Deutsches Institut für
Wirtschaftsforschung

DIW BERLIN

Discussion Papers

1111

Pia Rattenhuber

Building the Minimum Wage

Germany's First Sectoral Minimum Wage and its Impact on Wages in the Construction Industry

Berlin, March 2011

IMPRESSUM

DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin

Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
http://www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

Papers can be downloaded free of charge from the DIW Berlin website:
http://www.diw.de/discussionpapers

Discussion Papers of DIW Berlin are indexed in RePEc and SSRN:
http://ideas.repec.org/s/diw/diwwpp.html
http://www.ssrn.com/link/DIW-Berlin-German-Inst-Econ-Res.html

Building the Minimum Wage

Germany's First Sectoral Minimum Wage and its Impact on Wages in the Construction Industry[†]

Pia Rattenhuber[⋆]

March 7, 2011

Abstract

The very first minimum wage in Germany was introduced in 1997 for blue-collar workers in sub-sectors of the construction industry. In the setting of a natural experiment blue-collar workers in neighboring 4-digit-industries and white-collar workers are used as control groups for differences-in-differences-in-differences estimation based on linked employer-employee data. Estimation results reveal a sizable positive average impact on wages in East Germany and no effect in West Germany. Size and significance of effects are not homogeneous across wage regimes (individual vs. collective contracts) and across the distribution suggesting spillover effects to wages where the minimum is not binding.

KEYWORDS: Minimum wage, construction sector, linked employer-employee data, differences-in-differences-in-differences, unconditional quantile regression.
JEL classification: C21, J18, J38.

[⋆] German Institute for Economic Research Berlin (DIW), Mohrenstr. 58, D-10785 Berlin,
Tel.: +49 30 98789 353, Fax: +49 89789 114, E-mail: prattenhuber@diw.de

[†] I thank Viktor Steiner, Kai-Uwe Müller, Peter Haan, and participants of the Economic Policy Seminar of Free University Berlin, the BeNA seminar and at the 2010 conference of the Verein für Socialpolitik for very valuable comments and suggestions on earlier versions of the paper. Martin Gornig and Gregor Asshoff graciously shared information on the construction sector and I owe particularly thanks to all the staff at the Federal Research Data Centre of the State Statistical Institute Berlin-Brandenburg.

1 Introduction

Minimum wages (MWs) have been for a long time and continue to be brought up as a panacea in discussions about labor market policy, equality and fairness. MWs are implemented in developed and developing countries alike. The institutional designs range from a nation-wide MW to regional and sector-specific rates. Some countries rely on different levels of pay for younger and older or more and less educated employees. Such great variety of institutional details reveals the manifold opinions and beliefs in societies and governments across the world about the effects of the MW.

Germany introduced its first MW only in 1997 as a sector-specific MW in parts of the construction industry. The MW covered blue-collar workers ("gewerbliche Arbeitnehmer") in substantial parts of the main construction trade with different rates in East and West Germany and was negotiated between organized employers and unions of the industry. Since then sector-specific binding lower floors for wages have been installed in several other sectors such as cleaning and postal services while more sectors shall follow. There is unison that the MW in the construction sector constituted a breach in the till then dominating reservation against MWs in the political establishment.

Despite its seminal importance it has been little evaluated. This can be blamed mainly on the lack of suitable data. König and Möller (2007) find small positive effects of the MW introduction on wages and negatively (slightly positively) employment effects in East (West) Germany using data from the Federal Employment Agency that do not allow for calculation of hourly wages and a proper distinction of those treated. The results on employment are challenged by Müller (2010) who finds negative employment effects, particularly large for East Germany.

Evidence on wage effects of the MW from the UK reports a significant increase in wages and a compression of the lower part of the wage distribution (Machin and Wilson, 2004; Machin et al., 2003; Dickens and Manning, 2004b). Studies for the US emphasize the role of spillovers and effects of the MW on parts of the wage distribution where it is not binding (Katz and Krueger, 1992; Card and Krueger, 1995; Manning, 2003). The institutional design of the German MW is closely tied to the wage bargain on the sectoral level in contrast to many other countries' institutions

and the MW was introduced as an additional lowest rung to the pay scale in the wage bargain. For the Spanish setting which is somewhat more akin to the German case Dolado et al. (1997) attribute a 6.21% wage gain to the existence of collectively bargained sectoral MWs situated above the national statutory minimum. While the general effect of unions and/or collective agreements on wages has not been conclusively settled yet for the German case (Stephan and Gerlach, 2005; Fitzenberger et al., 2008) it remains an open question how the introduction of a lowest wage floor determined in the wage bargain that is binding for all workers in an industry affects average wages and the structure of wages overall.

The aim of this study is to shed light on the following issues: Did the MW truly bite? Was there an average effect on wage growth and was such effect heterogeneous across wage regimes? Are there spillover effects of the MW?

Owing to the initial introduction of the MW to certain sub-sectors of the industry these questions can be evaluated in the scope of a natural experiment. One of the few data sources in Germany that allow for calculation of hourly wages while offering enough observations with industry information on the 4-digit level is the German Structure of Earnings Survey (GSES; "Gehalts- und Lohnstrukturerhebung"), a linked employer-employee data set. Based on two cross sections I can properly distinguish between employees that were eligible to the MW and those that were not. Due to the data structure two groups of employees in the construction sector lend themselves naturally as control groups; blue-collar workers in establishments that make part of the construction sector but are not in the treated sub-sectors and white-collar workers in the industry. Based on a "differences-in-differences-in-differences" (DDD) estimation strategy these two groups are used as a means to back out the treatment effect of the MW on gross hourly wages. Moreover the impact heterogeneity along the wage distribution is analyzed with unconditional quantile regressions as proposed by Firpo et al. (2009).

I find a surprisingly large positive mean effect of the MW on wages in the treated sub-sectors of East Germany. Average wages grew by 8% due to the policy. Coefficients estimated for West Germany are small and insignificant. The impact is not homogeneous; while the wage growth for East German blue-collar workers under individual contracting is highly significant, the effect for those under the sectoral collective agreement (CA) is not significantly different from zero. Along the wage

distribution the treatment effect for those under individual bargaining in East Germany is highest in the lowest quartile but treatment at higher percentiles remains positive and significant albeit of smaller size. In West Germany the insignificant mean effect for wages under collective contracts is complemented by a clearly positive and significant treatment effect in the middle and upper part of the distribution.

This study is a first step in evaluating the impact of sectoral MWs that are set in the scope of the wage bargain. The evidence suggests that the institutional setting at hand is a lot more conducive to spillovers and hence larger wage effects of the MW than under statutory MWs. It also underlines that a MW introduction may affect wage dispersion and may increase wages that were not the initial target of the MW policy.

