Discussion Paper No. 10-069

Which Personnel Measures are Effective in Increasing Productivity of Old Workers?

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Nontechnical Summary

In most Western industrialised countries the workforce is ageing rapidly. If the productivity contributions of old workers are low, dealing with increasing shares of old employees could be decisive for the competitiveness of establishments. A large fraction of establishments already uses specific measures for old employees (SMOE) to cope with aging workforces. In this paper, we investigate whether the application of SMOE leads to an increase in relative productivity of old employees. Despite the widespread use of these measures, to our knowledge, this is the first attempt to investigate this topic. In order to study the relation between SMOE and the relative productivity of old workers, we compare age-productivity profiles for different subgroups of establishments. A representative linked employer-employee panel data set allows us to calculate establishment age-productivity profiles and to split the sample into establishments that use SMOE and those that do not use them. We find that a change in work requirements and specific equipment of workplaces for old employees are associated with a significantly higher relative productivity of old employees. Establishments that apply age mixed working groups are characterised by higher productivity of old employees and young employees. This might be an indication of important complementarity effects between age groups. Finally, flexible working times for old employees and the inclusion of old employees in training measures are not associated with differences in the age productivity profiles. We argue that missing effects of these measures might be a consequence of wrong implementation. Overall, the application of certain SMOE is associated with significantly higher relative productivity of the targeted age groups. Our findings therefore suggest that SMOE are an effective way to raise the relative productivity contribution of old workers.

Das Wichtigste in Kürze

Das Durchschnittsalter der Arbeitnehmer stieg in einem Großteil der westlichen Industrienationen während der letzten Jahre stark an. Falls ältere Arbeitnehmer eine niedrigere Produktivität haben sollten als jüngere Arbeitnehmer, dann kommt dem Management älterer Beschäftigten große Bedeutung für die Wettbewerbsfähigkeit von Betrieben zu. Die betriebliche Nutzung von passgenauen Maßnahmen des Personalmanagements spielt hierbei eine entscheidende Rolle und ein bedeutender Anteil der Betriebe wendet bereits spezifische Maßnahmen für ältere Beschäftigte (SMÄB) an. In dieser Studie untersuchen wir ob die Anwendung von SMÄB zu einer Steigerung der relativen Produktivität älterer Angestellter führt. Trotz des großen Verbreitungsgrads dieser Maßnahmen handelt es sich bei der vorliegende Studie um die erste, die sich dieses Themas annimmt. Für die Untersuchung des Zusammenhangs zwischen der Anwendung von SMÄB und der relativen Produktivität älterer Angestellter, vergleichen wir Alters-Produktivitätsprofile unterschiedlicher Betriebsgruppen. Die Verwendung eines repräsentativen, verknüpften Beschäftigten- und Betriebsdatensatzes erlaubt es uns, kausale Alters-Produktivitätsprofile zu schätzen und die Betriebe in zwei Gruppen mit und ohne spezifische Maßnahmen einzuteilen. Wir finden, dass eine Anpassung der Arbeitsanforderungen und eine spezielle Ausstattung der Arbeitsplätze älterer Arbeitnehmer mit einer signifikant höheren Produktivität älterer Arbeitnehmer verbunden sind. In Betrieben mit altersgemischte Arbeitsteams ist nicht nur die Produktivität älterer Beschäftigter höher – auch jüngere Beschäftigte haben eine höhere relative Produktivität. Dies könnte ein Hinweis darauf sein, dass es starke positive Ausgleichseffekte zwischen Altersgruppen gibt, die durch altersgemischte Teams aktiviert werden. Schließlich finden wir, dass flexible Arbeitszeiten für ältere Beschäftigte und die Einbeziehung Älterer in Weiterbildungsmaßnahmen nicht mit Abweichungen im Alters-Produktivitätsprofil zusammenhängen. Wir argumentieren, dass dies möglicherweise mit der spezifischen Implementation der Maßnahmen zusammenhängt. Zusammengefasst legen unsere Ergebnisse nahe, dass die SMÄB ein effektive Möglichkeit sind, um die relative Produktivität älterer Angestellter zu erhöhen.

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Abstract

In this study, we investigate the effect of five specific human resource measures for old employees (SMOE) on their relative productivity. Despite the fact that SMOE are applied in the majority of establishments, this is the first representative study on the effectiveness of these measures. We find that the relative productivity contributions of old workers are significantly higher in establishments that provide either specific equipment of work places or age-specific jobs for old workers. In establishments that apply mixed-age working teams the productivity contributions of old and of young employees are significantly higher than in establishments without this measure. Working time reductions and specific training for old employees are not associated with higher relative productivity of these employees. Our paper provides a joint explanation for two recent findings, the only modest decline of the productivity contributions of old workers and the high variance for estimates of age-productivity profiles.

1 Introduction

The rapid ageing of the workforce in almost all developed countries led to concerns whether establishment productivity and competitiveness would suffer. If this would be the case, ageing workforces could lead to a decline in welfare. Consequently, the literature on the relationship between age, productivity and wages is growing fast, recently.

Despite the fact that many medical studies highlight a decline in relevant individual skills and abilities for old employees (Skirbekk, 2008; van Ours, 2009), several recent contributions show that higher shares of old employees in an establishment on average does not necessarily lead to a decrease in establishment productivity (Aubert and Crépon, 2006; Malmberg et al., 2008; Börsch-Supan and Weiß, 2009). Moreover, recent studies point to large variance in age-productivity profiles between establishments (Lallemand and Rycx, 2009; Göbel and Zwick, 2009).

In this paper, we study the effect of different specific measures for old employees (SMOE) on the age-productivity profile. These measures are targeted at old employees and are implemented by the establishments, e.g. as part of their human resource strategies, in order to enhance productivity of old employees. The application of SMOE in firms is an important economic phenomenon that has not received much attention in the economic literature, so far. In fact, more than 50 percent of the establishments in Germany have implemented at least one measure that specifically targets old employees (compare Table 1).

If SMOE are successful in enhancing the productivity of old employees, then they provide a joint explanation for the recent empirical findings on the relationship between age and firm productivity. SMOE would contribute to the ability of enterprises to avoid a reduction in productivity contributions of old workers and they could augment the variance in age-productivity profiles between establishments. Moreover, SMOE would help to reconcile the seemingly contradictory results on the decline in individual peak performance, found for example in medical studies, and the modest decline in average productivity contributions of old workers (Skirbekk, 2004).

In order to shed some light on the relationship between SMOE and the productivity contribution of old workers, we investigate the relationship between the application of five different measures and the productivity contributions of old workers at the level of establishment. More specifically, we investigate: specific equipment of work places, working time reduction for old employees, age specific jobs for old employees, mixed-age working teams, and training for old employees. Until now, there exist only few case-studies on the effects of SMOE (Streb et al., 2008). To our knowledge, this paper is the first attempt to provide representative quantitative results on this subject.

Until recently, the availability of data on the application of SMOE was scarce. In the meanwhile, data on specific measures for old employees have been collected and are now integrated into the representative and extensive linked employer employee data of the IAB (LIAB), which is publicly available and widely used in economic research.

In order to identify the effect of SMOE, we exploit the fact that, according to theoretical considerations and since these measures are targeted at old employees, specific measures for old employees should affect the age-productivity profile in a very specific way, i.e. in most cases enhance the relative productivity of old workers when they are effective.

For our analysis, we require estimates of the relationship between the age composition of the workforce and productivity, at the establishment level. Since the age composition of the workforce is likely to be influenced by the establishment outcome, we have to consider potential endogeneity of the age composition of the workforce in order to obtain unbiased estimates of the age-productivity profiles (Aubert and Crepon, 2006; Göbel and Zwick, 2009). Moreover, we have to take into account that characteristics differ between firms with respect to many aspects – identification of the age-productivity profiles should therefore be based on within firm variation and include a broad spectrum of other establishment and employee characteristics.

We find that the productivity contribution of old employees is significantly higher in establishments with SMOE. Separate results for all measures reflect our theoretical considerations to a high degree. We interpret our findings in the following way: SMOE have a sizable impact on the relative productivity of old employees. Therefore, they contribute to the fact that productivity of old workers does not decline on average. Our

findings imply that from the firms' perspective SMOE can be an important human resource measure to enhance the productivity of old employees. From a macroeconomic perspective, our findings suggest that the ageing workforce is not a stroke of fate to economic welfare.

The remainder of this paper has the following structure. The next section provides an overview of human resource measures and their hypothetical impact on the relative productivity of old employees. The third section explains our empirical estimation strategy and the fourth section presents the representative linked employer-employee panel data set used. The fifth section contains the empirical results on the relationship between specific measures for old employees and age-productivity profile. The sixth part concludes.

2 Background

Establishments use personnel measures to cope with potentially constrained capability of old employees. The most pervasive method is to select the most able and best fitting employees and dismiss less productive employees (Howard, 1988). However, because of strict labour market protection for old employees, in many countries selective dismissal of old employees is expensive. This suggests that employers frequently cope with old employees, who might have a lower individual peak performance than younger workers or who are on average less productive than their younger colleagues. In times of a rapidly ageing workforce, successful sustainable personnel management is characterised by flat age-productivity profiles. For an establishment, a flat age-productivity profile implies that an increase of the share of old employees does not lead to a reduction in productivity. On the aggregate, macro economic level, flat average age-productivity profiles suggest that ceteris paribus a higher share of old workers would not lead to a decrease of overall productivity in a country.

Strategic human resource management measures that directly tackle disadvantages of old employees by specific measures for old employees (SMOE), provide methods to cope with a decline in the capability of old employees in cases where adjustment of wages or dismissal of old employees is not feasible. SMOE are based on the insight that old and young employees have complementary competencies and capabilities

(Boockmann and Zwick, 2004; Johnson, 2005; Skirbekk, 2008) and that input-based and transformational[1] competencies might be more important than managerial competencies or output-based competencies in order to obtain a sustainable competitive advantage (Verworn et al., 2009).

