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## Does it matter where you work? Employer characteristics and the wage growth of low-wage workers and higher-wage workers

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# IAB-Discussion Paper

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Articles on labour market issues

## Does it matter where you work?

Employer characteristics and the wage growth of low-wage  
workers and higher-wage workers

Jens Stephani

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# Does it matter where you work?

Employer characteristics and the wage growth of low-wage workers and higher-wage workers

Jens Stephani (IAB)

Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

The “IAB-Discussion Paper” is published by the research institute of the German Federal Employment Agency in order to intensify the dialogue with the scientific community. The prompt publication of the latest research results via the internet intends to stimulate criticism and to ensure research quality at an early stage before printing.

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## Abstract

Using rich German linked employer-employee data and endogenous switching regression models, I show that large firms and firms with a high export share or a low proportion of fixed-term workers provide higher wage growth for low-wage workers. While having many low-paid co-workers dampens the wage growth of both low-wage workers and higher-wage workers, there are also employers who provide higher wage growth only for higher-wage workers. The results indicate a certain degree of labour market segmentation that is a) important for the wage mobility of individual workers and b) relevant in the context of polarisation and rising wage inequality.

## Zusammenfassung

Unter Verwendung von umfangreichen verbundenen Arbeitgeber-Arbeitnehmer-Daten aus Deutschland und multivariaten Modellen mit „endogenem Switching“ wird in dieser Studie gezeigt, dass die Löhne von Geringverdienern in großen Betrieben und in Betrieben mit einer hohen Exportquote oder einem niedrigen Anteil befristeter Beschäftigter vergleichsweise stärker wachsen als in anderen Betrieben. Ein hoher Anteil von Geringverdienern an der Belegschaft dämpft sowohl das Lohnwachstum von Geringverdienern als auch dasjenige von Höherverdienern. Außerdem zeigt sich, dass bestimmte Arbeitgeber nur Höherverdienern ein vergleichsweise erhöhtes Lohnwachstum bieten. Die Ergebnisse deuten auf eine gewisse Segmentierung des deutschen Arbeitsmarktes hin. Letztere ist sowohl für die individuelle Lohnmobilität von Beschäftigten als auch im Kontext einer Polarisierung des Arbeitsmarktes und steigender Lohnungleichheit von Bedeutung.

**JEL classification:** J30, J60

**Keywords:** Wage mobility; low-wage employment; endogenous switching regression model; Germany

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# 1 Introduction

Wage inequality in Germany has been rising in recent decades, at both the top and bottom ends of the wage distribution (e.g., Dustmann/Ludsteck/Schönberg 2009), while wage mobility has been decreasing (e.g., Gernandt 2009, Bayaz-Ozturk/Burkhauser/Couch 2011, Riphahn/Schnitzlein 2011).<sup>1</sup> At the same time, the low-wage sector has grown considerably (Eichhorst et al. 2005; Kalina 2008). In addition, concerns have been raised that there might have emerged a two-tier labour market in Europe that consists of “good” and well-paid jobs on the one hand and “bad” and low-paid jobs on the other hand (see, e.g., European Commission 2001, Pouliakas/Theodossiou 2010). Although these developments have led to a significant amount of research on low-wage work, several research gaps still exist.

For example, previous studies on low-wage work have shown that certain individual, job and firm characteristics are increasing the probability of low-wage workers escaping low pay. The fact that firm characteristics do play a significant role for the wage mobility of low-wage workers is important for two reasons. First, this information can help low-wage workers to move up on their own initiative by trying to find a job with an employer that offers them better chances for wage growth. Second, as suggested by Andersson/Holzer/Lane (2005) this information can provide a starting point for labour market policies aimed at increasing the wage mobility of low-wage workers, by improving their access to such firms, for example. However, due to a lack of data, previous studies have only been able to analyse a part of the considerable amount of firm heterogeneity that is associated with the wage growth of low-wage workers (Stephani 2012). Therefore, one aim of this paper is to identify further characteristics of wage-growth firms for low-wage workers, i.e., firms that provide higher wage growth for these workers.

In addition, previous studies have focused exclusively on low-wage workers and have not compared their wage mobility to that of other workers (whom I will call higher-wage workers, for the sake of simplicity). This is surprising, given that it is not clear “[...] whether the distinction between low-wage employment and the rest of the economy is due to the level of pay simply being lower than elsewhere or a different functioning of the labor market” (Lucifora/Salverda 2009: 272). Therefore, after investigating possible characteristics of wage-growth firms for low-wage workers, this paper also analyses whether the results are typical for low-wage workers, i.e., whether there are establishment characteristics that increase or decrease the wage growth of low-wage workers only and have no impact on the wage growth of higher-wage workers. In addition, this paper investigates whether there are establishment characteristics that influence the wage growth of higher-wage workers only.

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<sup>1</sup> See Riphahn/Schnitzlein (2011) for an overview of the literature on wage mobility in Germany and other developed countries.

To answer these research questions, this paper analyses the real wage growth of full-time employed workers between 2002 and 2007, using endogenous switching regression models and rich linked employer-employee data from Germany. The paper adds to the literature in two ways. First, it shows that being employed in a large firm or a firm with a high export share or a low proportion of fixed-term co-workers increases the wage growth of low-wage workers. Second, it demonstrates that the establishment characteristics associated with individual wage growth differ between low-wage workers and higher-wage workers. The paper is organised as follows. Chapter 2 gives a brief overview of the previous literature. Chapter 3 discusses the theoretical background. Chapter 4 describes the data. Chapters 5 and 6 present and discuss the empirical results. Chapter 7 concludes.

## 2 Literature review

Previous studies on the wage mobility of low-wage workers in Germany can be categorised roughly into a few groups, depending on their research objectives.<sup>2</sup> One group of studies provides evidence for the existence of state dependence in low wages and in unemployment (see, e.g., Uhlendorff 2006; Mosthaf/Schank/Schnabel 2009; Grün/Mahringer/Rhein 2011; Mosthaf 2011; Aretz/Gürtzgen 2012). In addition, these studies find that this state dependence has increased over time. Nevertheless, especially for low-skilled workers, low-wage employment seems to be a stepping stone to higher-wage employment.

Another group of studies shows that male, younger and higher-skilled workers have comparatively better chances of escaping low wages, i.e., of crossing the low-wage threshold and reaching higher-paid employment. In addition, the chances of escaping low wages are also higher for workers in large firms and firms with low proportions of females or of low-wage workers (see, e.g., Schank/Schnabel/Stephani 2009; Mosthaf/Schnabel/Stephani 2011; Schnitzlein/Stephani 2011). Gürtzgen/Heinze (2010) find that collective bargaining coverage and the existence of a works council in the establishment positively impact the probability of within-firm low-pay transitions in the West German manufacturing sector and service sector; however, this impact is different for women than for men.

Stephani (2012) shows that there is a significant amount of upward and downward wage mobility in the low-wage sector. The majority of low-wage workers who were able to escape low wages were still higher-paid two years later. In addition, firm heterogeneity which is not captured by firm size, industry affiliation and the composition

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<sup>2</sup> There are also a number of studies on the mobility of low-wage workers in other countries, such as those by Stewart/Swaffield (1999) and Cappellari/Jenkins (2008) for the UK, Bolvig (2005) for Denmark, Cappellari (2002, 2007) for Italy and Andersson/Holzer/Lane (2005) for the US. In addition, there are studies comparing the mobility of low-wage workers in several countries, such as those by Asplund/Sloane/Theodossiou (1998) and the European Commission (2004).

of the workforce in the firm is also important for the upward mobility of low-wage workers.

While the studies mentioned so far have analysed the wage mobility of low-wage workers exclusively, several studies have investigated various aspects of individual wage growth for all workers in Germany. For example, studies by Dustmann/Meghir (2005), Schönberg (2007) and Dustmann/Pereira (2008) measure the effects of tenure, sector-specific labour market experience, general labour market experience and job mobility on the wage growth of German workers.

Gernandt (2009) finds that university graduates, younger workers, white-collar workers and public sector employees are more likely to move up in the German wage distribution. In addition, wages are more volatile for low-wage workers and for workers moving downward in the wage distribution. Pavlopoulos et al. (2007) show that in Germany, workers in the lowest quartile of the wage distribution (categorised as low-paid workers) experience a greater amount of wage growth than workers in the highest quartile (categorised as high-paid workers). A voluntary change of employer results in wage growth for low-paid workers but not for high-paid workers.

In summary, previous studies have only investigated the impact of a few firm characteristics on the wage growth of low-wage workers. Furthermore, virtually none of these studies has analysed whether these firm characteristics also impact the wage growth of higher-wage workers. To the best of my knowledge, there are also no studies that analyse the impact of firm characteristics on the wage growth of all workers in Germany. The following section presents a theoretical discussion of possible determinants of individual wage growth.

