Fixing the leak: Unemployment incidence before and after a major reform of unemployment benefits in Germany *

Stephan Dlugosz†, Gesine Stephan‡, Ralf A. Wilke§

January 20, 2010

* We thank Bernd Fitzenberger, Elke Jahn, Arne Uhlendorff and Joachim Wolff for helpful discussions and comments, and Holger Bonin, Michael Feil, Barbara Hanel, Barbara Hoffmann, Walter Schaal and Christina Wübbeke for helpful hints. Dlugosz and Wilke are supported by the German Research Foundation through the *Statistical Modelling of Errors in Administrative Labour Market Data* grant. Wilke is also supported by the Economic and Social Research Council through the *Bounds for Competing Risks Duration Models using Administrative Unemployment Duration Data* (RES-061-25-0059) grant. The data used in this paper have been kindly provided by the ITM unit of the Institute for Employment Research.

† ZEW Centre for European Economic Research, L7 1, 68161 Mannheim, Germany, E-mail: dlugosz@zew.de

‡ IAB Institute for Employment Research and University of Erlangen-Nuremberg, Regensburger Str. 104, 90478 Nuremberg, Germany, E-mail: gesine.stephan@iab.de

§ School of Economics at the University of Nottingham, PSI Policy Studies Institute London, and ZEW Centre for European Economic Research Mannheim, Nottingham NG7 2RD, United Kingdom, E-mail: ralf.wilke@nottingham.ac.uk

This paper analyzes the effect of a considerable reduction in unemployment benefit entitlement lengths on unemployment incidence in Germany, using a difference-in-differences approach and extensive administrative individual data. First, we show that this highly disputed element of the Hartz-reforms, coming into effect in 2006, induced a rush of workers and firms to take advantage of the previous legislation in its last days. Second, we find a considerable decline in unemployment incidence among older workers after the reform. Third, we estimate that the policy change could have saved the German unemployment insurance fund about 15% of its annual expenses; it was, however, partly repealed as soon as 2008.

Keywords: unemployment incidence, policy evaluation, administrative data
JEL: J63, J65

1. Introduction

This paper investigates empirically how workers and firms reacted on a major institutional change within a rather strongly regulated European labor market. Economic theory suggests that unemployment benefits reduce work incentives (Moffitt and Nicholson, 1982; Mortensen, 1970); for older workers and their employers expected streams of unemployment benefits are an important determinant of retirement decisions (Hutchens, 1999; Stock and Wise, 1990).

In Germany, the so-called Hartz Reforms, the result of a 2002 commission on restructuring the labor market, attracted fierce opposition during and after their implementation. One of its most ambitious and divisive changes was a reduction in the length of time for which the older unemployed were eligible for contribution-based benefits. The reform was enacted in 2006. It nearly halved unemployment benefit durations for particular groups of older workers and thus strongly modified their out-of-work options.

Our paper analyzes for the first time the extent of the consequences of the scheme. The reform affected only older age groups and is thus a natural quasi-experiment. We identify the reform effects using a difference-in-differences approach, based on large high-quality administrative data. Because the reform shortened entitlement lengths of workers of age

45 and older, we compare unemployment incidence rates of older workers to those of a control group of workers aged 40 to 44. We distinguish between different age groups of older workers, because the treatment intensity (the cut in benefit lengths, respectively) varied between age groups. We also estimate the extent of the fiscal effects for the German unemployment insurance fund.

There is no a priori reason to presume that extensions and reductions of benefit receipt lengths should have symmetric effects on unemployment incidence of older workers. While previous papers have already analyzed the effects of large-scale extensions of entitlement lengths (Fitzenberger and Wilke, 2010; Winter-Ebmer, 2003), to our knowledge this is the first paper that estimates the effects of a large-scale reduction of unemployment benefit entitlement lengths on out of work transitions. The few other papers in this field analyze increases in age thresholds for early retirement (Kyyrä and Wilke, 2007), or rather small modifications in age thresholds for maximum entitlement lengths (Müller et al., 2007).

2. Short Theory and Literature Review

The competitive labor supply model as well as the basic job search model show that reservation wages increase with the generosity of unemployment benefits (Moffitt and Nicholson, 1982, Mortensen, 1970, see also Cahuc and Zylberberg, 2004, Chap. 1 and 3). From a dynamic perspective, expected streams of unemployment benefits might also determine the decision to terminate an employment relationship. In regulated European labor markets, the interplay between the system of unemployment benefits, retirement programs, and employment protection is particularly important.

From the workers' point of view, postponing retirement increases income over the remaining life period, while time to derive utility from being retired decreases. Stock and Wise (1990) developed an option value model of the (irreversible) retirement decision; the retirement decision is reassessed every period when new information on future earnings arrives. Several recent papers presented dynamic programming models of the retirement decision (e.g. Hakola and Määttänen, 2009; Karlstrom et al., 2004). If unemployment benefits can be utilized as a bridge into retirement, the generosity of unemployment benefits is also a determinant of an individual's retirement decision.

From the firm's point of view, it will often be preferable to end the employment relationship before a worker's optimal retirement age has been reached. Boeri and van Ours

(2008, Chap. 6.3.2) discuss the relationship between age and productivity and conclude that the objective relationship is difficult to establish; nonetheless, employers seem to have strong opinions about a decreasing productivity of workers with age. If dismissals are not enforceable due to employment protection (e.g. Jahn, 2009), or unwarranted due to implicit contracts or fairness considerations (e.g. Gerlach et al., 2008), both parties may settle on a mutual agreement accompanied by severance payments. Bentolila and Bertola (1990) developed a model of a firm's optimal employment policy in the presence of hiring and firing costs and showed that a firm reduces its labor force if the expected present values of further employment are lower than firing costs. Hutchens (1999) presented a model where the firm and its workers negotiate a three-period contract over wages, private pensions, and employment probabilities. While the worker is employed during the first and retired during the third period, his employment probability during the second period is a function of his productivity at work and at home. In this context, the availability of second-period social security benefits would raise the income of second-period retirees and thereby reduce a firm's costs to reach a mutual agreement on second period retirement.

There is a broad empirical literature on the effect of changes in the unemployment compensation system on unemployment duration (e.g. for recent studies Addison and Portugal, 2008; Lalive et al., 2006; Lalive, 2007, 2008; Lee and Wilke, 2009). Fewer studies analyze—as we do—the complementary question on the impact of such changes on unemployment incidence. Empirical evidence relies predominantly on difference-in-differences estimators, exploiting reforms in the length of unemployment benefit entitlements that affected different age groups differently.

For Germany, a number of papers have investigated reforms of the 1980s and 1990s and their effects on unemployment incidence. Fitzenberger and Wilke (2010) compared unemployment entries and unemployment duration before and after an unemployment benefit reform that took place in the 1980s and extended benefit durations for the elderly unemployed significantly. Whereas the reform had only a small effect on unemployment between jobs, it increased entries into permanent non-employment for elderly workers. Müller et al. (2007) showed that increasing age thresholds for maximum eligibility during 1997 reduced the unemployment incidence and in particular early retirement. Hanel (2008) approached the problem from the viewpoint of an introduction of permanent benefit reductions for early retirees that was enacted also during 1997. She found that this reduction led to a postponement of retirement entries by about fifteen

months and a delay of employment exits by about nine months. Empirical evidence for other countries obtained similar results. For Austria, Winter-Ebmer (2003) analyzed the quasi-experimental situation arising from a large extension of benefit duration in certain Austrian regions. He showed that unemployment entry rose considerably as a result of the new law. For Finland, Kyyrä and Wilke (2007) found that increasing the age threshold from which unemployment benefits could be utilized as an "unemployment tunnel" into early retirement decreased unemployment entries of the affected age group.

