

This is a preprint of

" M. Huber, M. Lechner, C. Wunsch: The effect of firms' phased retirement policies on the labour market outcomes of their employees, forthcoming in the Industrial and Labor Relations Review.

# The effect of firms' phased retirement policies on the labour market outcomes of their employees

This version: May 2015

*Date this version has been printed: 08 June 2016*

**Abstract:** In this paper, we assess the impact of firms offering a special form of phased retirement on their male employees' labour market outcomes. The program aims at smoothing the transition from work to retirement and at decreasing costs in the public pension and unemployment insurance schemes through an increase in employment of elderly workers that otherwise would have exited prematurely via unemployment and/or early retirement. In line with these objectives, we assess whether male employees spend more time in employment and less time in unemployment or inactivity after the introduction of the program. The analysis is based on unique linked employer-employee data that combine high-quality survey and administrative data. Our results suggest that phased retirement options offered by firms can help to reduce some of the public costs of low labour force attachment of elderly workers, mainly by reducing exits via unemployment and by increasing employment and earnings. However, under relatively good labour market conditions, they may also encourage a small share of workers to exit the labour market earlier.

**Keywords:** part-time work, elderly employees, treatment effects, matching

**JEL classification:** J14, J26, C21.

## 1 Introduction

Low labour market attachment of the elderly has far-reaching consequences for the sustainability of the public welfare system in general and the pension system in particular, as well as important implications for future labour supply in ageing societies. Despite increasing longevity, the average effective age at which older workers withdraw from the labour force has declined in almost all OECD countries since the 1970s (OECD, 2009). Even though this trend has slightly reversed since the turn of the millennium, the effective retirement ages in all but two OECD countries remain substantially lower than in the 1960s and 1970s. For Germany, which is the country we study, Börsch-Supan and Jürges (2011) report that the labour force participation of elderly men aged 60 to 64 has dropped from more than 80% in 1966 to less than 35% in 1980s and 1990s. Since about the year 2000, the participation rate has been increasing again, arguably in response to a sequence of cost cutting reforms after 1992, but it was still just over 40% in 2005. Also female labour force participation in this age group has dropped sharply in the 1970s and only started to recover in the mid-1990s, reaching approximately 25% in 2005.

An increasing number of studies show that elderly workers are quite responsive to the relative attractiveness of different pathways towards retirement such as early retirement options, unemployment insurance, and disability insurance (e.g. Staubli 2011, Staubli and Zweimüller 2013, Inderbitzin et al. 2013). We contribute to this literature by studying a special set of phased retirement options for workers aged 55 and older that Germany introduced in 1996 under the name of *part-time work for elderly employees* (henceforth PWE). Using this scheme, employers and employees can agree to reduce working time by half choosing one of two options: a part-time work schedule during the entire PWE period, or a full-time work schedule in the first half and a leave of absence in the second half of the PWE period (so-called block model). During the entire PWE period, employers have to pay at least 50% of the gross wage. In our study period Germany's Federal Employment Agency (FEA) actively encouraged take-up of PWE by

providing a supplement payment if workers leaving the firm via PWE were replaced with unemployed or young job seekers.

The objective of PWE is twofold. Firstly, it aims at smoothing the transition from work to retirement by offering the option of gradual or early withdrawal from the labour market.<sup>1</sup> Secondly, the aim is to decrease costs in the public pension and unemployment insurance schemes through an increase in the labour force attachment of elderly workers that otherwise would have withdrawn from work life completely via unemployment and/or early retirement. The political discussion of PWE has been highly controversial. Critics argue that the block model, which accounts for the vast majority of PWE agreements, has a similar character as "regular" early retirement schemes and encourages early exit (see the discussion in Brussig, Knuth, and Wojtkowski, 2009), thus, in contrast to its initial intention, creating unjustifiable public costs through the supplement payments of the FEA.

Motivated by the challenges of the negative effects of low labour market attachment of elderly workers in ageing societies and the ambiguity of the merits of PWE in the political discussion, this paper investigates the effects of the availability of PWE in German firms on the labour market outcomes of their male employees.<sup>2</sup> In line with the objectives of PWE, we assess whether following the introduction of PWE employees spend more time in employment and less time in unemployment or inactivity. Our findings can therefore serve as inputs to a cost-benefit analysis of PWE in terms of its public costs. Moreover, we analyse effect heterogeneity with respect to regions with different labour market conditions, as they may be important for the relative attractiveness of different potential pathways to retirement.

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<sup>1</sup> Indeed, multiple surveys that have been conducted in various countries suggest that workers have an interest in reducing their working hours as they get older, see for instance Abraham and Houseman (2004) and Drago, Wooden, and Black (2009).

<sup>2</sup> Note that the main text focusses on the results for males only, due to econometric issues in the female sample that are outlined in Section 6. The results for females are presented in the internet appendix to this paper.

Most of the existing literature has focused on studying the determinants of phased retirement (e.g. Gustman and Steinmeier, 1984; Honig and Hanoch, 1985; Ruhm, 1990; Hurd and McGarry, 1993; Haider and Loughran, 2001; Hutchens, 2003; Even and Macpherson, 2004; Hutchens and Grace-Martin, 2006; Hutchens and Chen, 2007; Robinson and Clark, 2010). Comparably few studies investigate the effect of these schemes on exit strategies of older workers. Using the 2006 Portuguese Labour Force Survey and a hazard model, Machado and Portela (2012), for example, investigate the effect of a voluntary reduction in hours of work on the timing of full retirement. The authors find that reductions are associated with earlier retirement in their data and conclude that reducing hours of work appears to signal the desire to retire sooner rather than to remain in the labour market (at reduced hours).

Relative to the existing literature, we also make some methodological improvements. We exploit unique linked employer-employee data that combine high-quality survey and administrative data. These data allow us to follow individual labour market outcomes for up to 6.5 years, such that both short and longer-term effects can be assessed. Moreover, we use robust and relatively flexible semi-parametric econometric methods, which, in contrast to parametric estimators, do not rely on tight functional form assumptions likely to be violated in applications, and they allow for effect heterogeneity. Last but not least, we explicitly address the selection problems involved in the estimation of the effects of PWE on workers' labour market outcomes. We eliminate the potential problem that workers may self-select into firms offering PWE by focusing on firms that did not offer PWE by mid-2000 and by excluding workers who entered the firm less than three years prior to this time. Then, by conditioning on a rich set of firm, worker and regional characteristics coming from various combined data sources, we account for the fact that some establishments introduced PWE between 2000 and 2002, while others did not. Finally, we exploit the panel structure of the data and take out time-constant unobserved factors as well as differential trends that may determine workers' labour market outcomes or

firms' performance. Estimating the effects for a group of workers that should be unaffected by the introduction of PWE serves as a placebo test which supports our empirical strategy.

Our results suggest that phased retirement options offered by firms can help to reduce some of the public costs of low labour force attachment of older workers, mainly by reducing exits via unemployment. For the majority of workers, we find that the introduction of PWE increases employment and labour earnings, and reduces unemployment of older workers, while leaving the time of complete withdrawal from the labour market unchanged. Hence, there are beneficial effects on the government budget in terms of increased tax revenue and social insurance contributions as well as reduced unemployment insurance payments. A rough cost-benefit analysis suggests average net savings in public costs per worker in PWE of about 3000-4500 EUR in West Germany and 4500-7000 EUR in East Germany (depending on the assumptions about discounting). However, under relatively good labour market conditions, there may also be some undesired effects. We find evidence that the availability of PWE encourages some workers to exit the labour market earlier than in the absence of PWE.

The remainder of the paper is organized as follows: Section 2 provides background information on PWE in Germany. In Section 3, we describe our empirical strategy. Section 4 presents descriptive statistics and balancing tests. Section 5 discusses the results. Section 6 concludes. An appendix provides further descriptive statistics and estimation results. An additional online appendix contains the results for females.

## **2 Background information on part-time employment for elderly in Germany**

### **2.1 Institutional background**

Minimum legal standards for phased retirement agreements have been introduced in Germany in 1996.<sup>3</sup> These agreements can be used for workers aged 55 or older. There is no

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<sup>3</sup> "Altersteilzeitgesetz" (PWE Act).

general legal claim to PWE. The adoption of PWE is conditional on the employer's decision to offer these options and formally requires the consideration in the collective wage agreement (if applicable) or some form of internal agreement (Brussig, Knuth, and Wojtkowski 2009). Employees and employers can agree to reduce working time by half choosing one of two options: a part-time work schedule during the entire PWE period, and the so-called block model that comprises a full-time work schedule in the first half and a leave of absence in the second half. Corresponding to the reduction of working hours by half, employers have to pay at least 50% of the gross wage during the entire PWE period, but several collective wage agreements provided for higher wages, the average payment being 73% (Wanger, 2009).

During our observation period, Germany's Federal Employment Agency (FEA) actively encouraged take-up of PWE by providing a supplement payment if workers leaving the firm via PWE were replaced with unemployed workers or young job seekers.<sup>4</sup> The supplement was granted for at most 6 years, even if the PWE agreement covered a longer period. The payment was a top-up of the employer's payment by 20% of the pre-PWE gross salary including single or irregular payments. Moreover, the FEA paid 90% of the worker's compulsory pension contributions. The FEA subsidies were abolished at the end of 2009.

## **2.2 Utilization of PWE**

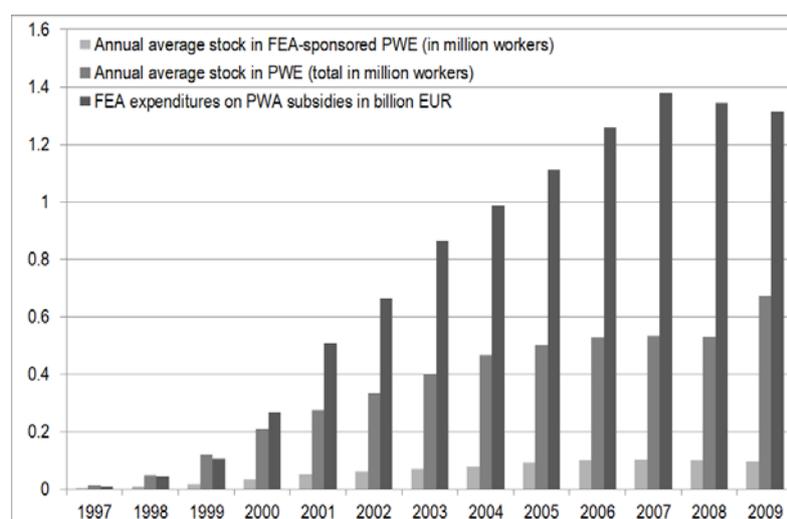
As shown in Figure 2.1, the utilization of PWE increased steadily in the 10 years after its introduction in 1996, reaching an annual average stock of almost 530,000 employees in 2006. In the subsequent two years, PWE utilization remained quite stable. Almost one fifth of employees subject to obligatory social security contributions aged 55 to 64 were in PWE in 2007 (Brussig, Knuth, and Wojtkowski 2009). In 2009, PWE experienced a sharp rise to more than 672,000 workers. This rise likely reflects a reaction to the great economic crisis and/or the anticipation of the abolishment of the FEA subsidies. In our observation period (2000-2008),

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<sup>4</sup> Smaller companies with up to 50 employees also receive the subsidy if they hire apprentices.

the average age at which workers entered PWE was 57 for females and 58 for males. The average duration in PWE increased from 3 years in the early 2000s to somewhat more than 4 years in the late 2000s (Wanger, 2009).<sup>5</sup>

*Figure 2.1: Utilisation of PWE and FEA subsidies 1997-2009*



Sources: Statistics of the German Pension Insurance Fund (<http://www.deutsche-rentenversicherung.de>, 2012) and of the German Federal Employment Agency (<http://statistik.arbeitsagentur.de>, 2012).

Interestingly, only 15-20% of total PWE in any given period was supported by the FEA, suggesting that many employers, albeit adopting PWE, preferred foregoing the FEA supplement payments at the benefit of remaining unconstrained in their hiring policies. After a continuous rise, the number of beneficiaries passed 100,000 in 2006 and has been declining slowly ever since 2008.<sup>6</sup> The costs of FEA-sponsoring were nevertheless far from being negligible. Expenditures increased substantially since the PWE Act came into force, therefore causing much controversy in political and public debates in Germany. They climbed from just 10.6

<sup>5</sup> Note that workers in PWE (or unemployed) have an early access to regular retirement at the ages of 60 to 63 (depending on their year of birth). Their retirement benefits will however be reduced by to some extent because of retiring before the regular retirement age.

<sup>6</sup> Note that this number only considers cases that received FEA transfers in the respective year, irrespective of the total time frame of the PWE agreement. For the block model, this implies that the individuals only enter these statistics during their leave of absence, i.e., in the second half of the PWE, as FEA payments only start after the full-time work phase.

million Euros in 1997 for 3,286 cases to a staggering 1.38 billion in 2007 when FEA-sponsored PWE reached its peak (104,350 cases).

Disentangling the two PWE models, namely part-time work over the entire time frame versus the block model, reveals that the latter is by far the more popular option and has become more important over time. Already in 2005, 84.6% of all FEA-sponsored PWE agreements were based on the block model, and its share increased to 89.1% in 2008 and 90.2% in 2011 (German Federal Employment Agency, 2012). The predominance of the block model seems to be contrary to the initial political intention to truly smooth the work-retirement transition rather than having separate periods of full and no employment. Wanger (2009) notes, though, that it was both the employer and the employee organizations that demanded the introduction of the block model in the PWE Act. Arguably, it provides employers with a socially acceptable means to adjust their workforce and enables employees to retire early without large financial losses, which explains the popularity of PWE.

### **2.3 Interactions with other retirement options**

As in most countries, there exist different options to leave the labour market before statutory retirement age in Germany. In the following we discuss the most important ones because they affect the relative attractiveness of PWE. Firstly, workers could retire early at age 60<sup>7</sup> before statutory retirement age (65 for most workers in our observation period)<sup>8</sup> under certain circumstances: (i) out of unemployment if they had been unemployed for at least 12 months after turning 58.5 years old, (ii) out of PWE if they had spent at least 24 months in PWE, or (iii) if they had contributed to the pension system for at least 35 years. However, early

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<sup>7</sup> For male workers born 1946-1948, the early retirement age increased by one month for each month born after 1945 until it reached 63 for cohorts born 1949-1951. Early retirement options (i) and (ii) were abolished for cohorts born in 1952 or later.

