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# Old-age poverty: The household perspective

## A microsimulation approach of pension entitlements in Germany

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HSU TECHNICAL WORKING PAPER

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### Abstract

Providing a decent living standard and preventing old-age poverty are the two major challenges of pension insurance schemes. Replacement rates below the poverty line despite many years of contribution represent a major challenge for public pension schemes with respect to the systems ‘raison d’être’. The focus of the present paper turns away from individual perspective and considers household retirement incomes in the light of analysing old-age poverty and designing (minimum) pension policies. Using household survey and administrative data, the paper examines actual needs of pensioner households in relation to the means-tested minimum pension. The simulation results suggest that 56% of those living in couple households would achieve a pension level lower than means-tested minimum pension if they were considered at the individual level. The findings clearly indicate gender discrepancies: households represent a noticeable insurance function. Especially women are better off if old-age poverty analysis integrates other household incomes. The German government intends to implement the *Grundrente* in 2019. This minimum pension policy entitles individuals who spent more than 35 contribution years to a 10% mark-up on the means-tested minimum pension. The microsimulation analysis also provides important findings regarding the extent of entitled beneficiaries. Whilst 30% of all new pensions would benefit from an individual perspective, after means-testing only 3% at all will meet the conditions of 35 contribution years which strongly questions the target orientation of the *Grundrente*.

**Keywords:** Old-Age Poverty, Pension Reform, Minimum Pension, Microsimulation, German Public Pension System

**JEL Classification:** C15, H55, J14, J18, J26

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# 1 Motivation

The major purposes of each pension insurance scheme are, first, ensuring a decent living standard and, second, preventing old-age poverty. Demographic ageing and fragmented employment biographies strongly challenge the balance between financing and spending in an old-age pension scheme which pursues these objectives. Decreasing fertility rates and lower labour force combined with increasing life-expectancy imply a twofold liability. A growing adverse relation between old pensioners and young contributors involves an escalating burden which has to be born by future generations in general and social security contributors in particular. Periods of unemployment disrupt individual employment biographies, so-called “atypical” employment adversely affects individual earned income and, thus, lowers the individual old-age pension. Considering the entire pension scheme, these adverse developments cause system imbalances and challenge the sustainability claim of a social security scheme built as a pay-as-you-go (PAYG) system (Beblo/Wolf, 2002; BMAS, 2003; 2016c; Schmähl, 2005).

In recent past, the German statutory pension insurance scheme (*Gesetzliche Rentenversicherung*, henceforth GRV) has undergone a range of profound changes to its contribution part. Especially the reform course pursued by the Socialist/Green coalition of former Chancellor Schröder (1998-2005) initially conveys the impression that the GRV departs from ensuring a decent living standard and preventing old-age poverty. The government raised the pension eligibility age instead and, furthermore, reinforced the third pillar by subsidising private old-age provision. On the one hand, distributing the age risk on several pillars within a social insurance implies a sustainable funding with regard to constant social security contributions in the long term (see Börsch-Supan, 2015a; 2015b). Adverse effects concerning retirement income more likely occur among individuals with particular socio-demographic features, particularly females, people from East Germany and those with a low level of education. In general, decreasing replacement rates combined with changing employment biography patterns result in an individual retirement income almost equal to a means-tested welfare benefit (Schmähl, 2004). An insurance benefit in the amount of minimum pension would counteract to the principles of GRV which means disparity between contributions and benefit. According to this, GRV is under pressure to demonstrate legitimacy which calls for further reforms especially on the benefit part.

A minimum pension can be a useful tool to alleviate old-age poverty. The approach of minimum benefit, old-age social assistance, or similar policies has been broadly discussed in scientific literature and in political debates as well.<sup>1</sup> Jiménez-Martín (2015) points out the strong incentives especially for low-income workers to early retirement.<sup>2</sup> Although minimum pensions contribute to reduce old-age poverty, however, they provoke adverse incentives to reduce labour supply and thus social security contributions.

Discussing about basic welfare benefits for pensioners requires a distinct terminology. A basic pension is tax-funded and does not require any prerequisites in terms of insurance periods or actual payments made in advance. A minimum pension defines a social security benefit financed by social security contributions and represents an insurance benefit if we assume equivalence between contributions and benefits. It also includes requirements which have to be met in order to qualify for benefits.

In 2019, the government intends to implement the *Grundrente*. The programme aims to acknowledge lifelong achievements of people who spent more than 35 contribution years including employment, parenting and care of relatives. Eligible persons will be entitled to a 10 per cent mark-up on the means-tested minimum pension (*Grundsicherung im Alter*, henceforth NBPS). The *Grundrente* includes a means-test corresponding to legal regulations of basic security. Classifying the *Grundrente* according to this definitions, the policy is neither a minimum nor a basic pension. The benefit rather deals with a pension supplement for long-term insured with more than 35 contribution years in particular (Köhler-Rama, 2018).

Taking these aspects into account, the present paper addresses problematic issues of the reform proposal’s current version. First, an eligibility criterion of 35 contribution years may be inappropriate to benefit those who are at highest old-age poverty risk. Using a comprehensive database consisting of household survey data

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<sup>1</sup>See the study of Atkinson et al. (2002) who present a case study of a European minimum pension. They explore the implications of a Europe-wide tax benefit using a microsimulation model.

<sup>2</sup>See the findings of von Weizsäcker (2003) who follows a similar line of reasoning.

combined with individual administrative data, the microsimulation models the development of future retirement income of German households. It examines structural differences between gender, region, and education level. Second, the household context applied in the analysis represents the major improvement of this work. Considering households rather than individuals represents a valid test for economic means and, thus, if a person qualifies for public welfare benefits. Other studies focus on retirement incomes of individuals and, thus, provide biased results which encourages a misguided pension reform debate. Taking retirement income and asset situation of pensioner's households as reference point provides valid arguments in a well-founded discussion about old-age poverty.

Section 2 introduces the German pension scheme and provides some institutional background (2.1). Subsection 2.2 presents and discusses the reform proposal including the implementation of a minimum pension in the second half of 2019. Subsection 2.3 provides evidence for Germany. Section 3 describes the data base (3.1) and its matching approach (3.2). Section 3.3 presents first interim results of the microsimulation model. Based on estimated cohort effects and age-earnings profiles, Section 4 outlines simulation results which initially consist of simulated retirement income on individual and household level (4.1). Subsection 4.2 examines the effect of the household context. The analysis quantifies old-age poverty by taking household income rather than individual income as a reference line. Section 5 summarizes the paper and closes with some concluding remarks.

## 2 Pension reform work in progress: State of play

### 2.1 The German Pension system in a nutshell

The German pension system consists of three pillars: The statutory pension insurance (GRV), occupational pensions, and private pensions. The GRV as the first pillar represents the most important element with respect to the number of insured persons (37.6 million contributors, 16.9 million recipients of benefit)<sup>3</sup> and the share of overall old-age income (75% of gross retirement income)<sup>4</sup>. The public pension insurance is built as a pay-as-you-go (PAYG) system and, contrary to the other two pillars, it is a compulsory insurance for dependent employees while being non-mandatory for civil servants and self-employed.

The monthly pension amount is determined by individual pension entitlements acquired during working life. According to pension calculation formula<sup>5</sup>, individual earnings points (*Entgeltpunkte*)<sup>6</sup> are multiplied by the access factor in pension calculation (*Zugangsfaktor*)<sup>7</sup>, the pension type factor (*Rentenartfaktor*)<sup>8</sup>, and the pension value (*aktueller Rentenwert*)<sup>9</sup>. Pension value amounts to 32.03 Euro per year in West Germany, 30.69 Euro in East Germany.<sup>10</sup>

In recent past, the contribution part as well as the benefit part of the German public pension system have been affected by a variety of (sometimes far-reaching) reforms. At the turn of the century, the Socialist/Green coalition led by former Chancellor Schröder reformed core elements of the GRV's contribution part several times. Mentioning the Pension Reform Act (*Rentenreformgesetz* RRG, 1992), the Old-Age Pensions Insurance Sustainability Act (*RV-Nachhaltigkeitsgesetz*, 2004), and the Old-Age Income Act (*Alterseinkünftegesetz* AltEinkG, 2005) which lead to a reduction in individual pension income.<sup>11</sup> In the light of sustainable funding and long-term stabilisation for the purpose of a pension system prepared for demographic change, Färber (2004), Schmähl (2004), and Ruhland/von der Heide (2004) rate the reform as a step into the right direction. However,

<sup>3</sup>DRV (2018) provides comprehensive GRV-related key dates and figures.

<sup>4</sup>See BMAS (2016c).

<sup>5</sup>See § 64 Book VI of the Social Code (*SGB*).

<sup>6</sup>See § 66 SGB VI.

<sup>7</sup>See § 77 SGB VI. The access factor deals with the date of retirement. The factor is equal to one if retiring at pension eligibility age. Otherwise there is a deduction by 0.3 per cent per month. Furthermore, there is an increase by 0.5 per cent per month after pension eligibility age.

<sup>8</sup>See § 67 SGB VI. The pension type factor represents a percentage of entitlement, payable according to type of pension, e.g. full widow's pension of 55 per cent of husband's entitlement.

<sup>9</sup>See § 68 SGB VI.

<sup>10</sup>The pension value is determined by several economic and demographic trends represented by the pensions adjustment formula. See appendix (A.1) for further details.

<sup>11</sup>See statement of the Association of German Pension Schemes (VDR, 2004) and Schnabel/Miegel (2001).

as Schmähl (2004) sends a reminder about, reducing benefits combined with changing employment biography patterns lead to an individual pension level almost equal to a means-tested welfare benefit. This would correspond to a minimum pension, whose primary target consists in preventing old-age poverty. A GRV benefit in such an extent would counteract to the principles of GRV concerning disparity between contribution and benefit. In that case, GRV is under pressure to demonstrate legitimacy.

In the context of Pension Insurance Retirement Age Adjustment Act (*RV-Altersgrenzenanpassungsgesetz* RVAGAnpG, 2007) the increase in the pension eligibility age became law in 2012. The reform takes effect stepwise with the result that all GRV-insured born after 1964 retire at pension eligibility age 67. Considering the sustainability effect, Ehrentraut and Heidler (2008) come to the result that achieving the 2030 pension level objective becomes more likely, however, a further raise in pension eligibility age has to follow on inevitably.

Accounting for decreasing pension benefits as well as increasing risk of old-age poverty, German government subsidises the third pillar of the GRV. The Riester pension scheme (so-called “*Riester-Rente*”, henceforth RPS) is a grant-aided privately funded pension scheme and symbolises a paradigm change in German old-age security. The RPS should provide an incentive for spending more resources on private savings in order to compensate decreasing GRV benefits. The implementation of RPS, however, did still not lead to an increase in savings rate but rather substitutes private non-subsidised savings (see Corneo et al., 2009; 2010).<sup>12</sup> Thus, RPS has led merely to a deadweight effect yet (Pfarr/Schneider, 2010). Moreover, there is evidence expounding that RPS has no significant effect on savings rate of low-income earners who are subject to an extra high old-age poverty risk (see Corneo et al., 2007; Coppola/Reil-Held, 2009; Geyer/Steiner, 2009).

## 2.2 The 2019 Reform: Pension Package II

These reforms described above contribute to ensure a sustainable financial endowment of the German public pension system on the one hand. On the other hand, there was a substantial need for taking further action on the benefit side in the light of decreasing replacement rates as well as demographic ageing and overall economic growth. Subsequent to the reconstruction of the contribution part, the problem of current and prospectively compounding old-age poverty came in focus of the current political discussion.

There were several reform proposals concerning a minimum pension during recent years. The first prominent discussion took place during the 2013 German national election campaign.<sup>13</sup> In general, all proposals made by the particular parties deal with the idea of a 10 to 15 per cent mark-up on the NBPS<sup>14</sup> which is equivalent to approx. 850 Euro per month. The extra charge can be granted if the requirement of attaining a certain amount of contribution and insurance years is fulfilled, respectively. The reform proposals aimed at individuals with discontinuous employment biographies or lower income who are thus faced with an increased risk of old-age poverty.

Carrying on the minimum pension purpose, the German government presented a similar concept called *Gesetzliche Solidarrente* (BMAS, 2016b, p. 33). In general, the proposal was addressed to persons whose employment biographies do not or did not run “ideal-typically” and aimed to enhance the situation of low-income people in particular. Insurants with more than 40 contribution years (35 contribution years after 2023) qualify for a guaranteed minimum pension whilst at most five years of unemployment can be treated as contribution years. Meeting all conditions, individual pension entitlements are provided with a 10 per cent mark-up so that the effective amount of pension payment exceeds the average regional NBPS.<sup>15</sup>

In the second half of 2019, the government intends to implement a policy in terms of a minimum pension as

<sup>12</sup>There are similar findings in Carroll/Summers (1987). By investigating savings rates in US after implementation of individual retirement accounts (IRA), they do not find a significantly increase in providing incentives for raise its private savings rate.

<sup>13</sup>For more detailed information see Finkler/Traub (2013).

<sup>14</sup>That corresponds to the needs-based pension supplement in old-age and in the event of reduced earning capacity, i.e. the *Grundsicherung im Alter und bei Erwerbsminderung*. according to Chapter 4, Book XII of the Social Code (*SGB XII*). As maintained by BMAS, the tax-financed needs-based pension supplement is a form of social assistance, meaning it is neither a ‘replacement’ nor a ‘minimum’ pension but rather a ‘basic’ pension.

<sup>15</sup>Focusing on the financial impact of a reform including a minimum pension with a required markup on the NBPS, cf. Finkler/Traub (2014).

part of *Rentenpaket II*<sup>16</sup>, the so-called *Grundrente*. According to the coalition agreement between CDU, CSU, and SPD (CDU et al., 2018, p. 92), the policy aims to acknowledge lifelong achievements of people who has worked for decades, brought up children, and nursed family members. People with more than 35 contribution years (including periods of child-raising and care) will be entitled to a 10 per cent mark-up on the NBPS. The *Grundrente* includes a means-test corresponding to legal regulations of basic security.<sup>17</sup> The GRV organises the means-tests in conjunction with the respective local social welfare authorities whilst the grant is processed only by GRV. The main difference to the *Gesetzliche Solidarrente* which can be seen as the precursor of the *Grundrente* is the aspect of means-testing. The *Gesetzliche Solidarrente* performs a means-test just one time at the beginning of the benefit period. The benefit thus represents a form of pension grant outside the GRV.

Although its precise design is unknown yet, the reform proposed by grand coalition between CDU/CSU and SPD parties provides a range of several justified criticisms. A minimum pension scheme within the GRV would lead to suspect distribution effects and serious inconsistencies which contradict core principles of a social insurance scheme.

- First of all, a minimum pension brings the **trade-off between equivalence principle and target compliance** to light. There is a legitimacy problem on the one hand and the old-age poverty on the other hand. Both phenomena should be analysed separately. Basically, the reform counteracts the equivalence principle which characterises a social insurance scheme. Regardless of whether the reform is financed by social security contributions or taxes: If the social security contributions should remain constant, the benefit has to be financed by taxes. The social insurance scheme mixes up with a system with a higher share in basic benefits rather than performance-related elements. The GRV thus takes one more step from a Bismarck system, which is primarily based on social insurance contributions, towards a Beveridge system, which is funded by taxes.
- Another noteworthy issue concerns the **eligibility criteria**. Employment interruptions of all kinds cause the most significant old-age poverty risk.<sup>18</sup> Unemployment, child-education, and parenting followed by part-time employment particularly increase the risk of failing to meet the current qualifying conditions. Several risk groups thus do not benefit from the reform due to insufficient amount of contribution years. Since the reform declares preventing old-age poverty as one of its major objectives, the policy would miss the needs of the actual target group.
- Besides distinct handling of full- and part-time employment, a **fixed amount of contribution years leads to adverse incentives**. Low-income earners scarcely meeting the conditions might be motivated not achieving a higher level of pension entitlements and thus reducing their labour supply.<sup>19</sup> A less clear-cut definition of eligibility criteria thus would be more productive in that case, e.g. in terms of a linear transition area. Furthermore, a clear distinction between full- and part-time employment would avoid a suspect equal treatment of the individual work extent.
- The reform intends a means-test at the beginning, i.e. when people retire. The organisation of the means-testing implies an **additional administrative outlay** for the GRV.
- Following up on this, the **dealing with changing individual needs** remains undetermined. This might be relevant especially in case of pension-related assets. Since individual income and welfare situation can vary over time, e.g. in case of partner's death or divorce, a person who is not entitled for benefit at the

<sup>16</sup>In 2018, the *Rentenpaket I* was passed. The reform includes five core elements: A fixed replacement rate at the 48 per cent level until 2025, a federal (and thus public) funded social security tax guarantee, further improvements of disability pension and the entitlements concerning child-care periods, and financial relief of low-income earners.

<sup>17</sup>The most recent version of the reform proposal does not provide a means-test. Status as of February 2019.

<sup>18</sup>Fixing the relative replacement rate at 48 per cent is another key component of the coalition agreement. This part of the pension reform is expected to remain without effect since the insufficient sum of earnings point rather than the relative replacement rate is the essential issue to consider.

<sup>19</sup>See also the theoretical framework to model dealing with optimal labour supply under hyperbolic discounting in Finkler (2018). The approach is based on Diamond/Köszegi (2003), Findley/Feigenbaum (2013), Feigenbaum/Findley (2015), and Zhang (2013).

beginning could be entitled in other circumstances later on. The proposal does not make any statement how to deal with situations like this.

- The reform proposal intends to address local conditions. By doing this, the minimum pension scheme takes different costs of living into account which would also imply different amounts of individual retirement income. The reform fails to achieve its second major goal since it **acknowledges lifelong achievements assesses them in a different manner**.
- Despite violating the equivalence principle, a benefit ten per cent above the local NBPS could still be insufficient.<sup>20</sup> Even an income subsidy would thus be **inappropriate to effectively prevent old-age poverty**.
- The source of funding is still not defined so the question “**how is the reform basically financed?**” remains. A benefit depending on actual needs (buzzword “means-testing”) would counteract the principle according to which preventing old-age poverty is a task for the whole society. A reform with this intention has to be financed by public funds instead of social security contributions.
- Despite the source of funding, however, the *Grundrente* would **increase the burden of future generations** and, thus, exacerbate the inter-generational conflict. If not publicly funded, reform will increase the sustainability gap of the GRV.
- The reform basically aims to implement a public guaranteed pension income above a means-tested minimum pension (a ten per cent mark-up) if conditions are met. There are considerable doubts that an automatically topped-up pension income accounts for both **principles of fairness and distributive justice** as well. Despite violating the equivalence principle applied in a social insurance scheme, it could be assumed that a harmonisation of both institutions – GRV and social welfare authorities – would aggravate rather than tackle the legitimacy problem of GRV.
- In conclusion, the question arises if the reform proposal is a target-oriented policy which reduces old-age poverty or if the *Grundrente* is no more than a red herring. Irrespective of wide-spread criticism, the **group size of individuals with entitlements is still unclear**. Quantifying the amount of persons who would benefit from the reform proposal will help to make the discussion about old-age poverty in Germany more objective.