### **3 Theoretical background and hypotheses**

According to human capital theory and job search theory, both the accumulation of human capital, via on-the-job learning and further training, and an improvement in job match quality should result in a higher individual wage (Cahuc/Zylberberg 2004, chapters 2 and 3). In addition, the theories of segmented labour markets state that the labour market can be divided roughly into a primary and a secondary segment (see, e.g., Taubman/Wachter 1986; Reich 2008). Jobs in the primary segment are well paid and offer good opportunities for further training and upward mobility, while jobs in the secondary segment are often low paid, offer unfavourable working conditions and a low degree of upward mobility (Schömann 1994). Although the German labour market is complex, it is likely that compared to higher-wage workers, low-wage workers often work in jobs that have features of a “secondary” segment. The labour market theories presented in this paragraph yield several hypotheses about the wage growth of individual workers.

According to human capital theory, it is reasonable to expect that due to a lower growth of individual productivity, a higher probability of work interruptions and a higher unemployment risk, women, foreigners, low-skilled workers and older work-



ers experience less individual wage growth than men, Germans, higher-skilled workers and younger workers. In addition, individual wages are expected to increase with labour market experience and tenure, at a decreasing rate (Topel 1991). In contrast, the theories of segmented labour markets imply that labour market experience and tenure are associated with individual wage growth only for higher-wage workers.

Concerning the employer characteristics that are of key interest in the study at hand, the literature indicates that large establishments are more likely to have an internal labour market and to provide further training. In addition, collective agreements often imply wage increases based on pre-defined tenure profiles (Gürtzgen/Heinze 2010; Siebert/Addison 1991; Gerner/Stegmaier 2009). Acemoglu/Pischke (1999) and Gerner/Stegmaier (2009) indicate that establishments with a low proportion of fixed-term workers might be more likely to offer further training to their workers because the probability that their workers will leave the establishment is smaller. However, because the internal labour market and further training may often not be accessible for low-wage workers, the establishment size, the coverage by a collective agreement and the proportion of fixed-term workers can be expected to influence the wage growth of higher-wage workers only.

Works councils in Germany are not supposed to bargain directly over wages; however, they are involved in the implementation of collective agreements and the negotiations on performance-related pay at the establishment level (Gürtzgen/Heinze 2010). In addition, works councils increase the probability of firm-provided training (Gerlach/Jirjahn 2001; Stegmaier 2012). In principle, this should lead to higher individual wage growth in firms that have a works council. However, there is evidence that works council members in Germany are significantly older than their co-workers (Behrens 2009) and that the incidence of low pay is especially high among young workers (Schnitzlein/Stephani 2011). In addition, low-wage workers are often only loosely connected to the labour market and have a high unemployment risk (de Latouwer/Marx 2005). Assuming that there is a tendency for works councils to get involved in actions that are advantageous to their own peer group, a positive effect of works councils on individual wage growth might be especially pronounced for higher-wage workers, who often are older employees and employees with longer tenure.

Workers who are employed in establishments where the state of the technology is more current might have better chances for individual wage growth, due to the opportunity to accumulate human capital that is more up to date than the human capital that workers employed in establishments using outdated technology have the opportunity to accumulate. Grün, Mahringer and Rhein (2011) note that young establishments might be characterised by a high number of low-quality jobs that provide few or no possibilities for human capital accumulation. Brixy/Kohaut/Schnabel (2007) show that newly founded firms do pay lower wages than incumbent firms in

the first years after their foundation, although this wage differential vanishes after four years.

In addition, the chances for individual wage growth might also vary according to the composition of the workforce in the firm. For example, higher-wage workers are likely to have increased wage growth due to knowledge spillover from their highly qualified co-workers. This is not necessarily the case for low-wage workers because their jobs are typically less knowledge-intensive. In addition, the jobs of low-wage workers and higher-wage workers often do not involve overlapping tasks or skills.

A high proportion of women, foreigners or low-wage workers in an establishment might be an indicator of workplace segregation or low-cost strategies in the firm, which also implies fewer possibilities for human capital accumulation and lower wage growth for low-wage workers (Bolvig 2005; Mosthaf/Schnabel/Stephani 2011). In contrast, the proportion of women, foreigners and low-wage workers in the firm is not necessarily associated with the wage growth of *higher-wage workers*. For example, think of a company that offers low-skilled services, such as a cleaning company. Because the cleaning staff often consists of women, foreigners and low-wage workers, the proportions of these workers in the establishment are quite high. Nevertheless, one may expect that the wage growth of the higher-wage workers in the company (e.g., the managerial staff) is not lower than the wage growth of comparable higher-wage workers in establishments with smaller proportions of women, foreigners and low-wage workers.

Several authors argue that due to higher job-match quality, greater informal learning and higher returns to education, individual productivity and wages should be expected to grow more rapidly in densely populated areas (see Phimister/Theodossiou/Upward 2006 for an overview). Because exporting firms are more productive and pay higher wages than firms that operate only on the domestic market (Schank/Schnabel/Wagner 2007, 2010), one may expect the export share of a firm to also be positively associated with the wage growth of individual workers.

According to search theory, the probability that a new wage offer that a worker receives either from her current employer or from another employer will exceed her current wage declines with the level of her current wage (e.g., Fitzenberger/Garloff 2007). This implies that low-wage workers are likely to have – *ceteris paribus* – higher wage growth than higher-wage workers. Accordingly, it is likely that the effect of any given explanatory variable on the individual wage growth of a worker is higher for low-wage workers than for higher-wage workers.

## 4 The data

I use the cross-sectional version of the Linked Employer-Employee Data Set LIAB of the German Institute for Employment Research (IAB) for the year 2002. The LIAB is compiled by matching the representative IAB Establishment Panel Survey with the personal information and employment histories of the employees of the surveyed

establishment. The employee data stem from the labour administration and social security data processing of the Federal Employment Agency. By combining these data sources, the LIAB provides a rich and unique data set for analysing both the demand side and the supply side of the German labour market. For more information on the LIAB, see Alda/Bender/Gartner (2005) and Jacobebbinghaus/Seth (2010). To improve the quality of the linkage between the survey data and the administrative data, I adopt a procedure suggested by Jacobebbinghaus (2008: 53).

The data set at hand provides individual, job and employer information, as well as the daily wage of a worker on 30 June 2002, together with her daily wage and employment status five years later (i.e., on 30 June 2007). This data set enables me to analyse the wage growth of low-wage workers and higher-wage workers between 2002 and 2007. Because the data do not include precise information on the daily working time, accurate categorisation of part-time workers as low-wage workers or higher-wage workers is not possible. Therefore, I limit my analysis to full-time workers. Based on the literature, I classify a full-time worker as being low-paid (higher-paid) if she earns less (more) than the commonly accepted low-wage threshold of 2/3 of the median daily gross wage of all full-time employees. Because the LIAB is representative only at the establishment level, I compute the low-wage threshold separately for West Germany and East Germany, using a representative 2% random sample from the Integrated Employment Biographies (IEB) of the IAB (see Jacobebbinghaus/Seth 2007 and Dorner et al. 2010 for information on these data).

Individual wages in the LIAB are censored at the top due to legal requirements. The nominal value of the censoring threshold is set separately every year for West Germany and East Germany by the German government. To avoid biased results and time inconsistencies due to time-varying proportions of censored observations, I apply 'consistent top-coding', as suggested by Burkhauser/Feng/Jenkins (2009) and by Riphahn/Schnitzlein (2011). First, I use the representative wage distribution computed from the IEB to determine the individual rank position in the German wage distribution in a given year for every full-time worker in the LIAB. I then delete those worker observations from the LIAB that correspond to wages among the top 15% (10%) in West (East) Germany in each year's wage distribution.

Because it stems from administrative sources, the information on individual workers in the LIAB can be regarded as highly reliable. Nevertheless, I exclude full-time workers who earn implausibly low hourly wages of less than 4 € (3.5 €) in West (East) Germany in 2006 prices.<sup>3</sup> Because this paper focuses on the core groups of the labour market, I further limit the sample to workers who are liable to social security and I exclude workers younger than 20 and older than 59 years in 2002, as

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<sup>3</sup> This is equivalent to a monthly wage of about 645 € in West Germany (4 € × 37.5 h × 4.3 weeks) and 602 € in East Germany (3.5 € × 40 h × 4.3 weeks) and is affecting about 1% of the full-time employed workers in the LIAB. I compute real wages by using the consumer price index of the German Federal Statistical Office, with 2006 = 100.

well as trainees, working students and retired individuals. After these modifications, my sample covers 9,591 low-wage workers and 322,521 higher-wage workers. Table 1 presents summary statistics of the data set.

(Table 1 around here)

## 5 Descriptive evidence

Table 2 presents the real wage levels and real wage growth of low-wage workers and higher-wage workers in the LIAB, disaggregated by selected individual and establishment characteristics.<sup>4</sup> The first column shows that in 2002, the low-wage workers in the data set had a real daily wage of approximately 45 € on average and that they experienced a real wage growth of approximately 11% between 2002 and 2007. In addition, the figures suggest that low-wage workers have a higher relative real wage growth in certain establishments, e.g., in establishments that are covered by a collective agreement or that have a works council, establishments that use modern technology, establishments that export and establishments that are located in highly urbanised areas.

(Table 2 around here)

The figures in the second column of table 2 show that higher-wage workers experienced a relative wage growth of approximately 4% on average. They often have higher wage growth in the same types of establishments in which low-wage workers have higher wage growth. However, low-wage workers experience a large and positive amount of wage growth when changing employers, while higher-wage workers experience a slightly negative amount of wage growth in this case. Based on these descriptive results, the next chapter provides an econometric analysis to address the two research questions posed by this paper.

