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Hanna Frings

The Employment Effect of Industry-Specific, Collectively-Bargained Minimum Wages

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Hanna Frings[1]

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Abstract

This paper estimates the employment effects of industry-specific, collectively-bargained minimum wages in Germany for two occupations associated with the construction sector. I propose a truly exogenous control group in contrast to the control group design used in the literature. Further, a difference-in-differences-in-differences estimator is presented as a robustness test for occupation-specific and/or industry-specific, time-varying, unobserved heterogeneity. I do not find a significantly negative employment effect, even though the minimum wage is binding in (East) Germany. This result can be explained by substitution effects, noncompliance and models of monopsonic competition.

JEL Classification: J38, J42

Keywords: Minimum wage; monopsonic competition; difference-in-differences

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1 Introduction

Germany is one of the few European countries without statutory minimum wages. For decades this fact had remained broadly unquestioned by officials, academics and the general public, because collective bargaining was developed to such an extent that effective minima existed in the absence of any state regulation. However, since the beginning of the 1990's an erosion of collective wage agreements can be observed. Consequently, the German labour market finds itself in a unique situation within the European Union as neither statutory, country-wide minimum wages nor widely employed extension laws exist, which make collectively bargained rates generally binding. At the same time, the completion of the EU's Single Market as well as its eastward enlargement increased the supply of low wage labour, especially in the construction industry. Based on these developments a debate has emerged on the advantages and problems of the introduction of a country-wide or industry-specific, statutory minimum wage.

In the beginning of the 90s, a number of empirical studies based on establishment level data conducted in the US reported neutral or positive employment effects (e.g. Katz and Krueger, 1992). The most well-known representative of this 'new minimum wage research' is Card and Krueger's (1994) study of the New Jersey fast food industry, in which the employment change fast food stores in New Jersey is compared with the employment development in Pennsylvania where minimum wages remained unchanged. At the same time Neumark and Wascher (2004) conclude, after providing an extensive survey of studies on the employment effects of minimum wages exploiting the variation to be found in panel data at the state level, that the effect on youth employment is generally negative. This is in line with the theoretical model of perfectly competitive labour markets, which infers that labour market interventions such as minimum wages will reduce employment exactly for those workers they are supposed to protect.

More recently, Dube, Lester and Reich (2010) report neutral employment effects using panel data at the county level. The novelty of these contributions is to control explicitly for time-varying spatial heterogeneity at the county level, either by comparing only contiguous counties (Dube *et al.*, 2010) or by incorporating region-specific trends in order to capture differences in employment trends that are unrelated to the policy change (Addison, Blackburn and Cotti, 2009; Allegretto, Dube and Reich, 2011). The underlying idea is that counties with a strong minimum wage bite are characterized by lower employment

growth independently of the minimum wage. Traditional estimates would thus be biased downwards.

Neutral or positive employment effects of a minimum wage can be explained by the notion that (some) labour markets are characterized by monopsonic competition (Manning, 2003). In the absence of collective organization, market imperfections give employers some discretion in determining wages. Examples of such imperfections include the fact that it is costly for employees to change jobs, that employers are imperfect substitutes for each other, and that workers only possess imperfect information about alternative employment opportunities (Manning, 2004).

Metcalf (2008) identifies alternative explanations for missing disemployment effects of the minimum wage introduction in the UK, which are partly in line with the assumption of perfect competition on the labour market. Examples include an adjustment of working hours, increases in productivity, effort or education, price increases on product markets, reduction of profits of affected firms, and incomplete compliance. Based on a survey of firms in the US, Hirsch, Kaufman and Zelenska (2011) show that increases in labour costs are absorbed through non-employment channels of adjustment, such as price increases, profit reduction as well as higher performance standards. This indicates that minimum wages may have effects on an industry, even if there are no negative employment effects.

The existing research shows that the employment effect of any minimum wage policy is a question which cannot be answered theoretically. At the same time, the empirical results from one country cannot necessarily be carried over to another due to differences in labour market institutions. Boockmann (2010) performs a meta analysis of 55 empirical studies on the employment effects of minimum wages and shows that the interaction of the minimum wage policy with labour market institutions is especially important. More specifically, the benefit replacement ratio and the degree of coordination in the collective bargaining system reduce any employment effects, while employment protection enhances such effects.

Surprisingly few studies exist on industry-specific, collectively-bargained minimum wages in Germany, with the work by König and Möller (2009) constituting an exception. The authors investigate the minimum wage effect on employment in the main construction sector following a difference-in-differences (DiD) approach. While König and Möller (2009) were the first to employ this empirical strategy to Germany, their results may be biased due to the choice of the control group, which consists of workers in the same industrial branch

earning slightly more than the minimum prior to its introduction. This approach has been criticized, noticeably by Kluve and Schmidt (2007), because such a control group may be affected by the minimum wage treatment due to spillover and/or output effects. Therefore, the employment levels of both groups can be expected to react to a change in the minimum wage policy and the causal effect of the minimum wage on employment is not identified.

The study at hand uses the DiD approach in order to estimate the employment effect of a minimum wage introduction in Germany for two occupational groups in the construction industry, namely electricians and painters. In order to prevent the bias caused by a control group subject to the minimum wage, I propose an alternative control group which is not influenced by the treatment. It consists of workers belonging to other industrial branches, in which no minimum wage exists and collective bargaining is characterized by a low coverage rate. The disadvantage of such an approach is that additional time-varying determinants of employment may exist, which affect the treatment and control group differently.

In order to test the robustness of the results towards biases resulting from dissimilarity of the treatment and control group, a difference-in-differences-in-differences (DDD) estimator is specified, which exploits the fact that minimum wages are set for individual occupations within the construction industry and thereby eliminates all industry-specific or occupation-specific trends or shocks. While the DDD estimator is better able to deal with unobserved, time-varying heterogeneity, it is more likely to be biased due to spillover effects and labour mobility within the occupation but across industries. To the extent that both estimators are consistent with each other, it is possible to conclude that none of the two possible biases distort the results.

The remainder of this paper is organized as follows. The institutional background of minimum wages in Germany is discussed in Section 2. Section 3 describes the empirical strategy and introduces the data used for estimation. The basic results are given in Section 4. Finally, Section 5 concludes.

2 Institutional Background

In Germany, statutory, country-wide minimum wages do not exist. Instead, a few selected industries do have collectively-bargained minimum wages. Up to date, minimum wages have been introduced for the main construction sector (1997), electricians (1997), roofers (1997),

painters (2003), the commercial cleaning industry (2008), laundry services (2009), miners (2009), elderly care (2010), the waste industry (2010), and security services (2011).

The legal framework for any minimum wage introduction in Germany is the Posting of Workers Law (PWL; *Arbeitnehmerentsendegesetz*). The law is based on the European Union Posted Workers Directive (96/71/EC) and exists since 1996. The PWL has the aim to protect domestic workers from increasing low wage labour competition due to the completion of the EU's Single Market by demanding that foreign workers (i.e. posted workers) must be subject to the same working regulations and minimum standards as domestic workers. Examples of such minimum standards include working hours, holidays and minimum wages.

