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Institutional Reforms and an Incredible Rise in Old Age Employment

Abstract

We investigate whether a cut in unemployment benefit payout periods affected older workers' labor market transitions. We apply rich administrative data and exploit a difference-in-differences approach. We compare the reference group of 40-44 year olds with constant benefit payout periods to older treatment groups with reduced payout durations. For the latter job exit rates declined, job finding rates increased, the propensity to remain employed increased, and the propensity to remain unemployed declined after the reform. These patterns suggest that the reform of unemployment benefits may be one of the reasons behind the recent incredible rise in old age employment in Germany.

JEL-Codes: J140, J260.

Keywords: labor force participation, employment, unemployment insurance, retirement.

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Introduction

Between 2000 and 2014 the population share of employed older workers (age 55-64) in Germany increased by 53 percent for men and by 110 percent for women.[1] This development dwarfs the increase in labor force attachment observed among older workers in the United States (Banerjee and Blau 2016) and other countries (Hoffmann and Lemieux 2015). For countries in the grip of demographic ageing, it is important to understand the driving forces behind such a jump in older workers' labor force participation and employment.

This paper addresses the relevance of labor market institutions and their incentive effects for older workers' labor market outcomes. In particular, we use detailed administrative data to investigate the effects of an unemployment insurance (UI) reform on employment transitions of older workers. Understanding the impact of institutional changes on labor force participation choices of older workers is of general interest. The interplay between unemployment benefit provision and employment incentives is an internationally observed phenomenon. Numerous countries attempt to deal with the challenge of aging societies by adjusting the regulation of work, unemployment, and retirement. Therefore, the study of causal reform effects generates important policy-relevant insights.

This study connects to two prior contributions: Hoffmann and Lemieux (2015) analyze unemployment in the United States after the Great Recession and compare it to trends in other countries. They investigate the drop in nonemployment among older workers in Germany and argue that labor market reforms are unlikely to "explain a sizable part of the trends in nonemployment" (p. 132). Dlugosz et al. (2014) study the impact of German labor market reforms on older workers' subsequent entries to unemployment. In contrast to Hoffmann and Lemieux

[1] Shares computed from Mikrozensus data published by the German Federal Statistical Office; for a discussion see, e.g., Hoffmann and Lemieux (2015).

(2015), they find substantial reform effects of, e.g., up to 30 percent reductions in unemployment entries. Thus, the relevance of institutional reforms for employment trends of older workers is disputed and we contribute to that debate.

In this paper, we offer a broad and encompassing analysis. We differ from Hoffmann and Lemieux (2015) first by focusing on the effect of one specific reform and second by concentrating specifically on older workers' labor market flows. We extend the analysis of Dlugosz et al. (2014) in several respects. While these authors studied entries to unemployment exclusively, we consider three potential labor market states and investigate four independent transitions between employment and unemployment states, leaving a remaining "other" labor force state, for which we only have limited information, as a reference category. Also, we control more explicitly for institutional features such as changes in retirement regulations and account for seasonality and seam effects in monthly transition patterns.

Based on a difference-in-differences analysis with large samples taken from precise administrative data, we find that the reduction of unemployment benefit payments affected the transition rates of older workers in the expected ways. We compare the reference group of 40-44 year olds with constant benefit payout periods to older treatment groups with reduced payout durations. For the latter job exit rates declined, job finding rates increased, the propensity to remain employed increased, and the propensity to remain unemployed declined after the reform. We observe the largest behavioral adjustments among those affected most strongly by the reform. This suggests that the reform of unemployment benefits may be one of the reasons behind the incredible rise in old age employment in Germany.

Literature

This contributes to several lines of literature: we add to the study of older workers' labor force participation, contribute to the analysis of institutional reform effects, and offer a new perspective on recent labor market developments in Germany. We briefly review the literature in each of these fields:

Older workers' labor force participation (LFP) receives substantial attention due to its immediate fiscal implications (Coile et al. 2014). The trends and determinants of older workers' LFP shifted over recent decades. Peracchi and Welch (1994) refer to developments such as wage dispersion or changes in the industry and occupation mix to explain the falling LFP of older workers in the United States since the 1960s. Schirle (2010) looks at cross country data and finds that, generally, increases in older men's LFP can be explained by increases in the labor market participation of their wives. Blau and Goodstein (2010) conclude that changes in retirement incentives explain between one quarter and one half of the increase in U.S. older male workers' LFP by 2005. Recently, Banerjee and Blau (2016) inspect employment trends in the U.S. through 2010. They find only limited explanatory power in demographics, education, and institutional incentives. We add to this literature by offering evidence on the relevance of institutional reforms in attaining a substantial increase in old-age LFP.

Second, a large literature studies workers' responses to institutional incentives based on reforms of unemployment and retirement regulations. In an influential early contribution, Hunt (1995) applies survey data to study reforms of the German UI in the 1980s. She concludes that "[t]he large increase in potential duration of ALG [unemployment benefits] provoked a large response, (…)." (p. 118). Similarly, Lalive et al. (2006) find that an extension of the potential benefit duration resulted in longer unemployment spells among older workers; they exploited a 1989 reform of the Austrian UI system. In another study on Austria, Inderbitzin et al. (2016) look

at the relationship between UI and retirement incentives. Using an extension of unemployment benefits for older workers, they find strong effects on early retirement. The authors suggest that policies aiming at postponing retirement need to consider the full mix of available transfer programs. Hairault et al. (2010) adopt a different perspective and address the distance to retirement as a determinant of older workers' labor market behavior. They argue that the returns to job finding vary with a job's potential duration. They also confirm that employment rates of older workers in France increased when incentives to postpone retirement were strengthened. We add to this literature by evaluating the effects of a reform on labor market transitions while accounting for other relevant institutional features.

Third, the good performance of the German labor market attracted international attention (e.g., Hoffmann and Lemieux 2015, Burda and Hunt 2011). Interestingly, the dominant explanations of this development do not assign a central role to labor market reforms: Burda and Hunt (2011) and Dustmann et al. (2014) argue that the labor market reforms implemented between 2003 and 2006 are not of central importance. Instead, they stress different explanations such as the pessimistic hiring behavior of employers prior to the recession, wage moderation, working time accounts, and the governance structure of German labor market institutions with decentralized wage setting institutions as the main reason for the strong performance of the German labor market. In contrast, we study the relevance of the institutional framework and its reform for the labor force behavior of older workers. To the extent that transitions between labor market states (e.g., employment, unemployment, or out-of-the labor force) respond to reforms, prior studies may have underestimated the contribution of these institutions to the overall development.

Institutions and Hypotheses

We study the role of one institutional reform in the recent increase in older workers' employment, specifically for changes in employment entry and exit. When explaining labor market transitions, it is important "to carefully consider the entire set of welfare programs" (Inderbitzin et al. 2016, p. 286). Thus, we discuss the reform of unemployment benefits and other relevant institutions.

Unemployment insurance (UI) 2006 reform: Our attention centers on the reform of unemployment benefits by a law which passed parliament on Dec. 24, 2003 (Hartz IV law). The reform affected workers who became unemployed on or after February 1, 2006. It shortened the duration of unemployment benefit payout for workers aged 45 and above by up to 14 months. **Table 1** summarizes the changes in transfer durations. The changes vary by the age at which workers enter unemployment: column 2 describes the maximum pre-reform payout duration, column 3 the post-reform situation, and column 4 the change.

The UI 2006 reform intended to strengthen older workers' labor market orientation. Job search theory and the empirical literature (see, e.g., Mortensen 1970, Card et al. 2007) suggest that unemployment duration falls with shortened benefit entitlement periods as search intensity increases. We consider a situation of three mutually exclusive labor force states (employment (E), unemployment (U), other (O)) and expect that individuals chose their labor force transition based on a comparison of the expected utility in the potential destination states. The relative advantage of choosing any given destination state over both alternatives changes if the characteristics of either state change. If, e.g., an individual would prefer destination state U pre-reform but not post-reform, the propensity to transit into states E or O may be affected by the reform. More specifically, we expect that individuals aged 45 and above who became unemployed on or after February 1, 2006 ceteris paribus return to employment faster than their peers who had lost their job earlier (H1: U-E) because the duration of benefit payout had been shortened. We expect this effect on exits from

unemployment to employment to be strongest among those with the largest reductions in payout periods, i.e., age groups 52-54 and 57 and older (see **Table 1**). As the reform renders unemployment less attractive, it may reduce workers' reservation wages and propensity to enter unemployment from employment after the reform (H2: E-U). Ceteris paribus and with constant incentives to enter the other labor force state, we expect workers to be more likely to continue employment (H3: E-E), and to be less likely to remain unemployed (H4: U-U) after the reform.

In addition to these four hypothesized responses to the reduction in benefit durations, Dlugosz et al. (2014) show substantial evidence of anticipation behavior prior to the reform date. Those older workers who were to lose their jobs on or after February 1, 2006 had an incentive to start an unemployment spell earlier: they benefited from up to 14 additional months of transfer if their unemployment spell started prior to the reform cutoff, February 1, 2006. Thus, it is important to account for an anticipatory increase in unemployment entries among older workers prior to February 2006.

Unemployment insurance 2008 reform: In response to strong public opposition to the 2006 reform, the original reductions in payout durations were softened in a second reform. For an analysis of the 2008 reform on unemployed workers' search effort, see Lichter (2016). This 2008 reform law passed parliament in January 2008 and retroactively affected all those unemployed on January 1, 2008 and after. Payout durations increased from 12 to 15 and from 18 to 24 months for selected age groups (see columns 5 and 6 in **Table 1**). While this reform may have weakened some of the prior adjustments in transition behaviors for the concerned age groups, the net effect continued to be a substantial shortening of payout periods (see column 7 in **Table 1**). It is unlikely

that the 2008 reform generated anticipation effects.[2] Given the fast adjustment of the 2006 UI reform, it is not possible to evaluate its long run effects.

58 regulation: As an additional change, the '58 regulation' expired at the end of 2007 for those entering unemployment afterwards: the '58 regulation' exempted individuals aged 58 and older from the requirement to search for work which generally is a condition for receiving unemployment benefits. Workers who used the exemption had to retire as soon as they reached full retirement age. The change may have rendered unemployment less attractive for those affected. Workers may have anticipated the termination of the 58 regulation as it was announced already in 2006: those aged 58 and above had an incentive to bring forward an expected entry to unemployment and to enter unemployment prior to January 1, 2008.[3]

Retirement insurance: The German retirement system offers various pathways to retirement, which differ in their requirements (e.g., the number of contribution years, retirement age, gender, health, or prior unemployment). **Appendix Table A.1** describes five pathways with respect to the minimum age of retirement entry. Generally, each pathway allows entry at a full (i.e., normal) and an early retirement age, the latter involving benefit reductions (for a description see Engels et al. 2016). Due to reforms, the rules differ by birth cohort. If we are interested in determining the causal effect of unemployment benefit reforms, it is important to control for changes in the retirement system that might affect treatment or control groups.

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[2] The planned regulations were publicly known by Dec. 11, 2007 and benefited all those who continued to be unemployed beyond the end of 2007. In principle, individuals who received job offers after December 11 may have turned them down in expectation of an extension of their unemployment benefits. This might have generated a very brief anticipatory dip in unemployment exits.