## 2.3 Old-age poverty: Evidence for Germany

Introducing some empirical findings promotes a more profound discussion about old-age poverty.<sup>21</sup> As Figure 1 indicates, people with certain socio-demographic characteristics are affected by old-age poverty to a considerable extent. Seeming intuitive, people with low or no vocational training at all are at higher old-age poverty risk. Following this, the lower the periods spent in full-time employment the higher the old-age poverty risk. Side- and follow-up-effects like long-term unemployment, disability, low income, and insufficient amount of occupational or private pension inevitably worsen the downward spiral of poverty.

The comparison between the status quo scenario and selected results of the microsimulation analysis (see Section 4) provides interesting insights regarding risk factors of old-age poverty.<sup>22</sup> Considering periods of employment, simulation results indicate a clear upward shift of old-age poverty risk. Whilst old-age poverty risk (in terms of persons aged 65 and above receiving NBPS) is highest by about 50% for those with less than 15 years of employment, there is a trickle-up to those with 15-30 employment years: Old-age poverty risk is shifting upwards to the lower middle class. Looking at the second pie chart of the simulation results, atypical employment could be identified as the main driver of this risk shift. An employment biography mainly

<sup>20</sup>According to Köhler-Rama (2018), a minimum pension with a 10 per cent mark-up yields less than a quarter of average income.

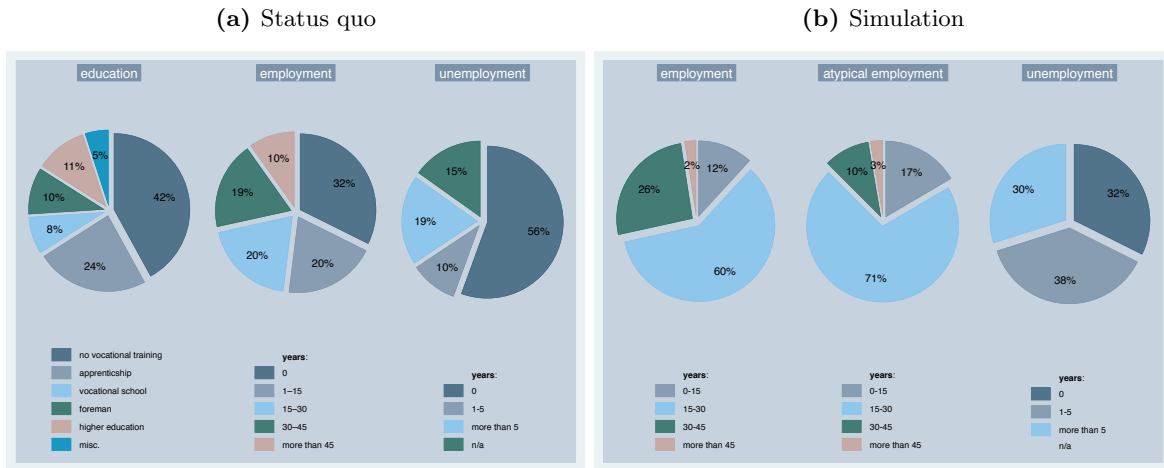
<sup>21</sup>Analysing old-age poverty requires selective distinctions regarding terminology. A brief sketch of poverty concepts can be found in appendix (A.2). See also Finkler (2018, pp. 41) for further readings.

<sup>22</sup>Due to discrepancies in data structure, there is not corresponding simulation result concerning the education variable.

consisting of atypical employment is likely to result in a retirement income below the NBPS and, thus, implies an increasing old-age poverty risk.

These findings should, however, be interpreted with caution. Whilst status quo includes persons actually benefit from NBPS, simulation results only cover pensioners with a retirement income below the NBPS which is not identical to an actual claim to NBPS.

**Figure 1:** Status quo vs. Simulation: Persons aged 65 and above receiving old-age security (NBPS)



Note: Observed persons (a) and *simulated* persons (b) aged 65 and above receiving old-age security.

Source: (a) BMAS (2016c); SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2015; own calculations, own illustration.

There is a broad range of discussion papers regarding old-age poverty in Germany (Arent/Nagl, 2010; Bäcker/Schmitz, 2013; Fratzscher, 2016; Geyer, 2014; Geyer/Steiner, 2014; Goebel/Grabka, 2011; Himmelreicher/Frommert, 2006; Krenz et al., 2009; Kumpmann et al., 2012). Both the expected dimension and the acuteness of the problem cause taking action in order to ensure a poverty-avoiding old-age income. Some studies only quantify old-age poverty among existing instead of new pensioners.<sup>23</sup> However, steadily growing importance is ascribed to an increasing risk of old-age poverty resulting from demographic ageing and unsteady employment patterns.<sup>24</sup> Although the poverty rate among the elderly remained constant since the 1990s (Strengmann-Kuhn, 2008), an increase in old-age poverty is on the cards. As a direct consequence of pension calculation formula (see Section 2.1), replacement rates are expected to decline. Discontinuous career patterns, atypical employment, and longer periods of education and training also lead to lower pension entitlements and thus increase poverty risk (Steiner/Geyer, 2010).

Goebel and Grabka (2011) investigate the progress of old-age poverty risks in recent past by analysing GSOEP pensioner households. The authors ascertain that in recent years, the elderly are exposed to the risk of poverty to the same extent as overall population. However, single households are subject to a higher risk than couples.<sup>25</sup> Declining amounts of pension payments and minor importance of other income components might suggest an increase in old-age poverty. The main reason are changing household patterns; an increasing share in couple households implies a lower old-age poverty risk. In addition, integrating other pension-related assets puts old-age poverty into perspective. However, households at a higher old-age poverty risk derive their retirement income from GRV for the most part rather than from other pension assets. On the contrary, high income households more likely have built up pension-related assets (Fratzscher, 2016). Therefore, integrating assets reduces old-age poverty while inequality rises.

<sup>23</sup>On the other hand, there are comprehensive data available analysing income situation of existing pensioners. See Bieber/Stegmann (2008) for further information.

<sup>24</sup>Due to (lack of) data availability there is some uncertainty regarding the expected dimension of old-age poverty (cf. Leiber, 2009). Nevertheless there is some observable indications implying an exacerbation of the problem.

<sup>25</sup>This is attributable to intra-household redistribution processes. Decreasing fixed costs on the one hand and higher incomes which compensate lower incomes on the other hand foster these situations in a single-breadwinner household.



## 3 Data and Method

### 3.1 Data

The microsimulation model consists of two datasets: The German Socio-Economic Panel (GSOEP) and the Insurance Accounts' Sample (IAS).

Information about socio-demographic characteristics and individual employment biographies as well as household data are provided by the German Socio-Economic Panel (GSOEP).<sup>26</sup> The survey data represent the main component of the microsimulation model presented in Section A.3. GSOEP data are representative longitudinal data collected from German households since 1984. They provide comprehensive information about living and income conditions of households and individuals living therein (Wagner et al., 2008). There are nearly 30,000 individuals living in about 15,000 households participating in the GSOEP survey (Goebel et al., 2018). Information about several kinds of income allows a detailed analysis of income and wealth situation both on individual and household level.

The survey covers 33 waves which implies up to 396 insurance months of entitlement generating activities. Taking this time span into account, the data structure allows for estimating cohort effects<sup>27</sup> since several birth cohorts of same age can be observed and analysed at different points in time (i.e. calendar years). This is a very useful feature with respect to the estimation of individual employment biographies and age-earnings profiles. Another valuable advantage of the GSOEP is the existent household structure. This is a key feature regarding the research question. Information about household size and structure allows for generating equivalence-weighted incomes such that valid statements concerning relative income position, inequality, and poverty are possible.

While valid information about schooling, vocational and academic training is available in a comprehensive manner,<sup>28</sup> there is imprecise information about individual pension entitlements. This is a characteristic weakness of survey data which base on personal information gained from interviews and questionnaires. Unless personal earnings points can be estimated retrospectively, the data could be affected by response bias or non-response bias.<sup>29</sup> Institutional data provided by the German statutory pension insurance scheme (*Deutsche Rentenversicherung Bund*, henceforth DRV) can provide a remedy. The process-produced data gathers contribution and insurance periods precisely.

The GSOEP data are combined with the sample of insured persons and their insurance accounts (*Versicherungskontenstichprobe*, henceforth IAS) provided by DRV. The IAS primarily consists of biography data<sup>30</sup> and data concerning individual type of pension insurance. It is drawn as a random sample from individual pension accounts since 1983 and continued as panel data (cf. Kreyenfeld/Mika, 2008, p. 72). The population includes persons aged between 15 and 67 holding an individual pension account. The scientific use file SUFVSKT2015 draws a 25%-subsample representing persons born between 1948 and 1985 and includes 66,975 observations of German nationals residing in Germany. IAS also consists of a fixed part including demographic and datastructure-related features as well as the amount of notionally computed individual pension annuities. Besides socio-demographic characteristics there is a very distinguishing feature in the dataset. Since some variables are process-produced there is access to information about the exact amount of acquired personal pension entitlements.

### 3.2 Integrated dataset: Statistical Matching

GSOEP and IAS complement each other since both datasets combine advantages either-way while eliminating particular information lacks. Thus, merging both datasets using a statistical matching approach would lead to an integrated database. The main challenge of a statistical matching technique consists in seeking and finding statistical twins. These refer to a pair of observations who exhibit quite similar or equal characteristics.

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<sup>26</sup>See Schupp (2009), Wagner et al. (2007), and Wagner et al. (2008) for further information.

<sup>27</sup>Holding age constant, cohort effects identify the marginal effect of birth cohort at different points in time.

<sup>28</sup>This feature is also important with respect to the statistical matching, see Section 3.2.

<sup>29</sup>See Guilford (1959) und Cronbach (1970).

<sup>30</sup>These data are provided by the Research Data Center of the statutory pension insurance (*Forschungsdatenzentrum der Rentenversicherung*, henceforth FDZ-RV).

There are some other pension-related studies using matched data from GSOEP and DRV data. First of all, there is the survey of Steiner and Geyer (2010) who also match GSOEP and IAS whilst applying the method of propensity score (“nearest neighbour”-approach)<sup>31</sup>. The authors predict trends in GRV old-age incomes also considering wealth assets. They come to the result that the situation will exacerbate noticeably – especially from East German pensioners’ perspective.<sup>32</sup> Rasner et al. (2011) combine GSOEP and IAS as well. They predict and analyse old-age income distribution of current rather than prospective pensioners. Arent and Nagl (2010) arrive at similar results using IAS and Institute for Employment research (IAB)<sup>33</sup> data. Rasner et al. (2007) also combine DRV data<sup>34</sup> and GSOEP whilst applying and assessing several matching techniques.

The matching techniques and data bases of the studies listed above have many things in common with this present work. There are, however, several differences concerning further microsimulation model. My model not only simulates individual retirement incomes and pension-related wealth assets. Using a behavioural approach, it assumes households who anticipate their future retirement income and accordingly adjust their labour supply and retirement savings behaviour during working life. See Finkler (2018) to get an extensive overview on and a detailed insight into the matching technique and the microsimulation model as well.

### 3.3 Employment Biographies and Earnings Profiles

This section documents some interim results in a nutshell.<sup>35</sup> Based on Tobit regressions (see Section A.3), Table 1 shows the simulated periods spent in full- and part-time as well as unemployment until retirement.

Apart from differences due to cohort effects presented in Tables A.1–A.3, there are differences due to migration between East and West Germany which accelerates the gap between both regions.<sup>36</sup> This relative change in population of both regions is controlled by weighting the results by modified sample weights, which takes changes in demographic structure into account. However, it should be noted at this point that findings are congruent with those in Section A.3 as a whole.

The left part of Table 1 addressing simulated full-time employment continues the trend indicated by cohort effects. Compared to West German males with low education born between 1950 and 1954, youngest cohort works about eight years less in full-time employment. Results show similar effects for higher education groups while the decrease is not that severe. Over all education groups, there is a drop in full-time employment of slightly more than two years. East German males also depict a slightly decreasing trend in simulated full-time employment among the two lower education groups, however, they all start from a lower level. Over all education levels, East German males show an increase by more than four years, taking the 1970–1974 cohort as reference.

Whilst there is a slight increase in atypical employment for all education groups in West, simulation results provide a strong increase for East German males; this especially applies for low education (from 9 months to almost 13 years). This group is also in a bad situation regarding unemployment, where periods double over cohorts. In contrast, years spent in unemployment decline for the two groups with higher education. Unemployment among West German males draws a consistent picture, which implies the lower the education the stronger increases unemployment years.

Table 2 shows simulation results concerning pension-relevant periods of full-time and part-time employment as well as unemployment. Besides the trend over cohorts, there is a significant gender-specific level effect. Taken as a whole, females work less full-time than males while working more part-time on the other hand. However, males depict an increasing trend of part-time employment as stated above. Unemployment years are concurrent while factoring out different level for several education groups.

<sup>31</sup>See also the work of Cameron and Trivedi (2005).

<sup>32</sup>This finding is also confirmed by the microsimulation analysis in the following (see Section 3) confirms.

<sup>33</sup>The IAB (*Institut für Arbeitsmarkt- und Berufsforschung*) is a special office of the Federal Employment Agency (*Bundesagentur für Arbeit*, BA) in Nuremberg.

<sup>34</sup>The Scientific Use File Completed Insurance Biographies SUFVVL2004 (*Vollendete Versichertenleben*).

<sup>35</sup>Section A.3 in the appendix introduces setup and operation mode of the microsimulation model.

<sup>36</sup>Unless lowering fertility rates can explain a decline in population, a lack of economic perspective is said to be a main driver of emigration from East Germany (“brain-drain”). See also Friedrich/Schultz (2005).

**Table 1:** Simulated Employment Biographies  
Males: Full- & part-time employment, unemployment

<i>education:</i>	full-time				part-time				unemployment			
	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>
<b>West</b>												
1950–1954	38.0	38.9	33.2	37.9	5.4	0.8	4.7	2.3	4.4	1.3	0.4	1.8
1955–1959	28.3	39.3	35.2	37.1	2.2	1.1	1.1	1.3	6.2	1.4	0.5	2.0
1960–1964	34.8	38.8	35.2	37.9	2.9	1.5	1.1	1.5	4.2	1.5	0.8	1.5
1965–1969	36.6	37.8	33.2	36.3	2.6	1.9	2.6	2.2	5.7	2.5	0.5	2.1
1970–1974	32.9	36.9	32.4	35.7	3.8	2.8	2.9	2.9	7.5	1.8	0.8	2.1
1975–1979	30.3	36.9	31.1	35.6	5.1	2.3	3.1	2.6	7.7	1.6	0.8	1.6
<b>East</b>												
1950–1954	29.6	33.4	27.4	32.5	0.7	1.4	1.8	1.4	9.1	7.7	7.4	7.7
1955–1959	23.9	37.2	29.3	36.1	1.9	1.2	5.5	1.6	11.7	3.8	2.3	3.8
1960–1964	31.9	36.9	34.9	36.5	6.1	1.9	3.2	2.1	11.7	4.0	2.0	4.0
1965–1969	25.8	37.1	31.5	36.0	6.2	1.9	3.4	2.2	17.1	4.1	2.3	4.5
1970–1974	24.6	37.3	34.5	36.7	9.8	2.3	4.2	2.6	19.9	3.5	0.9	3.7
1975–1979	28.2	33.9	31.9	32.7	12.7	1.9	4.1	3.7	18.5	4.5	0.6	5.4

Note: Simulated periods of full-, part-time employment, and unemployment in years. Data weighted by modified sample weights.

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

**Table 2:** Simulated Employment Biographies  
Females: Full- & part-time employment, unemployment

<i>education:</i>	full-time				part-time				unemployment			
	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>
<b>West</b>												
1950–1954	17.3	19.1	26.6	19.6	6.1	12.3	7.2	10.7	1.1	1.8	3.2	1.8
1955–1959	12.5	20.2	23.8	19.7	10.6	11.9	7.2	11.2	2.1	1.3	0.9	1.4
1960–1964	16.7	20.2	18.5	19.6	9.5	11.2	10.5	10.9	3.0	1.6	1.1	1.6
1965–1969	13.4	19.0	22.1	18.7	11.7	10.6	8.9	10.5	2.7	1.4	0.8	1.5
1970–1974	10.0	18.5	19.1	17.5	9.8	9.7	9.2	9.6	4.9	1.7	0.6	1.9
1975–1979	9.8	17.0	21.1	17.3	11.2	9.3	7.2	8.9	7.9	1.4	0.8	1.9
<b>East</b>												
1950–1954	19.5	30.7	29.7	29.3	8.3	6.9	4.5	6.6	6.9	5.3	3.2	5.0
1955–1959	13.5	28.6	32.0	28.3	6.0	6.5	4.9	6.3	13.8	4.8	1.6	4.8
1960–1964	20.6	28.4	27.9	28.0	7.3	6.6	8.3	6.7	3.8	4.7	2.1	4.4
1965–1969	14.2	26.1	28.5	25.8	12.6	8.1	7.4	8.2	10.9	4.7	2.2	4.7
1970–1974	18.7	25.0	25.4	24.8	10.2	9.1	10.3	9.4	10.9	4.2	1.4	4.1
1975–1979	7.3	24.7	22.8	23.8	6.9	7.7	12.6	8.7	18.1	4.1	1.4	4.0

Note: Simulated periods of full-, part-time employment, and unemployment in years. Data weighted by modified sample weights.

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Whilst decrease of medium and high education is relatively moderate, years of full-time employment falls by more than half for low educated females in both regions. However, decline is stronger in East than in West Germany. Part-time employment especially increases considering low educated females in West (almost doubled up to 11.2 years) and high educated females in East Germany (almost increased threefold up to 12.6 years) as well. Over all education groups, unemployment remains at a constant level of about two years while there is a decrease by 20 per cent in East Germany.