In order to establish minimum wages, the PWL allows collectively bargained wage rates to be extended to all workers and firms in an industry, independent of their membership in trade unions or employer associations. However, at least 50% of all employees in the respective industry have to be covered by the initial collective bargaining agreement for the law to be applicable.[1]

Posting of workers is quite common in the construction industry. Therefore, only associated industries such as main construction, electricians, painters or roofers were initially covered by the PWL. Because the coverage rate of collective bargaining has traditionally been rather high in these industries, the minimum wage introduction was mainly motivated by protectionism. However, during the last decade the focus has shifted to industries in which posting of workers appears less common, such as commercial cleaning, laundry services and elderly care[2]. This implies that the PWL is increasingly used to establish industry-specific, collectively-bargained minimum wage rates for domestic workers, instead of preventing low-wage competition from abroad. One possible explanation for this increased interest to establish minimum wages is a decline in union density and the coverage rate of

[1] In April 2009, a Law on Minimum Working Standards (*Mindestarbeitsbedingungengesetz*) has been amended to allow minimum wage introductions in industries with a coverage rate below 50%. After an industry has been suggested due to the existence of social exclusion, a special committee introduces (permanent) minimum wages such that 'working conditions are appropriate, fair competition is ensured and employment subject to social security payments is sustained'. However, up to date this law has not been applied and its practical relevance still needs to be proven.

[2] An alternative explanation for the introduction of minimum wages in these industries is the inclusion of the New Member States in terms of the unrestricted movement of labour in 2011. Anlong this line of argument, the more recent minimum wages are also motivated by protectionism, as firms feared increasing competition and trade unions worrried about decreasing wage levels.

collective bargaining which has started in the 1990s.

Union density has been falling from 30% in 1990 to 21% in 2004 in West Germany and from 50% in 1990 to 18% in 2001 in East Germany (Biebeler and Lesch, 2006). Naturally, union coverage is considerably higher, but the pattern observed for density applies equally: coverage has been decreasing from 69% in 1996 to 61% in 2004 in West Germany and from 56% to 41% in East Germany during the same time period (Ellguth and Kohaut, 2005). Not surprisingly, the coverage rates differ significantly between industrial branches. As Figure 1 shows, the coverage rate of area-wide collective agreements is (and always has been) especially low for the service sector, communication and transportation, wholesale and retailing, as well as for non-profit organizations. In contrast, the public sector, the banking and insurance sector, as well as mining and energy/water provision are characterized by high and stable coverage rates in East and West Germany alike. Finally, while area-wide collective agreements have been decreasing, company-level collective agreements have been increasing in number and importance. However, generally the proportion of workers not covered by any agreement is growing in most industries, implying that the increase in the latter was not large enough to outweigh the decrease in the former.

3 Empirical Strategy and Data

Minimum wages were introduced in 1997 for electricians and in 2003 for painters respectively. In addition, they were abolished again in 2003 for electricians. Thus, the observation period (1998-2008) covers one minimum wage introduction and one minimum wage abolition. Eligibility is defined by the occupation and the condition that the employer's main business activities are within the construction industry.[3]

In order to estimate the employment effect of the minimum wage, a difference-in-differences (DiD) estimator will be used. Any control group must fulfil two requirements in order for the DiD estimator to be credible. First, the control group must not be affected by the minimum wage treatment and second, its employment development must correspond to that observed in the treatment group if the minimum wage was not introduced. Because minimum wages are collectively bargained at the industry level, a trade-off exists between these

[3]Further, apprentices are excluded in the case of electricians. Similarly, unskilled painters aged 18 years or less do not receive a minimum wage.

two requirements. One possibility is to choose a control group within the same industry or in neighbouring industries. In this case, comparability is high, but the control group is likely to be affected by the minimum wage treatment due to substitution or spillover effects. The other possibility is to choose a control group from a different industry that is not directly connected to the treatment industry along the supply chain. This implies that the control group is clearly not subject to the treatment, but it is doubtful that no time-varying determinants of employment exist that affect the groups differently.

To ensure that neither of the two problems biases the results, two different empirical strategies will be followed. First, the control groups are chosen from different industries and applied within a 'traditional' DiD framework (compare with Section 3.1). This approach appears to be preferable insofar as it is possible to control for time-varying determinants of employment that vary between the included groups. Second, a difference-in-differences-in-differences (DDD) estimator is used with control groups from neighbouring industries and occupations (compare with Section 3.2). The results obtained with this estimator may be biased due to substitution and/or spillover effects. Additionally, it is not possible to determine whether the effect of the minimum wage introduction will be overestimated or underestimated. However, if the estimated effect obtained with the DDD estimator is consistent with the DiD estimator, the results are robust to the biases present with both empirical strategies.

3.1 Difference in Differences

The main interest of this study is to analyse the effect of the minimum wage on aggregate employment in the two treatment groups. Stated differently, the central research question is whether the number of full-time employed painters and electricians changes in response to the minimum wage.

Essentially, each industry comes into consideration when choosing a control group as long as the two conditions are met. The fact that a credible control group should not be affected by the minimum wage implies that other occupations in the construction industry as well as any neighbouring industries that are connected to the treatment groups along the supply chain cannot be used as control groups. In addition, any area-wide collective agreement with a high coverage rate mimics a minimum wage treatment, because minimum wages in Germany amount to extended collective wage agreements. Thus, the control group

should consist of workers from industrial branches with a low coverage rate of collective bargaining.

As Figure 1 shows the transport and communication industry as well as wholesale and retailing are characterized by rather low coverage rates. In addition, as these industries fulfil the common trends assumption (Figure 2), they constitute appropriate control groups. Note that it is a coincidence that the two treatment groups are matched by exactly two control groups. The idea behind using more than one control group is to reduce biases that might occur due to a violation of the common trend assumption (Meyer, 1995). If more industries that (a) do not belong to constructions or neighbouring industries, and (b) are characterized by a low coverage rate of collective bargaining could have been identified, more than two control groups would have been used.

Similarly, the employment of two treatment groups, one experiencing a minimum wage introduction, the other one a minimum wage abolition, aims at estimating the average effect of the minimum wage on employment in Germany. Clearly, the assumption is that a minimum wage introduction and abolition have a similar effect in terms of sign and size. In order to verify this assumption, the estimations are also run separately for each of the treatment groups as a sensitivity check (Table 4).