<sup>8</sup> For females, the statutory retirement age was 60 for cohorts born before 1940. Thereafter, it was gradually increased by one month for each month born later until it also reached 65 for cohorts born in 1945 or later. Moreover, for cohorts born in 1947 or later the statutory retirement age has been increased gradually to 67 for cohorts born in 1964 or later.

retirement via unemployment or PWE leads to penalties on the final pension of 0.3% for each month retired before statutory retirement age. As a consequence, it is attractive to use unemployment or PWE to be able to exit the labour market early and to use it for as long as possible in order to minimize pension penalties.

Secondly, workers could leave the labour market via unemployment covered by unemployment insurance (UI) payments. Workers aged 55 or older with sufficiently long work histories were eligible for 18-32 months of UI during our observation period (2000-2008). The time on UI counts as contribution period for the calculation of the pensions, however with a considerably lower value than regular employment. At 60% of the previous average after-tax salary the UI replacement rate is usually comparable to the replacement rate of statutory pensions, thus providing strong incentives to use up UI before retiring early (with penalties on the statutory pension) or to use UI from an age at which UI completely covers the time until statutory retirement age. Compared to UI, PWE has several advantages. Firstly, it covers a considerably longer period than UI (on average 3-4 years). Secondly, it provides higher income – on average 73% of the previous gross salary (Wanger 2009). Finally, it counts as contribution period for the calculation of the pensions with a higher value than UI. Hence, from an individual perspective, PWE is the most attractive option to leave the labour market before statutory retirement age followed by exit via UI and standard early retirement.

### **3 Empirical strategy**

#### **3.1 Parameter of interest and basic idea**

We are interested in the effects of a firm offering PWE compared to not offering PWE on the labour market outcomes of the firm's employees. Specifically, we estimate the effect of the *introduction* of PWE in a firm rather than *take-up* of PWE by its employees. Hence, we estimate a causal parameter similar to an intention-to-treat effect. By doing so, we avoid having to solve the selection problem associated with individual take-up of PWE, which would require

more information than is available in our data.<sup>9</sup> Moreover, the effect of *introducing* PWE at the firm level is interesting per se because this is the only thing that firms can influence directly. We focus on the so-called average treatment effect (ATE) of introducing PWE compared to not introducing it. This corresponds to the effect for an employee randomly drawn from our estimation sample.<sup>10</sup>

To disentangle the effects of the *introduction* of PWE by employers from other determinants of the worker's labour market outcomes, two selection problems remain. Firstly, workers may self-select into firms that offer PWE. We solve this problem by focusing on firms that did not offer PWE in mid-2000 and by only considering workers who have been with the firm for at least three years by mid-2000. Hence, all workers included in the analysis joined their firms at a time when they did not offer PWE and when it was not foreseeable that they might offer PWE in the future. The second selection problem arises because firms selectively rather than randomly introduced PWE between mid-2000 and mid-2002. To solve this problem, we firstly exploit exceptionally informative linked employer-employee data using matching techniques. Secondly, we exploit the panel structure of the data and take out time-constant unobserved factors as well as differential trends that may determine firm performance or workers' labour market outcomes.

### **3.2 Data**

Our empirical analysis relies on unique linked employer-employee data that combine different administrative and survey data from the Federal Employment Agency's Institute of Employment Research (IAB). The data are based on the IAB Establishment Panel (IAB-EP),

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<sup>9</sup> Mainly based on US data, Gustman and Steinmeier (1984), Honig, and Hanoch (1985), Ruhm (1990), Haider and Loughran (2001), Kim and DeVaney (2005) and Robinson and Clark (2010) identify the following determinants of take-up of phased retirement options: age, health, family status, pension coverage, mandatory retirement provisions, wages, education, expected social security income, nonwage income, self-employment, and labour force experience. Many of these variables, especially health and pension coverage as well as family status and self-employment are unobserved in our data.

<sup>10</sup> Our empirical strategy also allows estimating effects for the group of (non)treated employees, i.e. for those actually working in establishments with(out) PWE. They are available from the authors upon request. In general, they are comparable but considerably less precisely estimated.

which is a representative survey of German establishments<sup>11</sup> and covers a broad spectrum of firm level information. The survey was first conducted in 1993 and is annually repeated. It is an unbalanced panel due to attrition and the inclusion of new companies over time.

The information from the IAB-EP was merged with the so-called IAB Establishment History Panel that includes a rich set of aggregate information on the firm's employees. This information is based on the employees' social insurance records and is constructed, for each year, from the cross section of all workers employed in the firm on June 30. It describes the size and the composition of a firm's work force, for example in terms of age, education, tenure, and earnings, as well as the flows of workers into and out of the firm from one year to the next.

For the firms in our sample, which are described in more detail below, the social insurance records of their employees for the years 1990-2008 have been merged to the firm data. They comprise full employment, unemployment and earnings histories, as well as a rich set of personal characteristics for all workers employed by the firms in our data on June 30, 2000.<sup>12</sup> Finally, the data also contain a rich set of regional characteristics such as the federal state, urbanization, and local labour market conditions that have been merged via county identifiers from regional statistics.

### **3.3 Definition and measurement of the treatment**

For identification, we focus on estimating the effects of the *introduction* of PWE between 2000 and 2002. Information about PWE comes from two sources. Firstly, the 1999 and 2002 waves of the firm survey include a question whether the firm offers PWE. Secondly, the social insurance records of the employees indicate whether there is any worker on a PWE

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<sup>11</sup> An establishment is either a single firm, or comprises all branches of a larger firm within the same relatively narrowly defined region and industry. In the following, we will use the terms establishment and firm interchangeably.

<sup>12</sup> The social insurance records have also been used, for example, by Wunsch and Lechner (2008), Biewen et al. (2013), Wunsch (2013), and Lechner and Wunsch (2013), with a different sampling design, though.

contract. Our baseline sample consists of firms that do not offer PWE in 1999 and 2000 (measured in the 1999 survey and the administrative data from 1999 and 2000).

‘Treatment’ status is defined based on the availability of PWE in 2002: The treated pool consists of all firms that have switched to offering PWE (according to the survey data), while those not offering PWE in 2002 (according to both the survey data and the administrative data) constitute the nontreated sample. The very few firms for which PWE is offered according to the administrative data but not according to the survey data are discarded.

We do not distinguish between the two types of PWE – the block model and the part-time model – as this is not observed in the data. Workers in both models remain registered as employed in the firm for the full PWE period. In particular, workers in the block model remain registered as employed during their leave of absence. Hence, both types of workers look the same in that respect in our data. Moreover, as pointed out in Section 2.2, the vast majority of workers choose the block model (85-90%). Thus, the treatment we consider is dominated by the block model.

### **3.4 Sample selection**

Our empirical analysis is based on a subsample of the establishments included in the IAB Establishment Panel (IAB-EP) in 2000. For this project, we had access to a linked employer-employee dataset that covers 2,980 of the 13,931 establishments in the 2000 wave of the IAB-EP. Excluded are establishments with less than 100 employees (about 72% of the total sample), the 25 largest firms, and firms in the sectors agriculture, forestry, mining, energy, transportation, messaging, education and social insurance (about 20% of the total sample).<sup>13</sup> Thus, the sample is restricted to private companies that are representative for firms in the

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<sup>13</sup> The percentages provided here and below refer to the original sample of 13,931 firms. Hence, several firms satisfy multiple sample restriction criteria.

manufacturing and service sectors.<sup>14</sup> For the firms in this sample, we observe the administrative records of about 1.4 million workers employed by these firms in June 2000.

In the following, we describe how we selected firms and workers from this sample in order to ensure identification of the effect of introducing PWE. The effects on sample size and sample composition are documented in Table A1 in Appendix A and discussed below. In what follows we focus on males only, while the descriptive statistics and estimation results for females are presented in the internet appendix. This is due to econometric issues in the female sample that are outlined in detail below.

Firstly, to measure the treatment we need to observe firms in the 1999 and 2002 waves of the survey (see Section 3.3 above). Due to relatively high attrition rates in the IAB-EP and a small amount of item non-response in the relevant question about PWE, this reduces the original worker-firm sample by 28%. However, the sample composition remains very similar suggesting that attrition is non-systematic. Secondly, as we focus on estimating the effects of the *introduction* of PWE after 2000, our sample only consists of firms that do not offer PWE in 1999 and 2000, which reduces the worker-firm sample by another 85%. At this stage, selectivity in the introduction of PWE by firms becomes visible: Firms using PWE already in the baseline period are larger on average than non-users and are concentrated in the service sector with relatively high shares of clerks and workers in higher skilled occupations. In line with this, average earnings in the remaining firms are also lower. Other than that, however, the sample composition is again very similar to the original sample.

Thirdly, as regards the workers in our sample we only consider workers of age 31 to 60 years (in June 2000). This condition ensures that workers are sufficiently distant to educational choices and statutory retirement age (65). Moreover, as mentioned in Section 3.1 above, we

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<sup>14</sup> This paper is part of a larger cooperation project with the IAB which focused on intra-firm comparisons of workers in the private manufacturing and service sectors. The former required a sufficiently large numbers of employees per firms. For the latter, sectors with large public shares in the past were excluded as well.

exclude workers with less than 3 years of tenure in June 2000. This ensures that the workers we study did not self-select into firms that offer PWE because they joined the firms at a point in time when the firms did not offer and it was not foreseeable that they would offer PWE. Additionally, we exclude a small number of West German workers who have not been employed for all of the last 10 years before June 2000. This is done to ensure common support between firms with and without PWE, as this variable almost perfectly predicts whether firms offer PWE. Therefore, firms with and without PWE cannot be made comparable with respect to this characteristic. In total, the three criteria together reduce the sample by 44%. In terms of sample composition, this (by construction) increases the average age of workers and in line with that average earnings and the share of workers in the manufacturing sector.<sup>15</sup> It also increases (again by construction due to higher average tenure and the restriction on employment histories for West German workers) the average fraction of time employed in the last 10 years. Otherwise, the sample composition is again similar.

Again to avoid common support problems, we exclude firms with more than 1000 employees in the year 2000, East German firms in the construction sector, and firms that have neither a collective wage agreement nor tie pay to collective agreements, as these characteristics almost perfectly predict whether firms offer PWE. Because we exclude large firms, this reduces the number of workers by another 54%. However, except for average firm size, the composition of the sample is largely unaffected.

In summary, due to the selection steps we impose for the sake of identification, the effects we estimate generalize to the average worker and firm in the linked employer-employee data in many but not all dimensions: Firms in the estimation sample are smaller, more concentrated in the manufacturing sector, and less concentrated in service sectors that use more

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<sup>15</sup> Due to the structural change from the manufacturing to the service sector taking place in Germany and most other industrialized countries, older workers are concentrated in the former while younger workers, an overproportional share of which we exclude, are concentrated in the latter.

skilled labour. Workers in the relevant age group have larger average tenure and therefore somewhat more favourable employment histories as well as somewhat higher average skill and education levels but are less concentrated in clerks due to the differences in firms' sectors. This is important to keep in mind for the interpretation of our results.

We conduct our evaluation within six distinct strata. The resulting sample sizes of firms and (male) workers for each stratum and treatment are displayed in Table 3.1. We distinguish between East and West Germany because the incentives of firms to offer PWE might differ due to distinct labour market conditions in these two regions. In particular, the labour market conditions in West Germany are much more favourable than in East Germany. As we show in Section 4, the firms operating in the two markets are different implying that selection into PWE might be distinct. By estimating the effects separately for the two regions, we allow for maximum flexibility in the selection correction part of the estimation. On the other hand, labour market conditions affect earnings and unemployment insurance claims, which in turn may influence the relative attractiveness of different pathways towards retirement. Hence, there is also reason to believe that the effects of PWE offer might differ between East and West Germany.

*Table 3.1: Number of firms and male employees*

Age	West			East		
	31-40	41-50	51-60	31-40	41-50	51-60
Firms	179	178	176	166	167	171
Individuals	4098	4269	3390	4145	4894	2902

Furthermore, we split the sample into three age groups (31-40, 41-50, and 51-60). As eligibility for PWE starts at age 55, direct effects of PWE should be visible in the oldest group aged 51-60. We also include 51-54 year olds because all of them become eligible for PWE during the 6.5-year period for which we measure outcomes. Moreover, focusing on 55 to 60

year olds would almost halve the sample size of the most relevant group, thus leading to imprecise estimates. The intermediate age group (41-50) mainly serves to measure potential spillover effects on workers who are not yet eligible<sup>16</sup> but sufficiently close to ages where early retirement decisions become relevant. For example, firms that introduce PWE may be more attractive to these middle-aged workers, which may increase tenure with the firm. The youngest age group (31-40) allows us to validate our identification strategy because it should be unaffected by the introduction of PWE. These workers are too young for early retirement decisions becoming relevant. Moreover, because we require for identification that all workers in our sample be employed in the firm already prior to the introduction of PWE, they cannot be affected by hiring of replacements of workers who leave the firm via PWE.

### **3.5 Outcome variables**

The individual administrative records allow computing a large number of outcome variables that measure different dimensions of employees' labour market performance for 6.5 years from July 2002 to December 2008. With the exception of tenure, they are measured in the second half<sup>17</sup> of June or December of a given year in two different ways: as binary labour market status indicators or income measures for that particular period (so-called point-in-time estimates), and as months in a given labour market status or income from a given source accumulated since July 2002 (so-called cumulated effects). We present the results for selected outcomes that seem to be most interesting. We start by investigating take-up of PWE among employees to assess whether it is used in any quantitatively important way such that effects can be expected. We then analyse various individual labour market outcomes. Firstly and in line with the main objective of introducing PWE, we investigate whether PWE increases the labour market attachment of older workers by increasing employment. Secondly, we assess potential

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<sup>16</sup> Only a negligible fraction of this age group becomes eligible for PWE towards the end of the 6.5 year post-treatment observation period (see also Figure 5.1).

<sup>17</sup> To determine a unique labour market status for each period, the administrative records have been arranged as a panel data set with one observation for each half of a month in the period 1990-2008.

public cost savings in terms of higher tax revenue and social insurance contributions by looking at labour earnings. Thirdly, we investigate the effects on the time spent in unemployment. On the one hand, this provides information about potential savings in unemployment insurance payments. On the other hand, it is informative about exits from the labour market via unemployment. The reason is that only 11% of East German workers and 10.4% of West German workers in the oldest age group who enter unemployment in the 6.5-years for which we observe outcomes are employed at the end of the observation window, which is beyond or close to statutory retirement age for most workers in this group. Fourthly, we investigate whether PWE reduces or increases the total time spent out-of-the-labour-force, which is informative about whether PWE leads to delayed exits from the labour market or encourages early exits as in Machado and Portela (2012). This is because only 9% of East German workers and 12% of West German workers who enter inactivity in the 6.5-year outcome-period are employed at the end of the observation window. Finally, we complete the picture by assessing potential returns to the firms directly by analysing whether workers spend a longer time in the firms that offer PWE by looking at the effects on tenure.