The remainder of the paper is structured as follows. Section 2 briefly reviews theoretical and empirical literature on the topic while Section 3 summarizes the state of the German construction sector at the time of the MW introduction and its institutional design. In Section 4 details on the data source are presented, sample selection and group assignment are discussed and descriptive statistics provided. Section 5 illustrates the estimation strategies whose results are presented in Section 6. Finally, Section 7 concludes.

2 Previous Literature

Although MWs remain one of the most studied fields in economics the evidence does not argue conclusively in favor of one of the two sides of the political debate. Theory has derived antagonistic results with regard to employment effects depending on assumptions. Assuming compliance the effect on wages that were below the MW before its introduction clearly has to be positive.

Economists have developed theoretical models that explain effects of the MW on wages higher up in the wage distribution (see Neumark and Wascher (2008) for a concise overview also on empirical evidence). If firms substitute low qualified employees with better qualified employees to even up wages and worker productivity wages of the later increase according to Pettengill (1981). These spillover effects decrease along the distribution. A competing explanation is presented by Manning (2003); in the framework of an equilibrium search model with monopsonistic firms

employers that pay generous wages to hire workers matched with low-wage firms have to increase their wage offers even further after the introduction of the MW to hire enough workers. Again, this effect is strongest for firms that used to pay just a little more than the new MW.

Grossman (1983) explains spill-overs of the MW with the need to maintain the wage hierarchy. More skilled workers are better paid but their effort depends on the relative distance in pay to the low-skilled workers that experience a wage hike due to the MW introduction. This gives rise to a twofold pressure on the wages of the more skilled; for one, the employers' attempt to substitute the low-skilled workers with more skilled workers shifts demand, for two, the more skilled workers would reduce their effort in view of the smaller wage differential relative to the less-skilled workers, if their own wages were not increased accordingly as well. Finally, a recent model proposed by Dittrich and Knabe (2010) implements the Kalai-Smorodinsky bargaining solution as opposed to the common Nash bargain that cannot explain spillovers of the MW. Employers and unions agree on a bargain if their relative utility gains are equalized which is defined as the ratio of the actual gain relative to the maximum feasible gain. The introduction of the MW reduces the maximum feasible gain for the employers as the best solution available now is moved up to the statutory MW. The employers' bargaining set is thus reduced which in turn leads to higher wages.

Given the questions at hand and the institutional setting of the MW in Germany three fields of the empirical literature promise some useful insights to take away with: (1) the vast literature on MWs, particularly its effects on wages and spillovers, (2) the literature on the effect of the wage minima agreed on in collective bargaining, and as a sidestep (3) the literature on the general effect of unions and CAs on wages and wage structure given the importance of the social partners in the German case.

Compared to the very large literature on employment effects of the MW a comparatively small number of studies focuses on the effect on wages. In the UK the introduction of the National MW in 1999 is used to analyze the impact on wage growth and the wage distribution; Machin and Wilson (2004) find for UK care homes that on the home level wages rose significantly with a spike a the new MW and that the lower end of the wage distribution was compressed (Machin et al., 2003). Dickens and Manning (2004b) detect an impact of the MW at the 5% per-

centile that disappears at the 10% percentile, which confirms the findings assembled by Metcalf (2004). The overall effect on inequality is found to be small by Dickens and Manning (2004a).

The findings of little or no spill-overs run counter to evidence found for the US. In an early study Grossman (1983) finds that wages for occupations just above the MW see an increase at least in the short run as a response to a MW hike. Studies by DiNardo et al. (1996); Lee (1999); Teulings (2000) also oppose the view that the MW has little or no effect on the wage distribution. Manning (2003) follows Lee (1999) and finds based on CPS data that for wages just above the MW spillovers amount up to 11% of the MW yet the effect dies out at wages 50% higher than the MW. Katz and Krueger (1992) and Card and Krueger (1995) analyze spillovers of the MW in fast food restaurants in Texas; 16% of firms increase wages by more than the MW hike actually forced them to and a large fraction actually maintained the wage hierarchy. Amongst companies with a starting wage 5.88% higher than the newly introduced MW 60% increased wages.

For Germany König and Möller (2007) studied the impact of the MW in the construction sector on employment and wage growth in the familiar "difference-in-differences" (DD) framework with data from the Federal Employment Office. They found a positive and significant effect on wage growth due to the MW introduction for both parts of the country ranging from 1% to 3% in East Germany and 0.5% in West Germany. The control group is designed as employees situated slightly higher up in the wage distribution and no statement beyond the mean effect can be made. If there were any spillover effects of the MW, wage growth would be underestimated by construction of control group. Employment effects turn out negative (slightly positive) in East (West) Germany. Particularly the results for West Germany were hotly debated amongst economists and in the media (Storbeck, 2007; Kluve and Schmidt, 2007; Meier and Munz, 2008) in view of the choice of control group and data restrictions, i.e. the determination of treatment and control group without information on hourly wages. Müller (2010) uses semi-parametric estimation methods to gauge the employment effect based on the GSES for 2001. He finds small negative effects for West Germany (1-2%) and significant employment losses in East Germany (4-5%).

Given the important role played by the social partners in setting the MW a closer

look at the effect of union membership and more particularly collective bargaining on wages is helpful. For the US there is a vast literature on the effect of union membership (see Blau and Kahn (1999) for an overview, Card and Krueger (1995), Firpo et al. (2009) inter alia). A field less studied is the role of wage minima set in the scope of collective bargaining schemes. Dolado et al. (1997) analyze the case of Spain where collectively bargained minima covered about 85% of wage earners at that time and were much more binding than the statutory national minimum. They find that the collectively bargained wages significantly reduced wage dispersion and observe wage gains between 6.21% (overall) and 12.32% (semi-skilled workers) at the cost of non-negligible employment loss.

Studies on the effects of union membership in Germany in earlier years find mixed evidence; Schmidt and Zimmermann (1991) amongst others find no direct effect of individual union membership on earnings for Germany, Wagner (1991) finds a positive wage premium when restricting his analysis to blue-collar workers. Yet union density has always been a lot lower than coverage by collective agreements in Germany. In the year 2000, e.g., trade union density was only at 25% in 2000 in the overall economy, but 68% of employees were covered by collective wage bargaining (OECD, 2004, p. 145). This mirrors the fact that if an employer makes part of the employers' association and only one of his employees is in the union, the tariff is extended to all his employees (for greater detail see Haucap et al. (2006, p. 363)). Reliable information of union density on a sectoral level is unfortunately not available; anecdotal evidence suggests that deunionization did not spare the construction sector despite the traditionally strong presence of unions in the sector. Particularly in East Germany firms left the employers' association. Given the German institutional setting it is generally agreed that the debate should not so much center on the union wage premium but more on whether there is a (potentially additional) premium to coverage by a collective contract.

