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Specific Measures for Older Employees and Late Career Employment *

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Abstract

We analyse the effects of specific measures for older employees (SMOE) on employment duration of workers aged 40 and above. Using longitudinal employer-employee data for German establishments, we account for worker and establishment heterogeneity and correct for stock-sampling. We find a positive effect of mixed-aged team work on employment duration and a negative effect of a part-time scheme addressed at older workers. Employment duration does not appear to be related to other SMOE, such as training and specific equipment of workplaces.

Keywords: older workers, human resources policies, SMOE, employment duration, linked employer-employee data, age, tenure.

JEL classification: J14, J21, J26.

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1 Introduction

Against the background of demographic change and potential skills shortages, the employment of older workers becomes an increasingly important subject. Job exit of older workers occurs early on exit routes such as unemployment (Fitzenberger and Wilke, 2010), disability pensions (Autor and Duggan, 2003), and early retirement (Blau, 1994; Börsch-Supan, 2000). In the OECD countries, the average retirement age is currently 62 (OECD, 2009). While many firms have actively promoted early retirement in the past, there has been an increasing awareness that firms are reliant on their existing workforces in recent years. Therefore, many firms are developing strategies to preserve the potential of older employees and to induce them to stay longer in their jobs (Harper et al., 2006). Given low job mobility of older workers (Chan and Stevens, 2001; Ichino et al., 2007), enhanced employment duration of old workers often implies that they transit to retirement later.

The advantages of employing older as opposed to younger workers consist in the greater work experience and on average higher firm-specific human capital of older workers, their personal reliability and loyalty to the firm, and their lower risk of quitting the job. Potential disadvantages are declining physical and cognitive skills, human capital obsolescence and relatively low flexibility and mobility (Skirbekk, 2008). In order to deal with the specific requirements of older workers, firms apply a variety of different human resources policies specifically targeted at this group. These policies typically entail the age-specific equipment of workplaces, reduced working time, reduced work intensity, reorganisation, health or training measures. We refer to these human resources measures as *specific measures for older employees* (SMOE).

While these measures are often described as suitable instruments to deal with performance-related consequences of an ageing workforce (Avolio et al., 1990), to our knowledge, there no evidence on the relationship between SMOE and employment duration. In this paper, we are interested in the question of whether SMOE are associated with longer employment duration of older workers in the establishments. In order to assess this relationship, we estimate job exit rates for employees between the ages of 40 and 65. For our analysis, we use large longitudinal employer-employee data for Germany

that combine register data on employees with survey data on establishments. In the data, we observe the existence of SMOE at the establishment level and employment spells of individual employees. The data contain information on the application of the following specific measures for old employees: age-specific part-time work, age-specific equipment of workplaces, reduced work requirements, mixed-age work teams, standard training that is also offered to older employees, and specific training for older employees. In our sample, 50 percent of establishments[1] employing older workers apply at least one SMOE.

Many existing studies estimate the determinants of job or employment duration, but do not fully account for the fact that age is a time-varying variable. At best, theses studies include age at job entry or age at job exit among the regressors (Abowd et al., 2006; Boockmann and Steffes, 2010; Bronars and Famulari, 1997; Dohmen and Pfann, 2004; Mumford and Smith, 2004). On the other hand, studies that focus on the job exit for old employees typically focus on the age at exit and neglect or restrict the time-varying nature of elapsed employment duration (e.g. Backes-Gellner and Veen, 2009). Given our focus on older employees, a transition model for job exits should fully consider both duration dependence, i.e. how transitions out of employment vary with tenure, and age dependence, i.e. how transitions out of employment vary with age. Considering tenure, a 60-year-old employee who just started a new job differs substantially from another employee who has been in the current job for 30 years. On the other side, considering age, a 60-year-old employee is likely to have a higher risk of leaving employment than a 30-year-old if both have the same tenure. We disentangle the effects of age and duration by setting up a transition model with simultaneous consideration of duration and age dependence. Essentially, this results in a transition model with time-varying age effects, where survival at any point in time depends on both the elapsed duration and the elapsed age of the worker. This approach was inspired by a study of Imbens (1994), who models duration and calendar time effects simultaneously (see also van den Berg and van der Klaauw, 2001; Dohmen and Pfann, 2004). We are not aware that such a model has previously been

[1]It is possible to compute representative shares for all German establishment, based on the IAB-Establishment Panel. Using the cross-sectional weights reveals that 27,8% of all German establishments that employ older workers applied at least one SMOE in 2002.

used for the joint estimation of duration and age effects of old employees. Our transition model consists of parts for age dependence, for duration dependence, and a time-invariant explanatory part. The latter takes heterogeneity into account by exploiting a large set of covariates. Furthermore, the richness of the data allows for including establishment fixed effects. In this way, we consider the recent evidence of substantial heterogeneity between firms with respect to employment duration (e.g. Abowd et al., 2006).

It is cumbersome to obtain representative samples of employment spells of older workers, who are typically characterised by their long employment histories. Using a sample of inflows into jobs can avoid length-bias and left-censoring in some situations. However, the group of employees starting a new job when they are old is highly selective. Moreover, workers starting their jobs at a younger age would have to be followed for a long period of time until they are observed to be considered "old" in the data. Instead of using an inflow sample, we therefore draw a stock sample of older workers employed at a particular date. However, since long employment durations are over-represented in stock samples compared to short durations (Lancaster, 1990), our estimator corrects for the stock sampling bias.

Our estimation results show that employment spells of older workers last longer in firms applying mixed-age work teams as a SMOE. By contrast, we find that employment durations in firms that participate in a part-time scheme directed at older workers shorten employment duration. Employment duration does not appear to be related to other SMOE, such as training and specific equipment of workplaces. While we do not claim that our results necessarily have a causal interpretation, our explorative study provides empirical evidence that certain SMOE are related to a change of employment duration of older workers while others are not.

This paper is structured as follows. In the next section, we briefly review previous research on employment duration of older employees. In Section 3, we discuss specific human resources measures for older employees. Section 4 presents the empirical approach. We introduce the data set in Section 5 and show estimation results in Section 6. Section 7 concludes.

2 Employment of older workers

Ageing of the workforce is partly due to increasing employment-rates of older workers. In Germany, employment-rates of workers aged 60 to 64 has risen from 33 percent to 53 percent between 2000 and 2010 (Federal Employment Agency, 2011).

There is a large empirical literature on the determinants of job exit among older workers and one branch of this literature is interested in retirement decisions and early retirement. In our analysis, however, we are solely interested in the relationship between specific human resource measures and job exit. Since profit maximizing firms are more likely to focus on employment duration than on the fate of workers that leave the firm, our analysis focuses on employment duration , independent of the target state. Nevertheless, there is a close link between job exit of older workers and the transition to retirement, as both decisions often coincide. This is particularly true for countries such as Germany, where "bridge jobs" (Ruhm, 1990; Macunovich, 2009) are not frequently used in the job-stopping process. Even where bridge jobs exist, it has often been observed that older workers faced with choosing between the alternatives of retiring early or changing jobs in order to cut back in terms of working time or job requirements mostly choose the first option (Hurd, 1993; Abraham and Houseman, 2004).

Early retirement decisions have been studied frequently, for instance in Börsch-Supan (2000) and Gruber and Wise (2004). In this literature, sometimes structural models are derived, based on the assumption of voluntary retirement transitions; Blau (1994) and Gustman and Steinmeier (2004). However, transitions out of employment cannot always be considered a voluntary decision of the employee, particularly in countries in which strong institutional rules exist for the transition to retirement.

The institutional setting may either be related to the company or to government regulations. In our study, we consider the companies' policies. A number of determinants have been singled out as institutional reasons for job exit of older workers. Blau and Shvydko (2011) estimate the impact of company characteristics and (a lack of) flexibility on the job separation probability. They suggest that a lack of part-time and flexible-hours work schemes as well as lack of training and promotion opportunities for older workers may

be responsible for the abrupt (and permanent) change from full time employment into complete retirement.

