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Working Papers

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Wolfgang Nagl
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Unemployment compensation and unemployment duration before and after the German Hartz IV reform*

Abstract

In 2005, the unemployment benefits for long-term unemployed were reduced in Germany. We investigate the effect of this reform on the transition probability from unemployment to employment using a large German administrative spell data set (SIAB 1975–2010). We estimate that the daily transition probability of medium wage earners increased on average by 24% after the reform. The effect is lower for both, low and high wage earners. Men were less affected than women and West Germans were less affected than East Germans. For short-term unemployed the effect is increasing over unemployment duration while long-term unemployed apparently did not benefit from the reform.

JEL Code: J64, J68.

Keywords: Duration analysis, hazard rate, unemployment benefit, Hartz reform.

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1. Introduction

In the early 2000s far-reaching labor market reforms, referred to as “Hartz reforms”, were implemented in Germany. The four reform packages aimed at a reduction of unemployment using various measures.¹ We contribute to the evaluation of the Hartz reforms by examining at the micro level whether the reduction of the unemployment compensation for long-term unemployed in the course of the Hartz IV reform has reduced the duration in unemployment. Search-theoretic models of the labor market predict that a reduction of the level of unemployment compensation induces an increase of the transition probability from unemployment to employment, i. e. of the hazard rate, and thereby a reduction of unemployment duration (see e. g. Rogerson *et al.*, 2005). If the unemployment compensation scheme differentiates between short-term and long-term unemployed, a decrease of the unemployment compensation for long-term unemployed will increase the transition probability of the short-term unemployed as well (Mortensen, 1977; van den Berg, 1990).

The literature evaluating the German Hartz reforms is growing rapidly. Several studies examine the effect and effectiveness of active labor market programs which were introduced or changed by the first two Hartz reform packages. For a survey on these evaluations see Jacobi and Kluge (2007) or Eichhorst and Zimmermann (2007). Dlugosz *et al.* (2014) investigate the reforms’ impact on unemployment inflows, while Fahr and Sunde (2009), Klinger and Rothe (2012) and Hertweck and Sigrüst (2013) assess the reforms’ effect on unemployment outflows. The three latter studies estimate matching functions using aggregated time series. Hertweck and Sigrüst (2013) inspect the effect of the first two Hartz reform packages in 2003 and find an increase in matching efficiency by 20–40% in West Germany. Using stock flow models, Fahr and Sunde (2009) and Klinger and Rothe (2012) identify positive impacts of the Hartz I, II and III reforms on matching efficiency. The effects are larger in East Germany (Fahr and Sunde, 2009)

¹A description of the core elements can be found in Arent and Nagl (2013) and Jacobi and Kluge (2007).

and for long-term unemployed (Klinger and Rothe, 2012).

For the Hartz IV reform, Klinger and Rothe (2012) estimate a slightly negative effect on matching efficiency. However, they argue that this finding might be spurious. The result may be due to a change in the definition of unemployment or due to a decline in the positive effect of the Hartz III reform. This view is supported by Krause and Uhlig (2012) who show in a simulation model that the Hartz IV reform should have unambiguously shortened the duration in unemployment. In contrast, Launov and Wälde (2013) identify only a very small impact of the Hartz IV reform on unemployment. They simulate the reform in an equilibrium matching model. Parameter values are obtained by structural estimation using survey data at the individual level. Launov and Wälde (2013) conclude that unemployment has declined by less than 0.1 percentage points due to the reform.²

Hence, at the moment there is little consensus on the actual effects of the German Hartz IV reform on unemployment outflows. Moreover, little is known about effect heterogeneities for specific groups of job-seekers. We therefore contribute to the evaluation of the German Hartz IV reform by providing empirical evidence based on a large and novel administrative micro data set. The use of micro data allows us to examine several issues, most of which have not been addressed yet. First, the impact of the Hartz IV reform may vary across the wage distribution. Second, the results by Fahr and Sunde (2009) suggest that the effect of the Hartz IV reform might also vary between East and West Germany. Third, gender differences in labor force participation rates (Statistics of the German Federal Employment Agency, 2013b) may result in gender-specific effects of the Hartz IV reform as well. Fourth, the impact probably varies between short-term and long-term unemployed (see Klinger and Rothe, 2012). It might thus be advisable to estimate the Hartz effect separately for narrowly defined groups like “male short-term unemployed in East Germany”. Finally, if the

²Launov and Wälde (2013) also estimate a surprisingly positive effect of the Hartz IV reform on net wages. This result is at odds with theoretical predictions and empirical findings by other scholars, e. g. Giannelli *et al.* (2013).

effect indeed varies between short-term and long-term unemployed, it might vary over unemployment duration altogether.

In order to address all these issues, we estimate the impact of the Hartz IV reform on an individual's transition probability using the proportional hazard model. Proportional hazard models are usually applied to assess the effect of unemployment benefits on unemployment duration (see e. g. Lancaster, 1979; Moffitt, 1985; Narendranathan *et al.*, 1985; Katz and Meyer, 1990; Meyer, 1990; Winter-Ebmer, 1998; Roed and Zhang, 2003; Lalive *et al.*, 2006).³ For an extensive survey see Machin and Manning (1999). Examples for Germany include Hunt (1995), Winterhager (2006), Arntz and Wilke (2009), Fitzenberger and Wilke (2010b) and Caliendo *et al.* (2013).

Our findings imply that due to the Hartz IV reform the individual daily transition probability from unemployment to employment has increased by 24% on average for job-seekers with medium pre-unemployment earnings. Low wage and high wage earners were less affected. The effect is higher in East Germany and higher for women. The overall effect is driven by significant, positive effects for the short-term unemployed. In contrast, the effect is insignificant or even negative for most long-term unemployed. Our results imply that former job opportunities for long-term unemployed are now occupied by short-term unemployed.

The remainder of the paper is organized as follows. The next section briefly describes the institutional background with regard to the German unemployment scheme. In section 3 we discuss theoretic foundations and derive hypotheses about the effects to be expected for different groups of job-seekers. Section 4 describes our data and sample definition. In section 5 we present and discuss descriptive statistics. Our identification strategy is explained in section 6. Section 7 presents our estimation results. Section 8 concludes.

³Recently, quantile regression have been proposed as a more flexible alternative (see e. g. Koenker and Biliias, 2001; Koenker and Geling, 2001; Fitzenberger and Wilke, 2010a). However, quantile regressions cannot deal with covariates which vary over unemployment duration like the GDP growth rate, the type of benefit received or the remaining entitlement period.