### **3.6 Identification**

Given that we address self-selection by workers into firms by focusing on workers with sufficiently long pre-treatment tenure, the following discussion focuses on the issue of selective introduction of PWE by firms. Theoretical considerations suggest that firms' decisions to introduce PWE should be both employer and employee driven. On the one hand, PWE should be attractive for employers that want to downsize, rejuvenate, or otherwise restructure their workforce. The reason is that the only alternative would be to lay off workers. This, however, would be very costly, especially for older employees with long tenure. The reason is strong employment protection for these workers with long notification periods and eligibility for generous severance payments. Moreover, German law makes it difficult to lay off workers for economic reasons. Even in cases for which this is possible, workers with short tenure and young

workers without children must be laid off first. Whether firms want to downsize or restructure their workforce should be related to the economic conditions in the region and the industry of the firm, to firm size as well as to firm performance. Moreover, firms with physically more demanding jobs and a larger share of older workers should be more likely to offer PWE. The same is true for firms with a high incidence of health problems in their workforce because this is strongly correlated with age. Furthermore, for larger firms it is easier to accommodate PWE because they are more flexible in terms of the possibility to offer part-time work and job sharing. Finally, because costs of corporate pension plans are more dependent on tenure than on individual salaries, employers may be less likely to introduce PWE if they offer such plans, depending on their tenure structure. From the employees' perspective, introduction of PWE is always desirable as PWE is the most attractive option to leave the labour market before statutory retirement age. Hence, it is more likely if there is a strong worker representation in the firm, e.g. via union coverage or a works council, which is more likely the larger the firm is. Moreover, physically more demanding jobs and a larger share of older workers also raise interest in introducing PWE from the workers' point of view. Local labour market conditions also affect the attractiveness of PWE because the alternative might be being laid off. Lastly, workers may be more interested in PWE if they have accumulated sufficient financial means to be able to afford reductions of working hours or early exit from the labour market.

Several empirical studies confirm the importance of these factors. Hutchens and Grace-Martin (2006) conclude based on the US Health and Retirement Study (HRS) that phased retirement is more likely available in firms with flexible work hours, part-time employment, and job sharing.<sup>18</sup> This is in line with Hurd and McGarry (1993), who find that particular job characteristics such as the flexibility to reduce hours or move to a less demanding job increase

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<sup>18</sup> See also Hutchens (2010), who uses the same survey to investigate which types of employees have particularly good chances to be considered for phased retirement in firms offering it at all.

the prospective retirement age.<sup>19</sup> Again using the HRS, Even and Macpherson (2004) consider both firm and individual-level selection into phased retirement. Their results suggest that firms providing pension plans are less willing to allow workers to cut hours and that (in line with the studies mentioned before) pension-covered workers are less likely to switch to part-time employment and more likely to switch to full retirement. The latter is true even conditional on the original employer's willingness to allow for a reduction in work hours as well as various firm and worker characteristics. Hutchens and Chen (2007) combine the HRS with a representative US employer survey conducted in 2001 and 2002 and confirm previous findings that the opportunity of phased retirement depends on both employer and employee characteristics (e.g., whether the company is public or private, workers' age, defined benefit pension plans, and unionization). Furthermore, Hutchens (2003) finds that firm size and growth, as well as the composition of the work force in terms of age, gender, and tenure is correlated with the likelihood to offer phased retirement.

Table 3.2 summarizes the factors identified above from the theoretical considerations and the empirical literature and indicates how we can capture them with our data. There is only one factor we cannot capture, namely corporate pension plans. However, this is largely negligible because in Germany the vast majority of pensions come from the public pension insurance. With 6-8% for German females and 1-3% for men in East Germany, the share of recipients of corporate pension plan is extremely low during our observation period. Only for West German men this share is higher with about 30% (BMAS 2012). However, even for most of these workers the largest share of retirement income is coming from the public pension system (Börsch-Supan and Wilke, 2004). Only in some occupations corporate pensions play a somewhat more important role. For example, they are concentrated in certain industries like banking and finance. Hence, we capture this by including industry and occupations dummies.

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<sup>19</sup> Pensions and health care insurance are further important predictors of prospective retirement, in contrast to physical and mental job requirements.

Furthermore, corporate pensions are highly correlated with tenure and earnings, and we observe both the distribution of tenure and earnings in the firm, and workers' tenure and earnings directly. Hence, we are able to capture important aspects of corporate pensions for the cases where they might be somewhat more important.

*Table 3.2: Summary of potential confounders and control variables available in the data*

Potential confounders	Variables available in the data	Variables included in the estimation
Firm size	Firm size	Firm size
Industry of the firm	Industry of the firm	Industry of the firm
Occupation of the employees	Occupation of the employees	Occupation of the employees
Firm performance	Revenue, change in revenue compared to previous year, investments, firm growth, turnover	Share of employees leaving the firm
Restructuring activities , organizational factors and human resource policies	Dozens of variables	Indicators for whether firm is currently restructuring or not, foreign ownership, single branch firm, looking for staff in the future, hiring skilled/young workers is a problem, staff shortage is a problem
Flexible work schedules	Working time accounts, job sharing, job rotation, share of part-time workers, employee works part-time	Firm uses working time accounts, employee works part-time
Tenure	Distribution of tenure in the firm, workers' tenure	Workers' tenure
Strong worker representation	Indicators for whether firm has works council, is subject to sectoral or firm-specific wage contract, follows sectoral wage contract or is not subject to a wage contract	Indicator for whether firm ties pay to collective wage agreement
Region and its economic situation	Region dummies, unemployment rate, migration, commuting, dummies for urban and rural areas, population density, GDP growth, jobs per inhabitant aged 15-64, earnings per capita	Region dummies, rural/urban dummies, local unemployment rate
Composition of the firm's workforce/ individual characteristics of employees	Gender, age, education, nationality, part-time/full-time, earnings distribution, occupations, blue-collar/white-collar job	Gender, age, education, foreigner status, part-time/full-time, earnings, occupation
Health problems of the firm's workforce	Firm states to have problems with high absenteeism, share of employment contracts in the last 1-10 years that ended due to prolonged illness of more than 6 weeks	Firm states to have problems with high absenteeism
Employees' financial situation	Current wage, cumulated earnings during past 10 years, firm offers profit sharing	Current wage, cumulated earnings during past 10 years
Corporate pension plans	Industry of the firm, occupation of the employees, individual tenure and earnings, turnover, distribution of tenure and earnings in firm	Industry of the firm, occupation of the employees, individual tenure and earnings, share of employees leaving the firm, mean earnings in firm
Other factors and differential trends	More than 200 variables with half-yearly measurements of different types of employment, unemployment, receipt of unemployment insurance, wage earnings, program participation and inactivity; average duration and number of spells of employment/unemployment/program participation/inactivity, over the last 10 years	Tenure, cumulated earnings during past 10 years, unemployed in last 4/10 years, out of the labour force in last 4/10 years, fraction employed 9-10 years before

Note: All variables that are available in the data but are not used in the estimation have been tested in omitted variable tests. They are highly correlated with the included variables and therefore do not add much explanatory power.

Nevertheless, to address the issue of any potentially remaining unobserved factors and possible trends that differentially drive labour market outcomes of treated and untreated workers, we additionally exploit the panel structure of the data, which allows us to observe detailed pre-treatment labour market outcomes for all workers in our sample. Specifically, we are able to condition on a variety of summary measures of the workers' labour market performance over the 10 years prior to mid-2000. Hence, we can not only take out any time-constant unobserved factors (fixed effects) that drive labour market outcomes, but also any differential long-term trends because we can essentially equalize workers in terms of all kinds of dimensions of labour market performance over the 10 years prior to mid-2000. Moreover, note that we are also able to measure time trends in firm performance, which may differ between treated and untreated firms because we observe firm growth, changes in revenue, investments, and turnover. The exact specification we use for selection correction is described in the next section and summarized in the last column of Table 3.2.

Finally, as mentioned in Section 3.2 above, we use the youngest group of workers aged 31-40 to validate the identification strategy. They should be unaffected by the introduction of PWE because they are sufficiently far away from ages where early retirement decisions become relevant and because they already were employed in the firm prior to the introduction of PWE. Hence, they should be unaffected by hiring replacements for workers who leave the firm via PWE. Consequently, estimating the effects of the introduction of PWE for younger workers provides a placebo-type test where a negligible and insignificant effect supports our identification strategy.

### **3.7 Estimation**

Any estimator which eliminates selection bias based on observed factors is built on the idea of comparing outcomes across units with and without treatment that are similar with

respect to observed confounders in order to pin down the causal effect of the treatment. Instead of using parametric OLS, we use a propensity-score-matching estimator that defines similarity in terms of a function of the probability to be treated conditional on the confounders. In the program evaluation literature, this conditional probability is referred to as propensity score (see Rosenbaum and Rubin, 1983). An advantage of these estimators is that they are semi-parametric and therefore more robust than parametric methods like OLS, and that they allow for flexible effect heterogeneity.

Among many possible matching estimators, we chose radius matching on the propensity score with regression adjustment as suggested in Lechner, Miquel, and Wunsch (2011) to estimate the average effect of the introduction of PWE. This estimator has several attractive features. It is more precise than nearest neighbour matching (e.g. Dehejia and Wahba, 2002). It remains consistent if either the matching step is based on a correctly specified propensity score model, or the regression model is correctly specified (so-called double robustness property, see e.g. Rubin, 1979, Joffe et al., 2004). It reduces small sample as well as asymptotic biases of matching (Abadie and Imbens, 2006), and it performs well in finite samples (Huber, Lechner, and Wunsch, 2013), but without having to rely on functional form assumptions. The different steps involved in this particular estimator are described in Table A7 in Appendix E.

The propensity scores needed for selection correction are estimated with separate probit models for each stratum. The dependent variable in each subsample is zero for workers in firms that do not offer PWE in 2002 and one otherwise. All probit models and their results are presented in Appendix B (men) and IA (women). The specifications result from the identification issues discussed above as well as extensive specification tests for normality, heteroscedasticity and in particular omitted variables. The data contain hundreds of variables, a lot of them being highly correlated. We started with a parsimonious specification that included the most important potential confounders according to the empirical literature and theoretical

considerations summarized in Table 3.2. Based on omitted variables tests for all variables in the data, we sequentially added variables if suggested by the test statistics.

To capture the main incentives of firms to introduce PWE the final specifications include firm size, industry, the composition of the firm's workforce in terms of age and education as well as several measures of restructuring activities, organizational factors, human resource policies, flexible work arrangements, and health problems within the firm. We also control for potentially differential trends for firms by including a measure of changes in firm performance. Local labour market conditions are measured using region dummies, local unemployment rates, and rural/urban dummies. An indicator for pay being tied to a collective wage agreement likely captures the strength of worker representation to a certain extent. Furthermore, we include age, foreigner status, education, occupation, tenure, and five measures of different dimensions of past labour market performance as individual determinants of labour market outcomes and to capture potentially unobserved individual factors as well as potentially different trends in labour market performance. Finally, current earnings and the sum of earnings accumulated in the last 10 years capture the financial situation of employees.

Based on the estimated propensity scores we ensure overlap of the distributions of the covariates in the treated and nontreated samples by excluding treated individuals with scores higher than the maximum among the nontreated and, similarly, nontreated individuals with scores that are lower than the minimum among the treated. We document the loss of observations and the changes in the sample due to a lack of common support in Tables A4 and A5 in Appendix C. For five out six strata, we exclude less than 10% of workers, and for younger workers in East Germany we exclude 13%, in all cases with negligible effects on sample composition.

### 3.8 Inference

P-values for t-statistics to test whether the estimated effects are different from zero are obtained from a block bootstrap that resamples establishments (rather than individuals) along with all employees therein to account for clustering at the establishment level.<sup>20</sup> We use 499 bootstrap replications and compute the bootstrap t-statistics of the respective average effects in each of the samples (normalized by the estimated effect). We then estimate the p-value as the share of absolute bootstrap t-statistics that are larger than the absolute t-statistic in the original sample.<sup>21</sup>

## 4. Descriptive statistics and balancing tests

This section presents descriptive statistics for the key group of elderly male workers (aged 51-60) and their employers. In Table 4.1, we present characteristics of the firms in which the elderly workers were employed in June 2000, separately by PWE status, gender, and region. Table 4.2 displays the characteristics of male employees in those groups.<sup>22</sup> We report the mean characteristics by treatment status as well as their difference before and after matching. The latter shows how well our approach succeeds in eliminating selection bias, especially since most

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<sup>20</sup> Abadie and Imbens (2008) show that for standard matching (based on a fixed number of comparison observations) bootstrap-based inference may be invalid. However, our matching algorithm is smoother than the one studied by Abadie and Imbens (2008) because it uses a variable number of comparisons and a regression adjustment. For this reason, the bootstrap is most likely a valid inference procedure in our context.

<sup>21</sup> See for instance MacKinnon, 2006, for a discussion on bootstrapping symmetric statistics. Since the theoretical results by Abadie and Imbens (2006) and the simulation based results in Huber, Lechner, and Wunsch (2013a) suggest that the estimator is asymptotically normally distributed, bootstrapping the potentially pivotal t-statistic (computed under the assumption that the weights obtained to compute the control group are non-stochastic; see Lechner, 2002) has the advantage of potentially providing so-called asymptotic refinements and thus improving inference. In addition we also checked the bootstrap distribution of the estimated effects directly (quantile method). The results are similar (available on request).

