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Do Firms Hire Relatively More Older Workers? Evidence from Germany

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Abstract

This paper analyses how demographic changes affect the hiring of older workers. Do firms adjust their hiring behaviour to an ageing society? Combining data at the firm level and the administrative district level, we analyse the hiring behaviour of firms. Our findings suggest that firms with an ageing workforce hire relatively more older workers. Since the willingness to hire older workers also increases with the share of older unemployed, the propensity to employ older people does generally rise with an ageing labour force. Also, part-time employment induces firms to engage more older workers but this effect disappears for large firms. In contrast, partial retirement regulations have a negative effect on hiring older workers which reveals unintended incentives of the German law on this matter. Finally, firms with a higher share of educated personnel hire more older workers.

Keywords: Ageing labour force, hiring of older workers, panel data models

JEL classification: J11, J23, C33

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1 Introduction

The ongoing demographic transition implies population decline and population ageing. While birth rates and net migration do not compensate for mortality rates in Germany[1], life expectancy has risen steadily in the past, which constitutes a compositional effect. Hence, the population becomes older on average since the ratio of older people to the entire population rises. These developments are long-standing results depicting the development of the population on the whole. However, how do they relate to the labour market? For instance, Fuchs (2009) concludes that soon older workers will make for the grandest source of potential employees. Figure 1 shows the labour force shares (LFS) of the age cohorts 15 to 24 years and 50 to 64 years from 2000 to 2014. While the share of the youth cohort (dashed line) declines somewhat, the share of older workers (solid line) increases by almost ten percentage points, and the difference between both series has doubled in 15 years.[2]

- Figure 1 about here -

Notably, regarding the shifts in the age structure, Bellmann et al. (2003) point out that the main challenge demographic change imposes on society is the rising average age of the labour force, rather than a shortage of labour. Fuchs (2009) emphasizes that older people will be one of the existing labour force reserves that can still be tapped in the long run. Hence, demographically induced changes in the composition and size of the labour force should affect the demand for labour and thus the hiring behaviour of firms.

Surprisingly, comparatively little attention has been paid to this crucial conjunction and its ramifications on the German labour market since the compositional effect is likely to affect firms' hiring behaviour in two ways. On the one hand, the working population becomes older, implying a growing share of older personnel. On the other hand, the pool of the unemployed population grows older on average, too. Both trends should impact the hiring behaviour of firms, particularly with regard to the hiring of older workers. Figure 2 depicts the evolution of the annual share of newly hired workers aged 50 to 64 to all new hires for 2000 to 2014.

- Figure 2 about here -

Figure 2 reveals a positive trend implying that firms hire an increasing share of older workers, particularly during the financial crisis. From this, we derive the question of whether firms' hiring behaviour towards older workers can be ascribed to the demographic change in the labour force. Consequently, to assess the link between an ageing labour force and the hiring behaviour of firms more adequately, we consider the trend of both older employed and unemployed persons.

[1] For instance, in 2001, the Federal Statistical Office projected that the population of 82 million people in Germany would decline to 65 million people by 2050, given annual net migration into Germany of 100,000 people.

[2] We employ the labour force concept of the Federal Statistics Office. That is, the labour force equals the sum of employed and unemployed persons.

We estimate the impact of older employed and unemployed on the hiring at the firm level taking into account the age and education distribution, different types of part-time jobs, and reallocation of workers. This article contributes to the literature in several ways. Firstly, we can conduct a panel analysis using the Establishment History Panel (EHP) and match the original data set with data on unemployment at the administrative district level provided by the Federal Employment Agency. This marks a contrast to existing studies that mainly analyse cross-section data. Secondly, the data set enables us to precisely analyse the firm's hiring behaviour over a defined period of 15 years. Thirdly, to consider both parts of the labour force, we use variables at different aggregation levels to examine the hiring behaviour of firms. While we use the age structure of the employees at the firm level to control for the effect of an ageing workforce, we introduce age-specific unemployment shares at the administrative district level (Landkreise und kreisfreie Städte) to capture the effects of an ageing pool of unemployed.

We find that the joint effect of an ageing labour force on the hiring behaviour of firms is positive. In addition to the positive effect of the share of older employees on hiring older applicants, we show that a higher share of older unemployed increases the firms' hiring of older workers.[3] By considering this more comprehensive demographic pattern, we show that the internal age structure at the firm level is more important than the regional age structure of job seekers. Overall, firms react inelastic to the demographic trend. Thus, we provide new evidence that an ageing labour force leads to more new hirings of older workers. However, the adjustment of firms' to this demographic trend is rather slow. Secondly, those results hold also for part-time work in smaller firms. This suggests that working time models do not change the hiring of older workers in large firms. Thirdly, we show that a rising share of employees in partial retirement schemes decreases the share of newly hired workers aged 50 and older. This result has to be seen in context with particularities of the German law on partial retirement. Although the law intends to alleviate the employment situation of older workers, we show that the regulation impedes the hiring of new older workers. Lastly, our results reveal that older workers have a higher chance of getting hired in a more educated workforce. Furthermore, we present the results differentiated by groups of firm size and for East and West Germany.

Research on the implications of a growing share of older employees for human resource policy has shown a solid statistical link between the age structure within a firm and the average age at hire, as shown in Adams & Heywood (2007) for Australia and Medeiros Garcia et al. (2017) for Portugal, or the share of newly hired older workers, i.e. Scott et al. (1995) and Adler & Hilber (2009) for the USA, Heywood et al. (1999) for Hong-Kong, Daniel & Heywood (2007) and Kidd et al. (2012) for the UK, respectively. However, these studies use cross-section data exclusively and hence comparatively small samples. The sole study on the German labour market comes from Heywood et al. (2010). Yet, the authors do not measure the hiring behaviour directly, but managements attitudes towards hiring older workers in general. All studies show that a rising share of older personnel is positively related to the average age at hire or the share of newly hired older workers.

[3]We also consider the share of younger employees. The only study that also accounts for the youth share is Scott et al. (1995). However, they use a rather crude measure by employing the proportion of a firms workforce (up to the age of 55) that is younger than 40 years.

However, they are unable to capture developments over time (due to the cross-section structure of the data) and neglect the unemployed part of the labour force. Thus they cannot depict changes in the age structure of the labour force and their effects on the hiring of older workers comprehensively.

There is also some literature related to the hiring of older unemployed. Axelrad et al. (2018) demonstrate that the probability for an unemployed individual to find a new job decreases with age and Neumark et al. (2019) for the USA as well as Oesch (2020) for Switzerland both report age discrimination against older unemployed workers in the hiring process. In the German context, Dietz & Walwei (2011) calculate the yearly job entries to employment stocks and find that entry rates decrease steeply with age.[4] In this context, Cebulla & Wilkinson (2019) note that it is still uncommon among German (and European) businesses to have policies in place that are specifically tailored to assist in hiring older people. Wright (2015) adds to this by stating that German establishments are still somewhat reluctant to hire older workers, resulting in long-term unemployment (Dietz & Walwei 2011).[5] This might add some additional explanation to the finding of Daniel & Heywood (2007), who report that a high share of recent dismissals is negatively related to the hiring of older workers. Consequently, it appears to be a substantial problem for older workers to be re-employed after a job separation, especially if they are looking for full-time employment (Adams & Heywood 2007) or occupations related to high-skilled work (Heywood et al. 1999). However, none of the above studies analyse the joint implications of the increasing shares older employed and unemployed in the labour force on the hiring behaviour of firms.

This paper is organized as follows. The following section describes our database and variables. Section 3 provides the empirical strategy and discussion of the results. Section 4 concludes.

2 Data Description

This study uses the weakly anonymous Establishment History Panel (EHP) 1975-2014. Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and/or remote data access (Schmucker et al. 2016). The panel comprises cross-sectional data dating back to 1975 for West Germany and 1992 for East Germany. The EHP is a 50 per cent sample of all establishments throughout Germany with at least one employee subject to social security at the reference date of June 30th for a given

[4] They compute average entry rates for three age cohorts and the period 2002 to 2010. For the age cohort 50 to 54 years, they find an entry rate of 15 per cent. The age group 55 to 59 years shows an entry rate of about 11 per cent, while for the 60 to 64 years age cohort, they estimated an entry rate of 7.5 per cent.