2. The German unemployment compensation scheme

Germany, as many other European countries, uses a two component unemployment compensation scheme. The first component, called unemployment benefit I (*Arbeitslosengeld*, UB I), is a mandatory unemployment insurance that covers unemployed claimants for a limited period. The second component is tax financed and covers all unemployed job-seekers who are not (any more) eligible for UB I and who meet a means-test. The Hartz IV reform, becoming effective on January 1, 2005, altered the tax-based unemployment compensation scheme while leaving the insurance component almost unchanged.⁴

The UB I amounts to 60% of a worker's former net wage. With a child to support the proportion increases to 67%. In general, unemployed job-seekers are eligible for UB I if they have worked at least 360 days in the last two years preceding their current unemployment spell. They are then entitled to receive UB I for up to one year. The maximum entitlement period is slightly higher for older job-seekers with longer employment periods. Job-seekers participating in active labor market programs (ALMP) receive a specific type of benefit ("income maintenance" up to 2005, "UB I for training measures" since 2005) that equals the level of their UB I. However, the remaining entitlement period for UB I diminishes only by one half for every day the job-seeker participates in an ALMP measure; before 2003, the remaining entitlement period did not decrease at all.

Job-seekers who are not eligible for UB I — either because their entitlement has expired or because they do not meet the eligibility requirements — qualify for the tax-based unemployment compensation if they meet a means-test. Before the Hartz IV reform, this compensation was called unemployment assistance (*Arbeitslosenhilfe*) and amounted to a maximum of 57% of the previous net wage. The Hartz IV reform replaced this

⁴In the aftermath of the Hartz IV reform, on February 1, 2006, the maximal entitlement period for UB I has been shortened for older workers to a maximum of 18 months. It was slightly re-extended to 24 months at the beginning of 2008.

wage-dependent compensation by a fixed payment, now called unemployment benefit II (*Arbeitslosengeld II*, UB II) and tightened the means test. The new benefit consists of a basic rate (the actual UB II), housing costs and extra payments in case of special needs. The basic rate for a single person household has been steadily increased from 345 Euro in 2005 to 359 Euro in 2010. For the vast majority of job-seekers the level of UB II is lower than the level of the previous unemployment assistance. Unemployed whose unemployment income level did not change at first sight are potentially affected as well because they might fail the tightened means-test for UB II.

Though UB I and UB II cover in general different group of job-seekers, there is no clear-cut distinction between recipients of UB I and UB II or even between unemployed and employed workers. Unemployed job-seekers who are eligible for UB I but whose benefit level is below the UB II level qualify for an additional payment of UB II. The same holds true for employed workers whose working income is too low. These workers receive UB II as a top-up benefit. On the other hand, unemployed job-seekers receiving either UB I or UB II are allowed to work up to 15 hours a week in order to increase their household income (spare time work, *Nebenbeschäftigung*). Finally, the introduction of UB II went along with a redefinition of unemployment. Recipients of a former welfare scheme called social assistance were now considered as unemployed, resulting in a statistical increase of the aggregated unemployment figures. We take care of all these special characteristics of the German unemployment system when we define our samples and subsamples.

3. Theory and hypotheses

In the context of dynamic search theory (Mortensen, 1977; van den Berg, 1990), job-seekers entitled to UB I are “short-term unemployed”, while recipients of the former unemployment assistance and the new UB II are “long-term unemployed”. In the following, we stick to these definitions for the ease of understanding. We thus deviate

from the official definition used in German administrative time series, where long-term unemployment is solely defined on the basis of unemployment duration, irrespective of the type of benefit received.

Dynamic search theory (Mortensen, 1977; van den Berg, 1990) assumes that the short-term unemployed are aware of the limited duration of their entitlement. They know that they will fall back to the long-term unemployment benefit as soon as their entitlement to the short-term unemployment benefit expires. A reduction of the long-term unemployment benefit will thus not only affect the long-term unemployed, but the short-term unemployed as well. Faced with a lower expected discounted income flow each unemployed increases her search effort and reduces her reservation wage which results in a higher transition probability from unemployment to employment. Hence, dynamic search theory predicts that the reduction of the tax-based long-term unemployment compensation from its unemployment assistance level to the new UB II level in the course of the Hartz IV reform should have increased the transition probability of all unemployed, irrespective whether they receive the insurance-based short-term unemployment benefit or the tax-based long-term unemployment compensation.

Hypothesis 1: The Hartz IV reform has increased the transition probability from unemployment to employment.

Beyond this general result, we expect the effect to vary across several dimensions. First, the effect may vary over the wage distribution. Job-seekers with very low pre-unemployment earnings are not affected by the Hartz IV reform, if their benefit levels do not change due to the reform and if they are not affected by the tightening of the means test. In June 2010, the average person's requirement of housing costs was 204 Euro (Statistics of the German Federal Employment Agency, 2010). Together with the UB II basic rate of 359 Euro this makes an unemployment income of 573 Euro. In order to achieve an equivalent income with the former unemployment assistance, a job-seeker must have earned about 1,000 Euro (net wage) per month or about 35 Euro per day in her last job. The gross wage should be slightly higher. As a conservative approach,

we thus define all gross wages up to 35 Euro per day as low wages. Job-seekers with such low wages should be much less affected by the Hartz IV reform than job-seekers with higher earnings. However, job-seekers with very high pre-unemployment earnings are probably little affected as well. High wages correspond to high productivity and high re-employment probabilities. We expect job-seekers with high pre-unemployment earnings to find a job almost surely before their UB I entitlement expires. The Hartz IV reform has then little potential to affect the unemployment duration of these job-seekers. As a rough measure of high wages, we use the average starting salaries of university graduates. This amounts to 3.400 Euro per month (Bispinck *et al.*, 2012) or about 110 Euro per day.

Hypothesis 2: The effect of the Hartz IV reform varies over the wage distribution. Job-seekers with very low or very high pre-unemployment earnings are much less affected than job-seekers with medium wages.

Second, the impact of the Hartz IV reform might be higher in regions with higher wages. The former unemployment assistance was directly linked to one own's pre-unemployment earnings, while the new UB II amounts to the same value for all job-seekers. The implicit income loss between the former unemployment assistance and the new UB II is thus larger in regions where higher wages are paid. According to search theory, a larger drop in the unemployment compensation should result in a larger reduction of the reservation wage and thus a larger increase of the transition probability. In Germany, structural differences and wage differences persist especially between East and West Germany, with higher wages usually paid in West Germany (see e. g. Smolny, 2009; Blien *et al.*, 2010; Fuchs-Schündeln and Izem, 2012).

