{(6-10)}_{\text{“}bad''}$.

10 Health satisfaction is transformed according to the following rule: $\left(h_{it}^{l}\right) = log(h_{it} + (\sqrt{h_{it}^{2}+1}))$. This is a parallel transformation of the log transformation with $\left(h_{it}^{l} | h_{it} = 0\right) = 0$.

11 People with disabilities can be regularly employed as well as working in subsidised sheltered workshops. We exclude the latter group from our analysis.

REC status to actively participate in the labour market and, therefore, assume the great majority of the employed respondents in our sample who report a health-related handicap to hold the legal status of severe disability.

Descriptive findings for health and disability status

In our sample, the share of men in poor health amounts to about ten percent, and no time trend can be observed (Table 4.6 in the Appendix to this chapter).[12] As expected, general health status and labour market participation are strongly related. In accordance with our assumption that health constitutes one of the key labour market risks for male employees, the share of men in poor health is more than twice as high in the sample of non-employed men as in our estimation sample of employed men. It varies between 24 and 31 percent over the observed period. As Table 4.7 shows, the distribution of our estimation sample across the five-scale health measure is highly concentrated on the categories “good” and “satisfactory”. About 80 percent of the population report either good or satisfactory health, and about half of the sample falls into the category “good health”. Only a very low share, about one percent, falls into the worst health category, reporting “bad health”.

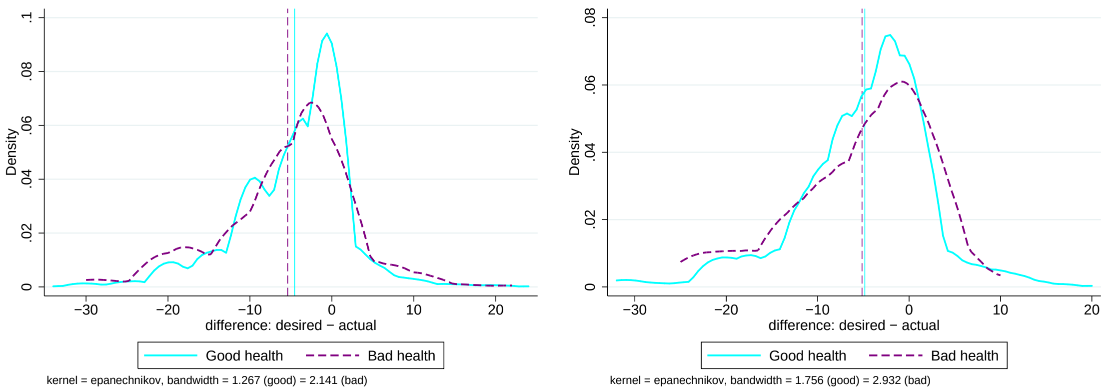
In West Germany, more employees report a very good health status, whereas employees in East Germany are more likely to report satisfactory health. In West Germany, 7.7 percent of all male employees aged 30-59 years have a disability status, compared to 4.9 percent in East Germany. Again, no time-trend can be observed for neither region. Fewer respondents report to have a disability status than health constraints as measured by SAH. Given the facts that we exclude individuals who received a disability pension from our analysis and that the disability status has to be legally recognized, this finding is plausible. Still, when comparing employed and non-employed male employees, we find the same pattern: more than twice as many non-employed respondents report to have a disability status than among the employed respondents.

Compared to respondents in good health, respondents who report deteriorated health worked 0.6 hours less in West Germany (43.2 and 43.8, respectively) and 0.5 hours less in the East in 2006 (44.1 and 44.6, respectively). Results are reported in Table 4.8. Employees with disability status worked 2.4 hours less in West Germany (41.5 and 43.9 respectively) and 1.2 hours less in the East (43.4 and 44.6 respectively). As a key difference between

12 Regional differences between East and West Germany are negligible and therefore not reported here.

the two health measures it can be considered that the disability status not only includes particular rights, but is also known to the employer. Thus, we assume that employees with disability status generally have greater bargaining power vis-a-vis employers, which also holds for working hours. Across all waves, respondents reporting deteriorated health desire to work 38.5 hours per week, which is 4.6 hours less than actual working hours.

As for respondents in good health, desired working hours are 39.1, i.e. 4.7 hours less than actual working hours. Interestingly, we can observe a difference between East and West Germany. The difference in desired working hours between employees in good and bad health amounts to 0.7 hours in West Germany, whereas it is nearly zero (0.1 hours) in East Germany. This difference is also visible in Figure 4.3, which depicts kernel densities of κ by region and health for 2006. Respondents with disability status prefer to work four hours less across all waves (37.4 hours compared to 41.4 actual working hours). Employees with no disability wish to work 4.8 hours less (39.1 hours compared to 43.9 actual working hours). Again, the difference between employees with and without disability status is higher in West Germany (0.8) than in the East (0.4).



(a) West Germany

(b) East Germany

Figure 4.3: Kernel densities of hours disequilibrium by region and health (2006)

Although the mean difference is negative, we do not find a higher probability of a negative disequilibrium for men in poor health (Table 4.10). To the contrary, in the total sample, 12 percent (+6.1 hours) of those in poor health desire to increase their working hours compared to only 10.1 percent (+5.3 hours) of the sample of healthy individuals. Those who desire to reduce their working time prefer a more comprehensive reduction of working hours than the sample of healthy individuals, and this is true for both East and West Germany.

In sum, descriptive statistics show that most individuals face some sort of hours constraint. However, it is important to keep in mind that we focus on prime age male employees. Although analyzing such a homogeneous group, we find considerable variation by region and health status in the hours disequilibrium. Sizeable deviations from realised hours can be observed for both those in negative and those in positive disequilibria. At first sight, health does not seem to add much variation to the disequilibrium. However, in terms of stress due to the workload, the marginal working time is likely to be the most important. Thus, stress increases with working hours, and the marginal 0.5 weekly working hours represent a higher stress load than the first half an hour of the work week.

4.2.3 Other covariates

Table 4.7 reports descriptive statistics for the key covariates that we include in our regression models. The regression sample consists of 25,785 person-year observations, 20,197 observations for West and 5,588 observations for East Germany.

Assuming that the measure κ is influenced by both demand side constraints and individual preferences, we first account for several individual characteristics, most notably education and age, as well as household characteristics, i.e. marital status and age of children in the household. To avoid endogeneity due to the "division bias" (Borjas, 1980), we use other household income instead of the hourly wage rate – the hourly wage rate is not observed and would have to be constructed from dividing monthly earnings through actual working hours which is part of the dependent variable, κ.

Although the household survey does not provide direct information on labour demand, we also include several variables reflecting both demand and supply elements, as e.g. tenure, firm size, and industry. In addition to variables that control for education, these set of occupational characteristics can be interpreted as a proxy for wages. Furthermore, we include the regional unemployment rate as an indicator of the local labour market situation[13] and the time of the interview to control for seasonal variations in working hours. The estimation strategy described in the next section allows to control for fixed effects and to include time constant variables.

13 We account for unemployment rates in 96 regional units, the so-called "Raumordnungsregionen".

4.3 Estimation strategy

The individual hours disequilibrium is defined as: $\kappa_{it} = h^*_{it} - h_{it}$, h^*_{it} denoting desired and h_{it} denoting actual working hours. In a formal theoretical model, we could model this difference as the difference between unconstrained hours of work resulting from individual optimisation conditional on individual gross wage, w_i, the tax and benefit function, χ, and taste-shifting characteristics, X_i:

$$h^*_{it} = f(U^{max}_{it} | w_{it}, \chi_t, X_{it}) \tag{4.1}$$

Observed actual hours would be modeled as a result of the constrained choice including demand restrictions (D_{it})[14]:

$$h_{it} = g(U^{max}_{it} | w_{it}, \chi_t, X_{it}, D_{it}). \tag{4.2}$$

The individual disequilibrium would then depend on a set of taste-shifting variables and on demand factors such as time of the interview and industry. Interestingly, health might affect both demand for and supply of labour, conditional on the wage level. It is equally possible to assume that individuals in poor health wish to work less to further reduce their workload or to raise hours of work to compensate for a reduced earnings capacity. At the same time, given that they are not free to adjust wages, employers may require individuals to work longer hours, despite a poor health status. Moreover, depending on its cause, poor health or disability may affect the disequilibrium in different ways. However, those employees who desire to work less may have difficulties to justify their working hours preference towards the employer.

Since κ_{it} is a combination of preferences and demand constraints, we assume a dynamic component in the hours disequilibrium. Table 4.1 documents (unconditional) transition probabilities for the three possible states. To begin with, we observe a relatively high probability to stay in a negative disequilibrium in the following period (78 percent). Secondly, those employees who want to reduce working hours in period t are very unlikely

14 Most recently, e.g., the widespread use of short-time work by German firms.

Table 4.1: Hours disequilibrium and transition probabilities

		Germany			West Germany			East Germany		
		κ_{t+1}			κ_{t+1}			κ_{t+1}		
		< 0	$= 0$	> 0	< 0	$= 0$	> 0	< 0	$= 0$	> 0
$\kappa_t^{(a)}$	<0	78.2	17.6	4.3	77.3	18.3	4.4	81.0	15.3	3.7
	=0	40.3	49.9	9.9	39.3	50.7	10.0	44.7	46.1	9.2
	>0	27.0	29.0	44.0	27.0	29.4	43.6	27.3	26.9	45.8

Notes: (a) κ denotes the difference between desired and actual working hours. Individuals can either be in equilibrium ($\kappa = 0$) or show a negative ($\kappa < 0$) or positive ($\kappa > 0$) deviation from the equilibrium.
Source: SOEP, own calculations

to prefer longer working hours in period $t + 1$ (4.3 percent). Only 44 percent show a positive disequilibrium in both periods t and $t + 1$, whereas a negative disequilibrium is the rule, without much adjustment over time. Thus, to model the state dependence of the process and to test for its significance, we apply a model with a lagged endogenous variable. Our basic specification of the estimated equation is:

$$\kappa_{it} = \delta\kappa_{i,t-1} + H_{it}\gamma + X_{it}\beta + \epsilon_{it} \tag{4.3}$$

$$\epsilon_{it} = \nu_i + e_{it} \tag{4.4}$$

where H_{it} denotes the variables that control for health, X_{it} specifies other observable characteristics including individual and demand-related variables, and ϵ_{it} comprises an individual fixed effect ν_i as well as a time-varying idiosyncratic error component e_{it}. We assume (a) no autocorrelation to remain in e_{it} after conditioning on $\kappa_{i,t-1}$ and X_{it}, (b) ν_i and e_{it} to be conditionally uncorrelated, and (c) e_{it} and all components in X_{it} to be at least pre-determined, i.e.:

$$E\left(e_{it}e_{i,t-\eta}|\kappa_{i,t-1},X_{it}\right) = 0; \quad \forall\eta > 0; \quad i = 1,\ldots,N; \quad t = 1,\ldots,T \tag{4.5}$$

$$E\left(\nu_i e_{it}|\kappa_{i,t-1},X_{it}\right) = 0; \quad i = 1,\ldots,N; \quad t = 1,\ldots,T \tag{4.6}$$

$$E\left(e_{it}X_{i,t+s}\right) = 0; \quad \forall X_{it},\ s = 1,2,\ldots; \quad i = 1,\ldots,N; \quad t = 1,\ldots,T \tag{4.7}$$

$$E\left(\kappa_{i1}e_{it}\right) = 0; \quad i = 1,\ldots,N; \quad t = 1,\ldots,T \tag{4.8}$$

We can estimate δ, *gamma* and β without further parametric assumptions about the distribution of the error components. The assumption that e_{it} is serially uncorrelated can be tested (see below). In particular, we allow the individual fixed effect to be correlated with the other explanatory variables. We cannot apply OLS to equation (4.3): this would lead to inconsistent estimates because of the dynamic panel bias (Nickell, 1981). Thus, we eliminate the fixed effect by taking first differences (Δ):

$$\Delta\kappa_{it} = \delta\Delta\kappa_{i,t-1} + \Delta H_{it}\gamma + \Delta X_{it}\beta + \Delta\epsilon_{it} \tag{4.9}$$

Given our assumptions in (4.5), appropriately lagged levels of κ_{it} can serve as instruments for $\Delta\kappa_{i,t-1}$ to estimate the model by GMM (Arellano and Bond, 1991; Holtz-Eakin et al., 1988). To increase efficiency, we also assume mean stationary of the autoregressive process and extend the estimator to the so called "system GMM" proposed by Arellano and Bover (1995) as well as Blundell and Bond (1998). The system GMM estimator is augmented by an equation in levels, for which we use lagged differences as instruments. The estimator allows to estimate the effects of time constant variables.