[5] A closer look at the long-term unemployment statistics reveals that older workers are statistically more prone to be long-term unemployed than all other age groups, which marks a critical indicator of the chances of older people being hired from the labour market. E.g. examining data for 2019, it can be stated that 42 per cent of all unemployed 55 to 65 year-olds were long-term unemployed. Moreover, with almost one-third of all long-term unemployed, this age group is the largest among the long-term unemployed.

year. Individual data are aggregated to the establishment level using the establishment numbers.

To capture the demographic changes in the labour market, we include measures for the two main consequences of the demographic transition into our analysis. On the one hand, we account for the size of the labour force. On the other hand, we consider the age cohort distribution of the labour force. To do so, we match data on unemployment at the administrative district level provided by the Federal Employment Agency with labour market reporting according to the EHP.

Summing up, our representative data basis consists of 4,250,022 observations (individuals) distributed across all 402 administrative districts in Germany for the period 2000 to 2014.

2.1 Dependent Variable

The dependent variable y is the ratio of new hires aged 50 to 64 to all new hires at the individual firm level. Henceforth, we denote the dependent variable by y_{ijst}, where i is the index of the individual firm, j stands for the administrative district, s for the state and t is the respective year.

2.2 Independent Variables

We distinguish the set of independent variables into three subsets. The first subset will entail variables regarding the personnel at the firm level and dummy variables for industry-specific effects. The second subset consists of variables that serve as proxy variables for the changes in the labour force and the degree of urbanisation at the administrative district level. Finally, we include macroeconomic indicators at the state level into our equation.

Firm level variables

Concerning the variables at the firm level, we control for the existing age structure of full-time employees. We include the youth share (15 to 24 years) and the share of older workers (50 to 64 years) and consider the age cohort of the 25 to 49 year-olds as the reference cohort. A rising share of older employees might indicate the propensity of firms to hire older workers, whereas a rising share of younger personnel could hint at either a specific or a more general reluctance of firms to hire older workers.

We also include the firm size, measured by the number of employees. At a given turnover rate, larger firms potentially hire new workers more often, and this could increase the chances for older applicants as found, e.g. in Daniel & Heywood (2007).

Concerning part-time employment, we control for the shares of the youth and older workers. Firms might be less reluctant to hire older workers in part-time employment (Heywood et al. 2010). In addition, we include the share of employees working in partial retirement schemes since a larger share might hint at firms trying to ease older workers out of the firm and into retirement. An inverse effect might be that firms use these schemes to make jobs more attractive to older workers.

Moreover, we consider the share of employees with an academic background as a control. A higher share of an academically trained workforce could imply that cognitive rather than physical labour is the major driver for the firms' added value. With rising age, mental capacities (as well as physical capabilities) start declining (Gilles et al. 2017), but experience may serve as compensation for this decline (Srilakshmi & Kulkarni 2018). In this regard, age might be less of a factor in the firm's hiring decision, and the probability of being hired at a later age could increase with the level of education. Also, new technologies are often complementary to more educated workers (Acemoglu 2002).

We add the share of low-skilled employees because a larger share of this skill group might hint at firms with more simple or physically demanding jobs. This reduces the chances of older applicants of getting hired. Conversely, Oi (1962) finds that employers will seek to maximize their workers tenure if they incur hiring or training costs each time they hire which might make older workers specifically attractive for low-skilled jobs.

Furthermore, we consider the share of apprentices that are almost exclusively young high-school graduates or university dropouts. Firms that train their own future workforce depend less on demographic change if they tie up the young to the firm in the long run. Thus, we argue that a larger share of apprentices might reduce chances for older workers to get hired.

We also include the share of marginal part-time workers, whose monthly earnings do not exceed 450 EUR. These low-paid jobs usually consist of menial services that neither require substantial and costly training efforts by the firm nor a highly distinguished skill-set from the employees. Thus a higher share of employees in marginal part-time might operate in a positive way for older job seekers.

To consider both sides of labour turnover, we include the ratio of older workers who left the firm to all separations. A rising share of separated older workers could hint at an effort by the firm to substitute younger for older workers, which would be against the demographic trend and imply a negative relationship between the variable and the share of newly hired older workers. A higher fluctuation among older employees could also improve chances for older workers to get hired when firms adjust to the demographic trend in the labour force which would hint at a positive relationship. Also, we control for industry-specific differences in the hiring behaviour of firms by including 13 sectors specific dummy variables.[6]

Finally, we include the share of job-to-job movers. This variable contains the share of newly hired workers with an employment relationship with another firm in the previous year. We consider the share of job-to-job movers because mobility decreases with age. Therefore, we assume that the share of job-to-job movers consists mainly of younger workers. This results in a negative relationship between the share of job-to-job movers and the share of newly hired older workers.

Administrative district level variables

To proxy the size and age structure of the labour force, we consider the share of the

[6]For a detailed depiction, see the FDZ-Data report of the Sample of Integrated Labour Market Biographies Regional-File 1975-2010 (SIAB-R 7510), table A7 on pages 57-58.

youth and older workers among the unemployed and the total number of the unemployed at the district level. We expect the share of older workers to be positively related to the dependent variable when firms follow the demographic trend. In addition, we interpret a positive relationship between the youth share and the share of newly hired older workers as a hidden ageing effect. This is because the share of prime-age workers declines simultaneously, and firms prefer the older unemployed instead of the unemployed youth. We expect that the number of registered unemployed people does not affect the dependent variable if scale effects appear. Also, we control for the degree of urbanisation at the administrative district level. We obtained the data from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and followed their classification, which defines four basic categories. The first entails cities with at least 100,000 inhabitants. Category 2 comprises all districts where at least 50 per cent of all inhabitants live in major or medium-sized cities, and the population density is at least 150 inhabitants per km^2. Category 3 encloses all districts sharing the attributes from category 2 but report a population density between 100 and 150 inhabitants per km^2. Finally, category 4 comprises all districts where under 50 per cent of the population lives in major or medium-sized cities, and the population density does not exceed 100 inhabitants per km^2.

State level variables

We include the unemployment rate and the GDP growth rate at the state level as macroeconomic indicators into our specification. Both variables should capture potential differences in economic developments.

All data are available for the period 2000 to 2014. In the basic specification, we remove all establishments from the panel that had less than five employees. Since our dependent variable is a fraction, small firms are more likely to hire fewer people. If, i.e. a firm hires exactly one person, the share of older workers entering the firm in that respective year is either 0 or 1. In order to preclude having to deal with extreme values, we censor the panel downwards.

Furthermore, we only use firms that are included at least five years in the panel. This is due to our general interest in within-firm changes. Table 1 provides summary statistics for all variables.[7]

- Table 1 about here -

3 Empirical Strategy and Regression Results

We analyse the impact of demographic change on the share of older hired workers by

[7]We acknowledge that the restrictions we apply reduce the sample size considerably. For reasons of comparison, we estimate the baseline regression on the unrestricted panel, too. The results are provided in Table 5 in Appendix A.

using a panel data model with fixed effects and different aggregation levels.[8]

We specify our model as follows:

$$y_{ijst} = \beta_0 + \sum_k \beta_k F_{kijst} + \sum_m \lambda_m X_{mjst} + \theta_1 UR_{st} + \theta_2 GDP_{st} + \alpha_i + \epsilon_{ijst}$$

F is a vector comprising $k = 1, ..., K$ variables at the firm level and X describes a vector of $m = 1, ..., M$ variables at the administrative district level. UR and GDP are the state level unemployment rate and GDP growth rate, respectively. Index i represents the firm level, j the administrative district level, s the state level, and t the time dimension. Finally, ϵ depicts the residuals and α the fixed effects. In all regressions we consider cluster-robust standard errors to control for heteroskedasticity, serial correlation and cross sectional dependence in the residuals.

Our specification potentially suffers from simultaneity bias. With the share of newly hired older workers being the flow and the share of already employed older workers as the stock, we assume that the variables might affect each other. To account for the potential simultaneity, we use an instrumental variable (IV) panel estimator and instrument the share of full-time employees aged 50 and older at the firm level. The instruments are the youth share in the labour force and the share of older workers in the labour force, both aggregated at the administrative district level.[9] We consider both shares because we assume that the age distribution within the labour force impacts the age distribution within the individual firm. Additionally, test statistics for weak instruments, exogeneity of the instruments, and endogeneity are provided for all IV estimates.
Concerning the statistical relevance of our estimates, we provide robust standard errors and the False Positive Risk (FPR). The latter measures the probability of the null hypothesis being true (Colquhoun 2019 and 2017). For the computation of the FPR we refer to Appendix B.