Hypothesis 3: The effect of the Hartz IV reform is larger in West Germany.

Third, we expect the reform's effect to be larger for groups which are more active on the labor market. In Germany, women have lower labor force participation rates

than men (Statistics of the German Federal Employment Agency, 2013b). The male breadwinner model apparently still plays some role, especially in West Germany (see Matysiak and Steinmetz, 2008).

Hypothesis 4: The effect of the Hartz IV reform is larger for men than for women. It is also larger for East German women than for West German women.

Fourth, the reform's impact for the long-term unemployed may actually be negative. Dynamic search theory predicts that the short-term unemployed will reduce their reservation wages in response to the reform. Hence, the short-term unemployed may now be willing to accept jobs they would have refused prior to the Hartz IV reform. They now compete with the long-term unemployed, who usually apply for these low-pay jobs. As most employers prefer short-term to long-term unemployed, the long-term unemployed are left with less job opportunities. Moreover, the Hartz IV reform may have unintentionally contributed to a stigmatization of the long-term unemployed (Booth and Scherschel, 2010). The short-term unemployed will fear such a stigmatization and thus increase their job search effort and decrease their reservation wages even further. This intensifies the competition for jobs.

Hypothesis 5: The Hartz IV reform has decreased the transition probability of the long-term unemployed.

Finally, the effect of the Hartz IV reform on the short-term unemployed very likely increases as their remaining entitlement period diminishes. Remember that the Hartz IV reform exacerbated the income loss associated with the change from short-term to long-term unemployment. Job-seekers who are entitled to the short-term unemployment benefit for still another year discount this income loss and thus react little to the reform. In contrast, job-seekers whose entitlement is close to expire face a high risk of becoming long-term unemployed. They respond to the reform with marked reductions of their reservation wages which results in a considerable increase of their transition

probabilities to employment.

Hypothesis 6: The effect of the Hartz IV reform increases from the begin of unemployment until the day the UB I entitlement expires.

4. Data and definition of the sample

4.1. Data base

We base our estimation on the weakly anonymous Sample of Integrated Labour Market Biographies (SIAB), years 1975 – 2010 (see vom Berge *et al.*, 2013).⁵ The SIAB contains daily administrative spell data of a representative 2% random sample of all individuals who were either employed, unemployed or participants in ALMP measures between 1975 and 2010. It is the largest and most reliable data set on unemployment and employment in Germany. The data stems from mandatory notifications of employers to institutions of the social security system, and from notifications by the federal employment agency on unemployment registrations and benefit payments. We observe, among others, an individual's year of birth, gender, nationality, daily income (while employed and unemployed), occupation (while employed) and benefit type (while unemployed) as well as the number of days until her entitlement to the insurance-based short-term unemployment benefit UB I expires. We also observe whether a job-seeker receives UB I, UB II or unemployment assistance. Due to the structure of the SIAB, we often observe an individual more than once for a given point in time. We use an extensive algorithm explained in the Appendix to assign each individual a single, unambiguous labor market state for each point in time.

⁵Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

4.2. Sample definition

With unique labor market states at hand, we construct labor market biographies and our sample. We define as an unemployment spell any period of consecutive unemployment observations, ignoring employment spells of less than 8 days or periods without any observation of up to 90 days. The latter exception accounts for missing observations due to sanctions, i. e. periods where no unemployment benefits were paid due to misbehavior of the job-seeker. We then drop all unemployment spells of less than eight days. In our point of view, such short unemployment spells do not reflect actual unemployment but rather (voluntary or involuntary) job-to-job-transitions. We also drop unemployment spells for which we do not observe an employment spell within the 90 days preceding the first unemployment observation of that spell. We consider these spells as left-truncated. An interruption of up to 90 days is plausible due to sanctions. Likewise, we consider an exit from unemployment as a successful transition into employment only if the employment spell starts within 30 days after the last unemployment observation. We finally constrain our sample to job-seekers who are not disabled, who have worked full-time before the current unemployment spell, who are looking for another full-time job, who are initially entitled to the short-term unemployment benefit UB I and who are in the age of 25 to 55 when entering unemployment. Unemployment spells are right censored when a job-seeker turns 55 years old.

We then divide our sample into a pre- and a post-Hartz subsample. The first subsample consists of unemployment spells starting in the period from January 1, 2000 to July 1, 2003. These unemployment spells are followed up until November 30, 2003. The second subsample consists of unemployment spells beginning between January 1, 2007 and July 1, 2010. These unemployment spells are followed up until November 30, 2010. This allows us to observe transitions back to employment until the end of the SIAB 7510 observation period. We do not consider spells before 2000 because of data limitations. The year 2004 is omitted in order to avoid anticipation effects. The years 2005 and 2006 are excluded because in these years the official authorities misreported

persons receiving the new UB II (vom Berge *et al.*, 2013). Note that by our sample construction we exclude all former social assistance recipients who entered registered unemployment on January 1, 2005. We thus avoid the structural break that is observed in aggregate time series.

For each job-seeker in our sample, we divide the observed unemployment spell into a short-term and a long-term unemployment sub-spell. We refer to job-seekers in these sub-spells as short-term unemployed or long-term unemployed. We consider a job-seeker to be long-term unemployed when her entitlement to the short-term unemployment benefit UB I is exhausted. Participants in ALMP measures who are still entitled to UB I are considered as short-term unemployed. Entitlement is observed by a specific variable in the SIAB which captures the remaining entitlement period. We use a corrected version of this variable that was provided by the FDZ after we have reported serious data irregularities (see FDZ, 2014, for details). We further adjust this variable so we observe the correct remaining entitlement period even during ALMP participation.