Because we model κ as a linear variable, we implicitly assume that changes in the regressors have the same effect on positive, negative and zero deviations from the equilibrium. This is a strong, but necessary assumption of our dynamic model. A model to control for selection bias in the context of hours mismatches has been suggested by Stewart and Swaffield (1997) and extended by Bryan (2007). However, none of the two suggestions controls for fixed effects which seems particularly important when dealing with health variables. Moreover, both studies only include a small number of regressors and make the strong assumption that job characteristics and labour market conditions influence the probability of a disequilibrium without affecting desired hours (exclusion restrictions to identify selection). Usually, though, no explicit information on demand side restrictions that we could use to identify such a model is available.

Finally, to select a valid model, we run standard tests for first and second order autocorrelation and test the overidentifying restrictions using the Hansen J test. In so doing, we test whether the instruments, as a group, prove to be exogenous. Moreover, we calculate difference-in-Hansen statistics to test the validity of two subsets (lagged levels and lagged differences) of the instruments. In contrast to the Sargan test, the Hansen test is robust to heteroskedasticity. However, the power of this test declines when the instrument count is high, so that we choose a "small" set of instruments using two lags. Results turn out to be robust to variations in the time window of instruments.

4.4 Results

Table 4.2 presents the results of the system GMM estimation for the full sample as well as for the East and West German subsamples. All specifications pass the test for autocorrelation as well as the tests for overidentifying restrictions with all tested subsets of instruments.

When examining the coefficient of the lagged dependent variable for the overall sample, we observe significant but small (0.09) evidence for persistence in the hours disequilibrium. The effect is driven by the West German subsample with a slightly higher coefficient of 0.11, whereas the effect remains insignificant in East Germany.[15] We have to interpret this effect as follows: in West Germany, the current hours disequilibrium is 0.11 hours larger than it would have been given an equilibrium in the previous year ($\kappa_{i,t-1} = 0$). This holds for both positive and negative deviations from the equilibrium. The small or insignificant coefficient indicates that the state dependence revealed in our descriptive analysis is in all likelihood caused by other factors than the disequilibrium itself.[16]

In the overall sample and in the West German subsample, the coefficients on SAH ("poor health") remain stable and significant across specifications. The system GMM estimation suggests a negative effect of about 0.69 hours of poor health on the hours disequilibrium, male employees in poor health being more likely to reduce working hours. Since the long run multiplier is small, the effect increases only slightly to -0.77 hours when the dynamics are taken into account. However, the effect is statistically significant and amounts to roughly 16 percent of the average disequilibrium of -4.4 weekly working hours. Assuming an average month of 4.33 weeks, the effect equals a preference to reduce working hours by three hours per month or 36 hours per year, i.e. almost a whole full-time work week. No such effects can be found for East Germany. Thus, although we observe predominantly

15 The effect for West Germany implies a fairly low long run multiplier of 1.13 ($\frac{1}{1-\delta}$).

16 As additional specification test, we compare the estimated coefficients of the lagged dependent variable with OLS and Fixed Effects estimates of equation (4.3). A consistent estimate should fall between the lower bound (Fixed Effects) and upper bound (OLS) the two other estimators define (Bond, 2002; Nickell, 1981). Table 4.11 in the Appendix to this chapter shows the expected pattern: OLS estimates are biased upwards and lie around 0.4, whereas Fixed Effects estimates are even negative.

Table 4.2: Dynamic GMM models for the hours disequilibrium by region

	Germany		West Germany		East Germany	
κ_{t-1}	0.086**	(0.017)	0.114**	(0.020)	0.018	(0.028)
Poor health = 1	−0.551	(0.344)	−0.686**	(0.238)	0.354	(0.598)
Disability = 1	0.002	(0.488)	0.110	(0.289)	−0.080	(0.889)
Age	−0.295†	(0.176)	−0.409**	(0.120)	0.022	(0.284)
$Age^2/10$	0.028	(0.019)	0.040**	(0.014)	−0.005	(0.033)
Years of education (ref. 11-12):						
<11	−0.168	(0.732)	−0.015	(0.181)	−0.155	(0.541)
>12	−0.541†	(0.298)	−0.435†	(0.232)	−0.505	(0.538)
Married = 1	−0.134	(0.307)	−0.072	(0.230)	−0.803	(0.512)
HH with children between						
...age 0-4 in HH	0.024	(0.199)	0.055	(0.181)	−0.260	(0.483)
...age 5-10 in HH	−0.126	(0.208)	−0.172	(0.149)	0.340	(0.398)
...age 11-18 in HH	0.148	(0.162)	0.213	(0.146)	0.102	(0.312)
Other income /1000	−0.097	(0.067)	−0.087*	(0.040)	−0.168	(0.114)
Job charateristics:						
Tenure	0.042†	(0.022)	0.042**	(0.010)	0.050*	(0.019)
Firm size (ref. 21-200 employees):						
1-20 employees	0.135	(0.263)	0.091	(0.278)	0.039	(0.413)
201-2000 employees	0.457†	(0.236)	0.550**	(0.175)	0.181	(0.438)
2001+ employees	0.676*	(0.263)	0.653**	(0.176)	1.117*	(0.492)
Occupation (ref. Blue collar, low qual.)						
Blue collar, qual.	−0.640*	(0.266)	−0.480*	(0.192)	−1.108*	(0.468)
Foreman	−1.726**	(0.323)	−1.727**	(0.288)	−1.783**	(0.624)
White collar, low qual.	−0.879*	(0.349)	−0.454	(0.352)	−2.023**	(0.678)
White collar, qual.	−1.766**	(0.338)	−1.472**	(0.247)	−2.652**	(0.683)
White collar, high qual.	−3.586**	(0.335)	−3.328**	(0.293)	−4.465**	(0.699)
Civil Servant	−3.260**	(0.655)	−2.778**	(0.387)	−3.947**	(0.859)
Public sector employee	1.444**	(0.303)	1.170**	(0.257)	2.057**	(0.549)
Changed job	0.175	(0.219)	−0.178	(0.239)	1.238**	(0.418)
Regional indicators:						
Regional unemployment rate	0.039	(0.429)	−0.039	(0.029)	0.055	(0.063)
Selection indicators:						
Sample attrition indicator	−0.194	(0.315)	−0.248	(0.335)	−0.382	(0.641)
IMR	0.931	(1.508)	1.326	(0.957)	−0.880	(1.894)
East German	−1.616	(7.307)				
Constant	2.436	(6.979)	5.698*	(2.623)	−6.011	(6.074)
Year dummies	Yes		Yes		Yes	
Industry dummies	Yes		Yes		Yes	
Interview month	Yes		Yes		Yes	
AR1 test	0.000		0.000		0.000	
AR2 test	0.166		0.206		0.433	
Hansen J Test (DF)	24.09 (21)		27.11 (22)		12.80 (22)	
p-value	0.289		0.207		0.939	
Test instrument subsets:						
Excl. first diff. instruments (DF)	16.84 (13)		19.61 (14)		7.70 (14)	
p-value	0.207		0.143		0.904	
Difference-in-Hansen (DF)	7.25 (8)		7.50 (8)		5.10 (8)	
p-value	0.510		0.484		0.747	
Excl. level instruments (DF)	9.26 (11)		11.30 (12)		7.93 (12)	
p-value	0.598		0.504		0.790	
Difference-in-Hansen (DF)	14.83 (10)		15.82 (10)		4.86 (10)	
p-value	0.138		0.105		0.900	
No. of groups	5,708		4,516		1,230	
Obs.	25,785		20,197		5,588	

Notes: Standard errors in parentheses; Significance levels: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Source: SOEP, own calculations

negative disequilibria in the East German subsample as well, the subjective health status has no effect on the desire to reduce working hours. This unexpected result proves to be remarkably stable.

In contrast to the subjectively assessed health status and consistent with our initial expectation, the effect of the disability status remains insignificant across all models. One has to keep in mind that our results do not apply to unemployed individuals with disability status. However, it is plausible to assume that a non negligible part of this group has difficulties in finding a job because the hours (and wage) arrangements that employers offer are incommensurate with their disability.

East and West Germany also differ with regard to the effect of personal and household characteristics. Whereas age, education and other household income significantly influence the hours disequilibrium in West Germany, none of these variables shows a significant effect in East Germany. To give an example, the age profile reveals a growing dissatisfaction with working hours until the age of about 51 years in the West German subsample. Afterwards, dissatisfaction prevails but remains relatively stable until the age of 59. Marital status and children in the household have no significant effect in neither West nor East Germany. When comparing results for our controls of supply and demand effects, results show that the effects are generally similar in significance and sign, but stronger in the East German subsample. As for occupational groups, we find that the higher the required qualification for the current job, the higher the preferred reduction in working hours. Given that employees in higher occupational groups typically work higher-than-average hours, this finding seems plausible.

Table 4.3: Dynamic GMM models: health and other income interacted

	Germany		West Germany		East Germany	
L.κ	0.085**	(0.016)	0.114**	(0.020)	0.018	(0.028)
PH = 1	−0.247	(0.301)	−0.320	(0.314)	0.242	(0.858)
PH = 1 × Other income/1000	−0.195	(0.130)	−0.259*	(0.129)	0.075	(0.409)
Other income /1000	−0.093*	(0.040)	−0.067	(0.041)	−0.173	(0.113)
$\varepsilon \vert PH = 0$	0.028		0.020		0.051	
$\varepsilon \vert PH = 1$	0.087		0.098		0.029	

Notes: Standard errors in parentheses; Significance levels: † p <0.10, * p <0.05, ** p <0.01
PH := poor health; ε := income elasticity; x1 := other income; x2 := otherincome × PH:
$(\varepsilon|PH = 0) = \beta^{x1} \times (\overline{x1}/\overline{\kappa})$
$(\varepsilon|PH = 1) = (\beta^{x1} + \beta^{x2 \times PH}) \times (\overline{x2}/\overline{\kappa})$
Source: SOEP, own calculations

The significant effect of other household income in the West German subsample is easier to interpret as an elasticity. We calculate the elasticity by multiplying the estimated coefficient with the ratio of the mean of other household income divided by the mean hours disequilibrium (for a detailed documentation see Table 4.7). The resulting elasticity is about 0.026. We have to interpret this small positive elasticity as follows: if other household income increased by 100 percent, the hours disequilibrium would increase by 2.6 percent. This low elasticity is plausible as it does not represent a change in own hourly wage rate but in other household income. However, we also tested whether the effect of other household income varies with respondents' health status. The interaction effect is significant, and as documented in Table 4.3, the elasticity indeed proves to be almost five times larger for employees in bad health, amounting to 0.098.