3. The 2006 Reform of Unemployment Benefits

The German unemployment compensation system consists of two main elements. The first pillar is the unemployment insurance system. For a limited time period, entitled contributors receive unemployment benefits (Arbeitslosengeld 1), whose amount depends on former wages and the employment history. In order to qualify for unemployment benefits, workers or employees need to have been in regular employment at least 12 months during the past three years until 2005, and during the past two years since 2006. Wage replacement rate amounts to 60–67% of the previous wage, depending on whether there are dependent children in the household or not. Even though workers and firms fund German unemployment insurance, there is no comparable experience rating system as in the US; thus, lay-offs do not increase social security contribution rates of firms. The second pillar is tax-financed and means-tested unemployment assistance (Arbeitslosengeld 2). Needy unemployed job-seekers and their household members are entitled to this assistance whose amount does (since 2005) not depend on former earnings.

Our paper focuses on the duration of unemployment benefit receipt and its reform in 2006. Until the mid 1980s, the maximum duration was 12 months independent of age, but it was gradually extended to up to 32 months (in 1987) for those aged at least 54. Because the minimum age to receive old age pensions after a period of unemployment was 60 years, workers of age 57 and older could utilize the long entitlement length as a bridge between employment and retirement pensions. Previous research showed that the extension of entitlement lengths during the 1980s has in fact led to a sharp increase in the incidence of unemployment for older workers (Fitzenberger and Wilke, 2010). In 1997, the age threshold for extended entitlement lengths was raised by a few years of age. Furthermore, old age pensions were lowered for individuals retiring prior to an age of 65 (this was implemented over a transition period, differently affecting different birth

Table 1: The 2006 reform of maximum entitlement length for unemployment benefits in Germany.

	maximum entitlement length in months		
age group	until 1/2006	2/2006 to 12/2007	reduction
<45	12	12	0
45–46	18	12	6
47–51	22	12	10
52–54	26	12	14
55–56	26	18	8
>56	32	18	14

cohorts).

This regime was valid until February 2006, when unemployment benefit entitlement lengths were substantially shortened to a maximum duration of 18 months (see also Table 1); maximum entitlement lengths for older individuals diminished by up to 14 months for those aged 52–54 and aged >56. This reform affected all individuals who lost their job after the 31st of January 2006, while the stock of unemployment benefits claimants was unaffected. Because entitlements for individuals younger than 45 were not affected, the policy change in 2006 involved a natural quasi-experiment, with well defined control and treatment groups. The shortening was one of the key elements in the series of the so called "Hartz-Reforms" of the coalition government by Social Democrats and the Green Party (the commission that worked out the restructuring during 2002 was led by Peter Hartz, a Volkswagen manager).

Nonetheless, even under the pre-reform regime, several institutional arrangements should impede the use of unemployment benefits as a "bridge" into early retirement.

- Dismissal protection for older workers with long tenure is rather strong. Jahn (2009) points out that it is nearly impossible for larger firms in Germany to dismiss older workers with long tenure; thus they have to "buy out" older workers by means of severance pay. Such separations are particularly costly and thus, large firms would be particularly likely to restrain from early retirement offers after a reduction in expected streams of unemployment compensation.

- Employees who voluntarily quit their job suffer a cut-off period without unemploy-

ment benefits receipt. The length of the period amounted to 12 weeks during the time period under investigation.

- From the end of 2003 up to the 2006 reform, firms (except for small firms) had to partly or fully refund unemployment benefits transfers for dismissed older workers with longer tenure; the underlying idea was to prevent anticipation effects of the reform. There are, however, important exceptions for firms and workers, which might have offered opportunities to bypass the law.

Based on the design of the 2006 reform and our economic reasoning in Section 2, we thus formulate the following three hypotheses, which we will analyze in our empirical analysis:

- The reduction in unemployment incidence for older workers depends on the strength of the treatment. We therefore expect the largest drop in unemployment entries for the aged 52–54 and aged >56.

- Because firms had to partly or fully refund unemployment benefits transfers for dismissed older workers with longer tenure, we expect that anticipation effects of the reform were prevented.

- The reform effect is larger for older employees with long tenure in large firms. Larger firms cannot easily dismiss older workers with long tenure due to social criteria and have to buy them out. Therefore, they have to offer higher severance payments (cash and other benefits) and use unemployment benefits as a subsidy to reach a mutual agreement.

As it was unpopular with large parts of the voting population, however, the successive government (grand coalition of Christian Democrats and Social Democrats) withdrew the 2006 reform to a large extent, by re-extending the entitlement lengths to up to 24 months. This new regime was enacted as soon as in January 2008 and applied to the entire stock of unemployed at that point of time. Furthermore, only until the beginning of 2008, unemployed persons of at least age 58 had the opportunity to withdraw from job search (and registered unemployment), while still receiving unemployment benefits. Thus in our empirical application we have to test whether these changes at the end of our observation period induced their own anticipation effects.

Finally, it should be noted that a couple of other changes in labor market institutions were enacted in 2006, too. There are, however, good reasons to assume that they do not have an impact on our results. First, as has been mentioned above, the qualification period for unemployment benefits has been reduced for all workers. To avoid additional selection issues, our analysis focuses on workers who would have fulfilled the qualification requirements of the pre-reform period. Second, since 2006, a previously granted tax-free allowance for severance pay (11 000 Euro) has been abolished. Because the allowance has not been that large anyway and financial consequences of changes in taxation might be bypassed by offering non-cash benefits, we presume that this change had no impact on retirement decisions. Third, the earliest entry age into retirement due to unemployment has been raised from 60 to 63 years. But this pension reform was implemented gradually for different birth cohorts and over very long transitions periods; thus its effects should not interfere with the effects of the (discontinuous) unemployment benefits reform analyzed by us. In our empirical analysis we perform a series of robustness checks. We do not find evidence for noticeable indirect effects of these legal changes which hamper identification of the effects of the reform under investigation.

4. Data and Descriptive Statistics

Our empirical analysis uses an excerpt from the Integrated Employment Biographies (IEB, see also Oberschachtsiek et al. (2009)) of the Institute for Employment Research (IAB). This merged administrative data set contains daily spell information about employment periods subject to social security contributions (excludes self employment and life time civil servants), job seeking periods, participation in active labor market programs, and unemployment and unemployment assistance claim periods[1]. Our sample is a 2% random sample of employees born before 1970 who were employed during 2001 to 2007; spells for these individuals are available since 1993. For our empirical analysis, we organize the data in form of a monthly panel of workers. We restrict our sample to individuals aged 40–64, who (would have) had the maximum entitlement lengths under the pre-reform regime. Because special regulations apply to seasonal unemployment in the construction sector, we exclude it from the following analysis. Table A.1 and Table

[1] The data do not distinguish between employee- and employer-initiated separations. Additional own calculations based on the German Socio-Economic Panel suggest that the share of employee-initiated separations amounts to less than 10 percent for persons aged 40 and older.

A.2 in Appendix A present a variables overview and some descriptives.

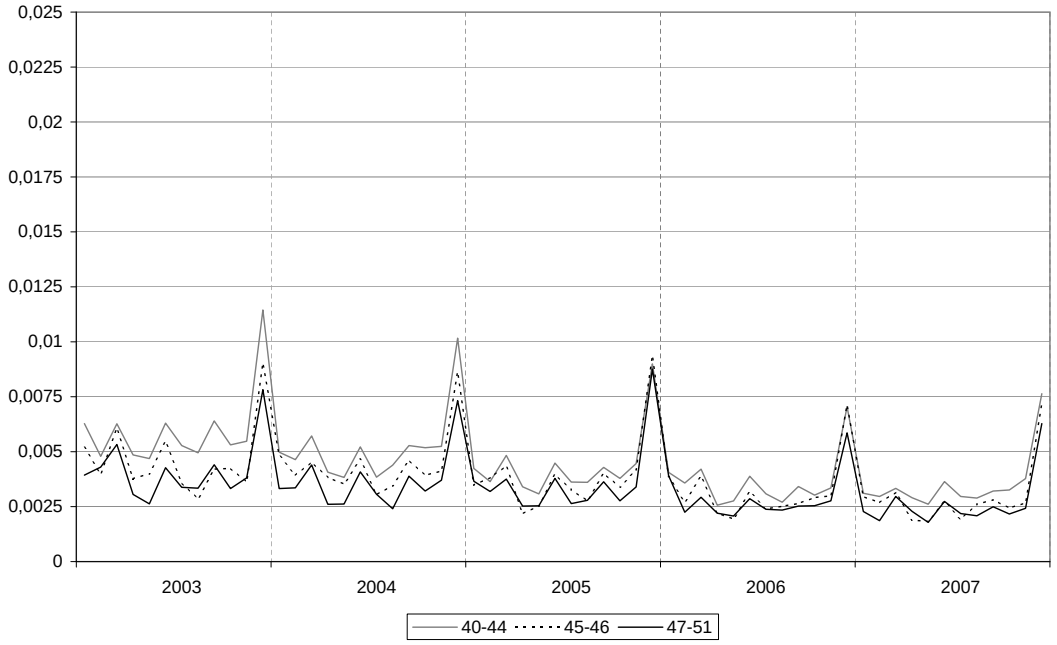
In the following, we define a transition to unemployment as a transition from employment subject to social security contributions to claiming unemployment benefits (Arbeitslosengeld 1)[2].