5. Descriptive statistics

Tables 1 and 2 provide a description of our final sample. Our sample consists of 188,886 unemployment spells in total. Only 40% of all spells are observed in the post-Hartz period. This is remarkable as we deliberately constructed the pre- and post-Hartz period of equal length. The much lower number of unemployment spells implies that unemployment incidence decreased over time. Moreover, the descriptive results imply a positive effect of the Hartz IV reform on a job-seeker's transition probability to employment: Compared to the pre-reform period, median unemployment duration and the fraction of job-seekers experiencing long-term unemployment are lower while the fraction of job-seekers finding a job is larger in the post-reform subsample. Conversely, the fraction of right-censored spells is halved. The initial entitlement diminishes as

Table 1: Descriptive statistics: West Germany

	Men		Women	
	2000–2003	2007–2010	2000–2003	2007–2010
age (in years)	37.73	38.52	38.31	38.51
foreign citizen (dummy)	14.86	14.64	9.68	10.55
married (dummy)	52.99	46.12	46.76	37.96
children (dummy)	49.20	42.78	39.99	32.32
low wage (dummy)	5.20	9.16	15.01	19.52
medium wage (dummy)	78.80	78.56	75.58	71.18
high wage (dummy)	16.00	12.28	9.40	9.30
initial entitlement period (in days)	336.85	306.67	343.04	311.48
entered long-term unemployment (dummy)	22.19	14.78	23.14	13.32
participated in ALMP (dummy) transition to employment (dummy)	3.21	5.77	3.94	6.68
right-censored (dummy)	70.20	75.46	65.38	71.74
median unemployment duration (in days)	16.38	8.21	17.83	8.72
Spells	151	125	202	151
	49,150	37,967	22,906	17,247

Source: SIAB 7510, own calculations. The first eight variables are measured at the begin of unemployment. Low wage: up to 35 Euro a day; medium wage: above 35 Euro and below 110 Euro; high wage: 110 Euro and more. All wages are deflated using the German CPI.

well, from about 11 months to 10 months. We further observe that job-seekers in the post-reform subsample have earned less on average than job-seekers in the pre-reform sample. This might point to a wage-pressure effect of the Hartz reforms; but it might as well reflect simply a change in the skill distribution of job-seekers. Unfortunately, the quality of the skill variable provided in the SIAB declines over time, leaving us with no information on skills for about the half of our unemployment spells in the post-reform period. Hence, we are not able to check for skill composition effects.

The average job-seeker in our sample is almost 40 years old when entering unemployment. About 50% of our job-seekers are married and parents, though these shares decline by about 10 percentage points over time. East German residents account for about one third of all unemployment spells. Relative to their share in population, East Germans are thus overrepresented among the unemployed. This represents the

Table 2: Descriptive statistics: East Germany

	Men		Women	
	2000–2003	2007–2010	2000–2003	2007–2010
age (in years)	39.32	39.81	40.30	39.54
foreign citizen (dummy)	2.40	2.93	2.04	3.15
married (dummy)	53.06	42.21	58.21	44.86
children (dummy)	53.25	42.66	55.74	43.13
low wage (dummy)	5.89	12.27	19.08	31.42
medium wage (dummy)	89.28	83.69	76.95	63.68
high wage (dummy)	4.83	4.04	3.96	4.90
initial entitlement period (in days)	349.00	303.23	333.65	304.96
entered long-term unemployment (dummy)	24.17	14.07	34.56	16.87
participated in ALMP (dummy) transition to employment (dummy)	4.83	5.45	6.65	6.40
right-censored (dummy)	75.70	81.25	63.06	74.78
median unemployment duration (in days)	13.77	6.98	23.98	10.56
Spells	164	111	306	150
	28,055	14,984	12,132	6,445

Source: SIAB 7510, own calculations. The first eight variables are measured at the begin of unemployment. Low wage: up to 35 Euro a day; medium wage: above 35 Euro and below 110 Euro; high wage: 110 Euro and more. All wages are deflated using the German CPI.

higher incidence of unemployment in East Germany (Statistics of the German Federal Employment Agency, 2013a). The share of foreign citizens among the unemployed is much lower in East Germany compared to West Germany, which reflects the lower share of foreign citizens in the overall population. Women account for about 30% of all unemployment spells. Compared to men, their pre-unemployment earnings and job finding probabilities are on average lower while their median unemployment duration is longer. However, women experienced a much larger decline in median unemployment duration after the Hartz IV reform than men.

6. Identification

In order to assess the impact of the Hartz IV reform on unemployment duration and the individual transition probability to employment, we estimate a conventional proportional hazard model of the type:⁶

$$h_i(\tau) = h_0(\tau) \cdot \exp\left\{\delta Hartz + X'\beta\right\} \quad (1)$$

The individual hazard rate h_i at duration τ denotes the probability of job-seeker i to find a job in the period $[\tau, \tau + dt]$ given that she is already unemployed for τ periods. The proportional hazard model divides the hazard rate into a baseline hazard $h_0(\tau)$, which determines the evolution of the hazard rate over unemployment duration, and a shift term depending on observed characteristics. One of these characteristics will be a dummy variable ($Hartz$) which equals one for all observations since 2005 and zero otherwise. Our coefficient of main interest is thus δ . A positive value of δ (or a hazard ratio larger than 1) implies an increase of the hazard rate and hence a reduction of unemployment duration after the Hartz IV reform.

In order to identify the causal effect of the Hartz IV reform on the hazard rate, one would like to employ some form of comparison between a treatment and a control group. Unfortunately, we are not able to construct a proper control group as all unemployed are potentially affected by the Hartz IV reform.⁷ Even unemployed for whom the income difference between the former unemployment assistance and the new UB II appears negligible are potentially affected as they might fail the tightened means-test for UB II. This means-test is related to household income and wealth as well as local prices. None of these variables is observable in our data. Identification of the

⁶For details on the specification of proportional hazard models see e. g. van den Berg (2001). The traditional model may be extended to a mixed proportional hazard model by including an individual-specific shift term that accounts for unobserved heterogeneity across job-seekers. Unfortunately, we cannot apply mixed proportional hazard models here as our data suffers from observation gaps, see section 4. However, we cluster standard errors at the individual level.

⁷Other studies on the effects of the Hartz IV Reform using individual data (Arent and Nagl, 2013; Giannelli *et al.*, 2013) are not able to construct a control group, too.

Hartz IV effect thus relies on the assumption that we control carefully for all potential confounding effects that might bias our results.

