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Long-term unemployment under two-tier
unemployment compensation schemes

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Abstract

We empirically investigate how two-tier unemployment compensation schemes affect the profile of re-employment hazards. We exploit the aggravation of an existing two-tier scheme in Germany in 2005 and estimate its impact on re-employment rates at different durations. For the short-term unemployed, the hazard rate increases and negative duration dependence declines. For the long-term unemployed, we find none and for certain groups of job seekers even negative impacts on the re-employment hazard. Our results indicate that two-tier unemployment compensation schemes might create a long-term unemployment trap: If employers rank applicants by their duration in unemployment, incentivizing all job seekers to exert higher search efforts may reduce the re-employment probabilities for the long-term unemployed.

JEL Code: J64, J65, J68.

Keywords: Unemployment insurance, two-tier unemployment compensation, unemployment duration, re-employment rate, Hartz reforms.

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1. Introduction

Many countries maintain two-tier unemployment compensation schemes to reduce unemployment. These schemes consist of an unemployment insurance for a limited duration of unemployment and, subsequently, a lower unemployment assistance. Compared to a flat rate compensation, such a declining profile of unemployment benefits incentivizes job seekers to exert a higher level of search effort and it improves welfare (Shavell and Weiss, 1979; Hopenhayn and Nicolini, 1997). Yet, we argue and demonstrate empirically that a two-tier system may lead to a long-term unemployment trap: Those who enter into long-term unemployment might experience lower re-employment probabilities under a two-tier unemployment compensation scheme than under a flat rate system.

To understand why, consider a mass of rational, forward-looking and utility-maximizing job seekers characterized by their unemployment duration, and a mass of vacancies, characterized by the distribution of their wage offers. Job seekers search for jobs and apply to vacancies whose wage offers exceed their reservation wages. Employers tend to call back the applicant with the shortest unemployment duration (Lockwood, 1991; Blanchard and Diamond, 1994; Kroft *et al.*, 2013). This causes negative duration dependence of the re-employment probability even in a flat rate system. In a two-tier system, the pattern of duration dependence changes. Both short-term unemployed and long-term unemployed exert higher search efforts and reduce their reservation wages relative to the respective profiles in a flat rate system. The short-term unemployed react because they anticipate the income loss that is associated with being long-term unemployed; and the long-term unemployed react because they receive a lower compensation (Mortensen, 1977; van den Berg, 1990). As the average number of applications per vacancy increases, the well-known congestion effect arises. Yet, the effect is asymmetric if employers rank applicants by the duration of their unemployment: It is negligible for the very short-term unemployed, but very large for the long-term unemployed. Hence, the degree of negative duration dependence might decline at short durations but increases for longer durations. Eventually,

the re-employment probability of the long-term unemployed might fall below the level that would emerge under a flat rate unemployment compensation scheme.

We provide empirical evidence for such an adverse effect of two-tier compensation schemes by exploiting the aggravation of the German scheme in 2005. At that time, the so-called Hartz IV reform¹ substituted an earnings-dependent long-term unemployment assistance by a compensation that consists of a fixed payment and the coverage of actual household expenditures. For a single person that has earned the median wage, the replacement ratio during long-term unemployment declined from 50% to about 38% of the former net wage, while the short-term unemployment compensation remained unaltered at a replacement ratio of 60%.

We estimate the effect of the Hartz IV reform on unemployment duration using inflow samples into unemployment before and after the reform. We derive these samples from a large and comprehensive German administrative micro data set of employment and unemployment spells, the SIAB 7510. We proceed in two steps. First, we reweigh the pre-reform unemployment inflows using entropy balancing (Hainmueller, 2012; Hainmueller and Xu, 2013), so that the pre-reform and the post-reform inflow subsamples share the same distributions of job-seeker characteristics. Second, we estimate the impact of the Hartz IV reform on an individual's conditional job-finding probability in our matched sample using the Cox proportional hazard model (Cox, 1972) and controlling for job-seeker characteristics, spell characteristics, and macro-economic conditions.

If we restrict the reform effect to be uniform for all durations, we estimate a 15% increase in daily re-employment probabilities due to the Hartz IV reform or, equivalently, a reduction in expected average unemployment duration by one month. When we allow the effect to vary between short-term unemployed and long-term unemployed, we observe that the overall effect solely stems from an increase of the re-employment probabilities of the short-term unemployed by 17%. For the long-term unemployed, the Hartz IV reform

¹This reform was part of a comprehensive reform plan to increase the flexibility of the German labor market. The plan was initially proposed by the Committee for Modern Services in the Labor Market and was named after the chairman of the committee, Peter Hartz.

had no statistically significant impact. When we allow the effect to vary freely over unemployment duration, we obtain the following profile: The marginal Hartz IV effect rises during short-term unemployment from virtually zero at the beginning of unemployment to a peak in the last month before the job seeker enters into long-term unemployment. Afterwards, the effect falls immediately back to approximately zero; for job seekers aged 25 to 29, for women, and for married parents it turns even negative. The young and the women are probably more vulnerable job seekers, and their vulnerability increases due to the reform. Long-term unemployed married parents might exhibit lower re-employment rates after the Hartz IV reform because their household income was least affected or even raised by the new compensation scheme. Yet, in general, the observed profile confirms our hypothesis regarding the adverse effects of two-tier unemployment compensation schemes: Such schemes reduce the inflow into long-term unemployment, while at best they have no impact on the outflow out of long-term unemployment.

Our analysis contributes to three strands of the literature. First, we contribute to the copious literature that examines the generosity of the unemployment compensation and its effect on unemployment duration (see, for instance, Holmlund, 1998; Card *et al.*, 2007; Lalive, 2007; Chetty, 2008; Schmieder *et al.*, 2012). This literature demonstrates that lowering unemployment benefits usually reduces unemployment duration. Our results indicate that both the timing of the benefits that are lowered and an individual's elapsed unemployment duration play an important role for the size and sign of this effect.

Second, we provide valuable input for the literature on optimal unemployment insurance. This research has established that a declining profile of unemployment compensation is welfare increasing relative to a flat rate benefit, even though it might create congestion effects (see, for instance, Shavell and Weiss, 1979; Hopenhayn and Nicolini, 1997; Kolsrud *et al.*, 2015). Yet, our results suggest that the negative externality of higher overall search intensity is increasing in unemployment duration, which might limit the welfare gains from two-tier unemployment compensation schemes.

Finally, we contribute to the vivid debate on the impact of the Hartz IV reform. Estimates from aggregate matching functions point to insignificant effects but might be downward biased (Klinger and Rothe, 2012) while simulation studies identify either large (Krause and Uhlig, 2012; Krebs and Scheffel, 2013) or small (Launov and Wälde, 2013, 2015) impacts. Using micro data, we demonstrate that studies that rely on aggregate data might be flawed by changes in the composition of the unemployed. Additionally, we provide evidence of heterogeneous treatment effects for various socio-demographic groups, which become even more important given the compositional changes of the unemployment inflows.

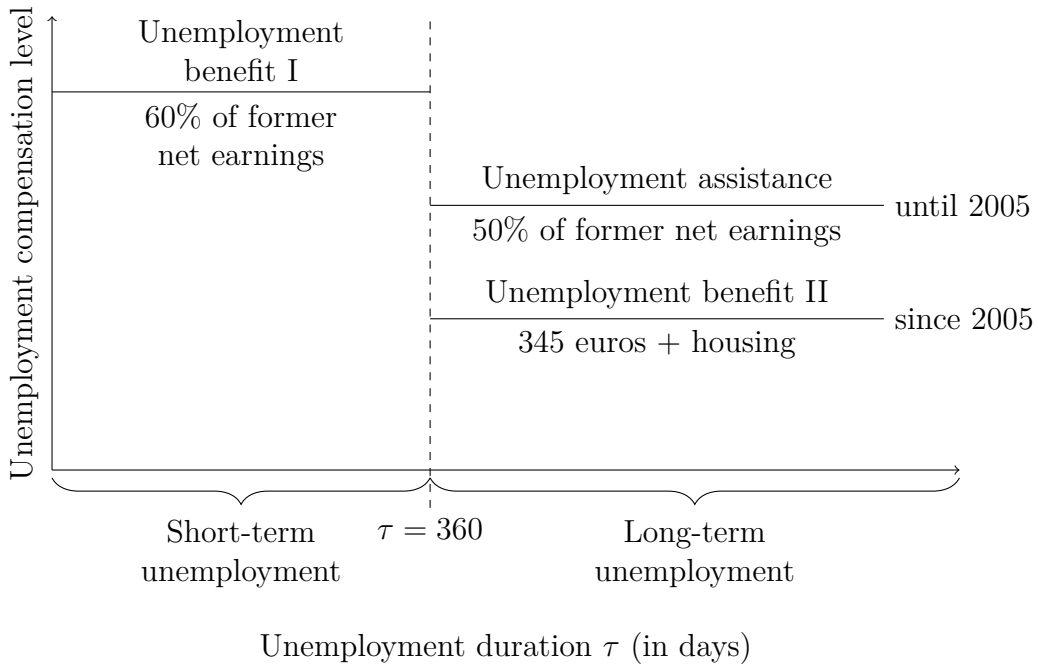
The remainder of this paper is organized as follows. The next section briefly describes the German unemployment scheme, its changes as a result of the Hartz IV reform, and the economic background of the reform. In Section 3, we derive our hypotheses regarding the effects of the reform on the conditional job-finding probability and its profile over unemployment duration. In Section 4, we present our empirical strategy, which consists of matching inflow samples and subsequently estimating duration models. Section 5 describes our data set, the SIAB 7510, and our estimation sample. Section 6 presents our empirical results. In Section 7, we discuss potential biases of these results. Section 8 concludes.