[3] However, if workers or employers had expected another prolongation (the regulation had been prolonged without interruption since 1985) the anticipation behavior may have been limited.

As a first pathway, **Table A.1** (column A) shows 'retirement due to unemployment' which allows individuals to retire if they were unemployed for at least 52 weeks after reaching age 58.5.[4] The minimum age for full retirement due to unemployment increased from 60 to 65 for the birth cohorts 1937 to 1941 and after. Since 2006, this pathway to retirement can be used prior to age 65 only via early retirement. Also, the minimum age for early retirement increased from 60 to 63. Thus, in addition to cutbacks in unemployment benefits after 2006 also retirement entry for the unemployed became more restrictive. This may have delayed exits from unemployment into retirement (and indirectly from employment to unemployment) after 2005 for the cohorts 1946 and after.

Column B in **Table A.1** describes a pathway to retirement that exists only for females: historically, women could enter full retirement at age 60. This entry age was raised and starting with the birth cohort 1952 this pathway to normal full retirement was abolished altogether. Until the birth cohort of 1951 women could still retire at age 60 via early retirement. Generally, the rising full retirement age for females in the early 2000s should contribute to prolonged employment. In comparison to men the abolition of early retirement at age 60 and the enforcement of age 65 as minimum age for full retirement came much later for women. Therefore, females may respond less strongly to changes in unemployment benefits than men.

Column C in **Table A.1** shows 'retirement after long term employment', which requires an insurance period of at least 35 years, and column D shows regular old age retirement. These pathways remained unchanged during our period of interest (2004-2008). They allow full retirement at age 65 and early retirement for the long term employed at age 63.[5]

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[4] The pathway is also available after partial retirement. Generally, additional requirements must be met. In 2005, 18 percent of all old age retirements occurred via this pathway (DRV 2015).

[5] For completeness, column E describes 'retirement for the severely handicapped' which became more restrictive, as well. Since 2012, there is a new pathway for the 'very long term employed' with insurance periods of at least 45 years (not shown in **Table A.1**); we do not discuss this as it is outside of our

Reorganization of unemployment agencies: The UI 2006 reform was part of larger labor market reform mandating the reorganization of the unemployment agencies. The related laws passed parliament in December of 2002 (Hartz I) and in December of 2003 (Hartz II and III). Given that these reforms are directed both at younger and older workers, and took place prior to our observation period, they should not affect our estimates.

Partial retirement subsidies: The German UI subsidized partial retirement schemes where workers work part time over the last (up to) six years of their employment contract. The subsidy was abolished for those starting partial retirement after Dec. 31, 2009. However, this should not affect behavior in the period we are focusing on.[6]

In sum, in testing our hypotheses, we account for anticipation of the 2006 reform, anticipation of the abolition of the 58 regulation, and for changes in retirement entry regulations. In addition, we investigate gender-specific effect heterogeneity.

Data and Method

Data, Sample, and Outcome Measures

We use administrative data collected by the UI. The Sample of Integrated Labour Market Biographies (SIAB) 7510 provides a two percent random sample of records on all individuals who were in touch with the UI at least once between 1975 and 2010 (see vom Berge et al. 2013). This covers about 80 percent of the adult population excluding civil servants and the self-employed. The SIAB data provide employment biographies for more than one million individuals with either a

investigation period. In addition, disability retirement allows early retirement under certain conditions. However, its regulation did not change in the period we focus on (see Börsch-Supan and Jürges 2012, Burkhauser et al. 2016).

[6] In addition to these institutional reforms, the German labor market underwent additional institutional changes prior to our reform. However, as most of these reforms either were of general nature affecting specific features of the unemployment insurance administration, took place at a much earlier date, or aimed at welfare recipients, which are not in the focus of our analyses, we do not discuss them (e.g., Eichhorst 2008, Eichhorst and Marx 2011).

period of employment subject to social security, unemployment benefit receipt, or job search. The data offer various advantages: survey problems such as non-response do not exist, labor force transitions are observed based on daily reporting, and the sample describes the entire work force subject to the regulations described above.

To test our hypotheses, our data cover March 2004 through December 2007; this provides periods of identical duration before and after the 2006 reform. We consider residents of East and West Germany, aged 40-64 (i.e., birth cohorts 1939-1967), and exclude workers in the construction and mining sectors because they face special regulations.

In order to be eligible for the maximum duration of unemployment benefits as described in **Table 1**, the unemployed must have contributed to the UI for a minimum number of months ("insurance months") (for details see **Table A.2)**. We follow Dlugosz et al. (2014) and concentrate on workers who are eligible for the maximum duration of unemployment benefits as they are fully affected by the reform (for details see **Appendix B**). Alternatively, we could use (i) the full sample without regard to actual benefit claims. However, in this sample not all individuals are affected by the reform. (ii) Also, we could use a sample of those workers who suffered at least some reduction in their claims as a consequence of the reform, even if they were not eligible to the full transfer duration. We offer robustness tests based on this latter sample in Section 4.3.

We consider individuals' labor force status at the beginning of a month. An individual in employment subject to mandatory social security contributions is coded as employed (state E). We code an individual as unemployed (state U) if the person receives unemployment benefits (*Arbeitslosengeld I*), which is our outcome of interest. Individuals who are in other labor force states (e.g., employed without mandatory social security payments, retired, out of the labor market)

are coded as other (state O).[7] Our analysis sample describes 8.02 and 0.43 million person-month observations in employment and unemployment during the 45 months period between March 2004 and December 2007 for 226,683 (and 37,358) different individuals starting at least one spell of employment (and unemployment).

Our administrative data are provided by the unemployment insurance (UI). They are based on precise records on spells of unemployment (UI pays transfers) and spells of employment subject to social insurance contributions (UI collects contributions). The unemployment insurance does not offer information on employment that is not subject to social insurance contributions such as self-employment and civil service employment. Also, the unemployment insurance does not offer precise information on out of the labor force spells. Moreover, our data is not informative about whether an individual searches for work without receiving unemployment benefits, dies, or leaves the country. We do not generally know whether individuals started to receive retirement benefits or private pensions. For these reasons, we do not explicitly analyze transitions into and out of this "Other" category as part of our main analysis.

Instead, we focus on four types of labor market transitions: continued employment E-E, job separations E-U, job findings U-E, and continued unemployment U-U. We code a transition from state A to state B in month t if an individual was in state A on day one of month t and in state B on day one of month t+1. In total, 99.3 and 92.0 percent of all monthly transitions stay in the original states of employment and unemployment, respectively. Starting in employment, 0.26 percent of all monthly transitions are to unemployment (20,855 observations), and 0.41 percent (32,886 observations) to "other". 2.89 percent of all monthly transitions from unemployment are into

[7] For details on the definition of the three labor force status, see **Appendix B**.

employment (12,436 observations) and 5.11 percent (21,988 observations) transit into "other". **Appendix Table A.3** shows the age group and gender specific transition rates and sample sizes.

Method

We are interested in identifying the causal effect of the UI 2006 reform on labor market transitions of older workers. We consider a discrete time duration approach to model transitions between labor market states. Our empirical strategy applies a difference-in-differences estimator where we compare the pre- (T=0) and post-reform (T=1) monthly labor force transitions for age groups affected (treatment group, G=1) and not affected (control group, G=0) by the reform. Our control group consists of individuals aged 40-44, as older workers are treated by the 2006 reform (see **Table 1**).[8] This identifies a causal treatment effect if the transitions of treatment and control groups would have continued to move in tandem without the reform. We address the validity of this parallel path assumption in detail below.

We believe that the difference-in-differences research design is most appropriate for the situation at hand as it compares transitions before and after the implementation of the reform of interest. For two reasons the setting of the reform in combination with the character of our data render a regression discontinuity design inappropriate. First, the reform law was passed in advance and generated substantial anticipation behavior (e.g., earlier entry into unemployment). This affects transition rates before as well as after the reform date. We cannot plausibly use time as a running variable to locally identify the causal effect as it is not randomly assigned: individuals (and firms) selected the timing of labor market transitions. Second, our data do not provide the exact date of birth (only birth year). We use approximations of the actual age. This is appropriate in a difference-

[8] We do not consider workers below age 40 in order to keep treatment and control groups as comparable as possible avoiding, e.g., childbearing related differences.

in-differences framework but excludes age as a running variable in an age based-discontinuity design. Our main estimation equation is:

$$E[\, Y \mid T, G, X] = \Lambda(\alpha\, T + \beta\, G + \gamma\, T * G + X\, \theta)\,, \qquad (1)$$

where T and G are time and group indicators, X contains different sets of control variables, Λ is the cumulative distribution function of the binary outcome (Y), and α, β, γ, and θ are parameters to be estimated.

As our dependent variables indicate rare events - with average transition probabilities of below one percent - estimation results are sensitive to the estimation approach. In such a situation, the predicted outcomes of linear probability models, which impose linearity in marginal effects, can differ substantially from those based on discrete choice models (Greene 2012, p. 729). We apply logit estimations to be able to calculate reliable marginal effects.[9]

In order to facilitate the quantitative and qualitative interpretation of the estimation results, we present coefficient estimates with standard errors clustered at the individual level and calculate marginal causal effects. We follow Puhani (2012) and determine the treatment effect of interest (τ) as the difference between two cross-differences, where Y^0 and Y^1 are potential outcomes without and with treatment:

$$\begin{aligned} \tau\,(T=1, G=1, X) \quad &= E[Y^1 \mid T=1, G=1, X] - E[Y^0 \mid T=1, G=1, X] \\ &= \Lambda(\alpha + \beta + \gamma + X\theta) - \Lambda(\alpha + \beta + X\theta). \qquad (2) \end{aligned}$$

Our dependent variable describes whether a given transition between two labor market states is observed for person i between months m and m+1; we consider indicators of *age* to represent treatment and control groups (G), and a post-reform indicator (*post*) as a period indicator (T).

[9] Dlugosz et al. (2014) follow the same strategy. Please note, that our data show rare events but not small samples (typically, we have at least 1,000 observations of the rare outcomes). We are therefore not at risk of small sample bias. Nevertheless, we apply estimators appropriate for rare events *and* small sample sizes to test the robustness of our estimates below.

The vector of control variables X contains two sets of measures (see **Table A.4**). One set (X1) contains general and socio-demographic characteristics: gender, education, federal state of residence, and state-level linear and quadratic time trends, controls for calendar month to capture seasonality, and for calendar year to capture time trends and the business cycle. A second set of controls (X2) accounts for relevant institutions, intervening mechanisms and regulatory changes which we code based on the individuals' year of birth, the period of observation, and the specific regulation.[10] We estimate the following model:

$$E[AB_{i,m}] = \Lambda(\alpha_0 + \alpha_1 \, post_{i,m} + \beta_1' \, age_{i,m} + \gamma' \, (post_{i,m} * age_{i,m}) + \theta_1' \, X1_{i,m} + \theta_2' \, X2_{i,m}) \quad (3)$$

In a linear model, the coefficient estimate of the interaction of the post-reform indicator with the vector of age measures (γ) would yield the causal treatment effect. As we estimate a nonlinear model, we calculate the treatment effect based on equation (2). This allows us to test hypotheses H1-H4 regarding the effects of the 2006 reform on labor force transitions accounting for additional relevant institutional features. To help quantify the marginal effects, we additionally present relative marginal effects (RME) which relate the marginal effects to the age-group specific pre-reform mean transition rate for the considered outcome.