Most importantly, we have to disentangle the impact of the Hartz IV reform from general economic conditions (see e. g. Klinger and Rothe, 2012). After the burst of the Dotcom bubble in 2001, Germany experienced a significant economic downturn with a decline of real GDP by 0.4% in 2003. In 2005, coinciding with the implementation of the Hartz IV reform, the economy started to recover. Two years later, in 2007, real GDP grew by as much as 3.3%. Another two years later the economic crisis induced a drop of real GDP by 5.2%. Each of these events affects unemployment and unemployment duration by its own. In order to control for this issue we include the growth rate of quarterly real GDP relative to the previous quarter in our set of control variables X . Additionally, we include monthly vacancy data. We do not use the unemployment rate as a measure for economic activity in order to avoid endogeneity problems. Lower unemployment may increase the individual hazard rate, but higher hazard rates also lead to lower unemployment (given a fixed inflow rate to unemployment). In order to separate the reform effect from long-run developments in the labor market, e. g. the increasing importance of online recruitment processes, we include a linear time trend on a monthly scale.

Furthermore, we control for a set of socio-demographic characteristics. We include the job-seeker's age and age squared as well as dummies for gender, residence in East Germany, foreign citizenship, marital status and the existence of children in the household. Age is centered at the sample mean of 40 years to obtain a reasonable baseline value. In order to account for a job-seeker's productivity and employment prospects, we include the job-seeker's employment history as well as her occupation and earnings of her last job. We construct the employment history by counting the number of days in regular employment in the last three years prior to the current unemployment spell. In order to allow for heterogeneous effects of the employment history, we split the three year period into six intervals, each of 180 days length. Occupations are classified into

83 occupational groups according to the Statistics of the German Federal Employment Agency (2009). Wages are deflated using the German CPI and are thus measured in 2010 Euro. We assume the wage to be a more appropriate measure for a job-seeker's productivity than the formal skill level, as the skill level does not capture experience and informal training. Moreover, in our data the information on skills is missing in almost every second spell in the post-reform period. In order to allow for non-linear effects of wages on the hazard rate, we use the three wage classes motivated in section 3: low wages up to 35 Euro a day, medium wages between 35 and 110 Euro a day and high wages above 110 Euro a day. We also interact these wage classes with the Hartz dummy variable in order to check for heterogeneous reform effects across the wage distribution.

With regard to unemployment itself, we account for the remaining entitlement period while the job-seeker is short-term unemployed, participation in ALMP measures, spare time work, and recalls. It is well-known that participants of ALMP measures suffer from a lock-in effect (see e. g. Lechner *et al.*, 2011) in the short-run, but may experience higher hazard rates in the long-run. We therefore measure ALMP participation by a dummy being one whenever a job-seeker receives ALMP specific benefits. Furthermore, we include a dummy which equals one after a job-seeker has finished her first ALMP measure. The dummy remains one for the rest of the unemployment spell, irrespective whether the job-seeker enters another ALMP measure or not. Spare time work may exhibit a similar lock-in effect like ALMP participation. Recalls are defined as returning to the previous employer. Finally, seasonal variation in the hazard rate is captured by season dummies of three month length, where the winter season corresponds to the months December, January and February.

7. Results

7.1. Average effect on the transition probability

Estimation results obtained with the robust Cox estimator and based on unemployment as a whole are shown in table 3. The first column presents the results from estimating equation (1) for Germany as a whole while the next four columns give the results for estimating the model separately for men and women in West and East Germany, respectively.

Table 3: Unemployment as a whole

	Germany all	West Germany men	West Germany women	East Germany men	East Germany women
Hartz (dummy)	1.2366***	1.1094**	1.2872***	1.2630***	1.7485***
Hartz \times low wage (dummy)	0.9315***	0.9927	0.8788***	0.9271*	0.8133***
Hartz \times high wage (dummy)	0.8528***	0.8824***	0.9299	0.8423**	0.8037
East Germany (dummy)	0.9084***				
women (dummy)	0.9708***				
age (centered at 40 years)	0.9818***	0.9792***	0.9794***	0.9860***	0.9840***
age squared	0.9996***	0.9995***	0.9994***	0.9999	0.9994***
foreign citizen (dummy)	0.7530***	0.7714***	0.7540***	0.6447***	0.6295***
married (dummy)	1.1348***	1.1921***	0.9187***	1.2298***	1.1315***
children (dummy)	0.9289***	0.9174***	0.8775***	0.9844	0.8660***
low wage (dummy)	0.8918***	0.8684***	0.9667	0.8243***	0.9568
high wage (dummy)	0.9882	1.0114	0.9085***	0.9572	0.9572
in ALMP (dummy)	0.3182***	0.3330***	0.3825***	0.2353***	0.3222***
after ALMP (dummy)	1.5898***	1.5653***	1.5870***	1.5784***	1.6221***
long-term unemployed (dummy)	0.8289***	0.8711***	0.8813***	0.7612***	0.7930***
vacancies (in 1000)	1.0015***	1.0023***	1.0016***	1.0005***	1.0000
GDP growth rate	1.0222***	1.0271***	1.0150**	1.0343***	0.1013
linear time trend	1.0020***	1.0029***	1.0006	1.0028***	0.9999
spells	186,633	86,428	39,890	42,674	18,376

Source: SIAB 7510, own calculations for the years 2000–2003 and 2007–2010. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; Standard errors are clustered at the individual level. Regression results are based on the robust Cox estimator and are presented as hazard ratios. Regressions include dummies for 83 occupational groups, three seasonal dummies, a dummy for spare time work, a dummy for the recall to the former employer and six variables for the number of days worked in the six half-years before becoming unemployed.

Consider at first the results for Germany as a whole. Most of the control variables show the expected signs. Hazard rates are lower for job-seekers with residence in East Ger-

many, women, foreign citizens, parents, older job-seekers and long-term unemployed. Higher GDP growth, more vacancies and being married go along with higher hazard rates. Job-seekers with low pre-unemployment earnings experience significantly lower hazard rates compared to job-seekers with medium pre-unemployment earnings. In contrast, we do not observe significant differences between the hazard rates of job-seekers with medium or high wages in their previous job. Participants of ALMP measures experience dramatically lower hazard rates, which represents the well known lock-in effect. However, after completion of the ALMP measure the hazard rates are on average higher. We also observe that hazard rates continuously increase over time. This might result from improved search and matching technologies, e. g. the increased use of online recruitment tools.

In addition to the positive time trend, we observe a large and significant increase of the hazard rates after the Hartz IV reform came into effect. Over the whole sample, the Hartz IV reform apparently has increased the transition probability of job-seekers with medium pre-unemployment earnings on average by about 24%. The rise amounts to about 15% for low wage earners, and to about 5% for high wage earners. Hence, we observe a positive effect of the Hartz IV reform as expected by Hypothesis 1. We also observe the expected inverse U-shaped relationship between the effect and pre-unemployment earnings as stated in our Hypothesis 2.