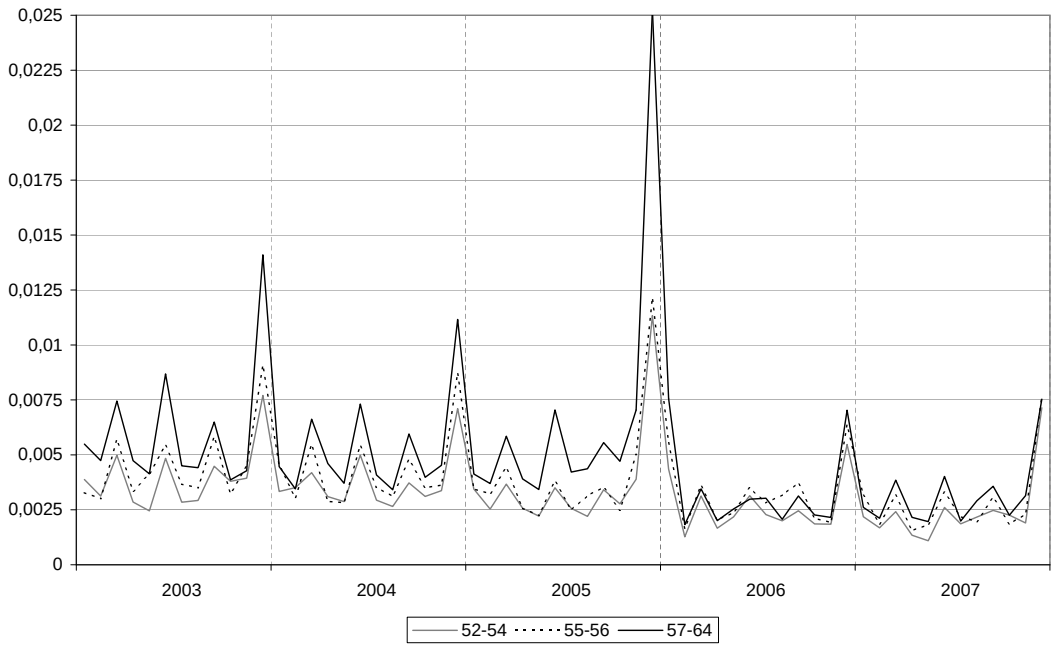
Figure 1 shows monthly transition rates into unemployment during each calendar month for the years 2003 to 2007, separately by age groups. Transitions occur more frequently at the end of the year or quarter, which leads to peaks in the incidence. This pattern is more apparent for the oldest age group 57+. Furthermore, there is a much higher peak at the end of 2005 for the age group 57+ and also—but less prominent—for the other age groups. This indicates the presence of an anticipation effect just before the unemployment benefit reform from November 2005 until January 2006. Moreover unemployment incidence for the oldest age group drops from about 0.005 to slightly above 0.0025 after the reform, while the decline for the other age groups is much smaller.

As described in Section 3, several laws were supposed to prevent early retirement at the expense of the unemployment insurance. First, workers who voluntarily quit their job experience a cut-off period. Second, large firms were obliged to refund unemployment benefits for dismissed older workers with more than 10 years of tenure. Official statistics of the Federal Employment Agency provide some information about the quantitative importance of these regulations: Entries of individuals of age 55 and older who were cut-off from benefits peaked in February 2006 at about 2 300 entries, nearly doubling the average number of cut-off cases. But average monthly entries in unemployment 2005–2006 amounted to about 18 000, thus the share of cut-off individuals seems to be rather low. The stock of unemployment benefit recipients of age 55 and older for whom unemployment benefits had to be refunded by the firm peaked at 5 300 cases during April 2006. Thus, while we cannot say anything about the ex-ante (threat) effects of these regulations, we conclude that they have been applied ex-post only partly and were not able to entirely eliminate anticipation behavior just before the reform.

[2] Due to cut-off periods or temporary drop outs, for example, claim spells do not always begin at the end of the previous employment spell. In these cases, it is not observable from the data whether there is an immediate transition to unemployment or a temporary inactivity period. As the number of these cases is rather small in our sample, our empirical results are robust with respect to the maximum allowed gap. We checked this for gaps of up to six months. Our following empirical results are obtained by allowing for gaps of up to three months between the end date of an employment spell and the start date of a subsequent claim spell.

Figure 1: Monthly unemployment incidence by time, year and age group. Source: IEB, own results.





5. Econometric Strategy

We evaluate a policy change that affected different groups of individuals differently. In order to obtain an estimate of the reform effect on unemployment incidence, we employ a difference-in-differences design with well defined pre- and post-reform periods and treatment and control groups. The idea is to estimate the treatment effect by computing the difference between transitions in unemployment before and after the reform for both the treated and the control group and then comparing the difference between the groups. The identifying assumption is that group-level omitted variables can be captured by group-level fixed effects (e.g. Angrist and Pischke, 2009, Chap. 5.2), in other words that trends in unemployment incidence would have been the same for different age groups in the absence of treatment. While this assumption cannot be tested, we can compare if the assumption seems to be justified at least during the pre-reform as well as during the post-reform period.

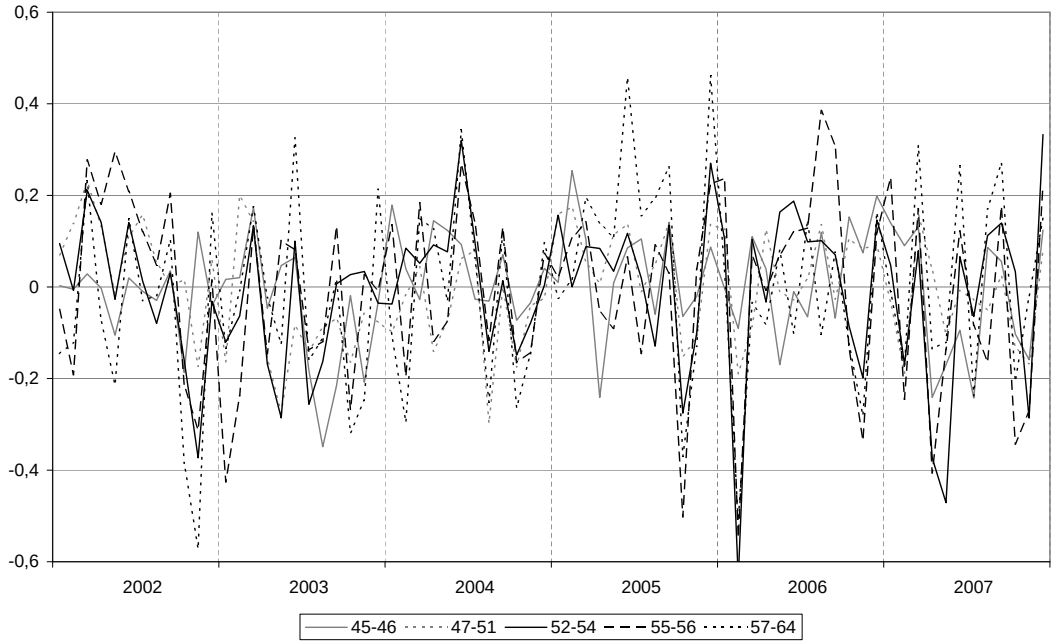
For an indirect test of the identifying assumption of the difference-in-differences estimator, we compute logit differences in unemployment incidence between treatment groups and the control group (which will be composed of individuals aged 40–44), based on observed unemployment incidence per month and correcting for the three time periods (pre-reform, anticipation, post-reform) underlying our empirical analysis. The logit differences (ld) are computed as