Based on the linked employer-employee data set of the GSES Stephan and Gerlach (2005) find that the expected wage of the average worker is higher in establishments under a collective contract than in the uncovered regime for full-time employees in large manufacturing firms (100 or more employees) in Lower-Saxony. In another study by the authors (Gerlach and Stephan, 2006) decomposition analysis on the sample of blue-collar workers shows that under industry-wide agreements

the dispersion of wages across and within establishments is always smaller than under individual wage bargaining. Fitzenberger et al. (2008) reach quite different conclusions based on a sample of male, full-time, working-age blue- and white-collar workers of all industries in West German firms in the GSES of 2001. Controlling for union density effects they find a significant positive effect of the share of coverage on firm level wages yet a negative effect of individual bargaining coverage which even increases along the wage distribution.

3 The German Construction Sector and the MW

Up till the 1990s the German construction sector was compared to other countries highly unionized and had developed a corporatist system that ensured a comparatively high and stable pay for German workers (Eichhorst, 2005). In the following years the German construction sector was stricken by the aftermath of the reunification boom and the dawn of the European unification. Earlier the number of posted workers from non-European countries had exceeded those from European countries. But the free movement of labor associated with the Single European Market had brought ever more posted workers from EU countries. Although the number of posted workers from non-EU countries that came to Germany based on bilateral contracts had continually decreased throughout those years labor market tightness continued to increase. With the abolishment of seasonal employment in 1993 policy makers had de facto exhausted the tool kit of then available protectionist policies.[1]

Several other European countries faced a similar dilemma and the European Commission presented a first draft for a directive on posted workers in June 1991. German legislation pre-empted the lengthy EU-level negotiations and passed its own bill. Later on only slight modifications of the German Posted Workers Act ("Arbeitnehmer-Entsendegesetz") were needed to comply with the final EU directive in 1996. For the Posted Workers Act to become effective the rate of the MW had to be determined in the scope of a CA and declared generally binding via the extension rule ("Allgemeinverbindlichkeitserklärung"). These three interacting

[1]Meier and Munz (2008) discuss the role of foreign companies and workers in the light of institutional changes at the time. They document a sizable employment decline in the construction sector overall amongst foreign workers in the framework of the bilateral contracts in the early 1990s and a stark decrease in numbers of posted workers after the MW introduction.

pieces of legislation are discussed in detail below.

The CA on the MW is bargained by the organization(s) of the employers and the unions within the general negotiations between the social partners on contracts for their members in an area tariff system. Negotiations typically revolve around the tariff for the basic wage which refers to employees with relevant 3-year vocational training and some kind of further specialization or a few years of work experience. In the main construction trade the geographic differentiation of pay rates refers to East and West Germany. In the wage bargain exemption clauses can be agreed on that allow deviating alas lower wages or higher working hours if the employer faces hard times. For the main construction trade exemption clauses included wage cuts of up to 10% (5%) in East Germany (West Germany) while not underbidding the MW. Some employers also opt to pay above the general pay scale.

CAs refer to the establishment level as opposed to the judicial entity of the firm. In the main construction trade different agreements on pay scales are negotiated for blue-collar and white-collar workers. Employees fulfilling typical construction tasks are classified as blue-collar workers with the exception of head masons who make part of the white-collar work force.[2] As the highest ranking group involved in construction task they are situated between their blue-collar colleagues fulfilling construction task and white-collar construction engineers. The pay scale for blue-collar workers was composed of more than eight different job grades at the time.

The extension rule declares the CA compulsory for all employers and blue-collar employees in the sector regardless of whether they are member of the collective bargaining parties or not. For the extension rule to be applicable the CA has to fulfill two requirements; for one it has to be passed in accordance with the law that regulates the collective wage bargaining process ("Tarifvertragsgesetz"). Moreover organized establishments have to employ at least 50% of the concerned employees and the extension rule has to be of "substantial public interest".

The extension rule has to be passed by the committee of collective bargaining parties ("Tarifausschus") that is made up of employee and employer representatives in equal measure before the Ministry of Labor can apply the extension rule.[3] The

[2]In the definition of skill groups in the basic agreement which the wage bargain refers to head masons in the white-collar pay scale are called "Polier" whereas the highest ranked group of blue-collar workers is referred to as "Werkpolier".

[3] This also marks the difference to a variety of other sectoral MWs discussed in Germany lately.

process to declare the CA compulsory for all employees and employers in the sector of the wage bargain was altered later on. In order to eliminate the employers' right of veto in the committee of collective bargaining parties, the red-green coalition that had come to power in 1999, changed the Posted Workers Act; since then the CA on MWs can be declared generally compulsory by statutory regulation through the Minister of Labor. Practically the application of the extension rule means that when organized employers negotiate with unions about the (introductory) level of the MW they make decisions about the cost structure of all employers in the sector including their non-organized competitors.

The Posted Workers Act finally extends the scope of the MW now binding on a national level with regard to foreign firms posting workers to Germany. The Posted Workers Law thus allows to set minimum standards for foreign employees posted to Germany if in conjoint with the commensurate extension rule on the industry level. Along the way it opened the loophole for setting a MW for all German employees in the sector.

The construction industry consists of several sub-sectors. In the official micro data an establishment is assigned to the sub-sector where it generates the major part of its value-added. To switch sectors an establishment has to shift the greatest part of its economic activity.[4] The social partners are grouped along the lines of certain sub-sectors or groups of sub-sectors. Great parts of the main construction trade are represented by two employers' organization ("Zentralverband Deutsches Baugewerbe" and "Hauptverband der deutschen Bauindustrie") and one union ("Industriegewerkschaft Bauen-Agrar-Umwelt").

Sub-sectors other than the main construction trade have traditionally their own structures and negotiate their own CAs. Electric installation, roofing, painting, and wreckage in construction introduced sooner or later their own MWs. Therefore a sizable part of employees in the construction sector became eligible later and/or at a

Most of those rely on the law for minimum working standards and are not negotiated by the social partners directly.

[4]Employers could have tried to escape MW coverage by shifting the major part of their economic activity to a non-covered sub-sector while generating a marginally smaller fraction of value-added in economic activity typical of the covered sector. The combination of occupations, thus the skill input by workers did neither change greatly in the covered nor in the non-covered part of the construction industry; this indicates that dodging the MW legislation by switching industry affiliation is not an issue. Given the subsequent introduction of MW in neighboring sub-sectors such behavior would have been quite short-sighted anyways.

different MW rate than the majority of 4-digit-level sectors in the main construction trade in January 1997. The MW introduction had been delayed by approximately 12 months owing to the rejection of the policy from the employers' side and ongoing disaccord within the different bodies involved. The employers' organizations in the main construction trade were not generally opposed to the introduction of a MW. But the umbrella organization of employers was strictly opposed and halted the introduction. As a compromise with regard to employers' opposition to its introduction, the MW was to be reduced after its first phase when it finally came into effect.[5]

The MW is an hourly and establishment based concept that is thus differentiated with regard to its validity in terms of sectors covered and employees covered. On the employee level only blue-collar workers above 18 and not on vocational training are eligible, regardless of their tasks and level of education. A few professions are explicitly excluded (i.e. kitchen aids, security guards, delivery and cleaning personnel). With the introduction of the MW a new wage group was created in the pay scale of the CAs.[6] It was agreed that this group should be situated below the till then lowest paid group of unskilled laborers in non-construction occupations.