7.2. Heterogeneous effects across subsamples

The size of the reform effect varies not only across wage groups but also considerably across subsamples. Job-seekers in East Germany gained more from the reform than job-seekers in West Germany and women gained more than men (see columns 2 to 5 in table 3). West German men, the primary group of interest in most studies on the German labor market, were least affected by the reform while East German women benefitted most. Altogether, these results rather contradict our hypotheses 3 and 4.

However, the larger effect for East Germany is qualitatively in line with the results of Fahr and Sunde (2009) who find a larger impact of the first three Hartz reform packages in East Germany as well.

We repeat our analysis separately for the short-term and the long-term unemployed by splitting each unemployment spell at the day when a job-seeker's entitlement to the short-term unemployment benefit UB I expires (provided the job-seeker is still unemployed at that day). For the subsample of short-term unemployed we control additionally for the remaining days of entitlement to the short-term unemployment benefit UB I in order to account for changes in potential entitlement durations before and after the Hartz IV reform. The remaining entitlement period has a positive and significant effect on the hazard rate of men only; for women the effect is insignificant. The other control variables exhibit the same effects we have found for the whole sample including long-term unemployment. Compared to unemployment as a whole, the impact of the Hartz IV reform on the transition out of short-term unemployment is larger for men and lower for women, but it remains positive and significant for all region-gender specific subsamples (see table 4).

Our results change somewhat when we consider long-term unemployment alone. In contrast to unemployment as a whole, long-term unemployed parents face a higher hazard rate than job-seekers without children. Moreover, prior to the Hartz IV reform the hazard rate out of long-term unemployment was independent of pre-unemployment earnings. This is well conceivable as the replacement ratio of long-term unemployment benefits to pre-unemployment earnings was fixed at 53% or 57%, depending on the presence of children in the household. After the Hartz IV reform the level of the unemployment compensation is fixed and thus the replacement ratio is lower for workers who have earned more previously. Accordingly, for the long-term unemployed we do not observe an inverse U-shaped relationship between the effect of the Hartz IV reform on the hazard rate and a job-seeker's pre-unemployment earnings. Instead the effect rather steadily increases over the wage distribution. Moreover, the impact is insignificant or

Table 4: Short-term unemployment

	Germany all	West Germany		East Germany	
		men	women	men	women
Hartz (dummy)	1.2613***	1.1729***	1.2380***	1.3273***	1.6615***
Hartz \times low wage (dummy)	0.9656*	0.9944	0.9101**	0.9455	0.8686***
Hartz \times high wage (dummy)	0.8491***	0.9001***	0.9101*	0.8290***	0.7802*
East Germany (dummy)	0.9036***				
women (dummy)	0.9565***				
age (centered at 40 years)	0.9767***	0.9722***	0.9792***	0.9770***	0.9820***
age squared	0.9992***	0.9989***	0.9994***	0.9990***	0.9994***
foreign citizen (dummy)	0.7294***	0.7409***	0.7403***	0.6141***	0.6294***
married (dummy)	1.1061***	1.1798***	0.8821***	1.1928***	1.0941***
children (dummy)	0.9119***	0.9051***	0.8597***	0.9701**	0.8476***
low wage (dummy)	0.8716***	0.8633***	0.9511*	0.8184***	0.9288**
high wage (dummy)	0.9787	0.9830	0.9143**	0.9426	0.9720
in ALMP (dummy)	0.2888***	0.2986***	0.3753***	0.2011***	0.2955***
after ALMP (dummy)	1.4553***	1.4733***	1.4745***	1.3870***	1.3798***
vacancies (in 1000)	1.0016***	1.0024***	1.0018***	1.0004**	1.0001
GDP growth rate	1.0191***	1.0220***	1.0147**	1.0314***	1.0169*
linear time trend	1.0025***	1.0029***	1.0015	1.0035***	1.0014
spells	186,618	86,366	39,825	42,606	18,348

Source: SIAB 7510, own calculations for the years 2000–2003 and 2007–2010. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; Standard errors are clustered at the individual level. Regression results are based on the robust Cox estimator and are presented as hazard ratios. Regressions include dummies for 83 occupational groups, three seasonal dummies, a dummy for spare time work, a dummy for the recall to the former employer, six variables for the number of days worked in the six half-years before becoming unemployed and a variable for the remaining days of entitlement to the short-term unemployment benefit UB I.

even negative for most long-term unemployed. For example, long-term unemployed men in West Germany who had medium pre-unemployment earnings suffered a drop in their hazard rate by about 37%. Only those long-term unemployed in East Germany who have earned higher wages in their previous job experienced a significant increase in their hazard rate (see table 5). We consider this finding as mild support for our hypothesis 5.

One may question whether the Hartz IV reform indeed reduced the transition probability of long-term unemployment into employment. Job-search theory predicts an unambiguously positive effect. Moreover, using aggregate administrative time series Klinger and Rothe (2012) find that in general the long-term unemployed benefitted

Table 5: Long-term unemployment

	Germany all	West Germany		East Germany	
		men	women	men	women
Hartz (dummy)	0.8623	0.6351***	1.4539	0.9170	1.8584*
Hartz \times low wage (dummy)	0.8286***	0.9661	0.7857**	0.8813	0.7086***
Hartz \times high wage (dummy)	1.4408***	1.5793***	1.0308	1.7317**	0.6190
East Germany (dummy)	0.9355***				
women (dummy)	1.0331				
age (centered at 40 years)	0.9871***	0.9822***	0.9907***	0.9870***	0.9962
age squared	0.9996***	0.9997	0.9989***	0.9999	0.9990**
foreign citizen (dummy)	0.8909***	0.9520	0.8296***	0.7358***	0.6932**
married (dummy)	1.2992***	1.3084***	1.2934***	1.3498***	1.1733***
children (dummy)	1.0452**	1.0389	1.0085	1.1179***	0.9926
low wage (dummy)	0.9555	0.8979*	1.0500	0.8439***	1.0300
high wage (dummy)	0.9200	0.9639	0.9301	1.0028	0.9298
in ALMP (dummy)	0.3884***	0.5308***	0.2806***	0.3178***	0.3283***
after ALMP (dummy)	1.6377***	1.5518***	1.7231***	1.6313***	1.7211***
vacancies (in 1000)	1.0018***	1.0025***	1.0013**	1.0012***	1.0006
GDP growth rate	1.0557***	1.0652***	1.0380*	1.0687***	1.0196
linear time trend	1.0048***	1.0090***	0.9965	1.0047*	0.9954
spells	33,935	14,748	6,183	8,310	4,855