In summary, a total of four groups is used in the estimation: Painters and electricians, which both experience a minimum wage treatment during the observation period, and the transport/communication as well as the wholesale/retail industry. The employment effect of the minimum wage introduction is estimated by a fixed effects model with time dummies, which serves the same purpose as a DiD estimator. The industry dummies eliminate any time-constant differences between groups, while the time dummies capture the effects of any exogenous variable that changes over time, but affects all groups equally. In summary, the regression equation can be expressed as:

$$empl_{it} = \alpha + \beta_1 mw_{it} + \beta_2 g_{it} + \beta_3 me_{it} + \beta_7 d_i + \beta_8 d_t + \epsilon_{it} \quad (1)$$

Aggregate employment at the level of the industry is represented by $empl_{it}$, while mw_{it} is the minimum wage indicator. This indicator takes the value one for industries and time periods in which a minimum wage exists and zero otherwise. The subscript i denotes the four groups (two treatment groups and two control groups) and the subscript t refers to the time periods.

The controls include industry-specific economic growth (g_{it}) as well as the proportion of marginal employment (me_{it}). The former is proxied by growth of revenues (treatment groups) and growth of gross value added (control groups). These different concepts are used due to data limitations. Therefore, this variable is only meant to measure general, possibly deviating, trends and the estimated coefficient should not be interpreted concerning its magnitude.

Marginal employment reduces the social security contributions an employer has to pay as long as the employee does not earn more than 400 Euros per months or a specific number of working hours is not exceeded. Therefore, the proportion of marginal employment among total employment is included in order to control for the possibility that regular employment is substituted for this less expensive type of workers. Insofar as these two control variables follow a different development over time for the included groups, it is indispensable to include them in the regression equation.

All variables enter the regression model as growth rates. There are two main reasons for estimating the equation in growth rates rather than in levels. First, employment expressed as a level follows a non-stationary process over time. This is not surprising, because the employment level is naturally determined by the level in previous periods to a large extent, especially because there are large differences in employment levels between groups. Differencing, or in this case calculating growth rates, is a simple and intuitive manner to solve this problem. As the regression results will show, some autocorrelation in the error term is still left, but serial correlation is decreased to an acceptable level. Second, the employment growth of the treatment groups is characterized by a strong, seasonal pattern (Figure 2). Using growth rates, calculated as the change in employment compared to the same quarter in the previous year, eliminates the seasonal pattern completely.

The focus on the employment development of entire industries or occupational groups has two advantages compared to the alternative of estimating the probability of continuous employment for individual workers. First, this approach takes account of terminated as well as new employment relationships. In contrast, new employment relationships are necessarily ignored when estimating probabilities at the level of the individual worker. Second, the data only contain average monthly wages, while the minimum wage is defined as an hourly wage rate. In addition, information on actual working hours is not available. Consequently, it is necessary to impose strict assumptions on individual working hours in order to identify

workers, who are affected by the minimum wage when estimating the probability of continuous employment. By focusing on the employment development of all eligible workers such individual identification is not necessary. At the same time, it is still possible to analyse whether or not the minimum wage has an influence on aggregate employment.

The majority of studies on the employment effect of minimum wages do not differentiate between a minimum wage introduction and a (sizeable) increase in the minimum wage. If the minimum wage is set by any outside agency, such as the government in the US or the Low Pay Commission in the UK, both events are exogenous. The institutional context in Germany is different. Because the social partners bargain over average wages, minimum wages and employment simultaneously, minimum wage increases are endogenous. Lemos (2005) argues that measures of the minimum wage bite, such as the Kaitz Index or the fraction of affected workers, are generally endogenous when estimating employment effects in the presence of collective bargaining. The reason is that these indicators depend on the wage distribution which is set simultaneously with employment. Therefore, this study concentrates on the minimum wage introduction, for which endogeneity is a smaller problem compared to changes in the existing minimum wage.

It should be noted, though, that the observation period does cover several increases in the minimum wage. A dummy that takes the value one for the treatment groups in each period after the minimum wage introduction therefore captures the average effect of the minimum wage introduction and all increases. Still, minimum wage increases cannot be expected to have a significant impact on employment for at least three reasons. First, future increases in the minimum wage are usually agreed upon for a period of two to three years. This implies that employers often know in advance when the minimum wage will be increased by a certain amount. Thus, there is no reason to expect a significant reaction of employment each time the minimum wage is increased (Pinoli, 2010). Second, increases are generally infrequent and, third, very small in magnitude.[4] For these reasons the minimum wage dummy mainly captures the effect of the minimum wage introduction, despite the fact that the minimum wages have also been increased during the observation period. [5]

[4]Painters have only experienced one increase in the minimum wage of 15 Cents per hour during a time period of four years (2003-2007). In contrast, increases are larger in magnitude and more frequent for electricians. However, these increases are agreed upon in advance in the collective agreements. More specifically, three increases during the time period 1999-2002 for electricians were already known in 1999.

[5]The specifications have also been estimated for time periods without any increase in the minimum wage.

3.2 Difference in Differences in Differences

The minimum wage treatment takes place for specific occupations (electricians and painters) in a specific industry (construction). Rattenhuber (2011) proposes that this fact can be exploited by an alternative empirical design that uses two control groups: One consisting of a different occupation in the same industry, and the other one consisting of the same occupations in different (sub-) industries. More specifically, the first control group consists of clerks in the construction industry and the second control group is composed of painters as well as electricians in any industry, besides construction, in the manufacturing sector.

Both control groups are employed simultaneously in a difference-in-differences-in-differences (DDD) framework. The DDD estimator has been predominantly used in contexts in which regional variation in treatment is present. Hamermesh and Trejo (2000) compare Californian men, who receive a treatment concerning overtime-pay, with Californian women as well as men in other states. Similarly, Gruber (1994) compares treated to untreated individuals in the state in which treatment took place. At the same time, the treated are compared with individuals in other states, who would have been eligible to the treatment had their state participated in the policy intervention. In the context at hand, variation in treatment does not exist between regions, but between industries. This implies that electricians (painters) are compared with untreated occupations within the construction industry, and with electricians (painters) in other industries, which do not experience a minimum wage introduction.

The DDD estimator requires a much weaker identification assumption than the usual DiD estimator: in absence of the minimum wage treatment, the relative difference in the employment growth rates of electricians (painters) and clerks in the construction industry should be the same as the relative difference in the employment growth rates of electricians (painters) and clerks in the manufacturing sector. Stated differently, all industry-specific trends are "differenced away" as long as all occupations in that industry are affected equally. Similarly, all occupation-specific trends disappear as long as occupations in all industries are affected equally.