In its essence, this paper is based on a comparison of establishments that apply specific measures with establishments that do not apply them and an obvious question is why we actually observe variation in the application of different measures. One answer is that establishments apply different measures because of exogenous reasons, e.g. an exogenous event that changes the decision to apply certain measure but which have no other effect on the relative productivity of workers. A different way to rationalise the variation in the application of SMOE in otherwise similar establishments is that some establishments have not yet adopted the new management "technologies" while others already did (Bloom and van Reenen, 2010). Because of this adoption process, or experimenting, we observe variation of SMOE over establishments (see Table 5). Figure 1 display the question on the application of SMOE, which has been used for this analysis. We merge the two questions on the training for old employees, since they are hard to distinguish in praxis. Furthermore, we exclude "other measures for old employees" from the analysis, since there is no economic theory for the effect of "other measures" on the age-productivity profile. In this paper, we investigate the following five SMOE:

Specific equipment of workplaces for old employees aims at adapting the working environment and conditions to the specific requirements of old workers. For example, these measures compensate constraints in hearing or seeing capabilities of old employees by increased illumination of workplaces, a higher contrast and no blue/green contrasts in signs. The measure might also try to avoid excessive environmental noise, because old employees are stronger negatively affected by noise (Spirduso et al., 2005; Magrain and Boulton, 2007). If the workplaces are adapted to the requirements of old employees, this is supposed to increase the relative productivity of old employees. Furthermore, this personnel measure is unlikely to have major spillover effects on the productivity of young employees.

[1] Transformational competencies encompass organisational capabilities to transform inputs into output, Lado and Wilson (1994).

Reduced working time for old employees is a measure that aims at increasing the productivity contribution of old employees by offering part-time contracts. For example, this measure might offer to old employees to fade out of employment gradually – or to stay in the firm beyond the retirement age, with a part-time contract. Reduced working times are popular amongst old employees because they frequently have to take care for a sick relative or because their own health condition is then less affected by demanding work conditions (OECD, 2006, p. 77). Especially in physically demanding jobs reduced working times might be a measure to prevent reduced productivity induced by health problems. Specific part time work for old employees therefore might be a measure to retain experienced workers as they approach retirement age and keep them motivated (Verworn et al., 2009). Moreover, part-time work gives old employees the possibility to recover completely during non-working times, because they need longer breaks to recover than their younger colleagues. This could lead to enhanced performance during working time. In Germany, firms can offer this measure voluntarily to employees older than 50 years of age. We suppose that a reduced and more flexible working time for old employees mainly positively affects the relative productivity of old employees, a spillover effect to other age groups seems not likely.

Age specific jobs for old employees aim at enhancing productivity of old employees by shifting duties for example away from physically demanding jobs or monotonous procedures or by shifting constrained old workers to workstations that better fit their capabilities. Age specific jobs (or so-called "bridge jobs") at the same employer could be an effective tool to keep old workers motivated and to provide attractive working conditions to experienced workers (Casey, 2004). Analogous to a reduction in working times for old employees, we assume that age specific jobs are likely to increase the relative productivity of old employees.[2]

Mixed-age working teams are another personnel measure that could have an effect on relative productivity of old employees. For example, firms could strategically put employees of different age groups together in a working team in order to balance their specific strengths and weaknesses. The fundamental theoretical assumption is that old and young employees have different strengths and weaknesses stemming from varying

[2] If reduced working requirements are part of an implicit incentive scheme, they could also have an effect on total productivity, through the change in incentives to invest in firm-specific human capital.

experience, perspectives, and social networks (Kearney et al., 2009). A mixture of different age groups could lead to an exchange of ideas, a transfer of knowledge and experience, and a synergistic combination of resources for all age groups because young and old employees can concentrate on their comparative advantages (Backes-Gellner and Veen, 2008). A certain complexity of decision-making tasks therefore supports the effectiveness of age mixed teams (Wegge et al., 2008). In addition, age mixed teams potentially have more approaches at hand to tackle problems and more quickly put outdated strategies into question (Pitcher and Smith, 2001; Page, 2007; Ely, 2004). On the other hand, diverse work teams create costs because communication is more difficult and employees might have different attitudes and aspirations (Prat, 2002). This may reduce the communication intensity in heterogeneous teams (Milliken and Martins, 1996) and as a consequence the identification of the team members with the employer. Given the contradicting theoretical arguments, it is unclear whether age mixed working teams increase the relative productivity of old employees and whether there are positive spill-over effects on the productivity of young employees (also compare the literature reviews in Horwitz and Horwitz, 2007 and Ilmakunnas and Ilmakunnas, 2010).

Training for old employees provides either specific training to old employees or integrates old employees in existing measures. Training can provide means to enhance general and firm specific human capital and can comprise a wide rage of different activities – class training, practical training, introduction to new technologies, and so on. In theory, training should enhance the productivity of the employees. In practice, training participation declines with age (Warr and Fay, 2001). Specific training for old employees might be very effective in increasing relative productivity of old employees, since an increase in training intensity on average increases establishment productivity (Zwick, 2006) and prior training seems to be a good predictor for productivity differences between old employees (Andrisani and Daymont, 1987). We also know that training can have positive spillover effects between employees (Dearden et al., 2006). For example, trained old employees might transfer part of their knowledge and this increases productivity of their young colleagues. Besides spill-over effects, the absence of training for old employees might develop expectations under the young employees that at some point in their careers, investments in upgrading skills will no longer be

However, the estimation of the effect of SMOE on total productivity is beyond the scope of this paper.

beneficial (Lawrence, 1988; Avolio et al., 1990). Therefore, training participation of old employees might also increase the productivity of young employees. The overall effect of training on the age productivity profile therefore is undetermined. However, if we assume that the indirect effects to young employees are weaker than the direct effect of training for old employees, we expect an increase in relative productivity for old workers.

To summarise, theoretical arguments suggest that application of SMOE has an effect on the age productivity profiles. Some of the measures investigated are likely to raise exclusively the relative productivity of old workers. Other measures, such as age mixed working teams, can be expected to reduce productivity differences between different age groups.

3 Estimation Strategy

There is a vast literature on the relationship between human resource measures and enterprise productivity. Unfortunately, it is inherent to human resource measures that their impact is hard to identify (Bloom and Van Reenen, 2010). For most of the human resource measures, it is virtually impossible to find experimental or quasi-experimental situations that can be exploited for an impact analysis and matters get even worse when we are interested in representative results, as it is the case in this study. The key economic idea behind our study is to exploit the fact that human resource measures that are targeted at specific age-groups should lead to specific modifications of the age-productivity profiles between firms that apply the measures and firms that do not apply the measure.

In this section, we discuss the main obstacles that we have to overcome when estimating the age productivity profiles. Our main concern is about a specific type of endogeneity between productivity and the age composition of establishments. Even though the age composition of the employees is likely to have an impact on productivity, it could also be possible that productivity shocks at the establishment level lead to changes, e.g. because of age-specific hiring or layoffs. In this case one could observe a simultaneous change of the age structure and productivity. However, the change of the age structure of the firm does not cause the change of productivity, in this case. We tackle the problem

of simultaneity by applying standard GMM methods, where we instrument changes in the age-structure with their lagged values.

In order to investigate the relationship between SMOE and the relative productivity of old employees, we estimate the average age-productivity profile of employees on the establishment level. Similar to Aubert and Crépon (2006) and Göbel and Zwick (2009), we start from a structural Cobb-Douglas production function that explains value added per head p by capital per head k and the fraction of the number of employees in age groups i, L_i of the total number of employees in the establishments L. Here, a_i is the marginal product of age group i. We use age classes in five-year brackets.[3] We add a share indicator for gender, part-timers and nationality, several indicators for the qualification level of the employees, average tenure and the age dispersion of the employees as well as several establishment characteristics such as the establishment size, sector, export activity and quality of the technical equipment. Especially the addition of variables such as tenure and qualification corrects for possible estimation biases induced by differences in tenure and qualification between age groups and a direct impact of tenure and qualification on productivity (Avolio et al., 1990; Daveri and Maliranta, 2007).

Assuming perfect substitution among workers, one can write the production function per head, for establishment j in period t as:

$$\ln(p_{j,t}) \approx c + \beta \ln(k_{j,t}) + \sum_{i-\{0\}} (1-\beta)\left(\frac{a_i}{a_0} - 1\right)\left(\frac{L_i}{L}\right)_{j,t} + \varepsilon_{j,t} \qquad (1)$$

OLS estimates of equation (1) are likely to be miss-specified because value added and the age structure might be determined simultaneously (Griliches and Mairesse, 1998). Successful establishments for example recruit more workers and job entrants tend to be younger than those who leave the enterprise (Heywood et al., 2009; Zwick, 2008). In addition, the variation between the establishments is likely to drive the results and in pooled cross section estimations, we can only observe part of the heterogeneity between establishments (Prskawetz et al., 2006). For example, establishments with better

[3] We only report the coefficients of employees between 20 years of age and 60 years of age. The estimates for the other age classes are summarised in a separate variable but not reported because they are likely to reflect unobserved characteristics of employees at the fringes of the age distribution - very young employees and very old employees are usually specific individuals. In addition, they represent only a small fraction of the population of all employees. In 2005, the last year of our observation period only

industrial relations might be able to bind their employees longer, which may lead to a higher productivity (Addison et al., 2010).

Therefore, we estimate the production function by classical dynamic Diff-GMM estimators. (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). The basic idea of these estimators is to use lagged levels as "internal instruments" for contemporary differences. The underlying assumption is that contemporary shocks that may affect productivity and the age structure of the workers are orthogonal to the past level of capital and the age structure of the establishment (Aubert and Crépon, 2006). Bond and Söderbom (2005) provide a review of recent insights about the identification of production functions. Moreover, they illustrate that the presence of variation in adjustment costs justifies the use of lagged values to instrument production inputs. In order to find the correctly specified estimation model, we start with moment conditions that require relatively mild assumptions and augment the set of instruments gradually. We test the validity of the additional instruments by the means of the Sargan/Hansen test for overidentifying restrictions. We also apply the test for serial correlation in the disturbance term in order to check whether the specification of the model is valid.

In the next step, we compare the age-productivity profiles of two samples of establishments, those that use our five SMOE and those that do not. We therefore implicitly assume that both groups of establishments are comparable, conditional on our explanatory variables, and more specifically that there are no third factors that affect the presence of the measures and the age-productivity profile at the same time. If this assumption is not fulfilled, one cannot interpret our results as causal relationships but just as conditional correlations. In addition, we carefully investigate the observable differences between both groups.