Hurd and McGarry (1993) study the effects of job characteristics on retirement for US workers. Among job characteristics, they look at physical and mental requirements and job flexibility. They find that physical and mental job requirements only have little influence on prospective retirement. By contrast, employer policies and job flexibility have a large stabilizing effect on employment and delay the transition to retirement. Related to the subject of our paper, the study by Cottini et al. (2011) for Denmark addresses the question of whether voluntary turnover is influenced by adverse workplace conditions and human resources measures. In particular, they look at the influence of High-Involvement Work Practices on employee turnover. The authors define these practices as "a cluster of complementary human resources management practices designed to promote employee involvement" (p. 872). More precisely, they look at whether the worker has influence on decisions concerning his/her work, whether the worker is informed of the decisions affecting his/her workplace, and whether the worker has participated in courses or on-the-job-training at his/her present workplace. They find that the first of these variables indeed reduces the propensity to separate from the employer. Furthermore, they show that the positive impact of some adverse workplace conditions is mitigated by the use of High-Involvement Work Practices.

For Germany, there is evidence that employment duration of older employees is influenced by firm-specific characteristics (Wübbeke, 1999). Moreover, the empirical personnel economics literature (Beckmann, 2007; Henseke and Tivig, 2008) suggests that firm characteristics and working conditions are important determinants of employment and re-employment after age 50.

Apart from adverse workplace conditions and employer measures to alleviate them, technological change and corresponding human resources policies may be related to job exit for old workers or retirement. Thus, Bartel and Sicherman (1993) find that unexpected technological change induces workers to retire earlier, and that training in industries with rapid technological change induces workers to retire later. In a similar vein, Schleife

(2006) investigates the effect of computer use on employment of older workers. While it is reasonable to hypothesise that older workers using computers have successfully adjusted to technological change and are, therefore, more likely to retire later than other workers (see also Friedberg, 2003), there is little empirical support for this proposition. As one example, Biagi et al. (2013) do find evidence that computer use prolongs employment among Italian men.

Finally, demand changes may affect older workers more strongly than younger workers, if firms adjust to changing demand by promoting early retirement. Consistent with this view, Gielen and van Ours (2006) find that older employees are more affected by firm-specific fluctuations than younger employees in the Netherlands.

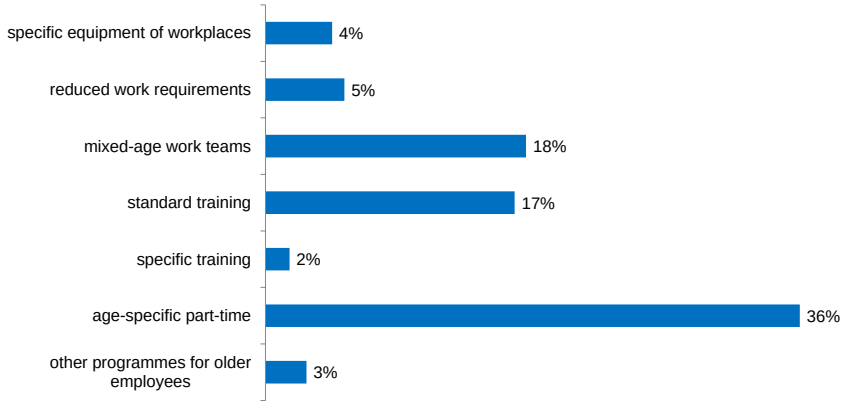
In addition to workplace conditions or other determinants related to the firm, social security institutions create incentives for retirement by defining age criteria for eligibility to certain benefits. Rust and Phelan (1997) show that social security institutions shape the distribution of retirement. For instance, they show that eligibility of early retirements benefits at the age of 62 produce a spike in the retirement distribution. Such incentives are present in most social security systems, in particular in the pension system (Börsch-Supan, 2000; Berkel and Börsch-Supan, 2004; Hakola and Uusitalo, 2005; Euwals et al., 2010; Coile and Levine, 2007) and the system of unemployment insurance (Dlugosz et al., 2009; Fitzenberger and Wilke, 2010). As we only consider transitions out of employment in one particular year, 2002, our data cover a period with a stable institutional setting and we do not aim to investigate the effects of changes in institutional rules concerning retirement.

3 Specific human resources measures for older employees

Many firms implement specific human resources measures for older employees. These measures are based on the insight that generally older employees have different competencies and requirements than their younger colleagues (Boockmann and Zwick, 2004; Skirbekk, 2008). In this section, we provide an overview of the following measures: specific equipment of workplaces, reduced work requirements, mixed-age work teams, standard training

offered to older employees, specific training for older employees, and age specific part-time. These six measures were included as items in the 2002 wave of the survey part of the LIAB (compare Section 5 and Appendix). Figure 1 shows the application of SMOE by establishments employing older workers between 40 and 65 years of age, in 2002, the year of our investigation. It displays sample frequencies. The six different SMOE differ substantially in the extent to which they are used.

Figure 1: Specific measures for older employees in 2002



Application of SMOE by establishments. Source: LIAB data, own computations.

A **specific equipment of workplaces** is, for example, provided to compensate constraints in hearing or seeing capabilities of older employees (Harper and Marcus, 2006). Examples for constraints in capabilities are an increased illumination of the workplace, higher font size on screens, a higher contrast in signs, or protection from excessive environmental noise (Magrain and Boulton, 2007; Spirduso et al., 2005). Implementation of specifically equipped workplaces for older employees is likely to be associated with prolonged employment duration. We suppose that there can be two effects of specifically equipped workplaces. First, older employees who work in an environment that satisfies their age-specific needs are more productive than without the measure. Göbel and Zwick (2010) support this hypothesis: application of specifically equipped workplaces is associated with higher productivity of workers aged 40 and above. Second, at an age-specific workplace, older employees feel more comfortable and are less likely to leave their job due to workplace-related reasons.

Workplaces with **reduced work requirements** allow participating employees to stay on their job until statutory retirement age is reached, but with a reduced work load. Being offered reduced work requirements, an older employee is expected to stay longer in the establishment and we expect that this measure prolongs their employment duration. Older employees are likely to stay in establishments that are willing and able to reduce the requirements if required.

Mixed-age work teams is another measure for the integration of older employees. The idea is that older and younger employees have different strengths and weaknesses stemming from varying experience, perspectives, and social networks (Kearney et al., 2009). On the one hand, a mixture of different age groups can create cross-fertilisation of ideas, a transfer of knowledge and experience, and a combination of resources for all age groups since younger and older employees can concentrate on their comparative advantages (Backes-Gellner and Veen, 2009). On the other hand, compulsory mixing of age groups might be stressful for older employees. A job charged with stress is more likely to be quit by the employee. The study by Börsch-Supan and Weiss (2007) finds no age differences in productivity for workers of one assembly line at Daimler AG. Göbel and Zwick (2010), in contrast, analyse a large data set for Germany and find that relative productivity increases for older and younger employees in establishments that apply mixed-age work teams. Given previous evidence, there is no strong expectation that mixed-age work teams lead to increasing employment duration of older workers.

Participation in **Standard training** declines with age (Ben-Porath, 1967; Becker, 1975; Fitzenberger and Mühler, 2011). This can partly be explained by a lack of motivation of older employees in improving human capital (Warr and Fay, 2001). At the same time, some establishments offer older employees access to their standard training programmes in order to deal with higher adaptability requirements of older workers in innovative firms or in firms investing in information and communication technology (Aubert et al., 2006). Controlling for self-selection into training, Picchio and van Ours (2012) find that firm-provided training increases employment of older workers aged 50 to 64.

Older employees might have different training needs than younger employees because

of different motivations for training participation or different skills to be trained. Several firms offer **specific training** for older employees, which can meet their specific requirements. Provision of training should increase employment duration of older employees. Age-specific training is likely to have even stronger effects on employment than standard training. Yet, on the contrary, training for the elderly may yield opposite effects when employees feel that they are bound to participate in training courses. When participation creates stress and pressure, older employees are even more likely to quit earlier than in absence of the training courses. We separately analyse whether standard training or specific training are associated with a change of the employment duration of older workers.