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<sup>4</sup> Note that due to the disproportionately stratified sampling procedure of the IAB Establishment Panel Survey, the proportion of low-wage workers in this data set is lower than the proportion of low-wage workers in the representative IEB sample. However, the weighted figure for the proportion of low-wage workers among all full-time workers in the LIAB was about 17.6% in 2002, while the proportion of low-wage workers calculated from the representative IEB was 17.9% in 2002. In addition, the weighted average of the real daily wages of the full-time workers in the LIAB in 2002 was about 43.9 € for low-wage workers and 88.4 € for higher-wage workers. These weighted figures are very close to the average real daily wages computed from the representative IEB: in that data set, the average of the real daily wages in 2002 was 45.0 € for low-wage workers and 89.2 € for higher-wage workers. Therefore, I am confident that this LIAB sample can be used for a representative analysis of the German labour force: after correcting for the disproportionately stratified sampling procedure of the IAB Establishment Panel Survey by including stratification variables (establishment size, industry sector and federal state) in the regression analyses, one can expect the results to deliver an unbiased picture of the real wage growth of low-wage workers and higher-wage workers in Germany (see Winship/Radbill 1994 for the validity of this correction).

## 6 Econometric analysis

### 6.1 The model

In analysing the determinants of the individual real wage growth of low-wage workers and higher-wage workers, one needs to take into account that the selection into the state of being a low-wage worker or a higher-wage worker may not be exogenous. Due to this initial conditions problem, the estimation of two separate linear wage growth regressions (one for low-wage workers and one for higher-wage workers) may lead to biased estimates. To take into account this potential endogeneity, I apply an endogenous switching regression model (see Maddala 1983: 223-224, and Lokshin/Sajaia 2004 for a general exposition of this model).

The model can be described as follows: let  $s_i$  be a dummy variable that takes the value 0 if a worker who was employed full-time in 2002 and 2007 was a higher-wage worker in 2002 and 1 if the worker was a low-wage worker in 2002:

$$P(s_i = 0) = P(s_i^* = g(z_i\gamma^* + \varepsilon_{i0}) > \kappa) = 1 - \Phi_0(z_i\gamma) \quad (\text{for a higher-wage worker}), \quad (1)$$

$$P(s_i = 1) = P(s_i^* = g(z_i\gamma^* + \varepsilon_{i0}) < \kappa) = \Phi_0(z_i\gamma) \quad (\text{for a low-wage worker}); \quad (2)$$

$s_i^*$  denotes the underlying latent variable and  $\kappa$  denotes the low-wage threshold.  $\Phi_0$  is the cumulative normal distribution, and  $z_i$  is a vector of variables that influence the selection of a worker into the state of being a higher-wage worker or a low-wage worker. This yields a probit selection equation.

The differences of the logarithms of the real daily wages of higher-wage workers and low-wage workers between 2007 and 2002 are given by

$$\Delta \ln w_{i1} = x_i \beta_1 + \varepsilon_{i1} \quad (\text{for a higher-wage worker}) \quad \text{and} \quad (3)$$

$$\Delta \ln w_{i2} = x_i \beta_2 + \varepsilon_{i2} \quad (\text{for a low-wage worker}), \quad (4)$$

where  $x_i$  is a vector of variables that determine the real wage growth of a worker. I assume that  $\varepsilon_{i0}$ ,  $\varepsilon_{i1}$ , and  $\varepsilon_{i2}$  follow a trivariate normal distribution with mean vector zero and a covariance matrix

$$\Omega = \begin{bmatrix} \sigma_0^2 & \sigma_{0,1} & \sigma_{0,2} \\ \sigma_{0,1} & \sigma_1^2 & \cdot \\ \sigma_{0,2} & \cdot & \sigma_2^2 \end{bmatrix}, \quad (5)$$

where  $\sigma_0^2$  is the variance of the error term in the selection equation,  $\sigma_1^2$  and  $\sigma_2^2$  are the variances of the error terms in the wage growth equations (3) and (4),  $\sigma_{0,1}$  is the covariance between  $\varepsilon_{i1}$  and  $\varepsilon_{i0}$ , and  $\sigma_{0,2}$  is the covariance between  $\varepsilon_{i2}$  and  $\varepsilon_{i0}$ . Because  $\Delta \ln w_{i1}$  and  $\Delta \ln w_{i2}$  are never observed simultaneously for a given worker, the covariance between  $\varepsilon_{i1}$  and  $\varepsilon_{i2}$  is not defined. Accordingly, the differences of the logarithms of the real daily wages of workers between 2007 and 2002 are

$$E(\Delta \ln w_{i1} | s_i = 0) = x_i \beta_1 - \sigma_1 \rho_1 \frac{\phi_1(z_i \gamma^* / \sigma_{\varepsilon 0})}{1 - \Phi_0(z_i \gamma^* / \sigma_{\varepsilon 0})} \quad (\text{for a higher-wage worker}) \quad \text{and} \quad (6)$$

$$E(\Delta \ln w_{i2} | s_i = 1) = x_i \beta_2 + \sigma_2 \rho_2 \frac{\phi_1(z_i \gamma^* / \sigma_{\varepsilon 0})}{\Phi_0(z_i \gamma^* / \sigma_{\varepsilon 0})} \quad (\text{for a low-wage worker}), \quad (7)$$

where  $\rho_1$  is the correlation coefficient between  $\varepsilon_{i0}$  and  $\varepsilon_{i1}$ ,  $\rho_2$  is the correlation coefficient between  $\varepsilon_{i0}$  and  $\varepsilon_{i2}$ ,  $\phi_1$  is the standard normal density function, and  $\frac{\phi_1(z_i \gamma^* / \sigma_{\varepsilon 0})}{1 - \Phi_0(z_i \gamma^* / \sigma_{\varepsilon 0})}$  and  $\frac{\phi_1(z_i \gamma^* / \sigma_{\varepsilon 0})}{\Phi_0(z_i \gamma^* / \sigma_{\varepsilon 0})}$  are the Inverse Mills Ratios for a higher-wage worker and a low-wage worker, respectively.

Based on the theoretical considerations presented in chapter 3,  $z_i$  and  $x_i$  contain a number of individual, job and establishment characteristics. Both  $z_i$  and  $x_i$  contain dummy variables describing the gender, age, level of education, citizenship and occupational group of a worker, as well as variables describing establishment size, the industry affiliation, the proportion of highly qualified workers in the establishment, the proportion of women, the proportion of foreigners, the proportion of low-wage workers and the median age of the workforce. In addition, variables are also included in order to analyse the impact of a number of potential establishment-level determinants of individual wage growth that have not been investigated in previous studies. These are the coverage by a sector-level collective agreement or a firm-level collective agreement, the existence of a works council in the establishment, the state of the technology that is used in the establishment, the establishment age, the degree of urbanisation at the location of the establishment (calculated according to the BIK classification; see Arbeitsgruppe Regionale Standards 2005: 54-60), the export share of the establishment, the proportion of fixed-term workers and the German federal state. All explanatory variables mentioned so far were measured in the starting year 2002 and are held fixed during the estimations.

In addition, there are some variables that are included in  $x_i$  only. These are four variables describing a worker's individual labour market experience<sup>5</sup> and tenure between 1993 and 2007, in linear and squared form, and one dummy control variable indicating whether a worker changed establishments between 2002 and 2007. As an exclusion restriction,  $z_i$  contains a dummy variable that indicates whether a worker was low-wage employed in 1998. I expect the latter variable to have a positive impact on whether the worker was a low-wage worker in 2002. Due to the temporal distance of four years to the starting period, I do not expect this variable to influence

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<sup>5</sup> Due to lack of data, empirical studies often use the age of an individual together with her level of education as a proxy for her amount of labour market experience. In doing so, these studies might report biased results since they do not take into account possible voluntary or involuntary work interruptions of individuals. Such work interruptions can occur, e.g., due to unemployment periods, childcare or elderly care needs, or sabbaticals. Therefore, the age of an individual together with her level of education is not necessarily a good proxy for her amount of labour market experience. Due to the comparatively high unemployment risk of low-wage workers, this is especially relevant when analysing the wage growth of low-wage workers and higher-wage workers.

the amount of real wage growth of low-wage workers and higher-wage workers between 2002 and 2007.<sup>6</sup> The model is estimated in Stata, using the maximum likelihood estimator for the endogenous switching regression model by Lokshin/Sajaia (2004).

## 6.2 Estimation results

Table 3 presents the average marginal effects on the differences between the logarithms of the real daily wages of low-wage workers and higher-wage workers between 2002 and 2007. The discussion of the estimation results is split into two parts, reflecting the two research objectives of this paper. First, I aim to identify further characteristics of firms that provide higher wage growth for low-wage workers. Second, I investigate whether these results are typical for low-wage workers or not, i.e., whether there are firm-level determinants that influence the wage growth of low-wage workers but not the wage growth of higher-wage workers and vice versa.