4 Data

In order to estimate the impact of the age structure on establishment productivity, this paper uses the waves 1997-2005 of the linked employer-employee data set (LIAB) of

3.5% of the employees is younger than 20 years and only 3.8% is older than 60 years old (OECD, 2005).

the *Institute of Employment Research,* which is widely used for empirical research.[4] We use a version of the LIAB that provides one observation per year for establishment characteristics and virtually all employees of the observed establishments on June 30th of the respective year (see Jacobebbinghaus, 2008 for details).[5] On the establishment level, the LIAB uses the representative survey data of the IAB establishment panel. This panel entails questions on value added, investments, industrial relations, sector, average employee characteristics and expectations of the managers. Most important for this study, questions on the application of specific measures for old employees have recently been integrated and are now available for research.[6] The employee is based on administrative data of the IAB employment register and can be linked to the establishment data by the means of a common identifier. Therefore, we are able to link yearly information on wages, qualification, gender, tenure and age of the employees to their establishments. Altogether, our version of the LIAB covers almost 7 million employees and more than 8,500 establishments.

Only establishments with more than five employees are included in our sample. We exclude establishments of the public- and non-profit sector, since the productivity measures are hardly comparable to those of private firms. Moreover, we exclude the financial sector since the measures of capital and value added have a different meaning than in the other sectors. In order to have a proxy for the capital stock, we use the yearly information on investments in the establishments and the depreciation rates on the two-digit sector level. We derive the capital stock by the perpetual investment method (Black and Lynch, 2001; Zwick, 2004). For the starting value, we use the average of real investment and divide it by the sum of the depreciation rate and the average growth rate of investment (Hempell, 2006). Capital in the next period is computed as capital of the previous period plus investment and minus depreciation. About eight percent of the establishments never report an investment during our observation period. We apply two different strategies to cope with the missing values. First, we delete the establishments that never report investments. Alternatively, we impute the missing values for capital

[4] The German name is "*Institut für Arbeitsmarkt- und Berufsforschung*".

[5] Confusingly, this version of the LIAB-data is called "cross section version", despite the fact that the data set provides panel data.

[6] To the best of our knowledge, at present LIAB is the only representative linked employer employee data set that contains information on SMOE.

stocks. Applying a sensitivity analysis, both empirical strategies lead to similar results, though. The results reported in this paper are derived with the imputed capital stocks.

Individual tenure is censored in some cases. For employees in West Germany we know the exact date for tenure since January 1st 1975 and for East Germany the date is known since January 1st 1990. For observations before these dates the censored date is given. This means that between 16% (1997) and 10% (2005) of the West German and between 46% (1997) and 27% (2005) of the East German employees have censored values. We account for censoring by multiply imputing their values (compare Gartner, 2005). We define 20 cells for different gender, qualification (five groups), and nationality. For each cell, censored Tobit regressions are estimated separately including the covariates tenure, tenure squared, age, age squared, a dummy for East Germany and the level of education. Yearly imputation of the values for tenure could lead to excess variance in these variables and therefore, for each employee we impute only the first value for tenure. For each additional year the employee stays in the same establishment, we update the value for tenure by adding one year to the value of the last year.

Strictly speaking, we are not estimating productivity per head, as mentioned above, but productivity per full time equivalent of employees. We do this in order to account for part-time work. Workers with part time contract enter with half of a full time equivalent because we do not know the exact number of working hours. Apprenticeships are included as full-time employees, but since apprentices are a specific group, we additionally control for the proportion of the apprentices.

We use the information on the specific human resource management measures for old employees (employees older than 50 years of age) provided by a specific question in the wave 2002 of the establishment survey: "Which measures that are related to the employment of old employees are used in your establishment?". Then follows the list of six possible SMOE.[7] We assume that the establishments offer these measures permanently during the observation period 1997-2005 (or at least for most of the time). In this study, we treat SMOE as time invariant establishment characteristics. Analyses of the impact of personal measures that are based on changing information are frequently plagued by measurement errors (Huselid and Becker, 1996; Black and Lynch, 2001;

[7] Since we group two categories on training for old employees, we only refer to five SMOE in the rest of the paper.

Zwick, 2004). We only include establishments that gave us information on SMOE. For a short description of the variables and their mean values, refer to Table 2 in the appendix.

5 The relationship between Human Resource Measures and the Age-Productivity Profile

Now we summarise our findings concerning the age-productivity profiles and their relations to human resource measures for old employees in Germany. The establishments, with and without SMOE, show a remarkable similarity with respect to their observable characteristics (table 3 and 4). This holds true, whether we compare characteristics of the establishments that offer individual measures or the characteristics of the establishments that offer any of the individual measures with those of the establishments that do not offer any measures. The only remarkable difference is in establishment size – those establishments that do not offer any measure have on average only 50 employees and establishments with measures have on average almost 400 employees, compare Table 3. In order to check the robustness of our results with respect to establishment size, we conducted separate estimations on a sample from which we excluded all establishments with more than 250 employees. This robustness check did not reveal strong qualitative differences.

Table 5 shows that the application of personnel measures are only slightly correlated among establishments. In other words, we hardly find evidence for clusters of measures that are implemented together (Ichniowski et al., 1997).

As mentioned in section three, we present the results for the impact of the share of 5-year age classes from 20-60 years of age on value added. For the results of the control variables, we refer to the tables in the appendix. We use the age group of 30-40 year old workers as a reference, since this group has the biggest share of workers. Figure 2 shows that for the entire sample the age-productivity profile is relatively flat. This is also found in comparable studies for other countries (Aubert and Crépon, 2006; Lallemand and Rycx, 2009; van Ours, 2009). We find a weak increase of productivity contributions with age until the age class 45-50. In the next figures, which differentiate between establishments with and without SMOE, we show that a) several measures are associated with a relative high productivity of old employees and b) the estimates of

several subsamples provide precise estimates of age productivity profiles that differ in their shape. The fact that we are able to derive precise estimates for subsamples suggests that GMM approach is able to provide precise estimates of age productivity profiles. If this is indeed the case, then large standard errors for other subsamples indicate either real variation in the age productivity profiles among establishments or small samples sizes of certain subgroups.

Figure 3 illustrates the age-productivity profile for the dynamic GMM estimates for establishments with and without **specific equipment** of workplaces for old workers. Given our reference group, we find that establishments with the measure have a significantly higher relative productivity of old employees, beyond the 40-45 years of age category (Figure 3). This suggests that establishments that invest in specific equipment are able to raise the relative productivity not only of the old workers, but also for workers that are in the middle of their career. Specific equipment of workplaces seems to have spill over effects of specific equipment for old workers on the productivity of employees between 40 and 55 years. In both groups, we find a decline of relative productivity for the age group of 50-55 year old employees.

The age productivity profiles for establishments with and without **reduced working time** for old employees are shown in Figure 4. The possibility to reduce the working time, when required, is related to a slight increase in the productivity of young and old employees – overall the age productivity profile is smoothed in establishments that apply this measure. We do not find significant differences, however. Against our hypothesis, a reduced working time for old employees does not increase the relative productivity of these employees. In Germany, around 90 percent of the employees that use working time reductions for old worker do this within the framework of a specific, subsidised public program (*Altersteilzeit*). According to Brussig et al. (2009) and Wanger (2009) most of the employees choose the so-called block model of working time reductions for old employees, within this program. This means that the bulk of old employees just retire earlier while working full time until they quit the establishment. In addition, Wanger (2009) does not find a correlation between physically demanding jobs and the incidence of working time reductions – the highest incidence of working time reductions is for example in banking and insurance jobs and for teachers. This means that the present implementation of the German program for working time reduction is *de*

facto a programme for early abrupt retirement that does not allow the establishments to reap the positive consequences of a slow and flexible fading out of labour market participation of old employees[8]. Therefore we think, that our finding reflects at least partly the public so-called reduced working program described.

The relative productivity contribution of establishments that offer **specific jobs for old employees** are statistically significantly higher for old workers than in establishments without specific jobs (see Figure 5). This finding is in line with our original idea that measures that are targeted to old employees should predominantly raise the productivity of the targeted age group. Even though, the point estimates for age groups 40-55 years are higher for establishment that apply the measure, we do not find significant effects for these age groups.

Mixed-age working teams are not only associated with a higher relative productivity of old employees but also with higher relative productivity of young employees, compare Figure 6. This finding suggests that mixed-age working teams are associated with flat age-productivity profiles. Our findings suggest that the theoretical arguments that speak in favour of mixed-age working teams have more impact than the potential disadvantages of mixed-age working teams. In other words – transfer of knowledge between different age groups, sharing tasks according to the specific strengths of different age groups seem to be more important than potential communication problems and problems that come from different attitudes and aspirations, on average.

Against our hypothesis, **specific training for old employees** is not related to a higher relative productivity of old employees (compare Figure 7). One reason for these finding might be that including old employees in continuing training *per se* does not increase their productivity. British data from the Labour Force Survey suggest that old employees more frequently receive cheaper on-the-job training and shorter training spells than young employees. In addition, old employees decline more often to participate in training when their employers offer it (O´Mahony and Peng, 2008). These results suggest that it would be more meaningful to incorporate a quality of training measure in our study. Unfortunately, we are not able to control for the quality and extent of individual training. In addition, it is important to use the knowledge acquired in training

[8] An international survey on publicly subsidised flexible working time schemes for older employees, shows that these programmes are often used as a vehicle to implement early retirement, see Casey (2004).

to transfer old employees to more productive and innovative activities. Old employees frequently seem to receive training but continue to work in their traditional jobs that have a declining relative productivity (Koller and Gruber, 2001).

To summarise, we find that the application of SMOE is related to different age-productivity profiles, compared to establishments that do not apply specific measures for old employees. Given our reference group, we find significantly higher relative productivity for old workers for establishments with specific equipment of work places, establishments with age specific working requirements and in cases where establishment use mixed age working teams. Even though we do not find significant differences for all cases, the general picture suggests that establishment are on average able to raise the relative productivity by means of specific measures for old employees.

6 Conclusions

Dealing with increasing shares of old employees could be decisive for future establishment competitiveness, if their productivity contributions are low. Establishments use human resource technologies in order to cope with ageing workforces, and a large fraction of establishments apply specific measures for old employees (SMOE). In this paper, we are interested whether SMOE lead to an increase of relative productivity of old employees. Despite the widespread use of these measures, to our knowledge, this is the first attempt to investigate this important topic.