Age-specific part-time phases the transitions of elderly from work to retirement and gradually passes their workplaces to younger employees. The measure offers a reduction of work time in combination with a prolonged employment contract. Within the phasing time span, human capital shall be preserved within the firm (Graf et al., 2011). When applying part-time contracts, firms have the opportunity to preserve valuable skills and knowledge of their older employees. Until 2009, age-specific part-time work was subsidised by the German Federal Employment Agency. The subsidy was paid to the employer for an employee older than 55 who reduces work time to 50 percent or less (Brussig et al., 2009). Comparable part-time schemes have been evaluated in Austria (Graf et al., 2011), the UK (Gielen, 2009), and Sweden (Wadensjö, 2006). For Austria and the UK, the authors find that the programmes are not successful in prolonging work life of older employees, but that subsidisation costs are high. For Sweden, (Wadensjö, 2006) isolates a positive effect on labour supply of older employees. His finding is explained by the consideration that the incentive to work part-time instead of full-time is higher than the incentive to work part-time instead of retiring. By contrast, Charles and Decicca (2010) implicitly emphasise the importance of flexible work time for older employees because their labour supply preferences conflict with firms' hours constraints. Concerning the subsidised part-time scheme in Germany, Brussig et al. (2009) indicate that the measure is applied mostly as a pathway to early retirement. Given this evidence, our expectation is that the application of part-time-schemes for older employees shortens the employment duration

of older employees, when they are used for early retirement. On the other hand part-time work could lead to longer employment duration if the measure is used to smooth the retirement process out.

4 Estimation approach

We specify a model that allows identification of age-specific transition rates out of employment. The transition model to estimate duration and age effects can be written as

$$\theta(a|t, X) \quad = \quad \theta_0(a) \cdot d_0(t) \cdot e(X), \tag{1}$$

were $\theta(a|t, X)$ denotes the transition rate at age a, given employment duration t and covariates X. The transition rate θ is the product of three distinct terms: The baseline transition rate $\theta_0(a)$, which is a function of age, a baseline duration part $d_0(t)$, which is a function of employment duration, and the explanatory part $e(X)$. Basically equation 1 is a transition model where the key variables, age and employment duration are time-varying. A similar specification has been applied by Imbens (1994), who uses a likelihood framework to estimate duration and calendar time effects simultaneously. He also suggests that a similar specification could be useful to estimate duration and age effects simultaneously.

Specification of the likelihood contributions

In our data, the information on employment duration is available on a daily basis. This justifies the application of a duration model in continuous time.

For the age-specific transition rate, we specify a piecewise constant baseline $\theta_0(a) = \exp(a_1)$ for $0 < a \leq a_1$, where a_1 is the age at the end of the first year of the employment spell. For further periods, $\theta_0(a) = \exp(a_t)$ for $a_{t-1} < a \leq a_t$ for all $t = 1, \ldots, T$, where a_T denotes the age at the end of the employment spell.

Duration dependence $d_0(t)$ is specified as piecewise constant function in a similar way for $t = 1, \ldots, T$, where t notes the elapsed employment duration since the start of the employment spell. The explanatory part $e(X)$ is specified as $\exp(X'\beta)$ where X denotes

the covariates and β is the vector of corresponding parameters.

We specify the transition function in equation 1 over age 40 to 65, that has been considered in our sample. Employment durations are indexed from 1 to 6, where "6" denotes employment durations that last longer than six years. Employment durations of one year denote the reference:

$$\theta(a|t,X) \quad = \quad \exp\left(\sum_{i=40}^{65} \alpha_i a_i\right) \cdot \exp\left(\sum_{j=2}^{6} \delta_j t_j\right) \cdot \exp(X'\beta). \tag{2}$$

The survival function, which provides the survival probabilities for a worker at age a given that he survived employment duration t and given the explanatory variables X comprises the integral over the transition function since the start of the employment spell:

$$S(a|t,X) \quad = \quad \exp\left(-\int \theta(a|t,X)\right). \tag{3}$$

In other words, the survival probabilities at age a depend on the development of the individual transition rates since the start of the employment spell, taking into account, that workers survive time-varying transition risks that depend as well on age as on elapsed employment duration. The likelihood function allows for exogenous right-censoring, e.g. when employment continues after the end of the observation period.[2] The individual likelihood contribution (with $c = 1$ when the employment spell is right-censored and $c = 0$ otherwise) can be written as

$$L_i \quad = \quad [\theta(a|t,X) \cdot S(a_t|t,X)]^{(1-c)} \cdot [S(a_t|t,X)]^c. \tag{4}$$

Stock sampling

Within a framework for employment durations and job exits of older employees, sampling is particularly involved as employment durations can be very long. An employee who started an ongoing employment spell at age 21 has achieved an employment duration of

[2] We restrict our analysis to the year 2002, this implies that ongoing employment spells are right censored at December 31st, 2002. This sample restriction is imposed because the application of SMOE is only observed in 2002 and the application of SMOE my change over time.

39 years at age 60. For older employees, flow sampling of employment spells is selective as employees who start a new job when they are old are a specifically selected group of the population of older employees. Moreover, since the data provides only information for a fixed observation period, with a flow sample we would only observe employment spells with a maximum duration equal to the length of this observation period. Since we are interested in the outcomes for all old employees, including long-lasting employment spells, we therefore draw a stock sample for our analysis. However, using stock-sampling, we have to correct for stock-sampling bias, as discussed in the following.

For our analysis we sample from the stock of workers that are employed at January 1st, 2002. It is well known, that stock sampling generates a bias, i.e. long employment spells are over-represented as compared to shorter employment spells (e.g. Lancaster, 1990; Berger and Black, 1998). This affects the estimates of the duration dependence as well as the distribution of associated observables and unobservables in the sample. We did not find a discussion on the relationship between (stock) sampling and identification of age-effects in the literature. However, both, the duration dependence as well as the age of the employee jointly determine the transition rate at a given age. Since duration dependence and age effects are interdependent, the consideration of stock-sampling bias, as discussed for standard duration models, is also relevant for the identification of age-effects.

For correcting the bias in our transition model, we follow Berger and Black (1998) and augment the individual contribution to the likelihood function by conditioning on the survival until a_s, the age (and associated elapsed employment duration) of the worker at sampling date. For example, we multiply the individual likelihood contribution with the term $\frac{1}{S(a_s - a_0)}$, where a_0 is the age at the start of the employment spell.[3] Consequently, $S(a_s - a_0)$ is the survival probability at employment duration $(a_s - a_0)$.

Given a transition function $\theta(a|t, X)$ that depends on age, duration and covariates, the survival rate can be written as $S(a_s - a_0|t, X) = \exp(-\int_{a_0}^{a_s} \theta(a|t, X)\, d\, a)$. Putting the sampling correction into the individual likelihood contribution for an observed transition

[3] In other words, we condition on survival up to age_s. See Lancaster (1990, p. 183) or Berger and Black (1998).

at age a yields

$$\begin{aligned} L_i &= \theta(a|t,X) \cdot \frac{S(a_t|t,X)}{S(a_s - a_0|t,X)} \\ &= \theta(a|t,X) \cdot exp(-\int_{a_s}^{a_t} \theta(a|t,X)\, d\, a), \end{aligned} \tag{5}$$

so the part of the integral before stock sampling cancels out, in the case without unobserved heterogeneity (see also Bergemann and Mertens (2011)). The individual likelihood contribution with this correction for stock sampling is

$$L_i = [\theta_0(a|t,X) \cdot S(a_t - a_s|t,X)]^{(1-c)} \cdot [S(a_t - a_s|t,X)]^c . \tag{6}$$

Considering stock-sampling, we also take into account, that the size of the time window, in which the the observed spells could have started depends on the duration of the observed spell. For example, consider spells with a duration in the interval of [0;1) months. Given the sampling date is January 1st, 2002, it follows, that these spells have to be started during a one month time window just before the sampling date, i.e. the spells must have started during December 2001, with a job exit in January 2002. Now, consider another example, spells with a duration in the interval of [1;2) months. Again, these spells could have started during the month just before sampling date (December 2001) with a job exit during February 2002. But now, there is an additional possibility: These spells could also have started during November 2011 with a job exit in January 2002. This example illustrates that the sampling probability of spells depends on the size of the time window in which the spell could have started. Since the time window, in which spells with a duration in the interval of [0;1) months is only half as large as the time window for spells with a duration in the interval [1;2), in our stock sample, we observe almost twice as much spells for the latter case. This example illustrates that the probability to be sampled depends on the observed duration and the implied size of the time-window in which these spells could have started. In order to correct for this sampling property, we additionally weight each observation with it's inverse sampling probability that follows from the variations of

the size of the time window, in which the observed spell could have started[4].