2. Institutional and economic background

2.1. The German unemployment compensation scheme and the Hartz IV reform

As in many other countries, Germany's two-tier unemployment compensation scheme differentiates between an unemployment insurance benefit with limited duration and a subsequent lower unemployment assistance with potentially unlimited duration (see Figure 1). The Hartz IV reform, which became effective as of 1 January, 2005, reduced the unemployment assistance relatively to the unemployment insurance benefit.

Figure 1: German unemployment compensation for single households



Note: Unemployment assistance and unemployment benefit II are subject to a means test. Unemployment benefit II income increases if an adult partner lives in the household. With dependent children living in the household, unemployment benefit I increases to 67%, unemployment assistance increases to 57%, and unemployment benefit II increases by up to 276 euros for each dependent child. Figures for unemployment benefit II denote monthly payments and refer to the year 2005.

The unemployment insurance benefit is called unemployment benefit I (*Arbeitslosengeld*, UB I), and a job seeker entitled to UB I receives 60% of her former net wage for her first year in unemployment.² Subsequently, the job seeker might qualify for unemployment assistance if she meets a means test. Before the Hartz IV reform, unemployment assistance (*Arbeitslosenhilfe*) amounted to 50% of the previous net wage, or 57% if dependent children lived in the job seeker's household. The Hartz IV reform replaced the wage-dependent compensation by a new scheme called unemployment benefit II (*Arbeitslosengeld II*, UB II), and tightened the means test. The new scheme consists of a flat rate for the unemployed job seeker, additional flat rates for partners and children, the true expenditures for accommodation, and extra payments in case of special needs. For a single person who has

²In general, unemployed job seekers are entitled to UB I if they have worked at least 360 days in the last two years preceding their current unemployment spell. The replacement rate increases to 67% of a worker's former net wage if dependent children live in the job seeker's household. The maximum entitlement period is higher for older job seekers with longer employment periods in the past.

earned the median wage, the replacement ratio decreased to about 38% of the former net wage. In fact, about 50% to 80% of the former unemployment assistance recipients are financially worse off; their household income decreased by 20% to 30%, on average (Blos and Rudolph, 2005; Goebel and Richter, 2007; Institut der deutschen Wirtschaft, 2014). Singles and childless couples were most, single parents were least affected.³ This suggests that the impact of the reform on a job seeker's hazard rate might vary between household types. We will assess this issue in our empirical analysis.

The Hartz IV reform was embedded in a larger legislation that aimed to reduce unemployment and the duration of unemployment in Germany. It was passed by the German parliament at the end of 2003 and became effective as of 1 January 2005. In the meantime, weekly rallies proved that the German population was well aware of the extent of the benefit reform. We consider these issues in our empirical strategy, and address sources of potential biases in Section 7.

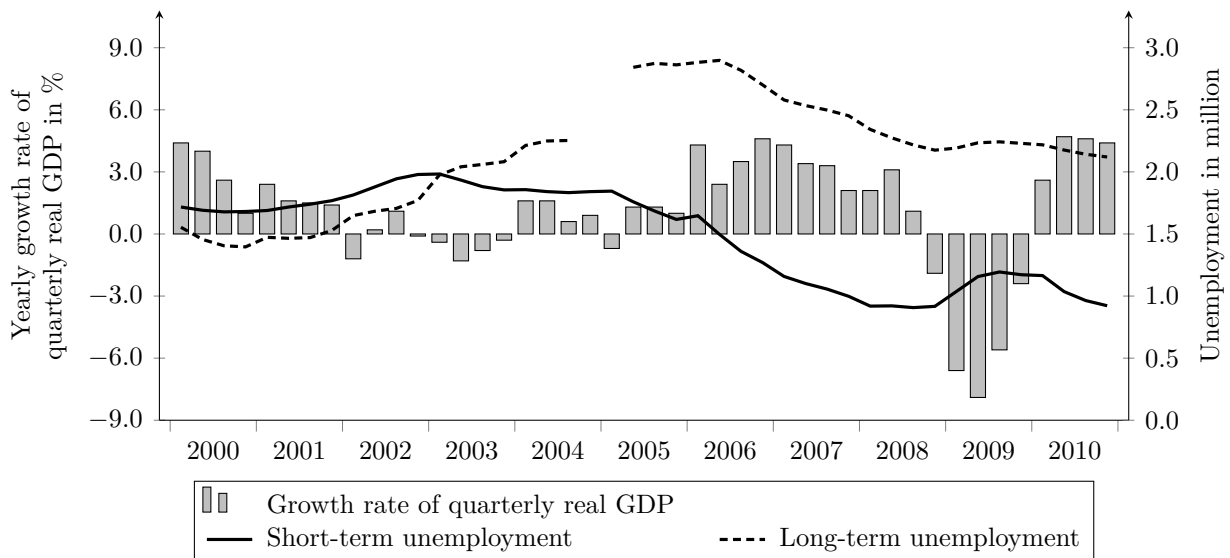
2.2. Economic growth and unemployment before and after the Hartz IV reform

The implementation of the Hartz IV reform coincided with the beginning upturn of the German economy, see Figure 2. The figure plots the yearly growth rate of quarterly real GDP (gray bars) along with the number short-term unemployed (solid line) and long-term unemployed (dashed line) during the 2000s. Before the Hartz IV reform, the German economy struggled with the aftermath of the burst of the dotcom bubble. GDP growth rates declined since 2000 and even turned negative in 2003. Simultaneously, short-term unemployment increased slightly and long-term unemployment rose from 2000 to 2004 by 45% to about 2.3 million. With the implementation of the Hartz IV reform in 2005, the number of registered long-term unemployed increased even further, as a legal redefinition of the unemployment status led to the inclusion of former social assistance

³In fact, every second long-term unemployed single parent is financially better off with UB II than with unemployment assistance (Goebel and Richter, 2007).

recipients into the unemployment counts. Subsequently, the number of registered long-term unemployed peaked at 2.9 million. In the years after the reform, Germany's GDP growth rate surged upwards, while short-term unemployment and later also long-term unemployment decreased. These positive trends were only shortly interrupted in 2009 when the Great Recession hit Germany. In that year, real GDP declined by 5.6% and total unemployment rose by 4.8%. Yet, the effects were only temporary, and there was almost no effect on long-term unemployment. Already at the beginning of 2010, both short-term and long-term unemployment continued to decline, while GDP growth rates turned positive again.

Figure 2: GDP growth, short-term and long-term unemployment, 2000–2010



Note: GDP growth rate relative to quarter of the previous year. Job seekers are short-term unemployed as long as they are entitled to the unemployment benefit UB I; otherwise they are long-term unemployed. Missing data due to a change of official definition of long-term unemployment.

Source: German Federal Statistical Office; Statistics of the German Federal Employment Agency.

The varying macroeconomic conditions might have affected both the composition of the inflow into unemployment as well as the job opportunities of the unemployed. We will assess these issues in detail in Section 6. There, we identify changes in the inflow of unemployed indeed, but, in general, these reflect long-term trends rather than the business cycle. The inflow composition changed continuously on a yearly basis, and the underlying trends remained largely unaffected by the beginning economic upturn in 2006 or the 2009

economic downturn. Yet, due to the generally more favorable economic situation during the post-reform period, our estimates of the Hartz IV effect might be upward biased. This has to be kept in mind when interpreting our results.

3. Theory and hypotheses

To study the potential effects of the German Hartz IV reform, we briefly sketch a job search model that combines the insights of the non-stationary job-search literature initially put forward by Mortensen (1977) and van den Berg (1990) with the idea of employer ranking that was proposed by Lockwood (1991) and Blanchard and Diamond (1994). Consider a mass of rational, forward-looking and utility-maximizing job seekers characterized by their unemployment duration τ , and a mass of vacancies, characterized by the distribution of their wage offers $F(w)$. A job seeker leaves unemployment and starts working during the short time interval $[\tau, \tau + \Delta\tau]$ if she learns of a job offer, applies to it and is called back by the employer. She learns of a vacancy with the exogenous and constant news rate α . For simplicity, we assume that job seekers never know about two or more vacancies at a time.

A job seeker applies to a vacancy if its wage offer exceeds her reservation wage w_R , which happens with probability $1 - F(w_R)$. As usual, job seekers determine the reservation wage w_R such that entering into employment at duration τ and subsequently earning the reservation wage yields the same expected discounted lifetime income flow as staying unemployed and continuing job search. The reservation wage, therefore, depends on the periodic unemployment benefit $b(\tau)$, on the news rate α , on the callback rate $\gamma(\tau)$, and on further parameters z , for instance the discount rate.