In order to study the effectiveness of SMOE we estimate age-productivity profiles for different subgroups of establishments. Age productivity profiles are an interesting measure because they provide insights on how changes in the share of a certain age group are associated with changes of the establishment productivity, on average.

Although establishments that offer specific human resource measures for old employees have similar observable characteristics to those establishments that do not use these measures, we find that the age-productivity profiles between groups of establishments differ. For the interpretation of our results, we exploit the information revealed by differences in the estimates of the age-productivity profiles. More precisely, we use the fact that specific human resource measures have a specific impact on the shape of age productivity profiles. This enables us to draw conclusions from our estimates, despite

the fact that currently the information on the application of these measures is only available for one year. Based on the different age-productivity profiles for subgroups of establishments, we argue that the average age-productivity profile for the whole economy masks large differences in the capabilities of enterprises to keep the old part of their workforce as productive as the younger part.

We compare the age-productivity profiles of establishments with and without SMOE specifically aimed at the improvement of the relative productivity of old employees. We find that age specific work requirements and specific equipment of workplaces for old employees are associated with a significantly higher relative productivity of old employees. Establishments with age mixed teams have not only a higher relative productivity of old employees but also young employees have a higher relative productivity. This might be an indication of spill-overs and balancing effects between productivity of employees of different age groups working together in working groups. Finally, flexible working times for old employees and inclusion of old employees in training measures are not associated with differences in the age productivity profiles of old employees. A reason for these findings might be that these measures are not adequately implemented so far. The German flexible working time programmes for old employees are mainly used as an early retirement device with full time work until quitting and usage is not correlated with physical demanding jobs. Continuing training of old employees frequently has a smaller scope and is not associated with the option to move on to jobs with higher productivity or adopting innovations in their jobs.

SMOE could have an impact on the voluntary quitting, turnover and therefore the selectivity of old employees observable in an enterprise (Pfeffer, 1981; Pfeffer and O´Reilly, 1987). We cannot discriminate between the direct effect of SMOE and its indirect effects via the selection of employees but only observe the combined effect. The availability of data on specific human resource management measures directed at old employees allows for a whole range of new studies. In the future, we aim to make explicit use of panel information on the introduction or abolition of SMOE.

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Table 1: Adoption of specific measures for old employees (SMOE)

SMOE	Share
At least one SMOE	50.4%
Specific equipment of workplaces	5.1%
Reduced working time	37.2%
Age specific jobs	6.2%
Mixed-age working teams	20.5%
Training for old employees	18.1%

Note: Share of establishments that confirmed the application of the measure specifically for old employees in the 2002 IAB-establishment-survey

Table 2: Description of the used variables

Variable	Description
Log (value added)	Log of (sales minus value of intermediate goods) per full time equivalent of employees
Log (capital)	Log of (capital) per full time equivalent of employees
Age	Age of the employee in years
Women	Dummy, 1 if gender is female
German	Dummy, 1 if nationality is German
Apprenticeships	Dummy, 1 if the employee follows an apprenticeship training
Unskilled	Dummy, 1 if not formally qualified
Lowskilled	Dummy, 1 formally qualified employee
Highskilled	Dummy, 1 formally qualified employee in leading position
White-collar	Dummy, 1 if white-collar employee
Parttime work	Dummy, 1 if employee has a part-time contract
Secondary education1	Dummy, 1 if employee has secondary schooling or lower
Secondary education2	Dummy, 1 if employee has secondary schooling or lower and has vocational training
Tertiary education1	Dummy, 1 if employee is qualified for university entrance
Tertiary education2	Dummy, 1 if employee is qualified for university entrance and has vocational training
Polytec	Dummy, 1 if employee has degree from university of applied science
University	Dummy, 1 if employee has a university degree
Average tenure	Tenure in years of the employee in the establishment
Average employee age	Average age of employees
Age-dispersion	Standard deviation of age
Number of employees	Number of employees per establishment expressed in full-time equivalents
Sector	Sector of the establishment; WZ 2003 classification of the Federal Statistical Office, based on NACE 2002
Exporting	Dummy, 1 if establishment indicates that it is exporting
Good equipment	Dummy, 1 if the establishment indicates that their equipment/capital-stock is in good shape
East-German	Dummy, 1 if the establishment is in east Germany

Table 3: Descriptives for establishments that apply any specific measures for old employees (SMOE) vs. establishments that do not apply SMOE

Variable	No SMOE		Any SMOE	
	mean	standard deviation	mean	standard deviation
log(value added)	10.76	0.74	10.98	0.73
log(capital)	9.90	1.48	10.56	1.44
age	40.05	11.42	41.09	11.25
age_(20,25]	0.08	0.09	0.07	0.06
age_(25,30]	0.09	0.09	0.08	0.06
age_(30,35]	0.12	0.10	0.12	0.06
age_(35,40]	0.15	0.10	0.16	0.06
age_(40,45]	0.16	0.10	0.16	0.06
age_(45,50]	0.14	0.09	0.14	0.06
age_(50,55]	0.12	0.09	0.12	0.06
age_(55,60]	0.08	0.08	0.09	0.06
age_(60,99)	0.06	0.07	0.06	0.05
number of employees	50.47	102.24	377.19	1128.22
parttime work	0.14	0.56	0.09	0.22
women	0.33	0.47	0.30	0.46
german	0.96	0.19	0.94	0.24
apprenticeships	0.06	0.23	0.05	0.21
unskilled	0.17	0.38	0.20	0.40
lowskilled	0.37	0.48	0.31	0.46
highskilled	0.02	0.14	0.03	0.16
whitecoll	0.30	0.46	0.33	0.47
secondary education1	0.14	0.34	0.15	0.36
secondary education2	0.64	0.48	0.65	0.48
tertiary education1	0.01	0.08	0.01	0.10
tertiary education2	0.03	0.16	0.03	0.17
polytec	0.03	0.16	0.04	0.20
university	0.03	0.16	0.05	0.21
eastgerman	0.49	0.50	0.36	0.48
good-equipment	0.68	0.47	0.72	0.45
sector_1	0.07	0.25	0.06	0.23
sector_2	0.25	0.43	0.36	0.48
sector_3	0.10	0.30	0.12	0.33
sector_4	0.18	0.38	0.12	0.33
sector_5	0.20	0.40	0.13	0.34
sector_6	0.04	0.20	0.04	0.20
sector_7	0.12	0.33	0.09	0.29
sector_8	0.03	0.16	0.05	0.22
sector_9	0.03	0.16	0.02	0.15
average tenure	6.92	4.05	8.77	4.44
N	12422		10620	

Table 4: Descriptive statistics for establishments that apply SMOE

Variable	Working time reductions		Specific equipment of work places		Age specific jobs	
	mean	standard deviation	mean	standard deviation	mean	standard deviation
log(value added)	11.09	0.69	11.08	0.70	10.96	0.68
log(capital)	10.77	1.39	10.77	1.21	10.40	1.36
age	41.41	11.21	41.03	11.20	40.81	11.12
age_(20,25]	0.06	0.05	0.06	0.04	0.07	0.06
age_(25,30]	0.08	0.05	0.08	0.05	0.09	0.06
age_(30,35]	0.12	0.05	0.13	0.06	0.13	0.06
age_(35,40]	0.16	0.05	0.17	0.06	0.16	0.07
age_(40,45]	0.16	0.05	0.16	0.05	0.16	0.07
age_(45,50]	0.14	0.05	0.14	0.05	0.13	0.06
age_(50,55]	0.12	0.05	0.12	0.05	0.11	0.06
age_(55,60]	0.09	0.05	0.09	0.05	0.08	0.05
age_(60,99)	0.06	0.05	0.06	0.04	0.06	0.06
number of employees	502.73	1330.51	610.38	1181.89	617.09	1711.42
parttime work	0.09	0.21	0.05	0.08	0.09	0.22
women	0.29	0.45	0.25	0.44	0.26	0.44
german	0.94	0.25	0.91	0.28	0.92	0.27
apprenticeships	0.05	0.21	0.04	0.19	0.04	0.19
unskilled	0.21	0.41	0.30	0.46	0.28	0.45
lowskilled	0.28	0.45	0.28	0.45	0.31	0.46
highskilled	0.03	0.16	0.03	0.18	0.02	0.14
whitecoll	0.35	0.48	0.29	0.45	0.28	0.45
secondary education1	0.17	0.37	0.18	0.38	0.17	0.38
secondary education2	0.65	0.48	0.68	0.47	0.64	0.48
tertiary education1	0.01	0.10	0.01	0.09	0.01	0.10
tertiary education2	0.03	0.18	0.02	0.15	0.03	0.17
polytec	0.05	0.21	0.03	0.17	0.03	0.17
university	0.05	0.22	0.03	0.16	0.03	0.16
eastgerman	0.29	0.45	0.19	0.39	0.19	0.39
good-equipment	0.73	0.44	0.73	0.44	0.71	0.45
sector_1	0.05	0.22	0.06	0.24	0.06	0.24
sector_2	0.40	0.49	0.44	0.50	0.34	0.47
sector_3	0.14	0.35	0.21	0.41	0.14	0.35
sector_4	0.10	0.30	0.07	0.26	0.12	0.33
sector_5	0.11	0.31	0.09	0.29	0.12	0.33
sector_6	0.05	0.21	0.05	0.22	0.06	0.24
sector_7	0.08	0.27	0.04	0.19	0.06	0.23
sector_8	0.05	0.22	0.02	0.14	0.06	0.24
sector_9	0.02	0.13	0.02	0.13	0.04	0.20
average tenure	9.44	4.46	10.07	4.50	8.91	4.72
N	7347		1072		1372	