Considering findings related to years spent with domestic work, Table 3 provides a differentiated image for

gender, region, and educational level. As we can expect from cohort effects, males show a lower level of domestic work compared to females overall. Thus, the meaning of male domestic work for pension entitlements as well as the role of housemen will not further discussed at this point.

**Table 3:** Simulated Employment Biographies  
Domestic work

<i>education:</i>	males				females			
	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>	<i>low</i>	<i>med.</i>	<i>high</i>	<i>total</i>
<b>West</b>								
1950–1954	0.2	0.2	0.2	0.2	24.8	13.9	8.2	15.1
1955–1959	0.3	0.8	0.0	0.6	19.6	12.4	10.4	13.0
1960–1964	0.2	0.4	0.3	0.4	17.7	12.7	11.9	13.0
1965–1969	0.3	0.2	0.2	0.2	17.8	12.6	6.8	12.5
1970–1974	0.4	0.2	0.2	0.2	20.1	12.5	8.2	12.6
1975–1979	0.2	0.3	0.1	0.2	13.5	10.7	5.6	9.6
<b>East</b>								
1950–1954	0.1	0.2	0.1	0.1	3.0	2.2	1.7	2.2
1955–1959	0.0	0.1	1.2	0.2	7.6	3.3	2.1	3.4
1960–1964	0.0	0.2	0.5	0.2	14.4	4.1	4.1	4.5
1965–1969	0.0	0.5	0.6	0.5	8.4	5.6	4.3	5.5
1970–1974	2.1	0.6	0.7	0.6	10.3	5.6	5.6	5.9
1975–1979	0.0	0.2	0.6	0.2	10.7	5.7	5.4	5.8

Note: Simulated periods of domestic work in years. Data weighted by modified sample weights.

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Contrary to males, females show substantially more periods of domestic work. Especially low educated women show a relatively large amount of domestic work in both East and West. It should be noted that there is, however, a decreasing trend among West German females from a high level of about 25 years of working in household and caring children while trend in East Germany points upward. The amount of domestic work is at a constant level among medium education in West whilst increasing by about two-and-a-half times among East German females. There is an increase in family-related support services for high education in East while West German females show no clear trend behaviour.

## 4 Results and Discussion

### 4.1 Individual vs. household perspective

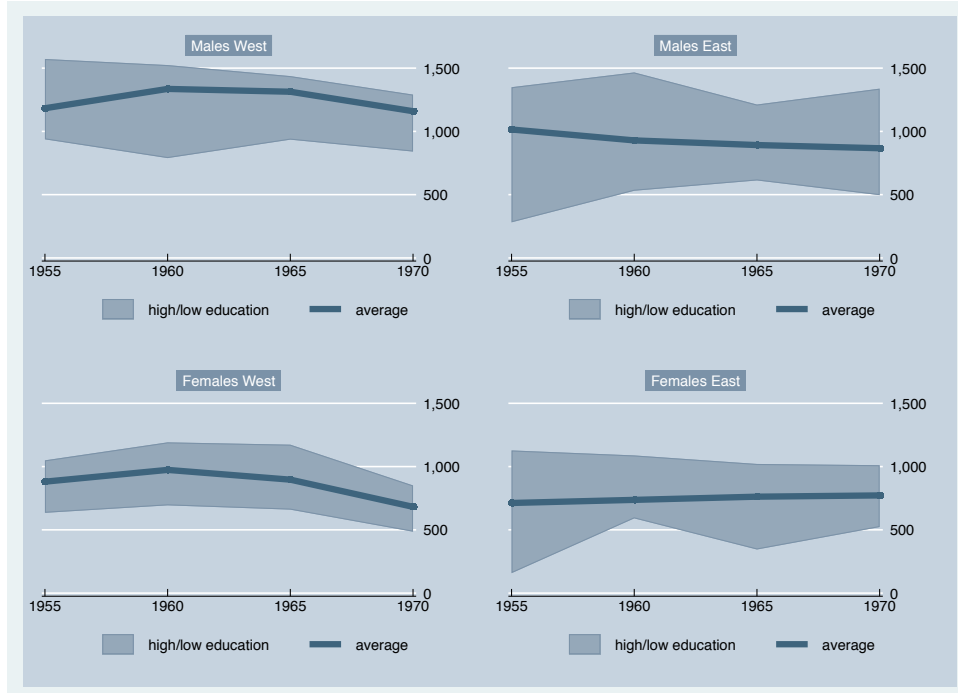
In previous section, it became obvious that individual employment histories vary significantly to some extent due to differences in socio-demographic characteristics. Apart from different effects caused by gender, region, and education level, several Tobit models identify marginal effects of particular birth cohorts on pension-relevant periods. Simulation results (see Tables 1–2) clearly show that younger cohorts achieve lower entitlement-increasing periods which implies lower individual pension level expected in old-age. This finding especially applies the more the lower educational level attains.

Figure 2 shows the simulated individual effective amount of pension, aggregated and disaggregated by gender, region, and education. The illustration transfers the interim results of previous sections to the next level. Pension entitlements can be derived from employment biographies based on Tobit models combined with age-earnings profiles based on random effects models.

The individual effective amount of pension payment (IEAPP)<sup>37</sup> decreases from 847 Euro (birth cohorts 1950–1954) to 695 Euro (1975–1979) on the aggregate level. This result implies a decline of almost 20 per cent over a time period corresponding to a new generation cycle. There are two main drivers determining the development of the IEAPP. First, the individual pension entitlements resulting from pension-relevant periods

<sup>37</sup>The individual effective amount of pension payment corresponds to the amount of pension minus health insurance and long-term care contributions.

**Figure 2:** Individual effective amount of pension payment



Note: Individual effective amount of pension payment (IEAPP) which corresponds to the amount of pension minus health insurance and long-term care contributions. Values weighted by modified sample weights and indicated in Euro (in 2018 prices). Inflation rate: 1,5 %.  
Source: SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2016; own calculations, own illustration.

with corresponding individual earnings points. Second, the general pension level, i.e. the current replacement rate, mainly represented by the pension calculation formula. West German males outline a u-shaped curve and almost return equal to its starting value (1,160 Euro), whereas East German male IEAPP remains nearly constant at 900 Euro. As we can expect from previous findings, income level considerably differs between educational level. High education males in West Germany depict, however, an 18 per cent decline over time (from 1,572 Euro to 1,291 Euro). The less adverse trend in East Germany can be explained by the harmonisation of gross earnings in both regions.<sup>38</sup> The actual wage development in East Germany still lags behind that of West Germany. Since wage levels still do not converge, there is a politically motivated harmonisation by law. Earnings points in East Germany thus tend to be overestimated.<sup>39</sup> Hothausen et al. (2012) talk about “*Ostaufwertung*”, i.e. an enhancement of pension-relevant incomes in East Germany.<sup>40</sup>

Considering the lower part of Figure 2 it becomes obvious that the female overall level of IEAPP is noticeably lower than male. Simulation results show a 22 per cent decline for West German females which might be mainly determined by the decline of full- and part-time employment (see Table 2). Both marginal education groups at both top and bottom follow the overall trend. Contrary to this, East German females’ IEAPP shows a slight and almost linear increase by about ten per cent (772 Euro). It should be noted at this point that the amount of individual earnings points is almost equal in both regions on the overall female level. Nevertheless, the IEAPP level is lower in East Germany which refers to the distinct valuation of the individual earnings (see above).

Figure 3 illustrates the simulated trend in gross replacement rate (GRR) in GRV. The GRR represents the ratio between the particular mean replacement rate and the average remuneration in base year. This definition thus differs from convention insofar as the standard pension (“*Eckrente*”) refers to the simulated average pension rather than gross earnings according to SGB VI<sup>41</sup>. As a result the simulated values turn out lower. The average income in 2015 amounts to 2,701 Euro in West, 2,257 Euro in East.

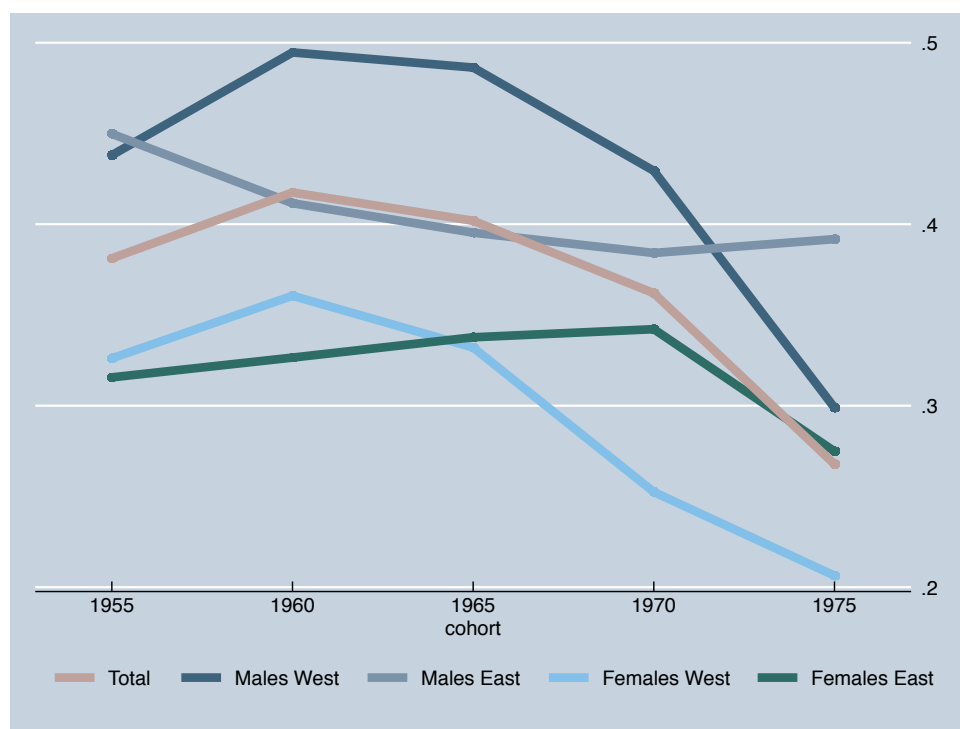
<sup>38</sup>Earnings points in East do not base on actual or predicted average remuneration but rather on values listed in Annex 10 SGB VI which are derived from Western average remuneration weighted by conversion factor.

<sup>39</sup>See also Sinn (2015).

<sup>40</sup>See also Börsch-Supan et al. (2009) who describe this phenomenon in detail.

<sup>41</sup>See average remuneration in Annex 1 SGB VI.

**Figure 3: Gross replacement rate**



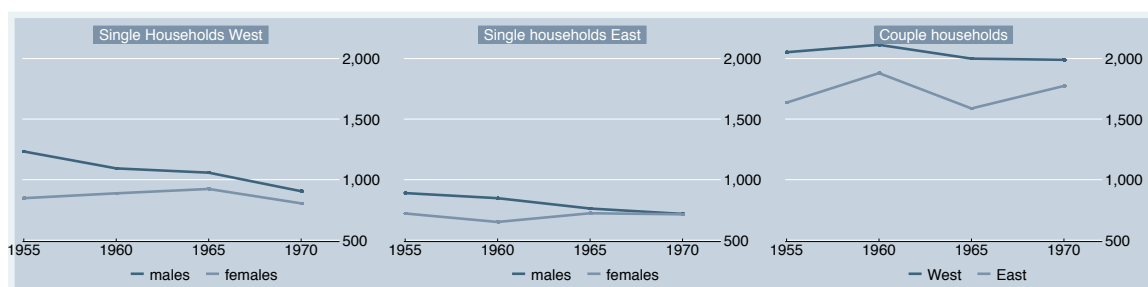
Note: The gross replacement rate (GRR) represents the ratio between the particular mean replacement rate and the average remuneration in base year.

Source: SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2015; own calculations, own illustration.

Above all groups there is a more or less strong decline in GRR over time. Whilst West German males born between 1960 and 1964 can expect a GRR of almost 50 per cent, this value declines by 30 percentage points during the following years and thus, cohorts 1975-1979 achieve only 30 percent of the average remuneration. The situation of East German males mitigates (45 to 39 per cent), however, they start from a lower level. Females in both regions show a similar trend. Starting from a GRR of a third, the value declines down to 21 per cent (West) and 27 per cent (East).

Talking about old-age poverty, it is necessary to change the perspective. Henceforth we introduce the household context rather than considering incomes and assets at the individual level. As can be seen from Figure 2, some socio-demographic groups show noticeably low IEAPP levels which conceivably can be compensated by several income types of other household members.

**Figure 4: Household's effective amount of pension payment**



Note: Individual effective amount of pension payment, aggregated on household level. Persons aged 65 and above receiving old-age security.

Source: BMAS (2016c); own illustration.

Figure 4 illustrates the IEAPP on the household level for single and couple households. It becomes clear that the development of household retirement income confirms that of individuals: There is a slightly downward sloping, in the best case horizontal running curve observable for single households in East and West. The three figures also provide clear differences between region, gender of household head, and especially household type. West German single households register an IEAPP level up to a third higher than East German ones.

Differentiating by gender, retirement income of households headed by males are higher in both regions over all cohorts. The most important aspect is represented by differences in household type. Couple households show significantly higher retirement incomes, i.e. more than twice as much as single households, in both regions over all cohorts.

Considering single households in West and East, the convergence between both genders becomes obvious. Younger cohorts decrease the gender pension gap over time or close it at all in East Germany. This fact could be explained by an increased labour market participation of women. The simulation results may also imply that there is an important inner-household distribution of retirement income resulting in levelling differences.<sup>42</sup> Prevailing traditional gender roles<sup>43</sup> may occasionally imply an enormous disparity in retirement incomes between several household members. Figure 4 shows an insurance effect arising from a household as a socio-economic structure. The average retirement income of households is more than double as high as average single household pension of corresponding region. Living in a couple household rather than single household thus represents an aspect which becomes relevant for social security in old-age.

Taking these findings into account, it should be noted again that considering the household level must be the basis for discussion and policy design which aims preventing old-age poverty. Poverty-provoking retirement incomes resulting from insufficient pension entitlements imply not inevitably a need for public welfare benefits. The household context allows to ascertain and assess actual individual needs efficiently.

The statements in the following section quantify the meaning of the household context and link these findings to the role of the NBPS.

## 4.2 Swing Pensioners

As a first step we have to quantify the reference value. The average NBPS in 2018 amounts for 750 Euro per month in case of single households and 1,213 Euro in case of couple households. The NBPS consists of a fixed standard rate on the one hand and of a variable part compensating accommodation costs on the other hand. These region-specific values incorporate different residential characteristics amongst German federal states.<sup>44</sup> The model assigns the particular normal requirement to the several household type. The NBPS fixed part amounts to 416 Euro (singles) and 790 Euro (couples), respectively. The average accommodation costs of 334 Euro for single households and 423 Euro for couple households base on calculations made by IAQ (2018a; 2018b). It should be noted that accommodation costs are only averages on the federal state level and thus do not exactly represent the actual need. Costs may vary within a federal state regarding rural-urban living costs disparities. This becomes intuitive while taking a look at Hamburg and Schleswig-Holstein. The values calculated for a big federal state as North Rhine-Westphalia should thus be interpreted with caution for that reason. Accommodation costs at the rural district level<sup>45</sup> would provide a more precise reference.

Table 4 documents the average number of simulated pension-relevant periods and earnings points, respectively. The values are separated by their relation to NBPS i.e. if the simulated household income is below or above the threshold. Over the whole simulation cycle, 22 per cent of all prospective pensioner households live in an household with a retirement income below the NBPS. The risk of falling below the threshold is unequally distributed: 84 per cent of those are single households whilst 16 per cent are couple households.

Discrepancies between both groups result from estimations in Section 3. The findings are basically not surprising given the characteristics of an employment biography which increase the risk of old-age poverty. Persons below the NBPS show a slightly higher level of part-time employment and unemployment, whilst this

<sup>42</sup>This is also established by law, whilst pension entitlements can be transferred to spouses in case of divorce (settlement of pension entitlements) or death (survivor's pension).

<sup>43</sup>The within-household role of men and women based on a male breadwinner model includes a higher earning man and a women working part-time or not working at all but rather raising children and caring for dependents. See also the workings of Jane Lewis and Ilona Ostner (e.g. Lewis/Ostner, 1994) who introduced this terminology to describe the interaction between family and working life within the prevailing gender role framework in the traditional welfare state.

<sup>44</sup>See also Table A.5 in appendix which lists NBPS (fixed part plus average accommodation costs) separated by German federal state.

<sup>45</sup>Rural district can be interpreted by the German term *Landkreis*, also known as *Kreis* in some federal states. Some cities are also referred as "district-free cities" (*kreisfreie Städte*) and "urban district" (*Stadtkreis*).

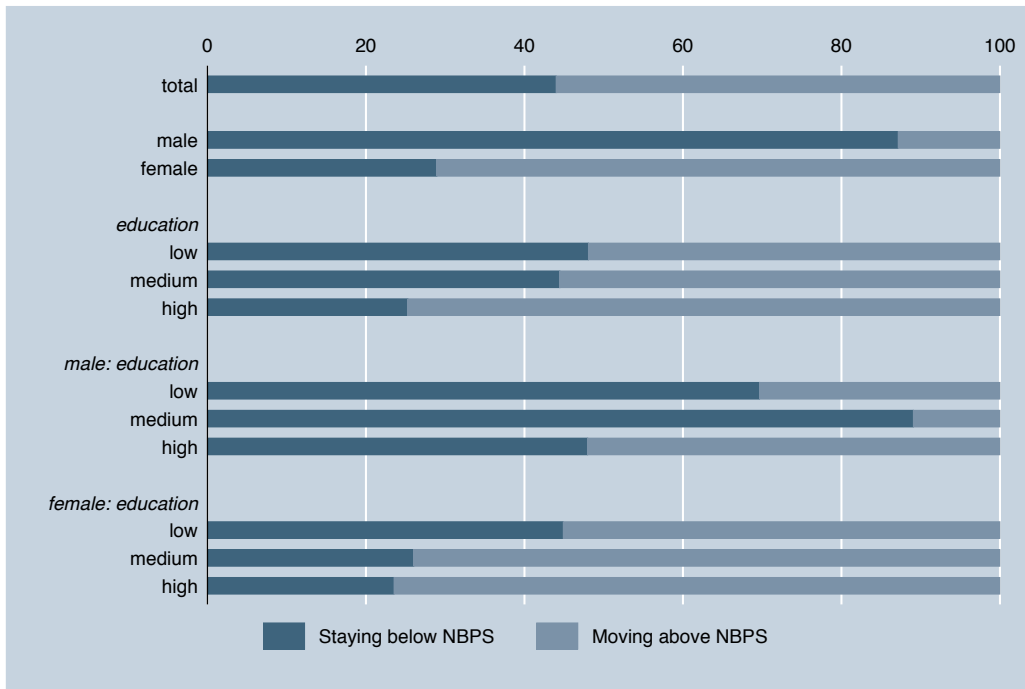
**Table 4:** Employment biography and earnings points related to NBPS

	above NBPS	below NBPS
full-time employment	28.7	20.3
part-time employment	5.6	6.7
unemployment	1.6	6.1
domestic work	6.3	6.9
earnings points	36.5	12.4

Note: Average simulated pension-relevant periods and earnings points, respectively. The values are separated by their relation to NBPS, i.e. if the simulated household income is below or above the NBPS.