Under this identification assumption an unbiased estimate of the employment effect of

The results do not change compared to estimations covering the entire observation period.

the minimum wage introduction $\hat{\beta}$ can be obtained by:

$$\begin{aligned}\hat{\beta} &= \Delta\bar{y}^{1,1} - \Delta\bar{y}^{0,1} - \Delta\bar{y}^{1,0} - \Delta\bar{y}^{0,0} \\ &= (\bar{y}_1^{1,1} - \bar{y}_0^{1,1}) - (\bar{y}_1^{0,1} - \bar{y}_0^{0,1}) - (\bar{y}_1^{1,0} - \bar{y}_0^{1,0}) - (\bar{y}_1^{0,0} - \bar{y}_0^{0,0})\end{aligned} \tag{2}$$

The subscript one (zero) represents periods after (before) the minimum wage introduction. The superscript shows that the group belongs to the construction industry if the first digit is equal to one. If the second digit is one, the group consists of electricians (painters). The regression equation takes the following form:

$$\begin{aligned}empl_{it} =& \alpha + \beta_1 occ_i + \beta_2 ind_i + \beta_3 d_t + \\ & \beta_4(occ_i * ind_i) + \beta_5(occ_i * d_t) + \beta_6(ind_i * d_t) + \beta_7 mw_{it} + \epsilon_{it}\end{aligned} \tag{3}$$

The dummy occ_i takes the value one if the group consists of electricians (painters), while the dummy ind_i takes the value one for the construction industry. These fixed effects eliminate time-constant differences between the different industries (manufacturing and construction) as well as the different occupations (electricians/painters and clerks). Time dummies for each quarter are given by d_t. The interaction between the industry-specific and occupation-specific fixed effects with the time dummies eliminate any time trends or shocks that affect all occupations within an industry or one occupation across industries equally. Finally, the dummy mw_{it} takes the value one for electricians (painters) in the construction industry in time periods after the minimum wage introduction. The coefficient β_7 therefore gives the effect of the minimum wage introduction on employment growth $empl_{it}$. The specification is estimated separately for electricians as well as painters.

The DDD estimator ensures that industry-specific and occupation-specific trends do not bias the coefficient of the minimum wage introduction. However, there are reasons to believe that both control groups might be affected by the minimum wage treatment in a similar manner as a control group consisting of higher wage workers within the same industry applied within a DiD framework. While biases might occur due to spillover effects as well as labour mobility, the probability of their existence as well as the expected magnitude of such an effect is considerably smaller compared to employing solely higher-wage workers from the same industry as a control group.

First, electricians (painters) in the manufacturing sector could be affected by the minimum wage introduction in the construction industry due to spillover effects in terms of

wages within occupations, but across industries. In the presence of spillover effects, wages for electricians (painters) in the manufacturing sector would be increased as a reaction to the minimum wage introduction for electricians (painters) in the construction industry. Table 1 shows that average wages of electricians (painters) in manufacturing are considerably higher compared to average wages of electricians (painters) in construction. However, wage dispersion also appears to be higher, implying that a considerable proportion of workers in the control group earns less than or exactly the minimum wage at the time of introduction. Thus, spillover effects at the lower end of the wage distribution cannot be precluded.

Additionally, the minimum wage could induce electricians (painters) in manufacturing to switch to construction. Alternatively, workers might move from the construction industry to manufacturing after losing their job due to the minimum wage introduction. While spillover effects and labour mobility from manufacturing to construction would overestimate a positive employment effect (underestimate a negative effect), the opposite is true for labour mobility from construction to manufacturing. Thus, it is not possible to determine if the estimator will be biased and if this is the case, in which direction.

Finally, clerks in the construction industry could be affected by the minimum wage introduction insofar as the minimum wage depresses output of the entire industry. In this case the reduction in output is industry-specific and will therefore (falsely) not enter the minimum wage coefficient. However, for this problem to occur, the minimum wage introduction in one specific occupation (e.g. electricians) would have to depress the entire construction industry with equal employment effects for all occupations. Given that clerks are characterized by deviating individual characteristics (Table 1) and perform very different tasks compared to electricians (painters), equal employment effects for both occupations are unlikely, even if the minimum wage introduction in one occupation depresses the overall industry output.

3.3 Data

The data employed in the empirical analysis is the BA Employment Panel supplied by the Research Data Centre of the German Federal Employment Agency at the Institute for Employment Research (Schmucker and Seth, 2009). The data are at the individual level and present a 1.92% sample of all employees subject to social security contributions. They are representative for all workers subject to social security payments, which amounted to almost 32 million individuals in 2002. The data are quarterly and cover the time period 1998 - 2007.

For each individual, several personal characteristics are included, such as gross wage, type of employment, occupation, age, nationality and educational attainment. Further, information at the establishment level is added, e.g. the economic sector and the composition of the workforce.

In order to aggregate the data to the level of the industry, each individual employee is assigned to one of the four groups. All persons who do not belong to one of the industries of interest are dropped from the data set. Additionally, only regular, full-time employees are kept. This excludes part-time employees, but also apprentices, interns and marginal employees. After the data set is scaled down to regular, full-time employment, the variables are aggregated at the sectoral level.

Two important variables are not contained in the original data set and are therefore added from an external source. First, information about minimum wage rates is taken from the Federal Bulletin (*Bundesanzeiger*), where each collective bargaining agreement declared generally binding must be published. Second, the indicator for economic growth consists of gross value added for the control groups and revenues for the treatment groups. These data are obtained from the Federal Statistical Office (*Statistisches Bundesamt*).

4 Empirical Results

A prerequisite for minimum wages to have any effect on employment is that they have a bite. Stated differently, wages at the lower end of the distribution should be increased due to the minimum wage introduction. While the focus of this paper is not to analyse whether minimum wages are an effective tool to increase the income of low wage workers, it is necessary to gain some insight on their effect on the bottom percentiles of the wage distribution.

Figure 3 shows the proportion of workers earning less than the minimum wage and the proportion of workers earning exactly the minimum wage. Insofar as the minimum wage is binding, the proportion of workers earning exactly the minimum wage should increase, while the proportion of workers earning less than the minimum wage should drop to zero.

In West Germany, such a pattern cannot be observed. In comparison with East Germany (Figure 3), the proportion of workers earning less than the minimum wage prior to its introduction is generally low. Further, this low proportion of workers earning less than or

exactly the minimum wage hardly reacts at all to the minimum wage policy. In contrast, the expected reactions occur for the treatment groups in East Germany. For electricians, the proportion of workers earning less than the minimum wage decreases from 20% to 5% and for painters from more than 40% to 15%. The proportion of workers earning exactly the minimum wage simultaneously increases for all treatment groups.

Apparently, the fraction of workers earning less than the minimum wage does not decrease to zero in any treatment group. This can be attributed to measurement error. First, the minimum wage is specified as an hourly wage rate, while individual wages in the data are provided as gross monthly earnings. When identifying those workers earning less than or exactly the minimum wage, it is assumed that each worker supplies exactly the number of weekly working hours as stipulated in the binding collective agreement.[6] Second, some measurement error may occur when identifying those workers eligible to the minimum wage. In either case, as long as this measurement error is random and the analysis is not conducted at the level of the individual worker, the results should not be distorted.

In conclusion, Figure 3 presents evidence that the minimum wage has been binding in East Germany, but not in West Germany. This result is in line with the estimates reported by König and Möller (2009), Rattenhuber (2011) and IAB, RWI and ISG (2011) for the main construction sector.