Source: SIAB 7510, own calculations for the years 2000–2003 and 2007–2010. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; Standard errors are clustered at the individual level. Regression results are based on the robust Cox estimator and are presented as hazard ratios. Regressions include dummies for 83 occupational groups, three seasonal dummies, a dummy for spare time work, a dummy for the recall to the former employer and six variables for the number of days worked in the six half-years before becoming unemployed.

more from each of the Hartz reforms than the short-term unemployed and that the Hartz IV reform in particular did not worsen their employment prospects. Though the definition of long-term unemployment adopted by Klinger and Rothe (2012) deviates from our one – they rely on unemployment durations of more than 12-months, while we apply a benefit-dependent criterion – the contradicting results may hint to a spurious effect issue. This is similar to the well-known problem of spurious duration dependence.⁸ Assume that high productive workers have a higher transition probability. Further assume that the Hartz IV reform has increased the transition probability for all unemployed, but that the increase is higher for workers with higher productivity. Under these assumptions the difference between the transition probabilities of high and low

⁸See van den Berg (2001) or Machin and Manning (1999) for a discussion on spurious duration dependence.

productive job-seekers has increased due to the reform. Hence, the average transition probability in the pool of unemployed will decrease faster over duration than prior to the reform. At some duration, the average transition probability after the reform might even be lower than the average transition probability prior to the reform – although the transition probability for every job-seeker has actually increased. Hence, we might observe a spurious negative effect of the Hartz IV reform on the transition probability for long-term unemployed, if the reform affected more productive short-term unemployed stronger than low productive short-term unemployed. The flaw of this explanation is that we do not observe significantly larger effects of the Hartz IV reform for job-seekers with higher pre-unemployment earnings during short-term unemployment.

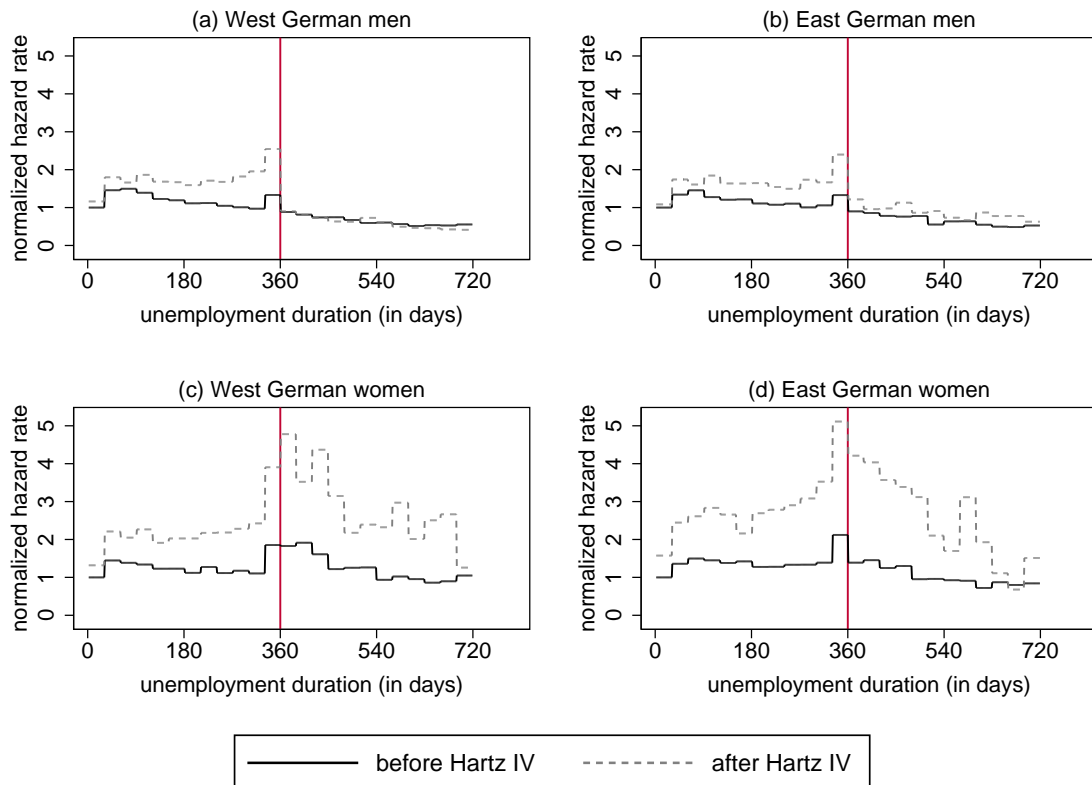
7.3. Duration dependence of the Hartz IV effect

So far, we have discussed the average impact of the Hartz IV reform on the transition probability from unemployment to employment. By doing so, we have implicitly assumed that the effect is independent of unemployment duration, at least within short-term unemployment or long-term unemployment. We now relax this assumption. As in the previous analysis, we estimate equation (1) separately for short-term and long-term unemployed within each of the region-gender specific subsamples. This time we add a piecewise-constant baseline hazard whose intervals are 30 days long. The intervals are calculated relative to the day on which the entitlement to the short-term unemployment benefit UB I has or should have expired. We interact the interval-specific dummy variables with the Hartz dummy variable to assess the duration dependence of the Hartz effect.

After estimating the piecewise-constant model we calculate the baseline hazards before and after Hartz. Our reference person is 40 years old, has earned the sample mean of 70 Euro a day (in 2010 Euro) in her last job as an office clerk and is initially entitled to UB I for 360 days. The person becomes unemployed during spring and the

growth rate of quarterly real GDP is set to 1.5%. All other variables are set to zero. With the season and the GDP growth rate kept constant throughout unemployment, shifts in the baseline hazard reveal the pattern of duration dependence. In order to gain independence of the definition of our reference person, we normalize the baseline hazards such that the hazard rate for the first 30 days in unemployment equals one. Figure 1 shows the baseline hazards of the four subsamples. The vertical line marks the day on which the entitlement to UB I is exhausted.