Source: SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2015; own calculations, own illustration.

value is about four times as high as that of those who achieve a retirement income above the NBPS. The extent of domestic work is almost equal. Simulated periods of full-time employment differ by more than eight years between both groups which seems quite intuitive since full-time employment is the main driver achieving pension entitlements. The most noticeable difference can be recognised by looking at the last column. People living in households below the NBPS only achieve a third of those who are above the NBPS. Reconsidering the statements corresponding to the *Pension Package II* (see Section 2.2), it becomes clear that there is a fault in construction. The fact that the average number of earnings points amounts to 36.5 and 12.4, respectively, supports the argument that the reform will not affect the actual target group and thus miss its major objective. Against this background, considering the household level whilst analysing the situation of pensioners living in couple household becomes more relevant.

**Figure 5:** Swing pensioners

Note: The extent to which household context affects income position effect relative to NBPS. The analysis provides the number of individuals in couple households who would achieve an income below the NBPS if their pension is considered in isolation and at the same time who would achieve a proportional income above the NBPS if the pension of the other household member is included.

Source: SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2015; own calculations, own illustration.

Table 5 illustrates the meaning of the household context. It provides a relevant explanation why it is necessary to consider retirement incomes on the household level rather than the individual level if discussing about old-age poverty. The major argument can be expressed by the main result illustrated by the sky-blue horizontal bar in the first line: 56 per cent of those who live in couple households would receive an IEAPP lower than NBPS if their income situation would be considered at the individual level. That means that 56 per cent of prospective pensioners living in couple households are better off by integrating the income of other household



member(s). On the other hand, 44 per cent are staying below the NBPS and thus the other household member cannot compensate the own (maybe too low) income resulting in moving above the NBPS.

The advantageous effect becomes more noticeable when differentiating by gender: Females benefit to a significantly greater extent than males from the integration of the household context. Over the whole simulation cycle until 2040, almost 9 of 10 males stay below the NBPS whilst females draw an entirely different picture: 71 per cent of females, whose pension would be considered individually, move above the NBPS. The share of moving females is thus about six times as high as male.

By almost three quarters, the share in “movers” is largest in the high education group. Medium and low education group register a relatively high amount of people staying below the NBPS (48 and 44 per cent, respectively). This can be explained by the fact that in households with a low-educated head another household member at the same educational level is more likely to be met. A lower retirement income of the entire household tends to be the result.

Differentiating by education and gender as well, we can observe impacts to a different extent. The male persistence ratio is relatively high over all educational levels compared to females. Medium-educated males are most likely to stay below the NBPS (almost 90 per cent) whilst for females the following applies: The lower the educational level, the lower is the proportion moving above the NBPS (from 76 to 55 per cent).

The gender-specific discrepancies can be interpreted again as a result of traditional gender roles. Male household members are more likely to contribute the major part to the total household income irrespective of its level whilst females throw in less which would result in an eligibility for benefits if their incomes would be considered in isolation. The trend to individualising household structure and differences between single and couple households regarding the NBPS take-up leads us to expect an enlargement in old-age poverty. It can be assumed that, on the one hand, the old-age poverty risk will increase at all since singles achieve lower income whilst at the same time an inner-household compensation possibility is absent.

On the other hand, a trend towards increasing individualisation could also imply an increasing intention to acquire pension entitlements. Given negative signs concerning the expected retirement income, this could require a higher labour supply preventing an insufficient individual pension level. Female single households in particular are more likely to show less birth- and parenting-related disadvantages and thus an increasing labour market participation due to a decreasing fertility rate in general in combination with an improved reconciliation of family and working life. It remains to be seen which of the two effects will predominate the development of single females’ retirement income. These challenges for family, labour, and pension policies constitute an area of tension and, however, a clearly defined field of taking action at the same time for those who are politically responsibly.

### 4.3 Is the Grundrente no more than a red herring?

Reconsidering the eligibility criteria described in Section 2.2, a person who is expected to benefit from the reform must have produced 35 contribution years. After we examined the meaning of the household context which improves the situation concerning old-age poverty, the following figure quantifies the expected size of the target group.

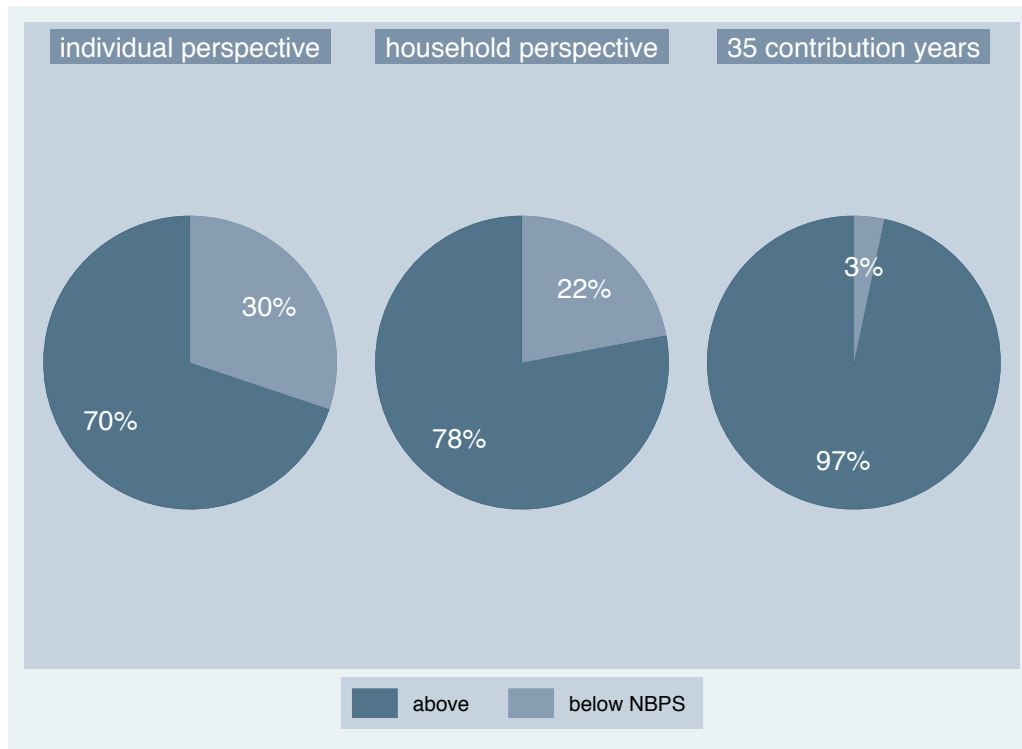
Figure 6 depicts another key result of the microsimulation model. It returns to the question how many people are likely to be affected by the reform which in consequence means that if the reform proposal remains little more than a red herring? Analysing old-age poverty from individual perspective, almost a third of all new pensions in next 25 years are expected to achieve a predicted retirement income below the NBPS.<sup>46</sup> Introducing the household context leads to a decrease of 8 percentage points; so there are only about twenty per cent of all new pensions below the NBPS and, thus, about a fifth of new pensioners who would benefit from the reform.

Combining the household context with the application of eligibility criteria (i.e. 35 contribution years), there are only three per cent of all new pensions in next 25 years below the NBPS and, thus, potentially entitled to

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<sup>46</sup>The analysis only focuses on new pensions, that means those who will retire during the simulation cycle between 2016 and 2040. The fact that the implemented *Grundrente* intends to include also existing pensioners would widen the actual scope of beneficiaries.

**Figure 6:** Target group



Note: The extent to which all new pensions in the next 25 years below the NBPS would benefit from the *Grundrente*.

Source: SOEPv33 (SOEP, 2016), FDZ-RV – SUFVSKT2015; own calculations, own illustration.

the reform.

This simulation result suggests that old-age poverty is already a serious issue and will be a field of action in pension policy. Future policies would be well-advised to focus on households rather than individuals. Highlighting the fact that only three per cent of new pensions will benefit from the reform arises the question if the reform actually is an appropriate policy. The predicted extent of beneficiaries puts the contribution of the *Grundrente* to the fight against old-age poverty in a new light. A well-promoted pension reform policy as the *Grundrente* affecting only a small amount of persons seems more like a ‘red herring’ than an effective, target-oriented tool to tackle old-age poverty.

## 5 Concluding remarks

German pension insurance scheme is challenged by two problematic issues. Disrupted employment biographies and atypical employment lead to decreasing retirement incomes in the amount of NBPS. First, GRV would thus transform to a basic-level old-age provision which throws considerable doubts on the system’s *raison d’être*. Second and more important, people with decades of social insurance contributions face with growing old-age poverty risk when they retire.

After many years of political, societal, and scientific discussions, German federal government intends to implement the *Grundrente* in 2019. As stated above, policy benefits those with more than 35 contribution years and, thus, embodies no more than a pension grant for the long-term insured. The reform proposal provides a range of several justified criticisms. A minimum pension scheme within the GRV would lead to suspect distribution effects and serious inconsistencies which contradict core principles of a social insurance scheme.

The microsimulation analysis provides strong arguments for considering households rather than individuals when designing pension reforms preventing old-age poverty. The results suggest that 56 per cent of those who live in couple households would achieve a pension level lower than means-tested minimum pension if their income situation would be considered at the individual level. That means that more than half of prospective pensioners

living in couple households are better off by integrating other household incomes. The microsimulation analysis also examines the quantitative scale of the pension reform proposal of the *Grundrente*. Only three per cent of all new pensions in next 25 years would benefit from the reform. There is, thus, only a small amount of new pensioners below the NBPS if we combine the household context with the application of eligibility criteria (i.e. 35 contribution years). Policies like the *Grundrente* contribute to reduce old-age poverty in the short run and, thus, to achieve one of the major GRV objectives. The *Grundrente*, however, only corrects rather than prevents old-age poverty. Thus, the policy has to be classified as a curative (rather than a preventive) action and is not able to deal with the root of the problem.

Simulation findings from retirement incomes and swing pensioners' analysis draw a clear picture of socio-demographic characteristics faced with an increased old-age poverty risk. Females, people from East Germany and those with a low level of education are more likely to achieve a retirement income below the NBPS. Individuals with these characteristics have less incentives to contribute to their own old-age provision since they get a public welfare benefit which does not require any social security contributions. Further research is needed to examine why these risk groups still provide for old age.

The present work clearly identifies socio-demographic characteristics of risk groups. Stressing the point stated above, further research is required to focus on these groups to tackle the problem effectively. Compensating lost pension entitlements of risk groups due to employment interruptions caused by unemployment, child-raising or care represents a core issue. This purpose predominantly addresses parenting or caring females whose career interruption is followed by part-time employment in most cases. There is a need for policies which remove barriers to come back to the labour market and enable to resume full-time work. This includes the provision of a comprehensive network of childcare facilities which ensures parent's freedom of choice. Accompanying wage compensation policies will not only enhance female labour market participation but also create conditions favourable to an increase in fertility rate. Further improvements in microsimulation analysis could contribute to encourage well-defined policies.

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## A Appendix

### A.1 Pensions adjustment formula

The pension value is determined by several economic and demographic trends represented by the pensions adjustment formula:

$$A_t = A_{t-1} \times \frac{BE_{t-1}}{BE_{t-2}} \times \frac{100 - \tau_{t-1}^{RPS} - \tau_{t-1}^{SV}}{100 - \tau_{t-2}^{RPS} - \tau_{t-2}^{SV}} \times \left( \left( 1 - \frac{RQ_{t-1}}{RQ_{t-2}} \right) \alpha + 1 \right) \quad (\text{A.1})$$

The pension value  $A_t$  is determined by the pension value of the previous period,  $A_{t-1}$ , the growth gross earnings over the last two periods,  $\frac{BE_{t-1}}{BE_{t-2}}$ , and the so-called “Riester-factor” of the current period,  $\frac{100 - \tau_{t-1}^{RPS} - \tau_{t-1}^{SV}}{100 - \tau_{t-2}^{RPS} - \tau_{t-2}^{SV}}$ . The latter one represents the development of private share in old-age provision as well as the social security contributions over the last two periods. The third multiplier of the pensions adjustment formula (equation A.1) represents the sustainability factor. The pensioner/contributor ratio,  $\frac{RQ_{t-1}}{RQ_{t-2}}$ , indicates the relation between “equivalence pensioners” and “equivalence contributors”.<sup>47</sup> From a contributors perspective, the parameter  $\alpha$  allows for mitigation against adverse effects for pension value resulting from demographic change. The parameter is equal to 0.25 and thus participates pensioners with a quarter by bearing demographic burden.

In general, principle of equivalence (i.e. the actuarial equivalence of contributions and benefit levels) applies to GRV as PAYG social security system. In fact, pension entitlements are determined not only by the amount of individual earnings points achieved during its career but also by several extraneous insurance benefits contravening the equivalence principle. Basically participatory equivalence is prevailing in GRV, i.e. there is a proportional relationship between contributions and benefits.<sup>48</sup> Taking aspects called above (demographic change, disrupted employment biographies, decreasing life-cycle income) into account, ensuring sustainability embodies a major challenge for a PAYG social security system. This could result in a trade-off between maintaining contribution equivalence and avoiding old-age poverty. There is, thus, a pressing need to reform this part of the pension scheme in Germany.

### A.2 Old-age poverty: Definitions of terms

Analysing old-age poverty and thus offering policy recommendations requires to define conditions in which persons or households already suffer in old-age poverty. However, there is neither general nor clear definition of a comprehensive concept of poverty. There are distinct definitions used depending on the specific research object. Following the definition of Bäcker (2008), poverty basically can be defined as a condition of insufficient endowment of economic means. This conditions describe an every situation determining, permanent lasting circumstance rather than a time-limited period. Differentiating the concept of poverty a step further, there is a difference between absolute poverty (a condition where a person lacks basic needs like nutrition, apparel, and housing) and relative poverty, in which the individual income position correlates to the direct economic environment. That means a situation causes relative poverty if a person’s income is insufficient to meet its socio-cultural existence requirements and thus cannot participate in social life.<sup>49</sup>

In our context old-age poverty is defined as a situation with an expected pension below or at most barely above the old-age security margin (i.e. the poverty line). As stated by Bäcker (2008), it can be seen as the predominant task of government to avoid emerging and to cope with existing poverty situations as well. An old-age pension scheme which does not fulfil these requirements is faced with a massive problem of acceptance and legitimacy. With this in mind, applying a poverty threshold expressed by a statistical measure does not seem to

<sup>47</sup>Computing the pensioner/contributor ratio, we divide the relation between the entire amount of pension assets and the standard pension (“*Eckrente*”) by the relation between entire amount of social security contributions and the amount of social security contributions of the previous average remuneration (an income equal to average remuneration is equivalent to one earnings point. A person attains the standard pension if she/he achieves 45 contributions years with an income equal to average remuneration, which implies one individual earnings point per year and thus 45 individual earnings points at date of retirement.

<sup>48</sup>See also the “Bismarck vs. Beveridge” discussion in Krieger/Traub, 2008; 2009.

<sup>49</sup>However, there is a problem of where the line should be drawn, i.e.: How is the socio-cultural subsistence level defined? The requirements to participate in social life are defined not only by individual economic power but also by human and social capital.



be favourable. It is more appropriate to use a poverty threshold resulting from a socio-politically motivated process, namely values applied in a needs-based social allowance like applied by NBPS. These numeric values consist of a fixed standard rate on the one hand and of a variable part compensating accommodation costs. Accommodation costs keep local conditions in mind and thus take different living costs in distinct domestic German economic areas into account.

Following this arguments, the analysis in the present paper thus applies the NBPS as reference point to individual retirement incomes.

### A.3 Microsimulation model design: Tobit, RE models, Population Ageing

The GSPOEP data structure allows to construct a 33 years long (from 1983 to 2015) individual employment biography containing information about pension-relevant periods and converted earning points. Thus, there is a sufficient amount of observations available which enables to estimate cohort effects using a Tobit approach. The model predicts by estimating marginal effects how birth cohort affects the extent of a pension-relevant period.

Thanks to a large panel horizon, analysis includes observations at the same age as well as different points in time. This Tobit model can estimate cohort effects and predict cumulated pension-relevant period within simulation cycle (2015–2040). First of all, pension-relevant periods include those of employment, i.e. full- and part-time. As it will become obvious from estimation output of random effects models (see Table A.4), full-time employment is the main driver of the amount of individual pension entitlements. Part-time employment is a specific form of atypical work or non-standard employment.<sup>50</sup> In general, this form of employment includes besides part-time work (less than 21 working hours per week), so-called “mini-jobs” (a form of minor employment), fixed-term employment relationships, and temporary work. Part-time work predominantly prevails among females. However, since several forms of atypical employment diffuse more and more among males, the microsimulation model includes a Tobit estimation for women and men as well (see also Traub/Finkler, 2015).<sup>51</sup>

Furthermore, the Tobit model also contains a part for estimation periods of unemployment. Insured persons generate personal earnings points while unemployed. However, unemployment also leads to eroding human capital and thus to a lower income level (Beblo/Wolf, 2002). The fourth activity also belongs to the group of non-working activity. The label “family” subsumes periods of child education and parenting, maternity, non-commercial care of a close relative as well as domestic care (housewife/houseman).