Table 2 shows the estimation results of the effect of the minimum wage introduction on employment for East and West Germany of the DiD estimator. The estimated coefficient of the minimum wage dummy is insignificant throughout all specifications. This result is less surprising for West Germany, because the minimum wage hardly binds. In contrast, the minimum wage does affect the wages of a significant proportion of workers in East Germany.

The industry-specific, macroeconomic growth exhibits a positive influence on the growth rate of employment. In West Germany, the joint significance of the industry dummies drops with the inclusion of this indicator. This observation may be interpreted as evidence that the time-constant differences in employment growth between the industries during the observation period can be explained by time-persisting differences in industry-specific growth, with the construction industry performing continuously worse than the communication and transport industry or wholesale and retailing.

[6]The collective agreement is binding for all workers and stipulates that mean, monthly working hours should be equal to a specific number over the course of 12 months.

The coefficient of the growth rate of the proportion of marginal employment is significant and negative in West Germany. However, it should be noted carefully that the coefficient is rather small in magnitude. It amounts to 0.05, implying that an increase of one percentage point in the growth rate of the proportion of marginal employment leads to a decrease of around 0.05 percentage points in the growth rate of full-time regular employment.

Two separate interpretations may explain the observed relationship. First, as a less expensive type of employment, marginal employment may generally crowd out a fraction of regular, full-time employment, independent of the minimum wage. Second, the negative coefficient of marginal employment may be interpreted as a substitution of marginal for regular employment in reaction to the minimum wage. In order to analyse the latter issue, an interaction term between the growth rate of marginal employment and the minimum wage dummy is included in the specification. However, as the coefficient of this interaction term remains insignificant, the first explanation appears more likely.[7]

The results of the DDD estimator, which are presented in Table 3, confirm the neutral employment effect of the minimum wage introduction found with the DiD estimator. In order to make the results of the two identification strategies more comparable, Table 4 in the appendix provides separate DiD estimations for each treatment group. The coefficient of the minimum wage dummy remains insignificant. The results obtained with the DiD and the DDD estimator are therefore consistent with each other.

Painters in East Germany constitute the only exception, because the DiD estimator suggests a neutral employment effect of the minimum wage introduction (Table 4), while the coefficient of the minimum wage dummy is positive and significant at the 5% level when employing the DDD estimator (Table 3). One possible explanation is that other time-varying determinants of employment growth in addition to included controls exist, which affect the treatment and control groups differently. In this case the DiD estimator would be biased. The DDD estimator, in contrast, is better able to deal with such time-varying, unobserved heterogeneity as long as these trends are occupation-specific or industry-specific. Stated differently, the underlying assumption is that either all occupations within one industry are affected equally or that one occupation is affected equally across all industries. To this extent it should be noted that the occupation-specific time dummies as well as the industry-specific time dummies are jointly significant at the 1% level in all specifications (Table 3),

[7]These results are not presented in any table, but can be obtained from the author upon request.

which points towards the existence of such trends.

Alternatively, the DDD estimator might be biased due to wage spillover effects or labour mobility between industries (compare with Section 3.2). If such effects are present, the employment level of painters in manufacturing is decreased as a reaction to the minimum wage introduction for painters in construction. Consequently, the estimated coefficient of the minimum wage dummy may be biased upwards. It is impossible to determine whether the deviating results are caused by a bias in the DiD or the DDD estimator. However, the DiD and DDD estimators are consistent with each other in the remaining three specifications. Additionally, independent of the nature of a possible bias, the explanations discussed for the neutral employment effect apply equally well to a possibly positive effect of the minimum wage introduction.

At least four, not mutually exclusive, explanations exist for the neutral employment effect of the minimum wage introduction in East Germany. First, the aggregate measure of employment at the occupational level might hide substitution effects between different types of workers. Stated differently, the employment effects could be unfavourable for the affected workers, but neutral at the aggregate employment measure at the occupational level. For example, if the minimum wage increases the price of unskilled labour, firms might exchange unskilled workers for skilled ones, who become relatively less expensive.

In order to analyse this issue more deeply, all specifications are estimated separately for skilled and unskilled workers, young and older workers, as well as workers employed in small and large firms. The estimated coefficient of the minimum wage dummy remains insignificant and very small in magnitude independent of the subsample used.[8] Thus, it appears unlikely that substitution effects occurred. The absence of such effects can be explained by the very homogenous composition of the workforce in the treatment groups. Only a maximum of 4% of the workers does not have any vocational training in East Germany and the majority of the workforce is employed in small firms (Table 1).

Second, the neutral employment effect could be caused by monopsonic competition. As Figure 1 shows, the coverage rate of collective bargaining is much lower in East Germany compared to West Germany and has been continuously decreasing during the last decade. This development might have increased the market power of employers, thereby giving individual firms some discretion in setting wages. As a consequence, the equilibrium established

[8]These results are not presented in any table, but can be obtained from the author upon request.

without minimum wages might be supply-side constrained, which implies that a minimum wage does not necessarily reduce employment. In this context, it is imaginable that skilled craftsmen, such as electricians or painters, move to the West German labour market due to large wage differentials (Table 1), thereby causing a shortage of skilled labour supply in East Germany. In this case, the price elasticity of labour supply, instead of labour demand, would be relevant when predicting the employment effects of a minimum wage introduction.

A third explanation is noncompliance with the minimum wage. To the extent that employers simply pay sub-minimum wage rates it is not surprising that the employment effect of the minimum wage is neutral. While no official statistics exist on noncompliance, several enquiries of two smaller parties to the German government and the corresponding answers suggest that controls are infrequent and penalties are hardly prohibitive.[9] Still, as Figure 3 shows, gross monthly wages are increased with the minimum wage introduction in East Germany. Thus, it would have been necessary to increase the number of working hours significantly in order to achieve sub-minimum wage rates despite higher gross monthly wages. Given that all workers in the sample are full-time employed, noncompliance through a higher number of working hours might explain partly, but not entirely, why the minimum wage has a neutral employment effect.

Finally, the minimum wage introduction might not have affected the employment growth of domestic, but that of foreign workers. Recall from Section 2 that the initial aim of the minimum wage introduction in Germany was to ensure that foreign (posted) workers are subject to the same minimum standards as domestic workers. In contrast, the data set only covers domestic workers paying social security contributions. Thus, the possibility exists that the minimum wage has been employment neutral (or even positive) for domestic workers, while it reduced the employment of foreign workers.

Two other empirical studies exist for the employment effect of minimum wages in Germany, which report deviating results compared to the study at hand. First, the already mentioned study by König and Möller (2009) focuses on the main construction sector. Workers in the same industry, but with wages in excess of the minimum wage, serve as a control group. König and Möller (2009) report positive employment effects in West Germany and

[9]For example, in 2010 the leftwing party "Bündnis 90/Die Grünen" submitted an enquiry to the German government in order to obtain more information on the results of inspections in the construction sector concerning minimum wages (Deutsche Bundesregierung, 2010).

negative employment effects in East Germany. However, the effects in West Germany are of low statistical significance. Compared to the study at hand, these deviating results may be caused by differences in the control group design, different treatment groups or the deviating empirical strategy, which focuses on the estimation of individual probabilities of continuing employment, thereby ignoring new employment relationships that started during the observation period.