3.1 Baseline Regression

Age structure of the labour force

The results of the fixed effects and IV baselines estimates are provided in Table 2. The most important result is that the trend of an ageing labour force increases the firms' propensity towards hiring older workers. This is shown by the empirically robust positive effect of the share of older employees in the firms' workforce (share_ft_50to64). A firm employs the more older workers, the higher the share of newly hired older workers. A rise in the share of older employees by five percentage points increases the share of newly hired older workers by one percentage point. Possible explanations are existing firms experiences with older employees and adjustments of the production processes and services to working conditions suitable for older persons. Moreover, a rising share of older employees also

[8] We used a Hausman-Test to decide whether a random effects model was more appropriate but found strong evidence for using fixed effects.

[9] We obtain the instruments from data provided by the BBSR.

implies that these firms experience higher fluctuations among their workforce (for example, due to retirement decisions) and more hiring decisions to the advantage of older workers when firms follow the demographic trend. However, the estimated effect is inelastic, which means a slow adjustment to demographic change. The possible simultaneity bias seems to be small since the coefficient of the IV estimates differs only slightly.

The older unemployed (share_unemployed_50to64) coefficient implies that a larger share of older unemployed in the region of the firm coincides with a larger share of older workers among new hires. A ten percentage point rise in the share of older unemployed increases the share of newly hired older workers by 0.5 percentage points. For the positive impact of the share of the older unemployed, a reduction in search costs is a possible explanation. Even if firms hired employees by chance, they would choose a higher share of older workers from a pool with more unemployed at higher ages.

Both explanations show that firms do adjust their hiring behaviour towards the ageing process in the labour force. If older workers become the relatively abundant resource in the labour market, firms appear to hire them more frequently. However, taking both estimated effects together, a four percentage point rise in the share of older workers in the labour force is related to only one percentage point rise in the hiring of this share. Hence, firms react inelastic to a change in the age cohort distribution of the labour force.

- Table 2 about here -

A rising share of younger employees (share_ft_15to24) deteriorates the chances for older workers to be hired. One reason could be that firms that already employ many young workers prefer to hire younger flexible workers if those fit the firms' production process. Also, firms are potentially interested in establishing long-term employer-employee relationships to increase individual productivity and reduce fluctuation costs. Hiring is costly, and if new employees undergo on-the-job training, firms might prefer to hire younger workers since that gives them more time to amortise their initial costs.

Conversely, the share of the younger unemployed (share_unemployed_15to24) has a positive effect. Keeping the share of the older unemployed constant, a growing share of younger unemployed implies a decreasing share of unemployed prime-age workers. Hence, in regions with a smaller share of prime-age workers in the unemployment pool, older unemployed job seekers are preferred. This does not contradict the findings at the firm level because the within-firm age distribution of the workforce is related to the firms' production technology. The age distribution of additional potential workers on the labour market is not related to firms specific issues. In addition, firms might be targeting to hire older workers (in contrast to younger workers) for their specific traits since older workers are usually more experienced and assumed to be reliable and dutiful.

The negative impact of the firm size (workforce_total), measured as the number of workers, implies that large firms hire a smaller share of older workers. According to the estimates, the share of newly hired older workers declines by one percentage point when the firm size is equal to 1250 employees.

Part-time and partial retirement

Another important albeit expected result is that an increase of part-time positions occupied by older workers is positively related to the hiring of older workers (share_pt_50to64). This points towards a strategic hiring behaviour of the firm. Even though this seems like a relatively straightforward notion, it highlights particularities of German law. Usually, part-time employees enjoy the same rights as full-time employees regarding vacation time or dismissal protection. However, paragraph 14, section 3 of the Teilzeit- und Befristungsgesetz (TzBfG) allows the employer to causelessly limit the employment contract to a maximum of five years if the employee has been unemployed before re-employment for at least four months and is at least 52 years old. This information is important because it grants the employer more flexibility. Employers might specifically target hiring older workers to exploit this option since they do not have to account for dismissal protection. In this sense, Heywood et al. (2010) and Daniel & Heywood (2007) point out that older workers might be hired into part-time positions to protect the core workforce meaning full-time or long-tenure employees (Drago & Heywood 1995).

A rising share of young part-time employees (share_pt_15to24) is negatively related to the engagement of older workers. Some firms presumably target long-term relationships with their workforce. A rising share of younger part-time employees might therefore indicate firms with an opposing human resource policy. Potential employers could be start-ups or small firms trying to establish themselves while simultaneously seeking to keep operating costs low. Such firms potentially reside in highly dynamic markets, such as information and communication technology, where high fluctuation among firms concerning market entries and exits is common. Since the knowledge and skills of older workers are typically more outdated and depreciated, those firms prefer young graduates as employees, and they prefer flexible employment contracts. In such an environment, the chances for older workers of getting hired are diminished. Overall, we find that the total effect of a rising share of part-time employees (younger and older) is larger in size than the effect of a rising full-time share (younger and older). Consequently, more part-time jobs do increase the chances for older workers to get hired. However, this result is true only for firms with a smaller number of employees. For large firms with many part-time jobs for older workers the effect is much smaller for part-time jobs than full-time jobs (see below).

The negative sign for the coefficient for partial retirement (share_pr) poses not only an interesting example of how intentions of the legislation may be undermined by the effects of law but might also be connected to the positive impact of a larger share of older workers working in part-time. The German law for partial retirement has the goal to alleviate the transition of older employees into retirement and to improve the working conditions of older workers. However, our robust result shows that the hiring of older workers decreased as a consequence of this legislation. Paragraph 1, section 2 of the Altersteilzeitgesetz (AltTZG) states that the Federal Employment Agency subsidises firms that offer partial retirement schemes if the respective worker has reached an age of at least 55 years and if the firm hires someone new into the then vacant position. Thus a rising share of employees in partial retirement could indicate that firms use these schemes specifically to ease the transition into retirement for their older part-time personnel. Potentially this may render the jobs in the firm more attractive for older workers. However, there are some additional regulations in Paragraph 3, section 2 of the AltTZG. To be entitled to the

subsidy, a firm must fill the vacant spot either with a worker who has been unemployed previously or a worker who has successfully completed his/her vocational training. In this sense, the law not only eases the transition from working life into retirement for older employees, but also subsidizes efforts by the firms to rejuvenate their workforce.

Education, turnover and others

The share of marginal part-time employees (share_marg_pt) is positively related to the share of newly hired older workers. As pointed out above, marginal part-time covers all activities which earn the employee no more than 450 Euros per month. Our interpretation is that this effect mainly concerns secondary earners to supplement the household income and maintain living standards. Consequently, this could imply that especially firms with many marginal part-time positions hire more older persons.

The share of academically trained personnel (share_academic) indicates that a higher level of education within the firms' workforce enhances the chances for older applicants to be hired. This is in line with intuition as we argue that even though both mental and physical capabilities decline with rising age, the offsetting effects of experience might be more pronounced in occupations that comprise mental work rather than physical labour, rendering age less of a factor when it comes to hiring decisions.

Firms employing a higher share of low-skilled workers (share_low_skilled) could be companies that specialise in mass production or other forms of manual labour. Since the decline of physical strength can be far less compensated in higher ages than mental restraints, these enterprises favour young workers over old workers.

Concerning the share of separations from older employees aged 50 and above (share_dismissals_50to64), we report a negative effect on the share of newly hired older workers. We argue that firms with frequent separations from older employees, for example, due to retirement, might prefer to hire prime-age or younger workers. However, the estimated effect is very small, perhaps due to the current demographic situation.

Finally, the share of job-to-job movers (share_job-to-job-movers) is also negatively related to the hiring of older workers. The effect is very similar to the effect of the older workers dismissal share. Intuitively, we assumed that job-to-job movers mainly comprise younger workers since job mobility declines with age. Hence, a rising share of job-to-job movers might hint at a firms' general preference for younger hires. Consequently, if strategic hiring by firms on the grounds of age occurs, it could be inferred that the share of newly hired older workers will decrease. Again, this effect is softened by the current demographic trend.

State-level indicators

As mentioned, state-level variables (unemployment_rate & gdp_growth) are included to capture possible general economic effects at a higher aggregation level. Both state-level variables are negatively correlated with the share of newly hired older workers, but the unemployment rate has only weak empirical evidence. We argue that firms generally hire more workers in times of higher growth and appear to favour younger workers (Blanchard & Diamond ,1990; Fujita & Ramey 2006). In recessions, however, the relative hiring

situation for older workers is better.