Table 1: The Development of the Nominal Minimum Wage across Time (in €)

		East	West
January 1997	- August 1997	8.00	8.69
September 1997	- August 1999	7.74	8.18
September 1999	- August 2000	8.32	9.46
September 2000	- August 2001	8.49	9.65
September 2001	- August 2002	8.63	9.80

Source: Tarifsammlung Bauwirtschaft 1997/1998, 1998/1999, 1999/2000 and 2001/2002, Elsner Verlag.

In West Germany the MW finally set came equal to 90.55% of what the lowest wage group had earned at the time the MW came into effect. In East Germany this difference was marginally smaller with 8.34 percentage points distance. Social partners set the level of the MW without any formal knowledge of their competitors'

[5]More information on the political mayhem surrounding the MW introduction can be found in German on http://www.boeckler.de/27758_21459.html

[6]In September 2003 an additional MW for workers with vocational training was implemented, so called "ML2").

wage structure. At the time of the MW negotiations no data base with reliable hourly wage information differentiated along wage regime was available. Table 1 shows the path of the MW from its introduction in January 1997 up till August 2002. The nominal MW increased by 7.86% (12,77%) in East (West) Germany during this time.

4 Data, Differentiation of Treatment and Control Groups & Descriptive Evidence

4.1 The GSES

This study is based on official micro data from the GSES, the German salary and wage survey (Hafner and Lenz, 2007).[7] It collects every few years a cross section of data from establishments ("Betrieb") with 10 or more employees. On the employee level the GSES assembles information on wages, hours worked, overtime, (payroll) taxes, education, job description, a rough classification of the tasks fulfilled in terms of intra-firm hierarchy, and time with the employer amongst other things. On the establishment level the region, the industry code, number of employees, fraction of blue and white-collar workers, fraction of men and women, participation in CAs are provided i.a. The data does not contain any information on job quits. As the GSES makes part of the official micro data statistics establishments are liable to respond if sampled and non-response is low.

I use two cross sections of the data for October of the years 1995 and 2001 and restrict the sample to employees between 18 to 65 years old, not on vocational training or internships. The data allow for an accurate calculation of hourly wages since the gross wage can be broken down into normal labor income and labor income due to overtime, time worked on weekends, bank holidays etc. Any extra pay is subtracted from the pay bill of October and hours according to contract are used to compute hourly wages since the variable on hours paid only exists for 70% of observations in the sample.[8] For estimation results it does not make a difference if

[7] Since 2006 it is called "Verdienststrukturerhebung".

[8] Hourly wage=[gross wage for October-remuneration for extra work-remuneration for shifts worked-remuneration for work on weekends/bank holidays-remuneration for night shifts]/(weekly work time according to contract*4.3)

I use log gross hourly wage based on total working hours or log of monthly labor income as the dependent variable instead of hourly wages based on hours according to contract. Hourly wages calculated to be lower (higher) than €3 (€150) were not considered in the analysis for plausibility. The data discern between individual wage contracts, coverage by a CA, firm or establishment agreement. If not explicitly mentioned otherwise the term "collective agreement" (CA) will be used as a synonym for all three types of agreements in the following. The variable on the difficulty of tasks fulfilled captures differences in education needed for the job and degree of responsibility; yet it is not possible to identify the pay scale as implemented in the CAs.

4.2 Treatment and Control Groups

The sectoral MW was passed on a national scale and differentiated in its level with regard to East and West Germany. For that reason geographical variation cannot be used to construct treatment and control group as is commonly done in the literature. Yet I exploit the fact that not all workers in the construction industry became eligible. Two subgroups within the industry lend themselves readily as control groups; blue-collar workers from other sub-sectors in construction and white-collar workers. As explained in more detail in Section 5 I use these two control groups together to back out the treatment effect that goes beyond general time, (sub)industry, and worker type effects.

Table 2 outlines the choice of treatment and control group in terms of the 4-digit-industry classification. Some sub-sectors of the construction industry are not suitable neither for the treatment nor for the control group. The excluded 4-digit-industries were overridden due to one of the following two reasons; (1) Industry classification on the 4-digit-level changed between 1995 and 2001 from SYPRO code to WZ93 in 2001. Conversion from one to the other is in some cases not unambiguously possible. (2) As explained in Section 3 a few other sector-specific MWs were introduced from 1997 on. Sectors that passed their own MW rate in 1997 were excluded. For simplicity the finally chosen sectors are referred to as "treatment and control sectors" below.

Another source of differentiation within the construction industry is the distinc-

Table 2: Treatment and Control Group along the lines of the 4-digit-industry classification, sectors that cannot be assigned in gray font

Treated sectors	**Industry code**
General constructions or parts thereof; civil engineering	4521
Construction highways, roads, airfields and sport facilities	4523
Construction of water projects	4524
Other construction work involving special trades	4525
Control sectors	
Plumbing	4533
Other building installation	4534
Floor and wall covering	4543
Painting and glazing	4544

Source: Federal Statistical Office (http://www.destatis.de/EN).
Notes: Structure of the sectors and subsectors according to the German Classification of Economic Activities ("Klassifikation der Wirtschaftszweige"), Edition 1993 (WZ 93).

tion between blue- and white-collar workers. MW legislation covers exclusively blue-collar workers in treatment sectors. As the data set is a linked employer-employee data set one observes wages for blue- and white-collar workers that are employed at exactly the same establishments. In view of general shocks affecting an establishment white-collar workers thus constitute another natural comparison group for their blue-collar colleagues.

4.3 Descriptive Evidence

Figure 1 displays the distribution of gross hourly wages in East and West Germany before and after the introduction of the MW for blue-collar workers in establishments in the treatment and the control sectors. For comparison gross hourly wages in 1995 were inflated to 1997 and the MW rates as of October 1997 and October 2001 were added as reference lines in the subfigures for the covered sectors. Plots for the control sectors display the familiar bell-shaped distribution of wages in both years and both parts of the country in the control sectors. Inspection of the top left panel shows that in East Germany a non-negligible range of wages of blue-collar workers in the covered sector was below the MW to be introduced quite in contrast to the West German situation depicted two panels further down. While the histograms for eligible workers are of similar shape in West Germany for both points in time, this

is not the case for East Germany after the introduction of the MW. The histogram in the top right panel reveals a very pronounced heaping of wages to the right of the MW for East Germany in 2001. For 2001 29.05% of blue-collar workers in the treated sectors of East Germany received wages in the range of the MW and 10 percentage points above. In West Germany this fraction amounts to a comparatively meagre 4.32%.