$$ld(t) = \text{logit}(UI_{\text{treat}(a),t}) - \text{logit}(UI_{\text{control},t}) - \sum_{t \in p} \left[\text{logit}(UI_{\text{treat}(a),t}) - \text{logit}(UI_{\text{control},t}) \right] \ ,$$

where t refers to different months, treat(a) to the five treatment groups and p to the three time periods. The measure thus mirrors the empirical variation of differences in logit transformed unemployment incidence between the various treatment groups and the control group, using period specific means to correct for possible discontinuities arising from the policy change. If the assumption of a common trend in unemployment incidence is justified, we should observe only random variation over time. The logit differences are displayed in Figure 2. The Figure does not reveal any patterns in logit differences; thus it does not provide any evidence against the identifying assumption of the model.

Another method would have been to apply a regression discontinuity design (e.g. Angrist and Pischke, 2009, Chap. 6). This approach requires a measurable discontinuity, which identifies the effect of the policy change (Hahn et al., 2001). It is typically ap-

Figure 2: Logit differences in unemployment incidence across treatment groups and the control group, based on the observed unemployment incidence per month. Source: IEB, own results.



plied to estimate the effects of discontinuities in benefit receipt by age under the same regime (e.g. Lalive, 2007, 2008). One might also interpret the implementation of the reform as a discontinuity arising for particular age groups in small neighborhoods of the timing of the reform. However, as we find strong anticipation effects of the reform, a regression discontinuity design cannot be applied: Anticipation enlarges the discontinuity tremendously; thus reform and anticipation effects cannot be disentangled.

Because Figure 1 indicated anticipation effects, our analysis takes into account that such behavior might be present just before the reform. If anticipation takes place, short- and long-term effects of the reform do not have to coincide. While the short-term effect can be directly estimated, the difference-in-differences estimator may be a biased estimator of long-term effects: by advancing dismissals from the post-reform period to the pre-reform period, unemployment incidence decreases—for a limited period after the reform—more strongly than in absence of anticipation. Unfortunately, the 23 months post-reform period (the reform has been partly abolished as soon as in 2008) is not long enough to resolve this issue. Thus the estimator will probably overestimate the magnitude of the long-term effect.

We model the conditional probability that an employed individual becomes unemployed during the period 2001 to 2007 as

$$Pr[y_{it} = 1|x_{it}] = \frac{\exp[x_{it}\beta)]}{1 + \exp[x_{it}\beta]} \ , \tag{1}$$

where x_{it} represents row it of the design matrix for d (dummy coded) variables and the constant. The matrix has k columns; β is a k vector of unknown coefficients. We use the standard maximum likelihood estimator for logit models to estimate model 1. The vector of explanatory variables x_{it} includes information on worker's socio-demographic characteristics and work history, firm and region characteristics as well as a number of time dummies.

We estimate four models, which differ only in the regressor sets[3]. Estimates of model A are stratified by calendar year and control for individual, firm and regional characteristics, and seasonal effects. Model B, C and D are estimated on the full dataset. Model B controls for the aforementioned characteristics and seasonal effects as well as for the calendar year (and thus for business cycle effects). The difference-in-differences estimator is implemented in Model C through additional interactions of age group variables and the post-reform dummy, while Model D encompasses also interactions between age group variables and the anticipation period.

As logit coefficients do not have a direct interpretation, we also express several estimation results in terms of marginal changes in unemployment incidence. The marginal effect of a dummy variable d is defined by

$$me(d) = \mathbb{E}_x\big([Pr[y_{it}|u(x_{it}, d)] - [Pr[y_{it}|l(x_{it}, d)]\big) \ , \tag{2}$$

where $u(x_{it}, d) = (x_{it,1}, \ldots, x_{it,d-1}, 1, x_{it,d+1}, \ldots, x_{it,k})$, i.e. function $u(x_{it}, d)$ replaces the value at position d in vector x_{it} with one. $l(\cdot, \cdot)$ operates in the same way but puts in a zero.[4] Furthermore, the magnitude of the marginal effect depends in our framework on the longitudinal frequency (daily, monthly, yearly etc.), and the probabilities and marginal effects on a monthly level are rather small. For this reason, we also report relative marginal effects (rme), which is the marginal effect relative to an average reference

[3] More detailed information on the regressors is given in Table A.1 (Appendix A).

[4] Cf. Ai and Norton (2003) and e.g. Puhani (2008) for a discussion on marginal effects of interaction terms in nonlinear models. We also computed effects according to Ai and Norton, which were similar to the presented results.

individual with the same age in the pre-reform period, i.e.

$$rme(d) = \frac{me(d)}{\mathbb{E}_x\big([Pr[y_{it}|\ddot{x}_{it}]\big)} \quad . \tag{3}$$

$\ddot{x}_{it}$ is the covariates vector with zeroed reform effect dummies (interactions between age and post-reform). The rme is more informative as it is invariant with respect to panel frequency.

6. Econometric Analysis

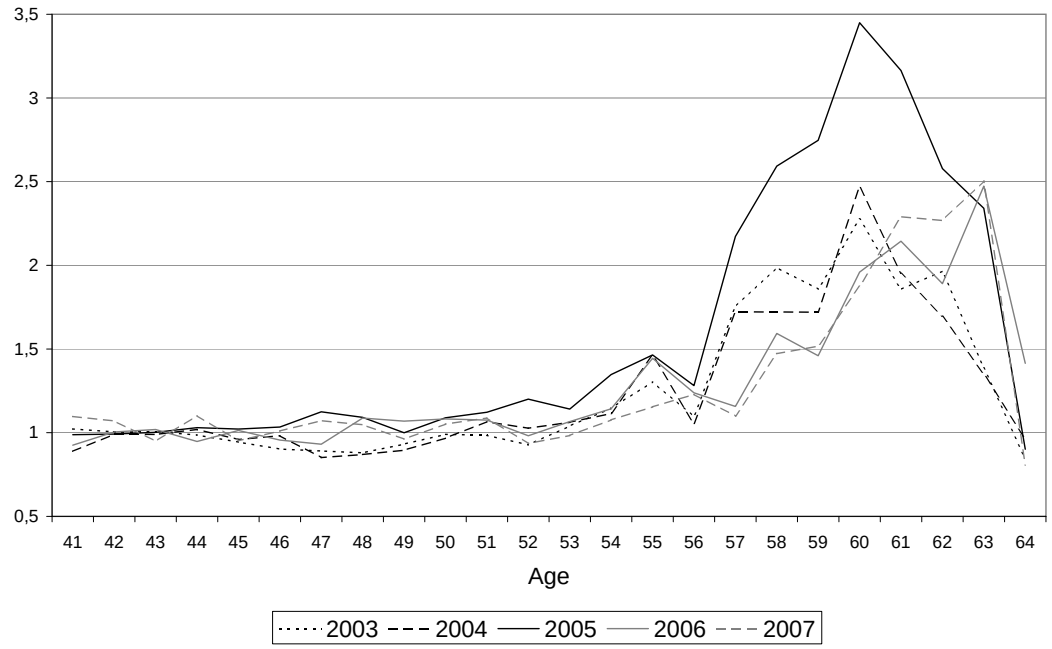
We first estimate separate logit models for the years 2003 to 2007 (Model A) with age 40 as reference age. Figure 3 presents the resulting age effects in terms of odds ratios[5]. The figure suggests that there are three relevant age intervals. The first ranges from 40 to about 50, where there is no difference in the odds ratios in all years between the age groups. From age 51 to 56, there is a monotone and parallel increase in odds ratios for all years. The third interval includes those aged 57+, and it is characterized by larger odds ratios for all years. While pre- and post-reform years form rather homogenous groups, the year 2005 is an outlier with considerably higher odds ratios. They are mainly driven by the anticipation effect of individuals who became unemployed between November and December 2005 (see also Figure 1). Comparing the pre-reform years 2003 and 2004 to the post-reform years 2006 and 2007, we clearly see a downward shift in the interval 57–61 years. This provides further evidence for considerable changes in unemployment incidence, now controlling for different compositions of individuals. Furthermore, the Figure shows that age-specific odds ratios were very similar during both pre-reform years (2003–2004) as well as during both past-reform years (2006–2007). This observation further supports our identifying assumption that trends in unemployment incidence would have been the same for different age groups in the absence of treatment.