<sup>22</sup> Information on the younger groups that are also considered in the econometric analysis (aged 41-50 and 31-40, respectively) is available from the authors on request. Also, due to the very large number of variables in the data (several hundred) we abstain from presenting statistics on all variables. They are available on request. The information available in administrative data is well documented in Wunsch and Lechner (2008) and Lechner and Wunsch (2013). For a detailed documentation of the variables available in the IAB Establishment Panel see [http://fdz.iab.de/de/FDZ\\_Establishment\\_Data/IAB\\_Establishment\\_Panel/IAB\\_Establishment\\_Panel\\_Working\\_Tools.aspx](http://fdz.iab.de/de/FDZ_Establishment_Data/IAB_Establishment_Panel/IAB_Establishment_Panel_Working_Tools.aspx), for those in the IAB Establishment History Panel see [http://fdz.iab.de/de/FDZ\\_Establishment\\_Data/Establishment\\_History\\_Panel/Establishment\\_History\\_Panel\\_Working\\_Tools.aspx](http://fdz.iab.de/de/FDZ_Establishment_Data/Establishment_History_Panel/Establishment_History_Panel_Working_Tools.aspx).

of the variables in the tables are not included in the estimation of the propensity score (see Table 3.2, and Appendix B).

*Table 4.1: Mean characteristics of firms employing elderly male workers by region*

	West		East		West		East	
	PWE		Difference		PWE		Difference	
	No	Yes	Unmatche d	Matche d	No	Yes	Unmatche d	Matche d
<i>Basic firm characteristics</i>								
Number of employees	284	354	70	9	252	302	50	0
Share of newly hired employees	0.13	0.11	-0.02	0.00	0.12	0.09	-0.03	-0.03
Share of employees leaving the firm	0.28	0.29	0.01	0.00	0.17	0.15	-0.02	0.01
Mean age of employees	40	40	0	1	41	40	-1	0
Share of employees being 55 or older	0.14	0.13	-0.01	0.01	0.13	0.12	-0.01	0.00
Mean of monthly earnings in 1000 EUR	2.44	2.68	0.24	0.19	1.88	2.18	0.3	0.08
<i>Human capital</i>								
Share of apprentices	0.03	0.05	0.02	0.03	0.05	0.05	0.00	0.00
Share of unskilled workers	0.28	0.29	0.01	0.01	0.17	0.15	-0.02	0.00
Share of skilled workers	0.30	0.27	-0.03	-0.04	0.41	0.45	0.04	0.02
Share of clerks	0.29	0.33	0.04	0.09	0.29	0.28	-0.01	-0.05
Share of employees without vocational degree	0.26	0.27	0.01	0.02	0.1	0.08	-0.02	-0.01
Share of employees with vocational degree	0.61	0.64	0.03	0.06	0.74	0.75	0.01	0.05
Share of college/university graduates	0.05	0.07	0.02	0.02	0.11	0.15	0.04	0.00
<i>Industry</i>								
Manufacturing	0.66	0.88	0.22	0.03	0.59	0.78	0.19	0.02
Construction	0.13	0.01	-0.12	-0.07	0.00	0.00	0.00	0.00
Trade/sales/retail	0.08	0.06	-0.02	0.08	0.06	0.08	0.02	0.02
Service industry	0.14	0.05	-0.09	-0.04	0.35	0.14	-0.21	-0.05
<i>Organization</i>								
Foreign ownership >50%	0.37	0.14	-0.23	-0.14	0.13	0.04	-0.09	0.02
No working-time accounts	0.21	0.25	0.04	-0.03	0.25	0.19	-0.06	0.11
Profit sharing	0.16	0.24	0.08	-0.01	0.07	0.17	0.10	0.05
Pay tied to collective agreement	0.24	0.11	-0.13	-0.07	0.20	0.18	-0.02	-0.14
Recent reorganization of corporate structure	0.33	0.55	0.22	0.03	0.44	0.27	-0.17	-0.23
<i>Staff-related issues</i>								
Looking for staff right now	0.60	0.67	0.07	0.13	0.27	0.45	0.18	0.01
Hard to find skilled workers	0.59	0.67	0.08	0.08	0.42	0.53	0.11	0.15
High rate of absences	0.38	0.21	-0.17	0.03	0.22	0.25	0.03	0.11
<i>Firm performance</i>								
Firm growth	-	-0.4	13.3	5.9	3.6	-1.5	-5.1	-9.0
Revenue increased compared to last year	0.45	0.52	0.07	0.04	0.30	0.42	0.12	-0.01
Share of capital widening investments	0.24	0.32	0.08	0.02	0.28	0.46	0.18	0.11
<i>Regional characteristics</i>								
Firm in city	0.38	0.29	-0.09	0.05	0.19	0.11	-0.08	-0.02

Mean unemployment rate 2002	8.4	8.4	0.00	-0.01	13.6	15.0	1.4	1.47
Number of observations	1167	222 3			136 5	153 7		

Note: All variables are measured in 2000 or relative to June 30, 2000. None of the differences is statistically significant on the 10% level.

Table 4.1 shows that the introduction of PWE is selective with respect to a range of firm characteristics. Establishments providing PWE are on average performing better than those that do not: They are substantially larger, pay higher wages, have increasing revenues and a higher rate of capital investments. Moreover, they differ considerably from non-providers of PWE in terms of the distribution of industries and organizational characteristics. Foreign-owned firms or companies that tie wages to a collective agreement are less likely to offer PWE, while firms with profit sharing arrangement are more likely to do so. The incidence of recent corporate reorganizations is also related to the treatment, however, in opposite directions for West and East Germany. A further important dimension concerns staff-related issues such as difficulties in hiring or retaining employees, because PWE could potentially be used to alleviate such problems. The data suggest that firms reporting searching for employees and having trouble in finding skilled personnel are more likely to offer PWE, arguably to prevent experienced elderly employees from leaving the firm too early. There are also interesting differences between East and West German firms that underline the importance of looking separately at the two regions. The most pronounced differences occur with respect to average skill levels, turnover, and foreign ownership.

Table 4.2 shows the average characteristics of the employees aged 51-60 who are part of our estimation sample. The differences in earnings and occupations mirror those on the firm level displayed in Table 4.1. In all other dimensions, the differences between workers in firms that offer PWE and those that do not are rather small. Most importantly, the labour market performance of the firm's employees prior to the potential introduction of PWE is very similar and, hence, seems to be unrelated to this event. This suggests that by limiting our sample to

workers with at least 3 years of tenure in the studied firms before potential treatment we largely succeeded in eliminating bias due to self-selection of workers into firms.

*Table 4.2: Mean characteristics of elderly male workers by region*

	West				East			
	PWE		Difference		PWE		Difference	
	No	Yes	Unmatched	Matched	No	Yes	Unmatched	Matched
Age	55	55	0	0	56	55	0	0
No vocational degree	0.18	0.20	0.02	0.00	0.05	0.04	-0.01	0.02
Vocational degree	0.68	0.71	0.03	0.02	0.72	0.72	0.00	-0.02
College/university degree	0.06	0.05	-0.01	0.01	0.19	0.23	0.04	0.02
Share employed in last 10 years	1.00	1.00	0.00	0.00	0.85	0.88	0.03	-0.01
Share unemployed in last 10 years*	0.00	0.00	0.00	0.00	0.02	0.01	-0.01	0.00
Share out of labour force in last 10 years*	0.00	0.00	0.00	0.00	0.13	0.11	-0.02	0.01
Gross earnings per month	3060	3240	180	-50	2180	2480	300	60
Unskilled worker	0.24	0.26	0.02	-0.01	0.16	0.13	-0.03	0.04
Skilled worker	0.39	0.34	-0.05	0.07	0.50	0.53	0.03	-0.03
Clerk	0.37	0.40	0.03	-0.06	0.34	0.34	0.00	0.00
Job in engineering	0.30	0.33	0.03	0.11	0.27	0.36	0.09	0.02
Job in construction**	0.09	0.03	-0.06	-0.03	0.00	0.00	0.00	0.00
Job in manufacturing	0.15	0.26	0.11	-0.11	0.16	0.21	0.05	-0.03
High-skilled job in services	0.27	0.24	-0.03	-0.01	0.28	0.22	-0.06	0.00
Low-skilled job in services	0.09	0.07	-0.02	0.02	0.18	0.12	-0.06	0.00
Other job	0.10	0.08	-0.02	0.01	0.10	0.06	-0.04	0.00
No German citizenship**	0.12	0.14	0.02	0.00	0.00	0.00	0.00	0.00
Number of observations	1167	2223			1365	1537		

Note: All variables are measured in 2000 or relative to June 30, 2000. Observations with a non-zero value have been excluded for \*men in West Germany and \*\*East German workers. None of the differences is statistically significant on the 10% level.

Tables 4.1 and 4.2 also show that applying the matching estimator outlined above (on the common support) results in very satisfactory balancing of the covariate distributions across treated and untreated establishments. None of the differences in mean firm and worker characteristics is significant after matching. Moreover, for important firm characteristics with large differences before matching, balancing could be improved considerably, e.g. for the sectorial distribution of firms as well as organizational and human resource factors. Maybe most

importantly, firm size, growth, and capital investments are well balanced after matching ensuring that firms are not subject to differential trends in firm performance.

## **5 Results**

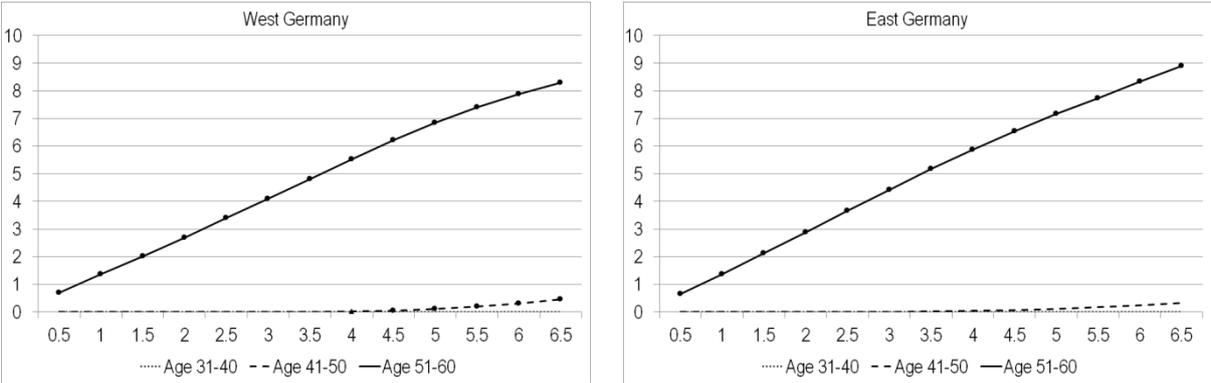
In the following, we only present the results for men, because the results for women failed the placebo test of the introduction of PWE on younger workers. The main explanation is a balancing problem that we cannot solve because of sample size issues. As evident from Table IA.3 in the internet appendix, higher-skilled service occupations were strongly over-represented among females in firms that offer PWE. Closer inspection revealed that this mainly concerns specific occupations in the health sector such as nurses and midwives. Unfortunately, although there is very detailed 3-digit occupation information in the data, we cannot include it in the probit estimation in sufficient detail to remove selection in that particular respect due to sample size issues. The alternative would be to exclude all women with occupations that we cannot balance. This, however, results in rather small sample sizes, which is why we decided to abstain from discussing the results for women altogether. They are available in the internet appendix, though. There are no such problems for men.

### **5.1 Take-up of PWE**

The first question of interest is to which extent PWE is actually utilized if available in a firm. Figure 5.1 plots the estimated average effects of PWE availability on the cumulative utilization of PWE, separately for the three age groups. The effects are measured in months and half-yearly from mid-2002 to end of 2008. As expected, none of the ineligible youngest workers takes up PWE. Moreover, workers aged 41-50 start to take up PWE after 4 years when the first workers turn 55, but the total amount is negligible, even at the end of the observation period (also see Table A6 in Appendix D). This is in line with the average age of entering PWE being 58 (Wanger 2009). For the oldest age group, PWE take-up is statistically significant on the 5% level at any point in time, as indicated by the round dots on the lines indicating the effects.

About 6% of this age group take up PWE (see Table A6 in Appendix D), which results in the accumulation of on average about 9 months of PWE over the 6.5-year post-treatment observation period.

Figure 5.1: ATE on cumulative months in PWE (men)



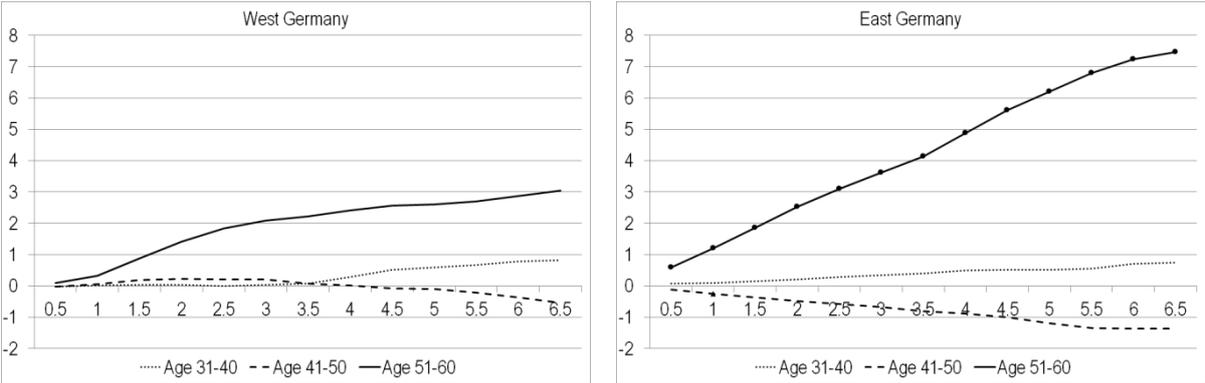
Note: Lines denote average treatment effects for the respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

**5.2 Labour market outcomes**

Figures 5.2 to 5.5 show the cumulated effects for different labour market outcomes in a similar fashion as Figure 5.1. The point-in-time estimates are reported in Table A6 in Appendix D. Firstly, we investigate whether PWE increases the labour market attachment of older workers by increasing employment (Figure 5.2). Secondly, we assess potential public cost savings in terms of higher tax revenue and social insurance contributions by looking at labour earnings (Figure 5.3), and in terms of lower unemployment insurance payments by looking at unemployment (Figure 5.4). As discussed in Section 3.5, the latter is also informative about exits from the labour market via unemployment. We also investigate whether PWE reduces or increases the total time spent out of the labour force (Figure 5.5). This is informative about whether PWE leads to delayed exits from the labour market, or instead encourages early exits as in Machado and Portela (2012). Finally, we complete the picture by assessing whether workers spend more time with firms that offer PWE (Table 5.1).