For each vacancy that has received at least one application, employers call back only the applicant with the shortest unemployment duration. This preference for job seekers with shorter unemployment duration is supported by empirical evidence (Oberholzer-Gee, 2008; Eriksson and Rooth, 2014; Kroft *et al.*, 2013) and is rationalized by human capital models (Acemoglu, 1995; Ljungqvist and Sargent, 1998) or ranking models (Lockwood,

1991; Blanchard and Diamond, 1994). Therefore, job seekers face a callback rate $\gamma(\tau)$ that is exogenous to them and that declines over the duration of unemployment. As usual, the callback rate declines if job seekers jointly exert higher search efforts because of the well-known congestion effect. However, in contrast to models that ignore employer ranking, the congestion effect operates asymmetrically over unemployment duration. The callback rate of applicants with short unemployment durations is not affected by the increased search effort of job seekers with longer durations, while the latter are severely affected by higher search efforts of the former.

The probability of transitioning from unemployment to employment during the short time interval $[\tau, \tau + \Delta\tau]$, the hazard rate, is given by the product of the news rate, the acceptable share of vacancies, and the callback rate:

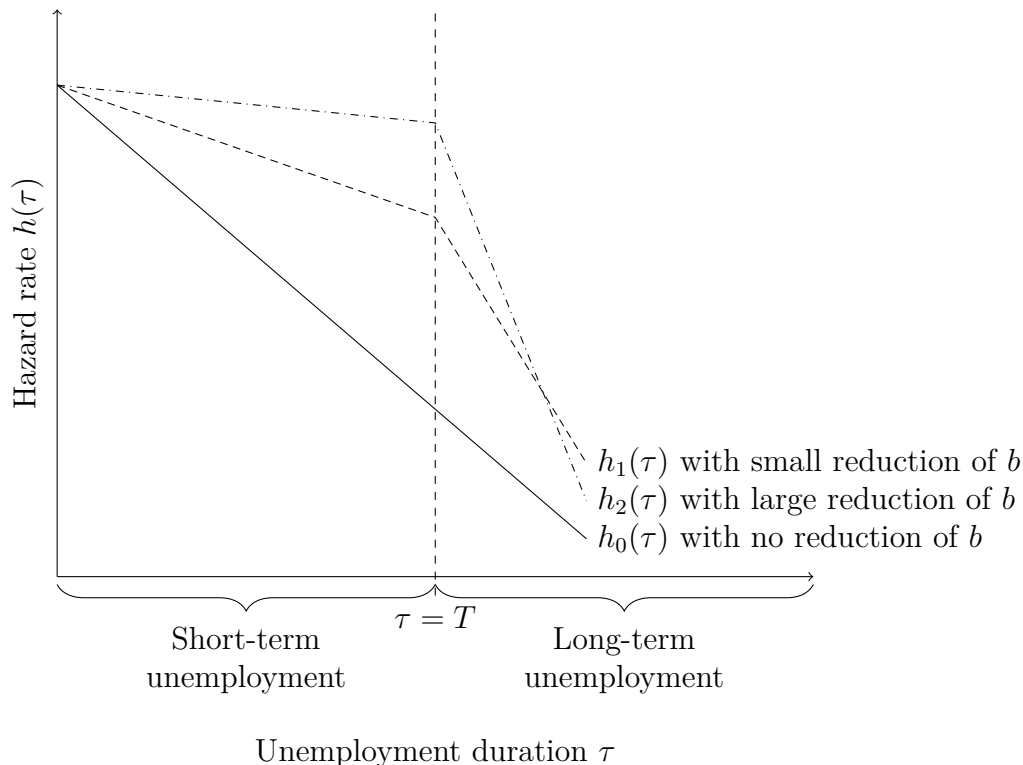
$$h(\tau) = \alpha \cdot [1 - F(w_R(b(\tau), \alpha, \gamma(\tau), z))] \cdot \gamma(\tau). \quad (1)$$

Because the callback rate $\gamma(\tau)$ is negatively duration-dependent, that is $\gamma'(\tau) < 0$, the job seekers continuously decrease their reservation wages w_R over unemployment in order to increase the share $1 - F(w_R)$ of vacancies they will apply to. The net effect on the hazard rate $h(\tau)$ is ambiguous, but in the light of recent empirical evidence (see, for instance, van den Berg and van Ours, 1994; Roed and Zhang, 2003, 2005; Schmiuder *et al.*, 2012; Kroft *et al.*, 2013) let us assume that the hazard function itself exhibits negative duration dependence, $h'(\tau) < 0$.⁴ Such a stylized hazard function is depicted by the solid line $h_0(\tau)$ in Figure 3 for the case that the unemployment benefit $b(\tau)$ is a flat rate, $b'(\tau) = 0$.

Many countries, however, stipulate a reduction of the unemployment benefit at a specific duration $\tau = T$ in unemployment, so that $b = b_1$ if $\tau < T$, $b = b_2$ if $\tau \geq T$, and $b_1 > b_2$. We call job seekers receiving the high unemployment benefit ‘short-term unemployed’ and the other job seekers ‘long-term unemployed’. Non-stationary search models and models of optimal unemployment insurance suggest that short-term unemployed, because they

⁴Our argument does not hinge on this assumption. For a comprehensive survey and critical assessment of estimates of duration dependence see Machin and Manning (1999).

Figure 3: Stylized hazard functions with no, small, and large reduction of unemployment benefits b at $\tau = T$



are forward looking, decrease their reservation wages even faster over the duration of their unemployment than in the benchmark case with a flat-rate unemployment benefit. Hence, when learning about a vacancy, they are more likely to apply. Compared to the benchmark case, this increases the average number of applications per vacancy and it reduces the callback rates for job seekers with longer unemployment durations even further. A two-tier regime with short-term and lower long-term unemployment benefits, therefore, probably slows down the decline of the hazard function during the interval $[0, T)$ but it may accelerate the decline of the hazard function for durations in the interval $[T, \infty)$. The resulting hazard function is sketched by the dashed line $h_2(\tau)$ in Figure 3.

If the long-term unemployment benefit is reduced relatively to the short-term unemployment benefit, as it was the case with the German Hartz IV reform, the opposing deceleration and acceleration effects on the decline of the hazard function over the unemployment spell are intensified. The accelerated decline of the hazard function during long-term unemployment

may eventually result in lower hazard rates than in a regime with a smaller difference between the short-term and the long-term unemployment benefit. Figure 3 depicts the hazard function of such an aggravated two-tier regime as the dash-dotted line $h_1(\tau)$. In Germany, the accelerated decline of the hazard function during long-term unemployment is probably particularly severe since 2005, as the Hartz IV reform has unintentionally contributed to a stigmatization of the long-term unemployed (Booth and Scherschel, 2010).

In our empirical analysis, we estimate the effect on the hazard function that results from aggravating the two-tier regime, that is, we estimate the difference between the hazard function $h_1(\tau)$ and the hazard function $h_2(\tau)$. Figure 3 indicates that the effect of the Hartz IV reform is initially small (small difference between $h_1(\tau)$ and $h_2(\tau)$) and that it increases as unemployment prolongs (the difference between $h_1(\tau)$ and $h_2(\tau)$ widens). The effect likely reaches its maximum when the entitlement to the short-term unemployment benefit expires. From then on, we expect the Hartz IV reform effect to decline, and potentially to become negative ($h_1(\tau)$ declines below the level of $h_2(\tau)$).

Therefore, in our empirical analysis we investigate three hypotheses regarding the effect of the Hartz IV reform on the hazard rate:

Hypothesis 1: The Hartz IV reform has increased the average probability of transitioning from unemployment to employment (incentive effect).

Hypothesis 2: The effect of the Hartz IV reform increases from the beginning of unemployment until the day the short-term unemployment benefit entitlement expires (threat effect).

Hypothesis 3: The Hartz IV reform has decreased the transition probability of the long-term unemployed (ranking effect).

Note that the same line of reasoning applies when a two-tier unemployment compensation system is implemented in the first place (change from $h_0(\tau)$ to $h_1(\tau)$). Therefore, examining the aggravation of a two-tier system yields useful insights into the overall effects of a two-tier system compared to a flat rate unemployment compensation.

4. Empirical strategy

4.1. Double robust estimation

We are interested in the causal effect of a reduction in long-term unemployment benefits on the individual conditional re-employment hazard. In terms of the potential outcome approach (Newman, 1923 [1990]; Roy, 1951; Rubin, 1978) and in the usual hazard ratio notation, this effect is given by the ratio between the potential hazard rate if a job seeker is subject to the regime after the Hartz IV reform and the potential hazard rate if she is not. We approximate the counterfactual hazard rates for job seekers from the post-reform period (treatment group) by the observed hazard rates of job seekers from the pre-reform period (control group). We thus implement a variant of the double robust estimator.