Figure 1: Baseline hazards



Source: SIAB 7510, own calculations for the years 2000–2003 (before Hartz IV) and 2007–2010 (after Hartz IV). Baseline hazards are obtained from proportional hazard models with piecewise constant baseline hazards and represent the effects for medium wage earners. Regressions include all covariates mentioned in table 3. The vertical line denotes the end of the entitlement to the short-term unemployment benefit UB I.

In each subsample, the pre- and post-reform baseline hazards exhibit different patterns of duration dependence. While both baseline hazards are close to each other

at the begin of unemployment, the post-reform baseline hazard increases relative to the pre-reform baseline hazard as the end of the entitlement period approaches. On the exhaustion date, both baseline hazards exhibit a spike. Once the entitlement to UB I is exhausted, the post-reform baseline hazard shrinks back towards the pre-reform baseline hazard. For men, this results in an immediate drop of the hazard rate, while for women the hazard rate declines more gradually. We also observe the negative impact of the Hartz IV reform for long-term unemployed men in West Germany that was suggested by the robust Cox estimates.

The differences between the pre- and post-reform baseline hazards within each subsample display the effect of the Hartz IV reform. The huge variation of these differences over unemployment duration imply strong duration dependence of the reform's effect. As suggested by the robust Cox estimates we observe an unambiguously positive impact of the Hartz IV reform for the short-term unemployed. The effect increases continuously until the entitlement to UB I expires. The effect is largest immediately before the expiration day. After that day the size of the effect decreases sharply for men and slowly for women. This pattern of duration dependence in the reform's effect supports our hypothesis 6.

8. Conclusion

The implementation of the Hartz IV reform in 2005 reduced the unemployment compensation for long-term unemployed in Germany. We use a unique and large administrative spell data set, the SIAB (1975–2010), to study the impact of this reform on the transition probability from unemployment to employment. We explicitly examine whether the effect varies over the wage distribution, across subsamples defined by region and gender, between short-term and long-term unemployed or over unemployment duration.

According to our results, the reform has increased the daily transition probability of

a median-wage earner by about 24% on average. Over unemployment as a whole, the effect is lower for both, low-wage earners and high-wage earners, lower for men than for women and lower for job-seekers in West Germany than for job-seekers in East Germany. West German men, the primary group of interest in most studies on the German labor market, experienced an increase in their transition probability by 11% after the implementation of the Hartz IV reform. The overall effect is mainly driven by an increase of the transition probability for the short-term unemployed. For most long-term unemployed, the Hartz IV reform had no or even a negative impact. For example, the transition probability of West German men out of long-term unemployment decreased by 37%. This negative impact probably reflects an increased competition about jobs between the short-term and the long-term unemployed which results from the Hartz IV reform itself. A more detailed analysis reveals that the effect of the Hartz IV reform increases over unemployment duration until the entitlement to the short-term unemployment benefit is exhausted. From then on, the effect is declining in size – sharply for men, more gradually for women. Eventually, the effect of the Hartz IV reform becomes insignificant or even negative.

While most of our results turn out as expected, the larger effects of the Hartz IV reform for women and for job-seekers in East Germany come as a surprise. They imply that the reduction of the long-term unemployment benefits affected those groups more, which are less attached to the labor market (women) or face less fortunate economic conditions (East Germany). We leave it to future research to inspect the mechanisms behind these findings in more detail.

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A. Appendix: Data preparation

We base our estimation on the weakly anonymous Sample of Integrated Labour Market Biographies (SIAB), years 1975 – 2010. Data in the SIAB stems from independent notifications by employers and several labor market institutions. Each notification is treated and reported separately. Hence, we often observe an individual more than once for a given point in time. The usual job-seeker, for example, comes along with at least two observations: One for registered unemployment and one for benefit payments. Frequently, we even observe an individual in different labor market states at the same time. Such simultaneous observations may represent actual events, for example unemployment with spare time work, or just data errors, for example arising from delayed notification. For our analysis, we need to construct labor market biographies where each individual is assigned a unique labor market state at each point in time.

To achieve this aim, a thorough data preparation is advisable. Kruppe *et al.* (2007) and Scioch and Oberschachtsiek (2009) demonstrate that each data cleansing procedure in German administrative spell data affect the outcome of later data analyses. A simple procedure, adopted e. g. by Nordmeier (2012), discards all unemployment spells which occur simultaneously to some employment spell. In our point of view, this procedure is rather rough and ignores some legal constellations. We thus conduct an exhaustive algorithm taking into account advices given by Jaenichen *et al.* (2005) and Bernhard *et al.* (2006). We also benefitted from a helpful discussion with experts of the IAB Nuremberg.

We start our data preparation by classifying the observed labor market states into three types of employment (regular employment⁹, marginal employment and other forms of employment) and four states of unemployment (short-term unemployment, long-term unemployment, participation in ALMP measures, and registered unemployment).

⁹We consider as regular employed all employees subject to social security contributions, trainees and old-age part-time workers. Trainees differ from the other regular workers simply by the fact that they are not yet qualified workers. Old-age part-time workers are another form of specific regular employment.

Participation in ALMP measures is identified if the job-seekers receives a specific type of benefit (“income maintenance” up to 2005, “UB I for training measures” since 2005). The SIAB provides two different variables to distinguish ALMP specific benefits from “regular” unemployment benefits, an aggregate one and a more detailed version. As the aggregate variable provided in the SIAB wrongly considers ALMP participants as short-term unemployed after 2005, we use the more detailed variable.

In the next step, we aim to derive the single labor market state of a person at a given point in time. First, we derive the main employment observation. Within each of the three types of employment, we keep the observation with the highest wage (deliberately dropping spells with zero or unknown earnings). We then keep the observed type of employment, that is ranked highest in the following list: regular employment, marginal employment, and other forms of employment. Second, we derive the main unemployment observation in a similar manner: Within each of the four states of unemployment, we keep the observation that started latest. We then keep the observed state of unemployment, that is ranked highest in the following list: short-term unemployment, long-term unemployment, ALMP participation, and registered unemployment (no benefit information). This leaves us with at most two observations per person and period: One employment observation and one unemployment observation. From these two observation, we keep in general the employment observation. We consider firm notifications as slightly more trustworthy because mis-notifications of firms are heavily fined. However, this general rule ignores two important aspects of the German labor market: spare time work and topup benefits (see section 2). We therefore consider a person to be actually unemployed if the employment spell is completely embedded in a period of benefits (spare time work), unless the person is full-time employed and receives UB II (which hints to employment with topup benefits).

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