3.2 Extensions

We offer two extensions of the baseline regression. As a first extension, we consider three firm size groups to check for the robustness of our estimated effects. In the baseline regression, we restrict the number of employees in a firm to a minimum of five. In the small firms' group, we remove this restriction and consider only those firms with at least one and up to nine employees. These enterprises represent around 80 per cent of all German firms. Subsequently, we run our regressions on firms with at least ten but no more than 49 employees and refer to these firms as medium firms. Together, both groups cover around 96 per cent of all German enterprises. The last firm category employs at least 50 people but no more than 249 and will be labelled large firms. These three firm groups covered 99.3 per cent of all German enterprises in 2016 and employed more than 60 per cent of the German workforce. Thus, we get a representative reflection of the German corporate landscape by analysing the three groups. The results are provided in Tables 3 to 5.

As a second extension, we estimate the regressions separately for East Germany and West Germany. We divide the panel into two sub-samples for the former territory of East Germany and West Germany and assign the city of Berlin to East Germany. Tables 6 and 7 show the results.[10]

3.2.1 Firm size

Overall, the empirical evidence and direction of the estimated effects in the baseline model are confirmed by the different subgroups. However, while the medium-sized firms roughly match the baseline, small and large firms portray notable deviations.

Age structure of the labour force

Regardless of the tested firm size category, we find that the share of older employees is always positively related to the share of newly hired older workers. While the results of the FE regressions reveal no specific trend in conjunction with the firm size, the IV results report a rising effect of the firms' share of older workers on the share of newly hired older workers as the firm size increases. Large firms are characterised by a comparatively deeper organisational structure and might operate in more than one location. Also, large firms will have comparatively more different positions for (older) workers to fill since the range of potential tasks is larger. When the effect for older unemployed is added, a one percentage point change in the labour force results in a rise in the share of newly hired older workers by almost 0.2 to 0.35.

Concerning the youth share in the firm, the estimated effects are very similar to the baseline estimates. For the youth share among the local unemployed, the results provide no empirical evidence for large firms. This might be related to the groups' differences because the summary statistics reveal that large firms have the smallest share of younger

[10] We provide summary statistics for all sub-panels in Appendix C.

employees among the three considered groups. Taken together, we infer that the reaction towards the compositional effect of demographic change of the baseline model can be observed in all three firm size groups.

For the size of the firm, we note that the coefficient for small firms is substantial. When small firms increase their personnel, the chances for older workers to get hired decline by roughly one half of a percentage point. One reason why the effect is particularly strong for small firms might be that about 42 per cent of all small firms reside in either the automobile industry, which is traditionally an industry with a notable fraction of employees in vocational training, the construction sector, which is characterised by primarily physical labour, and the hospitality industry. All of these industries employ younger workers predominantly. Another potential reason is that small growing firms still have to be cautious with their finances since their resources might be limited. Due to employment protection for permanent workers, hiring an older employee will likely result in higher expenses than hiring a younger worker.

- Tables 3 -5 about here -

Part-time and partial retirement

Turning to the part-time variables, we find that the positive effect of the share of older employees in part-time declines as the firm size increases. At the same time, the share of this group in the workforce increases with firm size (see the Appendix). Hence, although this share is larger in large firms, it plays a less important role in hiring older workers.

The share of young part-time workers is also larger in large firms. The estimated small negative effect changes only slightly when the firm size changes. Hence, overall, it seems more challenging to find new employment for older workers when the share of part-time workers is larger. One reason for this could be that firms hire especially young workers into part-time positions and provide these young workers a stepping stone into future full-time positions (Cai et al. 2014).

Concerning the effect of a growing share of workers employed in partial retirement schemes, we find that the adverse impact decreases with the firm size. Furthermore, the effects for small and large firms differ substantially from the baseline results. However, on average, only one per cent of the workforce is in partial retirement schemes, regardless of the firm size. Hence the difference in the coefficient size is mainly caused by the size of the workforce.

Education, turnover and others

Moving to the group of variables covering education, we find for small firms that the share of apprentices is positively related to the hiring of older workers, while the opposite is the case in large firms. Also, the share of apprentices is larger in small firms than in large firms. The motivation for firms to employ apprentices is to regard general training as either a strategy for substitution or investment (Mohrenweiser & Backes-Gellner 2010). Given that small firms look at apprenticeship from an investment point of view, they

will employ apprentices to increase their workforce, likely as part of a corporate growth process. This might also increase the chances for older workers to get hired. In contrast, large firms have (larger) internal labour markets, and it may be beneficial for large firms to match vacancies over their internal labour market. This coincides with the findings of a slightly larger negative effect of the youth share at the firm level and the disappeared positive effect at the district level.

The share of marginal part-time employees is always positively related to the hiring of older workers and of similar size. However, the summary statistics report that small firms use marginal part-time employment more frequently. This may be for reasons of personnel flexibility or due to temporary demand. Moreover, marginal part-time employment poses a strategic advantage for small firms since the wage and total non-wage labour costs are lower than those of regular employment.

For small and medium firms, the share of workers with an academic background affects the share of newly hired older workers positively. However, for large firms, we find the opposite effect when the share of employees with an academic background rises. As mentioned earlier, as firms grow in size, business models and processes become more complex, and new technologies might be more complementary to workers with an apprenticeship and experience, like, for example, in the automobile industry.

In contrast to the share of academically trained personnel, the share of low-skilled workers exhibits a clear trend. In addition, with increasing firms size, the negative effect becomes larger. With the negative effect of workers with academic background, in large firms, mainly (older) workers with medium education are hired. Low-skilled workers are exposed to a comparatively higher risk of automatisation (Gardberg et al. 2020) and will partially be substituted. Hence, a decreasing share of low-skilled employees increases the chances for older workers to get hired.

Tables 4 and 5 report results for the share of separated older workers and the share of job-to-job movers similar to the baseline. However, for large firms, both effects provide only weak empirical evidence. Since the share of older separated workers is larger in large firms, we expect these firms to adjust faster to demographic change. This is in line with the diminishing adverse effect of job-to-job movers.

State-level indicators

Across the firm size groups, the GDP growth rate is always negatively related to the share of newly hired older workers. Hence, in times of higher growth, firms hire a larger share of younger or prime-age workers. For the unemployment rate, the results are inconclusive.

3.2.2 East Germany and West Germany

The separate estimates for East and West Germany provide some interesting differences. In general, baseline and West Germany estimates are very similar. The only two noteworthy differences for the firm-level variables are related to the shares of apprentices and academics. Even at the administrative district and state level, the results are similar.

Concerning the dependent variable, we find that the share of newly hired older workers is on average four percentage points larger in East Germany.

Age structure of the labour force

The larger effect of the older workers' share and the fact that the share of older employees is larger in East Germany reflects that East German firms react to their own demographic situation (faster ageing). However, once the potential simultaneity bias is removed, we find that the coefficients for both territories are closer to one another. This implies that the potential bias is more pronounced in East-German firms than in West-German firms, which is also confirmed by the endogeneity test provided at the end of Tables 6 and 7. Considering the effect of the share of older unemployed, we find a slightly stronger effect for the East.

The effect of the share of the younger workforce is almost twice as large for East Germany, implying that with a rising share of younger employees, East German firms would start again to hire younger workers to the disadvantage of older workers. In turn, the chances for older workers to get hired by smaller firms are larger because of the smaller East German firms' share of young employees and the enterprise landscape, which consists of few larger firms and more small firms.

- Tables 6-7 about here -

Part-time and partial retirement

The shares in part-time and partial retirement are very similar in East and West Germany. For the estimates, however, the positive effect of the older part-time worker and the negative effect of partial retirement are somewhat smaller in the East. This might be related to cultural differences in the labour market because, before the German reunification, such employment schemes were very uncommon in the East.

Education, turnover and others

While the baseline regression does not provide empirical evidence for the share of the apprentices, the two regional regressions reveal statistical evidence. For West Germany, the effect is small and positive, whereas the relationship for East German firms turns out to be negative. We interpret the result for West Germany as a complementary relationship in favour of mixed age cohorts. In contrast, for East Germany, we argue that firms that train younger workers try to mitigate the demographic trend.