To account for differences in observable characteristics between the two subsamples, we apply entropy balancing (Hainmueller, 2012; Hainmueller and Xu, 2013). This method non-parametrically assigns each control observation a non-negative weight so that the reweighted control group and the treatment group match exactly in terms of pre-specified sample moments of their covariate distributions. For the reweighing, all covariates are measured at entry into unemployment. The weights are derived via minimizing the distance between the vector of actual weights and a vector of base weights, subject to the balance constraints, a normalization constraint, and the constraint that weights must not be negative. The base weights are those weights that would be assigned if the covariate distributions were already balanced before the reweighing takes place. Our final results do not change when we use inverse probability weighting instead of entropy balancing.

Using our reweighted sample, we estimate the impact of the Hartz IV reform on unemployment duration in a Cox (1972) proportional hazard model. The proportional hazard model separates the hazard rate $h_i(\tau)$ of individual i into a baseline hazard $h_0(\tau)$, which determines the evolution of the hazard rate over the duration τ of unemployment, and a shift term depending on observed characteristics. The most important characteristic will be the Hartz dummy variable which equals one for all job seekers unemployed since

2005 and zero otherwise. We additionally control for individual characteristics $X_{it}(\tau)$, that may vary over calendar time t and over the duration τ of unemployment, and for macro-economic indicators Z_t . We thus estimate the following model:⁵

$$h_i(\tau) = h_0(\tau) \cdot \exp\left\{\delta Hartz_i + \beta_X X_{it}(\tau) + \beta_Z Z_t\right\}. \quad (2)$$

Our coefficient of interest is δ . A positive value of δ or a hazard ratio $\exp\{\delta\}$ being larger than 1 implies an increase in the hazard rate and hence a reduction in unemployment duration due to the Hartz IV reform. To investigate variations of this effect over unemployment duration or across job seekers, we interact the Hartz dummy variable with the baseline hazard or with socio-demographic variables. Subsample-specific analyses yield, by and large, similar treatment effects. Yet, only interaction terms allow us to formally test for effect heterogeneities. Standard errors are clustered at the individual level.

This strategy of double robust estimation provides an unbiased estimate of the average treatment effect on the treated under three assumptions. First, the non-parametric balancing in the first step comprises all individual determinants of the hazard rate that might differ between the pre-reform and the post-reform inflow samples. Under this assumption, the estimate of the average treatment effect is unbiased (subject to the other two assumptions) even if equation (2) is misspecified. Second, unobserved dynamic selection does not play a role. Third, neither the variation in macro-economic conditions over time nor the other aspects of the Hartz legislation have an impact on our results. We discuss the variables involved in our balancing and estimation steps in the following subsection. The latter two assumptions are assessed in more detail in Section 7.

4.2. Variables

At the individual level, we match on and control for socio-demographic characteristics that are known to affect a job seeker's re-employment probability: her age (we include 5-year

⁵We cannot apply mixed proportional hazard models as our data suffers from observation gaps, see Section 5.

age groups), gender, German nationality, region of residence (East or West Germany)⁶, occupation (production, construction, engineering, simple services, qualified services, and other) and productivity. As productivity indicators, we consider a job seeker's former earnings and employment history. The pre-unemployment earnings are measured in 2010 euros and are classified according to the quintiles of the cross-sectional wage distribution.⁷ The employment history reflects the number of days in regular employment during each half-year of the last three years prior to the current unemployment spell.⁸ We additionally match on and control for the job seeker's household type (single, single parent, married, married parents) to assess whether the household-type specific financial impacts of the Hartz IV reform resulted in different economic effects.

We additionally account for variables that describe the job seeker's status during the current unemployment spell and that likely affect her re-employment rate. In the balancing step, we consider the initial entitlement period for the short-term unemployment benefit UB I as it likely determines a job seeker's search effort. In the regression step, we include dummy variables for receiving long-term unemployment benefits, for participation in active labor market policy (ALMP) measures, for continued unemployment after a measure has been completed, and for spare-time work during unemployment. Spare-time workers are officially unemployed as they work less than 15 hours a week. Their effort may provide positive signals to potential employers, but it also limits the time spent on job search.

Finally, we control for macro-economic conditions as they affect job creation or the efficiency of the matching process. The number of open vacancies is accounted for by the number of registered vacancies, and, because not all vacancies are registered, by the year-to-year growth rate of quarterly real GDP, and by season dummies.⁹ Long-term trends in matching efficiency, for instance, the increased use of online recruitment tools,

⁶In general, employment prospects are less favorable in East Germany.

⁷In slight abuse of terminology, we refer to the wage groups as wage quintiles 1 (lowest) to 5 (highest).

⁸We do not match on or control for the formal skill level because such a variable does not account for experience or on-the-job training. Moreover, in our data, information on skills is missing in almost every second unemployment spell of the post-reform period.

⁹The winter season corresponds to the months December, January, and February.

are captured by a monthly time trend. All metric indicators are included as linear and quadratic terms to allow for non-proportional effects on the hazard rate.

5. Data and definition of the sample

We base our estimation on the weakly anonymous Sample of Integrated Labour Market Biographies, years 1975 – 2010 (SIAB 7510; see vom Berge *et al.*, 2013).¹⁰ The SIAB 7510 contains daily administrative spell data of a representative 2% random sample of all individuals in Germany who were either employed, unemployed, or participants in ALMP measures between 1975 and 2010.¹¹ It is the largest and most reliable data set on unemployment and employment in Germany. The data stem from mandatory notifications of employers and from register data of the Federal Employment Agency. Employer notifications, for instance, on wages or employment periods, are extraordinarily reliable, as mis-notifications are heavily fined. We observe, among others, an individual’s year of birth, gender, nationality, daily income, occupation, benefit type, and her remaining period of entitlement to the short-term unemployment benefit UB I

Our sample consists of two subsamples of inflows into unemployment out of former full-time employment.¹² The first subsample, the pre-Hartz subsample or control group, comprises unemployment inflows in the period from 1 January, 2000 to 1 July, 2003. These unemployment spells are followed up until 30 November, 2003. The second subsample, the post-Hartz subsample or treatment group, comprises unemployment inflows between 1 January, 2007 and 1 July, 2010. These unemployment spells are followed up until 30 November, 2010. The year 2004 is omitted to avoid anticipation effects. The years 2005 and 2006 are excluded because in these years, the official authorities misreported persons receiving the new long-term unemployment benefit UB II (vom Berge *et al.*, 2013). Note

¹⁰Data 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 (research project fdz480).

¹¹Labor market states are not unambiguous in the SIAB. We use an algorithm that is explained in Appendix A to resolve these ambiguities.

¹²The restriction to former full-time employees is necessary because we do not observe hourly wages.

that by our sample construction, we exclude all former social assistance recipients who entered registered unemployment on 1 January, 2005. We thus avoid the structural break that is observed in aggregate time series.

During the gap in our sample period, one additional labor market reform was implemented: The maximum entitlement period for the short-term unemployment benefit was reduced for job seekers who have been unemployed since 2006 and are 45 years or older. This reform had two effects. First, in 2005, there was a rush into unemployment by workers who sought to benefit from the longer entitlement period (see Dlugosz *et al.*, 2014). Second, affected job seekers who became unemployed after the reform likely reacted to it in the same way as they did to the Hartz IV reform. Job seekers are affected if they are at least 44 years old upon entering short-term unemployment. Including these job seekers would likely bias our estimation results upward. We therefore right-censor unemployment spells when a job seeker turns 44 years old.

We further constrain our sample so that finally it consists only of job seekers who are in the age range of 25 to 44, who are not disabled, who have worked full-time before the current unemployment spell, who are looking for another full-time job and who are initially entitled to the short-term unemployment benefit UB I. Our final sample consists of 118,608 unemployment spells in total. Almost 70,000 spells are observed in the pre-Hartz period and more than 48,000 spells are observed in the post-Hartz period. Given that both periods are of equal length, the lower number of unemployment spells in the post-reform period implies that the incidence of unemployment decreased over time.

6. Empirical results

6.1. Descriptive statistics

We first assess the compositional differences between the two inflow samples from before and after the Hartz IV reform. Table 1 summarizes the variables' means for the post-reform

Table 1: Job-seeker characteristics when entering into unemployment

	Post-Hartz subsample	Unweighted pre-Hartz subsample	Weighted pre-Hartz subsample
<i>Socio-demographics</i>			
Female	28.6%	27.9%***	28.6%
Foreign citizen	12.2%	10.2%***	12.2%
East German resident	26.5%	35.7%***	26.5%
<i>Age</i>			
25–29 years	30.3%	23.3%***	30.3%
30–34 years	23.1%	25.6%***	23.1%
35–39 years	21.3%	27.2%***	21.3%
40–44 years	25.2%	23.9%***	25.2%
<i>Household type</i>			
Single	50.7%	39.1%***	50.7%
Single parent	14.5%	13.8%***	14.5%
Married	9.2%	9.8%***	9.2%
Married parents	25.5%	37.2%***	25.6%
<i>Wage quintile</i>			
1	24.8%	16.7%***	24.8%
2	20.7%	19.5%***	20.7%
3	19.4%	20.4%***	19.4%
4	17.8%	21.5%***	17.8%
5	17.4%	21.8%***	17.4%
<i>Occupation</i>			
Production	35.2%	33.5%***	35.2%
Construction	7.7%	14.2%***	7.7%
Engineering	3.5%	3.9%***	3.5%
Simple services	23.1%	20.7%***	23.1%
Qualified services	26.0%	22.1%***	26.0%
Other	4.6%	5.5%***	4.6%
Initial entitlement period (in days)	295.6	293.9 ***	295.6
Spells	48689	69919	48689 ^{a)}

Notes: Statistical significance of differences in group means: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Wages are deflated using the German CPI and are measured in 2010 Euro. a) Sum of weights.