(Table 3 around here)

Consistent with the results of previous studies, the results in the left column of table 3 show that the wage growth of low-wage workers is positively associated with establishment size and negatively associated with the proportion of women and low-paid workers in the establishment. Compared to the reference group of low-wage workers in small establishments with up to 19 employees, low-wage workers in large establishments with more than 499 employees experience wage growth that is more than 5% higher. A proportion of low-paid workers in the establishment that is higher by 10% is associated with a lower wage growth of approximately 1%.

Turning to the establishment characteristics that have not been investigated in previous studies, the results show that low-wage workers who are employed in establishments that are covered by a sector-level collective agreement or in establishments that have a works council have a real wage growth that is approximately 2% higher; however, these effects are only significant at the 10%-level. Furthermore, an export share that is higher by 10% is associated with a higher individual wage growth for low-wage workers of approximately 1%. Obviously, the fact that exporting firms are usually more productive and pay better than non-exporting firms also translates into higher upward wage mobility for their low-paid employees. Compared to workers employed in less densely urbanised areas, workers in highly urbanised areas have a higher wage growth by approximately 2%. In contrast, certain potential determinants such as the state of technology or the establishment age are not found to influence the wage growth of low-wage workers.

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<sup>6</sup> Other studies on the wage mobility of low-wage workers, such as the one by Stewart/Swaffield (1999), use socio-economic information about the parents as exclusion restrictions. However, such information is not available in my data set.

To control for differences between the employment trajectories of women and men that are not captured by the gender dummy variable integrated in the previous analysis, the results of separate estimations for low-paid women and low-paid men are presented in column 1 and column 3 of table 4. The results of these separate estimations qualitatively confirm several of the results from the previous analysis. For example, this is the case for the effects of the proportion of low-paid workers, the proportion of women and the export share. However, the effect of the coverage by a sector-level agreement is statistically significant only for low-paid women, while the effect of a works council is significant only for low-paid men. In addition, the proportion of fixed-term workers is negatively associated with the wage growth of low-paid women, while the proportion of highly qualified co-workers is positively associated with the wage growth of low-paid men.

(Table 4 around here)

Compared to the reference group of low-paid women in small establishments with up to 19 employees, low-paid women in medium-sized establishments with 20-499 employees have a significantly lower amount of individual wage growth. In contrast, no significant difference between the wage growth of the reference group and the group of low-paid women in large establishments with more than 499 employees can be found. This suggests that small establishments and large establishments do not differ in the extent of upward wage mobility that they provide for low-paid women.

Although quite a few years have passed since German reunification, pronounced differences between West Germany and East Germany still exist, with respect to labour market performance and the relevance of industrial relations, for example (Görzig/Gornig/Werwatz 2004; Jung/Schnabel 2011). To see whether these differences might influence the results, I further disaggregate the sample into West Germany and East Germany. Most of the results of the previous models are qualitatively confirmed after this disaggregation (see columns 1, 3, 5 and 7 of table 5). However, the effects of the variables describing industrial relations are not statistically significant at conventional levels here. In addition, only low-paid women in West Germany have a lower wage growth in medium-sized establishments.

(Table 5 around here)

In summary, after controlling for a number of potential determinants of individual wage growth, a high export share seems to be a characteristic of wage-growth firms for low-wage workers. In contrast, a high proportion of fixed-term co-workers seems to be a characteristic of firms that provide lower wage growth for female low-wage workers. In addition, there is also weak evidence that the state of industrial relations and the degree of urbanisation are positively associated with the wage growth of low-wage workers. However, the latter results are not robust to splitting of the sample by gender and by West Germany versus East Germany. To see whether the



results that have been presented so far are typical for low-wage workers or whether they apply to higher-wage workers as well, I now compare the results for low-wage workers with the results for higher-wage workers that are also presented in tables 3 to 5.

In comparing the results for low-wage workers and higher-wage workers in column 1 and column 2 of table 3, one can see that certain firm variables affect the wage growth of both low-wage workers and higher-wage workers: just as for low-wage workers, for higher-wage workers, the coverage by a sector-level collective agreement and the existence of a works council in the establishment increase individual wage growth, while the proportion of low-paid co-workers decreases individual wage growth. The latter result shows that low-cost strategies of employers that are often characterised by employing a high proportion of low-wage workers dampen the wage growth of all of their employees. While for low-wage workers, changing establishments is associated with an individual wage growth that is approximately 17% *higher*, for higher-wage workers, changing establishments is associated with an individual wage growth that is approximately 4% *lower*. Of course, these results must be interpreted with caution, due to the possible endogeneity of workers changing employers.<sup>7</sup>

In contrast, there are several establishment characteristics that are associated with higher wage growth for low-wage workers but not for higher-wage workers. These are the establishment size, the export share and the degree of urbanisation at the location of the establishment. The reason for this might be that firms provide higher-wage workers with career prospects and further training irrespective of their size, exporting activity or geographical location.

In addition, certain establishment characteristics, such as the state of the technology used in the establishment and the establishment age, increase the wage growth of higher-wage workers only. Higher-wage workers who are employed in an establishment that is using modern technology instead of outdated technology have an individual wage growth that is approximately 2% higher, while higher-wage workers in incumbent establishments that are older than four years have an individual wage growth that is approximately 3% higher. The fact that the effects of these variables are not relevant for low-wage workers suggests a certain degree of segmentation of the German labour market.

Most of the results of this aggregate analysis are qualitatively confirmed in separate analyses by gender (see table 4) and in separate analyses by gender and by West

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<sup>7</sup> Note that only 7% of the low-wage workers and 4% of the higher-wage workers in the LIAB changed establishments between 2002 and 2007. Therefore, holding the establishment characteristics fixed in the year 2002 and at the same time controlling for possible establishment changes of workers ensures that the estimation results for the establishment variables are not confounded by variations of the establishment characteristics between 2002 and 2007.

Germany versus East Germany (see table 5).<sup>8</sup> Table 6 provides an overview of the most interesting results of the separate analyses by gender, while tables 7 and 8 in the Appendix give an overview of the most interesting results of the aggregated analysis and of the separate analyses by gender and by West Germany versus East Germany. Overall, the results summarized in this section suggest that firms that provide higher wage growth for low-wage workers differ from firms that provide higher wage growth for higher-wage workers in certain respects. This indicates that there indeed are *typical* wage growth firms for low-wage workers.

**Table 6**  
**Summary of selected results from table 4**

Average marginal effects of selected establishment characteristics on the real wage growth of low-wage workers and higher-wage workers	Low-wage workers		Higher-wage workers	
	Women	Men	Women	Men
Coverage by a sector-level collective agreement (1=yes)	(+)	n.s.	+	(+)
Existence of a works council (1=yes)	n.s.	+	(+)	+
Proportion of low-paid workers	-	-	-	-
Establishment size	- / n.s.	+	n.s.	n.s.
Proportion of women	-	-	n.s.	n.s.
Export share	+	+	n.s.	n.s.
Highly urbanised area (1=yes)	n.s.	n.s.	n.s.	n.s.
Modern technology (1=yes)	n.s.	n.s.	+	+
Proportion of highly qualified workers	n.s.	+	+	+
Establishment older than 4 years (1=yes)	n.s.	n.s.	+	+
Proportion of fixed-term workers	-	n.s.	n.s.	n.s.

Note: own calculations based on LIAB. “+/-” denotes a positive/negative relationship that is statistically significant at least at the 5%-level; brackets denote a relationship that is significant at the 10%-level only; n.s. denotes statistical insignificance.

<sup>8</sup> Since I analyse the wage growth of employed individuals between two points in time, I need to restrict the sample to workers who had positive earnings both in the starting year and in the ending year; this procedure is standard in the analysis of wage growth (see, e.g., Riphahn/Schnitzlein 2011). However, compared to higher-wage workers, low-wage workers have a higher risk of becoming unemployed and therefore dropping out of the sample. To determine whether this risk biases the results, I estimate two separate Heckman selection models for the wage growth of low-wage workers and higher-wage workers. The selection equation of the model for the wage growth of low-wage workers (higher-wage workers) also incorporates full-time low-wage workers (higher-wage workers) from 2002 who were no longer employed full-time in 2007. By doing so, I control for a possible bias due to differences between the unemployment risk of low-wage workers and that of higher-wage workers. I find that most results are qualitatively robust to non-random selection of full-time workers from 2002 into the group of full-time workers in 2007. However, for low-paid women, the effect of the proportion of fixed-term co-workers, and for higher-paid men, the effect of the share of low-paid co-workers, exhibit p-values of 11.5% and 18.3%, respectively, and are therefore not statistically significant at conventional levels.

## 7 Conclusions

Using the German Linked Employer-Employee Data Set of the IAB (LIAB), this paper contributes to the existing body of knowledge on the wage mobility of low-wage workers and higher-wage workers in several ways. First, I investigate the impact of a number of potential establishment-level determinants on the wage growth of low-wage workers that have not been analysed before. I find that large firms and firms with high export shares or low proportions of fixed-term workers are typical wage-growth firms for low-wage workers, while several other potential establishment-level determinants cannot explain their wage growth.

Second, I find that the wage growth of all employees in a firm is dampened by a high proportion of low-paid co-workers. While the impact of this variable on the wage growth of low-wage workers has been detected in previous studies, its impact on the wage growth of higher-wage workers was unknown to date. Obviously, there are employers that pursue a “low-road” or a low-cost strategy that dampens the upward wage mobility of all of their employees.