This approach follows the procedure already introduced in the statistical matching Section 3.2. The sample is sliced into several strata using gender, region (West and East Germany), and three levels of education as characterising slice variables.<sup>52</sup> As a result, there are 48 Tobit models to estimate. Observations featuring certain socio-demographic characteristics display cumulated periods equal to zero; this is the case for domestic work of men, for instance. Dealing with these “structural zeros”, the observed periods are estimated in a left-censored Tobit model as follows:

$$Y_{it} = \alpha + \beta_1 AGE_{it} + \beta_2 PERIOD_t + \beta_3 COHORT_i + \gamma X_{it} + \epsilon_{it} \quad (A.2)$$

$$Y_{it} = \max(0, Y_{it}^*) \quad (A.3)$$

The variable  $Y_{it}$  in equation A.2 describes the actual observed cumulated periods (in years) of full- or part-time, unemployment and domestic work.  $AGE_{it}$  stands for person  $i$ ’s age at period  $t$ ,  $PERIOD_t$  for the current period,  $COHORT_i$  for the individual year of birth respectively the birth cohort.<sup>53</sup>  $X_{it}$  represents a

<sup>50</sup>Due to different definitions of atypical employment in datasets used in this microsimulation model, henceforth, this term is used as synonym as long as the opposite is not maintained explicitly.

<sup>51</sup>Similar microsimulation models do not control explicitly for atypical employment among males (e.g. Steiner/Geyer, 2010). However, taking the old-age poverty roots identified above into account, there is a need for estimating a atypical employment model due to its growing quantitative and qualitative meaning.

<sup>52</sup>See Table A.4 in appendix.

<sup>53</sup>These three variables represent a linear combination so there is an identification problem. The approach of Deaton takes this into account: periodically appearing effects are modelled as cyclical deviations from a trend such that they can be regarded separately from cohort effects  $\beta$ . See Deaton/Paxson (1994) and Deaton (1997).

socio-demographic collective variable containing age at career entry, family status, number of children and their age, nationality, and a more detailed subdivision of the education variable  $educ_i$ .

Table A.1 shows the estimated marginal effects of several birth cohorts.<sup>54</sup> Holding all other variables constant, a cohort effect describes how the marginal effect of a birth cohort<sup>55</sup> affects the cumulated pension-relevant period. The marginal effect represents differences in birth cohorts regarding time spending in full- and part-time employment, unemployment and domestic work. In doing so, the birth cohort 1950–1954 serves as reference group.

**Table A.1:** Cohort Effects (Marginal Effects)  
Males: Full- & part-time employment, unemployment

<i>education:</i>	full-time			part-time			unemployment		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<b>West</b>									
1955–1959	-1.34***	-0.41***	0.81***	0.42***	0.15***	-0.41***	0.50***	0.11***	-0.08***
1960–1964	-1.63***	-0.80***	-0.13	0.13*	0.26***	-0.25***	0.68***	0.15***	-0.02
1965–1969	-1.87***	-1.09***	0.22	0.33***	0.32***	-0.20*	0.96***	0.14***	-0.10***
1970–1974	-2.05***	-1.15***	0.21	0.60***	0.35***	-0.06	0.84***	0.10***	-0.07*
1975–1979	-2.64***	-1.21***	0.55*	0.66***	0.42***	-0.19	1.19***	0.24***	-0.08*
1980–1984	-3.01***	-1.52***	0.76**	0.91***	0.46***	-0.35*	1.44***	0.31***	-0.15***
<i>N</i>	17,176	60,575	14,929	17,176	60,575	14,929	17,176	60,575	14,929
<b>East</b>									
1955–1959	-2.06***	-0.35***	-0.37	0.67***	-0.03	0.72***	1.30***	-0.03	-0.40***
1960–1964	-2.79***	-0.39**	1.15***	0.88***	0.04	0.47***	1.10**	-0.22**	-0.51**
1965–1969	-3.70***	0.15	1.15**	0.89***	-0.02	0.32	1.74***	-0.36***	-0.88***
1970–1974	-4.28***	-0.09	2.51***	1.17***	0.06	0.48**	2.37***	-0.18	-1.00***
1975–1979	-5.01***	-0.02	2.92***	1.47***	0.03	0.69**	2.97***	-0.40**	-1.39***
1980–1984	-5.32***	0.05	3.61***	1.80***	0.10	0.36	2.80***	-0.62***	-1.60***
<i>N</i>	2,820	24,149	4,602	2,820	24,149	4,602	2,820	24,149	4,602

Note: The marginal effect represents the effect of a birth cohort on the amount of cumulated pension-relevant period (full-, part-time employment and unemployment). Birth cohort 1950–1954 is the reference group. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Table A.1 clearly shows declining full-time employment over birth cohorts. The number of months declines the more the lower educational attainment. Compared to reference cohort 1950–1954, youngest cohorts (1980–1984)<sup>56</sup> achieve about three years less in full-time employment. This drop is only half that severe in medium educated group (-1.52) while there is rebounding effect for individuals at highest educational level. Acting prematurely, Table 1 in Section 3.3 shows that simulated full-time employment of low education group exceeds those of medium and high education due to longer training periods by far.

Considering cohort effects for part-time/non-standard employment, we can draw a consistent picture: Both lower educational levels show a significant increase in years spent in part-time employment. Youngest cohorts in low education work about a year more part-time than reference cohort while the increase halves when looking at medium educated individuals. Contrary to this result, there is a slight but significant decreasing trend among highest educational level. Coping a look at the right-hand third of Table A.1, full-time employment is partially substituted by non-standard employment and an increase in unemployment as well. Individuals with lower education register a higher degree of substitution than medium educational level which is in line with findings

<sup>54</sup>The appendix includes the complete Tobit estimation output; see Tables A.6–A.9.

<sup>55</sup>More precisely, the analysis is dealing with a group of birth cohorts. There are five sequential cohorts summarized in a cohort dummy.

<sup>56</sup>Despite GSOEP data allow for analysing more younger cohorts (1985–1994), analysis is restricted to persons aged 30 years and above in base year 2015. Cohort effects for these cohorts are less noteworthy since these persons will not retire during simulation cycle. Furthermore, the simulation of an entire employment history is the less robust the longer the younger the respective cohort. These cohorts show partly heavy outliers also due to insignificant marginal effects. This can be reduced to an insufficient number of observations.

just described. The group of high education level even shows a slight but significant decline in unemployment by approx. two months.

Cohort effects of East German men trend towards the same direction as West German men, however, they come up in a different extent at the most. There is an enormous decline in full-time employment for low educated by more than five years. However, high education group displays an increase by 3.6 years which implies an effect of about five times as much as West German men. Youngest low education cohort works 1.8 years longer in part-time than the oldest one and hence twice as much as male West German group. There is also a slight enlargement in part-time work among medium and high education group; however, effects are statistically not significant. Findings concerning unemployment depict trends in East similar to West Germany. This does not apply for medium education group who register an increment in unemployment something more than seven months relative to the oldest cohort. Considering low education East German males, unemployment extends up to almost three years which implies an increase of about twice as much as West German men. Cohort effects of high educated East German males delineate an enormous decline in unemployment; youngest cohort will spent 1.6 years less in unemployment which means a more than ten times stronger effect than in West Germany.

**Table A.2:** Cohort Effects (Marginal Effects)  
Females: Full- & part-time employment, unemployment

<i>education:</i>	full-time			part-time			unemployment		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<b>West</b>									
1955–1959	-0.36**	0.13	0.29	0.80***	0.82***	0.46*	0.57***	0.17***	-0.16***
1960–1964	-1.39***	-0.27**	-0.48*	1.06***	0.99***	0.73***	0.64***	0.33***	-0.17***
1965–1969	-2.49***	-0.76***	-0.37	0.85***	1.06***	0.49*	0.71***	0.16***	-0.40***
1970–1974	-3.46***	-1.12***	-0.31	0.70***	0.86***	0.93***	0.88***	0.27***	-0.51***
1975–1979	-3.98***	-1.33***	-0.17	1.53***	0.98***	0.71*	0.83***	0.20***	-0.51***
1980–1984	-4.19***	-1.82***	-0.04	1.88***	1.48***	0.50	0.87***	0.14***	-0.48***
<i>N</i>	36,005	78,517	11,482	36,005	78,517	11,482	36,005	78,517	11,482
<b>East</b>									
1955–1959	0.53	-0.34	-1.79***	-2.51***	-0.27*	0.60	-0.22	-0.19**	0.04
1960–1964	-0.17	-2.69***	-4.27***	-1.77***	1.00***	1.54	-0.86**	-0.29***	-0.05
1965–1969	-1.25*	-3.63***	-6.99***	-1.51***	1.42***	3.02	-0.20	-0.45***	0.05
1970–1974	-1.30	-4.20***	-7.01***	-1.94***	1.99***	3.15	-0.70	-0.93***	-0.48
1975–1979	-2.35**	-4.56***	-8.65***	-2.38***	2.05***	4.44	-1.10*	-1.43***	-0.42
1980–1984	-1.34	-5.02***	-9.36***	-2.06**	2.63***	4.69	-1.78***	-1.80***	-0.36
<i>N</i>	4,070	27,512	5,149	4,070	27,512	5,149	4,070	27,512	5,149

Note: The marginal effect represents the effect of a birth cohort on the amount of cumulated pension-relevant period (full-, part-time employment and unemployment). Birth cohort 1950–1954 is the reference group. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Table A.2 provides cohort effects for West German Women with respect to career-relevant trends in full- and part-time employment as well as unemployment. Relative to the reference cohort 1950–1954, there is a more than four years drop in full-time employment for low educated West German females born between 1980 and 1984. Looking at part-time employment (1.9 years) and unemployment (0.9 years), these increments partly “compensate” full-time employment drop. Medium educated women show also a decline in full-employment over birth cohorts (-1.8 years) while part-time work extends to one and a half years. There is a slight decline (increase) regarding full-time (part-time) employment, however, the trend is not statistically significant for high education. Unemployment follows a steadily downward sloping trend which implies about half a year less time spent in unemployment. In addition, females show a more dynamic retrogressive effect compared to high educated males.

For East German Women, full-time employment estimation results draw a different picture regarding

marginal effects. While there is a weak negative, however, statistically non significant decreasing trend for low education group, full-time employment declines noticeably over cohorts. Youngest cohort registers an almost ten year drop for high education group; even medium educated are expected to work about five year less in full-time than reference cohort 1950–1954. These effects exceed those of West German women many times over. Despite low education, East German women display the same trends in part-time as observed for West German. Whilst the effect for low high educated group is statistically non significant, periods of unemployment are expected to lower for younger cohorts.

**Table A.3:** Cohort Effects (Marginal Effects)  
Men & Women: Domestic work

<i>education:</i>	males			females		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<b>West</b>						
1955–1959	-0.01	0.01	-0.16	-1.98***	-1.37***	-0.99***
1960–1964	-0.12	0.01	-0.06	-1.47***	-1.52***	-0.92***
1965–1969	-0.09	0.00	-0.11	-1.07***	-1.80***	-1.09***
1970–1974	-0.10	-0.02	-0.13	-0.93***	-1.66***	-1.33***
1975–1979	-0.13	0.04**	-0.11	-1.16***	-1.45***	-0.93***
1980–1984	-0.23	0.03	-0.14	-1.28***	-1.04***	-0.21
<i>N</i>	17,176	60,575	14,929	36,005	78,517	11,482
<b>East</b>						
1955–1959	-0.02	-0.04	0.05	1.40***	0.24***	0.04
1960–1964	-0.28	-0.04	0.05	1.49***	0.90***	0.51
1965–1969	0.02	0.00	0.02	2.04***	1.69***	0.87
1970–1974	0.02	-0.00	0.01	2.59***	2.19***	0.75
1975–1979	0.10	-0.01	0.03	3.17***	2.48***	1.07
1980–1984	0.10	-0.01	0.02	3.11***	2.75***	0.98
<i>N</i>	2,820	24,149	4,602	4,070	27,512	5,149

Note: The marginal effect represents the effect of a birth cohort on the amount of cumulated pension-relevant period (full-, part-time employment and unemployment). Birth cohort 1950–1954 is the reference group. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

It becomes clear from Table A.9 (A.4) that domestic work is not really an issue in male employment biographies. Over all cohorts, there is no significant change in male houseman periods. However, the situation of females outlines entirely different. Periods of domestic work decrease slightly but significantly among West German female cohorts over time. In contrast, estimation results show an increase in about three years for low or, respectively, medium educated females in East Germany compared to the oldest birth cohort. These findings suggest that these groups of East German females spend more time on caring children or being housewife rather than working in full- or part-time employment as well as being unemployed.

Based on the dataset consisting of GSOEP and IAS, personal earnings points are estimated in several random effects models. The RE models are separated by gender, region, and educational level (see equation A.4). The model is structured in accordance with the Mincer earnings function (Mincer, 1974).

$$\log\left(\frac{w_{it}}{\bar{w}}\right) = \alpha + \beta_1 AGE_{it} + \beta_2 FT_{it} + \beta_3 PT_{it} + \beta_4 UE_{it} + \beta_5 FAM_{it} + \gamma X_{it} + \epsilon_i + u_{it} \quad (\text{A.4})$$

$$E\left[u_{it} \mid \epsilon_i, AGE_{it}, FT_{it}, PT_{it}, UE_{it}, FAM_{it}, X_{it}\right] = 0 \quad \forall t \quad (\text{A.5})$$

$$E\left[\epsilon_{it} \mid AGE_{it}, FT_{it}, PT_{it}, UE_{it}, FAM_{it}, X_{it}\right] = 0 \quad (\text{A.6})$$

The logarithm of the relative wage approximately corresponds to the personal earnings points achieved at the current period.  $\log\left(\frac{w_{it}}{\bar{w}}\right)$  is regressed on the periods of full- and part-time, unemployment and domestic work hitherto cumulated. In order to control for the intensity of effects of several variables, their polynomials are also included. The variable  $X_{it}$  includes age at career entry, nationality, family status, and number of children. The model does not control for birth cohort explicitly. The Tobit model already took this variable into account and thus birth cohort affects simulated pension entitlements indirectly. Residual  $u_{it}$  and the observation-specific time-constant effect  $\epsilon_i$  describe the unobserved effect of the random effects model. The variables are i.i.d. and uncorrelated with explanatory variables.

The sample includes persons aged 15 to 65 years. The model only considers logarithmised relative wages and thus only wages actually achieved in the current period. Self-employed and civil servants are excluded from analysis as far as identifiable. In conclusion, the model only includes wages subject to social insurance contributions. It would, however, be possible that minor employed refuse the opportunity of voluntary social insurance. The estimation results of the random effects models allow for simulating the complete age-earnings profile until the individual retirement date. See Tables A.10 (for males) and A.11 (for females) in tabular appendix (Section A.4). In general, coefficients provide results as expected. The coefficients are in line with general findings of human capital theory. See Mincer (1957, 1958) and Becker (1962, 1964). For that reason, they will not be discussed extensively and in detail at this point.

Age of life shows strongly positive but diminishing effect on relative wage over both sexes and all education groups excepting high educated males (West) as well as low (East) and high educated (both regions) females. Tables A.10 and A.11 also identify full-time employment as one of the most drivers of individual earnings points. Part-time employment shows a negative effect which is larger and, in addition, more often statistically significant for males rather than females. Unsurprisingly, periods of unemployment show a strong significant decreasing effect on relative wage for both sexes. Also intuitive, the effects increase with higher educational level. Being married turns out unfavourable especially for West German females. However, they are the only ones who benefit from having kids (this holds for those with medium education).

The NPS dataset provides information about the month when individuals actually retire. The data come from New Pensions Sample (*Rentenzugang*, SUFRTZN16XVSBB) another GRV scientific use file. After subdividing the sample into strata presented above (gender, region, education), we reproduce the frequency distribution at GSOEP data. The exact reflection embodies the expected individual age of retirement. We assume that the retirement behaviour remains constant over the whole simulation period until 2040. The model also integrates the increase in pension eligibility age according to the Pension Insurance Retirement Age Adjustment Act (see chapter 2.1.) from 65 to 67 as far as allowed by data structure. Individuals alternatively could not suit to the expected pension eligibility age and thus retire earlier while accepting deductions. However, the model does not integrate behavioural adaptations. All individuals retire according to their year of birth.

Demographic development is assumed to be basically in line with the 13<sup>th</sup> coordinated population projection for Germany, a project of the statistical offices of the Federation and the federal states of Germany. Population grows by re-weighting sample weights. This includes individual behavioural adaptations like migration or fertility decisions. Furthermore, there are several behavioural assumptions concerning household structure and size as well. Households are expected to be smaller in general and trend towards to be single without children or single parent in particular. Predicted household development also bases on calculations of the statistical offices of the Federation and the federal states of Germany (2011) and the method used in Buslei et al. (2007).

## A.4 Tabular appendix

**Table A.4:** Categorisation of educational attainment

Education level	educational attainment/vocational qualification
low education	no school leaving qualification
	(lower) secondary school or higher secondary school without vocational degree
medium education	(lower) secondary school or higher secondary school without vocational degree
	High school or technical high school without vocational degree
	High school or technical high school with vocational degree
high education	Completed degree at university of applied sciences
	Completed degree at university

Note: Educational attainment of IAS is represented by the variable *ttsc3<sub>k</sub>ldb*, in GSOEP data by *psbil*. The six-stage scale refers to international standard classification of education (ISCED).

Source: own illustration.

**Table A.5:** Average NBPS by German federal state

German Federal State	single household	couple household
Baden-Wuerttemberg	753	1,218
Bavaria	770	12,45
Berlin	813	1,315
Brandenburg	689	1,114
Bremen	760	1,230
Hamburg	835	1,352
Hesse	771	1,247
Lower Saxony	721	1,167
Mecklenburg-Vorpommern	697	1,127
North Rhine-Westphalia	748	1,210
Rhineland-Palatinate	711	1,150
Saarland	742	1,201
Saxony	668	1,080
Saxony-Anhalt	676	1,093
Schleswig-Holstein	754	1,219
Thuringia	660	1,068
<i>Germany (avg.)</i>	750	1,213

Note: Average NBPS separated by German federal state. The values base on average accommodations costs of 334 Euro for single households and 423 Euro for couple households according to calculations made by IAQ (2018a; 2018b). Couple households thus require 27,4 per cent more than single households. The normal requirement (NBPS fixed part) amounts to 416 Euro (single) 790 Euro (couple), respectively. All values in 2018 prices.

Source: IAQ (2018a; 2018b); own calculations, own illustration.