Data source: SIAB 7510. Pre-Hartz subsample: Unemployment inflows in 2000–2003. Post-Hartz subsample: Unemployment inflows in 2007–2010. In the last column, the pre-Hartz subsample is reweighted using entropy balancing to match socio-demographic characteristics, occupations, and employment history of the post-Hartz subsample at time of entry into unemployment.

(first column) and the pre-reform (second column) subsamples (more detailed results by year of inflow into unemployment are available upon request). There are statistically significant differences with respect to virtually any individual characteristic that potentially affects the individual re-employment probability. These differences are removed by our entropy-balancing procedure (see the third column).

Women (28%) and foreign citizens (10%–12%) accounted for relatively stable shares among the inflow into unemployment over time. The comparably low share of women very likely results from our restriction to former full-time employees. In Germany, women are more often employed part-time than men. The share of East Germans among all job seekers declined from 36% in the pre-Hartz subsample to 27% in the post-Hartz subsample. The decline was continuous over the years, reflecting East Germany's decreasing importance for overall unemployment in Germany. Yet, relative to their share of the German population, East Germans were still overrepresented among the unemployed. This reflects the higher incidence of unemployment in East Germany. We also observe an increase of the share of job seekers younger than 30 years from 23% to 30%, an increase of the share of singles from 39% to 50%, and an increase of the share of job seekers who formerly earned wages of the lowest quintile of the wage distribution. Again, these changes evolved gradually over time and were apparently not affected by the Hartz IV reform or the 2009 economic downturn. Simultaneously, there was a long-term shift in job seekers across occupations, with a decline in the share of job seekers having worked in construction occupations and a simultaneous increase in job seekers who had formerly worked in simple or qualified services. Due to the 2009 economic downturn, manufacturers and employees with wages between the third and fourth quintile of the wage distribution accounted for a slightly higher share of all unemployment inflows than in the years 2008 or 2010. Yet, this temporary effect on the sample composition does not affect our estimates. Finally, the initial entitlement period for the short-term unemployment benefit UB I upon entering unemployment amounts to 294 and 296 days, respectively.

Table 2: Job-seeker characteristics when entering into long-term unemployment

	Post-Hartz subsample	Unweighted pre-Hartz subsample	Weighted pre-Hartz subsample
<i>Socio-demographics</i>			
Female	26.7%	31.7%***	26.7%
Foreign citizen	20.6%	15.5%***	20.6%
East German resident	30.1%	43.5%***	30.1%
<i>Age</i>			
25–29 years	26.9%	18.6%***	26.9%
30–34 years	24.7%	24.6%***	24.7%
35–39 years	22.4%	28.5%***	22.4%
40–44 years	26.0%	28.3%***	26.0%
<i>Household type</i>			
Single	51.0%	33.3%***	51.0%
Single parent	15.7%	19.6%***	15.7%
Married	5.8%	6.5%***	5.8%
Married parents	27.5%	40.7%***	27.5%
<i>Wage quintile</i>			
1	42.4%	26.7%***	42.4%
2	23.6%	24.5%***	23.6%
3	17.3%	21.0%***	17.3%
4	10.3%	16.7%***	10.3%
5	6.5%	11.2%***	6.5%
<i>Occupation</i>			
Production	42.0%	35.7%***	42.0%
Construction	5.5%	12.7%***	5.5%
Engineering	2.0%	2.9%***	2.0%
Simple services	29.3%	23.9%***	29.3%
Qualified services	17.1%	18.1%***	17.1%
Other	4.0%	6.7%***	4.0%
Days already unemployed	221.7	247.4 ***	221.7
Spells	5,443	15,125	5,443 ^{a)}

Notes: Statistical significance of differences in group means: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Wages are deflated using the German CPI and are measured in 2010 Euro. a) Sum of weights.

Data source: SIAB 7510. Pre-Hartz subsample: Unemployment inflows in 2000–2003. Post-Hartz subsample: Unemployment inflows in 2007–2010. In the last column, the pre-Hartz subsample is reweighted using entropy balancing to match socio-demographic characteristics, occupations, and employment history of the post-Hartz subsample at time of entry into long-term unemployment.

Table 2 provides analogous results for the inflows into long-term unemployment. In about 20,000 of our 118,000 unemployment spells, the entitlement to the short-term unemployment benefit was exhausted and job seekers entered long-term unemployment. This happened at an average unemployment duration of 247 days in the pre-Hartz period but only 222 days in the post-Hartz period. Foreign citizens, East German residents, workers with lower productivity, and job seekers with fewer days of regular employment in the preceding three years were more likely to enter long-term unemployment than other job seekers from our inflow sample. Yet, the numerical differences in average group characteristics observed at the time of entry into unemployment apply also to the time of entry into long-term unemployment. Again, all differences are balanced out using the entropy-balancing procedure.

Finally, we take a preliminary descriptive look at unemployment outcomes. Table 3 indicates that the Hartz IV reform had a positive effect on the hazard rate and that it has largely operated through the threat-effect for the short-term unemployed. First, the unconditional median unemployment duration declined from 152 days to 122 days. Second, the share of job seekers actually entering into long-term unemployment declined from 24% to 15%. Third, the share of job seekers who found a job within our follow-up periods increased from 71% to 76%. Note also that the share of job seekers who participated in ALMP measures slightly increased from 7% to 8%, while the share of job seekers engaged in spare-time work at least once during their unemployment remained constant at approximately 15%. Remarkably, these differences in outcomes before and after the Hartz IV reform are unaffected by the reweighing of the control observations, which indicates that these differences might result from the reform itself.

Further descriptive support for our hypothesized threat and ranking effects is revealed by the evolution of the unconditional job-finding rates over the duration of unemployment (see Figure 4). The job-finding rate is calculated as the number of transitions from unemployment to employment over the number of unemployed. Before the Hartz IV reform, the unconditional job-finding rate showed a distinct pattern of negative duration

Table 3: Unemployment outcomes

	Post-Hartz subsample	Unweighted pre-Hartz subsample	Weighted pre-Hartz subsample
Median unemployment duration (days)	122	152 ***	155 ***
Entered into long-term unemployment	14.6%	24.3%***	24.0%***
Transition into employment	75.7%	71.6%***	70.3%***
Participated in ALMP	7.5%	6.6%***	6.5%***
Participated in spare-time work	15.2%	15.3%	15.3%
Spells	48,689	69,919	48,689 ^{a)}

Notes: Statistical significance of differences in group means: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

a) Sum of weights.

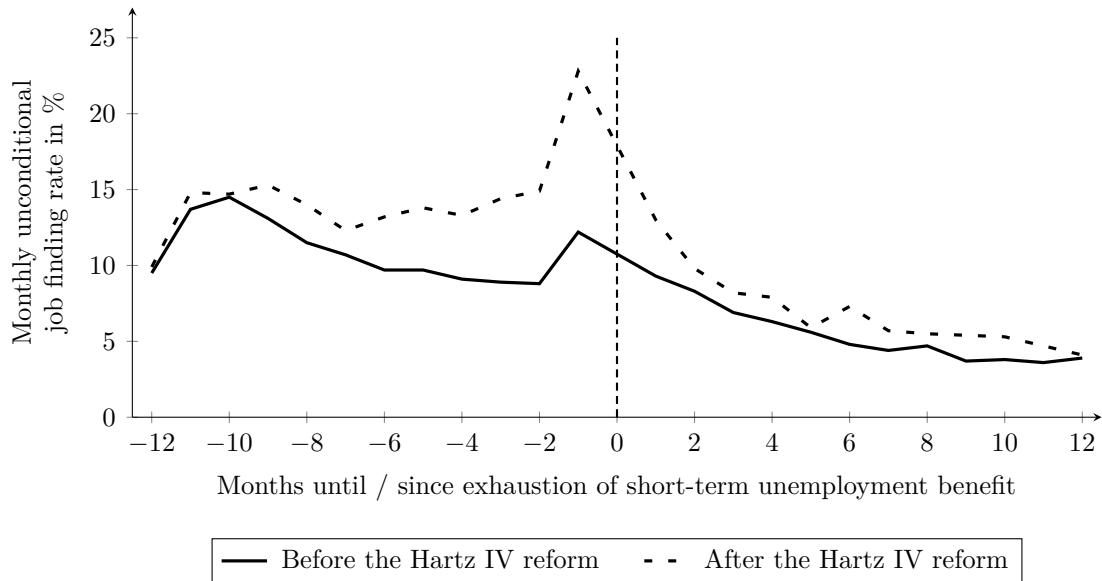
Data source: SIAB 7510. Pre-Hartz subsample: Unemployment inflows in 2000–2003. Post-Hartz subsample: Unemployment inflows in 2007–2010. In the last column, the pre-Hartz subsample is reweighted using entropy balancing to match socio-demographic characteristics, occupations, and employment history of the post-Hartz subsample at time of entry into unemployment.

dependence, with a spike around benefit exhaustion. After the Hartz IV reform, the job-finding rate first rises relative to its pre-reform level until it culminates in a high spike at benefit exhaustion and then it decreases quickly to its pre-reform level. This assessment indicates that the effect of the Hartz IV reform on the job-finding rate was quite large and increasing for the short-term unemployed, but rather small for the long-term unemployed.