The results from the alternative specifications of the health variable (see Section 4.2.2) are shown in Tables 4.4 and 4.5. Table 4.4 shows the results of the model which includes four dummy variables to measure SAH with "satisfactory" health status as reference category. It reveals results very similar to the original model. The four health dummies are jointly significant in both the overall model and in the West German subsample, whereas they remain insignificant in East Germany. Moreover, results turn out to be more differentiated in the West German subsample than revealed in the main model. Interestingly, the relative effect of bad or very bad health at the one extreme and good or very good health at the other extreme is even larger than the effect of the dichotomized dummy variable that we used in our main model. When comparing the extreme categories, the difference amounts to over 1.5 hours. However, one should keep in mind that numbers

Table 4.4: Dynamic GMM models: disaggregated SAH

	Germany		West Germany		East Germany	
L.κ	0.085^{**}	(0.016)	0.114^{**}	(0.020)	0.019	(0.028)
SAH (ref. Satisfactory)						
Very good	$0.431^{\dagger}$	(0.229)	0.721^{**}	(0.239)	-1.245^{*}	(0.556)
Good	0.294^{*}	(0.124)	0.350^{**}	(0.130)	0.020	(0.244)
Bad	$-0.385^{\dagger}$	(0.231)	$-0.470^{\dagger}$	(0.243)	0.264	(0.426)
Very bad	−0.185	(0.563)	−0.636	(0.624)	1.038	(1.086)
Disability = 1	0.146	(0.282)	0.157	(0.288)	−0.147	(0.898)
Joint sig. (p-value)	0.033		0.001		0.123	

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
Source: SOEP, own calculations

of observations are rather small in the extreme categories.

Finally, Table 4.5 reports the results for variants (a), (b), and (c), which use different specifications of health satisfaction as health indicator. The findings support our previous results: the health status turns out to have a significant effect only in West Germany. The disability status remains insignificant across all three specifications. Regarding effect size, models are not directly comparable. For the linear model specification (a) we observe a coefficient of -0.144, indicating that a one point decrease in health satisfaction leads to an increase in the hours disequilibrium by about three percent. The effect size is similar to the one we observed for the five-scale measure of SAH. In the non-linear specification (b), however, the effect turns out to be much smaller.

Table 4.5: Dynamic GMM models: health satisfaction

	Germany			West Germany			East Germany		
	a	b	c	a	b	c	a	b	c
L.κ	0.085**	0.086**	0.086**	0.115**	0.115**	0.115**	0.016	0.016	0.017
	(0.016)	(0.017)	(0.016)	(0.020)	(0.020)	(0.020)	(0.028)	(0.028)	(0.028)
Linear HSAT	−0.126**			−0.144**			−0.009		
	(0.037)			(0.038)			(0.077)		
Log HSAT		−0.327**			−0.389**			0.050	
		(0.100)			(0.104)			(0.234)	
(ref. HSAT 2)									
HSAT 0-1			0.158			0.265†			−0.380
			(0.146)			(0.153)			(0.369)
HSAT 3			−0.133			−0.173			−0.252
			(0.131)			(0.142)			(0.270)
HSAT 4			−0.382*			−0.631**			0.120
			(0.175)			(0.192)			(0.305)
HSAT 5			−0.498**			−0.398†			−0.491
			(0.189)			(0.203)			(0.353)
HSAT 6-10			−0.485*			−0.475*			−0.181
			(0.230)			(0.241)			(0.434)
Disability = 1	0.176	0.180	0.181	0.195	0.207	0.210	−0.103	−0.115	−0.091
	(0.283)	(0.282)	(0.282)	(0.287)	(0.286)	(0.286)	(0.906)	(0.903)	(0.906)
Joint sig. (p-value)			0.022			0.001			0.349

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01.
a: linear model; b: log model; c: disaggregated model. HSAT denotes health satisfaction. Scale: 0 "very satisfied", 10 "not at all satisfied".
Source: SOEP, own calculations

4.5 Conclusions

The relationship between health and labour market activity can be considered a key issue for employment policies and an important aspect of understanding individual economic behaviour. While it is relatively well established that health plays an important role in determining employment, its effect on productivity as well as on choices and opportunities in terms of the "intensive margin" are not yet researched very well. We believe that if labour market policies, which aim at increasing employment, are to be effective, in particular concerning participation of older individuals, more attention ought to be given to the constraints imposed by poor health on both employees and those who seek employment. This chapter focused on the former group and allows us to draw several fundamental policy implications from our quantitative results.

Using data on prime-age men from the German Socio-Economic Panel study for the years 1996-2007, we examined the effect of health on the hours of work disequilibrium, defined as the difference between desired and actual working hours. The analysis has been set in a dynamic framework to capture state dependence of the disequilibrium at work. Focusing on the sample of employees and further limiting it to allow for a dynamic estimation required substantial sample restrictions.

In our descriptive analysis, the hours disequilibrium appears to be relatively persistent. However, after controlling for a broad set of covariates and fixed personal and job characteristics, the estimated coefficient of the lagged endogenous variable only results in a small (West Germany) or an insignificant (East Germany) effect. Regarding policy demands of higher labour market flexibility, this is positive evidence and implies that hours mismatches have no strong inherent state dependence.

The system GMM estimation suggests a negative effect of poor health of about 0.69 hours on the hours disequilibrium. Less healthy male employees desire to reduce their work intensity. Since the long run multiplier is low (low state dependence), this effect increases only slightly to 0.77 hours when we take the dynamics into account. The economic relevance of this effect is not negligible. It amounts to roughly 16 percent of the average disequilibrium of -4.4 weekly working hours. Assuming an average month of 4.33 weeks, the effect equals a reduction of three hours per month or 36 hours per year, i.e. a reduction of almost one full-time working week. No such effects can be found in the East German subsample, which reveals the importance to regionally differentiate labour market analyses for Germany. Although observed disequilibria were predominantly negative, the subjective health status has no effect in this subsample. This is an unexpected and remarkably stable result.

In West Germany, we find a small but significant income elasticity of the hours disequilibrium. The elasticity turns out to be about five times larger for men in poor health. We run several robustness checks which do not alter our conclusions. Results are robust to the functional form of the health measure and deliver qualitatively similar results when using a different health measure.

In both regions, household characteristics play no important role for the hours match. Since our focus is on prime age males, this evidence is interesting but plausible: the male breadwinner model still constitutes the predominant household model in West Germany. In East Germany, women and men work generally full-time.

The effects of job characteristics are mostly significant, have the same sign and a similar magnitude in East and West Germany. Generally, jobs that imply longer working hours have a strong negative effect on the hours match in comparison to other jobs.

In accordance with our initial expectations, the analysis reveals no effect of disability status on the hours disequilibrium. We interpret this evidence as reflecting the strong position of legally disabled individuals in the labour market: their stronger bargaining position allows disabled individuals to chose their hours of work more freely than the reference group. As far as employment relationships of only short duration are concerned, our results can as well be interpreted as reflecting a particular selection process: since the disability is known to the employer at the time she/he hires the individual, he/she knows about the limitations of her/his capacities.

Appendix

4.A Tables

Table 4.6: Number of observations and health status by year

Year	Total			Working			Non-working		
	Obs.	PH[(a)]	Disab.[(b)]	Obs.[(c)]	PH	Disab.	Obs.	PH	Disab.
1998	3,058	0.12	0.09	2,599	0.10	0.07	459	0.24	0.16
1999	2,934	0.12	0.08	2,541	0.10	0.07	393	0.28	0.19
2000	4,791	0.12	0.08	4,185	0.10	0.07	606	0.30	0.18
2001	4,412	0.12	0.08	3,834	0.10	0.07	578	0.31	0.19
2002	4,809	0.12	0.08	4,212	0.09	0.07	597	0.30	0.16
2003	4,474	0.12	0.08	3,845	0.10	0.07	629	0.25	0.14
2004	4,334	0.13	0.09	3,758	0.11	0.07	576	0.26	0.16
2005	3,897	0.14	0.09	3,360	0.11	0.08	537	0.30	0.19
2006	3,927	0.13	0.09	3,386	0.11	0.07	541	0.26	0.17
Total	36,636	0.12	0.08	31,720	0.10	0.07	4916	0.28	0.17

Notes: (a) "PH" denotes the share of men in poor health. (b) "Disab." denotes the share of men in disability. (c) The number of observations differs from the sample in Table 4.2 because we also included the first observations.

Source: SOEP, own calculations

Table 4.7: Descriptive statistics: Regression samples

	Germany	West Germany	East Germany
Desired working hours	39.021	38.873	39.557
Working hours	43.643	43.282	44.950
κ	−4.622	−4.409	−5.393
$\kappa < 0$ (%)	63.035	61.484	68.666
$\kappa = 0$ (%)	26.831	27.955	22.750
$\kappa > 0$ (%)	10.134	10.561	8.583
$\kappa \vert \kappa < 0$	−8.144	−8.012	−8.576
$\kappa \vert \kappa > 0$	5.103	4.883	6.084
Poor health = 1	0.102	0.106	0.090
SAH (disaggregated):			
Very good	0.079	0.086	0.055
Good	0.489	0.489	0.489
Satisfactory	0.329	0.319	0.366
Bad	0.091	0.095	0.080
Very bad	0.011	0.011	0.010
Disability	0.071	0.077	0.049
Regional unemployment rate	11.414	9.312	19.013
East German	0.217	0.000	1.000
Age	43.782	43.614	44.388
Years of education:			
<11	0.323	0.375	0.137
11-12	0.353	0.307	0.521
>12	0.324	0.319	0.342
Married = 1	0.785	0.787	0.778
HH with children between			
...age 0-4 in HH	0.133	0.147	0.082
...age 5-10 in HH	0.235	0.259	0.150
...age 11-18 in HH	0.330	0.322	0.357
Other income /1000	1.388	1.332	1.588
Job charateristics:			
Tenure	13.577	14.308	10.939
Firm size:			
1-20 employees	0.157	0.135	0.234
20-200	0.305	0.280	0.393
201-2000 employees	0.257	0.275	0.189
2001+ employees	0.282	0.309	0.184
Blue collar, low qual.	0.146	0.157	0.104
Blue collar, qual.	0.234	0.204	0.341
Foreman	0.075	0.069	0.098
White collar, low qual.	0.039	0.036	0.050
White collar, qual.	0.153	0.163	0.117
White collar, high qual.	0.249	0.255	0.227
Civil Servant	0.104	0.115	0.063
Public sector employee	0.248	0.244	0.259
Changed job	0.067	0.064	0.076
Obs.	25,785	20,197	5,588