An additional aspect is relevant for the interpretation of our estimates. Under hypothesis H2 entry into unemployment changes as an effect of the reform. If the unobservable characteristics of individuals entering unemployment vary over time (e.g., only those with lower ability enter after

[10] When estimating transitions from employment, we account for potential anticipation of the 2006 reform, its interaction with age group indicators and anticipation of the end of the 58 regulation. When estimating transitions from unemployment, we account for whether there are remaining unemployment benefit entitlements and for the duration of past unemployment benefit receipt in the ongoing unemployment spell. With both outcomes, we consider a vector of retirement indicators, which describe current eligibility for early and full retirement and the number of years until eligible for early and full retirement (see **Table A.4** and **Appendix B** for definitions and **Table A.5** for descriptive statistics).

benefit payout periods are reduced) and if these unobservables are correlated with subsequent transitions from unemployment, this selection into the state of unemployment may bias our estimates. In order to address this issue we offer a specific set of robustness tests.

Parallel Path Assumption

Our estimations identify causal treatment effects only if the parallel trends assumption holds. Without the reform, the development in labor market transitions for treatment and control groups should have followed parallel trends. Here, we offer two approaches to evaluate the validity of this assumption; later, we discuss placebo tests in the section on robustness tests.

First, we inspect graphic pre-reform trends in outcomes for treatment and control groups. **Figure 1** presents the development of seasonally adjusted transition rates for the control group (age 40-44) and the pooled treatment group (age groups 45-64). The lines in the top left panel represent the propensity to remain employed (E-E transitions). The upward trends for control and treatment groups appear to run in tandem in the pre-reform period except for brief deviations at the end of 2004 for the control group. At the end of 2005, we observe a strong decline of the employment stays of the treatment group which confirms that we have to account for anticipation behavior. The two groups' monthly U-U transition rates (see top right panel) differ in levels. The rates for the control group are more volatile, yet, neither group experiences clear shifts in transition rates over time. The bottom left panel presents monthly unemployment entry rates (E-U transitions). The trends develop in parallel for treatment and control groups until the end of 2005. Here, again, we observe clear anticipation behavior of the treatment group as the transition rate of the treatment group sharply increases shortly before the reform. The lines in the bottom right panel represent U-E transitions, which - in levels and volatility - differ substantially for the two groups. Again, both groups appear to follow roughly parallel pre-reform trends. In sum, overall and particularly

immediately prior to the anticipation and reform periods, the graphs suggest mostly parallel paths for the control and treatment groups.

Second, we offer significance tests of time trend differences. Based on data for the pre-reform (and, for transitions from E, the pre-anticipation) period, we estimate the following specification using a logit estimator:

$$AB_{i,m} = \gamma_0 + \gamma_1 \, age_{i,m} + \gamma_2 \, t_{i,m} + \gamma_3' \, (t_{i,m} * age_{i,m}) + \gamma_4' \, X1_{i,m} + \gamma_5' \, X2_{i,m} + \varepsilon_{i,m} \, . \qquad (4)$$

We interact age indicators for the treatment group with measures of the time trend (t) controlling for the *X1* and *X2* vectors of covariates. The coefficient vector γ_2 estimates the time trend for the control group; γ_3 indicates whether the time trend differs significantly for the treated age groups. We consider the four relevant transitions and apply linear, quadratic, and cubic specifications of the monthly time trend. If the estimates of γ_3 are jointly statistically significant, the identifying assumption does not hold and we cannot claim to establish causal effects.

Table 2 presents the results of the hypothesis tests for the full sample: in Panel A we consider the entire treatment group jointly and in Panel B we separately consider age groups which were differently affected by the reform (see **Table 1**). We show the p-values of joint significance tests of γ_3 for the different functional forms of the time trend for our four transition outcomes. If the test yields statistical significance at the five or one percent level, the p-value is underlined or marked in bold.[11] Across the four outcomes, we find different patterns. While for the U-U transitions the hypothesis of parallel paths is significantly rejected for the pooled and most age-specific treatment groups, only a few age-groups appear to follow significantly different time trends

[11] In addition to the p-values, we inspected the coefficient estimates themselves. In Panel A, their signs do not alleviate concerns regarding non-parallel paths: the significant trend difference is positive for the treatment group in the E-E transitions and negative for the treatment group in the U-U transitions.

compared to the control group of 40-44 year olds for the other outcomes. For E-E transitions, we observe significantly different paths in the pooled treatment group and in two of the seven age groups (57-59 and 63-64). For E-U transitions, there is evidence for non-parallel paths for age group 63-64 when cubic terms are used. With respect to the U-E transitions, two interaction terms (out of 21) yield significant coefficient estimates. The results differ depending on the specification of the time trend functional form. Overall, these results suggest that our difference-in-differences estimates of U-U transitions may reflect different pre-reform trends and therefore do not present causal effects. This may be due a number of possible mechanisms including changes in the composition of the young unemployed, shifts in job finding rates and labor demand, or random fluctuations. In the other cases, there is no general indication of heterogeneous pre-reform trends confirming the patterns suggested by **Figure 1**. We consider this in our interpretation of findings and offer robustness tests controlling for group-wise time trends.

Results and Robustness

Baseline Results

To determine the causal reform effects on older workers' labor force transitions and to test our hypotheses we estimate difference-in-differences models on samples of employed and unemployed workers and consider four transition outcomes (E-E, E-U, U-U, and U-E), each coded as a binary indicator.

We estimated logit models of equation (3): the individual coefficients mostly yield the expected sign and small standard errors (the online appendix presents coefficient estimates with standard errors clustered at the individual level). To interpret the estimated effects, we calculated marginal effects and their standard errors based on the delta method (see columns 1-4 of **Tables 3** and **4**).

Panel A of **Table 3** and **4 (**columns 1-4) presents our estimates of marginal reform effects for the pooled treatment group. The estimates yield the expected direction of reform effects: after the reform the propensity to stay employed (E-E) increased, the propensity to enter unemployment (E-U) decreased insignificantly[12], the propensity to remain unemployed (U-U) fell and the propensity to reenter employment (U-E) increased on average for the treatment group. We calculated relative marginal effects (RME) dividing the marginal effects by the mean of pre-reform transition rates in the considered age group. The propensity to remain employed increased by only 0.4 percent per month which is due to the very high mean persistence in employment (see **Table A.3**). In contrast, the RME is largest - though statistically insignificant - for entry to unemployment (E-U). The two RMEs describing transitions out of unemployment are large, as well, with a significant decline in the propensity to stay unemployed (U-U) by 4 percent per month and a significant increase in the monthly job finding rate (U-E) by about 22 percent.

These results show that the reform had independent effects on the four considered transitions. Indeed, the fact that we see differences in the reform effects for H1 and H4, and H2 and H3 suggests that the reform also affected transition into the "other" labor force state. Given our controls for other institutional changes (e.g., regarding retirement) this reflects effects of the unemployment benefit reform.

The marginal effects in Panel B show treatment effects by age group. With only one exception (age group 45-46 in column 1 of **Table 3**), all age group-specific results show the same direction as the pooled results in Panel A. Generally, the estimates for age groups, who suffered the largest decline in benefit duration (see **Table 1**) show the largest and most statistically significant reform effects. For example, columns 1 and 2 of **Table 4** suggest that for all age groups

[12] This marginal effect is statistically significant when linear age controls are considered. The coefficient estimate for the underlying interaction term is statistically significant at the 1 percent level. In non-linear models marginal effect and coefficient estimates can differ in precision.

the reform reduced the propensity to enter unemployment with significant effects. However, while the 55-56 year olds lost 8 months in unemployment benefit duration those in the younger (52-54) and older (57-64) age groups lost 14 months and show stronger responses. Surprisingly, we do not obtain statistically significant estimates for E-U transitions in the oldest age group (63 and 64). Columns 1-4 of **Table 4** describe reform effects on transitions from unemployment. The propensity to stay unemployed (columns 1-2) declined and the job finding rate (columns 3-4) increased for all age groups, in part substantially.

In columns 5-8 of **Table 3** and **4,** we show the results that obtain when using the set of controls as in Dlugosz et al. (2014).[13] With these estimates, we test how our controls for institutional features and especially our additional retirement controls affect the results. Compared to our preferred results, the estimates in Panel A differ - in part substantially - in magnitude and significance. The estimates in Panel B also partly differ in magnitudes, but mostly show similar signs and significance. Of particular interest is the change of direction and statistical significance of the marginal effect estimates of the older age groups. It is for these age groups where we expect our controls and especially the retirement controls to matter most. The results confirm this. Without our set of controls, we find a significant decline of E-E transitions for the 60-62 year olds (see column 5 of **Table 3**) as well as a significant positive reform effect on U-U transitions of the 63-64 year olds.

To illustrate the estimated effect sizes, we first calculate the mean duration in a given state prior to the reform (not shown). If, e.g., we consider the 60-62 age group and invert the transition rates, the average period in employment prior to any transition is about 43 months (E-E), the time until a transition to unemployment is almost 15 years (E-U), the duration of unemployment is about

[13] See **Table A.6** for definitions.

22 months (U-U), and the time until finding a job after unemployment on average about 40 years (U-E). The latter reflects a very unusual outcome in this age group. Our RME estimates in columns 2 and 4 of **Table 3** suggest that uninterrupted stays in E for this age group are extended by about one month, employment prior to job loss is about 4.5 years longer, time in uninterrupted unemployment spells decreases by about 9 months, and the time until finding a job declines from 40 to 15 years on average. The uninterrupted periods in employment and unemployment change little and the rates of job loss and job finding adjust more strongly after the reform.

In addition, we calculated the marginal and relative effects per month of benefit reduction for each age group. We obtain the largest effects again for U-E transitions where the reduction of unemployment benefit duration by one month increases monthly transition rates between 1.9 and 11.4 percent (see online appendix).

Overall, these results show that the reforms indeed had effects consistent with our hypotheses: for employed workers, the reforms reduced entry into unemployment and encouraged workers to remain employed. For unemployed workers, the reforms increased the probability of finding a job and reduced the probability of remaining unemployed. It is also possible that the reforms affected transitions into the "Other" category. While transitions into and out the "Other" category is not our main focus, **Table A.7** in the appendix presents multinomial logit results by age group including this "Other" category. For Panel A, we find that transitions into and out of employment and unemployment are very similar in magnitude and significance compared to the results in **Tables 3** and **4** with the only exception of E-E transitions; also, for Panel B we obtain results very similar to those observed before. Columns 5 and 6 of **Table A.7** show (relative) marginal effects for transitions to O. Generally, we do not find significant reform effects on transitions from E to O suggesting that reduced unemployment entry is not reflected in labor force exits. In contrast, we find a significant increase in transitions from unemployment to O in Panels

A and B. Given that relevant pension reforms are accounted for, we conclude that the shortening of unemployment benefit duration did not only incentivize older workers to move from unemployment to employment, but might also have encouraged labor force exit or employment in "other" environments such as self-employment.