5 Data

We use the LIAB, a German longitudinal employer-employee data set of the Institute for Employment Research (IAB).[5] The version of the data we use contains survey information on establishments in the years 2000 to 2002, and retrospective register data for all workers that were employed within this time span. Employee data stem from German social security employment registers and from unemployment registers by the Federal Employment Agency. Civil servants, the self-employed and inactive workers are not covered, since they are not subject to social security contributions. In this data, individual information on wages, tenure, education, experience, profession, and benefit recipiency status is available on a daily basis. Employer information is collected at the establishment level in annual surveys. The data contains information on industrial relations and human resources management, business development and establishment characteristics.[6] In the 2002 wave, which is used for our analysis, establishments are interviewed about their use of specific measures for older employees.

The total sample consists of 1,063 West German establishments.[7] We impose the restriction that a firm has to have at least five employees aged 40 to 65. This restriction is justified by computational reasons of estimations with establishment fixed effects. To the establishment data, information is linked on all workers between ages 40 and 65 employed by the establishments in 2002. The number of employees in our sample is 241,042. We are able to observe employees back to 1975.[8] Since some of the employment spells started before 1975, about 20 percent of observed employment spells are left-censored. We at-

[4]Under the assumption of constant inflow, this sampling probability is proportional to the size of the time window in which the spell could have started.

[5]The version of the data set is LIAB longitudinal model 1.

[6]The data set is described in more detail in Boockmann and Steffes (2007). Their paper describes definitions of employment, unemployment, and non-employment, which we applied in the same way.

[7]We exclude East German establishments from our analysis, since for these establishments there is no data available before the 1990th.

[8]The data set covers full information on employment and unemployment from 1993 on. But we also have information on the start of the current employment spell, given it started after 1st January 1975. In 1975, electronic register data collection was initiated by the (West) German Federal Employment Agency.

tribute a random job start for these workers, assuming a constant rate for employment start between the age of 20 and their age at January 1st, 1975.

The definition of employment duration in our study is as follows: employment duration or tenure is the time t a worker is employed by one establishment. The duration is the period from the start until the end of an employment relationship within a particular establishment. Similar to Boockmann and Steffes (2010) we allow the job to be interrupted by up to 92 days, which might be caused by seasonal employment or short periods of non-employment. We assume short interruptions to be a recall to the same employer. Employment ends if either the worker has a transition into unemployment, a job with another establishment, non-employment, or if the current employer reports the end of the employment relationship to the social insurance institution (see Boockmann and Steffes, 2010, who apply the same definition of employment).

In the 2002 LIAB questionnaire, establishments are asked about SMOE with respect to the six measures discussed in Section 3: reduced working time, specific equipment of workplaces, reduced work requirements, age-mixed teams, standard training offered to older employees, and specific training for older employees. Our empirical analysis is based on several sub-samples of older employees. Establishments are grouped according to application of SMOE. In this way, we obtain six groups of establishments that apply the respective measure and six different comparison groups that do not apply the respective measure. One should keep in mind that establishments that apply more than one SMOE appear in more than one sample.

In Table 1, we display descriptive information on establishment and employee characteristics for all groups defined by the application of SMOE. The first obvious difference between establishments offering or not offering SMOE is their size, measured by the number of employees. As an example, establishments that provide training employ on average 2,091 workers, while those not offering training only have 1,206 employees. Another noticeable difference is the gender ratio, e.g. the share of female employees. Establishments with SMOE have on average fewer female employees. The gender difference is particularly large for establishments that provide specifically equipped workspaces (24 percent) and

offer reduced work requirements (22 percent). Striking differences in establishment characteristics are whether the firm is subject to collective agreements and possesses a works council. Both are clearly more prevalent in establishments with SMOE. Correspondingly, the shares of blue-collar workers and white-collar workers differ.

For computational reasons, all following estimations are based on a random draw of 300 establishments, which has a sample size of 59,099 worker observations.

6 Estimation results

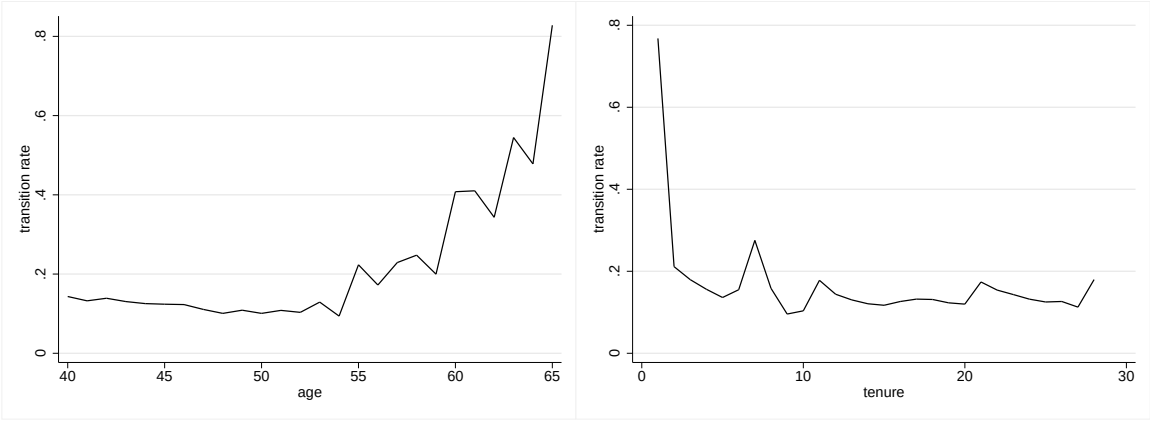
In this section, we present results for the analysis of duration and age-effects for transition rates out of employment of older workers and their relation to the application of SMOE. As described in Section 4, the dependence of job exit on age is modelled by a piecewise constant baseline hazard with annual intervals. We investigate the impact of SMOE on job exit for each year of age beyond 40, i.e. we cover 25 years, from age 40 to 65. Duration dependence is also specified as piecewise constant with annual intervals.[9]

The graph on the left in Figure 2 shows the descriptive age profile of transition rates for employees aged 40 to 65, irrespectively of the use of SMOE by their employers. The profile is characterised by a strong increase in the transition rates as workers reach age 55. For middle-aged employees between 40 and 54, there are little changes in the transition rates, with annual transition probabilities between 0.1 and 0.15. As expected, after age 55, the transition probably increases dramatically. There are particularly strong increases at ages 55, 60, 63, and 65. After age 65, i.e. regular pension age, only few transitions out of employment occur. This is why we refrain from calculating transition rates above age 65.

In the graph on the right in Figure 2, descriptive transition rates show transition rates according to years of tenure (i.e. duration dependence). The tenure profile shows a familiar pattern (compare, e.g., Boockmann and Steffes, 2010); immediately after the start of a new employment spell, transition rates out of employment are very high. With

[9] As mentioned above, we restrict duration effects to be equal beyond an employment duration of 6 years.

Figure 2: Age and duration profile of transition rates



Transition rates out of employment by age and by tenure; tenure in years. Descriptive profiles.

increasing job duration, the risk of job exit decreases substantially and remains roughly constant after five years (with the exception of a small spike at seven years duration). Therefore, we use dummy variables for each year of tenure from one to five years of tenure and a further dummy for all durations beyond five years in our estimations. Both age and duration profiles shown here are corrected for the bias induced by stock sampling.