For the East-German labour market, the estimate for the share of academics is positive and somewhat larger than in the baseline. For the considered period from 2000 to 2014, East Germany suffered from overall net emigration. In this regard, there is a clear migration pattern concerning young graduates who left the East German labour market (Haußen & Übelmesser 2015), with Berlin being the exception. This generates a shortage of young academics to the advantage of older academics. Also, firms may opt to hire older

workers who might not have a formal academical background but are well experienced. For West Germany, we find no statistical evidence for a relationship between academics and the hiring of older workers.

We find similar effects in both regions for the share of marginal part-time workers and the share of low-skilled workers. However, the negative effect for the low-skilled is somewhat stronger in the East.

Finally, the coefficients for the share of job-to-job movers and the share of dismissals of older workers for West Germany are very similar to the baseline. However, for East Germany, both effects provide no empirical evidence. The latter finding might reflect that the East German firms adapt better to the demographic circumstances.

State-level indicators

Compared to the baseline, the negative statistical relationship between the dependent variable and the GDP growth rate is somewhat stronger for West Germany and smaller and less reliable in the East. Again, this might be related to the procyclical demand for younger workers (Blanchard & Diamond, 1990). For the unemployment rate at the state level, we find correlations with different directions for both regions. While for West Germany, we could still argue that in regions with declining unemployment, the share of older newly hired workers increases, for East Germany, the correlation is positive. In addition, the unemployment rate in the East is twice as large as in the West. Hence, for East Germany, the results remain inconclusive.

4 Conclusion

The main goal of this paper was to determine whether the demographic change of the labour force affects the hiring behaviour of firms towards older workers. Using a unique joint dataset comprising of the Establishment-History-Panel by the IAB and unemployment data from the Federal Employment Agency, we consider the age and education distribution, different types of part-time jobs and reallocation of workers to examine the hiring behaviour of firms. In contrast to the existing literature, we consider panel data and confirm at the firm level the positive effect of the share of older employees on the hiring of older applicants and the negative impact of the share of younger employees. Also, our findings show a robust positive correlation between the share of the older unemployed and the share of older workers hired by firms. We interpret this as an adaption to the demographic trend additionally to the demographic structure at the firm level. However, the overall adaption to demographic change is inelastic. The results for full-time employed are similar to those of part-time worker. The implication is that the working time models appear to have no specific influence on hiring older workers in large firms where the most part-time jobs exist. In addition, we find that a rising share of employees in partial retirement schemes decreases the share of newly hired workers aged 50 and older. Lastly, our results reveal that a more educated workforce is more complementary to the hiring of older workers. High labour turnover negatively affects the firms hiring practices towards older workers, particularly when the reallocation process is enhanced

by hiring job-to-job movers. Our results might be interpreted in the light of the ongoing debate in Germany about the retirement age. Firms do react to demographically induced changes in the labour force by hiring more older workers. The argument that raising the retirement age would result in higher unemployment among older workers might be attenuated. A promising agenda for future research might be the consideration of gender-related questions. Specifically, the hiring behaviour towards women in general and, in particular, older women might yield interesting results since female labour is seen as yet another underutilised source of labour besides older workers.

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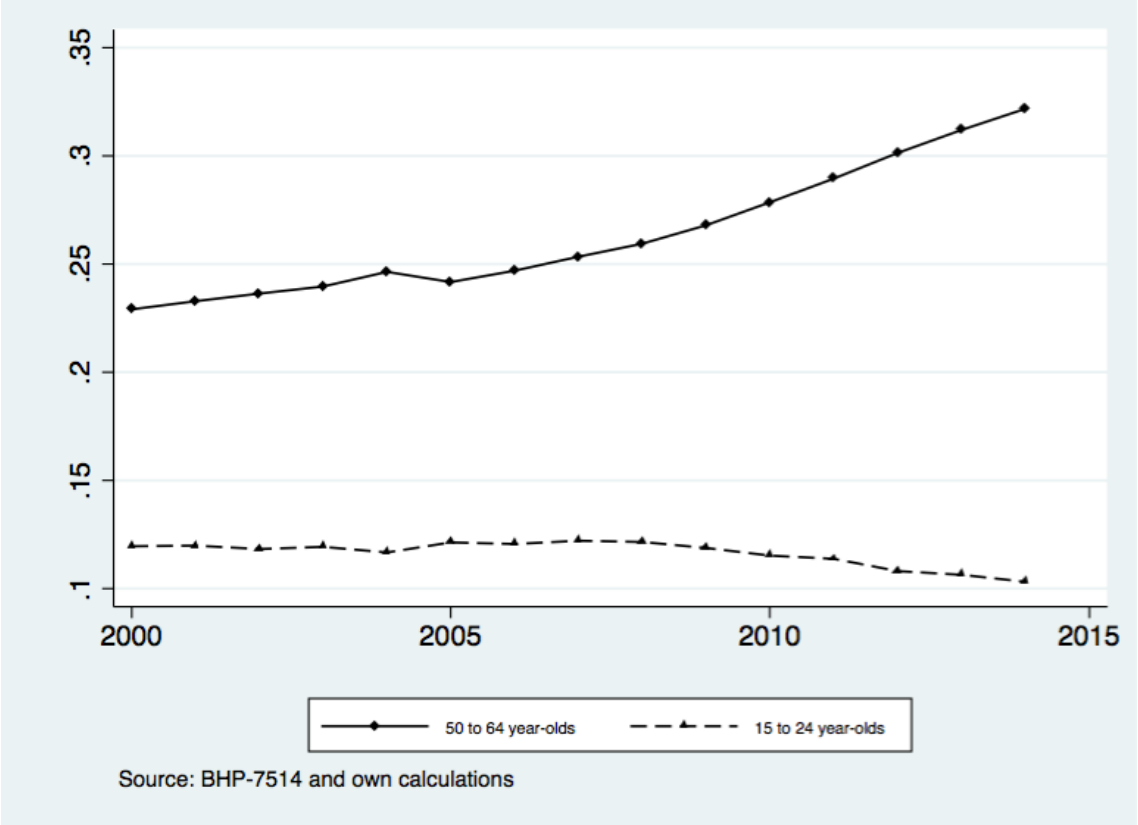