Heterogeneity by Gender and Education

We discussed above that due to the retirement insurance regulations women in contrast to men may still have access to early retirement at age 60 even without prior unemployment spells. Also, women may enter normal retirement prior to age 65, see **Table A.1**.[14] Females might thus respond less to the unemployment benefit reform of 2006. In order to investigate gender-based heterogeneities, we re-estimated our models of **Table 3** and **4** (columns 1-4) separately for male and female subsamples. We show coefficient estimates and age group specific results (similar to Panel B in **Table 3** and **4**) in the online appendix. The first two rows of **Table 5** present the (relative) marginal effects of the pooled treatment group separated by gender which are mostly statistically significant. While we expected larger reform effects for males than for females we find the opposite pattern. Thus, either the share of females using the female retirement option is too small to affect the overall female response or female labor force participation choices respond more strongly to financial incentives than those of men.[15]

In addition, the effect of reduced unemployment benefit duration may differ depending on workers' human capital. Workers with little formal education may be under stronger financial pressure and they may experience greater difficulties in finding and holding on to employment than

[14] Women must meet specific requirements regarding their past retirement insurance contributions to be able to enter early and normal retirement prior to men.

[15] In separate estimations, we tested for different reform response among unemployed individuals with and without dependent children. We did not observe significant differences by family status, neither for men nor for women.

better educated individuals. We split samples based on educational groups (see **Tables A.4** and **A.5**) and estimate our models separately for these subsamples. The bottom rows of **Table 5** present the (relative) marginal effects (for coefficient estimates - also by age groups - please see the online appendix). Generally, only about half of the marginal effects estimates are statistically significant. Across education groups, we find indeed the largest reform effects among those with low education. This heterogeneity may be due to better job opportunities for the highly educated.

Placebo and Robustness Tests

So far, we found that the 2006 unemployment benefit reform went along with and potentially caused increased persistence in employment, reduced persistence in unemployment, reduced unemployment entries, and increased unemployment exits. We obtained these results for our preferred specification given certain assumptions regarding sample selection, standard error calculations, and the choice of an estimator. In this section, we offer results from placebo tests to evaluate our identification strategy and investigate whether the results are robust to modifying our procedures.

First, we conduct a placebo test of the parallel path assumption. **Table 6** presents marginal effects obtained after we set the reform date to February 1, 2005 instead of February 1, 2006 and considered transitions between March 2004 and November 2005. This avoids the period of the actual reform and most of its anticipation period. Except for U-U transitions the marginal effects in Panels A and B either show the opposite sign of the baseline results or are statistically insignificant. This confirms the conclusions based on **Table 2**: except for the U-U transitions, we have no reason to doubt our identifying assumptions. We obtained very similar results with alternative placebo reform tests which can be found in the online appendix.

In a first set of our robustness tests, we address an issue already mentioned in the section on methods: the selection into unemployment may have changed over time.[16] To test whether this might affect the estimated effects on transitions from unemployment, we offer additional robustness checks (see **Table 7**). First, to avoid anticipation related selection, we drop observations from the sample that had entered unemployment in the three months preceding the reform (Nov. 1, 2005 – Jan. 31, 2006). Compared to the baseline results in **Table 3** and **4** (columns 1-4)**,** the marginal effects (see row 2 of **Table 7**) hardly change with this adjustment. In a second test, we drop all observations in the state of unemployment after February 1, 2006 which had entered unemployment prior to February 1, 2006. The results (see row 3 of **Table 7**) are slightly smaller in magnitude but remain highly statistically significant. Third, to limit the relevance of unobservable characteristics, we compare transitions from unemployment before and after the reform only for those who had been unemployed for less than 3, 6, 9, and 12 months. The reform effects (see rows 4-7) are smaller for unemployment spells of shorter duration but maintain the expected direction and statistical significance. In sum, the potential selection does not appear to affect our results substantively.

Table 8 presents a set of additional, more general tests. First, we extend our sample of observations. We use not only those workers who can claim the maximum duration of unemployment benefits based on their past labor market career but instead, we now consider all those at least somewhat affected by the reform. As an example, all 45 year olds, who had not yet accumulated 39 insurance months prior to an unemployment spell (but, e.g., 32), could not claim 18 (but e.g. 16) months of unemployment benefit pre-reform (see **Table A.2**). Therefore, they did not experience the full reform-induced decline from 18 to 12 months benefit payout. **Table 8** row

[16] For all robustness tests, we show and discuss the marginal effects only of the pooled treatment group analyses. For separate results by age group and for coefficient estimates of the estimations (also for placebo tests), please consult the online appendix.

2 shows the estimated marginal effects with a thus enlarged sample. Compared to the baseline results of **Table 3** and **4** (Panel A, columns 1-4) reprinted in row 1 of **Table 8,** the estimates in row 2 confirm the robustness of our main findings: the patterns of signs, significance, and (relative) marginal effect sizes are very similar. The effect for transitions from employment to unemployment is now estimated more precisely.

We perform a second test to evaluate a selectivity dimension in our data. While we explicitly control for anticipation behavior prior to the reform, we do not account for the potential mechanical effect of such anticipated transitions on post-reform transition. As an example, the propensity to leave unemployment for employment may be subdued early after February 2006 if numerous workers just moved the unemployment entry forward to complete it prior to February 1. As a result, there may be a reduced risk of job loss in the months immediately afterwards. To test whether such mechanisms affect our findings, we apply a "donut-estimator" and re-estimate the model after omitting observations from periods right after the reform. In row 3 of **Table 8**, we show the estimated (relative) marginal effects after omitting the months February - July 2006.[17] Our estimates are robust. Surprisingly, the marginal effects for E-E transitions increases in magnitude compared to the baseline estimates. The results for the other transitions are confirmed.[18]

A third aspect refers to the specific incentives that derive from the discrete jumps in the duration of benefit receipt at certain ages. These jumps generate incentives for 'almost unemployed' workers close to the age cutoffs of age 44, 46, 51, 56 pre-reform and at 54 post-reform to postpone unemployment entry. Since these incentives differ before and after the reform, they may bias our estimates for transitions from E. We repeat our estimations omitting individuals of the relevant

[17] We also estimated the model when omitting only February - May 2006. There, we observe even smaller changes in effects.

[18] Given the lack of parallel pre-reform time trends for the U-U transitions (see **Table 2**), we estimated a model accounting for age-groups specific trends (results not yet presented). The results of **Table 3** and **4** (columns 1-4) were robust to this modification.

ages and show the results for transitions from employment in row 4 of **Table 8**. We find that the estimates of the reform effect increase in magnitude. This suggests that the age specific incentives attenuated our estimates which, however, are confirmed in direction and significance.

In duration models, the omission of controls for duration dependence may cause biased estimation results. In our models for transitions from unemployment, we account for the duration of the ongoing spell. In our fourth test, we add controls for the duration of the ongoing spell in models for transitions from E as well. The marginal effects (see row 5 of **Table 8**) increase in magnitude and are robust in sign and significance.

In our fifth test, we change the way standard errors are computed. While we allowed for clusters at the individual level so far, we now cluster at the cohort and calendar year level because that is the level at which the reform affects workers. We show the estimated marginal effects in row 6 of **Table 8**. Clustering the standard errors at a more conservative level eliminates the statistical significance of the reform effects on E-E transitions. As the other estimates did not change in important ways, we conclude that our results are not due to unaccounted correlation patterns of unobservable error terms.

Next, we evaluate to what extent the results are robust to the choice of an estimator. We first replaced the logit by a probit and then by a complementary log-log model. The estimates of the marginal effects in rows 7 and 8 of **Table 8** confirm that the results are highly robust to the choice of an estimator.

Conclusions

When we observe vast changes in labor force participation, it is important to understand the underlying processes. This is of particular and international interest if the observed change is one that is relevant and desired for many labor markets. We study a potential determinant of an

incredible rise in older workers' labor force participation in Germany, where since 2000 the population share of employed older workers (age 55-64) increased by 53 percent for men and by 110 percent for women.

As the literature disagrees on the relevance of the institutional framework, we investigate whether labor market reforms affect older workers' transitions between labor force states. We focus on a reform of unemployment benefit duration, implemented in February 2006 that shortened unemployment benefit payout by between 6 and 14 months for workers above age 44. Based on a difference-in-differences estimator we compare the change in labor force transitions of workers affected and not affected by the reform.

We consider a setting with three labor force states (employment, unemployment, other). Based on a search theory rationale, we expect that shortened unemployment benefit payout reduces the propensity to enter unemployment (E-U) and to leave employment (E-E); also, it should increase the propensity to take up employment (U-E) and to leave unemployment (U-U). We test these hypotheses while considering a number of institutional developments; we account for potential anticipation behavior, which has been found in prior research (Dlugosz et al. 2014). Moreover, we carefully control for changes in retirement regulations that might affect labor market choices. Our precise administrative data offer large sample sizes.

We find that the reduction of unemployment benefit payments affected the transition rates of older workers in the expected ways. Compared to a reference group of 40-44 year olds for whom benefit payout did not change, we find that after the reform job exit rates declined, job finding rates increased, the propensity to stay in employment increased and the propensity to stay in unemployment declined. We observe the largest behavioral adjustments among those affected most strongly by the reform. We cannot interpret all of our findings as causal effects. This is particularly the case for U-U transitions and for certain older age groups in E-E transitions. Nevertheless, the

patterns we find suggest that the reform of unemployment benefits may be one of the reasons behind the recent incredible rise in old age employment in Germany.

We compare the effects for subsamples separated by gender and education. Females appear to respond more strongly than males to the reform and out of all education groups those with low education show the larges behavioral adjustments. We pay particular attention to possible selection biases in transitions from unemployment offering a variety of tests. Finally, we test the robustness of our results to different specifications of the estimation model, sample selection mechanisms and estimators, and conduct placebo tests. In all cases, our results are corroborated.

We confirm the relevance of institutional reforms for labor force participation choices of older workers. There is strong evidence that institutions matter and can have substantial effects on the employment behavior of older workers. This is important news for many countries with ailing retirement systems.

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Table 1 Maximum duration of unemployment benefit receipt (in months) by age and period

1	2	3	4	5	6	7
Age	Pre-Reform until 1/06	Post-Reform 2006 2/06-12/07	Change in months 3 - 2	Post-Reform 2008 since 1/08	Change in months 5 - 3	Total change in months 5 - 2
< 45	12	12	0	12	0	0
45-46	18	12	-6	12	0	-6
47-49	22	12	-10	12	0	-10
50-51	22	12	-10	15	3	-7
52-54	26	12	-14	15	3	-11
55-56	26	18	-8	18	0	-8
57	32	18	-14	18	0	-14
> 57	32	18	-14	24	6	-8

Note: The cut in durations as of February 2006 affected those unemployed since February 1, 2006. The prolongation of unemployment benefit durations as of January 2008 affected those entering unemployment on or after January 1, 2008 and aged 50 or 58 at that time, or those still receiving unemployment benefits from a prior entry to unemployment on January 1, 2008 and aged at least 50 or 58 at that time.