In the estimations of the hazard rate model, the age profiles are interacted with each of our six different SMOE. Thus, the impact of SMOE on job exit is estimated as the difference in the age effect on transitions between workers in establishments using a specific type of SMOE and workers in the establishments not applying the SMOE. Note that we have to normalise the difference at a particular age when using firm-level fixed effects because the fixed effect absorbs the effect of the SMOE. We choose to normalise the difference at age 40, thereby assuming that SMOE do not influence transition probabilities at that age. We will discuss the plausibility of this assumption after presenting the results further below.

We estimate three different specifications for the explanatory part in equation 1. Our preferred specification includes employee characteristics and establishment-level fixed effects. This specification is the least restrictive of our models since it allows for unobserved time-constant heterogeneity at the firm level. Employee characteristics are gender, nationality, daily wage (mean set to zero), formal education, job position, and type of occupation.

The second specification includes establishment-level covariates from the survey instead of establishment fixed effects. These estimates are instructive for an analysis of the relationship between establishment characteristics and the transitions out of employment for older workers. In this specification, we include firm size, skill structure, legal form, type of wage bargaining, works council, and the shares of female and older workers. In addition, we estimate a third specification without any covariates or fixed effects. In the following, we present our fixed-effects estimation results and discuss their differences to the other two estimators; results for these other estimators are contained in the internet appendix.[10]

The estimated age profiles for establishments with and without SMOE are shown in Figures 3 to 8. For **reduced work requirements**, the estimated age profiles can be found in Figure 3. Reduced work requirements do not influence employment duration of older workers; there are no significant differences between establishments applying or not applying this measure for any of the age groups between 41 and 65. From the results for the other two specifications, we find significantly lower exit rates in establishments using reduced work requirements only for a small number of age groups. Unexpectedly, there is also a positive effect at age 55 in the model with establishment variables. All in all, the effects are either insignificant or appear to be unsystematic.

Transition profiles for **mixed-age work teams** are displayed in Figure 4. This measure seems to reduce transition rates of older workers substantially in most of the age groups. Even at ages 45 and 52, transition rates are significantly lower in establishments using mixed-age work teams. Starting at age 55, the differences in transition rates are quite large in magnitude and are further increasing with age. The fact that an impact appears to be present even at relatively low age could guard against the normalisation of age profiles at age 40. However, the differences from age 55 to 65 would remain substantial even if the normalisation were done with respect to any other age group from age 40 to 50. Therefore, it appears that the application of mixed-age work teams are associated with prolong employment spells of older workers.

In Figure 5, we show the transition profiles of those establishments that do and those

[10]The internet appendix can be downloaded here: http://ftp.zew.de/pub/zew-docs/div/DP12_059_paper_age_duration_appendix.pdf .

that do not offer **age-specific part-time**. Several variants of this part-time scheme exist. The "block model", according to which the employee works full-time during the first half of the scheme and then reduces working time by 100% for the second half, is the most frequent one. Even if the worker is effectively retired in the second half of the scheme, he or she counts as being employed in our data. If there is substitution between age-specific part-time and other means of early retirement, we would expect the presence of the scheme to prolong (nominal) employment durations. In the case, unlike in the "block model", in which the employee actually chooses to work part-time during the scheme, employment duration could also be increased if this helps older workers reconcile work and leisure. The results, however, suggest that the application of age-specific part-time tends to reduce employment duration. However, the difference is only significant at ages 58 and 63. The results of the other two models suggest that the measure is related to longer employment duration of "younger older workers" aged below 55. This could be explained by the additional benefit that participation in the scheme conveys to workers, which could induce them to separate from these establishments later. In our preferred fixed-effect specification, however, the effect on workers below 55 is not present.

Figures 6 and 7 show the age profile for **age-specific training** and **standard training**, respectively. In both cases, we expect the measures to decrease transition rates. By giving older workers access to training programmes, the employer's interest in keeping these workers in employment increases. However, the figures show that training does not relate to transition rates out of employment. Exit rates have the same magnitudes irrespective of whether training is provided. The differences are never statistically significant. In the models without covariates and with firm-level variables instead of fixed effects, we do find significantly negative effects of standard training (but not of age-specific training) on transition rates at ages 45 to 55. Since the effect vanishes with the inclusion of establishment fixed effects, it is probably due to unobserved heterogeneity at the establishment level correlated both with training and the transition rate.

Finally, the transition profile of establishments that apply **specific equipment of workplaces** is contained in Figure 8. Although older workers' transition rates out of

their jobs appear to be lower in establishments with specifically equipped workplaces, these differences are never statistically significant. We conclude that the use of specific equipment of workplaces is not used as a means to increasing older workers' employment duration.

We briefly comment on the influence of worker and establishment characteristics on the exit rates of older workers from their jobs (see Table 2). Among the individual characteristics, women tend to have lower exit rates than men. As expected, a higher wage reduces transitions. Perhaps surprisingly, white-collar employment is associated with higher exit rates; this could be due to a more frequent use of early retirement in these occupations. The use of age-specific part-time increases the exit rate; this is consistent with the estimated effect of this measure at the establishment level. There is little systematic influence of education, which is plausible for the group of older workers. The effects do not differ much between the models with and without fixed effects.

Among establishment characteristics, works councils and the use of ICT reduce transitions in our estimations; this is also found in other studies for employment durations of younger workers (see, e.g., Boockmann and Steffes, 2010). The effect of workforce composition and company size are not strong. The same is true for the application of collective agreements.

7 Conclusion

Many German firms apply specific human resources measures for older employees (SMOE). These measures cover different aspects, such as the equipment of workspaces, working time and intensity of work, mixed-age work teams and training. In this paper, we have investigated the difference of older workers' exit rates from their jobs according to the use of SMOE by their establishments. We apply a flexible specification to distinguish effects at different ages, controlling for duration dependence and correcting for stock-sampling.

We show that, among the SMOE considered, only aged-mixed teams are positively related to employment duration of older employees: transitions out of employment are lower in firms that apply this SMOE. For other measures, such as training, reduced work

requirements and specific equipment, we do not find a similar relation to employment duration. Age-specific part-time is related to shorter employment durations of older workers. This result may be surprising because the measure is intended as a means to increase working time flexibility and provide a better work-life balance for older workers. Yet, the result is in line with descriptive information from the literature on the use of age-specific part-time as a means of early retirement.

The effect of mixed-age work teams complements existing evidence on the relationship between productivity and the application of SMOE (Göbel and Zwick, 2010). Our analysis could be extended in future research to differentiate the effect with respect to different sectors or occupations. Backes-Gellner and Veen (2009) show that mixed-age work teams have positive productivity effects for workers only in non-routine occupations. It would be interesting to see whether this result transfers to employment durations.

The ineffectiveness of the other measures could be explained by a variety or reasons, such as limited resources provided for training and the re-design of workplaces and other difficulties of implementation. In any case, it needs to be stressed that, although we condition on a plethora of worker-level information and time-constant unobserved heterogeneity at the establishment level, our effects are not necessarily causal. To derive causal effects, one would need better data, e.g. detailed information on SMOE at the level of the worker. However, high-quality worker-level data including information on participation in SMOE are currently not available.

All in all, it appears that the search for suitable instruments of human resources management to tackle demographic change and to better exploit the potential of older workers must go on. Despite the importance of this subject, there have been only very few quantitative studies that have addressed this topic. More research is required before definite conclusions as to "what works in age management" can be drawn.

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Appendix

Question #50 from 2002 wave of the IAB establishment panel survey

"Which of the following measures concerning employment of older workers do you apply in your establishment?"

- reduced working time
- specific equipment of workplaces
- reduced work requirements
- mixed-age work teams
- involvement of older workers in standard training programmes
- specific training for older workers
- no measures for older workers.