Table 3 further underlines the differential impact of the MW across the country; while in East Germany 10.65% of eligible workers have hourly wages below the MW, this only holds true for 0.44% in West Germany. The Kaitz index as the ratio of the nominal MW to the median of hourly wages further supports that the MW bit a lot more in East Germany than in the West of the country. While the MW amounts to 81% of the median of gross hourly wages of all employees in East Germany before the reform, the Kaitz index for West Germany equals 63%. The index is of similar value for both regions in 2001 and comes very close to the Kaitz index as calculated by König and Möller (2007). For comparison: In none of the OECD countries with a statutory national MW did the Kaitz index (OECD, 2010) reach more than 55% between 1995 and 2001, while the unweighted average across countries amounted to roughly 35%.

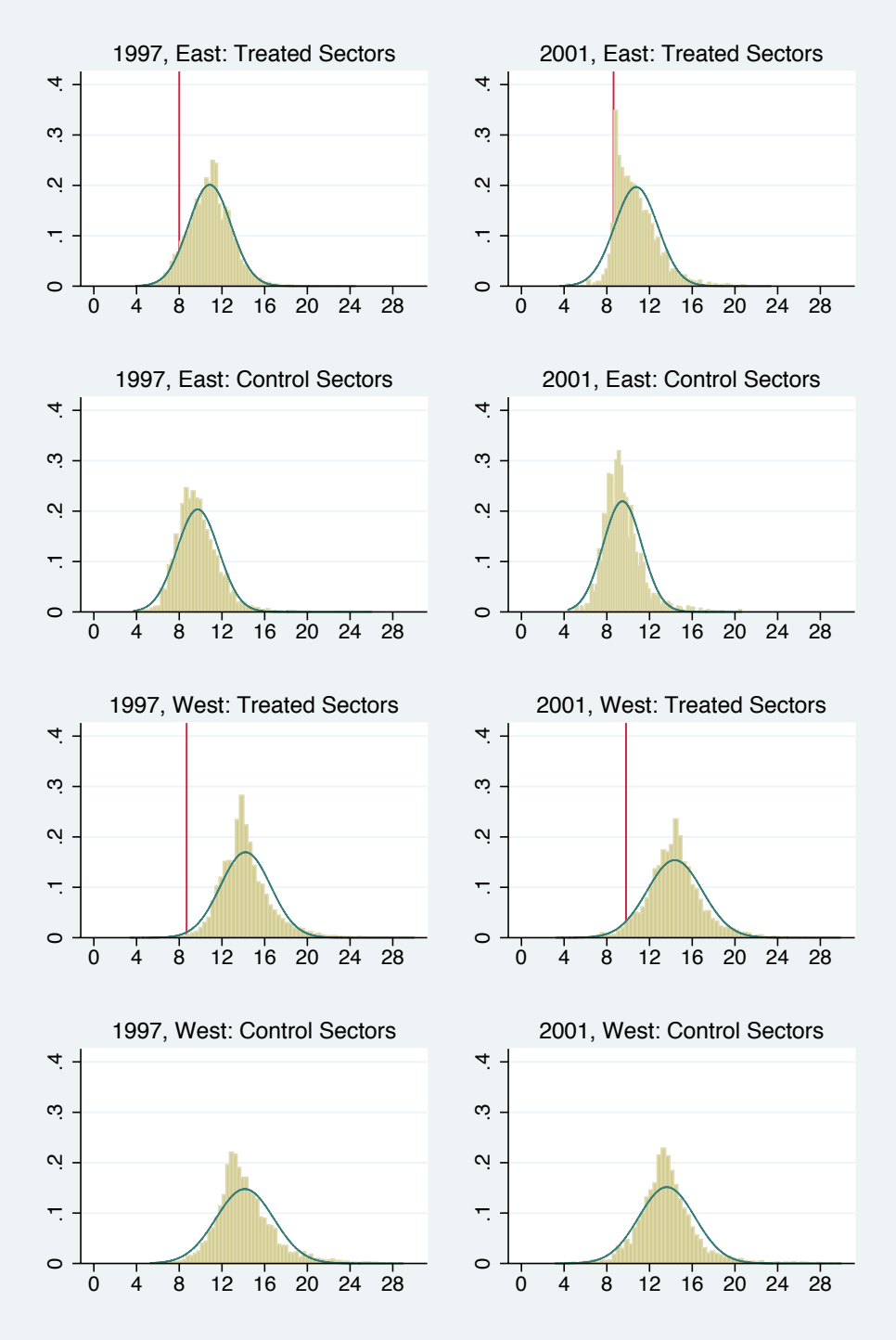
Table 3: Details on Eligible Employees with Gross Hourly Wages below the Initial Minimum Wage in 1997

	East	West
Kaitz index (median of wages in all sectors)	81%	63%
Kaitz index (median of wages for all eligible observations)	77%	63%
Eligible workers below the minimum wage		
... number of observations	877	61
... average establishment size	36	48
... as a fraction of all eligible workers	10.65%	0.44%
... average age	34	30
... fraction low-skilled	55%	74%
... average tenure in months	23	25

Source: GSES 1995.
Notes: weighted calculations based on wages inflated to level of 1/1997 using data from www.destatis.de.

Table 7 in the Appendix shows average characteristics of all workers in both periods. Blue-collar workers in the treated establishments are predominantly male

Figure 1: Distribution of Gross Hourly Wages in 1997 and 2001 for blue-collar workers in East and West Germany



Source: GSES 1995 and 2001.
Notes: own calculations based on gross hourly wages of October 1995 inflated to October 1997 using data from www.destatis.de. Reference lines plot the respective MW rates as of October 1997 and 2001.

and work full-time (columns 2 and 3). Coverage by a collective, firm or plant level agreement is particularly high in West Germany. The composition of occupations in treatment and control group remains stable across time. Table 3 provides as a comparison some average values for those earning below the MW prior to its introduction. Not surprisingly it is on average the younger employees with less than half of the average tenure in the full sample that are paid below the level of the MW to be introduced. Those paid lower than the MW also work predominantly in positions requiring less skills and training. On average they are employed in smaller establishments. This is in line with the descriptive evidence of a study by Müller and Steiner (2010) which shows that it is predominantly employees in smaller firms whose wages would fall short of a hypothesized economy wide MW.

Compliance with the nominal MW rate would have meant a wage growth between 10.96% and 12.83%[9] on average for entitled workers below the MW in East Germany before the policy reform. Adjusting wages for those below the new threshold and keeping all other workers in the eligible group at their actual wage level reveals a hypothetical average increase of at least 1.17% for the overall group. In the Western part of the country such nominal adjustment would have entailed a 11.80% to 12.59% (0.05%) increase for those entitled below the MW (everyone entitled).