Notes: κ denotes the difference between desired and actual working hours. Individuals can either be in equilibrium ($\kappa = 0$) or show a negative ($\kappa < 0$) or positive ($\kappa > 0$) deviation from the equilibrium.
Source: SOEP, own calculations

Table 4.8: Distribution of working hours by region, health status and year

	All				Good health				Bad health			
Year	∅	p(25)	p(50)	p(75)	∅	p(25)	p(50)	p(75)	∅	p(25)	p(50)	p(75)
Germany												
1998	43.5	39.0	42.0	48.0	43.5	39.0	42.0	48.0	43.5	38.5	41.0	48.0
1999	43.4	39.0	41.0	48.0	43.5	39.0	41.0	48.0	43.2	38.5	40.0	49.5
2000	43.7	40.0	42.0	47.0	43.8	40.0	42.0	47.0	42.4	38.5	40.0	45.0
2001	43.5	40.0	42.0	47.5	43.6	40.0	42.0	47.5	43.0	38.5	41.0	48.0
2002	44.0	40.0	42.0	48.0	44.0	40.0	42.0	48.0	43.3	38.5	41.0	48.0
2003	43.7	40.0	42.0	48.0	43.7	40.0	42.0	48.0	43.2	38.5	40.0	47.8
2004	43.8	40.0	42.0	48.0	43.9	40.0	42.0	48.0	42.9	39.0	41.0	47.0
2005	43.9	40.0	42.0	48.0	44.0	40.0	42.0	48.0	42.9	40.0	41.0	46.0
2006	43.9	40.0	42.0	48.0	43.9	40.0	42.0	48.0	43.4	40.0	42.0	48.0
Total	43.7	40.0	42.0	48.0	43.8	40.0	42.0	48.0	43.1	38.5	41.0	47.5
West Germany												
1998	42.6	38.5	40.0	45.0	42.6	38.5	40.0	45.0	42.8	38.5	40.0	47.0
1999	42.9	38.5	40.0	45.0	42.9	38.5	40.0	45.0	42.5	38.0	40.0	46.0
2000	43.2	39.0	40.0	45.0	43.4	39.0	41.0	45.0	42.0	38.5	40.0	45.0
2001	43.2	38.5	40.0	45.8	43.2	38.5	40.0	46.0	43.0	38.5	40.0	45.0
2002	43.7	40.0	42.0	48.0	43.8	40.0	42.0	48.0	42.8	38.5	40.0	46.0
2003	43.4	39.0	41.0	47.0	43.5	39.0	41.3	47.0	42.4	38.5	40.0	45.0
2004	43.6	40.0	42.0	47.0	43.6	40.0	42.0	47.0	42.9	38.5	41.0	47.0
2005	43.7	40.0	42.0	48.0	43.8	40.0	42.0	48.0	42.7	39.0	41.0	46.0
2006	43.7	40.0	42.0	48.0	43.8	40.0	42.0	48.0	43.2	39.5	42.0	48.0
Total	43.4	39.0	41.0	47.0	43.5	39.0	41.5	47.0	42.7	38.5	40.0	46.0
East Germany												
1998	46.0	40.0	45.0	50.0	46.1	40.0	45.0	50.0	45.5	40.0	44.0	50.0
1999	45.1	40.0	44.0	50.0	45.1	40.0	44.0	50.0	45.4	40.0	42.0	50.0
2000	45.3	40.0	44.0	50.0	45.4	40.0	44.0	50.0	44.1	40.0	43.0	50.0
2001	44.7	40.0	43.0	50.0	44.9	40.0	43.0	50.0	43.0	40.0	42.0	50.0
2002	45.1	40.0	44.0	50.0	45.0	40.0	44.0	50.0	45.6	40.0	45.0	50.0
2003	44.7	40.0	43.0	50.0	44.5	40.0	43.0	50.0	46.8	40.0	43.0	52.0
2004	44.5	40.0	43.0	50.0	44.7	40.0	43.0	50.0	42.6	40.0	40.5	45.6
2005	44.4	40.0	42.5	48.5	44.4	40.0	43.0	49.0	44.0	40.0	42.0	48.0
2006	44.5	40.0	43.0	48.0	44.6	40.0	43.0	48.0	44.1	40.0	42.0	50.0
Total	44.9	40.0	43.0	50.0	45.0	40.0	43.8	50.0	44.5	40.0	42.0	50.0

Notes: (a) ∅ denotes the mean; p(25), p(50), p(75) the respective percentiles.
Source: SOEP, own calculations

Table 4.9: Distribution of desired working hours by region, health status and year

Year	All				Good health				Bad health			
	∅[(a)]	p(25)	p(50)	p(75)	∅	p(25)	p(50)	p(75)	∅	p(25)	p(50)	p(75)
Germany												
1998	38.1	35.0	40.0	40.0	38.1	35.0	40.0	40.0	37.5	35.0	38.0	40.0
1999	38.7	35.0	40.0	40.0	38.8	35.0	40.0	40.0	38.3	35.0	40.0	40.0
2000	38.9	36.0	40.0	40.0	39.0	36.0	40.0	40.0	38.4	35.0	40.0	40.0
2001	39.0	36.0	40.0	40.0	39.0	36.5	40.0	40.0	38.5	35.0	40.0	40.0
2002	39.1	36.0	40.0	40.0	39.2	36.5	40.0	40.0	38.4	35.0	40.0	40.0
2003	39.2	37.0	40.0	40.0	39.2	37.0	40.0	40.0	38.6	35.0	40.0	40.0
2004	39.2	37.0	40.0	40.0	39.2	37.0	40.0	40.0	39.2	35.0	40.0	40.0
2005	39.4	37.5	40.0	40.0	39.4	37.5	40.0	40.0	38.9	35.0	40.0	40.0
2006	39.3	37.5	40.0	40.0	39.4	38.0	40.0	40.0	38.1	36.3	40.0	40.0
Total	39.0	36.0	40.0	40.0	39.1	36.5	40.0	40.0	38.5	35.0	40.0	40.0
West Germany												
1998	37.8	35.0	39.0	40.0	37.9	35.0	39.0	40.0	37.1	35.0	38.0	40.0
1999	38.4	35.0	40.0	40.0	38.4	35.0	40.0	40.0	37.9	35.0	38.0	40.0
2000	38.7	35.0	40.0	40.0	38.7	35.5	40.0	40.0	38.5	35.0	38.5	40.0
2001	38.9	36.0	40.0	40.0	38.9	36.0	40.0	40.0	38.4	35.0	38.5	40.0
2002	39.0	36.0	40.0	40.0	39.1	36.0	40.0	40.0	37.8	35.0	38.5	40.0
2003	39.0	36.0	40.0	40.0	39.1	36.0	40.0	40.0	38.2	35.0	38.5	40.0
2004	39.1	36.0	40.0	40.0	39.1	37.0	40.0	40.0	39.0	35.0	40.0	40.0
2005	39.3	37.5	40.0	40.0	39.4	37.5	40.0	40.0	38.6	35.0	40.0	40.0
2006	39.2	37.5	40.0	40.0	39.3	37.5	40.0	40.0	38.0	35.0	40.0	40.0
Total	38.9	36.0	40.0	40.0	38.9	36.0	40.0	40.0	38.2	35.0	38.5	40.0
East Germany												
1998	38.9	38.0	40.0	40.0	39.0	38.0	40.0	40.0	38.8	35.0	40.0	40.0
1999	39.8	38.0	40.0	40.0	39.9	38.0	40.0	40.0	39.3	36.0	40.0	42.0
2000	39.6	38.0	40.0	40.0	39.7	38.0	40.0	40.0	37.9	35.0	40.0	40.0
2001	39.4	38.0	40.0	40.0	39.5	38.0	40.0	40.0	38.6	38.0	40.0	40.0
2002	39.8	38.0	40.0	40.0	39.7	38.0	40.0	40.0	41.1	40.0	40.0	40.0
2003	39.8	38.0	40.0	40.0	39.7	38.0	40.0	40.0	40.5	40.0	40.0	40.0
2004	39.4	38.0	40.0	40.0	39.4	38.0	40.0	40.0	40.4	40.0	40.0	40.0
2005	39.6	38.0	40.0	40.0	39.5	38.0	40.0	40.0	40.3	40.0	40.0	40.0
2006	39.8	38.0	40.0	40.0	39.9	38.0	40.0	40.0	38.9	38.0	40.0	40.0
Total	39.6	38.0	40.0	40.0	39.6	38.0	40.0	40.0	39.5	38.0	40.0	40.0

Notes: (a) ∅ denotes the mean; p(25), p(50), p(75) the respective percentiles.
Source: SOEP, own calculations

Table 4.10: Hours disequilibrium by region, health status and year

Year	All					Good health					Bad health				
	$\kappa < 0$		$\kappa = 0$	$\kappa > 0$		$\kappa < 0$		$\kappa = 0$	$\kappa > 0$		$\kappa < 0$		$\kappa = 0$	$\kappa > 0$	
	%	∅	%	%	∅	%	∅	%	%	∅	%	∅	%	%	∅
Germany															
1998	66.9	-8.5	20.0	13.0	4.7	66.7	-8.5	20.0	13.4	4.7	69.4	−9.0	20.6	10.1	4.1
1999	63.9	-8.2	24.1	11.9	4.9	64.1	-8.1	24.2	11.8	5.0	62.9	−8.9	23.7	13.5	4.3
2000	62.2	-8.5	28.4	9.4	5.6	62.4	-8.5	28.5	9.1	5.3	59.6	−8.7	27.5	12.9	7.3
2001	61.3	-8.3	29.6	9.1	5.7	61.4	-8.2	29.8	8.8	5.7	60.4	−9.1	27.9	11.7	5.8
2002	61.5	-8.7	28.9	9.6	6.0	61.5	-8.7	28.9	9.6	5.9	61.5	−8.9	28.8	9.8	6.8
2003	59.9	-8.4	30.3	9.9	5.6	60.0	-8.3	30.4	9.6	5.5	58.9	−8.9	29.0	12.1	7.1
2004	63.1	-8.1	26.7	10.2	5.1	63.8	-8.0	26.6	9.6	4.9	57.1	−8.6	28.2	14.7	5.8
2005	61.0	-8.3	28.8	10.2	5.4	61.1	-8.4	28.8	10.1	5.3	60.3	−8.0	29.0	10.7	6.1
2006	66.2	-8.0	22.7	11.2	5.5	66.0	-7.9	23.0	11.0	5.4	67.7	−8.9	19.9	12.4	6.2
Total	62.6	-8.3	27.1	10.3	5.4	62.8	-8.3	27.1	10.1	5.3	61.6	−8.8	26.4	12.0	6.1
West Germany															
1998	65.2	-8.2	20.2	14.6	4.5	65.0	-8.2	20.0	15.0	4.5	66.8	−8.5	22.8	10.3	3.3
1999	63.4	-7.8	24.1	12.5	4.6	63.3	-7.7	24.3	12.4	4.7	64.3	−8.4	22.0	13.7	3.8
2000	60.6	-8.3	29.5	9.9	5.2	61.0	-8.4	29.4	9.6	5.0	56.9	−8.1	30.5	12.6	7.1
2001	59.7	-8.1	31.2	9.1	5.6	59.6	-8.0	31.3	9.1	5.6	59.9	−8.9	30.1	9.9	5.7
2002	59.8	-8.7	30.2	10.0	5.7	59.7	-8.6	30.3	10.0	5.7	60.9	−9.0	29.2	9.9	6.0
2003	58.4	-8.3	31.5	10.1	5.5	58.5	-8.3	31.7	9.8	5.3	57.7	−8.9	29.6	12.7	7.1
2004	61.6	-8.0	27.9	10.4	5.0	62.2	-7.9	27.9	9.9	4.7	57.0	−8.9	28.0	14.9	6.1
2005	60.2	-8.3	29.4	10.4	5.1	60.2	-8.3	29.5	10.3	4.9	60.1	−8.3	28.7	11.2	6.1
2006	65.8	-8.0	22.9	11.3	5.4	65.4	-7.8	23.4	11.2	5.2	69.2	−8.8	19.0	11.9	6.9
Total	61.3	-8.2	28.0	10.7	5.2	61.4	-8.2	28.1	10.5	5.1	60.9	−8.7	27.1	11.9	6.0
East Germany$^{(b)}$															
1998	72.3	-9.4	19.3	8.4	5.8	71.8	-9.3	19.9	8.3	5.7	76.6	−10.4	14.1	9.4	6.7
1999	65.6	-9.3	24.2	10.2	6.0	66.4	-9.2	23.7	9.9	6.0	58.7	−10.7	28.6	12.7	5.9
2000	67.6	-9.1	24.6	7.8	7.1	67.3	-8.9	25.5	7.2	6.9	70.5	−10.6	15.4	14.1	8.0
2001	67.2	-8.7	24.0	8.8	6.1	67.7	-8.7	24.5	7.9	6.1	62.2	−9.6	18.9	18.9	6.1
2002	68.1	-8.7	23.9	8.0	7.2	68.4	-8.7	23.6	8.0	6.8	64.2	−8.7	26.9	9.0	11.3
2003	65.5	-8.5	25.6	8.9	6.3	65.5	-8.5	25.6	8.9	6.3	64.6	−8.9	26.2	9.2	6.5
2004	68.8	-8.4	22.2	9.0	5.5	69.9	-8.5	21.6	8.6	5.8	57.6	−7.6	28.8	13.6	3.9
2005	64.1	-8.7	26.8	9.1	6.7	64.4	-8.8	26.4	9.2	6.8	61.3	−6.8	30.6	8.1	5.6
2006	67.7	-8.2	21.7	10.7	5.8	68.4	-8.1	21.4	10.3	6.1	60.7	−9.4	24.6	14.8	3.7
Total	67.4	-8.8	23.7	8.9	6.3	67.7	-8.7	23.7	8.6	6.3	64.2	−9.3	23.5	12.3	6.3