6.2. The average treatment effect of the Hartz IV reform on unemployment duration

We now use our reweighted sample and estimate equation (2) using the robust Cox estimator. The estimated marginal effects of the Hartz IV reform on the daily hazard rate are shown in Table 4. The first column gives the average marginal reform effect on the daily hazard rate. It is estimated to be 15%. Thus, as predicted by Hypothesis 1, the Hartz IV reform indeed increased the average probability of transition from unemployment to employment and thereby reduced the average duration of unemployment. The second and the third columns of Table 4 show the average marginal effects of the Hartz IV reform for the short-term unemployed and the long-term unemployed, respectively. The results

Figure 4: Evolution of the monthly unconditional job finding rate over the duration of unemployment



Note: The unconditional job finding rate is calculated as the number of transitions from unemployment to employment over the number of unemployed.

Source: SIAB 7510.

were obtained by interacting the Hartz treatment indicator with the indicator for long-term unemployed job seekers. The average marginal treatment effect of the Hartz IV reform for the short-term unemployed amounts to almost 17%. We consider this as first evidence for large threat effects of the Hartz IV reform. In contrast, as shown in the third column, the Hartz IV reform had no statistically significant effect on the hazard rate of the long-term unemployed. We consider this as indirect support for Hypothesis 3: The reform-induced higher search effort of the short-term unemployed reduces the re-employment probability of the long-term unemployed because of the employers' preference for applicants with shorter unemployment durations. Otherwise we should observe a positive impact of the Hartz IV reform on the hazard rate of the long-term unemployed because these job seekers have presumably reduced their reservation wages in response to the Hartz IV reform.

Table 4: Cox estimates: Marginal effect of the Hartz IV reform on the daily hazard rate

	All unemployed	Short-term unemployed	Long-term unemployed
Hartz IV	1.154***	1.168***	0.955
Full set of controls	Yes	Yes	Yes
Spells	97,378	97,378	97,378

Notes: Statistical significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Marginal effects are presented as hazard ratios. Job seekers are short-term unemployed as long as they are entitled to the unemployment benefit UB I; otherwise they are long-term unemployed.

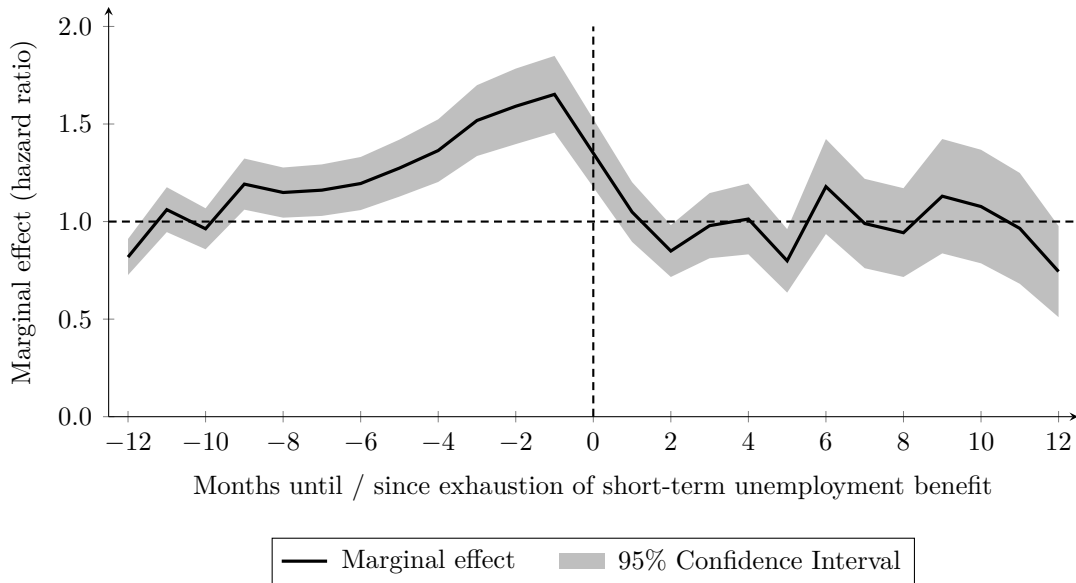
Data source: SIAB 7510. Matched inflow samples from 2000–2003 and 2007–2010.

6.3. Dynamics over the duration of unemployment

We now allow the Hartz IV treatment effect to vary freely over unemployment duration and assess how the profile of the re-employment hazard has changed due to the Hartz IV reform. We re-estimate equation (2) and interact the Hartz IV treatment indicator with a piecewise-constant baseline hazard. The duration intervals are 30 days long and are calculated relatively to the day on which the entitlement to the short-term unemployment benefit UB I expired or was projected to expire.

The resulting profile of the point estimates of the Hartz IV treatment effect along with its 95% confidence interval is shown in Figure 5. The graph starts twelve months before the entitlement to the short-term unemployment benefit UB I expires, as this is the date of entry into unemployment for the ‘typical’ job seeker. Figure 5 reveals that the Hartz IV effect increases continuously as short-term unemployment is prolonged and the risk of long-term unemployment rises. It is slightly negative or statistically indistinguishable from zero (the hazard ratio is not statistically significantly different from one) during the first three months of the ‘typical’ unemployment spell, and highest in the last month before the entitlement expires. This result fully supports Hypothesis 2: The Hartz IV reform has intensified the threat of becoming long-term unemployed, which is why the short-term unemployed accelerated the continuous decrease of their reservation wages, which in turn decelerated the decline of their hazard function. After the entitlement to the

Figure 5: Evolution of the marginal Hartz IV effect over the duration of unemployment



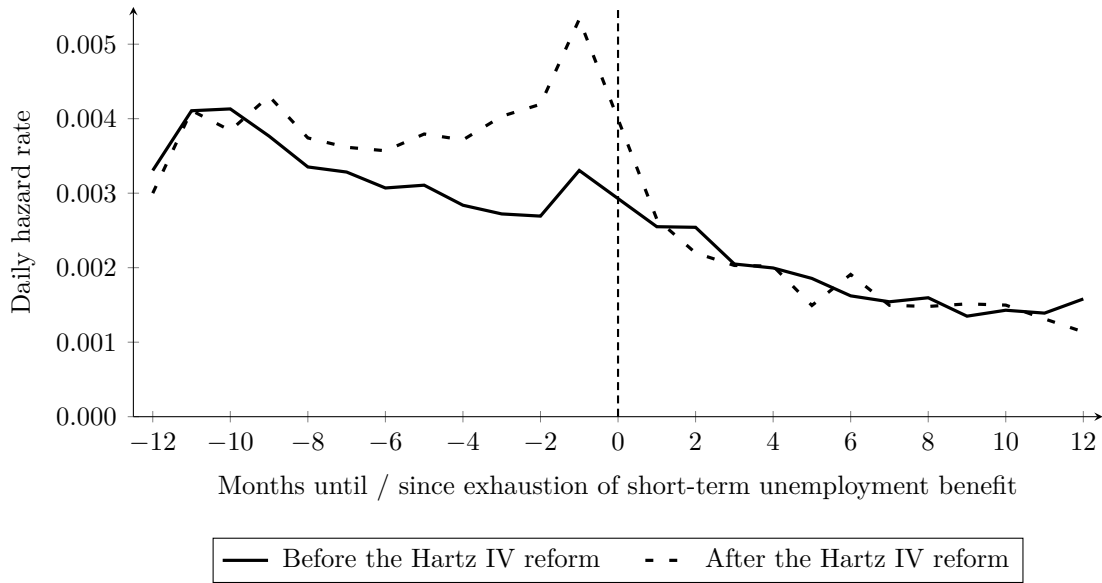
Notes: Marginal effects are presented as hazard ratios and are obtained from interaction models which are estimated with matched samples using the robust Cox estimator. The Hartz IV dummy equals one for job seekers becoming unemployed in 2007–2010 and zero otherwise. The regression includes the full set of control variables, intercepts for each 30-day interval relative to the (projected) date when the entitlement to UB I is exhausted, and interactions of the Hartz dummy variable with each interval dummy.

Data source: SIAB 7510. Sample period: 2000–2003 and 2007–2010. Samples are matched at the time of entry into unemployment or long-term unemployment, respectively, on socio-demographic characteristics, occupational dummies, and employment history using entropy balancing.

short-term unemployment benefit UB I has expired, the marginal effect of the Hartz IV reform immediately drops back to a hazard ratio of about one and becomes statistically insignificant. Again, the negligible impact of the Hartz IV reform on the hazard rate during long-term unemployment points to the negative ranking effect from our Hypothesis 3.