Figure 1: Labour force shares of different age cohorts

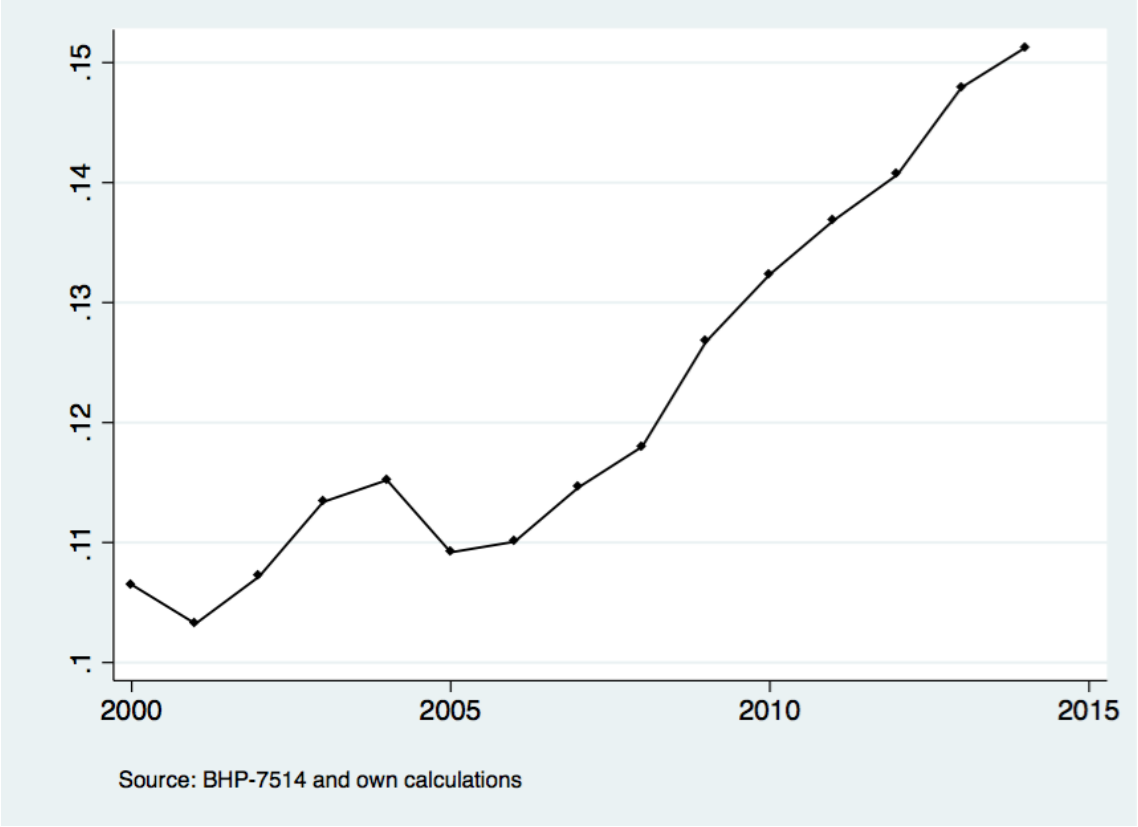

Figure 2: Share of newly hired older workers

Table 1: Summary statistics

Variable	Description	Statistics				
		Obs.	Mean	Std. Err.	Min.	Max.
hires_50to64	Share of new hires aged 50 to 64 at all new hires	4,250,022	12.50	22.01	0	100
Firm level variables						
share_ft_50to64	Number of employees aged 50 to 64 years to all employees	4,250,022	19.85	21.31	0	100
share_ft_15to24	Number of employees aged 15 to 24 years to all employees	4,250,022	10.12	16.58	0	100
workforce_total	Total number of employees	4,250,022	43.32	179.68	5	40,953
share_pt_50to64	Number of part-time employees aged 50 to 64 to all employees	4,250,022	23.53	24.87	0	100
share_pt_15to24	Number of part-time employees aged 15 to 24 to all employees	4,250,022	25.43	28.26	0	100
share_pr	Number of employees in partial retirement to all employees	4,250,022	0.52	2.32	0	100
share_apprentices	Number of employees in apprenticeship to all employees	4,250,022	5.41	9.58	0	100
share_marg_pt	Number of employees in marginal part-time to all employees	4,250,022	24.87	25.88	0	100
share_academic	Number of employees with an academic education to all employees	4,250,022	9.71	15.98	0	100
share_low-skilled	Number of employees without or with secondary school qualification but without vocational training to all employees	4,250,022	14.88	14.43	0	100
share_dismissals_50to64	Number of dismissals of 50 to 64 year-old employees to all dismissals	4,250,022	16.59	25.57	0	100
share_job-to-job-movers	Number of hires previously employed with another firm to all new hires	4,250,022	48.17	32.93	0	100
industrial branch	Dummy variables for 13 industry sectors	4,250,022			0	1
Administrative district level variables						
share_unemployed_50to64	Number of unemployed aged 50 to 64 years to all unemployed aged 15 to 64 years	4,250,022	28.73	5.12	17.68	58.33
share_unemployed_15to24	Number of unemployed aged 15 to 24 years to all unemployed aged 15 to 64 years	4,250,022	10.92	2.25	3.47	21.09
unemployed_total	Number of unemployed aged 15 to 64 years scaled by the factor 1.000	4,250,022	21.76	44.56	0.003	319.18
urbanisation	Dummy variables for 4 degrees of urbanisation	4,250,022			0	1
State level variables						
unemployment_rate	Average rate of unemployment on a yearly basis by state	4,250,022	8.46	3.66	3.7	20.5
gdp_growth	Yearly growth rate of the gross domestic product by state	4,250,022	2.42	2.51	-9.58	8.28

Table 2: Hiring of older workers: Baseline Regression

dependent variable:	**FE**			**IV**		
hires_50to64	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2173	*(0.0010)*	0.0000	0.2045	*(0.0039)*	0.0000
share_ft_15to24	-0.0344	*(0.0007)*	0.0000	-0.0358	*(0.0008)*	0.0000
workforce_total	-0.0008	*(0.0002)*	0.0005	-0.0008	*(0.0002)*	0.0003
share_pt_50to64	0.2903	*(0.0009)*	0.0000	0.2905	*(0.0009)*	0.0000
share_pt_15to24	-0.0251	*(0.0006)*	0.0000	-0.0251	*(0.0006)*	0.0000
share_pr	-0.2819	*(0.0112)*	0.0000	-0.2842	*(0.0112)*	0.0000
share_apprentices	-0.0016	*(0.0020)*	>0.5	-0.0007	*(0.0020)*	>0.5
share_marg_pt	0.0461	*(0.0011)*	0.0000	0.0462	*(0.0011)*	0.0000
share_academic	0.0077	*(0.0020)*	0.0025	0.0083	*(0.0020)*	0.0009
share_low_skilled	-0.0600	*(0.0013)*	0.0000	-0.0608	*(0.0013)*	0.0000
share_dismissals_50to64	-0.0032	*(0.0006)*	0.0000	-0.0034	*(0.0006)*	0.0000
share_job-to-job-movers	-0.0037	*(0.0004)*	0.0000	-0.0037	*(0.0004)*	0.0000
Adminsitrative district level						
share_unemployed_50to64	0.0515	*(0.0031)*	0.0000	0.0500	*(0.0032)*	0.0000
share_unemployed_15to24	0.0438	*(0.0094)*	0.0000	0.0349	*(0.0097)*	0.0073
umemployed_total	-0.0015	*(0.0015)*	0.4975	-0.0012	*(0.0015)*	>0.5
State level						
unemployment_rate	-0.0211	*(0.0101)*	0.2496	-0.0410	*(0.0117)*	0.0093
gdp_growth	-0.0216	*(0.0040)*	0.0000	-0.0216	*(0.0040)*	0.0000
No. of Observations	4,250,022			4,250,022		
R-squared	0.1080			0.1079		
Cragg-Donald Wald F statistic				70,000		0.0000
Hansen-J-statistic Chi-sq.				0.727		>0.5
Test of Endogeneity Chi-sq.				11.160		0.0153

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

Table 3: Hiring of older workers and different firm sizes

No. of employees

Dependent variable:	**1 - 9**					
hires_50to64	**FE**			**IV**		
	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2862	*(0.0015)*	0.0000	0.1456	*(0.0109)*	0.0000
share_ft_15to24	-0.0333	*(0.0007)*	0.0000	-0.0442	*(0.0011)*	0.0000
workforce_total	-0.5052	*(0.0137)*	0.0000	-0.4281	*(0.0151)*	0.0000
share_pt_50to64	0.4667	*(0.0013)*	0.0000	0.4653	*(0.0013)*	0.0000
share_pt_15to24	-0.0280	*(0.0007)*	0.0000	-0.0269	*(0.0007)*	0.0000
share_pr	-0.3956	*(0.0242)*	0.0000	-0.4525	*(0.0246)*	0.0000
share_apprentices	0.0156	*(0.0017)*	0.0000	0.0103	*(0.0017)*	0.0000
share_marg_pt	0.0218	*(0.0011)*	0.0000	0.0127	*(0.0013)*	0.0000
share_academic	0.0113	*(0.0020)*	0.0000	0.0140	*(0.0021)*	0.0000
share_low_skilled	-0.0300	*(0.0011)*	0.0000	-0.0333	*(0.0011)*	0.0000
share_dismissals_50to64	-0.0060	*(0.0008)*	0.0000	-0.0114	*(0.0009)*	0.0000
share_job-to-job-movers	-0.0040	*(0.0005)*	0.0000	-0.0045	*(0.0005)*	0.0000
Administrative district level						
share_unemployed_50to64	0.0633	*(0.0057)*	0.0000	0.0440	*(0.0060)*	0.0000
share_unemployed_15to24	0.0730	*(0.0171)*	0.0006	0.0039	*(0.0178)*	>0.5
unemployed_total	-0.0032	*(0.0027)*	0.4805	0.0002	*(0.0027)*	>0.5
State level						
unemployment_rate	0.0922	*(0.0181)*	0.0000	-0.0511	*(0.0214)*	0.1568
gdp_growth	-0.0359	*(0.0072)*	0.0000	-0.0366	*(0.0073)*	0.0000
No. of Obs.	1,933,711			1,933,711		
R-squared	0.2223			0.2116		
Cragg-Donald Wald F statistic				6,966.64		0.0000
Hansen-J-statistic Chi-sq.				5.362		0.1768
Test of Endogeneity Chi-sq.				164.17		0.0000