Third, certain establishments, such as establishments that use modern technology or incumbent establishments that are older than four years provide higher wage growth only for higher-wage workers, not for low-wage workers. This result points to a certain degree of segmentation of the German labour market.

In summary, the evidence presented in this paper suggests that it may be necessary to investigate firm heterogeneity in more detail to identify further characteristics of typical wage-growth firms for low-wage workers. For example, there might be specific personnel policies that help low-wage workers to move up that are not captured by the (rather generic) establishment variables that are available in large-scale establishment surveys such as the one used in this study. As suggested by previous studies (e.g., Lane 2009; Stephani 2012), case studies might be helpful in this context.

In addition, this paper shows that one cannot apply the existing theoretical and empirical knowledge about the factors that influence the wage growth of individual workers to the wage growth of individual *low-wage* workers. On the one hand, this insight may be helpful to policy makers because it makes clear that any policy measure aimed at increasing the wage growth of low-wage workers needs to be specifically tailored to them. On the other hand, this insight suggests that the current understanding of the wage mobility of individual workers might be extended considerably by analysing this mobility at different quantiles of the wage distribution rather than only at the mean. In light of important labour market trends, such as polarisation and rising wage inequality (see, e.g., Antonczyk/DeLeire/Fitzenberger 2010), this may be a promising area for future research.

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**Table 1**  
**Summary statistics of variables in the sample**

	Low-wage workers			Higher-wage workers		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Individual characteristics						
Real daily wage in 2002	9,591	44.97	9.38	322,521	95.50	19.96
Real wage growth 2002-2007	9,591	0.11	0.38	322,521	0.03	0.13
Woman (1=yes)	9,591	0.71	0.46	322,521	0.25	0.43
Foreigner (1=yes)	9,591	0.07	0.25	322,521	0.08	0.27
20-24 years (1=yes)	9,591	0.10	0.31	322,521	0.05	0.22
25-34 years (1=yes)	9,591	0.21	0.41	322,521	0.24	0.43
35-54 years (1=yes)	9,591	0.65	0.48	322,521	0.69	0.46
55-59 years (1=yes)	9,591	0.03	0.18	322,521	0.03	0.16
Secondary school certificate without voc. training (1=yes)	9,591	0.22	0.41	322,521	0.15	0.36
Secondary school certificate with voc. training (1=yes)	9,591	0.63	0.48	322,521	0.75	0.44
High school certificate (1=yes)	9,591	0.02	0.16	322,521	0.04	0.19
University degree (1=yes)	9,591	0.01	0.10	322,521	0.04	0.19
Education unknown (1=yes)	9,591	0.12	0.32	322,521	0.03	0.17
Agricultural occ. (1=yes)	9,591	0.04	0.20	322,521	0.01	0.09
Unskilled manual occ. (1=yes)	9,591	0.33	0.47	322,521	0.33	0.47
Skilled manual occ. (1=yes)	9,591	0.11	0.31	322,521	0.23	0.42
Unskilled comm. and administr. occ. (1=yes)	9,591	0.09	0.28	322,521	0.03	0.16
Skilled comm. and administr. occ. (1=yes)	9,591	0.15	0.36	322,521	0.14	0.35
Unskilled services (1=yes)	9,591	0.16	0.37	322,521	0.10	0.30
Skilled services (1=yes)	9,591	0.05	0.22	322,521	0.03	0.17
Semiprofessions (1=yes)	9,591	0.03	0.18	322,521	0.05	0.23
Technicians/engineers/professions/ managers (1=yes)	9,591	0.04	0.19	322,521	0.07	0.26
Tenure 1993-2007	9,591	9.52	4.18	322,521	11.98	3.58
Tenure 1993-2007 squared	9,591	108.18	74.55	322,521	156.35	72.15
Experience 1993-2007	9,591	12.00	2.86	322,521	13.92	1.81
Experience 1993-2007 squared	9,591	152.20	61.98	322,521	196.93	42.68
Change of estab. 2002-2007 (1=yes)	9,591	0.07	0.25	322,521	0.04	0.19
Low-paid in 1998 (1=yes)	9,591	0.14	0.35	322,521	0.003	0.06
Establishment characteristics						
1-19 employees (1=yes)	9,591	0.13	0.34	322,521	0.01	0.12
20-99 employees (1=yes)	9,591	0.31	0.46	322,521	0.08	0.27
100-499 employees (1=yes)	9,591	0.40	0.49	322,521	0.28	0.45
More than 499 employees (1=yes)	9,591	0.17	0.37	322,521	0.63	0.48
Proportion of highly-qualified workers	9,591	4.71	8.00	322,521	10.08	10.11
Proportion of women	9,591	50.76	25.47	322,521	28.72	24.06
Proportion of foreigners	9,591	6.00	10.47	322,521	7.13	8.34
Median age of the workforce	9,591	39.80	5.06	322,521	40.56	3.27
Proportion of low-paid workers	9,591	38.32	29.47	322,521	1.89	6.51
Sector-level collective agreement (1=yes)	9,591	0.39	0.49	322,521	0.69	0.46



**Table 1 (cont.)**  
**Summary statistics of variables in the sample**

	Low-wage workers			Higher-wage workers		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Firm-level collective agreement (1=yes)	9,591	0.10	0.30	322,521	0.20	0.40
Works council (1=yes)	9,591	0.45	0.50	322,521	0.92	0.28
Modern technology in use (1=yes)	9,591	0.74	0.44	322,521	0.68	0.46
Proportion of fixed-term workers	9,591	6.29	14.14	322,521	4.30	7.68
Estab. older than 4 years (1=yes)	9,591	0.95	0.21	322,521	0.97	0.18
Export share	9,591	11.75	19.80	322,521	28.93	29.47
Highly urbanised area (1=yes)	9,591	0.37	0.48	322,521	0.60	0.49
East Germany (1=yes)	9,591	0.39	0.49	322,521	0.25	0.43

Note: own calculations based on LIAB.

**Table 2**  
**Real daily wages and wage growth of the low-wage workers and higher-wage workers in the sample between 2002 and 2007, disaggregated by selected individual and establishment characteristics**

	Low-wage workers		Higher-wage workers	
	Mean wage in 2002	$\Delta$ wage (2002-2007)	Mean wage in 2002	$\Delta$ wage (2002-2007)
Individual characteristics				
Women	44.4 €	8.2%	88.4 €	2.6%
Men	46.3 €	17.3%	97.8 €	3.8%
Germans	44.6 €	10.7%	95.3 €	3.4%
Foreigners	50.4 €	12.7%	98.2 €	4.0%
No change of establishment	45.0 €	9.0%	95.6 €	3.6%
Change of establishment	45.0 €	36.8%	92.5 €	-0.4%
Establishment characteristics				
1-19 employees	41.6 €	3.7%	76.3 €	-1.3%
20-99 employees	43.3 €	5.2%	81.6 €	0.6%
100-499 employees	46.6 €	8.8%	88.4 €	2.5%
More than 499 employees	47.0 €	31.7%	100.8 €	4.4%
No collective agreement	43.3 €	6.1%	80.6 €	1.6%
Sector-level collective agreement	47.0 €	16.3%	96.2 €	3.9%
Firm-level collective agreement	45.7 €	13.8%	101.0 €	3.0%
No works council	43.3 €	4.9%	78.7 €	-0.1%
Works council	47.1 €	18.3%	97.0 €	3.8%
No modern technology in use	44.5 €	8.4%	98.9 €	1.4%
Modern technology in use	45.1 €	11.7%	93.9 €	4.4%
Establishment age 0-4 years	44.4 €	10.4%	90.8 €	0.6%
Establishment older than 4 years	45.0 €	10.9%	95.7 €	3.6%
No exporter	43.3 €	6.5%	88.6 €	1.5%
Exporter	47.1 €	16.5%	98.5 €	4.4%
Not highly urbanised area	44.9 €	8.8%	89.4 €	3.9%
Highly urbanised area	45.1 €	14.3%	99.5 €	3.2%
West Germany	49.3 €	13.6%	101.0 €	3.8%
East Germany	38.2 €	6.6%	78.9 €	2.5%
Overall	45.0 €	11.1%	95.5 €	3.5%

Note: own calculations based on LIAB.