Table 4: … continued: Descriptive statistics for establishments that apply SMOE

Variable	Mixed-age working teams		Specific training for old employees	
	mean	standard deviation	mean	standard deviation
log(value added)	10.91	0.72	11.02	0.74
log(capital)	10.41	1.39	10.69	1.41
age	40.85	11.12	40.93	11.27
age_(20,25]	0.07	0.06	0.07	0.06
age_(25,30]	0.08	0.06	0.08	0.06
age_(30,35]	0.12	0.06	0.12	0.07
age_(35,40]	0.16	0.07	0.16	0.06
age_(40,45]	0.16	0.07	0.15	0.06
age_(45,50]	0.14	0.07	0.14	0.06
age_(50,55]	0.12	0.06	0.13	0.07
age_(55,60]	0.09	0.06	0.09	0.06
age_(60,99)	0.06	0.05	0.06	0.05
number of employees	373.72	846.69	433.64	972.07
parttime work	0.09	0.19	0.09	0.19
women	0.29	0.45	0.31	0.46
german	0.94	0.24	0.94	0.24
apprenticeships	0.05	0.21	0.05	0.22
unskilled	0.19	0.39	0.18	0.38
lowskilled	0.35	0.48	0.28	0.45
highskilled	0.02	0.15	0.02	0.15
whitecoll	0.31	0.46	0.37	0.48
secondary education1	0.14	0.35	0.14	0.34
secondary education2	0.66	0.47	0.65	0.48
tertiary education1	0.01	0.07	0.01	0.09
tertiary education2	0.03	0.17	0.03	0.18
polytec	0.04	0.20	0.05	0.22
university	0.04	0.20	0.06	0.23
eastgerman	0.42	0.49	0.38	0.49
good-equipment	0.72	0.45	0.75	0.43
sector_1	0.06	0.24	0.06	0.23
sector_2	0.34	0.47	0.37	0.48
sector_3	0.13	0.33	0.14	0.34
sector_4	0.16	0.37	0.08	0.27
sector_5	0.11	0.31	0.13	0.34
sector_6	0.03	0.16	0.04	0.19
sector_7	0.09	0.28	0.11	0.31
sector_8	0.06	0.23	0.06	0.23
sector_9	0.03	0.16	0.02	0.15
average tenure	8.62	4.45	8.74	4.38
N	4306		3717	

Table 5: Correlation coefficients for the application of SMOE in establishments

Variable	1	2	3	4	5
1 Working time reductions	1.00				
2 Specific equipment	0.20	1.00			
3 Age specific jobs	0.14	0.28	1.00		
4 Mixed-age teams	0.23	0.19	0.16	1.00	
5 Training for old employees	0.28	0.18	0.11	0.42	1.00

All correlations are statistically different from zero at the 5% level.

Table 6: Diff – GMM estimation for the whole sample

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	-0.02	0.06	-0.32	0.75	-0.13	0.09
Lag 2 of dep. var.	-0.18	0.05	-3.51	0.00	-0.28	-0.08
log(capital)	0.08	0.10	0.84	0.40	-0.11	0.27
age_(20.25]	-0.22	0.45	-0.50	0.62	-1.10	0.65
age_(25.30]	-0.15	0.39	-0.38	0.71	-0.90	0.61
age_(30.35]	0.13	0.26	0.48	0.63	-0.39	0.64
age_(40.45]	0.21	0.26	0.80	0.43	-0.30	0.71
age_(45.50]	0.41	0.30	1.35	0.18	-0.19	1.01
age_(50.55]	0.72	0.37	1.92	0.06	-0.01	1.45
age_(55.60]	0.36	0.44	0.82	0.42	-0.50	1.22
age_(60.99]	0.36	0.50	0.73	0.47	-0.61	1.33
women	-0.09	0.06	-1.48	0.14	-0.20	0.03
Germans	-0.06	0.11	-0.52	0.60	-0.26	0.15
apprenticeships	0.04	0.09	0.45	0.65	-0.14	0.22
unskilled	-0.10	0.07	-1.33	0.18	-0.24	0.05
highskilled	0.03	0.13	0.24	0.81	-0.23	0.30
whitecoll	0.13	0.06	2.19	0.03	0.01	0.25
parttime	0.12	0.08	1.44	0.15	-0.04	0.28
good equipment	-0.03	0.05	-0.66	0.51	-0.13	0.06
average tenure	0.03	0.02	1.55	0.12	-0.01	0.08
age-dispersion	0.01	0.02	0.58	0.56	-0.03	0.06
exporting	0.07	0.10	0.67	0.51	-0.13	0.27
number of employees	0.00	0.00	1.28	0.20	0.00	0.00
6 year dummies included						

Number of obs = 8571
Number of instruments = 402
Wald chi2(29) = 66.03. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation
GMM-type (missing=0. separate instruments for each period unless collapsed)
L3.lnvalue added L3.lnkapital L3.ant_25 L3.ant_30 L3.ant_35 L3.ant_45 L3.ant_50 L3.ant_55 L3.ant_60 L3.ant_99
L(2-5): geschl nationd apprent unskill highskill whitecoll partt_frac anl estabten estabagesd exp_d leute
Sargan test of overid. restrictions: chi2(373) = 387.51 Prob > chi2 = 0.292
Hansen test of overid. restrictions: chi2(373) = 374.02 Prob > chi2 = 0.475

Difference-in-Hansen tests of exogeneity of instrument subsets:
L3.lnvalue added L3.lnkapital L3.ant_25 L3.ant_30 L3.ant_35 L3.ant_45 L3.ant_50 L3.ant_55 L3.ant_60 L3.ant_99
Hansen test excluding group: chi2(223) = 226.58 Prob > chi2 = 0.421
Difference (null H = exogenous): chi2(150) = 147.44 Prob > chi2 = 0.544

L(2-5): geschl nationd apprent unskill highskill whitecoll partt_frac anl estabten estabagesd exp_d leute
Hansen test excluding group: chi2(121) = 112.84 Prob > chi2 = 0.689
Difference (null H = exogenous): chi2(252) = 261.19 Prob > chi2 = 0.332
Arellano-Bond test for AR(1) in first differences: z = -5.19 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = 1.44 Pr > z = 0.149

Estimation Results for SMOE:

Table 7: Diff – GMM estimation for establishments with specific equipment

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.02	0.08	0.26	0.79	-0.13	0.17
Lag 2 of dep. var.	-0.09	0.05	-1.68	0.09	-0.19	0.01
log(capital)	0.29	0.17	1.70	0.09	-0.05	0.63
age_(20.25]	-1.14	1.36	-0.84	0.40	-3.81	1.53
age_(25.30]	-0.78	1.18	-0.66	0.51	-3.09	1.53
age_(30.35]	1.04	1.04	1.00	0.32	-1.00	3.07
age_(40.45]	1.34	1.06	1.27	0.20	-0.73	3.41
age_(45.50]	2.57	1.04	2.46	0.01	0.53	4.62
age_(50.55]	2.53	1.06	2.40	0.02	0.46	4.60
age_(55.60]	1.02	1.40	0.73	0.47	-1.73	3.76
women	-0.06	0.04	-1.47	0.14	-0.14	0.02
Germans	0.09	0.06	1.56	0.12	-0.02	0.20
apprenticeships	-0.05	0.09	-0.55	0.58	-0.22	0.12
unskilled	0.05	0.05	1.05	0.29	-0.04	0.14
highskilled	-0.15	0.18	-0.84	0.40	-0.50	0.20
whitecoll	0.06	0.05	1.13	0.26	-0.04	0.15
parttime	2.30	0.50	4.59	0.00	1.32	3.29
good equipment	-0.01	0.07	-0.16	0.88	-0.16	0.13
average tenure	0.02	0.03	0.65	0.51	-0.04	0.08
age-dispersion	0.11	0.07	1.60	0.11	-0.02	0.24
exporting	-0.05	0.07	-0.71	0.48	-0.19	0.09
number of employees	0.00	0.00	1.36	0.17	0.00	0.00
6 year dummies included						

Number of obs = 386
Number of instruments = 381
Wald chi2(29) = 148.80. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(352) = 384.85 Prob > chi2 = 0.110
Hansen test of overid. restrictions: chi2(352) = 102.54 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -3.81 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = 1.45 Pr > z = 0.148

Table 8: Diff – GMM estimation for establishments without specific equipment

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.06	0.05	1.29	0.20	-0.03	0.16
Lag 2 of dep. var.	0.04	0.04	1.14	0.25	-0.03	0.11
log(capital)	0.17	0.09	1.92	0.06	0.00	0.34
age_(20.25]	-0.96	0.37	-2.60	0.01	-1.68	-0.23
age_(25.30]	-0.41	0.32	-1.29	0.20	-1.03	0.21
age_(30.35]	-0.13	0.21	-0.61	0.54	-0.53	0.28
age_(40.45]	-0.27	0.23	-1.19	0.24	-0.72	0.18
age_(45.50]	-0.13	0.27	-0.47	0.64	-0.65	0.40
age_(50.55]	0.11	0.32	0.34	0.73	-0.52	0.74
age_(55.60]	-0.62	0.38	-1.65	0.10	-1.36	0.12
women	-0.12	0.06	-2.14	0.03	-0.23	-0.01
Germans	-0.14	0.10	-1.43	0.15	-0.33	0.05
apprenticeships	0.08	0.09	0.89	0.37	-0.09	0.25
unskilled	-0.06	0.07	-0.83	0.40	-0.18	0.07
highskilled	-0.04	0.12	-0.34	0.74	-0.27	0.19
whitecoll	0.11	0.05	2.00	0.05	0.00	0.22
parttime	0.09	0.09	0.95	0.34	-0.09	0.27
good equipment	-0.02	0.05	-0.36	0.72	-0.11	0.07
average tenure	0.06	0.02	2.97	0.00	0.02	0.11
age-dispersion	0.02	0.02	0.77	0.44	-0.03	0.06
exporting	-0.17	0.10	-1.71	0.09	-0.37	0.02
number of employees	0.00	0.00	0.51	0.61	0.00	0.00
6 year dummies included						

Number of obs = 7495
Number of instruments = 462
Wald chi2(29) = 70.23. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 479.24 Prob > chi2 = 0.062
Hansen test of overid. restrictions: chi2(433) = 449.50 Prob > chi2 = 0.282

Arellano-Bond test for AR(1) in first differences: z = -5.31 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.81 Pr > z = 0.071

Table 9: Diff – GMM estimation for establishments with reduced working time for old employees