Source: BGBL.I, 1997, p. 627; BGBL.I, 2003, p. 3004; BGBL.I, 2008, p. 681

Table 2 Tests for parallel trends: pooled sample

	E-E transitions			E-U transitions			U-U transitions			U-E transitions		
	linear	quadratic	cubic	linear	quadratic	cubic	linear	quadratic	cubic	linear	quadratic	cubic
Panel A:												
45-64 years old	0.0987	**0.0088**	**0.0010**	0.7648	0.9541	0.9468	**0.0000**	**0.0000**	**0.0000**	0.1155°	0.1339°	0.0136°
Panel B:												
45-46 years old	0.0819	0.2126	0.3551	0.1821	0.2769	0.3386	0.6764	0.0933	0.1106	0.5577	0.0484	0.0720
47-51 years old	0.3141	0.5271	0.7359	0.5647	0.7895	0.8961	0.0141	0.0386	0.0856	0.1007	0.2340	0.3655
52-54 years old	0.0934	0.1143	0.0773	0.1397	0.3103	0.3976	**0.0005**	**0.0005**	**0.0002**	0.2325	0.3441	0.0297
55-56 years old	0.1462	0.0574	0.0517	0.0540	0.0900	0.1803	**0.0000**	**0.0000**	**0.0000**	0.2935	0.5623	0.3591
57-59 years old	**0.0050**	**0.0004**	**0.0000**	0.8615	0.8288	0.5203	**0.0000**	**0.0000**	**0.0000**	0.4566	0.2045	0.0946
60-62 years old	0.6480	0.9074	0.0770	0.0564	0.1227	0.1406	**0.0000**	**0.0000**	**0.0000**	0.7032	0.8986	0.9538
63-64 years old	0.9892	**0.0002**	**0.0001**	0.2352	0.4747	**0.0071**	**0.0013**	**0.0058**	**0.0042**	0.8204	0.9731	0.8346
Controls:												
Age, gender, education, state of residence		yes			yes			yes			yes	
Month effects		yes			yes			yes			yes	
Retirement controls		yes			yes			yes			yes	
Unemployment benefit controls		no			no			yes			yes	

Note: Standard errors are clustered at the individual level. In estimations marked by ° (U-E transitions in Panel A) convergence could only be attained after replacing age fixed effects; the results presented are based on a specification with a linear trend in age. Estimation period: Transitions from E=03/2004 –08/2005; Transitions from U=03/2004 –01/2006. Table shows p-values for the tests of joint significance of the coefficient for age specific time trends (γ_3 in equation 4). For a list and definition of control variables, see **Table A.4**.

Source: SIAB 7510 and own calculations.

Table 3 Baseline results: Logit estimates of marginal reform effects for treatment groups pooled for all age groups and by age groups

	E-E transitions			E-U transitions			E-E transitions			E-U transitions		
	ME		RME	ME		RME	ME		RME	ME		RME
	(1)		(2)	(3)		(4)	(5)		(6)	(7)		(8)
Panel A:												
45-64 years old	0.00401	***	0.40%	-0.00087		-30.85%	0.00132	**	0.13%	-0.00044	***	-15.60%
Panel B:												
45-46 years old	-0.00013		-0.01%	-0.00007		-2.90%	-0.00017		-0.02%	-0.00002		-0.83%
47-51 years old	0.00011		0.01%	-0.00040	***	-16.33%	0.00025		0.03%	-0.00042	***	-17.14%
52-54 years old	0.00032		0.03%	-0.00038	**	-14.84%	0.00057	*	0.06%	-0.00062	***	-24.22%
55-56 years old	0.00002		0.00%	-0.00022		-7.77%	0.00014		0.01%	-0.00045		-15.90%
57-59 years old	0.00144	***	0.15%	-0.00127	***	-34.70%	0.00178	***	0.18%	-0.00154	***	-42.08%
60-62 years old	0.00059		0.06%	-0.00130	***	-28.63%	-0.00200	**	-0.20%	-0.00093	**	-20.48%
63-64 years old	0.00226	*	0.24%	-0.00031		-9.51%	0.00441	*	0.47%	0.00003		0.92%
Controls:												
Age, gender, education, state of residence	yes			yes			yes°			yes°		
Linear and quadratic trends x state	yes			yes			no			no		
Month and year effects	yes			yes			yes			yes		
Retirement controls	yes			yes			yes			yes		
Anticipation controls	yes			yes			yes			yes		
Unemployment benefit controls	no			no			yes*			yes*		
N	8,020,998											

Note: Standard errors are clustered at the individual level. ***: p < 1 %; **: p < 5 %; *: p < 10 %. RME are calculated as the relation of the age-specific marginal effect and the mean probability of the transition in the pre-reform period for the specific age group. Estimations include main reform effect "post-reform". Pre-reform period: 03/2004-08/2005; Anticipation period: 09/2005-01/2006; Post-reform period: 02/2006-12/2007. For a list and definition of control variables for columns (1)-(4), see **Table A.4.** ° Plus firm-specific controls (see **Table A.6**). * Plus employment controls (see **Table A.6**). For a list and definition of control variables for columns (5)-(8), see **Table A.6.**

Source: SIAB 7510 and own calculations.

Table 4 Baseline results: Logit estimates of marginal reform effects for treatment groups pooled for all age groups and by age groups

	U-U transitions			U-E transitions			U-U transitions			U-E transitions		
	ME		RME	ME		RME	ME		RME	ME		RME
	(1)		(2)	(3)		(4)	(5)		(6)	(7)		(8)
Panel A:												
45-64 years old	-0.03871	***	-4.14%	0.00379	***	21.51%	-0.01544	***	-1.65%	0.00622	***	35.30%
Panel B:												
45-46 years old	-0.02076	***	-2.36%	0.00410	**	7.66%	-0.01075	***	-1.22%	0.00464	***	8.67%
47-51 years old	-0.04345	***	-4.78%	0.00255	*	6.35%	-0.01663	***	-1.83%	0.00447	***	11.13%
52-54 years old	-0.06960	***	-7.51%	0.00730	***	27.08%	-0.02042	***	-2.20%	0.00789	***	29.27%
55-56 years old	-0.05174	***	-5.51%	0.00437	**	24.58%	-0.00924	***	-0.98%	0.00441	**	24.80%
57-59 years old	-0.03714	***	-3.88%	0.00588	***	95.45%	-0.00663	***	-0.69%	0.00397	***	64.45%
60-62 years old	-0.03225	***	-3.38%	0.00331	***	159.90%	-0.00058		-0.06%	0.00172	***	83.09%
63-64 years old	-0.03153	***	-3.41%	0.00003		2.14%	0.00418	***	0.45%	0.00024		17.14%
Controls:												
Age, gender, education, state of residence	yes			yes			yes°			yes°		
Linear and quadratic trends x state	yes			yes			no			no		
Month and year effects	yes			yes			yes			yes		
Retirement controls	yes			yes			yes			yes		
Anticipation controls	no			no			no			no		
Unemployment benefit controls	yes			yes			yes			yes		
N	430,301											

Note: Standard errors are clustered at the individual level. ***: p < 1 %; **: p < 5 %; *: p < 10 %. RME are calculated as the relation of the age-specific marginal effect and the mean probability of the transition in the pre-reform period for the specific age group. Estimations include main reform effect "post-reform". Pre-reform period: 03/2004- 01/2006; Post-reform period: 02/2006- 12/2007. For a list and definition of control variables for columns (1)-(4), see **Table A.4**. ° Plus firm-specific controls (see **Table A.6**). For a list and definition of control variables for columns (5)-(8), see **Table A.6**.

Source: SIAB 7510 and own calculations.

Table 5 Heterogeneity of reform effects by gender and education for treatment groups pooled for all age groups

	E-E transitions			E-U transitions			U-U transitions			U-E transitions		
	ME		RME	ME		RME	ME		RME	ME		RME
	(1)		(2)	(3)		(4)	(5)		(6)	(7)		(8)
Men	-0.00024		-0.02%	-0.00044	***	-16.79%	-0.03659	***	-3.91%	0.00275	***	15.28%
Women	0.00548	**	0.55%	-0.00188		-62.05%	-0.05666	***	-6.05%	0.00460	***	26.65%
Low educated	0.01018	*	1.03%	-0.01320		-427.18%	-0.04848	***	-5.16%	0.00260		23.70%
Middle educated	0.00314		0.32%	-0.00064		-22.38%	-0.03906	***	-4.17%	0.00366	***	20.14%
Highly educated	0.00287		0.29%	-0.00075		-34.09%	-0.02956	***	-3.18%	0.00531	**	23.19%
Controls:												
Age, gender, education, state of residence	yes			yes			yes			yes		
Linear and quadratic trends x state , month and year effects	yes			yes			yes			yes		
Retirement controls	yes			yes			yes			yes		
Anticipation controls	yes			yes			no			no		
Unemployment benefit controls	no			no			yes			yes		

Note: Standard errors are clustered at the individual level. ***: p < 1 %; **: p < 5 %; *: p < 10 %. RME are calculated as the relation of the age-specific marginal effect and the mean probability of the transition in the pre-reform period for the specific age group. Estimations include main reform effect "post-reform". Pre-reform period: Transitions from E=03/2004-08/2005; Transitions from U=03/2004-01/2006. Anticipation period: Transitions from E=09/2005 – 01/2006. Post-reform period: 02/2006 – 12/2007. For a list and definition of control variables, see **Table A.4**. The estimations in row 1 and 2 omit controls for gender and the estimations in rows 3, 4, and 5 omit controls for education.

Source: SIAB 7510 and own calculations.

Table 6 **Placebo test: Logit estimates of marginal effects (ME) and relative marginal effects (RME) of the reform effects on labor market transitions when assuming a reform on February 1, 2005**

	E-E transitions		E-U transitions		U-U transitions		U-E transitions	
	ME	RME	ME	RME	ME	RME	ME	RME
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
45-64 years old	-0.00034	-0.03%	0.00018	5.86%	-0.02782 ***	-2.97%	0.00118	6.69%
Panel B:								
45-46 years old	-0.00026	-0.03%	-0.00002	-0.78%	-0.01368 **	-1.55%	0.00163	3.19%
47-51 years old	-0.00018	-0.02%	-0.00003	-1.14%	-0.03253 ***	-3.56%	0.00066	1.75%
52-54 years old	-0.00002	0.00%	-0.00010	-3.48%	-0.04904 ***	-5.27%	0.00220	8.51%
55-56 years old	0.00006	0.01%	-0.00003	-0.94%	-0.05528 ***	-5.86%	0.00320	19.14%
57-59 years old	-0.00056 **	-0.06%	0.00048 **	12.21%	-0.02116 ***	-2.21%	0.00036	7.26%
60-62 years old	0.00029	0.03%	0.00050	10.25%	0.01765 **	1.85%	0.00027	13.11%
63-64 years old	-0.00177	-0.19%	-0.00077	-19.40%	-0.04466 **	-4.88%	-0.00048	-39.34%
Controls:								
Age, gender, education, state of residence	yes		yes		yes		yes	
Linear and quadratic trends x state , month and year effects	yes		yes		yes		yes	
Retirement controls	yes		yes		yes		yes	
Unemployment benefit controls	no		no		yes		yes	
N	3,599,085				216,403			

Note: Standard errors are clustered at the individual level. ***: p < 1 %; **: p < 5 %; *: p < 10 %. RME are calculated as the relation of the age-specific marginal effect and the mean probability of the transition in the pre-reform period for the specific age group. Estimations include main reform effect "post-reform". Pre-reform period: 03/2004-01/2005. Post-reform period: 02/2005-11/2005. For a list and definition of control variables, see **Table A.4**.

Source: SIAB 7510 and own calculations.