**Table 3**  
**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression model, conditional average marginal effects**

	Low-wage workers	Higher-wage workers
	(1)	(2)
Individual characteristics		
Woman (1=yes)	-0.045*** (0.009)	-0.011*** (0.002)
Foreigner (1=yes)	0.005 (0.013)	-0.001 (0.001)
25-34 years (1=yes)	-0.032*** (0.011)	-0.048*** (0.004)
35-54 years (1=yes)	-0.083*** (0.010)	-0.080*** (0.005)
55-59 years (1=yes)	-0.119*** (0.015)	-0.096*** (0.005)
Secondary school certificate without voc. training (1=yes)	-0.010 (0.010)	0.003 (0.002)
High school certificate (1=yes)	0.104*** (0.026)	0.018*** (0.003)
University degree (1=yes)	0.051 (0.033)	-0.007** (0.003)
Education unknown (1=yes)	-0.015 (0.012)	-0.007 (0.006)
Agricultural occ. (1=yes)	3.7e-04 (0.020)	-0.008 (0.006)
Skilled manual occ. (1=yes)	-0.020 (0.017)	0.004 (0.003)
Unskilled comm. and administr. occ.(1=yes)	-0.016 (0.014)	0.013** (0.005)
Skilled comm. and administr. occ. (1=yes)	0.014 (0.013)	0.029*** (0.003)
Unskilled services (1=yes)	-0.051*** (0.013)	-0.004 (0.003)
Skilled services (1=yes)	-0.021 (0.022)	0.012* (0.007)
Semiprofessions (1=yes)	0.031 (0.028)	0.015*** (0.004)
Technicians/engineers/professions/managers (1=yes)	0.039* (0.022)	0.021*** (0.003)
Tenure 1993-2007	0.009** (0.004)	0.020*** (0.004)
Tenure 1993-2007 squared	-4.5e-04** (2.0e-04)	-0.001*** (1.8e-04)
Experience 1993-2007	0.014 (0.011)	-0.010** (0.004)
Experience 1993-2007 squared	-0.001 (0.001)	4.4e-04** (1.9e-04)
Change of establishment 2002-2007 (1=yes)	0.173*** (0.022)	-0.036*** (0.009)
Establishment characteristics		
20-99 employees (1=yes)	-0.010 (0.009)	1.0e-04 (0.004)
100-499 employees (1=yes)	-0.017 (0.012)	0.005 (0.006)
More than 499 employees (1=yes)	0.054** (0.022)	0.009 (0.007)
Proportion of highly qualified workers	0.001 (0.001)	0.001*** (2.5e-04)

**Table 3 (cont.)****Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression model, conditional average marginal effects**

	Low-wage workers	Higher-wage workers
	(1)	(2)
Proportion of women	-0.001*** (2.1e-04)	-1.0e-04 (1.3e-04)
Proportion of foreigners	-1.9e-05 (0.001)	-0.001 (3.8e-04)
Median age of the workforce	-0.002** (0.001)	4.8e-04 (0.001)
Proportion of low-paid workers	-0.001*** (1.9e-04)	-0.001*** (1.7e-04)
Sector-level collective agreement (1=yes)	0.020* (0.011)	0.012** (0.005)
Firm-level collective agreement (1=yes)	0.024 (0.017)	0.008 (0.009)
Works council (1=yes)	0.021* (0.012)	0.016*** (0.005)
Modern technology in use (1=yes)	0.007 (0.009)	0.019*** (0.006)
Proportion of fixed-term workers	-3.8e-04 (3.4e-04)	2.7e-05 (1.9e-04)
Establishment older than 4 years (1=yes)	-0.012 (0.014)	0.027** (0.010)
Export share	0.001*** (3.6e-04)	1.3e-04 (1.2e-04)
Highly urbanised area (1=yes)	0.021** (0.010)	-0.007 (0.005)
Joint significance of dummy variable groups	Age***, level of education***, occupational group***, estab. size***, industry***, fed. state n.s.	Age***, level of education***, occupational group***, estab. size n.s., industry***, fed. state***
Observations	9,591	322,521
Selection equation		
Low-paid in 1998 (1=yes), effect on the probability of being low-paid in 2002		0.035*** (0.002)
Correlation coefficient $\rho_1$	-	-0.006
Correlation coefficient $\rho_2$	0.194***	-
Significance of the model	$\chi^2(72) = 3444.10^{***}$	
Wald Test for the independence of all three equations	$\chi^2(2) = 60.82^{***}$	
Total observations	332,112	

Notes: own calculations based on LIAB. Standard errors in parentheses (clustered at establishment level). 20 industry dummies and 16 federal state dummies suppressed in the table. Reference category of the dummy variable groups: age 20-24; secondary school certificate with vocational training; unskilled manual occupations; 1-19 employees; not covered by a collective agreement. Significance levels: \* p<0.1; \*\* p<0.05; \*\*\* p<0.01; n.s. denotes statistical insignificance.

**Table 4**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender, conditional average marginal effects**

	Women		Men	
	Low-wage workers (1)	Higher-wage workers (2)	Low-wage workers (3)	Higher-wage workers (4)
Individual characteristics				
Foreigner (1=yes)	0.006 (0.014)	-0.005* (0.003)	0.001 (0.023)	-1.4e-04 (0.001)
25-34 years (1=yes)	-0.002 (0.013)	-0.066*** (0.007)	-0.061*** (0.017)	-0.042*** (0.004)
35-54 years (1=yes)	-0.053*** (0.012)	-0.093*** (0.007)	-0.108*** (0.016)	-0.074*** (0.005)
55-59 years (1=yes)	-0.091*** (0.016)	-0.105*** (0.007)	-0.142*** (0.027)	-0.091*** (0.005)
Secondary school certificate without voc. training (1=yes)	0.002 (0.012)	0.003 (0.003)	-0.031** (0.015)	0.003 (0.002)
High school certificate (1=yes)	0.075*** (0.024)	0.015*** (0.003)	0.143** (0.065)	0.019*** (0.003)
University degree (1=yes)	0.094*** (0.036)	-0.005 (0.003)	-0.100 (0.092)	-0.007* (0.004)
Education unknown (1=yes)	-0.007 (0.012)	-0.001 (0.006)	-0.009 (0.018)	-0.009 (0.007)
Agricultural occ. (1=yes)	0.005 (0.025)	-0.019* (0.010)	0.010 (0.027)	-0.004 (0.005)
Skilled manual occ. (1=yes)	-0.025 (0.019)	-0.005 (0.005)	-0.023 (0.021)	0.005* (0.003)
Unskilled comm. and administr. occ. (1=yes)	-0.024 (0.015)	0.016** (0.007)	-0.015 (0.028)	-0.001 (0.007)
Skilled comm. and administr. occ. (1=yes)	0.011 (0.013)	0.026*** (0.006)	0.073** (0.031)	0.030*** (0.003)
Unskilled services (1=yes)	-0.048*** (0.015)	0.002 (0.005)	-0.050*** (0.018)	-0.005** (0.003)
Skilled services (1=yes)	-0.014 (0.024)	0.005 (0.006)	-0.059 (0.038)	0.015 (0.010)
Semiprofessions (1=yes)	0.026 (0.027)	0.011* (0.006)	0.057 (0.126)	0.014*** (0.005)
Technicians/engineers/professions/managers (1=yes)	0.019 (0.023)	0.017*** (0.006)	0.100*** (0.038)	0.021*** (0.003)
Tenure 1993-2007	0.003 (0.005)	0.018*** (0.002)	0.014*** (0.004)	0.020*** (0.004)
Tenure 1993-2007 squared	-1.6e-04 (2.6e-04)	-0.001*** (1.1e-04)	-0.001** (2.7e-04)	-0.001*** (2.1e-04)
Experience 1993-2007	0.039** (0.017)	0.006 (0.009)	-0.021* (0.012)	-0.017*** (0.005)
Experience 1993-2007 squared	-0.002** (0.001)	-2.6e-04 (3.5.e-04)	0.001* (0.001)	0.001*** (7.1e-04)
Change of establishment 2002-2007 (1=yes)	0.137*** (0.030)	-0.015 (0.012)	0.175*** (0.026)	-0.046*** (0.010)
Establishment characteristics				
20-99 employees (1=yes)	-0.023** (0.011)	-0.001 (0.008)	0.027 (0.017)	0.002 (0.005)
100-499 employees (1=yes)	-0.032** (0.014)	0.005 (0.008)	0.022 (0.020)	0.005 (0.006)
More than 499 employees (1=yes)	0.021 (0.021)	0.010 (0.009)	0.163*** (0.043)	0.009 (0.008)
Proportion of highly qualified workers	7.9e-05 (0.001)	0.001*** (1.7e-04)	0.003** (0.001)	0.001*** (3.4e-04)