Table A.6: Tobit model: Full-time

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>education:</i>												
<i>cohcd1955</i>	-2.033*** (-8.76)	-0.424*** (-7.90)	0.845*** (6.77)	-4.272*** (-5.54)	-0.359*** (-3.58)	-0.382 (-1.73)	-0.607** (-2.61)	0.152 (1.42)	0.357 (1.25)	1.127 (1.17)	-0.376 (-1.84)	-1.939*** (-6.39)
<i>cohcd1960</i>	-2.476*** (-11.26)	-0.829*** (-13.42)	-0.136 (-0.86)	-5.775*** (-6.97)	-0.403** (-3.06)	1.182*** (3.94)	-2.314*** (-10.73)	-0.320** (-3.17)	-0.586* (-2.13)	-0.372 (-0.32)	-3.011*** (-11.48)	-4.623*** (-9.86)
<i>cohcd1965</i>	-2.847*** (-12.18)	-1.134*** (-16.56)	0.230 (1.33)	-7.667*** (-7.02)	0.157 (0.91)	1.181** (2.87)	-4.157*** (-18.60)	-0.896*** (-8.44)	-0.448 (-1.52)	-2.672* (-2.05)	-4.057*** (-12.15)	-7.575*** (-11.48)
<i>cohcd1970</i>	-3.126*** (-12.87)	-1.197*** (-14.92)	0.223 (1.09)	-8.866*** (-6.89)	-0.0972 (-0.46)	2.585*** (5.60)	-5.761*** (-23.37)	-1.315*** (-11.18)	-0.383 (-1.14)	-2.780 (-1.75)	-4.701*** (-11.63)	-7.602*** (-9.20)
<i>cohcd1975</i>	-4.017*** (-14.66)	-1.259*** (-13.56)	0.576* (2.41)	-10.37*** (-6.67)	-0.0191 (-0.08)	3.007*** (5.19)	-6.640*** (-22.77)	-1.558*** (-11.84)	-0.209 (-0.54)	-5.011** (-2.79)	-5.104*** (-10.44)	-9.380*** (-9.47)
<i>cohcd1980</i>	-4.589*** (-15.53)	-1.577*** (-15.13)	0.798** (2.88)	-11.01*** (-5.98)	0.0481 (0.17)	3.718*** (5.55)	-6.990*** (-20.49)	-2.131*** (-14.16)	-0.0434 (-0.10)	-2.850 (-1.40)	-5.618*** (-9.95)	-10.15*** (-8.84)
<i>cohcd1985</i>	-4.850*** (-14.83)	-1.529*** (-12.40)	0.139 (0.39)	-10.64*** (-5.06)	0.725* (2.16)	3.739*** (4.41)	-8.524*** (-20.06)	-2.757*** (-14.32)	-1.688** (-3.07)	-4.061 (-1.71)	-5.844*** (-8.88)	-11.82*** (-8.74)
<i>cohcd1990</i>	-4.844*** (-13.00)	-1.032*** (-6.86)	-0.835 (-0.87)	-11.02*** (-4.61)	1.072** (2.69)	4.308* (2.54)	-10.34*** (-20.00)	-3.571*** (-13.73)	-2.791** (-3.04)	-2.881 (-1.04)	-5.120*** (-6.26)	-14.67*** (-7.41)
<i>cohcd1995</i>	-3.829*** (-7.11)	-0.973* (-2.15)	-48.75*** (-14.69)	-8.002** (-2.99)	4.454*** (5.55)	0 (.)	-9.873*** (-10.37)	-2.807** (-3.03)	0 (.)	3.505 (1.04)	-4.308** (-2.79)	0 (.)
<i>job * age.f.job</i>	0.753*** (14.52)	0.503*** (8.28)	0.731*** (10.34)	1.910*** (17.98)	0.838*** (6.46)	0.725*** (6.23)	2.104*** (61.37)	1.085*** (24.41)	1.480*** (6.77)	2.208*** (15.41)	1.109*** (12.61)	1.329*** (9.16)
<i>job * age.f.job<sup>2</sup></i>	-0.0290*** (-23.31)	-0.0225*** (-19.51)	-0.0196*** (-15.10)	-0.0599*** (-21.23)	-0.0255*** (-8.47)	-0.0216*** (-9.41)	-0.0464*** (-50.52)	-0.0279*** (-24.92)	-0.0351*** (-7.47)	-0.0478*** (-15.10)	-0.0277*** (-14.40)	-0.0316*** (-10.86)
<i>ISCED == 1</i>	-1.659*** (-16.81)	0 (.)	0 (.)	-1.353*** (-5.49)	0 (.)	0 (.)	-0.506*** (-3.32)	0 (.)	0 (.)	-3.073*** (-4.97)	0 (.)	0 (.)
<i>ISCED == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 3</i>	0	2.295***	0	0	1.304***	0	0	1.720***	0	0	0.531***	0

Continued on next page

Table A.6 – continued from previous page

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(.)	(39.99)	(.)	(.)	(13.84)	(.)	(.)	(25.08)	(.)	(.)	(3.98)	(.)
<i>ISCED</i> == 4	0	-0.774***	0	0	-1.942***	0	0	-2.977***	0	0	-3.829***	0
	(.)	(-6.35)	(.)	(.)	(-6.53)	(.)	(.)	(-15.12)	(.)	(.)	(-9.61)	(.)
<i>ISCED</i> == 5	0	0	0	0	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
<i>ISCED</i> == 6	0	0	1.689***	0	0	0.421***	0	0	1.113***	0	0	-0.0456
	(.)	(.)	(22.23)	(.)	(.)	(3.45)	(.)	(.)	(8.38)	(.)	(.)	(-0.26)
<i>german</i> == 1	-0.591***	0.00946	-0.561***	1.680	-2.226***	3.482***	-2.848***	0.0544	-0.534*	37.67***	1.019	2.445
	(-6.08)	(0.18)	(-3.70)	(1.13)	(-7.71)	(4.95)	(-20.88)	(0.60)	(-2.01)	(27.55)	(0.94)	(1.69)
<i>kids</i> == 0	1.575	-0.247	5.198***	10.61**	-0.650	10.56***	-0.798	3.617***	30.17***	4.905*	12.54***	21.02***
	(1.26)	(-0.63)	(5.34)	(3.12)	(-1.01)	(3.72)	(-0.94)	(4.72)	(11.61)	(2.20)	(10.61)	(8.23)
<i>kids</i> == [2, 3]	1.210	-0.0960	5.155***	10.41**	-0.622	10.41***	-3.934***	0.121	27.00***	5.179*	10.94***	19.30***
	(0.96)	(-0.24)	(5.34)	(3.13)	(-0.96)	(3.72)	(-4.66)	(0.16)	(10.27)	(2.30)	(9.39)	(7.59)
<i>kids</i> >= 4	0.124	-0.873*	4.970***	11.49***	-2.642***	9.952***	-5.136***	-3.453***	22.91***	4.037	6.551***	13.44***
	(0.10)	(-2.19)	(5.11)	(3.30)	(-3.86)	(3.48)	(-6.16)	(-4.46)	(8.68)	(1.88)	(5.45)	(5.19)
<i>married</i> == 1	1.688***	1.061***	0.460***	2.542***	1.435***	0.805***	-2.124***	-1.023***	-1.194***	0.702	-0.665***	0.294
	(11.07)	(26.23)	(4.97)	(7.12)	(20.82)	(5.02)	(-14.24)	(-15.23)	(-7.98)	(1.40)	(-6.66)	(1.78)
<i>kids</i> * <i>agefkid</i>	-0.0538	0.0336	-0.180**	-0.687**	0.104*	-0.552**	-0.329***	-0.823***	-2.244***	-0.493*	-1.063***	-1.348***
	(-0.61)	(1.26)	(-2.98)	(-2.64)	(2.21)	(-2.83)	(-5.01)	(-14.62)	(-12.80)	(-2.49)	(-11.57)	(-7.10)
<i>kids</i> * <i>agefkid</i> <sup>2</sup>	0.00119	-0.000743	0.00158	0.0118*	-0.00241**	0.00707*	0.0103***	0.0188***	0.0379***	0.0115*	0.0207***	0.0203***
	(0.79)	(-1.65)	(1.68)	(2.43)	(-2.86)	(2.17)	(7.82)	(18.40)	(13.07)	(2.40)	(11.68)	(5.79)
<i>constant</i>	32.28***	23.35***	30.89***	29.48***	5.224	-25.08***	-2.530*	6.863***	3.863	-65.52***	-3.547	-23.89***
	(8.10)	(9.45)	(9.37)	(12.11)	(1.01)	(-18.94)	(-2.48)	(6.87)	(1.10)	(-18.17)	(-1.06)	(-12.53)
$\sigma$	23.77***	10.73***	13.27***	17.06***	12.74***	12.01***	85.79***	49.49***	37.65***	80.06***	46.62***	24.85***
	(34.58)	(48.91)	(35.01)	(9.64)	(36.45)	(21.79)	(86.95)	(141.95)	(54.27)	(27.18)	(85.48)	(27.72)
$R^2_{pseudo}$	0.345	0.335	0.281	0.417	0.308	0.302	0.142	0.085	0.107	0.265	0.139	0.211
$N_{lc}$	5,250	1,114	260	1,328	468	55	12,490	4,687	938	2,006	1,276	150
$N_{unc}$	11,926	59,461	14,669	1,492	23,681	4,547	23,515	73,830	10,544	2,064	26,236	4,999
<i>AIC</i>	73,806.68	311,686.3	80,212.2	9,003.539	12,8414.6	24,483.61	180,545.7	504,811.3	69,820.12	15,835.16	177,360	30,616.03

Continued on next page



Table A.6 – continued from previous page

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>BIC</i>	74,636.07	312,641.5	80,980.92	9,562.321	12,9231.9	25,069.13	181,454.3	505,794.1	70,569.67	16,472.61	178,190.5	31,028.47

Note: Results based on Tobit models (see equation A.2). Dependent variable is the cumulated period of full-time employment at the current period. The variables *age \* agefjob* and *age \* agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3. Dummy variables for *age* (*aged15* to *aged70*) and *year* (*yeard86* to *yeard2015*) are omitted. Analogous to OLS regression,  $\sigma$  represents the estimated (robust) standard error of the regression, i.e. the square root of the residual variance. *AIC* represents Akaike, *BIC* Bayesian information criterion. *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Table A.7: Tobit model: Part-time

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>education:</i>												
<i>cohcd1955</i>	1.898*** (6.56)	0.971*** (9.71)	-1.325*** (-5.94)	3.899*** (5.74)	-0.130 (-1.13)	2.594*** (7.22)	1.766*** (7.34)	1.369*** (10.86)	0.697* (2.46)	-6.921*** (-7.62)	-0.509* (-2.16)	1.199** (3.21)
<i>cohcd1960</i>	0.608* (2.11)	1.708*** (14.47)	-0.815** (-3.29)	5.152*** (5.52)	0.217 (1.49)	1.680*** (3.68)	2.358*** (10.18)	1.646*** (13.41)	1.104*** (3.81)	-4.885*** (-4.97)	1.861*** (6.17)	3.096*** (5.97)
<i>cohcd1965</i>	1.506*** (4.94)	2.089*** (16.09)	-0.631* (-2.27)	5.212*** (4.67)	-0.100 (-0.55)	1.136 (1.92)	1.894*** (8.03)	1.767*** (13.42)	0.736* (2.31)	-4.166*** (-3.41)	2.653*** (7.07)	6.077*** (8.56)
<i>cohcd1970</i>	2.752*** (8.24)	2.291*** (15.35)	-0.189 (-0.59)	6.837*** (5.29)	0.305 (1.36)	1.740** (2.65)	1.553*** (5.80)	1.425*** (9.48)	1.401*** (3.85)	-5.348*** (-3.56)	3.728*** (8.19)	6.349*** (7.22)
<i>cohcd1975</i>	3.025*** (8.17)	2.717*** (15.99)	-0.596 (-1.58)	8.618*** (5.49)	0.164 (0.62)	2.492** (3.21)	3.399*** (11.06)	1.630*** (9.42)	1.067* (2.54)	-6.563*** (-3.84)	3.838*** (7.06)	8.948*** (8.72)
<i>cohcd1980</i>	4.136*** (10.53)	2.966*** (15.71)	-1.107* (-2.52)	10.51*** (5.74)	0.481 (1.55)	1.279 (1.44)	4.163*** (12.01)	2.466*** (12.42)	0.755 (1.53)	-5.669** (-3.02)	4.926*** (7.86)	9.449*** (7.96)
<i>cohcd1985</i>	4.463*** (10.72)	3.328*** (14.97)	-1.454** (-2.74)	10.28*** (5.14)	0.269 (0.74)	2.185* (1.99)	4.995*** (13.26)	3.164*** (12.11)	1.877** (3.17)	-6.601** (-3.13)	6.122*** (8.34)	10.76*** (7.75)
<i>cohcd1990</i>	3.931*** (8.77)	2.711*** (9.60)	-1.783 (-1.01)	11.10*** (4.98)	0.552 (1.16)	2.244 (1.50)	5.924*** (13.60)	3.306*** (8.28)	2.196** (2.77)	-8.332*** (-3.52)	6.946*** (7.21)	11.73*** (6.27)
<i>cohcd1995</i>	4.461***	2.783***	-29.45***	11.63***	-0.703	0	8.069***	5.106***	0	-5.777*	7.030***	0

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Table A.7 – continued from previous page

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(8.61)	(4.43)	(-9.42)	(4.75)	(-0.41)	(.)	(14.76)	(6.96)	(.)	(-2.18)	(3.75)	(.)
<i>job * agefjob</i>	0.572*** (11.69)	-0.00310 (-0.14)	-0.506*** (-4.94)	0.752*** (9.60)	0.104 (1.91)	-0.260** (-3.00)	1.155*** (53.78)	0.702*** (21.66)	0.227*** (5.03)	1.069*** (12.79)	0.740*** (12.49)	0.247 (1.43)
<i>job * agefjob</i> <sup>2</sup>	-0.0161*** (-8.46)	-0.000728 (-1.57)	0.00332 (1.58)	-0.0249*** (-8.03)	-0.00229* (-2.18)	0.00326* (2.10)	-0.0198*** (-40.36)	-0.0137*** (-18.37)	-0.00637*** (-8.17)	-0.0188*** (-8.66)	-0.0154*** (-11.01)	-0.00969* (-2.46)
<i>ISCED == 1</i>	1.262*** (11.62)	0 (.)	0 (.)	0.681*** (3.58)	0 (.)	0 (.)	-0.738*** (-5.20)	0 (.)	0 (.)	1.068* (2.16)	0 (.)	0 (.)
<i>ISCED == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 3</i>	0 (.)	-1.812*** (-22.70)	0 (.)	0 (.)	-0.493*** (-5.03)	0 (.)	0 (.)	0.0986 (1.22)	0 (.)	0 (.)	0.235 (1.54)	0 (.)
<i>ISCED == 4</i>	0 (.)	1.399*** (10.77)	0 (.)	0 (.)	1.953*** (9.20)	0 (.)	0 (.)	0.975*** (5.15)	0 (.)	0 (.)	1.767*** (4.55)	0 (.)
<i>ISCED == 5</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 6</i>	0 (.)	0 (.)	-1.559*** (-15.51)	0 (.)	0 (.)	-0.962*** (-5.52)	0 (.)	0 (.)	-0.643*** (-5.18)	0 (.)	0 (.)	1.078*** (6.17)
<i>german == 1</i>	-0.283* (-2.56)	0.0944 (1.03)	1.531*** (6.24)	-3.324** (-3.02)	1.869* (2.39)	-4.388*** (-6.36)	2.552*** (18.02)	1.168*** (8.70)	1.283*** (4.79)	2.728 (1.15)	3.090** (3.05)	-5.695*** (-4.37)
<i>kids == 1</i>	8.155*** (4.65)	2.388*** (4.19)	-8.555*** (-4.39)	1.838 (0.41)	0.383 (0.48)	-11.82*** (-4.23)	-0.862 (-1.15)	4.613*** (5.57)	-9.010*** (-3.68)	-19.04*** (-5.32)	-8.587*** (-5.95)	-17.68*** (-5.88)
<i>kids = [2, 3]</i>	9.127*** (5.19)	2.340*** (4.12)	-8.642*** (-4.47)	1.880 (0.42)	0.442 (0.56)	-11.84*** (-4.32)	-0.156 (-0.21)	5.010*** (6.02)	-7.440** (-3.01)	-18.13*** (-5.20)	-8.375*** (-5.86)	-15.89*** (-5.29)
<i>kids &gt;= 4</i>	8.481*** (4.96)	3.170*** (5.53)	-8.603*** (-4.44)	2.253 (0.49)	1.038 (1.28)	-11.06*** (-3.93)	-1.895* (-2.54)	3.690*** (4.39)	-10.28*** (-4.00)	-18.33*** (-5.32)	-8.937*** (-6.20)	-14.81*** (-4.82)
<i>married == 1</i>	-1.023*** (-6.26)	-1.023*** (-16.64)	-0.693*** (-5.06)	-0.992** (-2.94)	-0.716*** (-9.80)	-0.244 (-1.09)	0.924*** (6.36)	1.186*** (15.99)	0.709*** (4.94)	0.240 (0.55)	1.997*** (17.32)	-0.571** (-2.96)
<i>kids * agefkid</i> <sup>2</sup>	-0.645***	-0.180***	0.391**	-0.179	-0.0234	0.492**	0.248***	0.259***	0.804***	1.710***	0.791***	1.167***

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Table A.7 – continued from previous page

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>education:</i>	(-5.25)	(-4.76)	(3.28)	(-0.48)	(-0.42)	(2.86)	(4.08)	(4.21)	(4.77)	(5.84)	(6.96)	(5.32)
<i>kids * agefkid</i> <sup>2</sup>	0.0104*** (5.02)	0.00301*** (4.81)	-0.00497** (-2.73)	0.00399 (0.54)	0.000649 (0.67)	-0.00468 (-1.78)	-0.00592*** (-4.56)	-0.00908*** (-8.06)	-0.0148*** (-5.19)	-0.0376*** (-6.28)	-0.0161*** (-7.22)	-0.0184*** (-4.65)
<i>constant</i>	-7.009*** (-4.98)	0.162 (0.21)	6.732* (2.32)	-17.01*** (-6.88)	-1.757 (-1.32)	-12.81*** (-8.36)	-15.85*** (-15.33)	-14.90*** (-14.31)	-3.391 (-1.11)	-6.691 (-1.78)	-17.46*** (-4.30)	-24.55*** (-11.59)
$\sigma$	18.36*** (17.81)	13.04*** (20.90)	19.92*** (21.34)	7.447*** (6.06)	9.331*** (9.93)	17.64*** (11.34)	78.73*** (64.77)	60.65*** (119.68)	35.54*** (43.20)	54.82*** (16.18)	55.77*** (62.03)	28.20*** (21.45)
$R^2_{pseudo}$	0.052	0.049	0.047	0.142	0.022	0.046	0.079	0.063	0.040	0.122	0.033	0.039
$N_{lc}$	13,002	50,603	9,812	2,275	18,646	3,163	18,511	28,455	3,158	2,371	11,469	2,305
$N_{unc}$	4,174	9,972	5,117	545	5,503	1,439	17,494	50,062	8,324	1,699	16,043	2,844
<i>AIC</i>	33,323.88	82,687.21	38,778.47	3,938.755	41,650.46	11,023.23	144,469.7	385,796.4	58,709.67	13,519.99	125,594.2	20,509.84
<i>BIC</i>	34,153.27	83,642.45	39,547.19	4,390.537	42,467.75	11,537.97	145,378.2	386,779.1	59,459.22	14,157.44	126,424.6	20,693.15