Notes: (a) κ denotes the difference between desired and actual working hours. Individuals can either be in equilibrium ($\kappa = 0$) or show a negative ($\kappa < 0$) or positive ($\kappa > 0$) deviation from the equilibrium; % denotes the share of men in the respective states; ∅ denotes the mean deviation for each group. (b) The number of observations of East German men who want to work more than they actually do ($\kappa > 0$) and who are in bad health is below 20 for all years.

Source: SOEP, own calculations

Table 4.11: OLS and Fixed Effects estimates of the state dependence parameter

	Germany		West Germany		East Germany	
	OLS	FE	OLS	FE	OLS	FE
L.κ	0.435**	-0.073**	0.440**	-0.057**	0.412**	-0.135**
	(0.009)	(0.007)	(0.011)	(0.008)	(0.019)	(0.014)
Observations	25,785	25,785	20197	20,197	5,588	5588

Notes: Standard errors in parentheses; Significance levels: † p <0.10, ∗ p <0.05, ∗∗ p <0.01
Source: SOEP, own calculation

5 Conclusion

5.1 Main results

The rapid demographic ageing in Germany is putting pressure on social security systems. In addition, high and persistent unemployment and the increase of atypical employment have already had a massive impact on the employment biographies of younger cohorts. The economic risk of involuntary unemployment has a strong link to individual resources such as health and education. This cumulative dissertation contributes to the literature by addressing economic risks from three different perspectives. The first contribution took a general view on labour market changes, pension reforms, and on the impact of both on the development of future pensions. The second contribution focused on the relationship between short-term risks of unemployment and health and asked whether individuals take financial precautions against the related income risks. The above mentioned social challenges will most probably require individuals to generally work longer. A crucial precondition for rising employment rates of older employees will be sufficient individual flexibility to reconcile job requirements with age-related working time preferences. Therefore, the third contribution was dedicated to the question how flexible working hours react to individual preferences.

The first chapter showed that the decrease in pension levels due to the factor for private pensions ("Riester-Treppe") and the sustainability factor is accompanied by changing employment biographies. While the general impact of pension reforms on pension levels is negative, changes in labour market activities across cohorts have different implications. In addition to a separate empirical treatment for genders, the analysis particularly emphasises the importance of differentiation by regional and educational characteristics. We find that the increased labour market participation of West German women has led to a massive reduction of periods of inactivity in younger cohorts. According to our simulation results, West German women are the only group that will actually be able to increase pension levels in the future. However, if we take a closer look, we find that this trend does not hold for the group of low educated women. This is not visible in the general trend since the share of this group decreases in younger cohorts. This finding highlights the growing importance of education and is confirmed for the group of low educated West German men. Whereas West German men generally show a more or less stable development of employment over the life-cycle so that pensions mostly decrease due to pension reforms, the subgroup of low educated men who were able to reach relatively high pension levels in the past are likely to face lower pension levels in the future.

The picture is completely different for East Germany. Although the better educated can expect a slightly more favourable pension development, the general trend that our estimations reveal is a broad and strong decrease of average pensions in younger cohorts. This trend is to a large extent driven by the poor labour market development after reunification. According to our base scenario, average pension levels for both men and women will fall below the social minimum. However, this grim projection is put into perspective when we take into account the uncertainty of a simulation over such a long period. The longer the projection period the higher the uncertainty. If labour markets and employment recover in East Germany, the general trend can be mitigated.

The second chapter adds a short-term perspective on income risks. It shows that individuals save a considerable amount of resources as a financial precaution against unemployment and health shocks. As a contribution to the large and growing empirical literature on precautionary savings, this essay proposes a simulated ex-ante income uncertainty measure. Ex-ante risk measures have not been applied frequently in the literature. Instead realized income uncertainty has been used to create ex-post variances. This approach misses an important property of precautionary behaviour: individuals take financial precautions for events that do not actually have to happen. As a consequence, a convincing measure of income risk should incorporate counterfactual information.

The remarkably stable results reveal that income uncertainty explains about 14 to 16 percent of monthly savings flows – conditional on positive savings. This result holds whether or not the model is estimated in logs or in level-form including zero-savings observations. The buffer-stock wealth model results in a very similar amount of precautionary savings – at least for West Germany. Interestingly, results are robust to including housing equity in the wealth aggregate. Previous studies showed strong sensitivity of the estimated shares of precautionary wealth to the chosen wealth aggregate and to the estimation sample. In this chapter, most estimations resulted in similar shares of flow savings or wealth that could be attributed to the precautionary motive. Given the large dispersion of empirical estimates of the amount of precautionary savings, this is a remarkable result.

The last chapter brings up a different perspective on the risk of deteriorated health. The question is whether individuals can actually adjust working hours to their preferences and needs. Results show that a majority of employees is ready to forgo earnings to reduce working hours. From a social policy point of view this is important for several reasons. Among other aspects, the effectiveness of policies targeted at the intensive margin is likely to be affected by such labour demand restrictions. We test the relation of two different health indicators, the legal disability status and self-assessed health, with the hours match. The former health indicator is known to the employer whereas self-assessed health rather reflects private information.

In accordance with our expectations, legal disability has no systematic impact on deviations from the hours match. For West Germany, we find a significantly negative effect of bad health on the hours match. On average, employees in bad health want to reduce working hours per week by 0.7 hours. This is approximately equivalent to a full-time working week per year. Another contribution of this chapter is the application of a dynamic panel data model to test the persistence of hours disequilibria. The results show that state dependence has no large effect. Persistence of the hours disequilibrium is more likely associated with unobserved and observed characteristics.

Interestingly, household or individual characteristics in East Germany had no significant impact on the hours match. Instead, very similar and significant effects of job characteristics in East and West Germany could be found. This finding underlines the importance of the regional differentiation but also shows the need for further research on the determinants of hours matches between employers and employees.

5.2 Future research

It remains an open question by how much old-age poverty will increase in the future. However, this question is extremely important from a social policy point of view. As a matter of course, an increase in old-age poverty rates is not desirable from the perspective of future pensioners. Moreover, the expectation to be unable to obtain a retirement income level above the poverty line will have an effect on the labour market strategies of the active population. If an individual expects to reach only the social minimum, he/she cannot increase his/her pension by paying contributions since the social minimum is fixed and any pension income will be deducted. An important implication is that the incentive to accept a job subject to social security contributions decreases markedly; contributions can be interpreted as taxes in this case.

Thus, two research questions arise: first, the question how the poverty rate among pensioners is likely to evolve; second, the question how the active working population is likely to react to this change? To answer the first question, it would be necessary to take into account other household income as well. Research is needed to determine the mix of household income that cohorts, which are currently active in the labour market, can expect when they retire. Furthermore, it would be necessary to analyse how much individuals are willing and able to save on private pension plans. Obviously, to be able to stabilize the replacement rate and to maintain the standard of living, it will be necessary for individuals and households to complement public pensions with other income. However, although the government spends billions on subsidies for third pillar pensions (e.g. Riester and Rürup plans), research into the determinants of private pension savings is rare in Germany.

Another interesting question would be to compare and analyse the labour market success of East German cohorts that entered the labour market after 1990. Our results suggest that even for cohorts born in the late sixties, it has been difficult to establish a stable labour market career after reunification. Cohorts born after 1971 may have faced less problems as they were younger and experienced a different integration process.

One limitation of our study is that we do not analyse the implications of our model for macroeconomic aggregates. We simulate labour market and earnings for a part of the future labour force and do not consider how the predicted trends would influence the pension adjustment. In fact, the negative results for East Germany could have a negative effect on the current pension value. This argument is also true for the alternative, more optimistic scenario for East Germany in which the pension value could be positively influenced. An extension of the simulation model in this direction would lead to a better assessment of future pension levels.

Chapter 3 develops a detailed simulation of ex-ante income risks. A next step would be to simulate policy reforms and to evaluate their impact on savings behaviour. Regarding previous reforms, it could also be analysed how income variations resulting from policy reforms have influenced savings. And the model could be validated by checking whether it correctly predicts adjustments of savings behaviour to political reforms.

A further improvement of the approach would be to model the income risk jointly for all household members. So far, the model is restricted to males and represents a male-breadwinner approach. The simulation would have to account for a more complex decision process within the context of the household. In my model, as a simplifying assumption, economic risks are treated as exogenous – assuming voluntary unemployment not to exist. This assumption may be justified when focusing the analysis on prime age males, but for women it seems very restrictive. Here, it would be a useful expansion of the model to take into account the impact of childbearing and non-employment on savings.

Another extension would be to model health risks not only via employment but as an income risk by itself. To this end, it would be necessary to associate health shocks and health expenditures. Such an extension would also be important if the model were further extended to include retired households.