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.09	0.05	1.72	0.09	-0.01	0.19
Lag 2 of dep. var.	-0.07	0.04	-1.58	0.11	-0.15	0.02
log(capital)	0.20	0.11	1.79	0.07	-0.02	0.42
age_(20.25]	-0.41	0.76	-0.55	0.58	-1.90	1.07
age_(25.30]	0.12	0.87	0.14	0.89	-1.59	1.83
age_(30.35]	-0.09	0.56	-0.16	0.87	-1.19	1.01
age_(40.45]	-0.17	0.66	-0.26	0.80	-1.46	1.11
age_(45.50]	0.51	0.61	0.83	0.41	-0.69	1.70
age_(50.55]	0.34	0.69	0.50	0.62	-1.01	1.69
age_(55.60]	-0.08	0.75	-0.11	0.91	-1.55	1.38
women	-0.06	0.05	-1.18	0.24	-0.15	0.04
Germans	0.02	0.07	0.23	0.82	-0.12	0.15
apprenticeships	-0.03	0.08	-0.36	0.72	-0.18	0.13
unskilled	-0.02	0.05	-0.34	0.73	-0.12	0.08
highskilled	0.04	0.11	0.39	0.69	-0.18	0.26
whitecoll	0.00	0.04	0.07	0.94	-0.08	0.08
parttime	0.45	0.22	2.10	0.04	0.03	0.88
good equipment	0.01	0.05	0.17	0.86	-0.10	0.12
average tenure	0.01	0.02	0.57	0.57	-0.03	0.06
age-dispersion	0.03	0.03	1.04	0.30	-0.03	0.10
exporting	0.07	0.09	0.78	0.44	-0.11	0.26
number of employees	0.00	0.00	1.23	0.22	0.00	0.00
6 year dummies included						

Number of obs = 2592
Number of instruments = 462
Wald chi2(29) = 55.52. Prob > chi2 = 0.002

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 454.06 Prob > chi2 = 0.234
Hansen test of overid. restrictions: chi2(433) = 458.74 Prob > chi2 = 0.189

Arellano-Bond test for AR(1) in first differences: z = -4.61 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.78 Pr > z = 0.434

Table 10: Diff – GMM estimation for establishments without reduced working time for old employees

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.01	0.05	0.22	0.83	-0.09	0.11
Lag 2 of dep. var.	0.02	0.04	0.40	0.69	-0.06	0.09
log(capital)	0.03	0.09	0.35	0.73	-0.15	0.22
age_(20.25]	-1.03	0.35	-2.96	0.00	-1.72	-0.35
age_(25.30]	-0.39	0.33	-1.18	0.24	-1.03	0.25
age_(30.35]	-0.15	0.22	-0.68	0.50	-0.58	0.28
age_(40.45]	-0.38	0.23	-1.63	0.10	-0.83	0.07
age_(45.50]	-0.35	0.28	-1.21	0.23	-0.90	0.21
age_(50.55]	-0.12	0.34	-0.36	0.72	-0.79	0.55
age_(55.60]	-0.75	0.39	-1.94	0.05	-1.52	0.01
women	-0.15	0.06	-2.79	0.01	-0.26	-0.05
Germans	-0.19	0.09	-2.07	0.04	-0.38	-0.01
apprenticeships	0.06	0.09	0.63	0.53	-0.12	0.24
unskilled	-0.08	0.07	-1.18	0.24	-0.21	0.05
highskilled	-0.04	0.12	-0.34	0.73	-0.28	0.20
whitecoll	0.08	0.06	1.36	0.17	-0.04	0.20
parttime	0.05	0.07	0.72	0.47	-0.09	0.19
good equipment	0.04	0.05	0.87	0.38	-0.05	0.14
average tenure	0.05	0.02	2.49	0.01	0.01	0.10
age-dispersion	0.01	0.02	0.49	0.62	-0.03	0.05
exporting	-0.11	0.10	-1.16	0.25	-0.30	0.08
number of employees	0.00	0.00	-0.76	0.45	0.00	0.00
6 year dummies included						

Number of obs = 5289
Number of instruments = 462
Wald chi2(29) = 60.41. Prob > chi2 = 0.001

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 473.43 Prob > chi2 = 0.088
Hansen test of overid. restrictions: chi2(433) = 452.11 Prob > chi2 = 0.254

Arellano-Bond test for AR(1) in first differences: z = -5.17 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.21 Pr > z = 0.226

Table 11: Diff-GMM estimation for establishments with age specific jobs

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.03	0.06	0.50	0.62	-0.09	0.15
Lag 2 of dep. var.	-0.10	0.06	-1.69	0.09	-0.21	0.02
log(capital)	0.09	0.15	0.63	0.53	-0.20	0.39
age_(20.25]	-1.29	0.64	-2.01	0.05	-2.56	-0.03
age_(25.30]	-0.27	0.52	-0.52	0.60	-1.28	0.74
age_(30.35]	0.37	0.45	0.83	0.41	-0.51	1.26
age_(40.45]	0.28	0.46	0.61	0.54	-0.62	1.18
age_(45.50]	0.28	0.47	0.61	0.54	-0.63	1.20
age_(50.55]	0.62	0.49	1.27	0.21	-0.34	1.58
age_(55.60]	0.62	0.70	0.89	0.38	-0.76	2.00
women	-0.02	0.04	-0.48	0.63	-0.09	0.06
Germans	-0.06	0.04	-1.52	0.13	-0.13	0.02
apprenticeships	-0.01	0.06	-0.25	0.81	-0.13	0.10
unskilled	0.06	0.04	1.36	0.18	-0.03	0.15
highskilled	-0.11	0.06	-2.00	0.05	-0.22	0.00
whitecoll	0.02	0.04	0.57	0.57	-0.06	0.10
parttime	0.23	0.42	0.56	0.58	-0.58	1.05
good equipment	-0.01	0.05	-0.20	0.85	-0.11	0.09
average tenure	0.04	0.02	2.27	0.02	0.01	0.08
age-dispersion	0.00	0.03	0.10	0.92	-0.05	0.06
exporting	0.06	0.06	0.96	0.34	-0.06	0.17
number of employees	0.00	0.00	6.04	0.00	0.00	0.00
6 year dummies included						

Number of obs = 491
Number of instruments = 445
Wald chi2(29) = 129.41. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(416) = 449.15 Prob > chi2 = 0.126
Hansen test of overid. restrictions: chi2(416) = 137.41 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -4.35 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.76 Pr > z = 0.078

Table 12: Diff-GMM estimation for establishments without age specific jobs

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.06	0.05	1.25	0.21	-0.03	0.15
Lag 2 of dep. var.	0.04	0.04	1.09	0.28	-0.03	0.11
log(capital)	0.17	0.09	1.96	0.05	0.00	0.34
age_(20.25]	-0.97	0.38	-2.56	0.01	-1.71	-0.23
age_(25.30]	-0.49	0.33	-1.50	0.14	-1.13	0.15
age_(30.35]	-0.13	0.21	-0.60	0.55	-0.54	0.29
age_(40.45]	-0.33	0.24	-1.42	0.16	-0.79	0.13
age_(45.50]	-0.15	0.27	-0.54	0.59	-0.69	0.39
age_(50.55]	0.09	0.33	0.26	0.80	-0.56	0.74
age_(55.60]	-0.64	0.38	-1.69	0.09	-1.39	0.10
women	-0.11	0.05	-1.95	0.05	-0.21	0.00
Germans	-0.11	0.10	-1.10	0.27	-0.30	0.08
apprenticeships	0.10	0.08	1.19	0.23	-0.06	0.26
unskilled	-0.06	0.07	-0.93	0.36	-0.20	0.07
highskilled	-0.08	0.12	-0.64	0.52	-0.32	0.16
whitecoll	0.11	0.06	1.94	0.05	0.00	0.22
parttime	0.10	0.09	1.07	0.29	-0.08	0.28
good equipment	0.00	0.05	0.02	0.98	-0.09	0.09
average tenure	0.06	0.02	2.78	0.01	0.02	0.10
age-dispersion	0.01	0.02	0.69	0.49	-0.03	0.06
exporting	-0.10	0.10	-0.96	0.34	-0.30	0.10
number of employees	0.00	0.00	-0.34	0.73	0.00	0.00
6 year dummies included						

Number of obs = 7390
Number of instruments = 462
Wald chi2(29) = 68.60. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 479.51 Prob > chi2 = 0.061
Hansen test of overid. restrictions: chi2(433) = 459.59 Prob > chi2 = 0.182

Arellano-Bond test for AR(1) in first differences: z = -5.27 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.58 Pr > z = 0.114

Table 13: Diff – GMM estimation for establishments with mixed-age working teams

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.07	0.06	1.24	0.22	-0.04	0.19
Lag 2 of dep. var.	-0.06	0.04	-1.33	0.18	-0.14	0.03
log(capital)	0.27	0.11	2.43	0.02	0.05	0.50
age_(20.25]	0.55	0.71	0.77	0.44	-0.85	1.95
age_(25.30]	0.54	0.60	0.89	0.37	-0.65	1.72
age_(30.35]	0.56	0.58	0.96	0.34	-0.58	1.70
age_(40.45]	0.21	0.44	0.48	0.63	-0.65	1.08
age_(45.50]	0.11	0.53	0.22	0.83	-0.92	1.15
age_(50.55]	0.73	0.57	1.28	0.20	-0.39	1.85
age_(55.60]	0.77	0.57	1.36	0.18	-0.34	1.89
women	0.00	0.05	-0.10	0.92	-0.10	0.09
Germans	-0.04	0.06	-0.72	0.47	-0.17	0.08
apprenticeships	-0.04	0.08	-0.47	0.64	-0.21	0.13
unskilled	0.06	0.05	1.19	0.23	-0.04	0.17
highskilled	-0.23	0.13	-1.77	0.08	-0.49	0.03
whitecoll	0.03	0.05	0.52	0.60	-0.08	0.13
parttime	0.51	0.34	1.52	0.13	-0.15	1.18
good equipment	0.03	0.06	0.59	0.55	-0.08	0.14
average tenure	0.04	0.03	1.51	0.13	-0.01	0.09
age-dispersion	-0.01	0.03	-0.52	0.60	-0.07	0.04
exporting	0.08	0.10	0.80	0.42	-0.11	0.27
number of employees	0.00	0.00	0.66	0.51	0.00	0.00
6 year dummies included						