Second, Bauer, Kluve, Schaffner and Schmidt (2009) analyse the effect of different (hypothetical) statutory minimum wage rates on aggregate employment, separately for East and West Germany. While this study consists of a simulation analysis, it may still be classified as semi-empirical because the majority of parameters are derived from micro-data. The resulting employment effects are clearly negative. However, Bauer *et al.* (2009) make the crucial assumption that a minimum wage introduction will lead to a demand-constrained equilibrium. This assumption is a direct consequence of a perfectly competitive labour market. The equilibrium prior to the minimum wage introduction might just as well have been supply-constrained either due to monopsonic competition or labour mobility between East and West Germany. In this case, the negative employment effect is less certain.

5 Conclusion

This paper analyzes whether the minimum wage has influenced the employment level in thwo occupations belonging to the construction industry, painters and electricians. Strong emphasis is placed on the choice of an appropriate control group as well as the choice of a sensible minimum wage indicator. Both considerations are highly important for the identification assumption of the DiD estimator, because minimum wages in Germany are industry-specific and collectively bargained.

Industry-specific minimum wages imply that a fundamental trade-off exists when setting up an appropriate control group design. First, each control group constructed within the same industry is most likely subject to the minimum wage treatment as well. Second, any control group established outside the industry in question is most likely affected by other determinants of employment over time in addition to the minimum wage. I propose to solve this trade-off by using control groups from other industries, while controlling for industry-specific macroeconomic growth as an additional determinant of employment growth. The

DDD estimator provides a robustness check to the results obtained with the DiD estimator, because both estimators are subject to different biases. As long as the two estimators yield consistent results, the results obtained with the DiD estimator appear robust to biases due to time-varying, unobserved heterogeneity.

I find no significant effect of the minimum wage introduction on employment growth in East Germany, despite the fact that the minimum has been affecting a significant proportion of the workforce. Possible explanations include substitution effects between different types of workers, noncompliance and monopsonic competition. First, substitution effects between skilled and unskilled workers generally seem highly likely, but can be rejected in the case at hand due to the very homogenous nature of the treatment groups. In contrast, substitution of foreign workers for domestic ones cannot be precluded and is a sensible explanation, because the treatment groups belong to the construction industry where posting of workers is common. To the extent that a reduced number of posted workers is the main explanation for the neutral employment effect for domestic workers, the minimum wage achieved its initial aim of protecting domestic workers from low-wage competition from other EU countries. To answer the question whether or not a minimum wage should serve such a purpose is beyond the scope of this paper and open for debate.

Second, noncompliance with the minimum wage is a further possible explanation for the neutral employment effect. To the extent that workers are required to supply more hours, the true hourly wage rate might be below the minimum wage despite increasing monthly gross wages. Even though infrequent controls make this a viable option, the analysis of the fraction of workers affected by the minimum wage shows that a considerable proportion of workers have experienced an increase in wages with the minimum wage introduction. Stated differently, even if not all firms comply with the minimum wage, the majority appears to do so. Therefore, noncompliance cannot explain the overall neutral employment effect by itself.

Last but not least, monopsonic competition may serve as an explanation for the obtained results. In this case, the decrease of the coverage rate of collective bargaining during the last decade has provided individual employers with some discretion in setting wages. Then, the minimum wage simply counteracts the monopsonic power of firms, thereby taking on the same function as collective bargaining did previously. Other non-employment channels of adjustment, such as reduction in profits or an increase in product prices, are also imaginable

if imperfect competition prevails on the labour or on the product market. To determine whether such explanations are plausible for the case at hand is beyond the scope of this paper. To this end, additional research on whether labour market segments with a low coverage rate of collective bargaining in Germany are rather characterized by perfect or monopsonic competition promises to be interesting and fruitful.

Generally, it is dangerous to infer from the presented results that minimum wages will have no disemployment effects in Germany. Electricians and painters both belong to the construction industry, which is special for at least three reasons. First, to the extent that substitution of foreign for domestic workers is the main explanation for the neutral employment effect, a minimum wage introduction in other industries might well lead to negative employment effects. Second, the German minimum wage institution implies that a self-selection into the minimum wage treatment exists, because both social partners have to agree on the policy change. Third, the treatment groups consist predominantly of skilled, full-time employed men.

Future research on the employment effects of minimum wages in Germany should therefore focus on industries not belonging to the construction sector, where minimum wages were introduced more recently. Examples include the commercial cleaning industry (minimum wage introduction in 2008), laundry services (minimum wage introduction in 2009), or elderly care (minimum wage introduction in 2010). In contrast to the construction sector, protectionist motives appear to be less relevant for the minimum wage introduction in these industries. Instead, the expansion of low-wage labour markets is more important. If these minimum wage introductions also show to be employment-neutral, other explanations than substitution of domestic for foreign workers should be considered. One obvious choice is monopsonic competition in the labour market.

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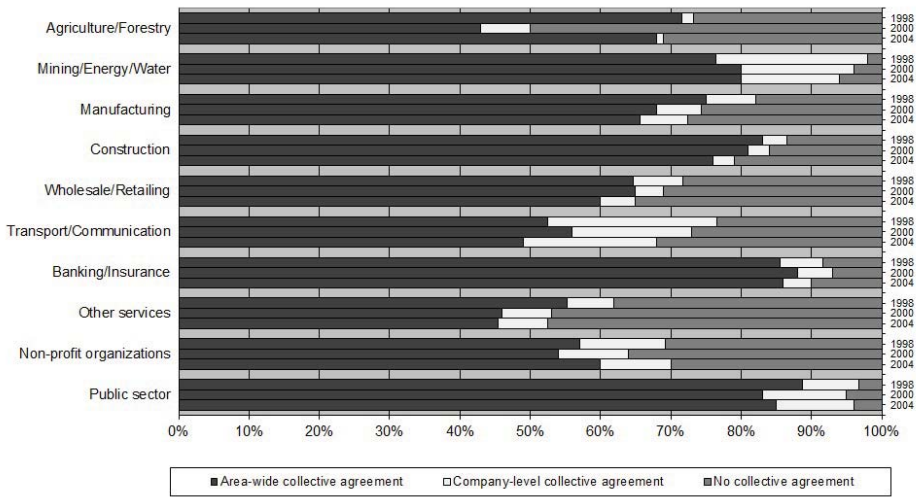
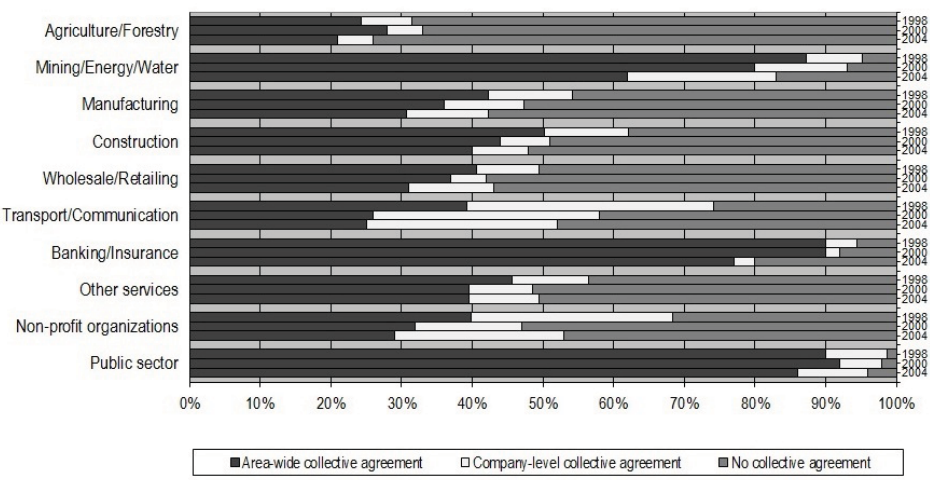
Appendix A Figures and Tables