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

Table 4: Hiring of older workers and different firm sizes

	No. of employees					
Dependent variable:	**10 - 49**					
hires_50to64	**FE**			**IV**		
	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2095	*(0.0015)*	0.0000	0.2077	*(0.0052)*	0.0000
share_ft_15to24	-0.0383	*(0.0011)*	0.0000	-0.0385	*(0.0012)*	0.0000
workforce_total	0.0012	*(0.0029)*	>0.5	0.0011	*(0.0029)*	>0.5
share_pt_50to64	0.2521	*(0.0012)*	0.0000	0.2521	*(0.0012)*	0.0000
share_pt_15to24	-0.0282	*(0.0009)*	0.0000	-0.0283	*(0.0009)*	0.0000
share_pr	-0.2759	*(0.0153)*	0.0000	-0.2764	*(0.0154)*	0.0000
share_apprentices	-0.0064	*(0.0032)*	0.2688	-0.0062	*(0.0032)*	0.2933
share_marg_pt	0.0519	*(0.0017)*	0.0000	0.0519	*(0.0017)*	0.0000
share_academic	0.0077	*(0.0030)*	0.1177	0.0078	*(0.0030)*	0.1123
share_low_skilled	-0.0697	*(0.0020)*	0.0000	-0.0699	*(0.0020)*	0.0000
share_dismissals_50to64	-0.0040	*(0.0008)*	0.0000	-0.0040	*(0.0008)*	0.0000
share_job-to-job-movers	-0.0063	*(0.0006)*	0.0000	-0.0063	*(0.0006)*	0.0000
Administrative district level						
share_unemployed_50to64	0.0450	*(0.0045)*	0.0000	0.0449	*(0.0045)*	0.0000
share_unemployed_15to24	0.0460	*(0.0135)*	0.0125	0.0448	*(0.0139)*	0.0219
unemployed_total	-0.0019	*(0.0023)*	>0.5	-0.0019	*(0.0023)*	>0.5
State level						
unemployment_rate	-0.0422	*(0.0147)*	0.0584	-0.0451	*(0.0168)*	0.0903
gdp_growth	-0.0156	*(0.0057)*	0.0774	-0.0156	*(0.0057)*	0.0776
No. of Obs.	2,074,405			2,074,405		
R-squared	0.0859			0.0859		
Cragg-Donald Wald F statistic				44,634.25		0.0000
Hansen-J-statistic Chi-sq.				0.028		>0.5
Test of Endogeneity Chi-sq.				0.125		>0.5

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

Table 5: Hiring of older workers and different firm sizes

	No. of employees					
Dependent variable:	**50 - 249**					
hires_50to64	**FE**			**IV**		
	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2389	*(0.0036)*	0.0000	0.3051	*(0.0064)*	0.0000
share_ft_15to24	-0.0637	*(0.0028)*	0.0000	-0.0477	*(0.0032)*	0.0000
workforce_total	0.0020	*(0.0008)*	0.1481	0.0030	*(0.0008)*	0.0068
share_pt_50to64	0.1451	*(0.0023)*	0.0000	0.1411	*(0.0023)*	0.0000
share_pt_15to24	-0.0168	*(0.0016)*	0.0000	-0.0170	*(0.0016)*	0.0000
share_pr	-0.0578	*(0.0198)*	0.0000	-0.0511	*(0.0197)*	0.1063
share_apprentices	-0.0848	*(0.0064)*	0.0000	-0.1039	*(0.0067)*	0.0000
share_marg_pt	0.0404	*(0.0033)*	0.0000	0.0348	*(0.0034)*	0.0000
share_academic	-0.0208	*(0.0060)*	0.0103	-0.0287	*(0.0060)*	0.0001
share_low_skilled	-0.1071	*(0.0043)*	0.0000	-0.0921	*(0.0044)*	0.0000
share_dismissals_50to64	-0.0026	*(0.0016)*	0.3950	-0.0045	*(0.0016)*	0.0661
share_job-to-job-movers	-0.0024	*(0.0015)*	0.4104	-0.0013	*(0.0015)*	>0.5
Administrative district level						
share_unemployed_50to64	0.0577	*(0.0054)*	0.0000	0.0594	*(0.0055)*	0.0000
share_unemployed_15to24	-0.0411	*(0.0169)*	0.1451	0.0005	*(0.0172)*	>0.5
unemployed_total	0.0046	*(0.0032)*	0.4410	0.0028	*(0.0032)*	>0.5
State level						
unemployment_rate	-0.0656	*(0.0195)*	0.0148	0.0369	*(0.0215)*	0.3655
gdp_growth	-0.0231	*(0.0069)*	0.0145	-0.0224	*(0.0069)*	0.0196
No. of Obs.	546,507			546,507		
R-squared	0.0825			0.0806		
Cragg-Donald Wald F statistic				38,538.24		0.0000
Hansen-J-statistic Chi-sq.				6.92		0.0992
Test of Endogeneity Chi-sq.				111.16		0.0000

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

Table 6: Hiring of older workers in East-Germany

Regions						
dependent variable:	**East-Germany**					
hires_50to64	**FE**			**IV**		
	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2966	*(0.0029)*	0.0000	0.2224	*(0.0137)*	0.0000
share_ft_15to24	-0.0617	*(0.0022)*	0.0000	-0.0706	*(0.0027)*	0.0000
workforce_total	-0.0004	*(0.0004)*	>0.5	-0.0008	*(0.0004)*	0.3436
share_pt_50to64	0.2563	*(0.0019)*	0.0000	0.2562	*(0.0020)*	0.0000
share_pt_15to24	-0.0206	*(0.0014)*	0.0000	-0.0211	*(0.0014)*	0.0000
share_pr	-0.1861	*(0.0232)*	0.0000	-0.1959	*(0.0231)*	0.0000
share_apprentices	-0.0407	*(0.0056)*	0.0000	-0.0346	*(0.0057)*	0.0000
share_marg_pt	0.0427	*(0.0032)*	0.0000	0.0424	*(0.0032)*	0.0000
share_academic	0.0310	*(0.0049)*	0.0000	0.0351	*(0.0050)*	0.0000
share_low_skilled	-0.0825	*(0.0039)*	0.0000	-0.0862	*(0.0039)*	0.0000
share_dismissals_50to64	-0.0002	*(0.0014)*	>0.5	-0.0011	*(0.0014)*	>0.5
share_job-to-job-movers	0.0032	*(0.0011)*	0.0639	0.0027	*(0.0011)*	0.1500
Administrative district level						
share_unemployed_50to64	0.0605	*(0.0118)*	0.0000	0.0786	*(0.0119)*	0.0000
share_unemployed_15to24	0.0101	*(0.0291)*	>0.5	0.0013	*(0.0291)*	>0.5
unemployed_total	-0.0004	*(0.0019)*	>0.5	-0.0012	*(0.0019)*	>0.5
State level						
unemployment_rate	0.1389	*(0.0191)*	0.0000	0.0574	*(0.0243)*	0.1646
gdp_growth	-0.0124	*(0.0127)*	0.4986	-0.0096	*(0.0128)*	>0.5
No. of Observations	710,176			710,176		
R-squared	0.1163			0.1141		
Cragg-Donald Wald F statistic				6,105		0.0000
Hansen-J-statistic Chi-sq.				1.20		0.4908
Test of Endogeneity Chi-sq.				30.09		0.0000