**Table 4 (cont.)**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender, conditional average marginal effects**

	Women		Men	
	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers
	(1)	(2)	(3)	(4)
Proportion of women	-0.001*** (2.5e-04)	-2.0e-04 (1.2e-04)	-0.002*** (3.3e-04)	-9.5e-05 (1.4e-04)
Proportion of foreigners	1.1e-04 (0.001)	-2.1e-04 (3.6e-04)	-1.8e-04 (0.001)	-0.001* (4.0e-04)
Median age of the workforce	-0.001 (0.001)	0.001** (0.001)	-0.004*** (0.001)	2.6e-04 (0.001)
Proportion of low-paid workers	-0.001*** (2.0e-04)	-0.001*** (1.6e-04)	-0.001** (2.6e-04)	-4.7e-04** (2.1e-04)
Sector-level collective agreement (1=yes)	0.020* (0.011)	0.012** (0.006)	0.029 (0.020)	0.011* (0.006)
Firm-level collective agreement (1=yes)	0.032* (0.018)	0.010 (0.008)	-0.015 (0.030)	0.007 (0.010)
Works council (1=yes)	0.009 (0.013)	0.011* (0.006)	0.049** (0.020)	0.019*** (0.006)
Modern technology in use (1=yes)	0.010 (0.009)	0.012*** (0.004)	-0.001 (0.013)	0.021*** (0.007)
Proportion of fixed-term workers	-0.001** (3.9e-04)	1.1e-04 (1.6e-04)	1.0e-04 (0.001)	-4.3e-05 (2.5e-04)
Establishment older than 4 years (1=yes)	-0.018 (0.017)	0.038*** (0.011)	0.008 (0.023)	0.023** (0.011)
Export share	0.001** (3.4e-04)	7.7e-05 (1.3e-04)	0.002*** (0.001)	1.3e-04 (2.5e-04)
Highly urbanised area (1=yes)	0.017 (0.011)	-0.001 (0.004)	0.024 (0.018)	-0.008 (0.006)
Joint significance of dummy variable groups	Age***, level of education***, occupational group***, estab. size***, industry**., fed. state**	Age***, level of education***, occupational group***, estab. size n.s., industry***, fed. state***	Age***, level of education*, occupational group***, estab. size***, industry n.s., fed. state n.s.	Age***, level of education***, occupational group***, estab. size n.s., industry***, fed. state***
Observations	6,783	80,148	2,808	242,373
Selection equations				
Low-paid in 1998 (1=yes), effect on the probability of being low-paid in 2002	0.076*** (0.005)		0.014*** (0.001)	
Correlation coefficient $\rho_1$	-	-0.027***	-	-0.022**
Correlation coefficient $\rho_2$	0.166***	-	0.197***	-
Significance of the model	$\chi^2(71) = 1836.15^{***}$		$\chi^2(71) = 2983.54^{***}$	
Wald Test for the independence of all three equations	$\chi^2(2) = 41.27^{***}$		$\chi^2(2) = 30.65^{***}$	
Total observations	86,931		245,181	

Notes: own calculations based on LIAB. Standard errors in parentheses (clustered at establishment level). 20 industry dummies and 16 federal state dummies suppressed in the table. Reference category of the dummy variable groups: age 20-24; secondary school certificate with vocational training; unskilled manual occupations; 1-19 employees; not covered by a collective agreement. Significance levels: \* p<0.1; \*\* p<0.05; \*\*\* p<0.01; n.s. denotes statistical insignificance.

**Table 5**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender and by West Germany and East Germany, conditional average marginal effects**

	Women, West Germany		Women, East Germany		Men, West Germany		Men, East Germany	
	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Individual characteristics								
Foreigner (1=yes)	0.008 (0.014)	-0.003 (0.003)	-0.006 (0.081)	-0.031** (0.015)	0.016 (0.024)	3.9e-04 (0.002)	-0.101 (0.070)	-0.011 (0.010)
25-34 years (1=yes)	-0.022 (0.017)	-0.073*** (0.008)	0.024 (0.021)	-0.043*** (0.007)	-0.068*** (0.022)	-0.042*** (0.004)	-0.056*** (0.021)	-0.043*** (0.006)
35-54 years (1=yes)	-0.064*** (0.015)	-0.093*** (0.008)	-0.039** (0.020)	-0.084*** (0.007)	-0.106*** (0.022)	-0.074*** (0.006)	-0.104*** (0.022)	-0.080*** (0.007)
55-59 years (1=yes)	-0.115*** (0.021)	-0.104*** (0.008)	-0.057** (0.026)	-0.093*** (0.008)	-0.163*** (0.040)	-0.089*** (0.006)	-0.126*** (0.031)	-0.101*** (0.008)
Secondary school certificate without voc. training (1=yes)	-0.004 (0.013)	0.006** (0.003)	0.026 (0.034)	-0.004 (0.007)	-0.052*** (0.018)	0.003 (0.002)	3.7e-04 (0.022)	-0.009 (0.006)
High school certificate (1=yes)	0.070*** (0.026)	0.018*** (0.004)	0.099* (0.057)	0.010* (0.005)	0.143** (0.069)	0.021*** (0.003)	0.116 (0.143)	0.012*** (0.004)
University degree (1=yes)	0.156*** (0.053)	0.008 (0.006)	0.027 (0.050)	-0.007* (0.004)	-0.289*** (0.081)	0.009* (0.005)	0.354* (0.184)	-0.018*** (0.006)
Education unknown (1=yes)	-0.013 (0.016)	-0.007 (0.008)	-0.015 (0.016)	0.007 (0.007)	-0.015 (0.022)	-0.011 (0.008)	-0.014 (0.023)	-0.001 (0.009)
Agricultural occ. (1=yes)	-0.015 (0.068)	-4.6e-04 (0.016)	0.041 (0.026)	-0.030** (0.013)	-0.049 (0.055)	0.003 (0.006)	0.067** (0.029)	-0.015* (0.009)
Skilled manual occ. (1=yes)	-0.032 (0.025)	-0.005 (0.006)	-0.001 (0.020)	-0.003 (0.009)	-0.068** (0.031)	0.005* (0.003)	0.035* (0.019)	0.003 (0.004)
Unskilled comm. and administr. occ. (1=yes)	-0.019 (0.020)	0.026*** (0.008)	-0.029 (0.021)	-0.006 (0.010)	-0.024 (0.038)	-2.0e-04 (0.008)	-0.011 (0.037)	-0.004 (0.011)
Skilled comm. and administr. occ. (1=yes)	-3.1e-04 (0.018)	0.035*** (0.006)	0.035 (0.022)	0.014* (0.008)	0.062 (0.040)	0.033*** (0.003)	0.039 (0.038)	0.020*** (0.005)
Unskilled services (1=yes)	-0.045** (0.020)	0.007 (0.006)	-0.055** (0.023)	-0.003 (0.009)	-0.086*** (0.026)	-0.004 (0.003)	-0.024 (0.022)	-0.008* (0.004)

**Table 5 (cont.)**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender and by West Germany and East Germany, conditional average marginal effects**

	Women, West Germany		Women, East Germany		Men, West Germany		Men, East Germany	
	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Skilled services (1=yes)	-0.027 (0.036)	0.014** (0.007)	0.023 (0.027)	-0.008 (0.011)	-0.085* (0.044)	0.020 (0.015)	-0.003 (0.080)	0.002 (0.009)
Semi-professions (1=yes)	0.003 (0.032)	0.016** (0.007)	0.089* (0.047)	-0.001 (0.010)	0.014 (0.147)	0.012** (0.006)	0.168 (0.198)	0.006 (0.008)
Technicians/engineers/ professions/managers (1=yes)	-0.002 (0.028)	0.027*** (0.008)	0.044 (0.035)	0.003 (0.009)	0.068 (0.050)	0.025*** (0.004)	0.051 (0.048)	0.005 (0.004)
Tenure 1993-2007	-0.001 (0.009)	0.014*** (0.003)	0.003 (0.005)	0.024*** (0.003)	0.016* (0.008)	0.021*** (0.006)	0.009** (0.005)	0.017*** (0.002)
Tenure 1993-2007 squared	-2.3e-05 (4.4e-04)	-0.001*** (1.5e-04)	-1.1e-04 (2.8e-04)	-0.001*** (1.5e-04)	-0.001 (4.8e-04)	-0.001*** (2.7e-04)	-5.0e-04* (3.0e-04)	-0.001*** (1.2e-04)
Experience 1993-2007	0.047** (0.022)	0.014 (0.013)	0.018 (0.016)	-0.006 (0.006)	-0.008 (0.018)	-0.018*** (0.006)	-0.031** (0.014)	-0.010** (0.004)
Experience 1993-2007 squared	-0.002** (0.001)	-0.001 (0.001)	-0.001 (0.001)	2.3e-04 (2.5e-04)	4.9e-04 (0.001)	0.001*** (2.5e-04)	0.002** (0.001)	4.8e-04** (2.1e-04)
Change of establishment 2002-2007 (1=yes)	0.123*** (0.044)	-0.031** (0.014)	0.155*** (0.041)	0.010 (0.020)	0.172*** (0.035)	-0.054*** (0.013)	0.181*** (0.037)	-0.018 (0.014)
Establishment characteristics								
20-99 employees (1=yes)	-0.028* (0.017)	0.002 (0.012)	-0.015 (0.014)	-0.004 (0.009)	0.045 (0.029)	0.003 (0.006)	0.028 (0.020)	-0.002 (0.007)
100-499 employees (1=yes)	-0.057*** (0.021)	0.007 (0.013)	0.019 (0.019)	0.004 (0.009)	0.028 (0.031)	0.002 (0.008)	0.032 (0.022)	0.007 (0.008)
More than 499 employees (1=yes)	-0.002 (0.027)	0.009 (0.013)	0.114** (0.048)	0.009 (0.012)	0.158*** (0.055)	0.006 (0.010)	0.205*** (0.075)	0.011 (0.013)
Proportion of highly qualified workers	0.001 (0.001)	0.001*** (2.5e-04)	-0.001 (0.001)	0.001*** (2.2e-04)	0.005* (0.003)	0.001** (4.8e-04)	0.001 (0.001)	0.001*** (3.2e-04)
Proportion of women	-0.001 (3.7e-04)	-1.6e-04 (1.5e-04)	-0.001*** (2.8e-04)	-1.0e-04 (2.4e-04)	-0.002*** (4.9e-04)	-3.0e-04* (1.8e-04)	-0.002*** (4.1e-04)	4.1e-04* (2.1e-04)