Table 7 Marginal effects for robustness tests affecting transitions from unemployment pooled for all age groups

	U-U transitions		U-E transitions	
	ME	RME	ME	RME
	(5)	(6)	(7)	(8)
1: Baseline Estimation (Tab. 4)	-0.03871 ***	-4.14%	0.00379 ***	21.51%
2: Without U in Nov 2005-Jan 2006	-0.03621 ***	-3.89%	0.00341 ***	19.60%
3: Without U before Feb 2006	-0.02769 ***	-2.95%	0.00321 ***	16.89%
4: Unemployment < 12 months	-0.02019 ***	-2.12%	0.00451 ***	17.96%
5: Unemployment < 9 months	-0.00898 ***	-0.95%	0.00353 ***	12.46%
6: Unemployment < 6 months	-0.00666 ***	-0.71%	0.00300 **	9.06%
7: Unemployment < 3 months	-0.00488 *	-0.52%	0.00125	3.07%
Controls:				
Age, gender, education, state of residence	yes		yes	
Linear and quadratic trends x state , month and year effects	yes		yes	
Retirement controls	yes		yes	
Anticipation controls	no		no	
Unemployment benefit controls	yes		yes	

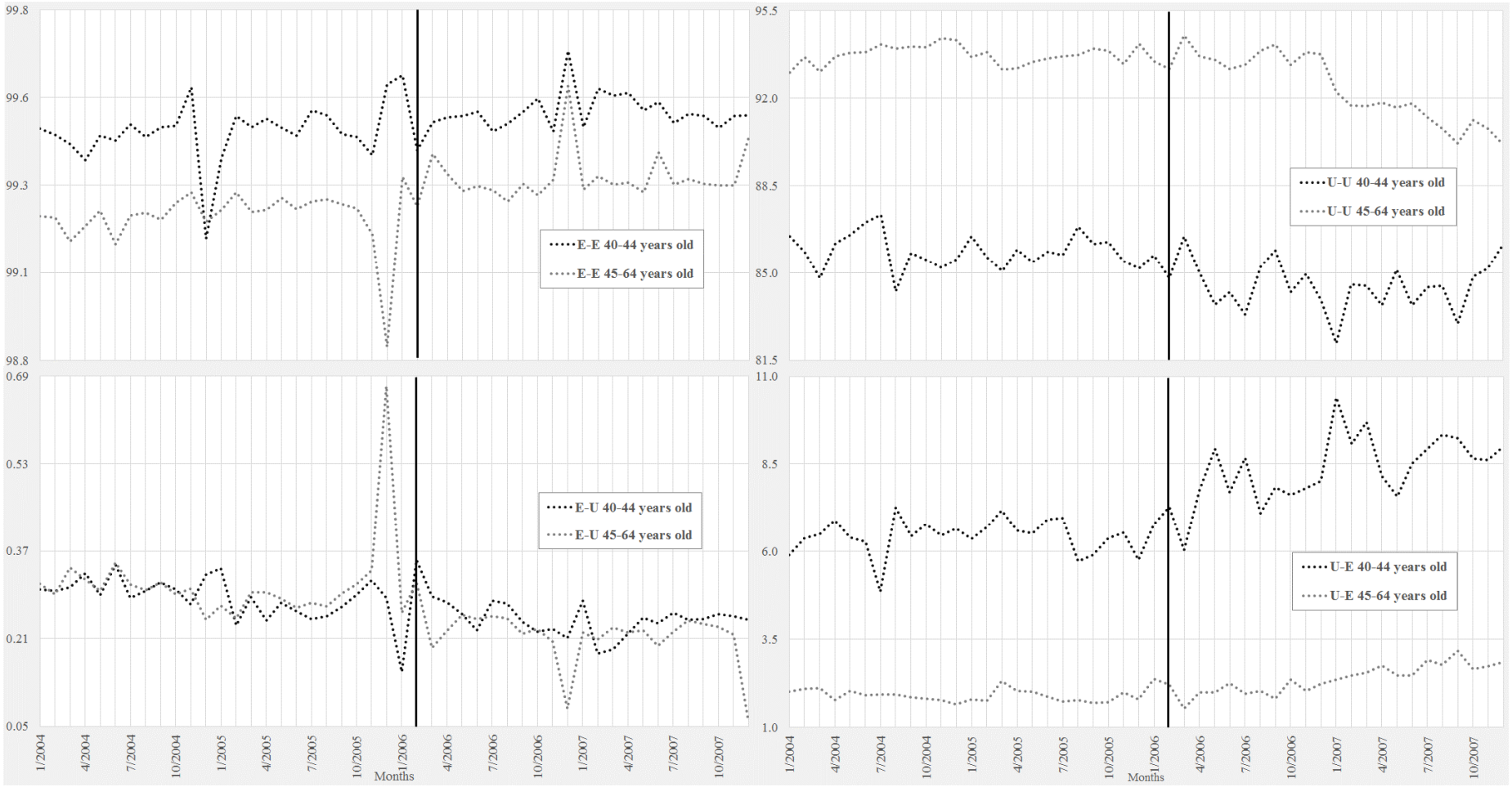
Note: Please see **Table 5**. We used the following numbers of observations: row 1: 430,301; row 2: 380,002; row 3: 311,678; row 4: 261,589; row 5: 202,624; row 6: 141,133, row 7: 69,627.
Source: SIAB 7510 and own calculations.

Table 8 Robustness checks of reform effects for treatment groups pooled for all age groups

	E-E transitions			E-U transitions			U-U transitions			U-E transitions		
	ME		RME	ME		RME	ME		RME	ME		RME
	(1)		(2)	(3)		(4)	(5)		(6)	(7)		(8)
1: Baseline Estimation (Tab. 3 and 4)	0.00401	***	0.40%	-0.00087		-30.85%	-0.03871	***	-4.14%	0.00379	***	21.51%
2: Extended pooled sample	0.00488	**	0.49%	-0.00088	**	-24.79%	-0.03346	***	-3.60%	0.00352	***	16.33%
3: Without Feb-Jul 2006	0.00727	***	0.73%	-0.00075		-26.60%	-0.03838	***	-4.11%	0.00341	***	19.53%
4: Without age 45, 47, 52, 55, and 57	0.00719	**	0.73%	-0.00301		-102.38%	-		-	-		-
5: Duration employment	0.00552	***	0.56%	-0.00241		-85.46%	-		-	-		-
6: SE birth cohort-by-year-level	0.00401		0.40%	-0.00087		-30.85%	-0.03871	***	-4.14%	0.00379	***	21.51%
7: Probit estimation	0.00211	**	0.21%	-0.00074	*	-26.24%	-0.03402	***	-3.64%	0.00379	***	21.51%
8: Cloglog estimation	0.00146	***	0.15%	-0.00087		-30.85%	-0.02865	***	-3.06%	0.00381	***	21.62%
Controls:												
Age, gender, education, state of residence	yes			yes			yes			yes		
Linear and quadratic trends x state , month and year effects	yes			yes			yes			yes		
Retirement controls	yes			yes			yes			yes		
Anticipation controls	yes			yes			no			no		
Unemployment benefit controls	no			no			yes			yes		

Note: Please see **Table 5**. The following number of observations was used in columns (1)-(4) / (5)-(8): rows 1 and 5-8: 8,020,998 / 430,301; row 2: 8,615,029 / 525,562; row 3: 6,980,023 / 368,752; row 4: 6,161,997.
Source: SIAB 7510 and own calculations.

Figure 1 Transition rates of control and treatment groups from 01/2004 to 12/2007



Note: Monthly employment and unemployment transition rates as a share of observations observed in employment and unemployment at the beginning of the ongoing month separately for control and treatment groups. Transition rates are seasonally adjusted by deducting calendar month-specific average deviations from mean transition rates from observed values.

Source: SIAB 7510 and own calculations.

Appendix A

Table A.1 Age at Retirement by Birth Cohort and Pathway

	A		B		C		D		E	
Birth	Retirement due to unemployment		Retirement for women		Ret. after long term employment		Regular old age retirement		Severely handicapped retirement	
Cohort	Full Age (Yr.)	Early Age (Yr.)	Full Age (Yr.)	Early Age (Yr.)	Full Age (Yr.)	Early Age (Yr.)	Full Age (Yr.)	Early Age (Yr.)	Full Age (Yr.)	Early Age (Yr.)
1934	60 (1994)	n.a.	60 (1994)	n.a.	63 (1997)	n.a.	65 (1999)	n.a.	60 (1994)	n.a.
1935	60 (1995)	n.a.	60 (1995)	n.a.	rising to 64 (1999)	63 (1998)	65 (2000)	n.a.	60 (1995)	n.a.
1936	60 (1996)	n.a.	60 (1996)	n.a.	rising to 65 (2001)	63 (1999)	65 (2001)	n.a.	60 (1996)	n.a.
1937	rising to 61 (1998)	60 (1997)	60 (1997)	n.a.	65 (2002)	63 (2000)	65 (2002)	n.a.	60 (1997)	n.a.
1938	rising to 62 (2000)	60 (1998)	60 (1998)	n.a.	65 (2003)	63 (2001)	65 (2003)	n.a.	60 (1998)	n.a.
1939	rising to 63 (2002)	60 (1999)	60 (1999)	n.a.	65 (2004)	63 (2002)	65 (2004)	n.a.	60 (1999)	n.a.
1940	rising to 64 (2004)	60 (2000)	rising to 61 (2001)	60 (2000)	65 (2005)	63 (2003)	65 (2005)	n.a.	* rising to 61 (2001)	60 (2000)
1941	rising to 65 (2006)	60 (2001)	rising to 62 (2003)	60 (2001)	65 (2006)	63 (2004)	65 (2006)	n.a.	* rising to 62 (2003)	60 (2001)
1942	65 (2007)	60 (2002)	rising to 63 (2005)	60 (2002)	65 (2007)	63 (2005)	65 (2007)	n.a.	* rising to 63 (2005)	60 (2002)
1943	65 (2008)	60 (2003)	rising to 64 (2007)	60 (2003)	65 (2008)	63 (2006)	65 (2008)	n.a.	* 63 (2006)	60 (2003)
1944	65 (2009)	60 (2004)	rising to 65 (2009)	60 (2004)	65 (2009)	63 (2007)	65 (2009)	n.a.	* 63 (2007)	60 (2004)
1945	65 (2010)	60 (2005)	65 (2010)	60 (2005)	65 (2010)	63 (2008)	65 (2010)	n.a.	* 63 (2008)	60 (2005)
1946	65 (2011)	rising to 61 (2007)	65 (2011)	60 (2006)	65 (2011)	63 (2009)	65 (2011)	n.a.	* 63 (2009)	60 (2006)
1947	65 (2012)	rising to 62 (2009)	65 (2012)	60 (2007)	65 (2012)	63 (2010)	rising to 65 1 m.	n.a.	* 63 (2010)	60 (2007)
1948	65 (2013)	rising to 63 (2011)	65 (2013)	60 (2008)	65 (2013)	63 (2011)	rising to 65 2 m.	n.a.	* 63 (2011)	60 (2008)
1949	65 (2014)	63 (2012)	65 (2014)	60 (2009)	rising to 65 3 m.	63 (2012)	rising to 65 3 m.	n.a.	* 63 (2012)	60 (2009)
1950	65 (2015)	63 (2013)	65 (2015)	60 (2010)	rising to 65 4 m.	63 (2013)	rising to 65 4 m.	n.a.	* 63 (2013)	60 (2010)
1951	65 (2016)	63 (2014)	65 (2016)	60 (2011)	rising to 65 5 m.	63 (2014)	rising to 65 5 m.	n.a.	63 (2014)	60 (2011)
1952	retirement pathway terminated		retirement pathway terminated		rising to 65 6 m.	63 (2015)	rising to 65 6 m.	n.a.	rising to 63 1 m.	rising to 60 1 m.
1953					rising to 65 7 m.	63 (2016)	rising to 65 7 m.	n.a.	rising to 63 2 m.	rising to 60 2 m.
1954					rising to 65 8 m.	63 (2017)	rising to 65 8 m.	n.a.	rising to 63 3 m.	rising to 60 3 m.
1955					rising to 65 9 m.	63 (2018)	rising to 65 9 m.	n.a.	rising to 63 4 m.	rising to 60 4 m.
1956					rising to 65 10 m.	63 (2019)	rising to 65 10 m.	n.a.	rising to 63 5 m.	rising to 60 5 m.
1957					rising to 65 11 m.	63 (2020)	rising to 65 11 m.	n.a.	rising to 63 6 m.	rising to 60 6 m.
1958					rising to 66 (2024)	63 (2021)	rising to 66	n.a.	rising to 63 7 m.	rising to 60 7 m.
1959					rising to 66 2 m.	63 (2022)	rising to 66 2 m.	n.a.	rising to 63 8 m.	rising to 60 8 m.
1960					rising to 66 4 m.	63 (2023)	rising to 66 4 m.	n.a.	rising to 63 9 m.	rising to 60 9 m.
1961					rising to 66 6 m.	63 (2024)	rising to 66 6 m.	n.a.	rising to 63 10 m.	rising to 60 10 m.
1962					rising to 66 8 m.	63 (2025)	rising to 66 8 m.	n.a.	rising to 63 11 m.	rising to 60 11 m.
1963					rising to 66 10 m.	63 (2026)	rising to 66 10 m.	n.a.	rising to 64	rising to 61
1964					rising to 67 (2031)	63 (2027)	rising to 67	n.a.	rising to 64 1 m.	rising to 61 1 m.