Based on these results and given the differences in treatment intensity for age groups (Table 1), we choose the aged 40–44 as the reference group for the pooled regression analysis in Models B–D. Based on Figure 1, we define November 2005 to January 2006 as the anticipation period.

As a next step, we estimate Model B, which is a basic reference model with calendar year dummies. Table 2 suggests that older employees have a much greater risk of

[5] Results for 2001 and 2002 are not displayed, but resemble those for 2003 and 2004.

Figure 3: Odds ratios of becoming unemployed from logit models compared with a reference worker aged 40 (Model A). Source: IEB, own results.



becoming unemployed than individuals aged 40–44. Moreover, it shows a strongly decreasing unemployment incidence over the course of the years. In particular, there is a downward shift after the year 2005. As this model is not able to separate business cycle effects from effects due to changes in the institutional setup, we next estimate a model that distinguishes between pre- and post-reform regimes for the different age groups (Model C).

The basic difference-in-differences estimates suggest that the age groups 52–54, 55–56 and 57–64 have a lower transition rate into unemployment after the reform. The magnitude of the estimated effect is greater for groups with larger treatment intensity. In particular, the effect appears to be large for the oldest age group (although logit coefficients do not have a direct interpretation). As the presence of anticipation behavior may directly affect the pre-reform period, we also estimate a model with pre-, anticipation- and post-reform period (Model D). The estimates confirm the results of the descriptive analysis that there is a significant anticipation effect before the reform. Mainly the oldest age groups are affected by anticipation. The other coefficients are stable across specifications.

To get an impression of the size of the estimated effects, marginal effects and rela-

Table 2: Logit estimates of unemployment incidence. Source: IEB, own results.

variable	Model B	Model C	Model D
const	-4.642***	-4.665***	-4.641***
female	-0.218***	-0.217***	-0.218***
UB received since 1993	0.819***	0.821***	0.820***
high wage	-0.785***	-0.785***	-0.785***
employment length >4 years	-1.347***	-1.346***	-1.346***
end of quarter	0.254***	0.265***	0.271***
end of year	0.784***	0.784***	0.740***
firm size >500	-0.542***	-0.542***	-0.542***
unskilled	0.119***	0.120***	0.120***
university degree	-0.092***	-0.093***	-0.092***
employed since 1993	0.030**	0.028**	0.029**
East Germany	0.341***	0.342***	0.342***
food	0.529***	0.529***	0.530***
trade & services	0.168***	0.168***	0.168***
semi-public services	-0.304***	-0.303***	-0.304***
public administration	-0.642***	-0.641***	-0.642***
age group 45–46	-0.011	-0.005	-0.013
age group 47–51	0.046***	0.051***	0.040***
age group 52–54	0.122***	0.155***	0.127***
age group 55–56	0.308***	0.336***	0.306***
age group 57–64	0.701***	0.766***	0.704***
2002	0.069***	0.069***	0.069***
2003	-0.022*	-0.022*	-0.022*
2004	-0.148***	-0.148***	-0.148***
2005	-0.201***	-0.202***	-0.282***
2006	-0.529***	0.066**	-0.232***
2007	-0.486***	0.170***	-0.129***
post-reform		-0.574***	-0.294***
age group 45–46 × post-reform		-0.029	-0.021
age group 47–51 × post-reform		-0.022	-0.011
age group 52–54 × post-reform		-0.155***	-0.127***
age group 55–56 × post-reform		-0.129***	-0.099***
age group 57–64 × post-reform		-0.315***	-0.253***
anticipation			0.002
age group 45–46 × anticipation			0.152***
age group 47–51 × anticipation			0.183***
age group 52–54 × anticipation			0.424***
age group 55–56 × anticipation			0.429***
age group 57–64 × anticipation			0.784***
# observations	20 408 640	20 408 640	20 408 640
McFaddens pseudo-R^2	0.119	0.120	0.120
# individuals	389 235	389 235	389 235

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$;

Pre-reform = 01/2001 to 10/2005; Anticipation = 11/2005 to 01/2006; Post-reform = since 02/2006.

Table 3: Estimated marginal effects (me) and relative marginal effects (rme)†. Source: IEB, own results.

	age	Model C		Model D	
period	**group**	**me**	**rme**	**me**	**rme**
pre-reform	45–46	-0.00002		-0.00006	
	47–51	0.00022***		0.00017***	
	52–54	0.00072***		0.00058***	
	55–56	0.00170***		0.00152***	
	57–64	0.00453***		0.00402***	
anticipation	basis			0.00001	0.16%
	45–46			0.00071***	16.32%
	47–51			0.00087***	19.92%
	52–54			0.00227***	52.41%
	55–56			0.00231***	53.06%
	57–64			0.00505***	117.73%
post-reform	basis	-0.00222***	-43.57%	-0.00119***	-25.36%
	45–46	-0.00013	-2.86%	-0.00009	-2.13%
	47–51	-0.00009	-2.15%	-0.00005	-1.09%
	52–54	-0.00063***	-14.31%	-0.00052***	-11.85%
	55–56	-0.00053***	-12.04%	-0.00041***	-9.37%
	57–64	-0.00120***	-26.95%	-0.00099***	-22.25%

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$;

Pre-reform = 01/2001 to 10/2005; Anticipation = 11/2005 to 01/2006; Post-reform = since 02/2006.

† Relative to an average reference worker with the same age under the pre-reform regime.

Table 4: Difference-in-differences estimators for samples stratified by firm size and length of previous employment (Model D). Source: IEB, own results.

	smaller firms				larger firms			
age	shorter employment		longer employment		shorter employment		longer employment	
group	me	rme	me	rme	me	rme	me	rme
post-reform								
45–46	-0.00083	-4.91%	-0.00006	-2.14%	0.00121	19.54%	0.00005	-5.01%
47–51	-0.00064	-3.76%	0.00002	-0.55%	0.00041	6.52%	-0.00009	-10.22%
52–54	-0.00321***	-18.92%	-0.00029***	-9.99%	-0.00013	-2.03%	-0.00003	-3.40%
55–56	-0.00102	-6.06%	-0.00022	-7.79%	-0.00064	-10.16%	-0.00042***	-45.02%
57–64	-0.00197***	-11.26%	-0.00082***	-28.30%	-0.00088	-13.98%	-0.00050***	-51.55%
# observations	2 732 024		12 402 117		636 951		4 637 548	
pseudo-R^2	0.0578		0.051		0.0932		0.0685	
# individuals	95 612		199 935		18 751		74 937	

For ease of presentation we do not display the other coefficients of Model D.

tive marginal effects for Models C and D are reported in Table 3. For the oldest age group, unemployment incidence is reduced by 0.1 percentage points, which corresponds to a 22.25% lower incidence in the post-reform period compared to the pre-reform risk. Similarly, the incidence for the age group 52–54 is reduced by 0.05 percentage points or 11.85%, while the partial anticipation effect for the oldest age group is 0.505 percentage points or an increase by 117%. The anticipation effect is in the range of 50% for the aged 52–56. These numbers suggest clear evidence for a strong anticipation of the reform. Thus we have found strong empirical support for the average reform effect being related to the treatment intensity and for the presence of a considerable anticipation of the reform. While the former result is in line with our first hypothesis, the latter result contradicts our second hypothesis—institutional arrangements were obviously ineffective to disable basic economic incentives to exploit the old scheme as far as possible.