Table 1: Descriptive statistics on employees and establishments

	reduced work time				specific equipment of workplaces			
	with measure		without measure		with measure		without measure	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Employee characteristics								
sex	0.285	0.451	0.342	0.474	0.209	0.406	0.309	0.462
job position								
unskilled	0.254	0.435	0.244	0.430	0.368	0.482	0.227	0.419
skilled	0.212	0.408	0.259	0.438	0.244	0.430	0.210	0.407
white-collar	0.386	0.487	0.329	0.470	0.292	0.455	0.401	0.490
other	0.149	0.356	0.167	0.373	0.096	0.295	0.163	0.369
education								
lower secondary	0.187	0.390	0.269	0.444	0.238	0.426	0.185	0.389
higher secondary	0.626	0.484	0.558	0.497	0.620	0.485	0.619	0.486
lower tertiary	0.007	0.085	0.005	0.067	0.004	0.065	0.008	0.087
higher tertiary	0.026	0.160	0.024	0.153	0.019	0.136	0.028	0.164
polytec	0.045	0.208	0.025	0.156	0.040	0.195	0.044	0.205
university	0.060	0.238	0.039	0.195	0.043	0.202	0.062	0.241
other	0.048	0.214	0.080	0.271	0.037	0.189	0.054	0.227
daily wage	103.771	33.396	84.355	36.848	105.951	30.036	100.948	35.065
nationality: not German	0.099	0.299	0.100	0.300	0.112	0.315	0.096	0.295
job type								
standard full-time	0.938	0.242	0.960	0.197	0.938	0.241	0.940	0.237
old-age part-time	0.054	0.226	0.004	0.065	0.057	0.231	0.048	0.213
other	0.008	0.090	0.036	0.187	0.005	0.071	0.012	0.110
age in 2002	49.380	6.454	48.736	6.456	49.264	6.276	49.330	6.498
entry after 1975	0.792	0.406	0.885	0.319	0.758	0.429	0.811	0.391
exit before 2003	0.169	0.375	0.185	0.388	0.140	0.347	0.177	0.382
N of individuals	217669		23373		45307		195735	
Establishment characteristics								
total employees in 2001	1029.634	2526.693	166.863	476.553	1131.982	1994.914	641.207	2036.785
ICT	0.774	0.418	0.575	0.495	*		0.675	0.469
collective agreement (industry)	0.808	0.394	0.637	0.481	*		0.730	0.444
collective agreement (firm)	0.100	0.301	0.050	0.219	*		0.084	0.277
wages above agreement	0.071	0.257	0.188	0.391	*		0.120	0.325
legal form								
individual firm	*		0.072	0.259	*		0.033	0.177
partnership	0.079	0.270	0.123	0.328	*		0.097	0.295
private limited	0.410	0.492	0.582	0.494	0.482	0.502	0.476	0.500
public limited	0.179	0.384	*		*		0.121	0.326
corporate	0.260	0.439	0.089	0.285	0.200	0.402	0.192	0.394
other	0.068	0.252	0.094	0.292	*		0.082	0.274
works council	0.937	0.244	0.425	0.495	*		0.715	0.452
share of ...								
blue-collar (unskilled)	18.459	22.508	24.279	28.011	25.473	25.633	20.190	24.834
blue-collar (skilled)	21.541	23.341	27.805	28.993	26.596	23.831	23.692	26.090
white-collar (low-skilled)	4.825	11.159	6.506	15.200	5.989	13.341	5.424	12.867
white-collar (high-skilled)	50.665	30.981	34.855	30.692	37.875	28.885	45.240	32.051
share of female employees	0.379	0.267	0.399	0.295	0.321	0.250	0.395	0.281
sector								
farming, food and raw materials	0.090	0.286	0.1225962	0.328368	*		0.103	0.304
processing trade	0.170	0.376	0.1105769	0.3139851	0.200	0.402	0.141	0.348
machinery and technical	0.195	0.396	0.0913462	0.2884476	0.300	0.460	0.137	0.345
construction	*		0.1129808	0.3169505	*		0.059	0.235
trade and repair	0.073	0.260	0.1706731	0.3766761	*		0.120	0.325
traffic and telecommunication	*		0.0504808	0.2191985	*		0.037	0.188
credit and insurance	0.063	0.244	*		*		0.054	0.225
data processing, R&D	*		*		*		*	
legal advice, renting, advertising	*		0.0841346	0.2779238	0.000	0.000	0.056	0.229
education and health	0.158	0.365	0.1298077	0.3364964	*		0.151	0.358
catering, education, health	*		0.0528846	0.2240726	*		0.036	0.186
public administration, lobbying	0.139	0.346	*		*		0.097	0.295
N of establishments	647		416		110		953	

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— continued —

	reduced work requirements				mixed-age work teams			
	with measure		without measure		with measure		without measure	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Employee characteristics								
sex	0.183	0.387	0.323	0.468	0.264	0.441	0.307	0.461
job position								
unskilled	0.343	0.475	0.226	0.418	0.270	0.444	0.242	0.429
skilled	0.261	0.439	0.203	0.402	0.261	0.439	0.187	0.390
white-collar	0.307	0.461	0.402	0.490	0.339	0.473	0.407	0.491
other	0.089	0.284	0.169	0.375	0.130	0.337	0.164	0.370
education								
lower secondary	0.207	0.405	0.192	0.394	0.203	0.402	0.190	0.392
higher secondary	0.580	0.494	0.631	0.482	0.645	0.479	0.603	0.489
lower tertiary	0.004	0.060	0.008	0.089	0.005	0.072	0.008	0.089
higher tertiary	0.016	0.125	0.029	0.168	0.024	0.154	0.027	0.162
polytec	0.049	0.216	0.041	0.199	0.038	0.192	0.046	0.210
university	0.044	0.204	0.063	0.242	0.055	0.227	0.061	0.239
other	0.101	0.301	0.036	0.186	0.030	0.170	0.065	0.246
daily wage	110.356	30.182	99.325	34.965	103.158	31.954	101.075	35.592
nationality: not German	0.133	0.340	0.089	0.285	0.097	0.296	0.101	0.301
job type								
standard full-time	0.941	0.235	0.939	0.239	0.937	0.244	0.942	0.234
old-age part-time	0.056	0.230	0.047	0.212	0.055	0.229	0.045	0.208
other	0.003	0.054	0.013	0.114	0.008	0.088	0.013	0.112
age in 2002	49.416	6.375	49.288	6.481	49.350	6.337	49.297	6.532
entry after 1975	0.740	0.439	0.820	0.384	0.772	0.419	0.820	0.385
exit before 2003	0.145	0.352	0.178	0.382	0.162	0.368	0.176	0.381
N of individuals	56019		185023		94150		146892	
Establishment characteristics								
total employees in 2001	1102.025	2220.704	640.304	2008.057	1015.736	1730.149	590.347	2115.065
ICT	0.832	0.376	0.679	0.467	0.787	0.410	0.667	0.471
collective agreement (industry)	0.790	0.409	0.735	0.441	0.795	0.404	0.724	0.447
collective agreement (firm)	*		0.076	0.266	*		0.084	0.278
wages above agreement	*		0.122	0.327	0.106	0.309	0.120	0.325
legal form								
individual firm	*		0.033	0.178	*		0.038	0.192
partnership	*		0.093	0.291	0.083	0.276	0.100	0.300
private limited	0.479	0.502	0.477	0.500	0.421	0.495	0.494	0.500
public limited	*		0.122	0.327	0.189	0.392	0.105	0.307
corporate	0.176	0.383	0.195	0.396	0.213	0.410	0.187	0.390
other	*		0.081	0.272	0.087	0.282	0.075	0.264
works council	*		0.718	0.450	0.902	0.298	0.685	0.465
share of ...								
blue-collar (unskilled)	27.432	26.475	19.893	24.645	21.033	25.345	20.644	24.849
blue-collar (skilled)	26.352	22.718	23.695	26.236	25.938	26.256	23.382	25.733
white-collar (low-skilled)	5.351	10.856	5.500	13.153	4.622	10.241	5.753	13.637
white-collar (high-skilled)	36.121	27.091	45.532	32.209	43.730	30.878	44.713	32.106
share of female employees	0.328	0.262	0.394	0.280	0.363	0.283	0.394	0.277
sector								
farming, food and raw materials	*		0.106	0.308	0.094	0.293	0.105	0.307
processing trade	0.176	0.383	0.143	0.350	0.169	0.376	0.140	0.347
machinery and technical	0.269	0.445	0.140	0.347	0.181	0.386	0.146	0.353
construction	*		0.059	0.236	*		0.058	0.234
trade and repair	*		0.114	0.318	*		0.125	0.331
traffic and telecommunication	*		0.036	0.186	*		0.040	0.195
credit and insurance	*		0.052	0.222	*		0.051	0.219
data processing, R&D	*		*		*		*	
legal advice, renting, advertising	*		0.055	0.228	*		0.051	0.219
education and health	*		0.149	0.357	0.157	0.365	0.143	0.351
catering, education, health	*		0.032	0.176	*		0.036	0.186
public administration, lobbying	*		0.102	0.302	0.114	0.319	0.098	0.297
N of establishments	119		944		254		809	