Note: * Individuals born before Nov. 17 1950 and who were severely handicapped on Nov. 16 2000 can retire at age 60 without deductions. n.a. = not available.

Table A.2 Duration of unemployment benefit receipt (in months) by age and insurance months (pre-reform regulation)

Age	Minimum number of insurance months	Duration of unemployment benefit receipt (months)
all ages	12	6
all ages	16	8
all ages	20	10
all ages	24	12
> 44	28	14
> 44	32	16
> 44	36	18
> 46	40	20
> 46	44	22
> 51	48	24
> 51	52	26
> 56	56	28
> 56	60	30
> 56	64	32

Note: Under the pre-reform regime, unemployment benefit eligibility required that the individual was employed for at least 12 months within the last 3 years or since the last receipt of unemployment benefits within the last 3 years. To be eligible for the maximum transfer duration, individuals 57 years old and older needed up to 64 months of employment within the last 7 years or since the last receipt of unemployment benefits within the last 7 years.
Remaining claims from a previous unemployment benefit receipt can be added to new unemployment benefit entitlements up to the age-specific maximum entitlement lengths if the remaining claims are not older than 4 years. This means that individuals can also get the age-specific maximum entitlement lengths without having the required number of months in employment (e.g. a 60-years-old has 56 insurance months but remaining claims of 4 months).

Source: BGBL.I, 1997, p. 627; BGBL.I, 2003, p. 3004; BGBL.I, 2008, p. 681

Table A.3 Descriptive statistics of transitions by age groups and by gender

A.3.1 Pooled sample

	40-44 years old	45-64 years old	40-64 years old
Transitions from Employment			
N	2,420,238	5,600,760	8,020,998
Share E-E=yes	0.9948	0.9926	0.9933
Share E-U=yes	0.0027	0.0026	0.0026
Transitions from Unemployment			
N	66,292	364,009	430,301
Share U-U=yes	0.8519	0.9324	0.9200
Share U-E=yes	0.0726	0.0210	0.0289

A.3.2 Men

	40-44 years old	45-64 years old	40-64 years old
Transitions from Employment			
N	1,234,247	2,900,011	4,134,258
Share E-E=yes	0.9957	0.9928	0.9937
Share E-U=yes	0.0023	0.0024	0.0024
Transitions from Unemployment			
N	26,218	172,377	198,595
Share U-U=yes	0.8375	0.9319	0.9194
Share U-E=yes	0.0815	0.0212	0.0292

A.3.3 Women

	40-44 years old	45-64 years old	40-64 years old
Transitions from Employment			
N	1,185,991	2,700,749	3,886,740
Share E-E=yes	0.9938	0.9924	0.9928
Share E-U=yes	0.0031	0.0029	0.0029
Transitions from Unemployment			
N	40,074	191,632	231,706
Share U-U=yes	0.8614	0.9328	0.9204
Share U-E=yes	0.0668	0.0207	0.0287

Note: Share is calculated as the mean sum of the respective monthly transitions in percent of all monthly transitions from E resp. U.
Source: SIAB 7510 and own calculations.

Table A.4 List of explanatory variables (for further details see **Appendix B**)

Variable	Description
Treatment indicators	
Post-reform	Indicator for transition after the 2006 reform
Post-reform x 40-44 years old, ..., Post-reform x 63-64 years old, Post-reform x 45-64 years old	Interaction: post-reform and age group indicators (ref. = 40-44 years old)
General and socio-demographic characteristics (X1)	
Age, gender, education, state of residence	
40-44 years old 45-46 years old 47-51 years old 52-54 years old 55-56 years old 57-59 years old 60-62 years old 63-64 years old 45-64 years old	Indicator for the age group (ref. = 40-44 years old)
Female	Indicator variable for the gender
No univ. degree & no voc. training Vocational training Univ. degree/techn. College Education missing	Indicator variables for the education groups (ref. = no university degree & no voc. training)
Schleswig-Holstein, ..., Sachsen-Anhalt	Indicator for residential state (ref. = NRW)
Linear and quadratic trends x state , month and year effects	
Year x Schleswig-Holstein, ..., Year x Sachsen-Anhalt	Interaction: calendar year (coded 1, 2, …) and residential state (ref. = NRW)
Year^2 x Schleswig-Holstein, ..., Year^2 x Sachsen-Anhalt	Interaction: calendar year squared and residential state (ref. = NRW)
January, ..., December	Indicator for month of transition (ref. =January)
2004, …, 2007	Indicator for calendar year of transition (ref. =2004)
Institutional indicators (X2)	
Retirement controls	
Early retirement	Indicator that transition to early retirement with benefit reductions is possible at time of transition
Full retirement	Indicator that transition to full retirement without benefit reductions is possible at time of transition
Distance to early retirement	Variable for the years until eligibility for early retirement
Distance to full retirement	Variable for the years until eligibility for full retirement
Anticipation controls	
Antic	Indicator for transitions from E: transition takes place in the anticipation period of 2006 reform: 09/2005 - 01/2006
Antic x treat	Interaction for transitions from E: anticipation period and treatment group (ref. = 40-44 years old)
Antic x 40-44 years old, ..., Antic x 63-64 years old, Antic x 45-64 years old	Interaction for transitions from E: anticipation period and age group (ref. = 40-44 years old)
reg58	Indicator for transitions from E: transition possibly affected by end of 58 regulation (cohorts 1944-49 in period 10/2007-12/2007)
Unemployment benefits controls	
Remaining entitlement of UB	Indicator for transitions from U: individual has unemployment benefit entitlements left at time of transition
Days of past UB receipt in current U period	Variable for transitions from U: number of days individual has received unemployment benefits in current U period at time of transition

Table A.5 Descriptive statistics of explanatory variable as described in **Table A.4**

	Transitions from Employment		Transitions from Unemployment	
	Mean	Std. Dev.	Mean	Std. Dev.
Post-reform	0.5081	0.4999	0.1726	0.3779
Post-reform x 40-44 years old	0.1518	0.3588	0.0477	0.2132
Post-reform x 45-46 years old	0.0544	0.2269	0.0151	0.1219
Post-reform x 47-51 years old	0.1199	0.3248	0.0309	0.1731
Post-reform x 52-54 years old	0.0636	0.2440	0.0182	0.1337
Post-reform x 55-56 years old	0.0403	0.1966	0.0165	0.1275
Post-reform x 57-59 years old	0.0465	0.2106	0.0215	0.1452
Post-reform x 60-62 years old	0.0243	0.1540	0.0167	0.1280
Post-reform x 63-64 years old	0.0074	0.0855	0.0059	0.0767
Post-reform x 45-64 years old	0.3564	0.4789	0.1726	0.3779
Age groups				
40-44 years old	0.3017	0.4590	0.1541	0.3610
45-46 years old	0.1067	0.3088	0.0546	0.2271
47-51 years old	0.2369	0.4252	0.1560	0.3628
52-54 years old	0.1278	0.3339	0.1159	0.3202
55-56 years old	0.0780	0.2681	0.1035	0.3046
57-59 years old	0.0862	0.2806	0.1788	0.3832
60-62 years old	0.0500	0.2179	0.1881	0.3908
63-64 years old	0.0127	0.1118	0.0490	0.2159
45-64 years old	0.6983	0.4590	0.0546	0.2271
Female	0.4846	0.4998	0.5385	0.4985
Education groups				
No university degree & no vocational training	0.0835	0.2766	0.1155	0.3196
Vocational training	0.7496	0.4333	0.7531	0.4312
Univ. degree/techn. college	0.1498	0.3569	0.1009	0.3011
Education missing	0.0171	0.1298	0.0305	0.1720
Early retirement	0.0179	0.1328	0.1337	0.3404
Full retirement	0.0022	0.0464	0.0078	0.0880
Distance to early retirement	13.4969	6.9026	8.5010	7.6680
Distance to full retirement	16.4037	6.6962	11.7578	7.2432
Antic	0.1085	0.3110	-	-
Antic x 40-44 years old	0.0327	0.1780	-	-
Antic x 45-46 years old	0.0116	0.1073	-	-
Antic x 47-51 years old	0.0257	0.1581	-	-
Antic x 52-54 years old	0.0139	0.1171	-	-
Antic x 55-56 years old	0.0086	0.0922	-	-
Antic x 57-59 years old	0.0092	0.0956	-	-
Antic x 60-62 years old	0.0055	0.0738	-	-
Antic x 63-64 years old	0.0013	0.0359	-	-
Antic x 45-64 years old	0.0758	0.2646	-	-
reg58	0.0082	0.0901	-	-
Remaining entitlement of UB	-	-	0.8624	0.3445
Days of past UB receipt in current spell	-	-	343.60	244.42
N	8,020,998		430,301	

Source: SIAB 7510 and own calculations.