Finally, we test our third hypothesis (that larger firms more likely dismiss their oldest employees with long tenure) by estimating Model D by stratifying the estimation sample with respect to firm size and employment length before unemployment (as a proxy for tenure). The resulting difference-in-differences estimators are given in Table 4[6]. It is remarkable that smaller firms (less than 500 employees) react in relation to the treatment intensity. In contrast, larger firms merely utilized extended benefit entitlements

[6] The full set of estimated coefficients can be obtained by the authors on request. Estimated coefficients of anticipation effects are not displayed, because they are very similar across regimes.

to generally shed employees aged 55 and older; the drop in unemployment incidence is related to age rather than treatment intensity. As dismissal protection makes it nearly impossible for large firms to dismiss older workers with long tenure due to social criteria, the reform made it more expensive to buy out older workers. Thus the result is in line with our theoretical predictions derived with the theoretical and institutional background sketched in Sections 2 and 3.

7. Robustness Checks

As robustness checks, we have estimated several other variants of the previous models: First, we allowed for additional variation due to previous institutional changes, in particular during 2005 (reform of unemployment assistance) and at the end of 2007 (subsequent reform of unemployment benefits as well as the abolishment of the opportunity to withdraw from job search at the age of 58). In addition, we have estimated the model for many combinations of restricted pre- and post reform periods. This includes single calendar years and sometimes even periods shorted than one year. Second, we modeled different lengths of the anticipation period (one to six months), and we excluded the anticipation period. The presented results are, however, stable with respect to these model variations. We therefore do not obtain evidence for non-parallel trends of our control and treatment groups which maybe due to noticeable indirect effects of other accompanying reforms.

We also estimated heterogeneous treatment effects. In particular, we analyzed the role of the previous wage (as another indicator for treatment intensity), but we found only weak evidence for stronger effects in the higher quintiles of the earnings distributions. For this reason, we do not present these results. Furthermore, we conducted separate estimates by federal states and by East and West Germany, by business sectors, and by education. Results were, however, very stable across groups.

8. Fiscal Benefit Analysis

Our empirical findings suggest that the financial burden for the unemployment insurance decreased due to the reform, partly maybe also due to the change in taxation of severance pay. Based on our empirical results, we now estimate per-capita-savings for

the unemployment insurance for employees aged 55 and older as well as savings for the entire age cohort. These estimates rely on several assumptions: First, we assume that older individuals fully exhaust their unemployment benefit entitlements, as they are in fact early retired and have a very low probability of re-entering employment (Arntz and Wilke, 2009). Second, we are interested in the long-run (or steady-state) fiscal benefits of the reform. We cannot, however, identify whether anticipation of the reform led to additional dismissals or whether separations were merely advanced. In the former case, our estimated parameters provide us with the correct long-run effects, while we overestimate the magnitude of long-run effects in the latter case. We can therefore only provide bounds for long-term savings.

Generally, the per capita change in costs for an employee aged a ($expenditures_a$) with maximum entitlement lengths for unemployment benefits is decomposed (see also Kyyrä and Wilke, 2007) as

$$\Delta expenditures_a = p_a \Delta \mathbb{E}_a(b+s) + \Delta p_a \mathbb{E}_a(b+s) + \Delta p_a \Delta \mathbb{E}_a(b+s) \ , \tag{4}$$

where p_a is the probability of becoming unemployed at age a before the reform. $\mathbb{E}_a(b+s)$ is the expected cost for the unemployment insurance for an unemployed at age a with maximum entitlement length before the reform. This consists of unemployment benefit transfers (b) and the foregone insurance premium (s). $p_a + \Delta p_a$ and $\mathbb{E}_a(b+s) + \Delta \mathbb{E}_a(b+s)$ are the corresponding post-reform values. $\Delta expenditures_a$ is therefore the estimated monthly per capita change in the financial burden for the unemployment insurance, where our decomposition separates the changes due to the reduction in unemployment incidence and the reduction due to shorter claim periods. We estimate p_a from the data (based on the years 2001–2005). As the level of unemployment benefits (b), we use the age cohort average, based on wages of employees with maximum entitlements; furthermore, we assume a joint employer-employee unemployment insurance contribution rate (s) of 5%, as the mean actual contribution rate was close to this value in the period under consideration.

The upper panel of Table 5 reports per capita changes in unemployment incidence, expected costs and change in the unemployment incidence. For a worker of age 55–56, the savings in expected costs amount to about 10 000 Euros, for a worker of age 57–64 to about 18 000 Euros, provided that workers exhaust their claims. The true change in the incidence level can only be bounded as we cannot identify whether the anticipation effect was caused by additional dismissals or by an advance to earlier periods. The upper

Table 5: Estimated monthly changes in financial burden for the unemployment insurance (based on the post-reform coefficients from Model D). Source: IEB, own results.

	p_a			$\mathbb{E}_a(b+s)$, in Euros		
Age group	40–44	55–56	57–64	40–44	55–56	57–64
Pre-reform	0.00437702	0.00901464	0.01129875	13 624	33 956	41 675
Post-reform	0.00318492	0.00741134	0.00912115	13 624	23 508	23 442
Change	-0.0011921	-0.0016033	-0.0021776	0	-10 448	-18 233
Δp_a		-0.0004112	-0.0009855	0	-10 448	-18 233
$\Delta p_{a(anticipation)}$		0.0023085	0.0050465			

Per capita changes (in Euros)		
Age group	55–56	57–64
Due to change in expected costs. $p_a \cdot \Delta\mathbb{E}_a(b+s)$	-73.14	-148.33
Upper bounds		
Due to change in incidence. $\Delta p_a \cdot \mathbb{E}_a(b+s)$	-13.96	-41.07
Cross effect. $\Delta p_a \cdot \Delta\mathbb{E}_a(b+s)$	4.30	17.97
$\Delta expenditures_a$	-82.80	-171.44

Total cohort changes (in million Euros)		
Age group	55–56	57–64
Number of employees in cohort (10/2005)	906 600	1 614 200
Due to change in expected costs	-66.307	-239.442
Upper bounds		
Due to change in incidence	-12.658	-66.296
Cross effect	3.895	29.004
Total savings (lower bound)	-66.307	-239.442
Total savings (upper bound)	-75.071	-276.733

bound for Δp_a is the difference-in-differences estimator of Model D, which is likely to be greater in magnitude than it would have been in absence of anticipation. The lower bound is 0, if the entire post-reform effect resulted from an advancing of dismissals. [7]

The middle panel of the table reports estimates for the decomposition (4). The major part of the total savings results from the reduction in expected costs. Finally, the lower panel reports the bounds for the monthly (steady-state) savings of the unemployment insurance, given the estimated size of the cohort of employees aged 55–64 with maximum entitlement lengths in October 2005. Our numbers suggest that the long-term burden for the unemployment insurance would have been reduced by $(66 + 239) \cdot 12 = 3\,660$ up to $(75 + 277) \cdot 12 = 4\,224$ millions Euros per year. This corresponds to 13 to 15 percent of the total expenditures for unemployment benefits in Germany during the year 2004.

Even though the long-term savings would have been rather large, it is important to note that the actual savings due to the change in expected costs started 18 months after the reform (due to anticipation, there was probably even an increase in the actual costs in 2005 and 2006). As the reform was already partly abolished after 23 months, the actual steady state period covers at most 5 months. Nonetheless, our computations clearly suggest that the reduction in unemployment benefit entitlement lengths had important fiscal consequences. Furthermore, our simple computations ignore savings for younger age cohorts and that budgets of other social insurance branches were likely to be positively affected, too. One might conclude that an additional financial burden has been shifted to the taxpayer, who funds unemployment assistance. However, Figure 3 indicates that many older workers have postponed retirement after the reform took place.