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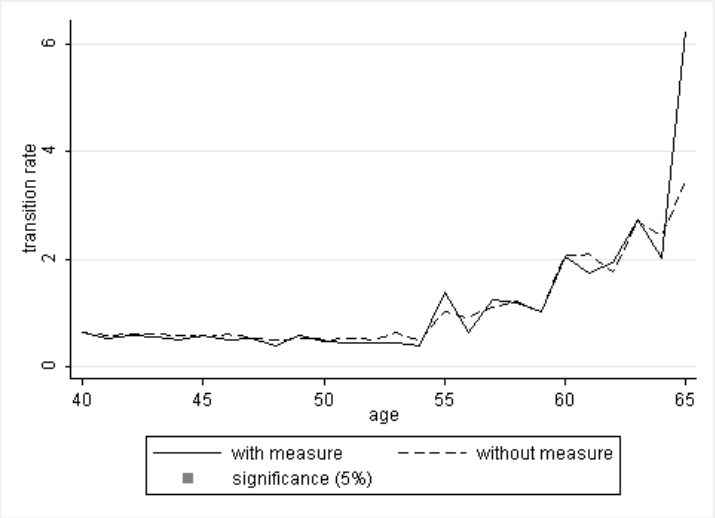
	standard training				specific training			
	with measure		without measure		with measure		without measure	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Employee characteristics								
sex	0.261	0.439	0.313	0.464	0.325	0.468	0.288	0.453
job position								
unskilled	0.235	0.424	0.267	0.442	0.212	0.409	0.256	0.436
skilled	0.245	0.430	0.194	0.395	0.111	0.314	0.223	0.416
white-collar	0.387	0.487	0.375	0.484	0.554	0.497	0.369	0.483
other	0.132	0.339	0.165	0.371	0.124	0.330	0.152	0.359
education								
lower secondary	0.186	0.389	0.202	0.401	0.141	0.348	0.198	0.399
higher secondary	0.620	0.485	0.619	0.486	0.476	0.499	0.628	0.483
lower tertiary	0.007	0.082	0.007	0.084	0.008	0.092	0.007	0.082
higher tertiary	0.028	0.165	0.025	0.155	0.034	0.182	0.025	0.157
polytec	0.043	0.204	0.043	0.203	0.058	0.233	0.042	0.201
university	0.063	0.243	0.054	0.227	0.102	0.302	0.056	0.229
other	0.053	0.224	0.050	0.217	0.180	0.384	0.043	0.203
daily wage	106.585	32.399	98.273	35.154	114.790	33.514	101.091	34.116
nationality: not German	0.096	0.295	0.102	0.302	0.068	0.251	0.101	0.302
job type								
standard full-time	0.934	0.248	0.944	0.230	0.908	0.288	0.942	0.234
old-age part-time	0.058	0.234	0.043	0.202	0.084	0.278	0.047	0.212
other	0.008	0.089	0.013	0.114	0.007	0.086	0.011	0.105
age in 2002	49.536	6.389	49.150	6.504	49.620	6.602	49.299	6.447
entry after 1975	0.768	0.422	0.827	0.379	0.775	0.417	0.803	0.398
exit before 2003	0.156	0.363	0.181	0.385	0.194	0.395	0.169	0.375
N of individuals	104840		136202		14031		227011	
Establishment characteristics								
total employees in 2001	1305.595	2543.085	491.288	1798.621	1843.318	1983.587	667.661	2032.074
ICT	0.832	0.375	0.652	0.477	*		0.691	0.462
collective agreement (industry)	0.771	0.421	0.732	0.443	*		0.744	0.437
collective agreement (firm)	0.099	0.300	0.075	0.263	*		0.077	0.266
wages above agreement	0.107	0.310	0.120	0.325	*		0.118	0.323
legal form								
individual firm	*		0.040	0.196	0.000	0.000	0.032	0.175
partnership	0.092	0.289	0.097	0.297	*		0.097	0.296
private limited	0.370	0.484	0.512	0.500	*		0.478	0.500
public limited	0.233	0.423	0.090	0.286	*		0.124	0.330
corporate	0.206	0.405	0.189	0.391	*		0.191	0.393
other	0.095	0.294	0.072	0.259	*		0.078	0.268
works council	0.901	0.300	0.683	0.466	*		0.732	0.443
share of ...								
blue-collar (unskilled)	17.662	22.358	21.743	25.683	27.059	31.626	20.603	24.799
blue-collar (skilled)	20.687	22.626	25.074	26.770	14.869	17.583	24.185	25.988
white-collar (low-skilled)	6.069	13.638	5.291	12.667	2.698	6.213	5.542	13.011
white-collar (high-skilled)	50.839	30.805	42.398	31.869	50.410	31.612	44.353	31.812
share of female employees	0.376	0.272	0.390	0.281	0.367	0.212	0.387	0.280
sector								
farming, food and raw materials	0.076	0.266	0.111	0.314	*		0.104	0.305
processing trade	0.210	0.408	0.126	0.332	*		0.144	0.351
machinery and technical	0.195	0.397	0.141	0.348	*		0.154	0.361
construction	*		0.071	0.257	0.000	0.000	0.058	0.233
trade and repair	0.088	0.284	0.119	0.324	0.000	0.000	0.113	0.317
traffic and telecommunication	*		0.044	0.205	0.000	0.000	0.037	0.188
credit and insurance	*		0.042	0.202	*		0.049	0.216
data processing, R&D	*		*		*		*	
legal advice, renting, advertising	*		0.055	0.228	*		0.049	0.216
education and health	0.160	0.368	0.142	0.350	*		0.147	0.354
catering, education, health	*		0.039	0.193	*		0.033	0.178
public administration, lobbying	0.103	0.305	0.101	0.302	*		0.103	0.304
N of establishments	262		801		22		1041	

* Note: Due to data protection, mean values of binary variables are not indicated when one category obtains less than 20 observations.