**Table 5 (cont.)**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender and by West Germany and East Germany, conditional average marginal effects**

	Women, West Germany		Women, East Germany		Men, West Germany		Men, East Germany	
	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion of foreigners	1.6e-04 (0.001)	2.5e-04 (3.8e-04)	3.1e-04 (0.003)	-0.002*** (0.001)	-0.001 (0.001)	-0.001 (4.2e-04)	0.002 (0.003)	-0.003** (0.001)
Median age of the workforce	-3.9e-04 (0.001)	-6.7e-04 (0.001)	-0.001 (0.001)	0.002** (0.001)	-0.002 (0.002)	-3.2e-04 (0.001)	-0.003** (0.001)	0.001 (0.001)
Proportion of low-paid workers	-0.001*** (2.8e-04)	-0.001*** (2.0e-04)	-0.001*** (2.5e-04)	-0.001*** (2.5e-04)	-0.001** (4.1e-04)	-3.8e-04 (3.7e-04)	-0.001* (3.0e-04)	-0.001** (6.0e-04)
Sector-level collective agreement (1=yes)	0.015 (0.014)	0.012* (0.007)	0.031 (0.022)	0.016* (0.008)	0.031 (0.030)	0.007 (0.008)	0.036 (0.027)	0.016* (0.009)
Firm-level collective agreement (1=yes)	0.034 (0.025)	0.009 (0.010)	0.032 (0.022)	0.012 (0.010)	0.023 (0.051)	0.004 (0.014)	-0.042 (0.032)	0.014 (0.011)
Works council (1=yes)	0.013 (0.016)	0.016* (0.008)	0.004 (0.019)	0.012 (0.009)	0.036 (0.026)	0.027*** (0.007)	0.039 (0.030)	0.006 (0.009)
Modern technology in use (1=yes)	-0.001 (0.012)	0.008 (0.006)	0.021* (0.012)	0.014*** (0.005)	-0.013 (0.020)	0.021** (0.008)	0.004 (0.016)	0.014** (0.007)
Proportion of fixed-term workers	-0.001 (0.001)	-1.6e-04 (2.6e-04)	-0.002*** (4.2e-04)	2.8e-04 (1.9e-04)	0.002* (0.001)	-0.001 (3.8e-04)	-0.001 (0.001)	2.0e-04 (2.7e-04)
Establishment older than 4 years (1=yes)	-0.022 (0.024)	0.032*** (0.009)	-0.021 (0.022)	0.046*** (0.017)	0.010 (0.032)	0.017 (0.013)	0.002 (0.035)	0.039** (0.018)
Export share	0.001** (3.8e-04)	6.5e-05 (2.6e-04)	2.3e-04 (0.001)	2.1e-04 (2.8e-04)	0.002** (0.001)	8.5e-05 (1.4e-04)	0.001** (0.001)	0.001*** (1.9e-04)
Highly urbanised area (1=yes)	0.015 (0.013)	-0.008 (0.005)	0.019 (0.020)	0.004 (0.006)	0.006 (0.026)	-0.013* (0.007)	0.022 (0.020)	0.012 (0.008)

**Table 5 (cont.)**

**Determinants of the real wage growth of low-wage workers and higher-wage workers between 2002 and 2007, endogenous switching regression models estimated separately by gender and by West Germany and East Germany, conditional average marginal effects**

	Women, West Germany		Women, East Germany		Men, West Germany		Men, East Germany	
	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers	Low-wage workers	Higher-wage workers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Joint significance of dummy variable groups	Age <sup>***</sup> , level of education <sup>***</sup> , occupational group n.s., estab. size <sup>***</sup> , industry <sup>***</sup> , fed. state <sup>**</sup>	Age <sup>***</sup> , level of education <sup>***</sup> , occupational group <sup>***</sup> , estab. size n.s., industry <sup>***</sup> , fed. state <sup>***</sup>	Age <sup>***</sup> , level of education n.s., occupational group <sup>***</sup> , estab. size <sup>**</sup> , industry <sup>***</sup> , fed. state <sup>**</sup>	Age <sup>***</sup> , level of education <sup>**</sup> , occupational group <sup>***</sup> , estab. size n.s., industry <sup>***</sup> , fed. state <sup>***</sup>	Age <sup>***</sup> , level of education <sup>***</sup> , occupational group <sup>***</sup> , estab. size <sup>**</sup> , industry <sup>***</sup> , fed. state n.s.	Age <sup>***</sup> , level of education <sup>***</sup> , occupational group <sup>***</sup> , estab. size n.s., industry <sup>***</sup> , fed. state <sup>***</sup>	Age <sup>***</sup> , level of education n.s., occupational group n.s., industry <sup>***</sup> , fed. state n.s.	Age <sup>***</sup> , level of education <sup>***</sup> , occupational group <sup>***</sup> , estab. size n.s., industry <sup>***</sup> , fed. state <sup>***</sup>
Observations	4,326	47,722	2,457	32,426	1,520	194,791	1,288	47,582
Selection equations								
Low-paid in 1998 (1=yes), effect on the probability of being low-paid in 2002	0.081 <sup>***</sup> (0.008)		0.025 <sup>***</sup> (0.003)		0.004 <sup>***</sup> (0.001)		0.008 <sup>***</sup> (0.001)	
Correlation coefficient $\rho_1$	-	-0.032 <sup>***</sup>	-	0.001	-	-0.012	-	-0.031
Correlation coefficient $\rho_2$	0.166 <sup>***</sup>	-	0.197 <sup>***</sup>	-	0.263 <sup>***</sup>	-	0.277 <sup>***</sup>	-
Significance of the model	$\chi^2(65) = 1242.40^{***}$		$\chi^2(61) = 1473.09^{***}$		$\chi^2(65) = 2486.24^{***}$		$\chi^2(61) = 1453.24^{***}$	
Wald Test for the independence of all three equations	$\chi^2(2) = 28.65^{***}$		$\chi^2(2) = 14.07^{***}$		$\chi^2(2) = 19.11^{***}$		$\chi^2(2) = 12.12^{***}$	
Total observations	52,048		34,883		196,311		48,870	

Notes: own calculations based on LIAB. Standard errors in parentheses (clustered at establishment level). 20 industry dummies and 10 (6) federal state dummies for West (East) Germany suppressed in the table. Reference category of the dummy variable groups: age 20-24; secondary school certificate with vocational training; unskilled manual occupations; 1-19 employees; not covered by a collective agreement. Significance levels: \* p<0.1; \*\* p<0.05; \*\*\* p<0.01; n.s. denotes statistical insignificance.

## Appendix

**Table 7**  
**Summary of selected results from table 3**

Average marginal effects of selected establishment characteristics on the real wage growth of low-wage workers and higher-wage workers	Low-wage workers	Higher-wage workers
Coverage by a sector-level collective agreement (1=yes)	(+)	+
Existence of a works council (1=yes)	(+)	+
Proportion of low-paid workers	-	-
Establishment size	+	n.s.
Proportion of women	-	n.s.
Export share	+	n.s.
Highly urbanised area (1=yes)	+	n.s.
Modern technology (1=yes)	n.s.	+
Proportion of highly qualified workers	n.s.	+
Establishment older than 4 years (1=yes)	n.s.	+
Proportion of fixed-term workers	n.s.	n.s.

Note: own calculations based on LIAB. “+/-” denotes a positive/negative relationship that is statistically significant at least at the 5%-level; brackets denote a relationship that is significant at the 10%-level only; n.s. denotes statistical insignificance.

**Table 8**  
**Summary of selected results from table 5**

Average marginal effects of selected establishment characteristics on the real wage growth of low-wage workers and higher-wage workers	Low-wage workers				Higher-wage workers			
	Women		Men		Women		Men	
	West	East	West	East	West	East	West	East
Coverage by a sector-level collective agreement (1=yes)	n.s.	n.s.	n.s.	n.s.	(+)	(+)	n.s.	(+)
Existence of a works council (1=yes)	n.s.	n.s.	n.s.	n.s.	(+)	n.s.	+	n.s.
Proportion of low-paid workers	-	-	-	(-)	-	-	n.s.	-
Establishment size	-	+	+	+	n.s.	n.s.	n.s.	n.s.
Proportion of women	n.s.	-	-	-	n.s.	n.s.	(-)	(+)
Export share	+	n.s.	+	+	n.s.	n.s.	n.s.	+
Highly urbanised area (1=yes)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	(-)	n.s.
Modern technology (1=yes)	n.s.	(+)	n.s.	n.s.	n.s.	+	+	+
Proportion of highly qualified workers	n.s.	n.s.	(+)	n.s.	+	+	+	+
Establishment older than 4 years (1=yes)	n.s.	n.s.	n.s.	n.s.	+	+	n.s.	+
Proportion of fixed-term workers	n.s.	-	(+)	n.s.	n.s.	n.s.	n.s.	n.s.

Note: own calculations based on LIAB. “+/-” denotes a positive/negative relationship that is statistically significant at least at the 5%-level; brackets denote a relationship that is significant at the 10% level only; n.s. denotes statistical insignificance.

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