The last chapter, finally, points to several aspects of future research into the determinants of hours matches. First, it seems necessary to complement labour supply data with data on labour demand and job requirements. It could improve identification of factors that influence actual working hours but not desired working hours. In household surveys it is difficult to distinguish between these factors. Second, it would be important to extend the analysis to include women and the non- or unemployed. The social policy dimension is particularly important for the latter group. Two interesting research questions would be: how large is the share of the unemployed who cannot find an adequate working hours arrangement? Does this effect vary with health? Third, we used general self-assessed health and "severe disability" as explanatory variables. It would be interesting to look at more specific health indicators and to relate these to specific job requirements. Fourth, another possibility would be to examine the turnover consequences of mismatch between desired and actual hours. If, for example, workers with deteriorating health who experience an hours mismatch are more likely to take early retirement, that could provide an argument for company and public policies to give workers more hours flexibility to keep them in the labour force longer and minimize social expenditures.

5.3 Policy implications

Although this dissertation did not aim at testing the efficiency or the welfare implications of a specific policy. However, it is possible to draw general conclusions from the previous chapters and to show potential opportunities to improve social policy.

The public debate about potential future old-age poverty has already started. Chapter 2 is based on a recent contribution to this discussion (Steiner and Geyer, 2010). The recent pension reforms have improved the systems' financial sustainability. However, the pessimistic projections of Chapter 2 suggest that its social sustainability may be challenged by the growing poverty risk of future pensioners.

The risk of old-age poverty is likely to increase, particularly in East Germany. The German public pension system is called “pension insurance” rather than “social security” like in the US. This is because of the strong linkage between contributions and benefits. Individuals who do not expect to reach a pension level above the minimum pension, so called “Grundsicherung”, have no incentive to work in a job subject to social security contributions. If this group grows, it could well harm the financial situation of the pension system. One immediate recommendation that would improve incentives to take up employment and to pay contributions is to introduce an allowance for public (and maybe private) pensions that is not deducted from the “Grundsicherung”.

A related question is if it pays to continue to subsidise employment that is not subject to social security contributions. It would be better to increase the average level of education and employability of the labour force. In the long run, this mitigates problems of old-age poverty and stabalises the pension system.

Policy makers could also increase redistribution if pension levels decrease. For example, one could grade up periods of unemployment in the pension calculation or revalue low wages to generally raise pension entitlements. However, such measures should not be considered an alternative to policies aimed at improving the labour market situation. They could even be combined with incentives to take up or extend employment.

Another aspect is the long-term perspective that has to be taken in the case of pensions. The expected increase of old-age poverty will rather be slow and does not start immediately. It has to be kept in mind that the simulations project pensions of individuals entering retirement. In the beginning of a negative trend, they do not have a large impact on average pensions or poverty rates. As a recommendation for policy the income situation of new pensioners should also be analysed separately from older cohorts.

Finally, the fact that we do not know much about private or occupational pension provision should alert politicians. This is particularly astonishing as the past pension reforms imply a growing importance of other income sources in old-age.

The main result of Chapter 3 was that individuals already spend a considerable amount of resources as a financial precaution against the “rainy day”. This is an important finding given the large German welfare system and has to be taken into account when deciding about more private provision for pensions, long-term care and health care treatments. Such programs can only be successful if individuals are able to save enough. Furthermore, as a general result, the models show an increase in precautionary savings when income uncertainty increases. Thus, changes of the tax-benefit system have an indirect impact on private savings.

Chapter 3 shows also the importance of the link between health and labour market status. Labour market policies that aim at increasing participation should take into account that the general health level is an important factor for its success.

The last chapter shows that there is probably room for welfare improvement by addressing working hours flexibility. It seems intuitive that the possibility of flexible hours adjustment, in particular among older and less healthy individuals, would play a role in their decisions to remain active on the labour market. It turns out, that a large number of individuals would reduce working hours and simultaneously forgo earnings. From a social policy point of view this could provide an additional starting point to increase labour supply of older employees. It is very likely that an ageing workforce will need more flexible working hours arrangements.

The results also suggest that there may be potential to improve the quality of work for those whose health is deteriorating and who do not qualify for disability by rendering working time more flexible. It was further found that the working hours disequilibrium does not show strong state dependence but is rather influenced by personal or job characteristics. On the basis of these results it might be possible to develop policies targeted at specific working hours constraints to reduce the disequilibrium.

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List of Abbreviations

ALG I	Unemployment benefit
ALG II	Unemployment assistance
AVID	Altersvorsorge in Deutschland (1996, 2005)
AWG	Ageing Working Group
BMAS	Federal Ministry of Labour and Social Affairs (Bundesministerium für Arbeit und Soziales)
CPV	Current pension value
DRV	German Pension Fund (Deutsche Rentenversicherung Bund)
EF	Entry factor
FDZ-RV	Research Data Center of the German Pension Fund
FW	Financial wealth
GDR	German Democratic Republic
IHS	Inverse hyperbolic sine
NW	Net worth
PAYG	Pay-as-you-go pension system
PB	Monthly pension benefit
PP	Pension point
PT	Pension type factor
REC	Reduced earnings capacity
SAH	Self-assessed general health
SOEP	Socio-Economic Panel Study

STSM	Tax-benefit microsimulation model (Steuer-Transfer-Mikrosimulationsmodell)
SUFRTZN06XVSBB	Scientific use file of retirement entries in 2006 (Rentenzugangsstichprobe)
SUFVSKT2005	Scientific use file of the insurance account sample 2005 (Versicherungskontenstichprobe)
VSKT	Insurance account sample (Versicherungskontenstichprobe)

Summary

This cumulative dissertation consists of three contributions that empirically analyse economic risks at the level of the individual and the household from different perspectives. The first analysis *"Future public pensions and changing employment patterns across cohorts"* aims to quantify the effects of labor market changes and pension reforms across birth cohorts in East and West Germany. The pension reforms since 1992 have reduced the generosity of the German pension system. While these reforms have improved the financial sustainability of the system, old-age poverty is expected to rise in the future. Furthermore, unemployment levels have been high and persistent in the past decades. And the "standard" full-time employment relationship covered by social security has lost significance. It is expected that both pension reforms and labour market changes will substantially reduce the level of public pensions for younger cohorts. To estimate these effects for cohorts born between 1937 and 1971, a microsimulation model is developed that accounts for cohort effects in employment biographies and pension reforms.

The empirical estimates and the simulated sample is based on data from the German Socio-Economic Panel Study (SOEP) from 1984 until 2006. Past pension entitlements of non-retirees are imputed by a statistical matching procedure from the insurance account sample of 2005 ("Versicherungskontenstichprobe", VSKT 2005) of the Public Pension Fund. Cohort effects are estimated for full-time employment, unemployment, part-time employment and non-employment. Models for the latter two categories are only estimated for women. This is the first study estimating cohort effects in cumulated employment and unemployment durations. Separate tobit models are estimated for different samples distinguished by region, gender and education. Estimated cohort effects are significant for most groups and differ by gender, region, and the level of education. In East Germany, for example, the effects show almost five years more unemployment relative to the oldest age cohort for the youngest cohort of men with a low or medium level of education. This difference between cohorts amounts to about two years for those with higher education. For East German women, the corresponding estimated cohort effects are about eight years

and three years, respectively. Cohort effects in unemployment estimated for West German samples are lower and show an increase in unemployment for lower educated men (women) of about two (1.5) years for the youngest cohort.

On the basis of simulated life cycle employment and income profiles, the estimation of future public pensions reveals 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 decline of average pension levels in younger birth cohorts is mainly driven by the impact of pension reforms, while future pension levels of West German women are increasing or remain stable due to increasing labour market participation among younger birth cohorts. This evidence refers to the “base scenario” which takes into account the demographic adjustment factor (“sustainability factor”) and the recently introduced long-term increase in the statutory retirement age.

Generally, the uncertainty of a simulation increases with the duration of the projection period. In the present case, the strongest negative effects are found for the youngest cohorts (in East Germany) for which the projection period is the longest. Therefore, to set an approximate limit if the labour market situation improves, an alternative scenario for East Germany was simulated. In this scenario, “positive labour market East Germany”, East German employment biographies of men and women develop like the average employment biography in the estimation sample. That implies the assumption that employment biographies of younger cohorts improve significantly to make up for the higher unemployment experience. Despite already accumulated unemployment in the past, results show a marked improvement compared to the “base scenario”.

The second contribution, *“The effect of health and employment risks on savings”*, focuses on short-term economic risks of the active population. The central questions are whether and to what extent individuals build up assets as a precaution to expected variance in net household income. Involuntary unemployment constitutes one of the most important risks during the pre-retirement period. A key determinant of unemployment is health status. The estimation model is based on the theory of precautionary savings which adds a savings motive to the theory of intertemporal allocation. The basic hypothesis states that a part of accumulated savings provides insurance against future contingencies. Although the theoretical concept is stringent and plausible, the empirical literature has not been able to set approximate limits to the amount of savings that can be attributed to the precautionary motive. A key question for empirical studies is how to model economic uncertainty. A large number of studies has considered ex-post measures of income uncertainty. Instead, it is assumed that individuals perceive economic uncertainty as variation in income conditional on the expected likelihood of certain risks to occur in the future. Therefore, it is proposed to model uncertainty ex-ante as a step to improve on models that estimate the effect of the precautionary savings motive. The proposed ex-ante measure of net income risk takes into account the relation between health and unemployment risk. The uncertainty measure is then used as an explanatory variable to test the significance and importance of the precautionary savings motive in different savings models.

The chapter presents an alternative ex-ante risk measure using a microsimulation model to generate counterfactual scenarios under the assumption of realisation of employment, health and wage risks. Probabilities for the realisation of these risks and the associated wages are estimated taking into account that prior unemployment and bad health may have negative effects on attainable wages. Net household income is simulated for these scenarios and an income variance is derived. The approach highlights the importance of including counterfactuals in a measure of income risk since future contingencies do not have to actually occur to spur precautionary savings. Household net income is simulated using the detailed tax-benefit microsimulation model STSM.

The SOEP study allows to test the precautionary savings motive using two different dependent variables. In a first step, a standard buffer-stock model of wealth is estimated. Wealth data from 2002 and 2007 are transformed applying the inverse hyperbolic sine transformation. This is a log-like transformation, which allows to estimate the model based on all observations of the sample, including those with zero or negative wealth. The data also allow to control for risk preferences which should alleviate problems of self-selection. About 17 percent of financial wealth or 14 percent of net worth – which additionally includes real estate assets – can be attributed to precautionary behaviour. In contrast to other studies, these results are robust to changes of the wealth aggregate. For East Germany, no significant effect of income variance in the buffer-stock model can be found. The point estimate for financial wealth results in implausible shares of precautionary wealth. Potential reasons are sample size and low variability of the dependent variable. Though insignificant, the model for net worth shows similar results as the models for West Germany and the flow savings regressions for East Germany.

In a second step, a panel model of monthly savings flows is estimated. The comparison of different models for stock and flow values is an informal test of the validity of both models and can be interpreted as two independent tests of the theory of precautionary savings. The advantage of using savings flows is that it enables to apply panel data methods. The model is estimated in logs (dropping observations without monthly savings) and in levels (including observations without monthly savings). The simulated income variance turns out significant across all specifications in both East and West Germany. A conservative estimate is that about 14 percent of saving flows can be attributed to precautionary motives. The result is remarkably stable without any large differences between East and West Germany – although the absolute amount of savings flows is lower in East Germany. For West Germany, results resemble the estimates of the first model which is a very strong result.