9. Conclusion

Investigating a major labor market reform within the European regulated labor market setting, our paper finds large anticipation effects of a reform, which nearly halved unemployment benefit entitlement lengths for older workers. We find that workers and firms exploited the old scheme as far as possible: Amid a rush to take advantage of the previous legislation in its last days, the number of workers aged 57 to 64 entering unemployment rose by nearly 120% in the three months prior to reform. The size of this

[7] Similarly, the upper bound for the per capita anticipation costs is $3 \cdot \Delta p_{a(anticipation)} \cdot \mathbb{E}_a(b+s)$ which is 235 Euros and 631 Euros for the aged 55–56 and 57–64 respectively. The upper bound of the total anticipation costs is therefore 1 232 millions Euros.

effect is surprising, as legal regulations were designed to prevent exactly this anticipation effect. Thus, our results suggest that legislation was not able to fully absorb economic incentives to exploit the old system as far as possible. This is an important finding for the design of future policy changes.

Thereafter, however, unemployment among the same age-group declined by around a fifth, which confirms a negative relationship between employment stability and generosity of unemployment benefits. These latter findings are in line with previous empirical results for earlier policy changes in Germany and Finland (e.g. Fitzenberger and Wilke, 2010; Kyyrä and Wilke, 2007). Because of the strong anticipation effects and the short period until the next reform took place, our analysis cannot exactly identify the longer-term reform effect. Nonetheless, our results suggest that the decrease in unemployment incidence after the reform clearly offsets the anticipation effect. We also provide estimates for considerable fiscal effects of the reform.

It is important to identify the reasons for the historically low employment rates of older workers in Germany (Arnds and Bonin, 2003). Whether it is due to the institutional design or due to discrimination, such knowledge is essential for the design of successful future policies. The results presented in our paper show that the 2006 reform was in fact successful in fixing an important leak in the design of the welfare state and barring the pathway into retirement through a period of unemployment: Short benefit durations make lay-offs more costly for firms and workers, which discourages the use of unemployment benefits as a pathway into retirement. The often criticized weak labor market performance of older workers in Germany had therefore been at least partly due to the generous social security system. However, the German voting population tends to prefer a more extensive social security system. Using 2006 survey data, Heinemann et al. (2009) found that only 18 percent of the German population was in favor of cutting unemployment benefits. Thus, it is not surprising that benefit entitlement lengths were re-extended to up to 24 months in 2008.

The existence of strong short-term anticipation effects in the last days before the reform renders the accurate identification of the long-term reform effects difficult. Our difference-in-differences approach can be expected to overestimate the magnitude of the long-term reform effect on unemployment incidence. A longer post-reform period would be required to attenuate this effect but the 2006 reform was already partly repealed after less than two years. This—as well as the fact that employment data are not available for the time period after 2007 yet—hampers also an investigation of reform

effects on unemployment duration. For these reasons, such an analysis is left for future research, which will at least be able to benefit from longer observed unemployment periods after the reform. Our analysis suggests that it will be important to take into account selectivity arising from anticipation behavior.

References

Addison, John T., and Pedro Portugal. 2008. "How do Different Entitlements to Unemployment Benefits Affect the Transitions from Unemployment into Employment?", Economics Letters, Vol. 101, No. 3, pp. 206–9.

Ai, Chunrong, and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit Models", Economics Letters, Vol. 80, No. 1, pp. 123–9.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. "Mostly Harmless Econometrics: An Empiricist's Companion", Princeton Universiy Press: Princeton and Oxford.

Arnds, Pascal, and Holger Bonin. 2003. "Frühverrentung in Deutschland: Ökonomische Anreize und institutionelle Strukturen", in: Matthias Herfurth, Martin Kohli, Klaus F. Zimmermann, eds, Arbeit in einer alternden Gesellschaft (Labor in an Aging Society), Leverkusen: Leske+Budrich, pp. 65–91.

Arntz, Melanie, and Ralf A. Wilke. 2009. "Unemployment Duration in Germany: Individual and Regional Determinants of Local Job Finding, Migration and Subsidized Employment", Regional Studies, Vol. 43, No. 1, pp. 43–61.

Bentolila, Samuel, and Guiseppe Bertola. 1990. "Pensions, Firing Costs and Labor Demand: How Bad is Eurosclerosis?", Review of Economic Studies, Vol. 57, No. 3, pp. 381–402.

Boeri, Tito, and Jan van Ours. 2008. "The Economics of Imperfect Labor Markets", Princeton Universiy Press: Princeton and Oxford.

Cahuc, Pierre, and Andre Zylberberg. 2004. "Labor Economics", MIT Press: Cambridge MA/London.

Fitzenberger, Bernd, and Ralf A. Wilke. 2010. "Unemployment Durations in West-Germany Before and After the Reform of the Unemployment Compensation System During the 1980s", German Economic Review, (forthcoming).

Gerlach, Knut, David Levine, Gesine Stephan, and Olaf Struck. 2008. "Fairness and the

Employment Contract: North American Regions vs. Germany", Cambridge Journal of Economics, Vol. 32, No. 3, pp. 421–39.

Hahn, Jinyong, Petra Todd, and Wilbert van der Klaauw. 2001. "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design", Econometrica, Vol. 69, No. 1, pp. 201–9.

Hakola, Tuulia, and Niku Määttänen. 2009. "Pension System, Unemployment Insurance and Employment at Older Ages in Finland", Prime Minister's Office Publications 2/2009.

Hanel, Barbara. 2008. "Financial Incentives to Postpone Retirement and Further Effects on Employment – Evidence from a Natural Experiment", BGPE Discussion Paper No. 54, May.

Heinemann, Friedrich, Bischoff, Ivo, and Tanja Hennighausen. 2009. "Choosing from the Reform Menu Card – Individual Determinants of Labor Market Policy Preferences", Jahrbücher für Nationalökonomie und Statistik, Vol. 229, No. 2+3, pp. 180–97.

Hutchens, Robert. 1999. "Social Security Benefits and Employer Behaviour: Evaluating Social Security Early Retirement Benefits as a Form of Unemployment Insurance", International Economic Review, Vol. 40, No. 3, 659–78.

Jahn, Elke J. 2009. "Do Firms Obey the Law When they Fire Workers? Social Criteria and Severance Payments in Germany", International Journal of Manpower, Vol. 30, No. 7, pp. 672–91.

Karlstrom, Anders, Marten Palme, and Ingemar Svensson. 2004. "A Dynamic Programming Approach to Model the Retirement Behaviour of Blue-Collar Workers in Sweden", Journal of Applied Econometrics, Vol. 19, No. 6, pp. 795–807.

Kyyrä, Tomi, and Ralf A. Wilke. 2007. "Reduction in the Long-term Unemployment of the Elderly – A Success Story from Finland", Journal of the European Economic Association, Vol. 5, No. 1, pp. 154–82.

Lalive, Rafael, Jan Van Ours, and Josef Zweimüller. 2006. "How Changes in Financial Incentives Affect the Duration of Unemployment", Review of Economic Studies, Vol. 73, No. 4, pp. 1009–38.

Lalive, Rafael. 2007. "Unemployment Benefits, Unemployment Duration, and Post-Unemployment Jobs: A Regression Discontinuity Approach", American Economic Association Papers and Proceedings / American Economic Review, Vol. 97, No. 2, pp. 108–12.

Lalive, Rafael. 2008. "How do Extended Benefits Affect Unemployment Duration? A regression Regression Discontinuity Approach", Journal of Econometrics, Vol. 142, No. 2, pp. 785–806.

Lee, Sokbae, and Ralf A. Wilke. 2009. "Reform of Unemployment Compensation in Germany: A Nonparametric Bounds Analysis Using Register Data", Journal of Business and Economic Statistics, Vol. 27, No. 2, pp. 193–205.

Moffitt, Robert, and Walter Nicholson. 1982. "The Effect of Unemployment Insurance on Unemployment: The Case of Federal Supplemental Benefits", The Review of Economics and Statistics, Vol. 64, No. 1, pp. 1–11.