Table 4: Hourly Wages of Eligible Blue-Collar Workers at Selected Percentiles

		q10	q20	q30	q40	q50	q60	q70	q80	q90
East	before	7.83	8.70	9.29	9.82	10.28	10.67	11.11	11.77	12.57
	after	8.72	9.04	9.42	9.90	10.38	10.90	11.50	12.21	13.38
West	before	10.98	11.72	12.33	12.83	13.15	13.56	14.06	14.87	16.16
	after	11.35	12.48	13.17	13.77	14.31	14.75	15.30	16.07	17.41

Source: GSES 1995 and 2001.

A rough comparison of quantiles of nominal hourly wages for eligible blue-collar workers before and after the policy is provided in Table 4. The first two rows show that percentiles on the tails of the wage distribution grew in East Germany.

[9]The size of theoretical wage growth needed for compliance hinges on the assumptions about wage inflation between October 1995 and January 1997. Assuming the general hourly wage inflation for the entire economy should constitute a lower bound given the unfavorable developments in the construction sector compared to the economy as a whole. As an upper bound the theoretical wage growth under compliance with no inflation adjustment is provided.

The median nominal wage barely grew, yet the 80%th wage percentile increased by 3.8%. What stands out most is the growth of the 10%-percentile; it increased by 11.33%. Considering only the wage distribution of blue-collar workers under individual contracts reveals that the distance to the median in that group more than halved over time. For West Germany the picture looks different. The small change in the left tail of the distribution increases along the percentiles and amounts to around 8% in the right tail. The picture is again heterogeneous across pay regimes; the median wage for employees under collective contract increased by nearly the double amount compared to the median of their colleagues not covered by a CA.

The MW introduced to parts of the German construction sector cannot be compared directly with other countries' experiences due to its deviating institutional design. Yet, drawing on the literature of wages effects from other countries discussed in Section 2, the set-up of the MW in the construction sector, and the descriptive evidence presented so far different scenarios come to mind about the potential effects of the MW. As it is unlikely that the higher labor costs were passed on into prices given the price pressure in the industry at the time (also see Lemos (2008) for a review of studies on the effects of MW on prices) and the scope for automatization limits the substitution of labor with capital in the sector, the major impact of the MW introduction should be detectable in the labor market.

Wages in the lower end of the distribution have to increase provided that the MW was set at a level high enough to cover some part of the work force in the sector and that there is compliance. On average one expects this effect to be large in East Germany, but less so in West Germany where the descriptive evidence reported above suggests that only a small wage hike was necessary to reach compliance. Theoretically employers could try to cover up the extra cost incurred in the lower end of the wage distribution by decreasing wages for those earning better than the MW but given wage rigidities this seems highly unlikely particularly for those employees under a collective contract.

Several explanations offer themselves for spillover effects of the MW. The wage hierarchy argument may come in two guises; for establishments with individual bargaining the MW could exert pressure on wages for those above the MW as illustrated in Section 2. This would entail a spillover effect that is biggest on the lowest tail of the distribution before it slowly dies out along the distribution. In

the institutional scheme of the MW unions and organized employers are pivotal in setting the MW rate as an additional lowest tariff in the pay scheme. If the social partners consider MWs as too high compared to the tasks fulfilled and the wage received by the other tariffs in the pay scale, namely in view of the basic wage rate, spillovers to skilled workers' wages will occur in order to maintain the wage hierarchy. The impact of the MW should then also be detectable in the upper part of the wage distribution. This again may exert additional pressure on wages for skilled workers not under CA. Given that there is a collective wage bargaining premium and unions strive to maintain it, they moreover may root for a shift of the pay scale by the amount the original premium is decreased due to the introduction of the MW and the subsequent wage increase for the non-covered employees.

Altogether mean effects of the MW on wages should be most pronounced for blue-collar workers that are not paid according to the CA, potentially also with spillovers, in East Germany where the MW is a lot more binding than in West Germany. Hypotheses with regard to wage effects for employees not under CA are less clear cut. If the MW introduction does not exert an upward pressure on the wage bargain no significant effects should be found. Yet, if pressure on parts or the whole pay scale occurs the compression of the wage distribution in the lower part of the wage distribution might actually be offset by an increase in dispersion on the upper end of the distribution.

5 Methodology

5.1 Difference-in-Differences-in-Differences Estimation

The construction sector went through troubled times in the 90s. The industry contracted as a whole while anecdotal and descriptive evidence suggest further that some sub-industries and establishments were hit harder than others by the downturn. In order to not confound the effects of the policy with general time, industry and worker type effects the two control groups defined in Section 4.2 are used to separate out the treatment effect. In the familiar DD framework the common trend assumption must not be violated. Given the unequal pressure on the labor market of construction industry's sub-sectors described above it is implausible to hold up

the assumption that in the absence of the policy wages of blue-collar workers in the treated and the control sectors would have experienced the same time trend. White-collar workers in the treated sectors make a doubtable control group as well in view of comparable time trends for blue- and white collar workers in the medium run perspective.

The DDD framework holds the advantage that its identifying assumption is considerably less restrictive. In this particular case it requires that in the absence of the policy the difference in time trends of wages for blue- and white-collar workers in the treated sectors would have been the same as the difference in time trends of wages of blue- and white-collar workers in the control sectors. The DDD framework thus allows for a differential overall trend in control and treatment sectors as much as for a differential time trend in blue- and white-collar workers' wages. While spillover effects on the control groups cannot be ruled out categorically descriptive evidence shows no significant change in the composition of occupations employed in the treated and the control sectors, and wage bargaining occurs separately across industries. The employees that appear the most susceptible of spillover effects in the control group are head masons and foremen; they are classified as white-collar workers in the wage bargain and the data yet their tasks are closest to those of the eligible workers. As a robustness check this group of employees is excluded from the baseline estimation and results do barely change (see Appendix).