Note: Results based on Tobit models (see equation A.2). Dependent variable is the cumulated period of part-time employment at the current period. The variables *age \* agefjob* and *age \* agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3. Dummy variables for *age* (*aged15* to *aged70*) and *year* (*yeard86* to *yeard2015*) are omitted. Analogous to OLS regression,  $\sigma$  represents the estimated (robust) standard error of the regression, i.e. the square root of the residual variance. *AIC* represents Akaike, *BIC* Bayesian information criterion. *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Table A.8: Tobit model: Unemployment

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>cohcd1955</i>	1.411*** (5.39)	0.353*** (5.10)	-0.379*** (-3.71)	3.338*** (4.02)	-0.0726 (-0.56)	-1.241*** (-5.84)	1.987*** (14.73)	0.551*** (9.37)	-0.534*** (-4.33)	-0.553 (-0.87)	-0.379** (-2.58)	0.104 (0.54)
<i>cohcd1960</i>	1.908*** (7.83)	0.506*** (7.18)	-0.0843 (-0.73)	2.839** (3.17)	-0.494** (-3.09)	-1.581*** (-5.51)	2.217*** (16.70)	1.092*** (17.59)	-0.593*** (-4.53)	-2.192** (-2.97)	-0.588*** (-3.31)	-0.138 (-0.56)
<i>cohcd1965</i>	2.695*** (10.01)	0.445*** (5.55)	-0.456*** (-3.72)	4.478*** (4.08)	-0.799*** (-3.93)	-2.714*** (-7.18)	2.466*** (17.32)	0.512*** (7.38)	-1.372*** (-9.06)	-0.520 (-0.60)	-0.921*** (-4.10)	0.140 (0.42)
<i>cohcd1970</i>	2.367***	0.315***	-0.337*	6.102***	-0.401	-3.103***	3.069***	0.881***	-1.744***	-1.788	-1.888***	-1.361***

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Table A.8 – continued from previous page

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(8.56)	(3.44)	(-2.24)	(4.75)	(-1.67)	(-7.36)	(19.27)	(11.00)	(-9.94)	(-1.73)	(-6.97)	(-3.32)
<i>cohcd1975</i>	3.351*** (10.37)	0.799*** (7.78)	-0.395* (-2.30)	7.642*** (5.25)	-0.897** (-3.14)	-4.305*** (-8.07)	2.880*** (15.58)	0.650*** (7.46)	-1.754*** (-8.79)	-2.815* (-2.52)	-2.899*** (-8.87)	-1.188* (-2.50)
<i>cohcd1980</i>	4.037*** (11.97)	1.013*** (8.74)	-0.715*** (-3.38)	7.208*** (4.32)	-1.384*** (-4.17)	-4.963*** (-8.00)	3.041*** (14.94)	0.450*** (4.55)	-1.651*** (-7.09)	-4.568*** (-3.77)	-3.653*** (-9.82)	-1.010 (-1.84)
<i>cohcd1985</i>	3.465*** (9.14)	0.510*** (3.46)	-0.482 (-1.71)	5.265** (2.78)	-2.488*** (-6.33)	-5.097*** (-6.31)	3.631*** (16.52)	0.443*** (3.40)	-2.793*** (-8.74)	-6.094*** (-4.44)	-4.649*** (-10.68)	-2.835*** (-3.95)
<i>cohcd1990</i>	2.858*** (6.70)	0.581** (2.83)	-0.813 (-1.07)	3.745 (1.76)	-3.542*** (-7.13)	-8.774*** (-5.83)	2.634*** (9.87)	-0.540** (-2.66)	-2.721*** (-4.60)	-8.862*** (-5.75)	-7.282*** (-12.50)	-4.987*** (-3.92)
<i>cohcd1995</i>	2.534*** (4.19)	-1.167 (-1.37)	1.300 (1.13)	2.749 (1.15)	-24.83*** (-28.05)	0 (.)	1.021* (2.18)	-0.647 (-1.02)	0 (.)	-12.35*** (-6.87)	-10.45*** (-7.56)	0 (.)
<i>job * agefjob</i>	-0.0251 (-1.10)	-0.0220 (-1.36)	-0.0668* (-2.57)	-0.285*** (-5.19)	-0.293*** (-9.09)	0.0132 (0.22)	0.188*** (19.13)	0.0937*** (9.07)	0.0243 (1.17)	-0.0630** (-2.89)	-0.216*** (-8.59)	-0.0708 (-1.23)
<i>job * agefjob</i> <sup>2</sup>	0.000203 (0.30)	0.000767** (2.65)	0.000137 (0.26)	0.00832*** (3.88)	0.00397*** (6.08)	-0.000912 (-0.72)	-0.00371*** (-16.95)	-0.00159*** (-7.92)	-0.00127** (-3.14)	-0.000291 (-0.39)	0.00383*** (7.43)	0.000598 (0.50)
<i>ISCED == 1</i>	0.0291 (0.27)	0 (.)	0 (.)	0.00749 (0.03)	0 (.)	0 (.)	-0.126 (-1.54)	0 (.)	0 (.)	-2.329*** (-8.78)	0 (.)	0 (.)
<i>ISCED == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 3</i>	0 (.)	0.547*** (11.04)	0 (.)	0 (.)	1.033*** (11.28)	0 (.)	0 (.)	0.804*** (18.87)	0 (.)	0 (.)	1.934*** (18.33)	0 (.)
<i>ISCED == 4</i>	0 (.)	-0.694*** (-6.44)	0 (.)	0 (.)	-0.293 (-1.50)	0 (.)	0 (.)	-0.0908 (-0.91)	0 (.)	0 (.)	-0.346 (-1.22)	0 (.)
<i>ISCED == 5</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 6</i>	0 (.)	0 (.)	0.127* (2.26)	0 (.)	0 (.)	0.627*** (5.67)	0 (.)	0 (.)	-0.172** (-2.68)	0 (.)	0 (.)	0.586*** (5.87)
<i>german == 1</i>	-0.712***	-1.038***	-0.217	1.416	0.224	-4.700***	-0.918***	-0.592***	-0.242	4.197***	-0.159	13.65***

Continued on next page

Table A.8 – continued from previous page

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(-6.72)	(-14.56)	(-1.62)	(1.39)	(0.43)	(-9.83)	(-12.08)	(-9.49)	(-1.95)	(4.37)	(-0.25)	(29.85)
<i>kids</i> == 1	9.511*** (6.60)	4.235*** (9.06)	2.013* (2.16)	-12.47*** (-3.69)	3.572*** (4.75)	-12.93*** (-4.85)	1.230*** (3.46)	4.606*** (12.80)	2.727** (2.59)	1.127 (0.64)	5.219*** (5.82)	0.264 (0.17)
<i>kids</i> == [2, 3]	10.02*** (6.94)	3.953*** (8.48)	1.469 (1.57)	-12.42*** (-3.73)	3.313*** (4.43)	-13.16*** (-4.96)	0.599 (1.70)	4.389*** (12.14)	1.947 (1.84)	1.227 (0.70)	5.116*** (5.76)	0.529 (0.34)
<i>kids</i> >= 4	11.42*** (8.03)	4.685*** (9.89)	1.614 (1.71)	-13.45*** (-3.77)	6.001*** (7.53)	-13.54*** (-5.00)	0.900* (2.57)	4.149*** (11.36)	0.375 (0.35)	2.116 (1.23)	7.135*** (7.98)	0.873 (0.53)
<i>married</i> == 1	-1.427*** (-9.29)	-1.382*** (-27.87)	-0.970*** (-12.11)	-2.604*** (-6.36)	-1.920*** (-25.19)	0.0430 (0.33)	-1.693*** (-20.30)	-1.404*** (-35.52)	-0.775*** (-11.05)	-0.0854 (-0.32)	-1.299*** (-17.36)	-0.765*** (-6.81)
<i>kids</i> * <i>agefkid</i>	-0.630*** (-6.37)	-0.256*** (-8.16)	-0.118* (-1.99)	0.996*** (3.87)	-0.269*** (-5.05)	0.822*** (4.45)	0.0300 (1.04)	-0.225*** (-8.30)	-0.126 (-1.77)	-0.109 (-0.71)	-0.233*** (-3.31)	-0.0191 (-0.17)
<i>kids</i> * <i>agefkid</i> <sup>2</sup>	0.0104*** (6.33)	0.00356*** (6.85)	0.00172 (1.82)	-0.0194*** (-4.06)	0.00455*** (4.88)	-0.0138*** (-4.39)	-0.00182** (-2.80)	0.00292*** (5.74)	0.00150 (1.26)	0.00224 (0.64)	0.00210 (1.53)	0.000918 (0.44)
<i>constant</i>	-1.680 (-0.94)	-0.927 (-1.66)	-0.927 (-0.80)	-15.83*** (-8.17)	-0.858 (-0.47)	-2.016 (-1.33)	-6.341*** (-10.76)	-4.863*** (-6.95)	-1.341 (-1.12)	-20.72*** (-13.29)	-4.952* (-2.47)	-27.15*** (-6.97)
$\sigma$	23.75*** (30.91)	10.33*** (47.57)	5.257*** (14.35)	18.51*** (15.40)	12.36*** (39.64)	6.666*** (13.24)	18.62*** (35.48)	10.65*** (34.06)	5.875*** (18.98)	19.07*** (22.34)	19.29*** (55.33)	7.796*** (14.71)
$R^2_{pseudo}$	0.087	0.020	0.029	0.194	0.060	0.055	0.072	0.024	0.037	0.194	0.055	0.031
$N_{lc}$	10,488	40,642	11,539	1,586	12,023	2,985	24,822	52,494	7,908	2,334	12,686	3,189
$N_{unc}$	6,688	19,933	3,390	1,234	12,126	1,617	11,183	26,023	3,574	1,736	14,826	1,960
<i>BIC</i>	49,260.87	141,967.1	23,906.32	8,296.541	78,539.6	10,537.03	84,325.33	184,844.7	23,752.89	11,737.07	101,503.4	12,940.25
<i>BIC</i>	50,090.25	142,922.3	24,667.43	8,879.101	79,356.9	10,916.65	85,233.91	185,827.5	24,502.44	12,374.52	102,333.9	13,267.58

Note: Results based on Tobit models (see equation A.2). Dependent variable is the cumulated period of unemployment at the current period. The variables *age* \* *agefjob* and *age* \* *agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3. Dummy variables for *age* (*aged15* to *aged70*) and *year* (*yeard86* to *yeard2015*) are omitted. Analogous to OLS regression,  $\sigma$  represents the estimated (robust) standard error of the regression, i.e. the square root of the residual variance. *AIC* represents Akaike, *BIC* Bayesian information criterion. *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

Table A.9: Tobit model: Domestic work

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>cohcd1955</i>	-0.109 (-0.12)	0.181 (0.77)	-2.599*** (-6.19)	-0.580 (-1.41)	-1.239*** (-4.06)	0.927** (3.14)	-3.161*** (-12.87)	-2.381*** (-18.63)	-2.186*** (-6.92)	4.546*** (4.60)	0.547*** (3.35)	0.110 (0.35)
<i>cohcd1960</i>	-2.493* (-2.03)	0.216 (0.80)	-1.015* (-2.00)	-8.735*** (-8.65)	-1.089** (-3.17)	0.831* (2.33)	-2.346*** (-10.05)	-2.647*** (-20.61)	-2.020*** (-5.78)	4.850*** (4.10)	2.025*** (9.88)	1.480** (3.16)
<i>cohcd1965</i>	-1.910 (-1.17)	0.113 (0.35)	-1.838** (-2.94)	0.463 (0.62)	0.150 (0.41)	0.422 (1.05)	-1.710*** (-6.99)	-3.119*** (-22.06)	-2.409*** (-6.20)	6.616*** (4.97)	3.788*** (14.32)	2.524*** (3.90)
<i>cohcd1970</i>	-2.165 (-1.07)	-0.436 (-1.08)	-2.201** (-2.87)	0.697 (0.82)	-0.127 (-0.29)	0.238 (0.48)	-1.477*** (-5.37)	-2.885*** (-17.83)	-2.920*** (-6.54)	8.407*** (5.26)	4.931*** (15.51)	2.167** (2.69)
<i>cohcd1975</i>	-2.800 (-1.14)	1.187** (2.59)	-1.743 (-1.92)	3.057** (3.06)	-0.363 (-0.68)	0.479 (0.83)	-1.854*** (-5.72)	-2.524*** (-13.71)	-2.051*** (-3.99)	10.31*** (5.90)	5.575*** (14.54)	3.101** (3.22)
<i>cohcd1980</i>	-4.944 (-1.73)	0.857 (1.60)	-2.281* (-2.15)	2.919** (2.64)	-0.397 (-0.64)	0.450 (0.69)	-2.033*** (-5.32)	-1.811*** (-8.54)	-0.462 (-0.74)	10.11*** (5.06)	6.190*** (13.89)	2.862** (2.59)
<i>cohcd1985</i>	-5.402 (-1.63)	0.261 (0.39)	-3.286* (-2.55)	2.791* (2.33)	-1.255 (-1.62)	0.804 (1.06)	-3.703*** (-8.38)	-0.399 (-1.33)	1.271 (1.52)	12.41*** (5.44)	7.106*** (13.52)	2.724* (2.06)
<i>cohcd1990</i>	-5.319 (-1.42)	0.228 (0.28)	-5.021* (-2.14)	3.029* (2.23)	-1.782 (-1.74)	-17.86 (.)	-5.155*** (-8.35)	-1.029 (-1.61)	1.255 (0.61)	16.28*** (6.32)	6.659*** (7.72)	-12.07*** (-4.75)
<i>cohcd1995</i>	-5.211 (-1.29)	-3.027 (-1.55)	21.41 (1.22)	2.431 (1.51)	1.540 (1.09)	0 (.)	-6.054*** (-5.85)	0.949 (0.56)	0 (.)	17.51*** (5.65)	5.658 (1.80)	0 (.)
<i>job * agefjob</i>	-0.128** (-2.97)	-0.125** (-3.06)	-0.288*** (-4.49)	0.185*** (4.04)	0.0527 (1.03)	-0.0862 (-1.67)	-0.809*** (-40.58)	-0.276*** (-7.69)	-0.603*** (-9.35)	0.105* (2.51)	0.128*** (3.59)	0.173* (2.49)
<i>job * agefjob</i> <sup>2</sup>	0.00535*** (4.37)	0.00307*** (4.11)	0.00430** (3.13)	-0.00984*** (-4.71)	-0.00322* (-2.15)	0.000895 (0.81)	0.0167*** (35.62)	0.00546*** (7.19)	0.0148*** (11.97)	-0.00222* (-2.06)	-0.00266*** (-3.98)	-0.00401** (-2.74)
<i>ISCED == 1</i>	-0.0276 (-0.15)	0 (.)	0 (.)	-0.0221 (-0.11)	0 (.)	0 (.)	-1.788*** (-10.71)	0 (.)	0 (.)	0.133 (0.26)	0 (.)	0 (.)
<i>ISCED == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>ISCED == 3</i>	0	-1.460***	0	0	-0.123	0	0	0.743***	0	0	0.367***	0

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Table A.9 – continued from previous page

<i>education:</i>	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(.)	(-10.71)	(.)	(.)	(-0.67)	(.)	(.)	(7.79)	(.)	(.)	(3.31)	(.)
<i>ISCED</i> == 4	0	-0.302	0	0	2.049***	0	0	2.714***	0	0	3.004***	0
	(.)	(-1.05)	(.)	(.)	(6.17)	(.)	(.)	(11.76)	(.)	(.)	(7.05)	(.)
<i>ISCED</i> == 5	0	0	0	0	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
<i>ISCED</i> == 6	0	0	0.238	0	0	0.271*	0	0	1.066***	0	0	1.199***
	(.)	(.)	(1.81)	(.)	(.)	(2.19)	(.)	(.)	(6.94)	(.)	(.)	(6.22)
<i>german</i> == 1	-0.472*	-1.241***	-1.982***	10.33***	-2.570**	6.903	-1.360***	-1.427***	-2.475***	-17.94***	-8.094***	0.712
	(-2.41)	(-6.18)	(-5.00)	(9.13)	(-3.13)	(.)	(-8.68)	(-10.35)	(-6.34)	(-9.17)	(-4.53)	(0.75)
<i>kids</i> == 1	9.016***	-2.707*	-3.906	-6.831	-0.814	-9.018***	11.64***	2.385**	-4.614	4.825	-0.393	-9.572***
	(4.44)	(-2.50)	(-1.67)	(-1.91)	(-0.75)	(-3.89)	(15.70)	(3.27)	(-1.84)	(1.60)	(-0.45)	(-4.66)
<i>kids</i> == [2, 3]	9.144***	-2.531*	-4.173	-5.395	0.594	-9.414***	14.45***	5.880***	-2.060	2.254	1.663	-7.702***
	(4.47)	(-2.36)	(-1.78)	(-1.54)	(0.54)	(-3.99)	(19.56)	(8.04)	(-0.81)	(0.75)	(1.92)	(-3.87)
<i>kids</i> >= 4	8.824***	-2.094	-5.665*	-13.80***	1.504	-10.09***	17.84***	9.671***	4.469	4.093	4.801***	-2.511
	(4.37)	(-1.95)	(-2.36)	(-3.79)	(1.35)	(-4.10)	(24.14)	(13.09)	(1.77)	(1.39)	(5.49)	(-1.29)
<i>married</i> == 1	-0.196	-0.261*	-0.282	-0.0709	0.420**	0.270	5.583***	3.718***	4.035***	0.752	1.567***	0.761***
	(-0.75)	(-2.04)	(-1.55)	(-0.25)	(2.81)	(1.77)	(31.56)	(41.99)	(21.50)	(1.77)	(19.98)	(5.06)
<i>kids</i> * <i>agfkid</i>	-0.635***	0.158*	0.164	0.472	-0.0996	0.571***	-0.150*	0.707***	0.905***	0.384	0.256***	0.687***
	(-4.45)	(2.34)	(1.17)	(1.83)	(-1.31)	(3.74)	(-2.57)	(13.23)	(5.39)	(1.49)	(3.73)	(4.72)
<i>kids</i> * <i>agfkid</i> <sup>2</sup>	0.00984***	-0.00150	0.000262	-0.00702	0.00443**	-0.00876***	-0.000303	-0.0139***	-0.0159***	-0.0107	-0.00259	-0.00861***
	(4.07)	(-1.43)	(0.13)	(-1.59)	(3.14)	(-3.48)	(-0.24)	(-14.19)	(-5.74)	(-1.90)	(-1.94)	(-3.45)
<i>constant</i>	-25.38	-25.45***	-22.04	-21.19	-13.63	-14.41	9.501***	1.514	6.889	-3.799	-9.390**	-22.44
	(.)	(-13.83)	(-1.26)	(.)	(.)	(.)	(6.68)	(1.05)	(1.71)	(-0.71)	(-3.02)	(.)
$\sigma$	21.51***	22.81***	16.34***	2.481***	9.759***	2.043***	114.0***	73.35***	43.10***	53.98***	23.49***	13.31***
	(7.48)	(11.16)	(6.94)	(6.55)	(6.27)	(4.78)	(93.31)	(119.86)	(33.33)	(14.68)	(30.98)	(7.23)
$R^2_{pseudo}$	0.070	0.029	0.067	0.212	0.089	0.155	0.141	0.113	0.146	0.141	0.056	0.083
$N_{lc}$	16,348	58,344	13,935	2,728	23319	4338	11901	27,628	5,518	2,689	14,038	3,054
$N_{unc}$	828	2,231	994	92	830	264	24,104	50,889	5,964	1,381	13,474	2,095
<i>AIC</i>	8,829.424	25,480.14	9,673.156	835.1979	8,467.194	2,038.646	193,036.3	390,154.5	43,993.26	11,310.97	96,456.32	14,109.94