Figure 1: Collective Bargaining Coverage per Industrial Sector

(a) Proportion of Employees Covered in West Germany



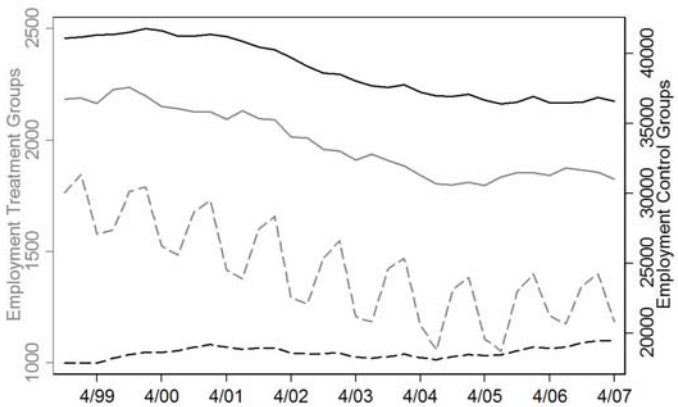
(b) Proportion of Employees Covered in East Germany



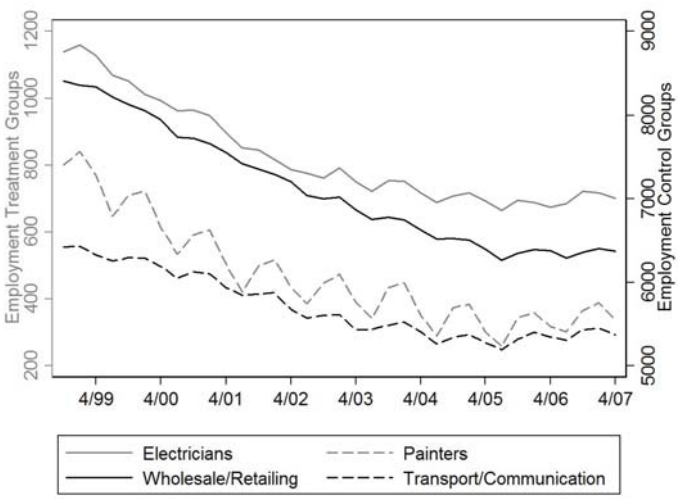
Source 1998/2000: Hans Böckler Stiftung (2008). **Source 2004**: Ellguth and Kohaut (2005).

Figure 2: Employment Development of Treatment and Control Groups

(a) Employment Development in West Germany



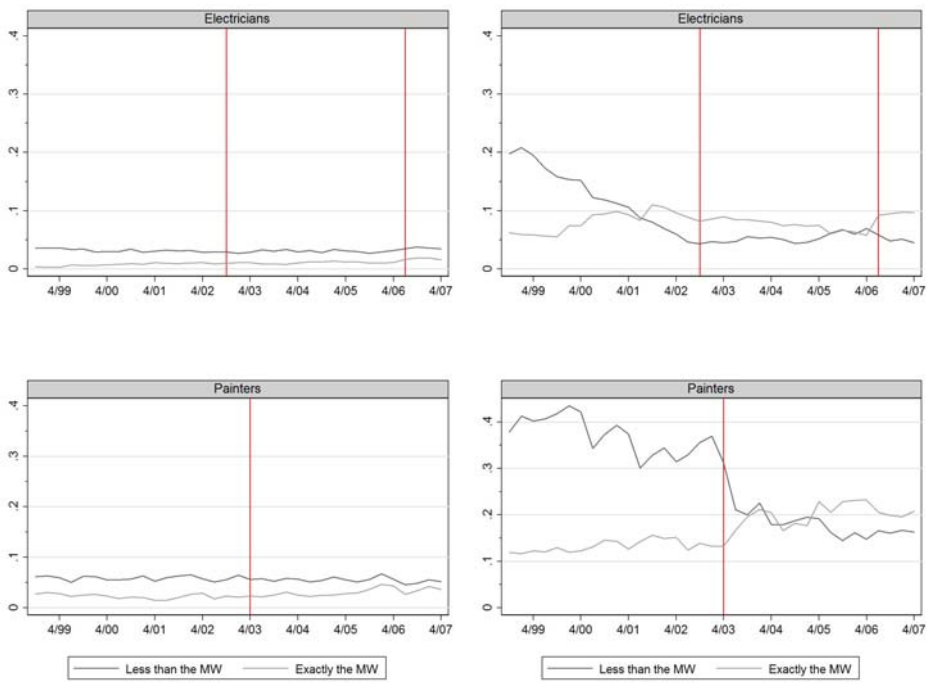
(b) Employment Development in East Germany



Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.

Figure 3: Bite of the Minimum Wage

(a) West Germany (b) East Germany



Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.
The figure shows the proportion of workers earning exactly/less than the minimum wage. The vertical lines depict the points in time when minimum wages were introduced (Electricians: First line - abolishment; Second line - re-introduction).