Yet, for the short-term unemployed the impact of the Hartz IV reform was sufficiently strong to alter the entire profile of the hazard function, see Figure 6. We derived hazard functions for a hypothetical job seeker with characteristics of the sample mean (including macro-economic conditions). The solid line represents the hazard function of our hypothetical job seeker becoming unemployed before the Hartz IV reform and the dashed line represents the hazard function of the same job seeker becoming unemployed after the Hartz IV reform. Prior to the Hartz IV reform, the hazard function showed a distinct pattern of negative duration dependence except for the well-known spike around the date of benefit exhaustion.

Figure 6: Hazard functions at the sample mean, before and after the Hartz IV reform



Notes: Predicted hazard rates are obtained from regressions that include the full set of control variables, intercepts for each 30-day interval relative to the (projected) date when the entitlement to UB I is exhausted, and interactions of the Hartz dummy variable with each interval dummy. The Hartz IV dummy equals one for job seekers becoming unemployed in 2007–2010 and zero otherwise.

Data source: SIAB 7510. Sample period: 2000–2003 and 2007–2010. Samples are matched at the time of entry into unemployment or long-term unemployment, respectively, on socio-demographic characteristics, occupational dummies, and employment history using entropy balancing.

After the Hartz IV reform, there is virtually no negative duration dependence left (during short-term unemployment). In contrast, the post-reform hazard function exhibits slight positive duration dependence during the last six months of short-term unemployment.

The effects are also economically relevant. Expected median unemployment duration for our hypothetical job seeker with characteristics of the sample mean was 190 days before the Hartz IV reform, but 164 days after the reform, hence, one month lower. Yet, if the same hypothetical job seeker had entered into long-term unemployment, her expected median duration in long-term unemployment would not have changed significantly due to the Hartz IV reform.

6.4. Heterogeneous treatment effects

We now investigate whether the Hartz IV effect varies across socio-demographic groups. To this end, we interact the Hartz IV treatment indicator with all of the job seekers' socio-demographic characteristics. Wald tests on the joint significance of the interaction terms indicate that the Hartz IV reform effect varies significantly across age groups, the distribution of the job seekers' former wages, and the region of residence. In fact, the marginal effect of the reform on a job seeker's hazard rate increases with the age of the job seeker, decreases with her former wage, and is higher in East Germany than in West Germany (see Table 5). In contrast, the reform impact does not vary statistically significantly between males and females, between Germans and foreign citizens, or between the different household types. The last result is remarkable, as it contradicts our intuition that the different reform impacts on household incomes should have induced household-type specific effects of the Hartz IV reform.

In a second step, we interact all interaction terms once more with the long-term unemployment indicator to investigate how the group-specific marginal effect of the Hartz IV reform varies between short-term unemployment and long-term unemployment. As for the sample as a whole, the Hartz IV reform had a positive impact on the short-term unemployed but no impact on the long-term unemployed of almost each socio-demographic group. Exceptions are long-term unemployed job seekers under the age of 30 and long-term unemployed women, for whom the Hartz IV effect is negative and highly statistically significant. Presumably, both groups of long-term unemployed job seekers were most affected by the intensification of the ranking effects through the Hartz IV reform. A negative effect, although only weakly statistically significant, is also observed for job seekers that are married and have children. These unemployed might have gained financially from the Hartz IV reform (see Goebel and Richter, 2007) which would explain their lower transition probability after the reform.

Table 5: Cox estimates: Marginal effect of the Hartz IV reform on the daily hazard rate by socio-demographic groups

	All unemployed	Short-term unemployed	Long-term unemployed
<i>Age</i>			
25–29 years	1.095*	1.124**	0.841***
30–34 years	1.140**	1.159***	1.029
35–39 years	1.205***	1.231***	1.038
40–44 years	1.234***	1.260***	1.080
<i>Gender</i>			
Male	1.169***	1.186***	1.044
Female	1.146**	1.192***	0.841***
<i>Household type</i>			
Single	1.168***	1.177***	1.073
Single parent	1.165***	1.218***	0.905
Married	1.199***	1.222***	0.905
Married parents	1.138**	1.181***	0.889*
<i>Nationality</i>			
German citizen	1.166***	1.188***	0.839
Foreign citizen	1.135**	1.186***	0.968
<i>Region of residence</i>			
West Germany	1.111**	1.130**	0.957
East Germany	1.317***	1.365***	1.055
<i>Wage quintile</i>			
1	1.191***	1.248***	0.935
2	1.209***	1.243***	0.933
3	1.197***	1.218***	0.953
4	1.178***	1.189***	0.986
5	1.023	1.019	1.151
Spells	97,378	97,378	97,378

Notes: Statistical significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Marginal effects are presented as hazard ratios. Job seekers are short-term unemployed as long as they are entitled to the unemployment benefit UB I; otherwise they are long-term unemployed.

Data source: SIAB 7510. Matched inflow samples from 2000–2003 and 2007–2010.

7. Discussion

So far, our estimation results indicate that the German Hartz IV reform has positively affected the conditional job finding rates of the short-term unemployed, but that it at best has not reduced the re-employment probabilities of the long-term unemployed. Yet, these findings might be biased by the gap in our sample period, by dynamic selection issues, by the change in macroeconomic conditions between the pre- and the post-reform period, or by other elements of the Hartz legislation, namely the reform of public employment services in 2004 and the subsequent decentralization of certain public employment offices in 2005. In this section, we discuss how each of these issues might affect our estimates.

7.1. The gap in the sample period

The gap in our sample period arose because we expected anticipation effects in 2004, and because data on the long-term unemployed is not reliable for the years 2005 and 2006. We now close this gap, but, owing the data quality issue, using the short-term unemployed subsample only. Results are shown in Table 6. First, we extend the post-reform subsample to the years 2005 and 2006. The Hartz IV effect increases in size, from 15% in our preferred specification to now 22%. This indicates that the effect of the Hartz IV reform might be diminishing over calendar time. Next, we additionally extend the pre-reform subsample to the year 2004. The effect of the Hartz IV reform declines to 12%. We consider this evidence for large anticipation effects: In the last specification, our ‘control’ group comprises job seekers who were treated with anticipation, whereas in our preferred sample specification, the control group consists just of untreated job seekers.

7.2. Dynamic selection

Our results might also be affected by dynamic selection issues. Dynamic selection arises if at any given duration in unemployment the Hartz IV reform has changed the composition

Table 6: Cox estimates: Marginal effect of the Hartz IV reform on the daily hazard rate for alternative sample definitions (short-term unemployed only)

Pre-reform sample	2000–2003	2000–2004
Post-reform sample	2005–2010	2005–2010
Hartz IV	1.216***	1.117***
Full set of controls	Yes	Yes
Spells	149,484	168,846

Notes: Statistical significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Regression results are presented as hazard ratios. The Hartz IV dummy equals one for job seekers becoming unemployed in the respective post-reform period and zero otherwise. Job seekers are short-term unemployed as long as they are entitled to the unemployment benefit UB I.

Data source: SIAB 7510. Pre- and post-reform samples are matched at the time of entry into unemployment.

of job seekers in terms of unobserved characteristics (see Bozio *et al.*, 2015, for a discussion). For instance, less motivated job seekers might have settled for the unemployment assistance as a sufficient source of income. If these job seekers leave unemployment earlier due to the Hartz IV reform, the job seekers' average motivation at any given duration is higher after the reform than before. Accordingly, the estimate of the Hartz IV reform effect on the hazard rate will be biased upward, particularly for the long-term unemployed. Conversely, more productive job seekers might respond more sensitively to the Hartz IV reform than low productive ones, because the reform-induced loss in long-term unemployment compensation increases with a job seekers former earnings. As more productive job seekers are usually more motivated and have higher re-employment rates, their stronger reaction induces a downward bias of our estimates for long durations. We cannot overcome this issue methodologically, for instance using the approach proposed by Bozio *et al.* (2015), because of the strong anticipation effects during the year preceding the implementation of the Hartz IV reform. Yet, our estimates in Table 5 indicate that the Hartz IV reform effect decreases with a job seeker's former wage. If former earnings are positively correlated with a job seekers unobserved search effort, our results imply that the Hartz IV reform had a relatively larger effect on less motivated job searchers. This suggests an upward bias of our estimated treatment effects at long durations and we underestimate the true negative ranking effect.

7.3. Macroeconomic conditions

As pointed out in subsection 2.2, Germany's macro-economic conditions were on average better during the post-reform period than before, even despite the Economic Crisis. Our estimates of the Hartz IV effect might, therefore, be upward biased. In particular, Germany's accelerated economic growth might have masked more distinct negative impacts of the reform on the conditional re-employment probabilities of the long-term unemployed. The case for negative ranking effects of the two-tier unemployment compensation might, therefore, be stronger than our point estimates suggest.