Before we discuss the results in detail, we check the validity of our identification strategy by looking at the effects for the youngest age group, which should be unaffected by the introduction of PWE. Indeed, we find quantitatively negligible and usually statistically insignificant effects for all outcomes. Hence, for men, our identification strategy appears to have successfully removed selection bias associated with the introduction of PWE. In the following, we discuss the results for the oldest group of workers, which is directly affected by the introduction of PWE. The first thing to note is that there is interesting heterogeneity in the effects when comparing East to West Germany, despite similar take-up rates of PWE. The main difference between the two parts of Germany is that labour market conditions are much more favourable in the West than in the East of Germany.

Figure 5.2: ATE on cumulated months in employment (men)

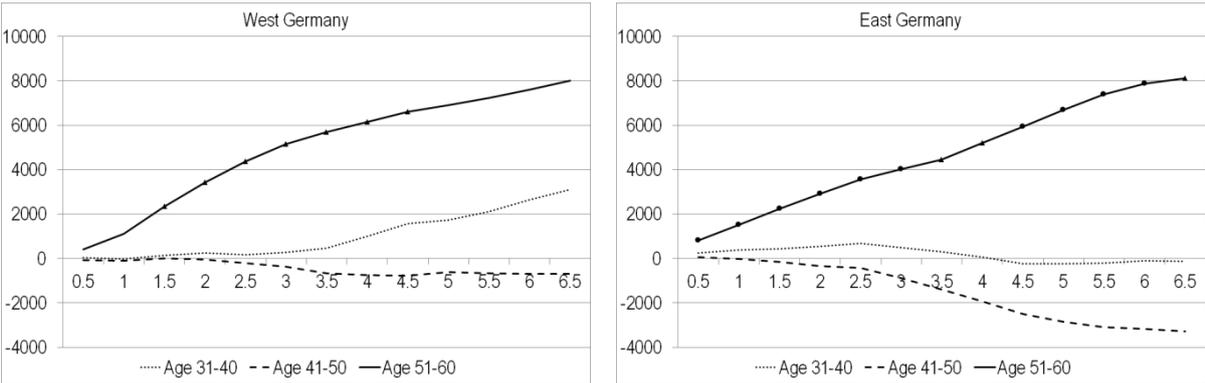


Note: Lines denote average treatment effects for the respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

For older employees in East Germany, the introduction of PWE significantly increases employment and by that labour earnings while, at the same time, reducing unemployment. Employment rates increase significantly by 5-6 percentage points throughout the observation period, which corresponds to the take-up rate of PWE. Unemployment rates fall significantly and almost to the same extent by 4-5 percentage points throughout the observation period (see Table A6 in Appendix D). In total, older workers in East German firms that offer PWE accumulate on average about 7 months of employment (Figure 5.2) in the same firm (Table 5.1)

and 8000 EUR labour earnings (Figure 5.3) more than in firms without PWE while experiencing about 6 months less of unemployment (Figure 5.4). However, the cumulative time spend out of the labour force remains unaffected (Figure 5.5). Hence, there is no evidence for undesired effects of PWE in terms of an increased number of early exits from the labour market for East Germany. Instead, we find that PWE reduces the number of exits via unemployment, which implies notable public cost savings through reduced unemployment insurance payments<sup>23</sup> and increased revenue through income taxes and social security contributions. There are no savings in terms of pension insurance payments, though, because the time when workers leave the labour market remains unaffected.

Figure 5.3: ATE on cumulated earnings from employment in EUR (men)



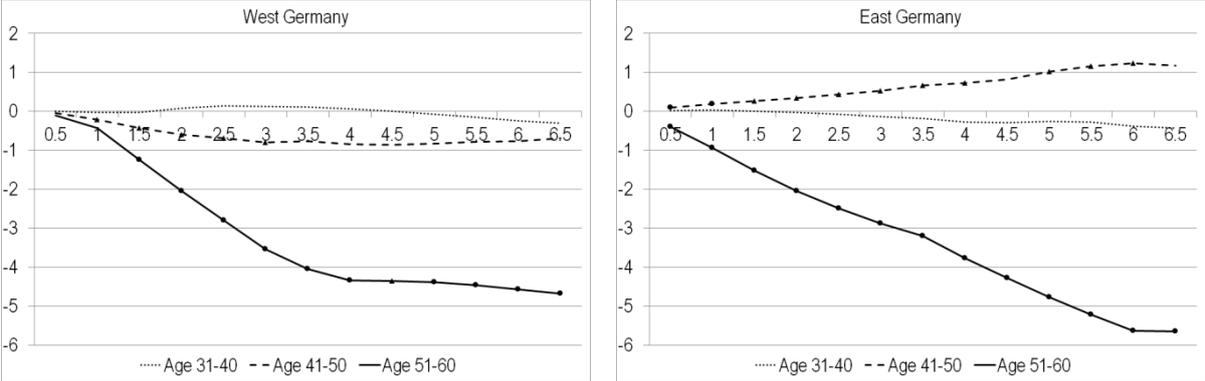
Note: Lines denote average treatment effects for the respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

For West Germany, the picture is more diverse with interesting differences between older workers who take up PWE shortly after the introduction of PWE and those who make use of this offer only later in the observation period (see the point-in-time estimates in Table A6 in Appendix D). For the first group, the effects are similar to the ones for East Germany. During the first 2 years after the introduction of PWE we find significantly higher employment rates that correspond to the take-up rate of PWE, similar reductions in unemployment rates and no

<sup>23</sup> All workers in our sample qualify for unemployment insurance benefits because of the tenure requirement we impose for identification.

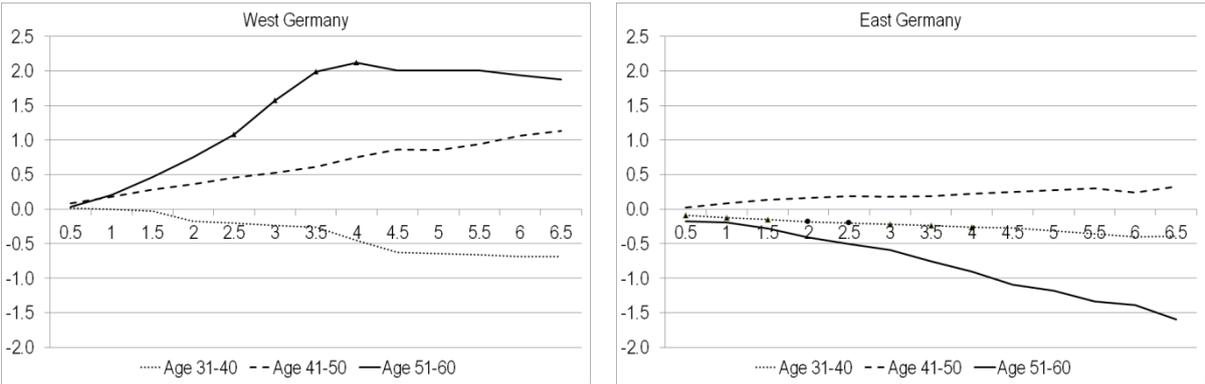
effects on the share of workers out of the labour force. However, 3-4 years after the introduction of PWE positive employment effects and effects on unemployment quickly vanish while we start to see significantly positive effects on the share of workers out of the labour force. Hence, from this point in time we find evidence for undesired effects of PWE in terms of an increased number of early exits from the labour market for West Germany.

Figure 5.4: ATE on cumulated unemployment in months (men)



Note: Lines denote average treatment effects for the respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Figure 5.5: ATE on cumulated time out of the labour force in months (men)



Note: Lines denote average treatment effects for the respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

In terms of cumulative effects the differential effects for West German workers result in small positive but not significant effects on employment, a significant reduction in cumulated months unemployed of about four month, which does not increase further after four years, and

a significant increase in the time out of the labour force of 2 months which is reached after 4 years when there are no further effects on employment or unemployment. Table 5.1 additionally reveals that the differential effects in employment lead to no visible average effects on tenure in the firm. The effects on cumulated labour earnings in Figure 5.3 are positive and significant despite much smaller employment effects. The reason is that West German workers earn considerably more than East German workers (see Table 4.2).

*Table 5.1: ATE on tenure in the original establishment in days (men)*

Region	Age	Effect	P-value in %
West	31-40	-91	72
	41-50	-147	56
	51-60	-40	82
East	31-40	-101	40
	41-50	-106	41
	51-60	224	14

Note: \*/\*\*/\*\* indicates significance on the 10/5/1% level. Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications). Tenure refers to the time with the establishment after treatment measured from July 2004. Tenure before that is a control variable.

As a last step, we look at potential spillover effects on middle-aged workers (41-50). Overall, we do not find any quantitatively important effects for this age group suggesting no such effects. If at all, there is some very weak evidence that East German firms increase employment of older workers by somewhat reducing employment of workers aged 41-50. The employment effects are not statistically significant but there is a small significant increase in cumulated unemployment of about one month. Given an observation period of 6.5 years, this effect is very small, though.

### **5.3 Cost-benefit considerations**

Based on the estimated effects on cumulated earnings, unemployment, and time out of the labour force it is possible to conduct a rough cost-benefit analysis from the perspective of the government. However, several additional inputs and assumptions are required. They are

summarized in Table 5.2. Firstly, we approximate average deductions for taxes and social insurance contributions with 40%, which is reasonable given the average gross earnings of workers in firms offering PWE reported in Table 4.2. Secondly, we need average monthly unemployment benefit payments. Because of the tenure requirement, all workers in our sample are eligible for UI. We assume that workers would have received UI during the entire estimated difference in months in unemployment. We approximate average monthly UI payments by applying the replacement rate of 60% to the average net earnings of workers in firms offering PWE. Thirdly, we assume that the share of workers who were not employed at the end of the observation period after entering inactivity has entered the pension system. Hence, the difference in cumulated time out of the labour force is evaluated at the average monthly pension benefit for the share of workers who has not returned to employment. For the pension benefits, we apply a replacement rate of 55% to the average net earnings of workers in firms offering PWE. We chose a lower replacement rate than for UI because the workers will face penalties on their statutory pensions. Finally, we approximate expenditures on FEA sponsored PWE by combining the average share of workers supported over the period 2002-2008 calculated from the numbers underlying Figure 2.1 with average expenditures per supported worker reported in Wanger (2009).

*Table 5.2: Inputs for cost-benefit analysis (men)*

	West	East
Difference in cumulated gross earnings	8009	8124
Difference in cumulated net earnings	4806	4874
Difference in months unemployed	-4.7	-5.7
Average monthly unemployment benefits	1166	893
Difference in months out of the labour force	1.9	-1.6
Share not returning to employment after inactivity in %	12.0	9.3
Average monthly pension benefits	1069	818
Share in FEA sponsored PWE in %*	18.5	18.5
Average expenditures on FEA sponsored workers*	12203	12203

Note: Deductions for taxes and social insurance contributions 40%, average wages of workers in firms with PWE from Table 4.2, replacement rate for pensions 0.55. \* From Wanger (2009), separate numbers for East and West Germany are not available.

The results of these calculations are displayed in Table 5.3. We report costs, benefits, and net savings both without discounting, and assuming a discount factor of 0.97 and 0.95 per annum to show how results change with different assumptions about discounting. We find that even with a discount factor of 0.95 there are net savings for the government: Over our 6.5-year observation period for outputs, the net gain per worker amounts to roughly 3000 EUR in West Germany and 4800 EUR in East Germany. Of course, these numbers are only rough approximations. However, they are sufficiently large to make it reasonable to conclude that there is a net gain for the government.<sup>24</sup> Unfortunately, it is not possible to conduct a similar cost-benefit analysis for firms because the necessary inputs are unknown.

*Table 5.3: Cost-benefit analysis (men)*

Discount factor	no discounting		0.97		0.95	
Region	West	East	West	East	West	East
Gain in tax revenue and social insurance contributions	3204	3249	2628	2666	2156	2187
Savings in unemployment benefits	5469	5052	4487	4145	3681	3400
Savings in pension benefits	-1769	1184	-1451	972	-1191	797
Total average savings per worker over 6.5 years	6904	9486	5664	7782	4646	6384
Total average expenditures per worker	2253	2253	1848	1848	1614	1614
Net savings per worker over 6.5 years	4651	7233	3816	5934	3032	4770

## 6 Conclusion

In this paper, we assess the impact of firms introducing phased retirement schemes on their employees' labour market outcomes for Germany. These PWE schemes are available to workers aged 55 or older. Grogger and Wunsch (2013) show that in the absence of attractive early retirement options, many older workers in Germany – both voluntarily and involuntarily – leave the labour market considerably before statutory retirement age (65) via unemployment during which they claim unemployment insurance benefits. PWE has been introduced and

<sup>24</sup> It nevertheless needs to be borne in mind that due to our empirical design, we consider a sample of firms that potentially differ from companies that already adopted PWE prior to 2000 in terms of factors that could be relevant for the costs and/or benefits.

supported by government subsidies with the aim of smoothing the transition from work to retirement and of decreasing costs in the public pension and unemployment insurance schemes through an increase in employment of elderly workers that otherwise would have exited prematurely via unemployment and/or early retirement. There is no legal claim to PWE but firms may voluntarily offer PWE to their employees.

Our results suggests that phased retirement options offered by firms can help to reduce some of the public costs associated with premature exit of older workers from the labour market, mainly by reducing exits via unemployment. In line with the objectives of PWE we find that the introduction of PWE increases employment and labour earnings, and reduces unemployment of most older workers, while leaving the time of complete withdrawal from the labour market largely unchanged. Hence, there are beneficial effects on the government budget in terms of increased tax revenue and social insurance contributions as well as reduced unemployment insurance payments. A rough cost-benefit analysis suggests average net savings in public costs per worker in PWE of about 3000-4500 EUR in West Germany and 4500-7000 EUR in East Germany.

However, there may also be some undesired effects. We find evidence that the availability of PWE encourages some West German but not East German workers to exit the labour market earlier than in the absence of PWE. The main difference between the two parts of Germany is that labour market conditions are much more favourable in West than in East Germany. East German workers in our sample are more likely to experience interruptions in their work career and earn considerably less than West German workers. Hence, for a given age on average they have contributed less to the pension system and consequently have lower pension claims than their West German counterparts making premature exit from the labour market less attractive for them. This suggests that undesired effects as documented by Machado and Portela (2012) are more likely the better the labour market conditions during the work life

and the higher earnings and accumulated pension claims. This is supported indirectly by the literature on take-up of phased retirement (see footnote 16), which shows higher take-up rates under these circumstances.