Table 1: Summary Statistics per Group

	Empl.	Average Wages	Minimum Wages	Kaitz Index	Marginal Empl. (%)	Unskilled Workers(%)	Young Workers (%)	Small Firms(%)	Blue Collar(%)
West Germany									
Wholesale/Retailing	38899	2470	n.a.	n.a.	18.47	9.38	11.14	37.99	26.86
Communication/Transport	18609	2457	n.a.	n.a.	14.13	13.92	8.66	27.60	61.91
Electricians	1989	2347	1417	60.94	3.70	5.61	17.25	54.02	91.15
Painters	1424	2257	1729	75.97	4.56	7.16	15.28	70.23	100.00
Clerks	1952	2055	n.a.	n.a.	19.79	4.51	8.38	53.91	2.21
Electricians (Manufacturing)	5576	2954	n.a.	n.a.	2.14	7.45	11.39	15.18	84.61
Painters (Manufacturing)	1195	2624	n.a.	n.a.	3.81	20.71	10.01	22.39	100.00
Clerks (Manufacturing)	22975	2819	n.a.	n.a.	11.50	5.53	10.60	22.49	2.36
East Germany									
	Empl.	Average Wages	Minimum Wages	Kaitz Index	Marginal Empl. (%)	Unskilled Workers(%)	Young Workers (%)	Small Firms(%)	Blue Collar(%)
Wholesale/Retailing	7113	1863	n.a.	n.a.	15.00	3.68	9.79	51.30	32.52
Communication/Transport	5711	2091	n.a.	n.a.	10.28	4.76	5.41	28.36	61.75
Electricians	829	1664	1247	75.87	2.54	1.81	13.44	53.53	95.35
Painters	472	1657	1517	90.18	4.92	3.50	18.37	63.61	100.00
Clerks	640	1705	n.a.	n.a.	13.98	2.18	7.88	57.45	4.35
Electricians (Manufacturing)	1193	2286	n.a.	n.a.	1.68	3.03	7.03	20.44	88.09
Painters (Manufacturing)	216	1876	n.a.	n.a.	3.32	6.18	12.81	31.67	100.00
Clerks (Manufacturing)	3308	2231	n.a.	n.a.	7.65	2.35	8.28	30.50	4.66

Values are averaged over the observation period 1998-2008. Minimum wages are averaged over the time periods during which they existed. They are expressed as monthly gross wages, assuming that actual working hours are equal to contractual working hours.

Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.

Table 2: The Employment Effect of the Minimum Wage Introduction

	West Germany				East Germany			
	Model 1		Model 2		Model 1		Model 2	
Minimum wage dummy	0.0045	(0.0084)	−0.0009	(0.0075)	0.0083	(0.0143)	−0.0104	(0.0120)
Marginal employment			−0.0689***	(0.0205)			−0.0155	(0.0105)
Macroeconomic growth			0.3185***	(0.0996)			0.5578***	(0.1217)
Communication & Transport	0.0249***	(0.0072)	0.0211***	(0.0068)	0.0123	(0.0176)	0.0041	(0.0096)
Electricians	−0.0075	(0.0084)	0.0014	(0.0077)	−0.0231	(0.0196)	0.0074	(0.0136)
Painters	−0.0220*	(0.0125)	−0.0038	(0.0111)	−0.0528*	(0.0282)	0.0145	(0.0213)
Industry dummies[1]	yes***		yes**		yes		yes	
Time dummies [1]	yes***		yes***		yes***		yes***	
Breusch-Pagan Test[2]	26.63***		18.61***		12.01***		17.16***	
Wooldridge Test[3]	36.75***		31.47**		109.85***		51.44***	
R^2	0.532		0.620		0.484		0.653	
Observations	124		124		124		124	

Legend: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets. All models are estimated by Prais-Winston regression to allow for AR(1) errors within panels. Standard errors are adjusted for heteroskedasticity between panels.

[1] Significance level of joint test of significance of all industry/time dummies.

[2] Chi-square value of the Breusch-Pagan test for heteroskedasticity with the null hypothesis of constant variances.

[3] F-value of the Wooldridge test for autocorrelation in panel data.

Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.

Table 3: Estimation Results of the DDD Estimator

	West Germany				East Germany			
	Electricians		Painters		Electricians		Painters	
Minimum Wage	−0.0063	(0.0049)	−0.0027	(0.0118)	0.0060	(0.0120)	0.0421**	(0.0196)
Occupation	0.0010	(0.0058)	−0.0321***	(0.0113)	−0.0299**	(0.0151)	−0.0265	(0.0198)
Industry	−0.0039	(0.0058)	0.0014	(0.0113)	−0.0369**	(0.0151)	−0.0216	(0.0198)
Occupation*Industry	0.0165***	(0.0054)	0.0170*	(0.0099)	0.0087	(0.0144)	−0.0421**	(0.0191)
Time dummies[1]	yes***		yes***		yes***		yes***	
Time dummies*Occupation[1]	yes***		yes***		yes***		yes***	
Time dummies*Industry [1]	yes***		yes***		yes***		yes***	
Breusch-Pagan Test[2]	3.83*		17.77***		0.74		9.32***	
Wooldridge Test[3]	177.76***		311.16***		243.24***		273.10***	
R^2	0.911		0.846		0.817		0.864	
Observations	124		124		124		124	

Legend: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets. All models are estimated by Prais-Winston regression to allow for AR(1) errors within panels. Standard errors are adjusted for heteroskedasticity between panels in all estimations, except for electricians in East Germany.

[1] Significance level of joint test of significance of all industry/time dummies.

[2] Chi-square value of the Breusch-Pagan test for heteroskedasticity with the null hypothesis of constant variances.

[3] F-value of the Wooldridge test for autocorrelation in panel data.

Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.

Table 4: Separate Estimations of the DiD Estimator

	West Germany				East Germany			
	Electricians		Painters		Electricians		Painters	
Minimum wage dummy	−0.0039	(0.0075)	0.0194	(0.0131)	0.0033	(0.0108)	−0.0130	(0.0251)
Marginal employment	−0.0262	(0.0199)	−0.0953***	(0.0290)	−0.0286***	(0.0100)	−0.0085	(0.0163)
Macroeconomic growth	0.0886	(0.0765)	0.3044***	(0.1084)	0.1861*	(0.1034)	0.7205***	(0.1614)
Communication & Transport	0.0241***	(0.0044)	0.0215***	(0.0057)	0.0106*	(0.0059)	0.0015	(0.0103)
Electricians	−0.0006	(0.0077)			−0.0120	(0.0110)		
Painters			−0.0129	(0.0114)			0.0318	(0.0297)
Industry dummies[1]	yes***		yes		yes*		yes	
Time dummies [1]	yes***		yes***		yes***		yes***	
Breusch-Pagan Test[2]	4.41**		35.45***		0.27		178.13***	
Wooldridge Test[3]	696.92***		125.68**		68.43**		101.93***	
R^2	0.671		0.674		0.665		0.668	
Observations	93		93		93		93	

Legend: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets. All models are estimated by Prais-Winston regression to allow for AR(1) errors within panels. Standard errors are adjusted for heteroskedasticity between panels.

[1] Significance level of joint test of significance of all industry/time dummies.

[2] Chi-square value of the Breusch-Pagan test for heteroskedasticity with the null hypothesis of constant variances.

[3] F-value of the Wooldridge test for autocorrelation in panel data.

Source: BA employment panel (Schmucker and Seth, 2009). Author's calculations.