Number of obs = 1497
Number of instruments = 462
Wald chi2(29) = 74.73. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 446.56 Prob > chi2 = 0.316
Hansen test of overid. restrictions: chi2(433) = 441.91 Prob > chi2 = 0.373

Arellano-Bond test for AR(1) in first differences: z = -4.35 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.02 Pr > z = 0.309

Table 14: Diff – GMM estimation for establishments without mixed-age working teams

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.08	0.05	1.66	0.10	-0.02	0.18
Lag 2 of dep. var.	0.04	0.04	1.01	0.31	-0.04	0.11
log(capital)	0.19	0.09	2.17	0.03	0.02	0.36
age_(20.25]	-1.26	0.37	-3.43	0.00	-1.99	-0.54
age_(25.30]	-0.61	0.33	-1.85	0.06	-1.25	0.04
age_(30.35]	-0.15	0.21	-0.72	0.47	-0.56	0.26
age_(40.45]	-0.38	0.23	-1.62	0.11	-0.84	0.08
age_(45.50]	-0.08	0.27	-0.29	0.77	-0.61	0.45
age_(50.55]	0.16	0.32	0.51	0.61	-0.46	0.79
age_(55.60]	-0.54	0.37	-1.46	0.14	-1.27	0.19
women	-0.11	0.06	-2.03	0.04	-0.22	0.00
Germans	-0.08	0.10	-0.79	0.43	-0.27	0.12
apprenticeships	0.08	0.09	0.95	0.34	-0.09	0.25
unskilled	-0.07	0.07	-1.08	0.28	-0.21	0.06
highskilled	-0.06	0.12	-0.55	0.58	-0.30	0.17
whitecoll	0.05	0.06	0.84	0.40	-0.07	0.16
parttime	0.12	0.09	1.37	0.17	-0.05	0.29
good equipment	-0.05	0.05	-1.10	0.27	-0.15	0.04
average tenure	0.03	0.02	1.57	0.12	-0.01	0.08
age-dispersion	0.01	0.02	0.67	0.51	-0.03	0.06
exporting	-0.07	0.10	-0.67	0.50	-0.27	0.13
number of employees	0.00	0.00	0.84	0.40	0.00	0.00
6 year dummies included						

Number of obs = 6384
Number of instruments = 462
Wald chi2(29) = 63.71. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 480.06 Prob > chi2 = 0.059
Hansen test of overid. restrictions: chi2(433) = 452.76 Prob > chi2 = 0.247

Arellano-Bond test for AR(1) in first differences: z = -5.54 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.03 Pr > z = 0.302

Table 15: Diff – GMM estimation for establishments with specific training for old employees

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.15	0.06	2.58	0.01	0.04	0.26
Lag 2 of dep. var.	-0.06	0.05	-1.35	0.18	-0.15	0.03
log(capital)	0.29	0.12	2.46	0.01	0.06	0.52
age_(20.25]	0.07	0.80	0.08	0.93	-1.50	1.63
age_(25.30]	0.79	0.68	1.16	0.25	-0.54	2.12
age_(30.35]	-0.23	0.57	-0.41	0.68	-1.35	0.88
age_(40.45]	0.32	0.43	0.74	0.46	-0.52	1.16
age_(45.50]	0.14	0.60	0.24	0.81	-1.03	1.31
age_(50.55]	0.22	0.72	0.30	0.76	-1.20	1.63
age_(55.60]	0.13	0.81	0.16	0.87	-1.45	1.72
women	0.01	0.04	0.37	0.71	-0.06	0.09
Germans	0.04	0.06	0.69	0.49	-0.08	0.17
apprenticeships	0.03	0.07	0.41	0.68	-0.11	0.16
unskilled	0.02	0.06	0.41	0.68	-0.09	0.14
highskilled	-0.13	0.13	-1.02	0.31	-0.39	0.12
whitecoll	0.01	0.04	0.25	0.80	-0.07	0.09
parttime	0.29	0.34	0.85	0.39	-0.38	0.97
good equipment	-0.01	0.06	-0.23	0.82	-0.13	0.11
average tenure	0.03	0.03	1.20	0.23	-0.02	0.08
age-dispersion	-0.03	0.03	-1.06	0.29	-0.09	0.03
exporting	0.08	0.10	0.83	0.41	-0.12	0.28
number of employees	0.00	0.00	0.66	0.51	0.00	0.00
6 year dummies included						

Number of obs = 1346
Number of instruments = 461
Wald chi2(29) = 57.61. Prob > chi2 = 0.001

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(432) = 423.16 Prob > chi2 = 0.610
Hansen test of overid. restrictions: chi2(432) = 409.68 Prob > chi2 = 0.773

Arellano-Bond test for AR(1) in first differences: z = -4.91 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.07 Pr > z = 0.286

Table 16: Diff – GMM estimation for establishments without specific training for old employees

Dependent variable: log(value added)

Variable	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lag 1 of dep. var.	0.05	0.05	0.98	0.33	-0.05	0.14
Lag 2 of dep. var.	0.03	0.04	0.87	0.39	-0.04	0.11
log(capital)	0.11	0.09	1.23	0.22	-0.07	0.28
age_(20.25]	-1.13	0.36	-3.13	0.00	-1.84	-0.42
age_(25.30]	-0.60	0.33	-1.81	0.07	-1.24	0.05
age_(30.35]	-0.19	0.22	-0.88	0.38	-0.62	0.24
age_(40.45]	-0.34	0.24	-1.43	0.15	-0.81	0.13
age_(45.50]	-0.10	0.28	-0.37	0.71	-0.65	0.44
age_(50.55]	0.11	0.33	0.32	0.75	-0.55	0.76
age_(55.60]	-0.54	0.38	-1.40	0.16	-1.29	0.21
women	-0.15	0.06	-2.72	0.01	-0.26	-0.04
Germans	-0.13	0.10	-1.36	0.17	-0.32	0.06
apprenticeships	0.04	0.09	0.47	0.64	-0.13	0.21
unskilled	-0.06	0.07	-0.85	0.40	-0.19	0.07
highskilled	-0.05	0.12	-0.40	0.69	-0.28	0.18
whitecoll	0.09	0.06	1.57	0.12	-0.02	0.21
parttime	0.11	0.10	1.15	0.25	-0.08	0.30
good equipment	-0.01	0.05	-0.14	0.89	-0.10	0.09
average tenure	0.06	0.02	2.53	0.01	0.01	0.10
age-dispersion	0.00	0.02	-0.09	0.93	-0.04	0.04
exporting	-0.19	0.10	-1.88	0.06	-0.38	0.01
number of employees	0.00	0.00	2.56	0.01	0.00	0.00
6 year dummies included						

Number of obs = 6455
Number of instruments = 462
Wald chi2(29) = 73.67. Prob > chi2 = 0.000

Instruments for orthogonal deviations equation:
GMM-type (missing=0. separate instruments for each period unless collapsed)
L(2-6): log(valueadded) log(capital) age_(20.25] age_(25.30] age_(30.35] age_(40.45] age_(45.50] age_(50.55] age_(55.60]
L(2-5): women Germans apprenticeships unskilled highskilled whitecoll parttime good equipment average tenure age-dispersion exporting number of employees

Sargan test of overid. restrictions: chi2(433) = 453.03 Prob > chi2 = 0.244
Hansen test of overid. restrictions: chi2(433) = 442.81 Prob > chi2 = 0.362

Arellano-Bond test for AR(1) in first differences: z = -5.38 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -1.36 Pr > z = 0.175

Figure 1: Question on SMOE in the 2002-IAB-establishment survey:

"Which of the following programs concerning employment of old workers/employees do you apply in your establishment?"

a) Reduced working time

b) Specific equipment of workplaces

c) Age specific jobs

d) Mixed-age working teams

e) Integration of old employees into training activities

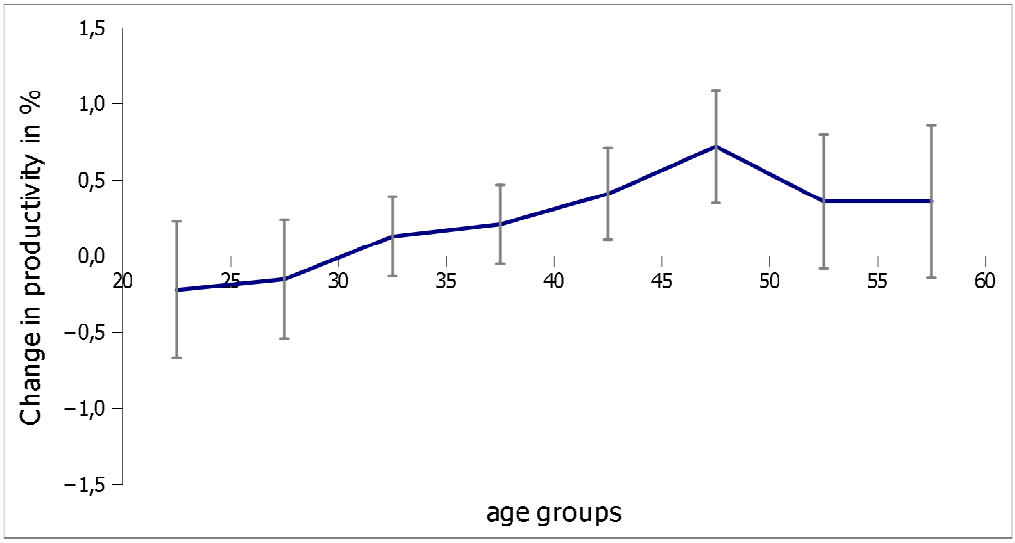
f) Specific training offers to old employees

g) Other measures for old employees

h) No measure for old employees

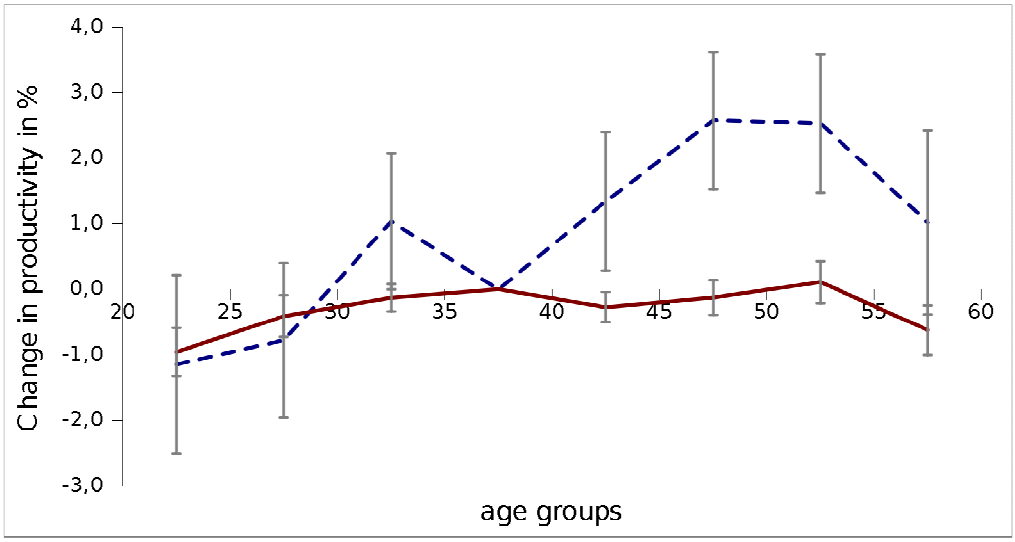
Note: The categories with training e) and f) are merged for the analysis. We exclude "other measures" g) from the analysis, since there is no economic theory for the effect of "other measures" on the age-productivity profile.