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## Appendix A: Descriptive statistics for different samples

Table A1: Means of selected variables for different samples (men)

	(1) In EP 2000	(2) In EP 2002	(3) No PWE 99/00	(4) Final workers	(5) Final firms
<b>Firm characteristics</b>					
Number of employees	1406	1605	699	778	373
Share of newly hired employees	0.15	0.14	0.15	0.11	0.11
Share of employees leaving the firm	0.14	0.13	0.16	0.13	0.12
Mean age of employees	38.7	39.3	39.6	39.9	39.9
Share of employees being 55 or older	0.11	0.11	0.11	0.11	0.11
Mean of monthly earnings in 1000 EUR	2611	2654	2256	2420	2305
Share of female employees	0.27	0.27	0.26	0.22	0.26
Share of employees w/o German citizenship	0.08	0.09	0.08	0.08	0.06
Share of part-time employees	0.10	0.10	0.09	0.05	0.06
Share of apprentices	0.04	0.04	0.04	0.04	0.05
Share of unskilled workers	0.24	0.24	0.26	0.27	0.25
Share of skilled workers	0.25	0.26	0.34	0.35	0.36
Share of clerks	0.36	0.35	0.27	0.28	0.29
Share of employees without vocational degree	0.20	0.20	0.20	0.21	0.17
Share of employees with vocational degree	0.64	0.65	0.65	0.66	0.70
Share of college/university graduates	0.11	0.11	0.08	0.09	0.09
Manufacturing sector	0.65	0.67	0.67	0.75	0.76
Construction sector	0.04	0.04	0.08	0.07	0.02
Trade/sales/retail sector	0.04	0.04	0.07	0.06	0.08
Service sector	0.25	0.25	0.18	0.12	0.14
Other sector	0.01	0.00	0.00	0.00	0.00
<b>Individual characteristics</b>					
Age	39.5	39.6	39.7	44.0	44.8
No vocational degree	0.19	0.18	0.19	0.16	0.11
Vocational degree	0.64	0.64	0.66	0.70	0.76
College/university degree	0.13	0.13	0.09	0.10	0.10
Share employed in last 10 years	0.80	0.82	0.78	0.92	0.93
Share unemployed in last 10 years	0.02	0.02	0.04	0.01	0.01
Share out of labour force in last 10 years	0.17	0.16	0.18	0.07	0.06
Gross earnings per month	2816	2832	2367	2736	2688
Unskilled worker	0.24	0.25	0.26	0.27	0.23
Skilled worker	0.29	0.30	0.39	0.43	0.46
Clerk	0.37	0.36	0.25	0.29	0.30
Job in engineering	0.30	0.31	0.29	0.32	0.32
Job in construction	0.04	0.04	0.07	0.06	0.02
Job in manufacturing	0.21	0.22	0.22	0.25	0.24
High-skilled job in services	0.28	0.27	0.19	0.19	0.21
Low-skilled job in services	0.09	0.08	0.11	0.09	0.11
Other job	0.07	0.07	0.10	0.08	0.09
No German citizenship	0.09	0.09	0.08	0.08	0.06
Number of observations	837137	602153	92320	52043	23698
Percent of previous sample	100	72	15	56	46

Note: (1) All employees of firms observed in the Establishment Panel (EP) for which we have linked employer-employee data. (2) Firms not observed in EP 2002 excluded. (3) Firms with PWE in 1999 or 2000 excluded. (4) Workers aged  $\leq 30$  or  $> 60$  or with tenure  $< 3$  years or from West Germany with share employed in last 10 years  $< 1$  excluded. (5) Firms with  $> 1000$  employees or in other sector or that neither have a collective wage agreement nor tie pay to collective agreements or from East Germany in construction sector excluded. All variables are measured in 2000 or relative to June 30, 2000.

## Appendix B: Probit specifications for selection into PWE

Table A2: Probit specifications for males in West Germany

	Aged 31-40		Aged 41-50		Aged 51-60	
	Coefficient	P-value in %	Coefficient	P-value in %	Coefficient	P-value in %
Constant	-6.984	0.0	-7.211	0.0	-5.948	0.0
Firm characteristics						
Log number of employees	0.792	0.0	0.966	0.0	0.902	0.0
501-1000 employees	-0.503	0.0	-0.818	0.0	-0.697	0.0
Share of employees being 55 or older	2.203	0.0	1.323	0.4	0.233	67.1
Share of employees leaving the firm	-1.480	0.0	-1.403	0.0	-0.311	8.1
Share of unskilled employees	-0.387	0.1	-0.366	0.2	0.155	27.4
Single branch firm	0.326	0.0	0.319	0.0	0.222	0.0
High number of absences is a problem	-0.426	0.0	-0.522	0.0	-0.705	0.0
Staff shortage is problem	-0.333	0.0	-0.266	0.0	-0.458	0.0
No working-time accounts	0.000	99.3	0.192	0.0	0.310	0.0
Reorganization of corporate structure	0.617	0.0	0.615	0.0	0.543	0.0
Pay tied to collective agreement	-0.751	0.0	-0.656	0.0	-0.739	0.0
Manufacturing industry	0.439	0.0	0.508	0.0	0.564	0.0
Employee characteristics						
Age	0.006	49.0	0.001	85.0	0.001	89.1
No German citizen	0.289	0.1	-0.111	18.3	-0.014	86.8
University entrance degree (Abitur)	-0.216	3.4	-0.272	0.2	-0.258	1.1
No vocational degree	0.041	59.3	0.034	64.6	-0.019	82.7
Manufacturing occupation	0.226	0.0	0.231	0.0	0.407	0.0
Service occupation	0.153	3.8	0.025	70.9	0.138	3.5
Unskilled worker	0.249	0.1	0.383	0.0	0.291	0.1
Clerk	0.104	20.1	0.196	0.8	0.188	1.3
Half-monthly earnings in EUR	1.060	0.0	0.923	0.0	0.414	0.1
Half-monthly earnings > 1500 EUR	-0.476	0.0	-0.388	0.0	-0.069	47.8
Tenure	0.059	30.6	0.064	24.1	-0.007	92.3
Tenure 7 years	-0.192	12.9	-0.441	0.0	-0.428	0.8
Regional characteristics						
Big agglomeration	-0.653	0.0	-0.629	0.0	-0.650	0.0
Local unemployment rate	0.131	0.0	0.097	0.0	0.080	0.0
Northern Germany	-0.459	0.0	-0.345	0.2	-0.577	0.0
Central Germany	-0.150	0.8	-0.102	7.3	-0.146	3.1
Number of individual observations	4098		4269		3390	
Efron's R <sup>2</sup>	0.26		0.28		0.28	

Note: All variables are measured in 2000 or relative to June 30, 2000.

*Table A3: Probit specifications for males in East Germany*

	Aged 31-40		Aged 41-50		Aged 51-60	
	Coefficient	P-value in %	Coefficient	P-value in %	Coefficient	P-value in %
Constant	-3.275	0.0	-1.277	0.7	-2.279	0.1
Firm characteristics						
Log number of employees	0.155	0.1	0.029	51.9	0.138	1.1
Share of employees with university or college degree	4.167	0.0	4.554	0.0	3.019	0.0
Share of employees being 55 or older	-0.670	13.0	0.033	93.7	1.946	0.0
No working-time accounts	0.178	0.4	0.280	0.0	0.065	45.5
Share of employees leaving the firm (survey)	-7.419	0.0	-9.973	0.0	-10.950	0.0
No reorganization	0.002	97.7	-0.035	59.8	-0.307	0.0
Looking for staff in future	0.833	0.0	1.071	0.0	1.047	0.0
Hiring skilled workers is problem	0.365	0.0	0.157	0.9	0.164	3.6
Hiring young workers is problem	-0.525	0.0	-0.472	0.0	-0.863	0.0
High number of absences is a problem	0.671	0.0	0.681	0.0	0.560	0.0
Foreign-owned to more than 50%	-0.491	0.0	-0.551	0.0	-0.930	0.0
Trade sector	0.964	0.0	1.097	0.0	0.767	0.0
Service sector	-0.531	0.0	-0.518	0.0	-0.633	0.0
Employee characteristics						
Age	-0.003	71.0	-0.027	0.1	-0.009	37.7
University entrance degree (Abitur)	-0.121	48.1	-0.169	21.1	0.232	22.1
Vocational degree	0.392	0.0	0.139	14.5	0.136	25.3
University or college degree	0.427	4.8	0.312	6.3	-0.099	68.1
Technical occupation	-0.453	0.0	-0.382	0.0	-0.142	8.8
Higher-skilled service occupation	-0.602	0.0	-0.578	0.0	-0.343	0.1
Low-skilled service occupation	0.075	44.7	-0.135	13.6	-0.084	45.0
Other occupation	-0.403	0.0	-0.451	0.0	-0.361	0.3
Skilled worker	-0.378	0.0	-0.301	0.0	-0.116	22.3
Clerk	-0.284	0.8	-0.360	0.1	-0.261	4.9
Half-monthly earnings in EUR	1.118	0.0	1.562	0.0	0.265	20.6
Half-monthly earnings > 1500 EUR	-0.209	8.8	-0.415	0.0	-0.037	76.1
Cumulated earnings from employment in last 10 years	-0.131	25.4	-0.298	2.3	0.105	40.7
Tenure	0.517	0.0	0.523	0.0	0.530	0.0
Tenure 7 years	-0.713	0.0	-0.854	0.0	-0.766	0.0
Unemployed in last 4 years	-0.344	1.0	-0.645	0.0	-0.583	2.6
Unemployed in last 10 years	-0.085	19.5	-0.203	0.2	-0.004	96.8
Out of the labour force in last 4 years	-0.021	82.4	-0.026	77.4	-0.002	98.8
Out of the labour force in last 10 years	0.320	0.0	0.177	0.1	0.113	10.9
Fraction employed 9-10 years before	1.015	0.0	1.014	0.0	1.257	0.0
Regional characteristics						
Rural area	0.271	0.0	0.395	0.0	0.390	0.0
Number of individual observations	4145		4894		2902	
Efron's R <sup>2</sup>	0.33		0.36		0.36	

Note: All variables are measured in 2000 or relative to June 30, 2000.

## Appendix C: Common support

Table A4: Loss of observations due to imposition of common support

Stratum	West			East		
	31-40	41-50	51-60	31-40	41-50	51-60
All observations	4098	4269	3390	4145	4894	2902
Percent remaining	93	97	94	87	91	95

Table A5:

Means of

*variables before and after imposing common support (men aged 51-60)*

	All	West		All	East	
		Remaining	Excluded		Remaining	Excluded
<b>Basic firm characteristics</b>						
Number of employees	386	377	520	336	339	296
Share of newly hired employees	0.12	0.12	0.12	0.10	0.10	0.26
Share of employees leaving the firm	0.14	0.14	0.08	0.11	0.10	0.24
Mean age of employees	40.0	40.0	40.1	40.9	40.8	42.6
Share of employees being 55 or older	0.13	0.13	0.11	0.13	0.13	0.17
Mean of monthly earnings in 1000 EUR	2593	2584	2727	2032	2053	1653
Share of female employees	0.23	0.23	0.13	0.30	0.30	0.28
Share of employees w/o German citizenship	0.13	0.13	0.09	0.00	0.00	0.00
Share of part-time employees	0.07	0.07	0.06	0.07	0.06	0.14
<b>Human capital</b>						
Share of apprentices	0.05	0.05	0.03	0.05	0.05	0.02
Share of unskilled workers	0.29	0.29	0.26	0.16	0.15	0.31
Share of skilled workers	0.28	0.28	0.38	0.43	0.44	0.24
Share of clerks	0.31	0.32	0.27	0.29	0.29	0.29
Share of employees without vocational degree	0.26	0.27	0.20	0.09	0.09	0.06
Share of employees with vocational degree	0.63	0.62	0.74	0.74	0.74	0.75
Share of college/university graduates	0.06	0.06	0.05	0.13	0.13	0.17
<b>Industry</b>						
Manufacturing	0.80	0.79	1.00	0.69	0.70	0.49
Construction	0.05	0.05	0.00	0.00	0.00	0.00
Trade/sales/retail	0.07	0.07	0.00	0.07	0.07	0.07
Service industry	0.08	0.09	0.00	0.24	0.23	0.44
<b>Organization</b>						
Foreign ownership >50%	0.22	0.23	0.12	0.08	0.09	0.01
No working-time accounts	0.23	0.22	0.40	0.22	0.20	0.44
Profit sharing	0.21	0.19	0.48	0.12	0.12	0.14
Pay tied to collective agreement	0.16	0.17	0.00	0.19	0.17	0.38
Recent reorganization of corporate structure	0.48	0.45	0.88	0.35	0.36	0.19
<b>Staff-related issues</b>						
Looking for staff right now	0.64	0.66	0.48	0.36	0.36	0.49
Hard to find skilled workers	0.64	0.64	0.60	0.48	0.47	0.54
High rate of absences	0.27	0.28	0.08	0.23	0.23	0.32
<b>Firm performance</b>						
Firm growth	-5.0	-5.5	3.8	0.9	0.0	17.0
Revenue increased compared to last year	0.49	0.48	0.62	0.36	0.36	0.46
Share of capital widening investments	0.29	0.29	0.29	0.38	0.38	0.26

Table A5 to be continued.

Table A5 continued.

	West			East		
	All	Remaining	Excluded	All	Remaining	Excluded
<b>Regional characteristics</b>						
Firm in city	0.32	0.33	0.15	0.15	0.14	0.28
Mean unemployment rate 2002	8.39	8.30	9.74	14.33	14.22	16.22
<b>Individual characteristics</b>						
Age	55.2	55.2	54.9	55.3	55.4	55.1
No vocational degree	0.19	0.20	0.15	0.04	0.04	0.03
Vocational degree	0.70	0.70	0.83	0.72	0.72	0.71
College/university degree	0.05	0.05	0.01	0.21	0.21	0.25
Share employed in last 10 years	1.00	1.00	1.00	0.86	0.86	0.86
Share unemployed in last 10 years*	0.00	0.00	0.00	0.01	0.01	0.03
Share out of labour force in last 10 years*	0.00	0.00	0.00	0.12	0.12	0.10
Gross earnings per month	3180	3173	3283	2345	2360	2068
Unskilled worker	0.25	0.25	0.27	0.15	0.14	0.34
Skilled worker	0.36	0.36	0.31	0.51	0.53	0.28
Clerk	0.39	0.39	0.41	0.34	0.34	0.38
Job in engineering	0.32	0.32	0.29	0.32	0.32	0.21
Job in construction**	0.05	0.05	0.03	0.00	0.00	0.00
Job in manufacturing	0.22	0.21	0.37	0.19	0.19	0.12
High-skilled job in services	0.25	0.25	0.23	0.25	0.25	0.23
Low-skilled job in services	0.08	0.08	0.07	0.15	0.14	0.37
Other job	0.09	0.09	0.01	0.08	0.08	0.07
No German citizenship**	0.13	0.13	0.13	0.00	0.00	0.01
Number of observations	3390	3177	213	2902	2746	156
Percent remaining within support		94			95	

Note: All variables are measured in 2000 or relative to June 30, 2000. Observations with a non-zero value have been excluded for \*men in West Germany and \*\*East German workers.