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

Table 7: Hiring of older workers in West-Germany

Regions						
dependent variable:	**West-Germany**					
hires_50to64	**FE**			**IV**		
	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2018	*(0.0011)*	0.0000	0.1956	*(0.0041)*	0.0000
share_ft_15to24	-0.0312	*(0.0007)*	0.0000	-0.0318	*(0.0008)*	0.0000
workforce_total	-0.0008	*(0.0002)*	0.0022	-0.0008	*(0.0002)*	0.0019
share_pt_50to64	0.3007	*(0.0010)*	0.0000	0.3008	*(0.0010)*	0.0000
share_pt_15to24	-0.0260	*(0.0006)*	0.0000	-0.0260	*(0.0006)*	0.0000
share_pr	-0.3100	*(0.0128)*	0.0000	-0.3112	*(0.0128)*	0.0000
share_apprentices	0.0092	*(0.0022)*	0.0006	0.0096	*(0.0022)*	0.0003
share_marg_pt	0.0481	*(0.0012)*	0.0000	0.0481	*(0.0012)*	0.0000
share_academic	0.0005	*(0.0021)*	>0.5	0.0008	*(0.0021)*	>0.5
share_low_skilled	-0.0570	*(0.0014)*	0.0000	-0.0574	*(0.0014)*	0.0000
share_dismissals_50to64	-0.0039	*(0.0006)*	0.0000	-0.0039	*(0.0006)*	0.0000
share_job-to-job-movers	-0.0050	*(0.0005)*	0.0000	-0.0051	*(0.0005)*	0.0000
Administrative district level						
share_unemployed_50to64	0.0449	*(0.0033)*	0.0000	0.0439	*(0.0034)*	0.0000
share_unemployed_15to24	0.0483	*(0.0102)*	0.0001	0.0443	*(0.0105)*	0.0007
unemployed_total	-0.0112	*(0.0040)*	0.0653	-0.0104	*(0.0040)*	0.1103
State level						
unemployment_rate	-0.0686	*(0.0144)*	0.0001	-0.0816	*(0.0161)*	0.0000
gdp_growth	-0.0215	*(0.0042)*	0.0000	-0.0214	*(0.0042)*	0.0000
No. of Observations	3,538,165			3,538,165		
R-squared	0.1072			0.1072		
Cragg-Donald Wald F statistic				609,191.2		0.0000
Hansen-J-statistic Chi-sq.				4.52		0.2362
Test of Endogeneity Chi-sq.				2.56		0.3976

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

6 Appendix

6.1 Appendix A: Unrestrained Baseline Regression

Table 8: Hiring of older workers: Unrestrained Baseline Regression

dependent variable:	**FE**			**IV**		
hires_50to64	Coef.	Std. Err.	FPR	Coef.	Std. Err.	FPR
Firm level						
share_ft_50to64	0.2886	*(0.0009)*	0.0000	0.1710	*(0.0039)*	0.0000
share_ft_15to24	-0.0388	*(0.0005)*	0.0000	-0.0495	*(0.0006)*	0.0000
workforce_total	-0.0018	*(0.0003)*	0.0000	-0.0020	*(0.0004)*	0.0000
share_pt_50to64	0.4249	*(0.0008)*	0.0000	0.4250	*(0.0008)*	0.0000
share_pt_15to24	-0.0237	*(0.0004)*	0.0000	-0.0234	*(0.0004)*	0.0000
share_pr	-0.4243	*(0.0115)*	0.0000	-0.4467	*(0.0116)*	0.0000
share_apprentices	0.0033	*(0.0012)*	0.0592	0.0011	*(0.0012)*	0.4989
share_marg_pt	0.0239	*(0.0007)*	0.0000	0.0174	*(0.0007)*	0.0000
share_academic	0.0139	*(0.0013)*	0.0000	-0.0173	*(0.0013)*	0.0000
share_low_skilled	-0.0377	*(0.0007)*	0.0000	-0.0412	*(0.0007)*	0.0000
share_dismissals_50to64	-0.0205	*(0.0005)*	0.0000	-0.0242	*(0.0005)*	0.0000
share_job-to-job-movers	-0.0054	*(0.0003)*	0.0000	-0.0060	*(0.0003)*	0.0000
Adminsitrative district level						
share_unemployed_50to64	0.0371	*(0.0029)*	0.0000	0.0196	*(0.0030)*	0.0000
share_unemployed_15to24	0.0926	*(0.0087)*	0.0000	0.0147	*(0.0090)*	0.3891
umemployed_total	-0.0048	*(0.0014)*	0.0117	-0.0013	*(0.0014)*	0.4999
State level						
unemployment_rate	0.1338	*(0.0093)*	0.0000	-0.0336	*(0.0108)*	0.0309
gdp_growth	-0.0239	*(0.0036)*	0.0000	-0.0232	*(0.0036)*	0.0000
No. of Observations	7,317,115			6,841,272		
R-squared	0.1954			0.1887		
Cragg-Donald Wald F statistic				66,000		0.0000
Hansen-J-statistic Chi-sq.				7.273		0.0863
Test of Endogeneity Chi-sq.				897.711		0.0153

Notes: FE = fixed effects regression, IV = instrumental variables regression, FPR = false positive risk. Additional variables: dummy variables for the degree of urbanisation and the industrial branch. Cluster-robust standard errors are in parentheses.

6.2 Appendix B: Computation of the False Positive Risk

The false positive risk (FPR) was introduced by Colquhoun (2019, 2017) and measures the probability that the result occurred by chance $P(H_0|data)$. The approach is based on the Bayes theorem that we express in odds:

$$\text{posterior odds on } H_1 = \text{Bayes factor} \times \text{prior odds}$$

This is equal to

$$P(H_1|data)/P(H_0|data) = P(data|H_1)/P(data|H_0) \times P(H_1)/P(H_0)$$

Following Colquhoun, the Bayes factor becomes a likelihood ratio (LR), and the prior odds can be expressed using the probability that there is a real effect,

$$P(H_1) : P(H_1)/(1 - P(H_1)).$$

Among others, Sellke et al. (2001) provide an approach to calculate the LR based on the p-value: $LR = 1/(-eplog(p))$. However, this measure can be considered only as long as $p < 1/e$, with e as Euler's number. Taking things together and considering $P(H_0|data) = 1 - P(H_1|data)$ gives us the FPR:

$$FPR = (1/(1 + (1/(-eplog(p))(P(H_1))/(1 - P(H_1)))))$$

Applying the FPR approach requires to specify $P(H_1)$ first. However, specifying the prior probability in regression analysis is (even in replication studies) difficult, and we should always be careful when defining this unknown number (you have to convince the reader). We use

$$P(H_1)/(1 - P(H_1)) = 0.5/(1 - 0.5) = 1$$

which means that both probabilities have the same weight. This is equal to a 50:50 chance for a real effect specified before the data are analysed. This seems reasonable when we do not know what to choose or are open to the results. Hence, the prior probability of a real effect, $P(H_1)$, is fixed to 0.5. In this case, the FPR is much larger than the corresponding p-value, and, for example, $p = 0.05$ is equal to a FPR of 0.2893.

6.3 Appendix C: Summary statistics of sub-panels

Table 9: Summary statistics of sub-panels

	Extensions									
	1 - 9		10 - 49		50 - 249		East		West	
Variable	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
hires_50to64	12.07	27.58	12.59	21.51	12.87	14.17	15.82	24.76	11.84	21.35
Firm level variables										
share_ft_50to64	12.82	25.06	20.88	20.34	25.57	14.83	23.60	21.73	19.10	21.14
share_ft_15to24	12.34	24.68	9.65	14.32	7.44	8.29	7.97	13.65	10.56	17.07
workforce_total	5.33	2.16	21.36	9.93	101.90	47.54	43.71	144.87	43.25	185.92
share_pt_50to64	18.73	28.32	24.04	24.49	27.37	20.44	24.68	28.73	23.30	24.02
share_pt_15to24	23.43	32.41	25.99	28.04	26.92	25.39	26.47	32.62	25.22	27.30
share_pr	0.09	1.43	0.45	2.23	1.28	3.01	0.76	3.22	0.47	2.09
share_apprentices	7.11	15.27	5.23	8.60	4.46	8.13	5.10	10.12	5.48	9.47
share_marg_pt	34.52	31.26	24.23	24.71	13.34	19.65	15.75	21.09	26.71	26.36
share_academic	7.44	16.07	9.62	15.94	12.07	16.54	12.67	18.48	9.12	15.35
share_low-skilled	17.05	21.24	14.42	13.29	14.48	12.71	9.64	12.49	15.93	14.57
share_dismissals_50to64	13.24	28.78	16.78	25.62	21.28	19.01	20.74	28.39	15.76	24.88
share_job-to-job-movers	46.63	41.86	48.31	31.75	48.74	21.15	44.84	33.23	48.83	32.83
Administrative district level variables										
share_unemployed_50to64	28.58	5.08	28.75	5.12	28.67	5.09	29.81	6.02	28.51	4.89
share_unemployed_15to24	10.97	2.24	10.95	2.25	10.83	2.24	10.72	1.93	10.97	2.30
unemployed_total	23.40	48.64	20.81	42.72	22.29	44.71	59.55	93.59	14.15	16.65
State level variables										
unemployment_rate	8.56	3.70	8.42	3.64	8.56	3.74	14.54	3.45	7.24	2.19
gdp_growth	2.39	2.50	2.42	2.53	2.42	2.52	2.41	2.18	2.42	2.57