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Table A.9 – continued from previous page

	Males						Females					
	West			East			West			East		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>BIC</i>	9,216.987	26,228.11	10,091.76	1,102.7	8,839.426	2,302.45	193,944.9	391,137.3	44,742.81	11,948.42	97,286.78	14,397.98

Note: Results based on Tobit models (see equation A.2). Dependent variable is the cumulated period of domestic work at the current period. The variables *age \* agefjob* and *age \* agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3. Dummy variables for *age* (*aged15* to *aged70*) and *year* (*year86* to *year2015*) are omitted. Analogous to OLS regression,  $\sigma$  represents the estimated (robust) standard error of the regression, i.e. the square root of the residual variance. *AIC* represents Akaike, *BIC* Bayesian information criterion. *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.



**Table A.10:** Random Effects Model (Males)

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>age</i>	5.776*** (4.21)	5.313*** (8.25)	8.752* (2.34)	6.050* (2.04)	4.822*** (3.82)	15.00 (1.69)
<i>age</i> <sup>2</sup>	-34.39*** (-3.71)	-33.40*** (-7.91)	-48.58* (-2.18)	-35.38 (-1.76)	-30.05*** (-3.71)	-84.38 (-1.63)
<i>age</i> <sup>3</sup>	1.052** (3.26)	1.092*** (7.60)	1.421* (2.04)	1.064 (1.51)	0.964*** (3.57)	2.484 (1.56)
<i>age</i> <sup>4</sup>	-0.175** (-2.86)	-0.197*** (-7.32)	-0.232 (-1.92)	-0.175 (-1.30)	-0.169*** (-3.41)	-0.405 (-1.50)
<i>age</i> <sup>5</sup>	0.00152* (2.51)	0.00186*** (7.09)	0.00200 (1.82)	0.00149 (1.12)	0.00155** (3.25)	0.00348 (1.44)
<i>age</i> <sup>6</sup>	-0.0000541* (-2.22)	-0.0000724*** (-6.91)	-0.0000718 (-1.75)	-0.0000519 (-0.97)	-0.0000582** (-3.12)	-0.000124 (-1.39)
<i>FT</i>	0.115*** (8.35)	0.0910*** (12.66)	0.106*** (6.92)	0.0842* (2.07)	0.0974*** (7.46)	0.122*** (4.41)
<i>FT</i> <sup>2</sup>	-0.396*** (-7.86)	-0.315*** (-9.75)	-0.426*** (-6.07)	-0.372* (-2.01)	-0.424*** (-6.75)	-0.432*** (-3.58)
<i>FT</i> <sup>3</sup>	0.00499*** (7.20)	0.00434*** (9.18)	0.00681*** (5.93)	0.00440 (1.50)	0.00604*** (6.46)	0.00709*** (3.60)
<i>PT</i>	-0.152*** (-4.72)	-0.207*** (-10.29)	-0.108*** (-3.88)	-0.437*** (-5.39)	-0.187*** (-6.73)	-0.0559 (-1.42)
<i>PT</i> <sup>2</sup>	1.515*** (4.08)	2.382*** (7.87)	0.939*** (3.52)	7.467*** (5.03)	2.697*** (5.18)	0.349 (0.70)
<i>PT</i> <sup>3</sup>	-0.0305*** (-3.55)	-0.0510*** (-5.14)	-0.0191** (-2.84)	-0.394*** (-5.57)	-0.0709*** (-4.17)	0.000183 (0.01)
<i>UE</i>	-0.0469 (-1.50)	-0.169*** (-7.48)	-0.385*** (-3.86)	-0.296*** (-3.73)	-0.119*** (-5.29)	-0.356*** (-4.55)
<i>UE</i> <sup>2</sup>	-0.412 (-0.86)	1.547** (2.90)	10.76** (3.20)	5.111*** (3.43)	0.214 (0.42)	6.152** (3.22)

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Table A.10 – continued from previous page

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>UE</i> <sup>3</sup>	0.0169 (1.08)	−0.0500 (−1.69)	−0.778*** (−3.31)	−0.250*** (−3.61)	0.00102 (0.04)	−0.285* (−2.44)
<i>FAM</i>	−0.219 (−1.77)	−0.208** (−2.66)	−0.606* (−2.48)	−0.230 (−0.32)	−0.0835 (−0.50)	0.390 (0.65)
<i>FAM</i> <sup>2</sup>	8.034 (1.19)	2.354 (1.48)	14.56 (1.19)	−3.701 (−0.05)	0.517 (0.05)	−66.89 (−0.83)
<i>FAM</i> <sup>3</sup>	−0.760 (−1.04)	−0.0682 (−1.13)	−0.462 (−0.26)	7.910 (0.40)	−0.211 (−0.19)	19.15 (0.91)
<i>job * age f job</i>	0.0354** (3.27)	0.0393*** (5.13)	−0.0188 (−0.99)	0.0362 (1.17)	0.0780*** (6.43)	0.0319 (1.11)
<i>job * age f job</i> <sup>2</sup>	−0.000226 (−0.68)	−0.000151 (−0.97)	0.000649 (1.66)	−0.000935 (−0.74)	−0.00117*** (−4.44)	0.000157 (0.27)
<i>educ == 1</i>	−0.182*** (−4.89)	0 (.)	0 (.)	−0.370** (−3.11)	0 (.)	0 (.)
<i>educ == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>educ == 3</i>	0 (.)	0.0407 (1.00)	0 (.)	0 (.)	−32.85*** (−4.11)	0 (.)
<i>educ == 4</i>	0 (.)	0 (.)	0 (.)	0 (.)	−32.91*** (−4.11)	0 (.)
<i>educ == 5</i>	0 (.)	0.140*** (3.47)	0 (.)	0 (.)	−32.76*** (−4.10)	0 (.)
<i>educ == 6</i>	0 (.)	0 (.)	−0.114*** (−3.80)	0 (.)	0 (.)	−0.0774 (−1.80)
<i>educ == 7</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>german == 1</i>	−0.160*** (−5.31)	−0.00393 (−0.16)	−0.00256 (−0.05)	−0.513* (−2.13)	0.231* (1.99)	0.334* (2.52)
<i>kids == 1</i>	−0.594	−0.337**	0.283	2.390*	−0.0834	−0.392

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Table A.10 – continued from previous page

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(−1.37)	(−2.74)	(0.67)	(2.51)	(−0.45)	(−0.58)
<i>kids</i> == [2, 3]	−0.569 (−1.32)	−0.322** (−2.63)	0.320 (0.76)	2.440* (2.57)	−0.0825 (−0.46)	−0.304 (−0.45)
<i>kids</i> >= 4	−0.588 (−1.37)	−0.271* (−2.16)	0.284 (0.68)	2.376* (2.53)	−0.131 (−0.72)	−0.384 (−0.55)
<i>married</i> == 1	0.0499 (1.75)	0.0319*** (3.31)	0.0329 (1.82)	0.165 (1.74)	0.00547 (0.32)	0.0159 (0.48)
<i>kids</i> * <i>agefkid</i>	0.0326 (1.17)	0.0182* (2.30)	−0.0148 (−0.59)	−0.178* (−2.49)	0.00724 (0.60)	0.0220 (0.49)
<i>kids</i> * <i>agefkid</i> <sup>2</sup>	−0.000455 (−1.03)	−0.000227 (−1.81)	0.000218 (0.58)	0.00321* (2.47)	−0.000127 (−0.65)	−0.000211 (−0.29)
<i>constant</i>	−40.12*** (−4.92)	−35.51*** (−8.91)	−64.78* (−2.52)	−41.82* (−2.38)	0 (.)	−110.1 (−1.77)
<i>N</i>	9902	54208	14153	1034	18857	4047
<i>N<sub>group</sub></i>	1923	7535	2144	269	2640	577
<i>sigma<sub>u</sub></i>	0.635	0.466	0.552	0.581	0.453	0.523
<i>sigma<sub>e</sub></i>	0.317	0.284	0.292	0.321	0.308	0.314
<i>rho</i>	0.800	0.729	0.781	0.766	0.684	0.734

Note: Results based on random effects models (see equation A.4). Dependent variable is the logarithmised relative wage at the current period. The variables *age* \* *agefjob* and *age* \* *agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3.  $\sigma_u$  represents the standard deviation of the residuals.  $\sigma_e$  represents the standard deviation of the time-invariant error term.  $\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2}$  represents the fraction of variance due to  $u_i$ . *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.

**Table A.11:** Random Effects Model (Females)

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>age</i>	7.989*** (7.99)	7.088*** (9.99)	-1.395 (-0.41)	6.001 (1.73)	4.417** (3.13)	-2.627 (-0.51)
<i>age</i> <sup>2</sup>	-51.94*** (-7.56)	-46.42*** (-9.78)	10.80 (0.51)	-38.09 (-1.56)	-30.27** (-3.26)	16.33 (0.52)
<i>age</i> <sup>3</sup>	1.736*** (7.14)	1.561*** (9.48)	-0.419 (-0.61)	1.273 (1.44)	1.072*** (3.37)	-0.515 (-0.50)
<i>age</i> <sup>4</sup>	-0.317*** (-6.76)	-0.286*** (-9.15)	0.0866 (0.70)	-0.236 (-1.37)	-0.208*** (-3.48)	0.0887 (0.49)
<i>age</i> <sup>5</sup>	0.00300*** (6.42)	0.00271*** (8.80)	-0.000911 (-0.78)	0.00229 (1.31)	0.00209*** (3.59)	-0.000795 (-0.47)
<i>age</i> <sup>6</sup>	-0.000116*** (-6.13)	-0.000105*** (-8.47)	0.0000383 (0.85)	-0.0000913 (-1.28)	-0.0000859*** (-3.69)	0.0000290 (0.45)
<i>FT</i>	0.138*** (16.91)	0.128*** (20.09)	0.156*** (10.13)	0.0940** (2.71)	0.101*** (9.06)	0.0645*** (3.46)
<i>FT</i> <sup>2</sup>	-0.418*** (-9.96)	-0.466*** (-16.56)	-0.637*** (-7.14)	-0.339* (-2.27)	-0.354*** (-8.09)	-0.294** (-3.09)
<i>FT</i> <sup>3</sup>	0.00499*** (7.23)	0.00599*** (14.28)	0.00913*** (6.02)	0.00473* (2.15)	0.00512*** (7.55)	0.00513** (3.13)
<i>PT</i>	-0.00942 (-0.88)	-0.0212*** (-3.35)	-0.0470** (-2.86)	0.00668 (0.18)	-0.0259* (-2.42)	-0.0640 (-1.94)
<i>PT</i> <sup>2</sup>	0.266*** (3.96)	0.334*** (8.06)	0.696*** (5.30)	0.365 (1.42)	0.364*** (5.60)	0.501 (1.31)
<i>PT</i> <sup>3</sup>	-0.00451*** (-3.90)	-0.00714*** (-8.05)	-0.0159*** (-4.96)	-0.0133* (-2.30)	-0.00696*** (-4.64)	-0.00932 (-0.83)
<i>UE</i>	-0.0857** (-3.11)	-0.153*** (-5.60)	-0.0730 (-0.82)	-0.185** (-3.04)	-0.163*** (-7.03)	-0.331*** (-3.54)
<i>UE</i> <sup>2</sup>	0.213 (0.55)	1.357* (2.01)	-2.774 (-0.73)	1.432 (1.46)	1.288*** (3.46)	5.607** (2.95)

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Table A.11 – continued from previous page

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
<i>UE</i> <sup>3</sup>	−0.00439 (−0.37)	−0.0603* (−2.05)	0.257 (0.96)	−0.0386 (−1.04)	−0.0375* (−2.28)	−0.293** (−2.85)
<i>FAM</i>	−0.0310* (−2.45)	−0.0809*** (−8.97)	−0.174*** (−5.35)	0.0448 (0.68)	−0.00135 (−0.09)	0.111* (2.15)
<i>FAM</i> <sup>2</sup>	0.264** (2.79)	0.517*** (6.15)	1.594*** (4.20)	−0.660 (−0.65)	−0.0946 (−0.43)	−3.939** (−3.07)
<i>FAM</i> <sup>3</sup>	−0.00452* (−2.47)	−0.00936*** (−5.11)	−0.0389*** (−3.69)	0.0154 (0.44)	0.00356 (0.58)	0.175** (2.80)
<i>job * age f job</i>	0.0329*** (4.59)	0.0440*** (7.52)	0.00460 (0.22)	−0.000612 (−0.03)	0.0697*** (5.04)	−0.0135 (−0.53)
<i>job * age f job</i> <sup>2</sup>	−0.000127 (−0.95)	−0.000275* (−2.43)	0.000172 (0.41)	0.000327 (0.61)	−0.000761** (−2.72)	0.000267 (0.53)
<i>educ == 1</i>	−0.254*** (−7.61)	0 (.)	0 (.)	−0.274* (−2.45)	0 (.)	0 (.)
<i>educ == 2</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>educ == 3</i>	0 (.)	−0.0926*** (−3.98)	0 (.)	0 (.)	−0.0479 (−1.03)	0 (.)
<i>educ == 4</i>	0 (.)	−0.214*** (−3.94)	0 (.)	0 (.)	−0.340** (−2.65)	0 (.)
<i>educ == 5</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>educ == 6</i>	0 (.)	0 (.)	−0.136*** (−3.57)	0 (.)	0 (.)	−0.125** (−2.76)
<i>educ == 7</i>	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)	0 (.)
<i>german == 1</i>	−0.294*** (−9.01)	−0.0693** (−2.91)	0.115 (1.28)	−40.01* (−2.03)	−0.0800 (−0.47)	0.133 (1.33)
<i>kids == 1</i>	0.0184	0.932***	−0.471	−0.431	−0.642	−2.575**

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Table A.11 – continued from previous page

<i>education:</i>	Western Germany			Eastern Germany		
	<i>low</i>	<i>medium</i>	<i>high</i>	<i>low</i>	<i>medium</i>	<i>high</i>
	(0.08)	(3.99)	(−0.69)	(−0.26)	(−1.93)	(−2.81)
<i>kids</i> == [2, 3]	−0.0704 (−0.29)	0.787*** (3.39)	−0.553 (−0.82)	−0.753 (−0.45)	−0.680* (−2.05)	−2.600** (−2.85)
<i>kids</i> >= 4	−0.0657 (−0.27)	0.739** (3.18)	−0.678 (−0.97)	−0.795 (−0.48)	−0.706* (−2.12)	−2.456** (−2.67)
<i>married</i> == 1	−0.0842** (−2.96)	−0.150*** (−12.21)	−0.150*** (−4.29)	0.0838 (1.15)	−0.0361 (−1.86)	0.00621 (0.10)
<i>kids</i> * <i>agefkid</i>	0.0106 (0.55)	−0.0624*** (−3.71)	0.0339 (0.77)	0.0744 (0.51)	0.0449 (1.70)	0.170** (2.58)
<i>kids</i> * <i>agefkid</i> <sup>2</sup>	−0.000634 (−1.58)	0.000693* (2.33)	−0.000672 (−0.96)	−0.00244 (−0.80)	−0.000896 (−1.75)	−0.00299* (−2.55)
<i>constant</i>	−50.76*** (−8.68)	−44.79*** (−10.44)	6.086 (0.28)	0 (.)	−27.66** (−3.20)	16.24 (0.48)
<i>N</i>	14179	53545	8765	1034	18581	4226
<i>N<sub>group</sub></i>	2990	8993	1663	323	3089	628
$\sigma_u$	0.674	0.583	0.659	0.593	0.517	0.473
$\sigma_\epsilon$	0.392	0.387	0.403	0.443	0.356	0.330
$\rho$	0.747	0.694	0.727	0.641	0.678	0.672

Note: Results based on random effects models (see equation A.4). Dependent variable is the logarithmised relative wage at the current period. The variables *age* \* *agefjob* and *age* \* *agefkid* are interaction variables with binaries *job* and *kid*, respectively. Educational level is subdivided according to definition in chapter A.3.  $\sigma_u$  represents the standard deviation of the residuals.  $\sigma_\epsilon$  represents the standard deviation of the time-invariant error term.  $\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_\epsilon^2}$  represents the fraction of variance due to  $u_i$ . *t*-statistics in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Source: SOEPv33 (SOEP, 2016); own calculations, own illustration.