## Appendix D: Further estimation results

Table A6: Point-in-time estimates (men)

		West Germany						East Germany					
		Age 31-40		Age 41-50		Age 51-60		Age 31-40		Age 41-50		Age 51-60	
		Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.
In PWE end of	12/02	.0000		.0000		.0589	.00	.0000		.0000		.0564	.00
	06/03	.0000		.0000		.0549	.00	.0000		.0000		.0603	.00
	12/03	.0000		.0000		.0539	.00	.0000		.0000		.0647	.00
	06/04	.0000		.0000		.0601	.00	.0000		.0000		.0633	.01
	12/04	.0000		.0003	.21	.0594	.00	.0000		.0003	.23	.0655	.01
	06/05	.0000		.0003	.21	.0582	.00	.0000		.0007	.24	.0628	.01
	12/05	.0000		.0005	.13	.0625	.00	.0000		.0015	.30	.0616	.01
	06/06	.0000		.0014	.06	.0585	.00	.0000		.0021	.25	.0561	.01
	12/06	.0000		.0027	.03	.0570	.00	.0000		.0023	.33	.0552	.01
	06/07	.0000		.0059	.01	.0504	.00	.0000		.0038	.29	.0488	.01
	12/07	.0000		.0090	.00	.0431	.00	.0000		.0059	.25	.0512	.01
	06/08	.0000		.0103	.03	.0374	.01	.0000		.0063	.24	.0478	.01
12/08	.0000		.0120	.02	.0337	.02	.0000		.0079	.22	.0477	.00	
Employed end of	12/02	.0016	.38	-.0010	.47	.0031	.43	.0019	.35	-.0121	.10	.0605	.01
	06/03	.0057	.19	.0092	.23	.0515	.10	.0024	.31	-.0108	.12	.0536	.01
	12/03	-.0124	.17	.0093	.25	.0561	.06	.0063	.21	-.0103	.18	.0467	.03
	06/04	-.0050	.38	.0035	.40	.0407	.13	.0039	.26	-.0090	.18	.0459	.04
	12/04	-.0012	.47	-.0015	.46	.0351	.17	.0068	.19	-.0095	.20	.0436	.05
	06/05	.0073	.24	.0043	.38	.0205	.29	.0041	.31	-.0086	.25	.0403	.05
	12/05	.0079	.26	-.0158	.25	.0141	.34	.0035	.34	-.0133	.17	.0494	.04
	06/06	.0280	.03	-.0049	.40	.0142	.35	.0085	.16	-.0050	.36	.0560	.03
	12/06	.0087	.20	-.0070	.37	.0083	.41	.0015	.43	-.0129	.15	.0568	.04
	06/07	.0093	.16	-.0094	.32	-.0006	.49	-.0024	.38	-.0184	.12	.0502	.06
	12/07	.0132	.13	-.0110	.31	.0086	.41	.0071	.28	-.0156	.19	.0459	.06
	06/08	.0077	.30	-.0131	.28	.0136	.33	.0100	.21	-.0069	.33	.0253	.15
12/08	.0056	.32	-.0108	.33	.0149	.30	.0049	.32	-.0025	.44	.0218	.17	
Unemployed end of	12/02	-.0023	.28	-.0081	.15	-.0152	.15	.0029	.28	.0098	.05	-.0412	.04
	06/03	-.0050	.12	-.0147	.07	-.0295	.09	-.0007	.44	.0063	.16	-.0475	.01
	12/03	.0013	.41	-.0177	.07	-.0749	.06	-.0052	.21	.0068	.15	-.0457	.02
	06/04	.0087	.27	-.0116	.13	-.0635	.05	-.0034	.27	.0083	.07	-.0394	.02
	12/04	.0039	.40	-.0065	.25	-.0635	.08	-.0054	.21	.0077	.16	-.0367	.04
	06/05	-.0057	.25	-.0087	.19	-.0600	.08	-.0060	.24	.0078	.16	-.0299	.04
	12/05	-.0026	.34	.0050	.38	-.0436	.14	.0000	.50	.0114	.08	-.0335	.02
	06/06	-.0068	.07	-.0043	.38	-.0051	.39	-.0080	.15	.0050	.21	-.0437	.02
	12/06	-.0099	.03	.0011	.46	.0017	.46	-.0026	.38	.0099	.10	-.0438	.02
	06/07	-.0071	.09	.0021	.42	-.0054	.36	.0037	.30	.0179	.06	-.0379	.02
	12/07	-.0105	.04	.0006	.48	-.0063	.30	-.0049	.36	.0097	.17	-.0399	.02
	06/08	-.0085	.17	.0033	.35	-.0128	.10	-.0056	.33	.0037	.33	-.0217	.06
12/08	-.0054	.24	.0075	.26	-.0101	.13	-.0066	.25	-.0076	.23	.0060	.36	
Out of labour force end of	12/02	-.0001	.49	.0092	.23	.0110	.16	-.0054	.08	.0020	.35	-.0186	.08
	06/03	-.0014	.37	.0096	.20	.0195	.10	-.0013	.27	.0043	.22	-.0057	.37
	12/03	-.0014	.36	.0085	.20	.0190	.14	-.0011	.31	.0040	.29	-.0062	.36
	06/04	-.0049	.18	.0084	.24	.0216	.14	-.0002	.46	.0019	.38	-.0063	.37
	12/04	-.0043	.15	.0059	.33	.0297	.10	-.0019	.15	.0031	.31	-.0048	.41
	06/05	-.0023	.30	.0021	.45	.0372	.10	.0007	.33	.0025	.37	-.0099	.32

Table A6 to be continued.

*Table A6 continued*

		West Germany						East Germany					
		Age 31-40		Age 41-50		Age 51-60		Age 31-40		Age 41-50		Age 51-60	
		Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.	Effect	P-val.
Out of labour force end of	12/05	-.0064	.23	.0094	.19	.0289	.17	-.0029	.22	.0019	.41	-.0144	.26
	06/06	-.0247	.13	.0090	.23	-.0086	.39	-.0022	.26	.0028	.37	-.0119	.30
	12/06	-.0014	.40	.0069	.31	-.0078	.40	-.0004	.45	.0042	.30	-.0133	.31
	06/07	-.0042	.26	.0063	.35	.0081	.40	-.0032	.25	.0004	.49	-.0113	.37
	12/07	-.0043	.27	.0082	.31	-.0025	.47	-.0034	.22	.0060	.29	-.0081	.39
	06/08	-.0009	.46	.0080	.31	-.0032	.45	-.0045	.19	.0040	.37	-.0054	.41
	12/08	-.0022	.40	.0030	.42	-.0044	.44	.0010	.42	.0106	.21	-.0259	.18

Note: Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

## Appendix E: Matching protocol

Table A7: A matching protocol for the estimation of a counterfactual outcome and the effects

Step A-1	Choose one observation in the subsample defined by treatment $d=1$ and delete it from that pool.
Step B-1	Find an observation in the subsample defined by $d=0$ that is as close as possible to the one chosen in step A-1) in terms of $P(x), \mathcal{X}$ . 'Closeness' is based on the Mahalanobis distance.
Step C-1	Repeat A-1) and B-1) until no observation with $d=1$ is left.
Step D-1	Compute the distribution of distances obtained for any comparison between a member of the reference distribution and matched comparison observations. Obtain the distance at quantile $Q(dist)$ .
Step A-2	Repeat A-1).
Step B-2	Repeat B-1). If possible, find other observations in the subsample of $d=0$ that are at least as close as $R \cdot dist$ to the one chosen in step A-2). Do not remove these observations, so that they can be used again. Compute weights for all chosen comparisons observations that are proportional to their distance. Normalize the weights such that they add to one.
Step C-2	Repeat A-2) and B-2) until no participant in $d=1$ is left.
Step D-2	D-2) For any potential comparison observation, add the weights obtained in A-2) and B-2).
Step E	Using the weights $w(x_i)$ obtained in D-2), run a weighted linear regression of the outcome variable on the variables used to define the distance (and an intercept).
Step F-1	Predict the potential outcome $y^0(x_i)$ of every observation using the coefficients of this regression: $\hat{y}^0(x_i)$ .
Step F-2	Estimate the bias of the matching estimator for $E(Y^0   D = 1)$ as: $\frac{\sum_{i=1}^N d_i \hat{y}^0(x_i)}{N_1} - \frac{(1-d_i) w_i \hat{y}^0(x_i)}{N_0}$
Step G	Using the weights obtained by weighted matching in D-2), compute a weighted mean of the outcome variables in $d=0$ . Subtract the bias from this estimate to get $E(Y^0   D = 1)$ .

The parameters used to define the radius for the distance-weighted radius matching are set to 0.9 for both,  $R$  and  $Q$ .  $Q$  refers to the quantile of the distribution of the distances to the closest neighbor in a one-to-one matching. It is defined in terms of the propensity score. Different values for  $R$  and  $Q$  are checked in the sensitivity analysis in Lechner, Miquel, and Wunsch (2011) as well as in the simulation study by Huber, Lechner, and Wunsch (2013). They showed a considerable robustness of the results with respect to the choice of  $R$  and  $Q$ .

**Online Appendix (not for publication in the journal)**

**Appendix IA: Results for females**

*Table IA.1: Number of firms and female employees*

Age	West			East		
	31-40	41-50	51-60	31-40	41-50	51-60
Firms	178	178	174	172	201	182
Individuals	3323	3412	2227	4339	4953	2454

*Table IA.2: Mean characteristics of firms of elderly female workers by region*

PWE	Women West		Women East	
	no	yes	no	yes
Basic firm characteristics				
Number of employees	240	365	260	365
Number of newly hired employees	0.16	0.15	0.13	0.12
Number of employees leaving the firm	0.33	0.27	0.13	0.09
Mean age of employees	40	39	41	39
Share of employees being 55 or older	0.13	0.12	0.12	0.11
Mean of monthly earnings in 1000 EUR	1.86	2.24	1.50	1.82
Share of female employees	0.55	0.51	0.65	0.66
Share of employees w/o German citizenship	0.13	0.11	0.00	0.00
Share of part-time employees	0.23	0.20	0.26	0.25
Human capital				
Share of apprentices	0.03	0.06	0.04	0.07
Share of unskilled workers	0.33	0.27	0.13	0.09
Share of skilled workers	0.15	0.13	0.22	0.17
Share of clerks	0.26	0.33	0.34	0.42
Share of employees without vocational degree	0.34	0.28	0.09	0.10
Share of employees with vocational degree	0.48	0.61	0.72	0.76
Share of college/university graduates	0.03	0.06	0.07	0.11
Industry				
Manufacturing	0.57	0.60	0.28	0.26
Construction	0.02	0.01	0.05	0.01
Trade/sales/retail	0.13	0.19	0.19	0.22
Service industry	0.28	0.20	0.49	0.51
Organization				
Foreign ownership >50%	0.19	0.06	0.07	0.03
No working-time accounts	0.39	0.36	0.44	0.50
No works council	0.32	0.04	0.27	0.04
Profit sharing	0.14	0.18	0.09	0.12
Pay tied to collective agreement	0.21	0.18	0.23	0.13
Recent reorganization of corporate structure	0.23	0.34	0.39	0.29
Staff-related issues				
Looking for staff right now	0.52	0.67	0.34	0.50
Hard to find skilled workers	0.51	0.66	0.30	0.50
High rate of absences	0.34	0.33	0.15	0.21
Regional characteristics				
Firm in city	0.30	0.31	0.12	0.30
Mean unemployment rate 2002	8.2	9.3	15.7	15.8
Number of observations	951	1276	1307	1147

Note: All variables are measured in 2000 or relative to June 30, 2000.

*Table IA.3: Mean characteristics of elderly female workers by region*

PWE	Women West		Women East	
	no	yes	no	yes
Age	55.1	54.6	54.8	54.8
No vocational degree	0.46	0.38	0.08	0.06
Vocational degree	0.42	0.56	0.76	0.82
College/university degree	0.01	0.01	0.07	0.08
Share employed in last 10 years	0.94	0.96	0.83	0.85
Share unemployed in last 10 years*	0.01	0.01	0.04	0.02
Share out of labour force in last 10 years*	0.05	0.03	0.13	0.13
Gross earnings per month	1760	2080	1660	1920
Unskilled worker	0.42	0.32	0.14	0.08
Skilled worker	0.06	0.01	0.12	0.09
Clerk	0.25	0.30	0.49	0.54
Job in engineering	0.03	0.03	0.04	0.07
Job in construction**	0.02	0.02	0.00	0.00
Job in manufacturing	0.20	0.16	0.06	0.06
High-skilled job in services	0.37	0.49	0.55	0.69
Low-skilled job in services	0.19	0.12	0.21	0.13
Other job	0.19	0.18	0.14	0.04
No German citizenship**	0.11	0.11	0.00	0.00
Number of observations	951	1276	1307	1147

Note: All variables are measured in 2000 or relative to June 30, 2000. Observations with a non-zero value have been excluded for \*men in West Germany and \*\*East German workers.