Table 2: Estimated coefficients on full sample

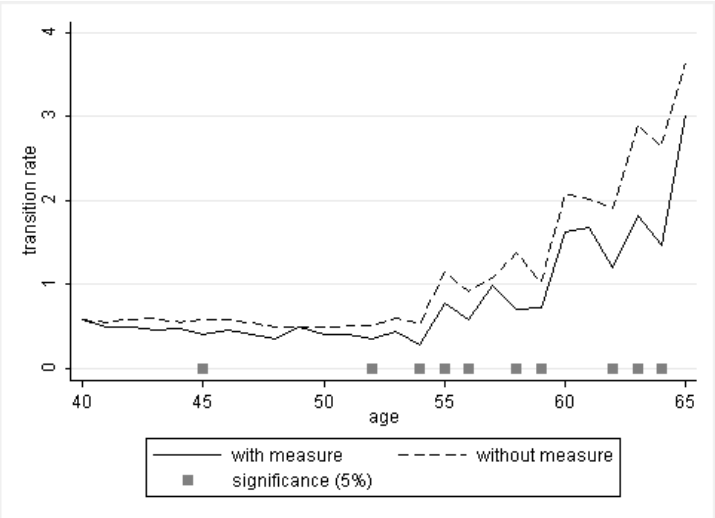
	individual-X and firm-X		individual-X and firm-FE	
	estimate	t-statistic	estimate	t-statistic
female	-0.089	-2.843	-0.098	-2.986
non-German	-0.043	-1.097	-0.054	-1.289
wage, demeaned	-0.010	-22.180	-0.009	-19.958
job position (ref.: unskilled)				
skilled	0.027	0.655	0.038	0.824
white-collar	0.199	4.955	0.186	4.284
other	-0.128	-3.011	-0.061	-1.270
parttime	-0.156	-3.431	-0.173	-3.655
education (ref.: lower secondary)				
higher secondary	-0.068	-2.024	-0.059	-1.621
lower tertiary	-0.029	-0.210	-0.068	-0.497
higher tertiary	0.139	2.058	0.017	0.242
polytec	0.088	1.388	0.050	0.717
university	-0.081	-1.372	-0.091	-1.471
other	-0.109	-1.967	-0.109	-1.710
employees in 2001	0.000	-1.655		
ICT	-0.143	-3.396		
wage agreement (ref.: none)				
collective agreement (industry)	0.071	0.545		
collective agreement (firm)	-0.107	-0.757		
wages above agreement	-0.205	-1.469		
legal form				
individual firm	0.545	3.192		
partnership	0.068	0.731		
private limited	0.094	1.136		
public limited	0.375	4.455		
corporate	-0.265	-3.309		
works council	0.103	1.540		
worker composition				
blue collar (unskilled)	0.007	2.329		
blue collar (skilled)	0.008	2.506		
white collar (low-skilled)	0.008	2.335		
white collar (high-skilled)	0.009	2.883		
share of female employees	0.312	3.446		
sector (ref.: farming, food and raw materials)				
processing trade	0.291	5.546		
machinery and technical	0.374	6.989		
construction	0.447	4.109		
trade and repair	-0.335	-3.980		
traffic and telecommunication	0.128	1.621		
credit and insurance	-0.131	-1.505		
data processing, R&D	-0.217	-2.468		
legal advice, renting, advertising	-0.215	-2.185		
education and health	-0.053	-0.603		
catering, education, health	-0.173	-0.941		
public administration, lobbying	0.155	1.491		
firm fixed-effects	no		yes	
	# obs. = 59099		# obs. = 59099	
	Log likelihood = -26042.9		Log likelihood = -24612.3	
	Schwarz B.I.C. = 26433.0		Schwarz B.I.C. = 26496.6	

Figure 3: Reduced work requirements



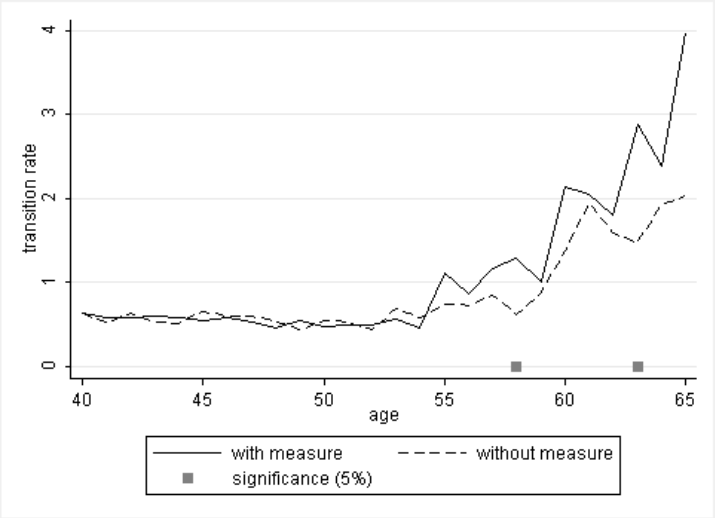
Transition rates by age. Profile with individual covariates and establishment fixed effects.

Figure 4: Mixed-age work teams



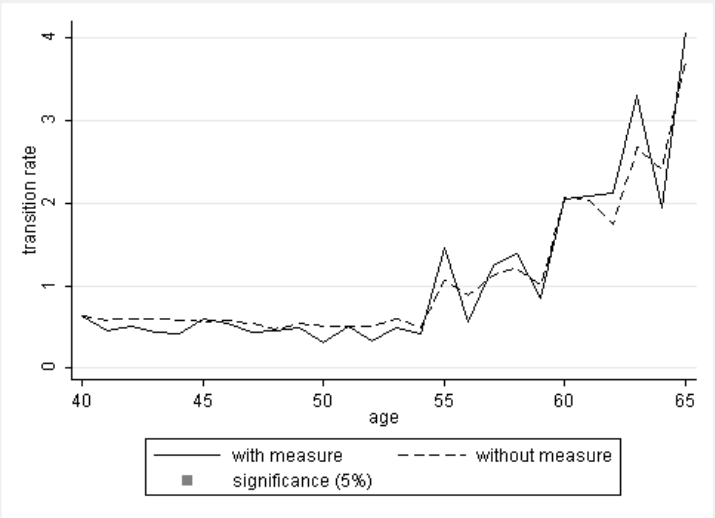
Transition rates by age. Profile with individual covariates and establishment fixed effects.

Figure 5: Age-specific part-time



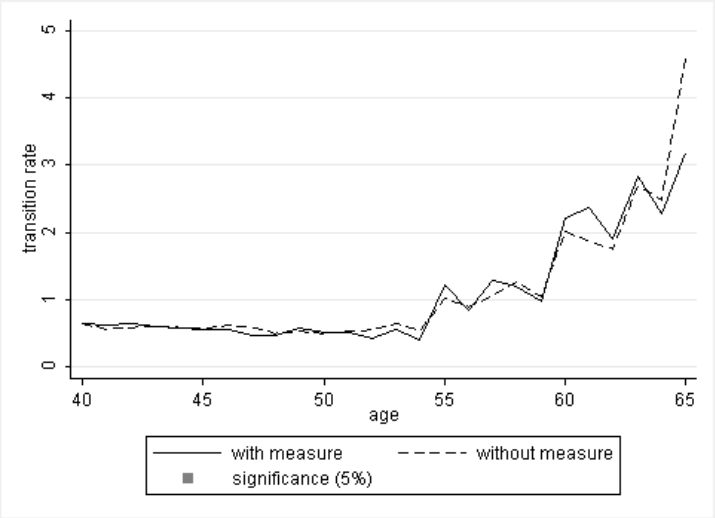
Transition rates by age. Profile with individual covariates and establishment fixed effects.

Figure 6: Age-specific training



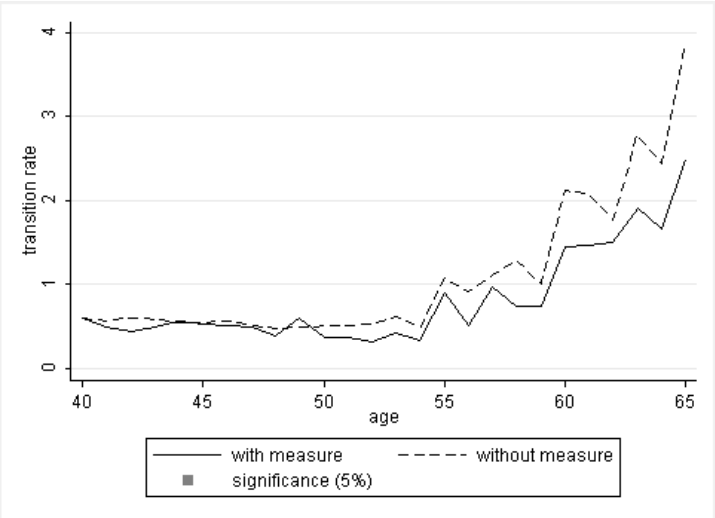
Transition rates by age. Profile with individual covariates and establishment fixed effects.

Figure 7: Standard training



Transition rates by age. Profile with individual covariates and establishment fixed effects.

Figure 8: Age-specific equipment of workspaces



Transition rates by age. Profile with individual covariates and establishment fixed effects.

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