Figure 2: Dynamic diff-GMM average productivity



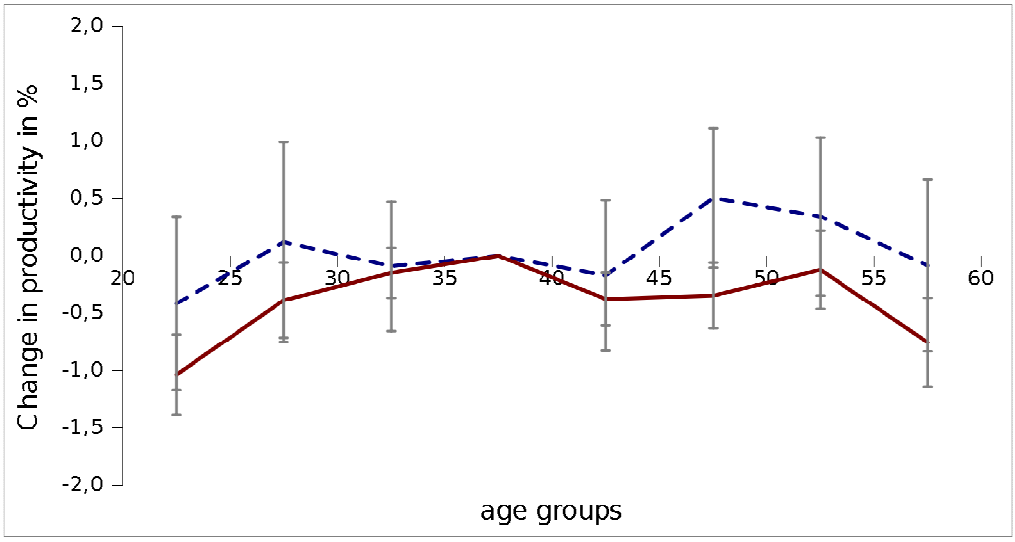
Note: The bars indicate the standard errors.

Figure 3: Dynamic diff-GMM estimates for establishments with and without specific equipment of work places for old employees



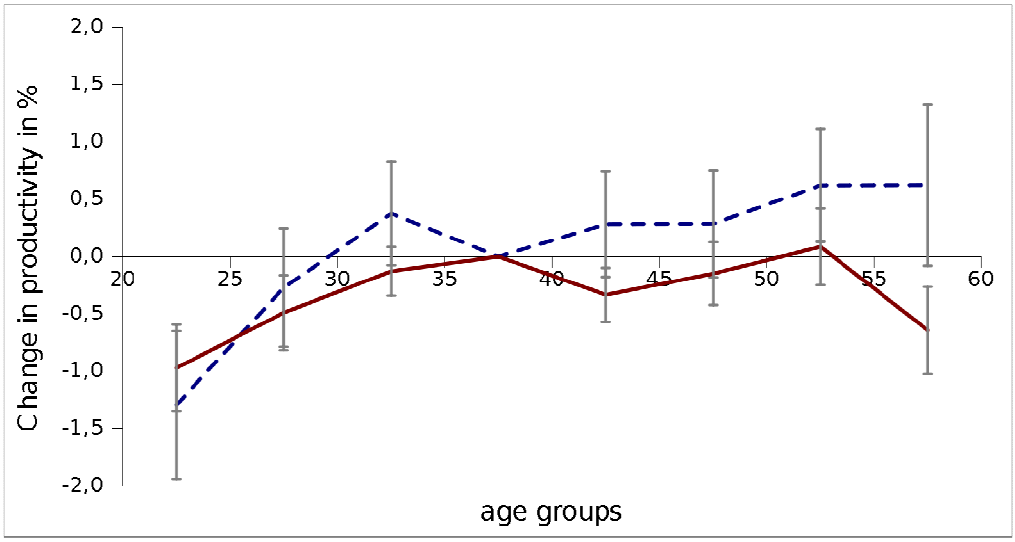
Note: The bars indicate the standard errors.
Source: own computations based on the LIAB-data. Waves 1997-2004. Blue dashed line: applies the age specific measure. Red solid line: Does not apply the age specific measure.

Figure 4: Dynamic diff-GMM estimates for establishments with and without reduced working time for old employees



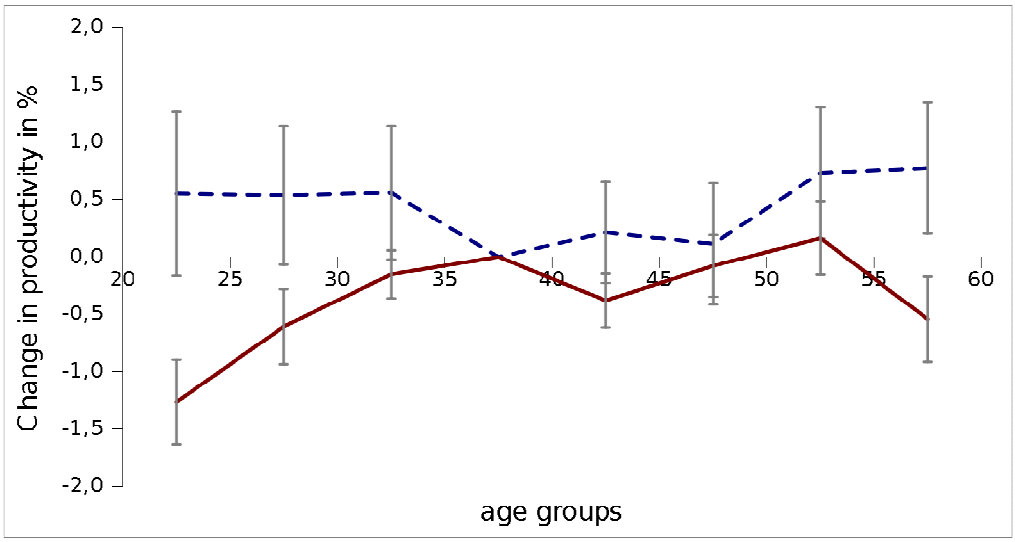
Note: The bars indicate the standard errors.
Source: own computations based on the LIAB-data. Waves 1997-2004. Blue dashed line: applies the age specific measure. Red solid line: Does not apply the age specific measure.

Figure 5: Dynamic diff-GMM estimates for establishments with and without age specific jobs for old employees



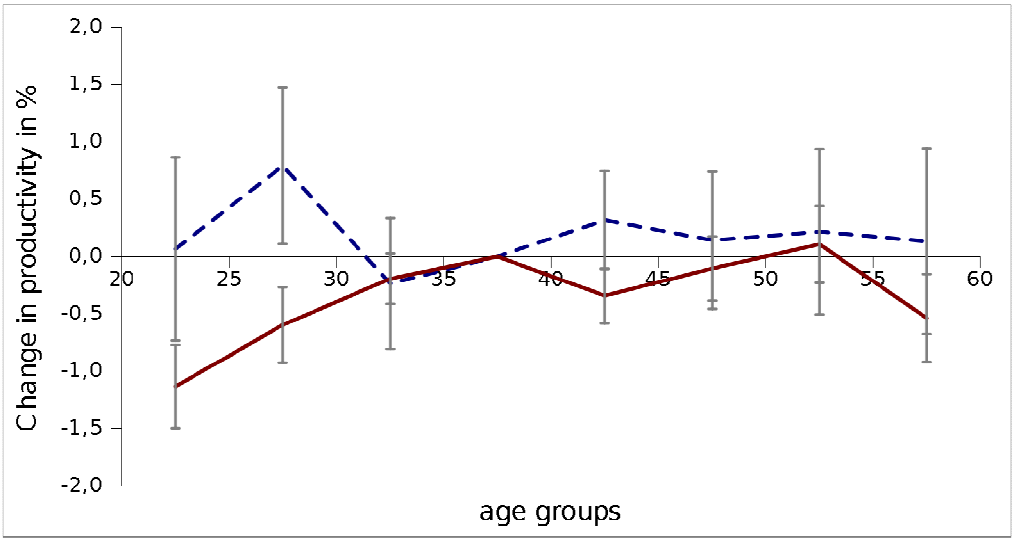
Note: The bars indicate the standard errors.
Source: own computations based on the LIAB-data. Waves 1997-2004. Blue dashed line: applies the age specific measure. Red solid line: Does not apply the age specific measure.

Figure 6: Dynamic diff-GMM estimates for establishments with and without mixed age work teams



Note: The bars indicate the standard errors.
Source: own computations based on the LIAB-data. Waves 1997-2004. Blue dashed line: applies the age specific measure. Red solid line: Does not apply the age specific measure.

Figure 7: Dynamic diff-GMM estimates for establishments with and without specific training for old employees



Note: The bars indicate the standard errors.
Source: own computations based on the LIAB-data. Waves 1997-2004. Blue dashed line: applies the age specific measure. Red solid line: Does not apply the age specific measure.