Table IA.4: Probit specifications for females in West Germany

	Aged 31-40		Aged 41-50		Aged 51-60	
	Coefficient	P-value in %	Coefficient	P-value in %	Coefficient	P-value in %
Constant	-4.917	0.0	-4.403	0.0	-4.070	0.0
Firm characteristics						
Log number of employees	0.795	0.0	0.678	0.0	0.694	0.0
Share of employees being 55 or older	-0.529	37.4	-0.165	75.5	-1.113	6.8
Share of employees leaving the firm	-0.291	39.5	-1.322	0.0	-0.318	33.9
Share of unskilled employees	-1.154	0.0	-0.711	0.0	-0.624	0.0
Single branch firm	0.058	31.9	-0.058	30.8	-0.013	85.6
High number of absences is a problem	-0.335	0.0	-0.307	0.0	-0.129	10.7
Staff shortage is problem	-0.645	0.0	-0.684	0.0	-0.668	0.0
No working-time accounts	0.050	43.7	-0.109	8.5	-0.241	0.2
Reorganization of corporate structure	0.709	0.0	0.572	0.0	0.298	0.0
Pay tied to collective agreement	-0.677	0.0	-0.454	0.0	-0.386	0.0
Trade sector	-0.281	1.0	-0.015	88.3	0.211	11.0
Service sector	-0.544	0.0	-0.177	4.4	-0.427	0.0
Employee characteristics						
Age	-0.003	73.1	-0.017	4.5	-0.022	5.4
No German citizen	0.298	0.4	0.324	0.0	0.367	0.1
No vocational degree	-0.049	48.6	0.043	50.2	0.040	59.0
Occupation						
Manufacturing, technical, construction	-0.399	0.0	-0.205	2.7	-0.068	55.6
Low-skilled service occupation	-0.516	0.0	-0.370	0.0	0.002	98.2
Other occupation	-0.030	74.8	0.076	38.0	0.143	15.6
Part-time worker	0.515	0.0	0.535	0.0	0.531	0.0
Half-monthly earnings in EUR	0.400	0.0	0.811	0.0	0.751	0.0
Half-monthly earnings > 1500 EUR	-0.330	0.2	-0.369	0.1	0.043	78.7
Tenure						
Tenure 7 years	-0.122	24.1	-0.248	2.5	-0.370	1.7
Out of the labour force in last 4 years	-0.067	33.7	0.041	60.1	0.119	23.8
Out of the labour force in last 10 years	0.107	9.9	-0.020	75.3	0.001	98.6
Regional characteristics						
Big agglomeration	-0.454	0.0	-0.462	0.0	-0.421	0.0
Local unemployment rate	0.089	0.0	0.112	0.0	0.122	0.0
Northern Germany			-0.511	0.0	-0.806	0.0
Central Germany	-0.235	0.0	-0.400	0.0	-0.286	0.0
Number of individual observations	3323		3412		2227	
Efron's R <sup>2</sup>	0.32		0.31		0.30	

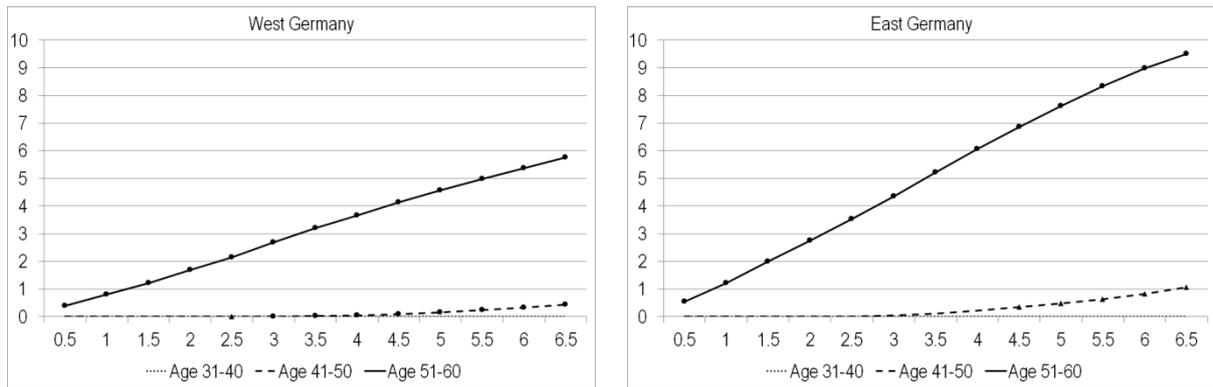
Note: All variables are measured in 2000 or relative to June 30, 2000.

Table IA.5: Probit specifications for females in East Germany

	Aged 31-40		Aged 41-50		Aged 51-60	
	Coefficient	P-value in %	Coefficient	P-value in %	Coefficient	P-value in %
Constant	-2.446	0.0	-2.837	0.0	-3.348	0.0
Firm characteristics						
Log number of employees	0.388	0.0	0.373	0.0	0.438	0.0
Share of employees with university or college degree	2.391	0.0	3.184	0.0		
Share of employees being 55 or older	-5.083	0.0	-4.374	0.0	-3.967	0.0
No working-time accounts	0.007	89.1	0.368	0.0	0.177	0.8
Hiring skilled workers is problem	0.835	0.0	0.622	0.0	0.611	0.0
Share of employees leaving the firm (survey)	-2.745	0.0	-2.971	0.0	-3.044	0.0
No reorganization	-0.061	19.7	0.152	0.0	0.181	0.4
Currently looking for staff	0.045	37.2	-0.061	19.6	0.112	8.1
Share of female employees	-0.615	0.0	-0.065	50.8	-0.238	10.9
Pay tied to collective agreement	-0.301	0.0	-0.274	0.0	-0.103	21.1
Trade sector	0.915	0.0			-0.009	91.3
Service sector	0.807	0.0				
Employee characteristics						
Age	-0.020	1.3	-0.009	19.3	0.007	49.1
No vocational degree	0.219	6.6	0.330	0.1	0.133	29.7
University or college degree	-0.093	45.2	-0.277	0.1	-0.071	58.4
Manufacturing, technical, construction occupation	-0.172	12.3	-0.229	0.9	-0.149	28.2
Low-skilled service occupation	-0.259	0.1	-0.042	52.2	-0.079	42.3
Other occupation	-0.688	0.0	-0.594	0.0	-0.740	0.0
Skilled worker	-0.108	28.2	0.175	3.5	0.307	2.2
Clerk	-0.541	0.0	-0.211	2.1	-0.154	27.7
Part-time worker	-0.283	2.5	0.317	0.0	0.301	3.3
Half-monthly earnings in EUR	1.203	0.0	1.073	0.0	0.987	0.0
Half-monthly earnings > 1500 EUR	-0.551	0.0	-0.616	0.0	-0.657	0.0
Tenure	0.172	2.3	0.043	57.6	-0.126	27.2
Tenure 7 years	-0.254	1.1	-0.042	68.6	0.159	32.3
Unemployed in last 4 years	-0.056	63.3	0.035	73.8	-0.079	65.4
Unemployed in last 10 years	-0.070	25.4	-0.189	0.0	-0.205	1.0
Out of the labour force in last 2 years	0.021	86.1	0.283	3.0	0.253	15.8
Out of the labour force in last 4 years	0.008	94.3	-0.105	36.1	-0.140	43.6
Out of the labour force in last 10 years	-0.001	99.2	0.012	80.7	-0.134	5.2
Fraction employed 9-10 years before	0.050	66.4	0.399	0.0	0.459	0.5
Fraction part-time employed in last 10 years	0.337	1.8				
Employment ended due to health problems in past 10 years	0.136	7.1	-0.072	37.5	-0.008	94.3
Regional characteristics						
Rural area	0.290	0.0	0.134	0.3	0.170	1.2
Number of individual observations	4339		4953		2454	
Efron's R <sup>2</sup>	0.33		0.27		0.24	

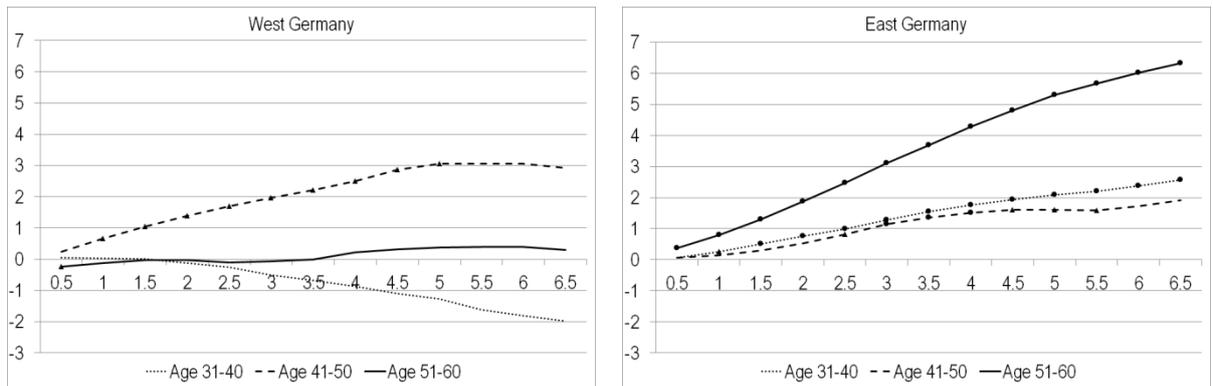
Note: All variables are measured in 2000 or relative to June 30, 2000.

Figure IA.1: ATE on cumulative months in PWE (women)



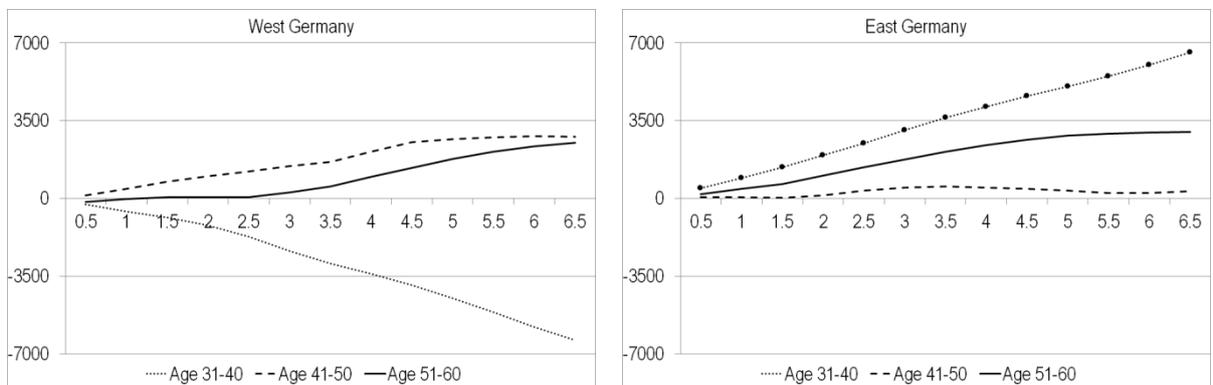
Note: Lines denote average treatment effects for respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Figure IA.2: ATE on cumulated months in unsubsidised employment (women)



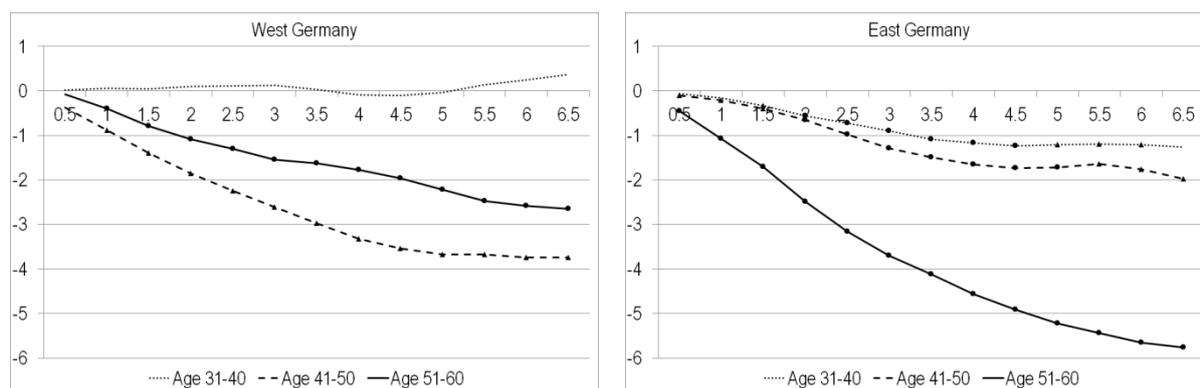
Note: Lines denote average treatment effects for respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Figure IA.3: ATE on cumulated earnings from employment in EUR (women)



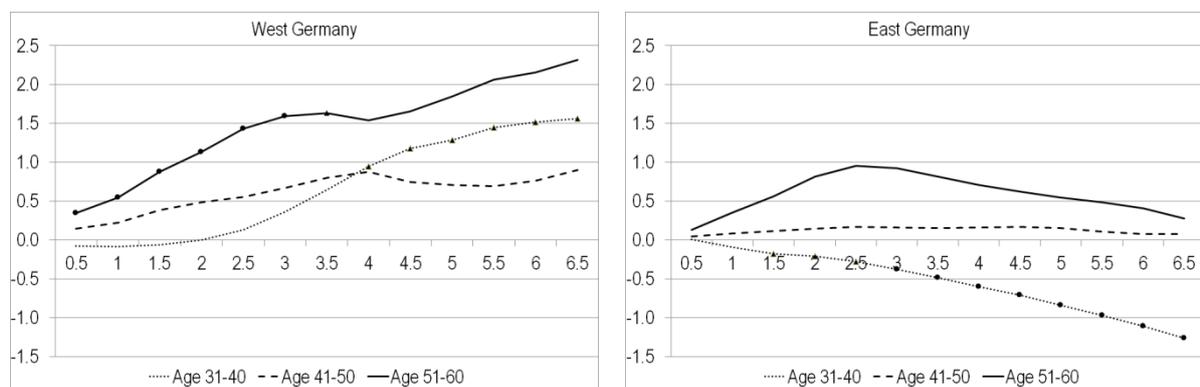
Note: Lines denote average treatment effects for respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Figure IA.4: ATE on cumulated unemployment in months (women)



Note: Lines denote average treatment effects for respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Figure IA.5: ATE on cumulated time out of the labour force in months (women)



Note: Lines denote average treatment effects for respective age stratum. Dots indicate significance at the 5% level, while triangles indicate significance at the 10% level. The horizontal axis measures the number of months since June 2004 (half-yearly measurements in June and December of each year). Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications).

Table IA.6: ATE on tenure in the original establishment in days (women)

Region	Age	Effect	P-value in %
West	31-40	-204	30
	41-50	10	96
	51-60	-1	99
East	31-40	298*	7
	41-50	178	19
	51-60	320***	<1

Note: \*/\*\*/\*\* indicates significance on the 10/5/1% level. Inference is based on block bootstrapping p-values (clustered at the establishment level, 499 replications). Tenure refers to the time with the establishment after treatment measured from July 2004. Tenure before that is a control variable.