Table A.6 List of explanatory variables for the estimation with controls from Dlugosz et al. (2014)

Variable	Description
Treatment indicators	
Post-reform	Indicator for transition after the 2006 reform
Post-reform x 40-44 years old, ..., Post-reform x 63-64 years old, Post-reform x 45-64 years old	Interaction: post-reform and age group indicators (ref. = 40-44 years old)
General and socio-demographic characteristics (X1)	
Age, gender, education, state of residence, firm	
40-44 years old 45-46 years old 47-51 years old 52-54 years old 55-56 years old 57-59 years old 60-62 years old 63-64 years old 45-64 years old	Indicator for the age group (ref. = 40-44 years old)
Female	Indicator variable for the gender
No univ. degree & no voc. training Vocational training Univ. degree/techn. College Education missing	Indicator variables for the education groups (ref. = no university degree & no voc. training)
East	Indicator for living in East Germany
Food, trade, and services Manufacturing Semi-public services Public administration	For transitions from E: indicator variables for industry (ref. = manufacturing)
Month and year effects	
End of quarter	Indicator for end of quarter (March, June, Sept., Dec. = 1)
End of year	Indicator for end of year (December = 1)
2004, …, 2007	Indicator for calendar year of transition (ref. = 2004)
Institutional indicators (X2)	
Retirement controls	
Pre-2004	Indicator for still being eligible for the pre 2004 pension system
Anticipation controls	
Antic	Indicator for transitions from E: transition takes place in the anticipation period of 2006 reform: 9/2005 - 01/2006
Antic x treat	Interaction for transitions: anticipation period and treatment group (ref. = 40-44 years old)
Antic x 40-44 years old, ..., Antic x 63-64 years old, Antic x 45-64 years old	Interaction for transitions: anticipation period and age group (ref. = 40-44 years old)
Employment/unemployment benefits controls	
UB received since 1993	Indicator for transitions from U: individual has received unemployment benefits since 1993
Employed since 1993	Indicator for transitions from E: individual has being continuously employed since 1993
Employment length > 4 years	Indicator for transitions from E: individual has a work experience of more than four years

Table A.7 Marginal effects for multinomial logit estimations

Transitions from Employment

	E-E transitions		E-U transitions		E-O transitions	
	ME	RME	ME	RME	ME	RME
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
45-64 years old	0.00334	0.34%	-0.00078	-27.70%	-0.00256	-53.65%
Panel B:						
45-46 years old	-0.00012	-0.01%	-0.00007	-2.90%	0.00019	8.92%
47-51 years old	0.00020	0.02%	-0.00040 ***	-16.32%	0.00020	8.77%
52-54 years old	0.00040 *	0.04%	-0.00038 **	-14.85%	-0.00002	-0.71%
55-56 years old	0.00012	0.01%	-0.00022	-7.77%	0.00010	3.00%
57-59 years old	0.00179 ***	0.18%	-0.00127 ***	-34.71%	-0.00052 ***	-9.01%
60-62 years old	0.00142 ***	0.15%	-0.00131 ***	-28.86%	-0.00011	-0.61%
63-64 years old	0.00197 *	0.21%	-0.00034	-10.43%	-0.00163	-3.29%
Controls:						
Age, gender, education, state of residence	yes		yes		yes	
Linear and quadratic trends x state , month and year effects	yes		yes		yes	
Retirement controls	yes		yes		yes	
Anticipation controls	yes		yes		yes	
Unemployment benefit controls	no		no		no	
N	8,020,998					

Transitions from Unemployment

	U-U transitions		U-E transitions		U-O transitions	
	ME	RME	ME	RME	ME	RME
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
45-64 years old	-0.04591 ***	-4.91%	0.00383 ***	21.74%	0.04209 ***	89.58%
Panel B:						
45-46 years old	-0.01820 ***	-2.07%	0.00422 **	7.89%	0.01397 ***	21.24%
47-51 years old	-0.04454 ***	-4.90%	0.00238 *	5.92%	0.04216 ***	82.24%
52-54 years old	-0.07380 ***	-7.96%	0.00656 ***	24.33%	0.06724 ***	144.73%
55-56 years old	-0.06166 ***	-6.57%	0.00391 **	22.00%	0.05775 ***	133.53%
57-59 years old	-0.05260 ***	-5.50%	0.00579 ***	93.96%	0.04682 ***	124.78%
60-62 years old	-0.06274 ***	-6.58%	0.00324 ***	156.25%	0.05950 ***	136.13%
63-64 years old	-0.08406 ***	-9.09%	-0.00011	-7.85%	0.08418 ***	114.26%
Controls:						
Age, gender, education, state of residence	yes		yes		yes	
Linear and quadratic trends x state , month and year effects	yes		yes		yes	
Retirement controls	yes		yes		yes	
Anticipation controls	no		no		no	
Unemployment benefit controls	no		no		yes	
N	430,301					

Note: Standard errors are clustered at the individual level. ***: p < 1 %; **: p < 5 %; *: p < 10 %. RME are calculated as the relation of the age-specific marginal effect and the mean probability of the transition in the pre-reform period for the specific age group. Estimations include main reform effect "post-reform". Pre-reform period: Transitions from E=03/2004-08/2005; Transitions from U=03/2004-01/2006. Anticipation period: Transitions from E=09/2005-01/2006. Post-reform period: 02/2006-12/2007. For a list and definition of control variables, see **Table A.4.**

Source: SIAB 7510 and own calculations.

Appendix B

B.1 Sample restriction and labor force status

Sample restriction

We restrict our sample to individuals who are fully affected by the reform because they are eligible or would have been eligible to receive the maximum duration of unemployment benefits under the pre-reform regime. Under the pre-reform regime, unemployment benefit eligibility required that the individual was employed for at least 12 months within the last 3 years or since the last receipt of unemployment benefits within the last 3 years. To be eligible for the maximum transfer duration, the individual needed up to 64 months of employment within the last 7 years or since the last receipt of unemployment benefits within the last 7 years.

Definition of labor force status

We consider three labor force participation states, i.e., employment (E), unemployment (U), and other (O). Our administrative data are provided by the unemployment insurance (UI). They are based on precise records on spells of unemployment (UI pays transfers) and spells of employment subject to social insurance contributions (UI collects contributions).

The unemployment insurance does not offer information on employment that is not subject to social insurance contributions such as self-employment and civil service employment. Also, the unemployment insurance does not offer precise information on out of the labor force spells. Moreover, our data is not informative about whether an individual searches for work without receiving unemployment benefits, dies, or leaves the country. We do not generally know whether individuals started to receive retirement benefits or private pensions. In this setting, we define three labor force states:

State E (employment) describes individuals who are in an employment relationship paying mandatory social insurance contributions. This does not include individuals in training, in early retirement, interns, protected disabled individuals in special employment situations, marginal employment, the self employed, and those in civil and military service.

State U (unemployment) describes individuals who receive unemployment benefits (Arbeitslosengeld I). In a few instances, where the data suggest simultaneous employment and unemployment spells, we follow the data producers' recommendations and code employment as this is the more reliable information (see Jaenichen et al. 2005).

State O (other) describes individuals who are not in states E or U. Instead, individuals may be self-employed, in civil service employment, in marginal employment; also, they may have died, left the country, left the labor market, exited from the last spell observed in the data, or who have gaps of more than 12 weeks between E and U spells. The actual labor force state of individuals in state O likely varies by age. Therefore, transitions into O cannot be interpreted as a reflection of retirement behavior. Because of the imprecision of "O spells" we did not use them for the analyses. Instead, our analyses look at all possible transitions between E and U and thus cover O only indirectly.

Gaps between spells: We code gaps of up to 12 weeks between E and U as well as between two U spells as direct transitions which take place immediately after the first spell because individuals who voluntarily quit a job or fail to report to the UI in time can be sanctioned by a delay of the start of their benefit payouts of up to 12 weeks (see Fitzenberger and Wilke 2009). In that case, they would be unemployed (without benefits) already up to 12 weeks prior to the start of the payout spell. Similarly, we coded gaps of up to 12

weeks between U and E spells and two E spells as direct transitions. Since 2005, the data informs on whether individuals were sanctioned.

Gaps of more than 12 weeks between spells suggest that the individual had an intermittent state between the E and / or U states, as otherwise the individual has an incentive to claim unemployment benefits. For gaps of more than 12 weeks and for the last spell of an individual's employment biography that does not end by death we add "other" spells to the data (coded O). Spells of individuals who receive minimum income support, i.e., unemployment benefits II (Hartz IV) are also coded as O unless individuals are employed (state E) or receive unemployment benefits (state U) at the same time.

B.2 Control variables

Education groups:
The education information provided in SIAB is at times inconsistent and missing. In order to correct for the inconsistencies and to "fill" missing values we chose an imputation method similar to method IP I suggested by Fitzenberger et al. (2006). We fill missing education values in the future with observations from the past assuming that educational degrees cannot be lost. In order to maintain observations without education information in the data, we code and control for a missing information indicator.

Retirement controls:
Early and full retirement: Variable is coded 1 if the individual is either eligible for early (full) retirement due to unemployment or for early (full) retirement for women at the time of transition.
As an eligibility condition for early (full) retirement due to unemployment, the individual has to fulfill the following criteria:

- have the respective minimum age for early (full) retirement valid for their birth cohort,
- have paid pension contributions for at least 8 years in the last 10 years before the start of retirement,
- have paid pension contributions for at least 15 years in total and
- have been unemployed for at least 52 weeks from the age of 58.5 years or have reduced their working time due to partial retirement for at least 24 months.

To be eligible for early (full) retirement for women, the individual has to fulfill the following criteria:

- have the respective minimum age for early (full) retirement valid for their birth cohort,
- have paid pension contributions for more than 10 years from the age of 40 and
- have paid pension contributions for at least 15 years in total.

Distance to early and full retirement: Variable provides the number of years until an individual is eligible for any of the available early (full) retirement pathways. Eligibility is measured as reaching the birth cohort specific minimum retirement age for early (full) retirement.

Anticipation controls:
Antic: Variable is coded as 1 for transitions from E in the period September 2005 to January 2006. The 2006 UI reform affected those unemployed since February 1, 2006. Therefore, workers who were to lose their jobs on or after February 1, 2006 had an incentive to start an unemployment spell earlier. Following Dlugosz et al. (2014), we consider a short anticipation period. As the UI benefit entitlement duration depends on age and the number of insurance months prior to unemployment, if individuals quit their jobs earlier to avoid the cut in unemployment benefit payout duration they will receive fewer months of unemployment benefits. We chose for September 2005 to January 2006 as the anticipation period based on **Figure 1.2**. We can see there that job-exits increase from September 2005 onwards reaching a peak in December 2005.

Reg58: Variable is coded as 1 for transitions of individuals possibly affected by the end of the 58 regulation. These are transitions from E for the cohorts 1944-1949 in the period November to December 2007. The exemption from the requirement to search for work for individuals aged 58 and above expired for those entering unemployment on January 1, 2008 and after. As the termination was already announced in 2006, those aged 58 and above in 2007 (cohorts 1949 and older) had an incentive to bring an expected entry to unemployment forward and to enter unemployment prior to January 1, 2008. We do not expect to see any anticipation effects for those turning 65 in 2008 (birth cohort 1943) because they would probably enter the regular old age retirement and should not care about unemployment regulations. Again, we do not expect to

see a large anticipation period because an earlier transition to unemployment probably implies a shorter unemployment benefit duration.

Unemployment benefits controls:
Remaining UB entitlement: Variable is coded as 1 if an individual has unemployment benefit entitlements left at the time of transition. The coding is based on the variable "restanspruch" in the data which provides the remaining number of days of unemployment benefit entitlement in an unemployment spell.

Days of past UB receipt in current U period: Variable is coded as the number of days an individual has received unemployment benefits in the current unemployment period prior to transition. Only days of the current unemployment episode are relevant. Days of former unemployment benefit receipts which are followed by an employment or an out-of-the-labor-force episode are not taken into account.