Mortensen, Dale. 1970. "Job Search, the Duration of Unemployment, and the Phillips Curve", American Economic Review, Vol. 60, No. 5, pp. 847–62.

Müller, Eva, Ralf A. Wilke, and Philipp Zahn. 2007. "Beschäftigung und Arbeitslosigkeit älterer Arbeitnehmer: Eine mikroökonometrische Evaluation der Arbeitslosengeldreform von 1997". Jahrbücher für Nationalökonomie und Statistik, Vol. 227, No. 1, pp. 65–86.

Oberschachtsiek, Dirk, Patrycja Scioch, Christian Seysen, and Jörg Heining. 2009. "Stichprobe der Integrierten Erwerbsbiografien IEBS – Handbuch für die IEBS in der Fassung 2008", FDZ Datenreport, No. 3.

OECD. 2003. "Statistical Appendix. Employment Outlook", Paris.

Puhani, Patrick A. 2008. "The Treatment Effect, the Cross Difference, and the Interaction Term in Nonlinear 'Difference-in-Differences' Models", IZA Discussion Paper No. 3478.

Stock, James H, and David Wise. 1990. "Pensions, The Option Value of Work, and Retirement", Economcetrica, Vol. 58, No. 5, pp. 1151–80.

Winter-Ebmer, Rudolf. 2003. "Benefit Duration and Unemployment Entry: A Quasi-Experiment in Austria", European Economic Review, Vol. 47, No. 2, pp. 259–73.

A. Additional Tables

Table A.1: Variables overview

variable	description
female	dummy for sex, indicating 1 for females
UB received since 1993	dummy for having received unemployment benefits since 1993
high wage	dummy for earning an upper-two-quintiles wage
employment length >4 years	dummy for currently having a work experience of more than four years
end of quarter	dummy indicating the end of a quarter
end of year	dummy indicating the end of a year
firm size >500	dummy for working in a firm with more than 500 employees (large firm)
unskilled	dummy for being unskilled
university degree	dummy for having any university degree
employed since 1993	dummy for being continuously employed since 1993
East Germany	dummy for working in the eastern parts of Germany (former GDR)
food, trade & services, semi-public services, public administration	dummies indicating the industry, reference is 'manufacturing'
age group 45–46, ..., 57–64	dummies for the age groups, reference is 41–44
2002, ..., 2007	dummies for the years, reference is 2001
post-reform	dummy for the post-reform phase, i.e. since 2/2006
age group and post-reform interactions	dummies for the interactions between age groups and post-reform phase
anticipation phase	dummy for the anticipation phase, i.e. 11/2005 to 1/2006
age group and anticipation interactions	dummies for the interactions between age groups and anticipation phase

Table A.2: Sample means by age groups and sampling period. Source: IEB, own results.

	40–44			45–46			47–51		
period	pre-ref.	anticip.	post-ref.	pre-ref.	anticip.	post-ref.	pre-ref.	anticip.	post-ref.
female	0.439	0.431	0.430	0.460	0.456	0.448	0.468	0.469	0.468
wage quantile 1	0.261	0.260	0.258	0.253	0.261	0.258	0.242	0.249	0.250
wage quantile 2	0.184	0.184	0.186	0.180	0.186	0.186	0.181	0.183	0.185
wage quantile 3	0.179	0.181	0.180	0.183	0.180	0.181	0.185	0.187	0.186
wage quantile 4	0.190	0.190	0.189	0.191	0.190	0.186	0.195	0.191	0.190
wage quantile 5	0.186	0.186	0.187	0.193	0.183	0.188	0.197	0.190	0.190
employment length (months)	89.613	105.228	109.917	95.975	113.108	119.176	100.167	119.181	126.074
firm size <=50	0.356	0.354	0.354	0.347	0.349	0.346	0.337	0.338	0.336
firm size 51–100	0.116	0.116	0.116	0.117	0.118	0.121	0.120	0.122	0.121
firm size 101–250	0.158	0.161	0.163	0.160	0.161	0.161	0.163	0.166	0.167
firm size 251–500	0.113	0.115	0.116	0.115	0.116	0.119	0.119	0.117	0.118
firm size >500	0.257	0.254	0.251	0.261	0.257	0.253	0.261	0.257	0.258
unskilled	0.226	0.227	0.228	0.222	0.227	0.228	0.221	0.223	0.223
skilled	0.663	0.657	0.653	0.671	0.665	0.660	0.675	0.667	0.666
university degree	0.111	0.116	0.119	0.107	0.109	0.112	0.104	0.110	0.110
East Germany	0.156	0.149	0.145	0.163	0.154	0.154	0.172	0.162	0.159
production	0.323	0.318	0.315	0.316	0.318	0.316	0.312	0.307	0.307
food	0.011	0.010	0.010	0.010	0.011	0.011	0.010	0.009	0.010
trade & services	0.417	0.427	0.434	0.406	0.406	0.414	0.403	0.406	0.406
semi-public services	0.173	0.173	0.173	0.180	0.182	0.178	0.179	0.185	0.187
public administration	0.076	0.071	0.068	0.086	0.083	0.080	0.095	0.092	0.090
age	41.954	41.978	42.009	45.493	45.494	45.495	48.939	48.951	48.930
transition	0.005	0.006	0.004	0.005	0.006	0.003	0.004	0.005	0.003

	52–54			55–56			57–64		
period	pre-ref.	anticip.	post-ref.	pre-ref.	anticip.	post-ref.	pre-ref.	anticip.	post-ref.
female	0.464	0.479	0.477	0.447	0.465	0.467	0.383	0.403	0.416
wage quantile 1	0.239	0.246	0.245	0.238	0.247	0.246	0.207	0.212	0.218
wage quantile 2	0.177	0.181	0.187	0.184	0.190	0.188	0.185	0.193	0.201
wage quantile 3	0.189	0.190	0.188	0.188	0.195	0.197	0.189	0.196	0.198
wage quantile 4	0.194	0.194	0.194	0.188	0.188	0.188	0.185	0.184	0.182
wage quantile 5	0.202	0.189	0.187	0.202	0.181	0.182	0.234	0.215	0.201
employment length (months)	103.360	122.972	130.839	104.440	123.971	131.593	106.862	128.784	137.110
firm size <=50	0.328	0.328	0.327	0.329	0.335	0.333	0.322	0.320	0.322
firm size 51–100	0.120	0.123	0.126	0.118	0.123	0.124	0.121	0.122	0.124
firm size 101–250	0.163	0.167	0.170	0.164	0.168	0.169	0.163	0.170	0.173
firm size 251–500	0.118	0.121	0.122	0.119	0.118	0.119	0.124	0.123	0.123
firm size >500	0.271	0.260	0.255	0.270	0.257	0.254	0.269	0.266	0.258
unskilled	0.229	0.226	0.223	0.239	0.232	0.229	0.229	0.227	0.227
skilled	0.677	0.672	0.668	0.670	0.668	0.670	0.659	0.662	0.661
university degree	0.094	0.102	0.108	0.091	0.099	0.101	0.112	0.111	0.112
East Germany	0.161	0.175	0.173	0.145	0.160	0.173	0.151	0.144	0.146
production	0.319	0.305	0.298	0.322	0.311	0.313	0.319	0.308	0.303
food	0.010	0.009	0.009	0.009	0.009	0.009	0.010	0.009	0.008
trade & services	0.397	0.402	0.404	0.400	0.402	0.400	0.402	0.402	0.403
semi-public services	0.171	0.181	0.186	0.162	0.172	0.176	0.149	0.161	0.165
public administration	0.103	0.103	0.103	0.106	0.106	0.101	0.120	0.121	0.121
age	52.962	52.973	52.969	55.476	55.477	55.487	59.272	59.374	59.335
transition	0.004	0.007	0.003	0.005	0.008	0.003	0.006	0.013	0.003

Note: Pre-reform = 01/2001 to 10/2005; Anticipation = 11/2005 to 01/2006; Post-reform = since 02/2006.