Let the DDD estimator be defined as:

$$\begin{aligned} log(wage_{gm}) &= \beta_0 + \beta_1 * blue_{gm} + \beta_2 * post_g + \beta_3 * sector_g \\ &+ \beta_4 * (blue_{gm} * post_g) + \beta_5 * (blue_{gm} * sector_g) + \beta_6 * (post_g * sector_g) \\ &+ \beta_7 * (blue_{gm} * post_g * sector_g) \\ &+ \mathbf{e'_g}\boldsymbol{\mu} + \mathbf{p'_{gm}}\boldsymbol{\delta} + \upsilon_{gm}, \end{aligned} \tag{1}$$

where establishments are indexed by $g = 1, ..., G$. Blue- and white-collar employees 1 through M_g work for establishment g. $log(wage_{gm})$ is thus the log gross hourly wage for individual m working at establishment g. e_g is a $K \times 1$ vector of establishment specific covariates and p_{gm} is a $L \times 1$ vector capturing explanatory variables that vary within and across establishments, thus for each individual. $blue_{gm}$ is a dummy variable equal to one if the observed individual is a blue-collar worker; $post_g$

is a dummy equal to one if the individual is observed after the policy change; $sector_g$ is the industry dummy and equal to one if the individual works for an establishment in the treated sector; the error term is denoted υ_{gm}. The coefficients of the double interactions with $post_g$ capture reform-independent differential time trends that affect all blue-collar workers or all workers in the construction industry covered by the reform. The double interactions with $blue_{gm}$ control for time-invariant differences between blue-collar workers and other workers in the covered sector. The coefficient of the third-level interaction, β_7, is the DDD estimate of the impact of the MW reform. It captures the mean treatment effect of the MW introduction on wages of eligible blue-collar workers in the treated sectors.

Several control variables are added to mimic a Mincer-type wage equation. Age and age squared capture the typical age profile in labor income earnings. Dummies control for gender and full-time work. The data set does not provide information on work experience but includes information on time with the current employer. I include tenure in months to account for potential effects of longer periods with the same employer on wages. The variable on difficulty of tasks fulfilled is recoded in three dummy variables for low, medium or high qualifications (reference category) needed on the job. Finally, dummies for 5 different establishment size categories are added with the smallest (10 to 20 employees) as the base value.

5.2 Unconditional Quantile Regression

The DD(D) methodology allows for identification of the mean treatment effect of a policy. In the public debate the MW was presented as a means to better support those employees receiving the worst pay. The target group of the policy are thus the lower ranks of the wage distribution. If this promise of policy makers had come true, one should be able to identify higher effects at the lower quantiles of the wage distribution and lower, possibly zero or even negative effects in the higher ranks of the wage distribution. In contrast to conventional OLS, quantile regression (QR) models as first introduced by Koenker and Bassett (1978) allow to capture such heterogeneous effects across the wage distribution.

Often covariates other than the industry dummy change along the wage distribution, e.g. observations in the lower tail of the wage distribution are typically

less educated and younger. Conditional QR estimates describe how the wage is affected at a particular quantile given the explanatory variables. A drawback of the traditional quantile regression approach is its limited scope for interpretation. Unlike conditional means in a least-squares regression do conditional QR estimates not average up to the unconditional mean. We can thus interpret conditional QR coefficients only as effects on the distribution conditional on observations sharing the same values of covariates. Recently Firpo et al. (2009) proposed a new method to estimate the impact of changes in the explanatory variables on the unconditional quantiles of the outcome variable which they termed the Recentered Influence Function (RIF) regression.

RIF regression basically consists of two steps; first the dependent variable is transformed via the RIF, second, a regression is run of the transformed dependent variable on the explanatory variables. For simplicity $i = 1, ..., N$ represents an index across individuals that uniquely identifies each observation in the full sample and across time in the following. Each element of i thus corresponds to one single combination out of the employer g and employee m identifier. Let the unconditional (marginal) distribution function of wages, Y, be $F_Y(y) = \int F_{Y|X}(y|X = x) \cdot dF_X(x)$ such that the the density of Y evaluated at τth population quantile, q_τ, is $f_Y(q_\tau)$.

The RIF is defined as the sum of the distributional statistic of interest and its influence function which measures the influence of an individual observation on the distributional statistic. In the case of quantiles the RIF is

$$RIF(y; q_\tau) = q_\tau + IF(y; q_\tau) = q_\tau + \frac{\tau - \mathbb{1}\{y \leq q_\tau\}}{f_Y(q_\tau)} = c_{1,\tau} \cdot \mathbb{1}\{y > q_\tau\} + c_{2,\tau},$$

where $c_{1,\tau} = 1/f_Y(q_\tau)$ and $c_{2,\tau} = q_\tau - c_{1,\tau} \cdot (1 - \tau)$. The RIF equals the underlying distributional statistic in expectation. Conditional on some explanatory variables X the expectation of the RIF can be written as $E[RIF(Y; q_\tau)|X = x] = c_{1,\tau} \cdot Pr[Y > q_\tau|X = x] + c_{2,\tau}$ and is termed unconditional quantile regression because its average derivative corresponds to the marginal effect on the unconditional quantile. The authors further show that the unconditional effect $E[dE[RIF(Y, q_\tau)|X]/dx]$ is closely related to the average marginal probability response model $Pr[Y > q_\tau|X]$ and the family of conditional quantile effects. In case of a simple linear relationship between covariates X and the dependent variable estimation of the conditional expectation

$E[RIF^{OLS}(Y; q_\tau, F_Y)|X = x] = X'\gamma_\tau$ leads to the unconditional quantile regression coefficient $\widehat{\gamma}_\tau = \sum_{i=1}^{N}(X_i X_i')^{-1} \sum_{i=1}^{N} X_i * \widehat{RIF}(Y; \widehat{q_\tau})$.

For computation of $\widehat{RIF}(Y; \widehat{q_\tau}, F_Y)$ $\widehat{q_\tau}$ and $f_Y(\widehat{q_\tau})$ need to be estimated. The estimate of the τth sample quantile is deduced by solving

$$\widehat{q_\tau} = \arg\min_q \sum_{i=1}^{N}(\tau - \mathbb{1}\{Y_i - q \leq 0\}) \cdot (Y_i - q).$$

The density of the Y is estimated using the kernel density estimator. In the second step $\widehat{RIF}(Y; \widehat{q_\tau})$ is regressed on the independent variables.

In order to analyze treatment effect heterogeneity along the wage distribution RIF regression is combined with the linear DDD model described in Section 5.1. Regressors for the RIF regression are just the same as in the least squares specification written out in equation (1).

6 Results

6.1 Differences-in-Differences-in-Differences Results

For all specifications additional controls such as age, gender, skill, tenure and establishment size were included. Table 5 and 6 summarize the main estimation results of the DDD specification for East and West Germany. Detailed regression output is supplied in the Appendix (Tables 8 and 9). Standard errors are clustered on the establishment level in all specifications to account for correlation of error terms within establishments.

The first column ("DDD") of Table 5 shows estimation results for the base specification (1). In the rest of the columns interactions of the variables *blue*, *sector*, *post*, *blue* $*$ *post*, *blue* $*$ *sector*, *sector* $*$ *post*, and *blue* $*$ *post* $*$ *sector* with coverage by a CA were added and different sample restrictions made. Model "$\leq$200" restricts the sample to establishments with up to 200 employees. This excludes only a few establishments yet they provide many observations. The column to the far right provides estimation results when the sample is restricted to employees whose wage contract is not part of a firm or establishment level agreement. Firm and establishment level agreements are typically found in larger firms but to smaller extent also

in medium-sized companies.