The third contribution, *"Dynamic Effects of Health on the Mismatch Between Actual and Desired Working Hours"*, examines how labour market restrictions interact with individual health resources. A majority of German men report to be "overworked", i.e. to work more hours than they wish to work. The determinants of the prevailing "hours disequilibrium" have not yet been well researched, which is astonishing given the success story of Germany's working hours flexibility. This chapter studies to what extent individuals in bad health are able to adjust working hours to their preferences. The model distinguishes between self-assessed health and legal disability status, which allows to take into account different aspects of the individual health status. Moreover, it tests how persistent divergences between realised and preferred working hours are. The relationship between health and working hours might gain importance due to rapid demographic ageing in the coming decades. Individuals are expected to extend their working life. Until 2029, the statutory retirement age will be gradually increased up to 67 years of age. And, as is found in the first chapter, longer employment biographies are necessary to maintain a sufficient level of old-age income. An important related question is whether individuals aged 55 and older will be able to work longer. Otherwise the increase in statutory retirement age and the pension reforms will only lead to a further reduction in pension levels. One important condition for this to happen might be that working hours are flexible enough to meet the preferences of an older workforce. Moreover, difficulties to realise preferred working hours may have a direct impact on the effectiveness of policies that aim at changing labour supply behaviour.

Research into the determinants of the working hours disequilibrium is still developing. The fourth chapter contributes to the evolving literature by addressing the question how health and hours match are correlated. Moreover, it contributes to the literature by applying dynamic fixed effects models to test the persistence of the hours match. The data used allow to distinguish self-assessed health status and the legally recognised state of severe disability. While the former measure constitutes a standard instrument in health economics, the latter has some unique properties. Whereas severe disability status entails several legal privileges and is usually known to the employer, the general health measure can be assumed to reflect private knowledge that is not easily revealed. Conditional on being employed, disability status should have no effect on the hours match. On the other hand, self-assessed bad health is more likely to be correlated with the desire to reduce working hours.

The descriptive analysis reveals a relatively high persistence of the hours disequilibrium. However, when controlling for a broad set of covariates and fixed personal and job characteristics, the estimated coefficient of the lagged endogenous variable results only in small (West Germany) or insignificant (East Germany) state dependence. With regard to labour market flexibility, this result can be considered positive, as it implies that hours mismatches have no strong inherent state dependence. Differences between East and West Germany are also found with regard to personal and household characteristics. Whereas age, education and other household income significantly influence the hours disequilibrium in West Germany, none of these variables shows a significant effect in East Germany. On the other hand, variables controlling for job characteristics are significant and have the same sign in both regional samples. A likely reason for this regional difference is that wages in East Germany are lower than in West Germany and dissatisfaction is not associated with household or individual characteristics but rather with job characteristics.

The hypothesis that the disability status should have no effect on the hours match – conditional on being employed – cannot be rejected. On other hand, bad health negatively affects the hours match. In West Germany, individuals in bad health wish to reduce their weekly working hours by about 0.7 hours. This reduction is small but corresponds nearly to a full-time working week per year. By contrast, no significant health effects are found for East Germany, which shows the importance of regional differentiation when analysing the German labour market. The elasticity with respect to other household income is about 0.026. That means, if other household income increased by 100 percent, the hours disequilibrium would increase by 2.6 percent. This elasticity is almost five times larger for employees in bad health and amounts to 0.098.

German summary

Diese kumulative Dissertation untersucht in drei empirischen Arbeiten die Wirkungen ökonomischer Risiken auf der Ebene des Individuums und des Haushaltes. Der erste Beitrag, *"Future public pensions and changing employment patterns across cohorts"*, hat zum Ziel den Effekt von Veränderungen am Arbeitsmarkt und die Wirkungen der Rentenreformen auf die Alterseinkommen der Kohorten, die zwischen 1937 und 1971 in Ost- und Westdeutschland geboren wurden, zu quantifizieren.

Durch die seit 1992 durchgeführten Rentenreformen wurde das langfristige Rentenniveau der Gesetzlichen Rentenversicherung (GRV) erheblich verringert. Betrachtet man die langfristigen Prognosen zur Entwicklung des Beitragssatzes und des Haushaltssaldos der umlagefinanzierten GRV, kann man folgern, dass das Ziel, die langfristige Finanzierbarkeit der GRV durch diese Reformen zu verbessern, erreicht wurde. Allerdings ergeben sich durch die Absenkung des Rentenniveaus weitere Effekte auf die zu erwartenden individuellen Rentenansprüche. Allgemein wird erwartet, dass das Risiko der Altersarmut deswegen in Zukunft zunehmen wird.

Neben den Rentenreformen gab es in den letzen Jahrzehnten tiefgreifende Veränderungen am Arbeitsmarkt und eine hohe und persistente Arbeitslosigkeit, insbesondere in Ostdeutschland nach der Wiedervereinigung. Auf dem Arbeitsmarkt hat die Bedeutung des sogenannten "Normalarbeitsverhältnisses" abgenommen, während atypische Beschäftigung zunehmend wichtiger wird. Die Rentenreformen führen zu einer langfristigen Senkung des Rentenniveaus und interagieren mit den Veränderungen am Arbeitsmarkt. Arbeitslosigkeit und atypische Beschäftigung in der Erwerbsbiographie sind wichtige Risikofaktoren für geringe Rentenanwartschaften. Denn die GRV ist im Prinzip an einer stabilen Erwerbskarriere mit überwiegender Vollzeitbeschäftigung orientiert. Insbesondere für jüngere Kohorten wird das Risiko von Altersarmut zunehmen. Um den Effekt dieser Entwicklungen auf die eigene Rentenansprüche in der GRV zu quantifizieren, wird ein Mikrosimulationsmodell entwickelt, das die Renten der Geburtskohorten 1937 bis 1971, unter Berücksichtigung von Kohorteneffekten in den Erwerbsbiografien und den Rentenreformen, simuliert.

Die empirischen Schätzungen und die Ausgangsstichprobe der Simulation basieren auf dem Sozio-oekonmischen Panel (SOEP) der Jahre 1984 bis 2006. Die bisherigen Renteansprüche werden mittels der Methode des statistischen Matchings aus Mikrodaten der gesetzlichen Rentenversicherung (Versicherungskontenstichprobe, VSKT 2005) imputiert. Die Kohorteneffekte werden für Vollzeit- und Teilzeiterwerbstätgkeit sowie für Arbeitslosigkeit und sonstiger Nichterwerbstätigkeit geschätzt. Modelle für Teilzeit- und Nichterwerbstätigkeit werden nur für Frauen spezifiziert.

Dies ist die erste Studie, die Kohorteneffekte in den aggregierten Erwerbsbiografien untersucht. Zu diesem Zweck werden für unterschiedliche Stichproben separate Tobit-Modelle geschätzt. Dabei wird zwischen Region, Bildung und Geschlecht unterschieden. Für die meisten Gruppen und Erwerbskategorien finden sich signifikante Kohorteneffekte, die sich je nach der untersuchten Gruppe unterscheiden. Betrachtet man zum Beispiel den Effekt für Ostdeutsche mit geringer oder mittlerer Bildung, hat sich die Arbeitslosigkeit in der jüngsten Kohorte im Durchschnitt um fast fünf Jahre im Vergleich zur ältesten Kohorte erhöht. In der Gruppe mit höherer Bildung liegt dieser Effekt bei zwei Jahren. Für ostdeutsche Frauen liegen die vergleichbaren Kohorteneffekte bei etwa acht (geringe oder mittlere Bildung) bzw. drei Jahren (höhere Bildung). Die Kohorteneffekte bezüglich der Arbeitslosigkeit für westdeutsche Stichproben sind niedriger und zeigen einen Anstieg der Arbeitslosigkeit bei Männern (Frauen) mit geringer Bildung von etwa zwei (1.5) Jahre bei der jüngsten Kohorte.

Auf der Grundlage von simulierten Erwerbsbiografien und Einkommensprofilen, zeigt die Schätzung der künftigen Rentenansprüche einen Rückgang der individuellen Renten ostdeutscher Männer und Frauen bei jüngeren Geburtskohorten. Entsprechend des Ausgangspunktes der Untersuchung, beruht der Rückgang zum Teil auf den Wirkungen der Rentenreformen und zu einem größeren Teil auf höherer kumulierter Arbeitslosigkeit. Für westdeutsche Männer findet sich nur ein leichter Rückgang des Rentenniveaus in jüngeren Kohorten, der Effekte begründet sich vor allem durch die Auswirkungen der Rentenreformen und weniger durch Arbeitsmarkteffekte. Wohingegen sich das künftige Rentenniveau westdeutscher Frauen, aufgrund der zunehmenden Erwerbsbeteiligung jüngerer Kohorten, erhöhen wird. Diese Ergebnisse beziehen sich auf das sogenannte “Basisszenario” unter Berücksichtigung des Nachhaltigkeitsfaktors und der kürzlich eingeführten langfristigen Anhebung des gesetzlichen Rentenalters.

Die Unsicherheit einer Simulation steigt allerdings mit der Dauer des Prognosezeitraums. Und gleichzeitig werden die stärksten Effekte für jüngere ostdeutsche Jahrgänge geschätzt, für die der Prognosezeitraum am längsten ist. Da diese Effekte in Ostdeutschland einen starken negativen Trend aufweisen, wurde ein alternatives und optimistischeres Szenario für Ostdeutschland simuliert. Dieses Szenario kann man interpretieren, also ob sich die Erwerbsbiographien von jüngeren Männern und Frauen an das durchschnittliche Niveau von Beschäftigung und Arbeitslosigkeit älterer ostdeutscher Kohorten anpassen. Trotz der hohen, bereits angesammelten Arbeitslosigkeit in der Vergangenheit, zeigen die Ergebnisse eine deutliche Verbesserung im Vergleich zum Basisszenario.

Der zweite Beitrag, *"The effect of health and employment risks on savings"*, konzentriert sich stärker auf kurzfristige ökonomische Risiken der aktiven Bevölkerung. Die zentralen Fragen sind, ob und inwieweit Individuen Vermögen aufbauen als Vorsichtsmaßnahme gegen mögliche Schwankungen des Nettohaushaltseinkommen.

Unfreiwillige Arbeitslosigkeit ist eines der wichtigsten ökonomischen Risiken während der aktiven Phase und ein entscheidender Faktor, der stark mit Arbeitslosigkeit zusammenhängt, ist der Gesundheitszustand. In der ökonomischen Theorie wurde schon lange vermutet, dass die Einkommensunsicherheit für viele Haushalte ein wichtiges Sparmotiv darstellt. Formalisiert wurde diese Idee in der Theorie des Vorsichtssparens, dem Modell der intertemporalen Allokation ein weiteres Sparmotiv hinzufügt. Die grundlegende Hypothese besagt, dass ein Teil der angesammelten Ersparnisse eine Absicherung gegen zukünftige, nicht versicherte Einkommensschocks bietet.