7.4. The reform of public employment services in 2004

Further confounding effects potentially arise from the other aspects of the Hartz legislation. One year ahead of the Hartz IV reform, the so-called Hartz III reform restructured Germany's public employment services. The empirical evidence suggests that this reform significantly raised the matching efficiency in the German labor market and that the effect has been larger for the long-term unemployed than for the short-term unemployed (Fahr and Sunde, 2009; Klinger and Rothe, 2012; Launov and Wälde, 2016). We examine the relevance of this issue for our estimates by exploiting an interesting by-product of the Launov and Wälde (2016) study, termed the 'intertemporal unemployment paradox'.

According to Launov and Wälde (2016), forward-looking rational job seekers react twofold to the Hartz III reform. First, as the public employment services become more efficient, job search becomes more productive and job seekers increase their search efforts (productivity effect). Second, the relatively larger increase in the matching efficiency for the long-term unemployed makes long-term unemployment less harmful, which reduces the search incentive for the short-term unemployed (disincentive effect). This second effect becomes stronger over the duration of short-term unemployment. Both effects reinforce the negative duration dependence of the short-term unemployed job seekers' hazard rate.¹³

¹³We thank Andrey Launov for his help in clarifying this issue.

Our estimates in subsection 6.3 are at odds with this pattern. The degree of negative duration dependence during short-term unemployment has decreased and not increased after the Hartz IV reform. We thus conclude that the Hartz III reform does not seriously affect our estimates. If any, the Hartz III reform biases our estimates for the long-term unemployed upwards, and the true negative ranking effect is larger than our results suggest.

7.5. The partial decentralization of public employment services in 2005

Finally, our estimates might be affected by the partial decentralization of public employment offices for the long-term unemployed that took place in 69 out of 432 districts in 2005. Decentralization likely decreased job-finding rates in the respective districts (see Holzner and Munz, 2013; Boockmann *et al.*, 2015), which might bias our estimates of the Hartz IV effect for the long-term unemployed as a whole downward. Yet, Table 7 shows that there is little indication of such a downward bias. In the first column, we re-estimate equation (2) for the subsample of long-term unemployed job seekers and additionally include a dummy variable indicating whether the job seeker is counseled in a decentralized public employment office. For either type of public employment office, the impact of the Hartz IV reform on the hazard rate of the long-term unemployed remains statistically indistinguishable from zero. In the second column, we restrict our sample to long-term unemployed clients of the centralized public employment offices. Again, we estimate a statistically insignificant effect of the Hartz IV reform. These checks suggest that our analysis is not distorted by the partial decentralization of public employment offices.

8. Conclusion

In this paper, we studied the German Hartz IV reform of 2005 to identify how a two-tier unemployment compensation scheme affects the profile of the job seekers' re-employment

Table 7: Cox estimates: Marginal effect of the Hartz IV reform on the daily hazard rate by type of public employment office (PEO)

	All long-term unemployed	Long-term unemployed in centralized PEO
Hartz IV (centralized PEO)	0.974	1.046
Hartz IV (decentralized PEO)	1.045	
Full set of controls	Yes	Yes
Spells	10,883	9,572

Notes: Statistical significance: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Regression results are presented as hazard ratios. Job seekers are long-term unemployed if they are not entitled to the unemployment benefit UB I.

Data source: SIAB 7510. Matched inflow samples from 2000–2003 and 2007–2010.

probability. The Hartz IV reform aggravated the existing two-tier scheme in Germany by reducing the long-term unemployment compensation relative to the short-term unemployment compensation. For a single household who has earned the median wage, the replacement ratio during long-term unemployment declined from 50% to 38%. The theoretical literature on non-stationary job search and the optimal design of unemployment insurance predicts that such a reform increases the re-employment probability of both short-term unemployed and long-term unemployed.

Indeed, we estimate a positive effect of the Hartz IV reform for the short-term unemployed; it amounts to 17% on average. In line with the theoretical predictions, the effect increases as short-term unemployment is prolonged and the risk of long-term unemployment rises. Yet, for the long-term unemployed, the estimated reform effects are statistically indistinguishable from zero. Long-term unemployed job seekers under the age of 30 and long-term unemployed women suffer even from negative treatment effects. In fact, the Hartz IV reform might well have reduced the re-employment rates of all long-term unemployed, as our estimates are likely biased upward because of unobserved effects of dynamic selection or of the improvement in macro-economic conditions over time.

Overall, our estimates point to three conclusions. First, the introduction or aggravation of a two-tier unemployment compensation scheme reduces expected unemployment duration.

In the case of the Hartz IV reform, expected median unemployment duration for the ‘average’ job seeker declined by one month. Second, this effect results from a reduced inflow into long-term unemployment, but not from an increased job finding of the long-term unemployed. Third, two-tier unemployment compensation schemes may lead to a long-term unemployment trap: Those who enter into long-term unemployment might experience lower re-employment probabilities under a two-tier unemployment compensation scheme than under a flat rate system. We suppose that the last result reflects employers’ preference for short-term unemployed applicants, due to which higher search effort of all job seekers leads to congestion effects that are asymmetric with respect to the job seekers’ elapsed unemployment duration. This ranking effect has not been considered in the literature on optimal unemployment insurance so far, but it might limit the welfare gains from two-tier unemployment compensation schemes.

Yet, we did not estimate the welfare gains of the Hartz IV reform as this is beyond the scope of this paper. We could also not assess whether the size of the ranking effect on a long-term unemployed job seeker’s hazard rate varies over macro-economic conditions as opposed to the job-seeker’s characteristics, or whether it varies over calendar time as opposed to unemployment duration. Investigating these issues in more detail is left for future research.

A. Data preparation

We base our estimation on the weakly anonymous Sample of Integrated Labour Market Biographies (Years 1975–2010, SIAB 7510). Data in the SIAB 7510 stem from independent notifications by employers and several labor market institutions. Hence, we often observe an individual more than once for a given point in time. The typical job seeker, for example, comes with at least two observations: one for registered unemployment and one for benefit receipt. Frequently, we even observe an individual in different labor market states at the same time. Such simultaneous observations may reflect legal constellations, for instance,

unemployed job seekers working in their spare time for less than 15 hours a week, or employees receiving unemployment benefit II as a top-up benefit because they cannot support themselves using their household income. Yet, the simultaneity of employment and unemployment spells may also stem from data errors, for example, those 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; Scioch and Oberschachtsiek, 2009). Nordmeier (2012) proposes to discard all unemployment spells that occur simultaneously with some employment spell. Yet, this procedure ignores the set-ups mentioned above. We thus create a more complex algorithm, taking into account the advice given by Jaenichen *et al.* (2005) and Bernhard *et al.* (2006). We also benefited from a helpful discussion with experts of the IAB Nuremberg.

We start our data preparation by classifying the observed labor market states into two types of employment (regular employment and other forms of employment) and four states of unemployment (short-term unemployment, long-term unemployment, participation in active labor market policy (ALMP) measures, and registered unemployment). Participation in ALMP measures can be derived by the variable *lart* which distinguishes ALMP-specific benefits from ‘regular’ unemployment benefits.¹⁴

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 two types of employment, we keep the observation with the highest wage, deliberately dropping spells with zero or unknown earnings. We then drop spells of other forms of employment if a person was simultaneously regularly employed. Second, we derive the main unemployment observation: 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 without benefit information. We thus consider

¹⁴An aggregate version of this variable, the variable *erwstat*, fails to distinguish ALMP-specific benefits from ‘regular’ unemployment benefits since 2005.

job seekers who receive UB I and UB II simultaneously as short-term unemployed. This is reasonable because unemployed job seekers who are eligible for UB I may qualify for an additional payment of UB II if their household income including UB I is below certain thresholds.

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 to be 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 top-up benefits. Unemployed job seekers are allowed to engage in spare-time work up to 15 hours a week in order to increase their household income. They are nevertheless unemployed. Employed workers in turn may receive the new long-term unemployment benefit UB II as a top-up benefit when their household income including labor earnings otherwise falls below certain thresholds. 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 employed full time and receives UB II (which suggests employment with top-up benefits). With this last step we have derived a set of observations of unique and unambiguous labor market states.

We then define any period of consecutive (un)employment observations that together last at least 8 days as an (un)employment spell. In our point of view, shorter unemployment spells do not reflect actual unemployment but rather (voluntary or involuntary) job-to-job transitions. Likewise, job seekers do not actually leave unemployment if their employment spell lasts only one week. We allow unemployment spells to contain periods with missing observations of up to 90 days to account for sanctions, that is, periods where no unemployment benefit was paid because the job seeker did non comply to her duties. For the same reason, we allow for gaps between an employment and a subsequent unemployment spell of up to 90 days. If the gap is longer, the notified entry into unemployment is likely to be delayed. We consider these spells as left-truncated and

drop them from our analysis. 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.

A central variable in our analysis is the remaining duration of the entitlement to the short-term unemployment benefit UB I (*Restanspruch*). We use a corrected version of this variable that was provided after we reported serious data irregularities (see RDC-IAB, 2014, for details). We further adjust this variable so that we observe the correct remaining entitlement period to UB I even during ALMP participation. If a job seeker participates in an ALMP measure, her remaining entitlement period for UB I diminishes by only one half day for every day of program participation; before 2003, the remaining entitlement period did not decrease at all. The remaining entitlement period also does not decrease below a minimum of 30 days during ALMP participation.

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