Während es bereits eine reichhaltige theoretische Literatur zu diesem Thema gibt, hat die empirische Literatur bisher keine einheitlichen Ergebnisse bezüglich der Existenz und Bedeutung des Vorsichtssparens geliefert. Ergebnisse aus Befragungen in unterschiedlichen Ländern zeigen, dass Vorsorge für unbestimmte Notfälle ein wichtiges Motiv der monatlichen Ersparnis ist. Eine zentrale Frage für die empirische Literatur ist, wie sich diese ökonomische Unsicherheit operationalisieren lässt. Eine Reihe von Studien hat hierzu Ex-post-Maße der Einkommensunsicherheit betrachtet. Das Problem dieser Modellierung ist, dass nur solche Ereignisse als Unsicherheit interpretiert werden, die auch tatsächlich eingetreten sind. Außerdem können viele beobachtete Einkommensänderungen auch gewollte Elemente enthalten, die also keine Einkommensunsicherheit darstellen. Stattdessen wird in diesem Beitrag davon ausgegangen, dass das Individuum ex ante Erwartungen über Einkommensunsicherheit bildet, also mögliche Ereignisse in der Zukunft relevant sind. Die Variation des Einkommens ist dabei abhängig von der Erwartung der zukünftigen Realisierung bestimmter Risiken. Die explizite Modellierung dieser Risikokonstellationen ("Szenarien") und deren Verknüpfung mit dem Haushaltsnettoeinkommen ist ein zentraler Beitrag dieser Arbeit zur Verbesserung der Modelle des Vorsichtssparens. Das vorgeschlagene Ex-ante-Maß der Unsicherheit des Nettoeinkommens berücksichtigt die Beziehung zwischen Gesundheitsstatus und Arbeitslosigkeit. Das simulierte Unsicherheitsmaß wird dann als erklärende Variable in verschiedenen Sparmodellen verwendet, um die Bedeutung des Vorsichtsprinzips bei der Ersparnis zu testen.

Dieses alternative Ex-ante-Risikomaß wird mit einem Mikrosimulationsmodell generiert. Hierzu werden kontrafaktische Szenarien unter der Annahme der Realisierung des Beschäftigungs-, Gesundheits-und Lohn-Risikos gebildet. Die Wahrscheinlichkeiten für die Realisierung dieser Risiken und der damit verbundenen Löhne werden geschätzt und berücksichtigen, dass vergangene Arbeitslosigkeit und schlechte Gesundheit negative Auswirkungen auf die erzielbaren Löhne haben können. Anhand der simulierten Haushaltsnettoeinkommen für unterschiedliche Szenarien wird die erwartete Einkommensvarianz abgeleitet. Der Vorteil dieser Methode ist die explizite Einbeziehung kontrafaktischer Szenarien zur Abschätzung des Einkommensrisikos. Denn diese Ereignisse müssen nicht erst eintreten, um Individuen zur Vorsorge durch Ersparnis zu bewegen. Das Haushaltsnettoeinkommen wird mit Hilfe des detaillierten Steuer-Transfer-Mikrosimulationsmodell (STSM) berechnet.

Die Daten des SOEP erlauben es, das Vorsichtsmotive bei der Ersparnis mit zwei verschiedenen abhängigen Variablen zu testen. In einem ersten Schritt wird ein sogenanntes "buffer-stock" Modell geschätzt. Die Vermögensdaten von 2002 und 2007 werden dafür mit der Methode der inversen hyperbolischen Sinus-Transformation transformiert. Dies ist eine ähnliche Transformation wie der Logarithmus, allerdings kann das Modell auf der Basis aller Beobachtungen geschätzt werden, also einschließlich solcher Beobachtungen, die über kein oder negatives Vermögen verfügen.

Das SOEP beinhaltet zudem Informationen über die Risikopräferenzen der Befragten. Damit können Selektionsprobleme vermieden oder wenigsten abgeschwächt werden. Über 17 Prozent des finanziellen Vermögens oder 14 Prozent des Vermögens mit Immobilien können dem Vorsichtsmotiv zugerechnet werden. Dieses Ergebnis ist, im Gegensatz zu anderen Studien, robust gegenüber Veränderungen des Vermögensaggregats. Das buffer-stock Modell zeigt für Ostdeutschland keine signifikanten Ergebnisse bezüglich der Einkommensunsicherheit. Mögliche Gründe dafür sind der Stichprobenumfang und geringe Variabilität der abhängigen Variablen. Allerdings liefern die Schätzungen plausible Ergebnisse für das Modell mit dem weiteren Vermögensaggregat (einschließlich Immobilien). Die Ergebnisse sind zwar insignifikant, aber ähneln den Ergebnissen bei dem zweiten geschätzten Modell.

In einem zweiten Schritt wurde ein alternatives Panel-Modell geschätzt, das die monatliche Ersparnis als abhängige Variable beinhaltet. Der Vergleich der Modelle für Bestands- und Flussgrößen kann als informeller Test der Güte der beiden Modelle interpretiert werden. Zudem sind beide Modelle unabhängige Tests der Theorie des Vorsichtssparens. Der Vorteil der Verwendung der laufenden Ersparnis ist, dass für zeitkonstante individuenspezfische Effekte kontrolliert werden kann (fixed effects). Das Modell wurde in Logs als auch für nominale Größen geschätzt und lieferte sehr ähnliche Ergebnisse. Die simulierte Einkommensvarianz ist in allen Modellen signifikant, auch in Ostdeutschland. Eine vorsichtige Schätzung zeigt, dass rund 14 Prozent der laufenden Ersparnis dem Vorsichtsmotiv zugeordnet werden können. Das Ergebnis ist bemerkenswert stabil, ohne dass große Unterschiede zwischen Ost- und Westdeutschland zu erkennen wären – obwohl die absolute Höhe der Ersparnis in Ostdeutschland niedriger ist. Für Westdeutschland ähneln die Ergebnisse denen des buffer-stock Modells und stellen damit ein sehr robustes Ergebnis dar.

Im dritten Beitrag, *“Mismatch Between Actual and Desired Working Hours: dynamic effects of health”*, wird untersucht, wie Arbeitsmarktbeschränkungen bezüglich der Arbeitszeit mit dem individuellen Gesundheitszustand interagieren. Das SOEP zeigt, dass die Mehrheit deutscher Männer im Durchschnitt mehr Stunden arbeiten, als sie wollen würden – selbst wenn dadurch das Einkommen entsprechend fallen würde. Die Determinanten dieses “Ungleichgewichts” sind noch wenig erforscht. Dies ist umso bemerkenswerter angesichts der Erfolgsgeschichte der Arbeitszeitflexibilität in Deutschland.

In diesem Kapitel wird untersucht, inwieweit Männer in schlechtem Gesundheitszustand in der Lage sind die Arbeitszeit ihren Präferenzen anzupassen. Das Modell unterscheidet zwischen der Selbsteinschätzung des Gesundheitszustands und dem rechtliche Status “schwerbehindert” und kann damit unterschiedliche Aspekte des Gesundheitszustands in der Analyse berücksichtigen. Auch mit Blick auf die demografische Entwicklung ist die Beziehung zwischen Gesundheitsstatus und Arbeitszeit von Bedeutung. Beispielsweise wird bis 2029 das gesetzliche Renteneintrittsalter schrittweise angehoben. Wie der erste Beitrag dieser Arbeit zeigt, werden in Zukunft längere Erwerbsbiographien notwendig sein, um ein ausreichendes Alterseinkommen zu erreichen. Eine damit zusammenhängende sozialpolitische Frage ist, ob ältere Personen in der Lage sind, länger zu arbeiten. Andernfalls ist die Erhöhung des gesetzlichen Renteneintrittsalters nur eine weitere Reduzierung der Rentenleistungen. Eine wichtige Voraussetzung für längere Erwerbsbiografien könnte sein, dass die Arbeitszeiten flexibel genug sind, sich an die Präferenzen einer älteren Belegschaft anzupassen. Darüber hinaus können diese Arbeitsmarktrestriktionen einen direkten Einfluss auf die Wirksamkeit politischer Reformen haben, die auf eine Veränderung des Arbeitsangebots abzielen.

Obgleich die Divergenz zwischen gewünschter und realisierter Arbeitszeit bekannt ist, steht die empirische Erforschung ihrer Determinanten noch in einem frühen Stadium. Dieser Beitrag zeigt, wie Gesundheit und Arbeitszeit korreliert sind. Dazu werden dynamische "Fixed Effects" Modelle mit der verallgemeinerten Momementenmethode (GMM) geschätzt, um außerdem den Grad der Persistenz des Ungleichgewichts zu schätzen. Die Verwendung von Daten zum subjektiven Gesundheitszustand und zur Schwerbehinderung erlaubt es zu testen, ob es unterschiedliche Effekte dieser beiden Gesundheitsmaße gibt. Eine anerkannte Schwerbehinderung ist ein rechtlicher Status mit einigen Privilegien, der zudem in der Regel dem Arbeitgeber bekannt ist. Im Gegensatz dazu, kann der subjektive Gesundheitszustand als privates Wissen betrachtet werden, das dem Arbeitgeber in der Regel nicht bekannt ist und nicht mit Privilegien einher geht.

Im Fokus der Betrachtung stehen abhängig beschäftigte Männer im Alter zwischen 30 und 59 Jahren. Die deskriptive Analyse zeigt eine relativ hohe Persistenz des Ungleichgewichts von gewünschter und realisierter Arbeitszeit. Wenn man allerdings für verschiedene Charakteristika und zeitkonstante individuenspezische Effekte kontrolliert, zeigen die Ergebnisse nur noch geringe (Westdeutschland) oder insignifikante (Ostdeutschland) Persistenz (sogenannte "state dependence"). Im Hinblick auf die Flexibilität des Arbeitsmarktes, kann dieses Ergebnis als positiv betrachtet werden, da es impliziert, dass Ungleichgewichte bei der Arbeitszeit keine starke inhärente Zustandsabhängigkeit aufweisen. Unterschiede zwischen Ost- und Westdeutschland werden auch im Hinblick auf persönliche und Charakteristika des Haushalts gefunden. Alter, Bildung und anderes Einkommen beeinflussen das Ungleichgewicht in Westdeutschland, zeigen aber keine signifikanten Effekte für Ostdeutschland. Variablen, die den Arbeitsplatz charakterisieren, haben in beiden Landesteilen signifikante Effekte und dasselbe Vorzeichen. In der Regel gehen Berufe mit hohen Arbeitszeiten mit einem höheren Bedürfnis nach Arbeitsreduktion einher.

Es zeigt sich, das Schwerbehinderung keinen signifikanten Einfluss auf das Ungleichgewicht hat – natürlich unter der Bedingung, dass man bereits beschäftigt ist. Ein schlechter subjektiver Gesundheitszustand hat einen negativen Effekt auf das Ungleichgewicht. In Westdeutschland wollen Menschen mit einem schlechten Gesundheitszustand ihre Wochenarbeitszeit um etwa 0,7 Stunden reduzieren. Dieser Effekt ist zwar gering, aber entspricht immerhin fast einer vollen Arbeitswoche pro Jahr. Im Gegensatz dazu finden sich keine signifikanten Effekte für Ostdeutschland. Das Ergebnis zeigt die Bedeutung der regionalen Differenzierung. Die Elastizität in Bezug auf sonstiges Haushaltseinkommen beträgt 0.026. Das heißt, wenn das sonstige Haushaltseinkommen um 100 Prozent erhöht würde, würde sich das Ungleichgewicht um 2.6 Prozent erhöhen. Diese Elastizität ist fast fünfmal so groß für Personen mit einem schlechten Gesundheitszustand und beläuft sich auf 0.098.