Table 5: Overview of Main Differences-in-Differences-in-Differences Results for West Germany

	DDD all	DDD-CA all	DDD-CA ≤200	DDD-CA no firm CA
Blue*post*sector	0.017	0.056	0.055	0.056
	(0.020)	(0.038)	(0.040)	(0.038)
Blue*post*sector*CA		−0.024	−0.046	−0.022
		(0.044)	(0.044)	(0.044)
Blue*post*sector + blue*post*sector*CA		0.033	0.009	0.035
		(0.024)	(0.023)	(0.024)
F-Test for differential effects across coverage by a CA				
... on intercept & slopes		11.03	3.01	11.02
... p-value		0.000	0.002	0.000
... on slopes		8.01	1.78	8.16
... p-value		0.000	0.086	0.000
R^2	0.569	0.572	0.536	0.572
N	53651	53651	36939	53525

Source: GSES 1995 and 2001.
Notes: standard errors clustered on the establishment level in parentheses. ***significant at 1% level, **significant at 5% level, *significant at 10% level. The dependent variable is log hourly wages. "CA" refers to collective, firm or establishment agreement. "DDD-CA" stands for least squares estimation of the differences-in-differences-in-differences specification differentiated along union status. "<200" restricts the sample to observations in establishments with up to 200 employees. "no firm CA" excludes observations from establishments with a firm or establishment level agreement. For further details and the full regression output refer to Table 9.

Results for West Germany confirm that there was no significant mean treatment effect of the MW. This holds across the different specifications and sample restrictions. While point estimates suggest a slight positive impact none of the coefficients is significantly different from zero. The magnitude of effects is stable across specifications except for the overall point estimate ($blue*post*sector+blue*post*sector*CA$) for the effect on blue-collar workers not covered by a CA in the sample restricted to establishments with 200 employees, yet also this point estimate is insignificant. The F-Tests reject that slopes (and intercept) in the interacted model are jointly zero and support caution with regard to effect heterogeneity along coverage by a CA. The negative and significant base effect of coverage by collective contracting ("with CA") are in line albeit a little smaller than the findings by the study of Fitzenberger et al. (2008). Compared to blue-collar workers in the treated sectors after the introduction is the penalty for individuals under CA barely detectable (-0.5%) and insignificant. Column "no foremen" of Table 9 shows that estimation results do not

change when head masons and foremen that are classified as white-collar workers are excluded from the regression.

Table 6: Overview of Main Differences-in-Differences-in-Differences Results for East Germany

	DDD all	DDD-CA all	DDD-CA ≤200	DDD-CA no firm CA
Blue*post*sector	0.080***	0.130***	0.109***	0.130***
	(0.028)	(0.036)	(0.038)	(0.036)
Blue*post*sector*CA		−0.013	0.004	−0.030
Blue*post*sector + blue*post*sector*CA		0.117*	0.112*	0.100
		(0.063)	(0.064)	(0.070)
F-Test for differential effects coverage by a CA				
... on intercept & slopes		31.88	33.51	34.63
... p-value		0.000	0.000	0.000
... on slopes		5.60	6.33	4.86
... p-value		0.000	0.000	0.000
R^2	0.579	0.585	0.548	0.591
N	27640	27640	21986	26903

Source: GSES 1995 and 2001.
Notes: Refer to Table 5 for general details and to Table 8 for full regression output.

In East Germany the mean treatment effect is clearly positive and significant. Differentiation of the treatment effect along the wage contract regime reveals not so much different magnitudes of the treatment effect as confidence intervals for those under individual wage contracts and those under collective or firm agreements overlap. But while the treatment effects on those under the non-covered regime are highly significant in all regressions, estimates for those under CA are on the brink of significance. The base effect of coverage by a CA is large and significant with 11% in contrast to the results for West Germany. Amongst the blue-collar workers in the treated sectors wages under collective contracts were 7.3% higher than for those with individual wage contracts after the policy had been implemented. When employees contracted under firm and establishment level agreements are left out of the sample (column "no firm CA" in Table 6) the treatment effect is not significantly different from zero for those under collective contract. Compared to the sample restriction with regard to establishment size (column "≤200") a lot less observations are left out of the estimation but these observations stem from only a few establishments

underlining the particular dimension of firm/establishment specific agreements.

The MW introduction led to an average wage growth of 8% for all entitled blue-collar workers in East Germany. Further differentiating by wage bargain regime reveals a surprisingly high positive effect of 13% on wages of those under individual contract which is close to the calculated theoretical wage increase needed for those observations prior to the introduction below the MW. Regressions for the effect on monthly earnings show the same patterns and magnitudes as those on hourly wages for both parts of the country. Estimations on the effect of hours worked did reveal no impact of the MW policy. In a next step, the question who benefitted the most along the distribution will be addressed.

6.2 Unconditional Quantile Regression Results

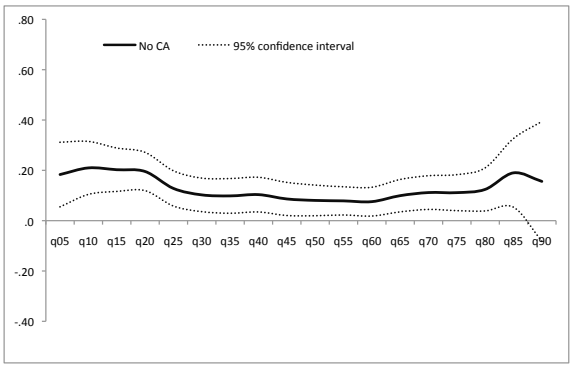
Figure 2 shows graphically the main coefficients and the respective confidence intervals for RIF coefficients. The two panels on the left refer to results for workers under individual bargaining (a) and covered by a CA (b) for East Germany and the panels to the right refer to the results for West Germany (panels (c) and (d) respectively). Tables 11 and 10 in the Appendix provide detailed estimation results at selected quantiles.

For West Germany OLS regressions found no significant mean effect of the MW on wages for non-covered workers. This result is confirmed along the whole distribution by RIF regression results. The coefficients are quite small and never significantly different from zero. The mean effect for employees under CA was not significant either but RIF results show a non-homogeneous picture along the distribution. Up till the 30%-percentile coefficient estimates meander around zero and are insignificant. Between the 40%- and the 80%-percentile coefficients take a leap in magnitude and significance: estimates range between 5.4% and 10.1%, are highly significant. The MW thus had a sizable positive impact on the upper part of the wage distribution for wage contracts under CA and wage dispersion increased. The pattern of coefficients and significance does not differ if observations with firm level agreements are excluded. It is also worth mentioning that the 40%- to 80%-percentiles encompass those tariffs in the pay scale that apply to blue-collar workers that have completed at least a relevant three-year vocational training.

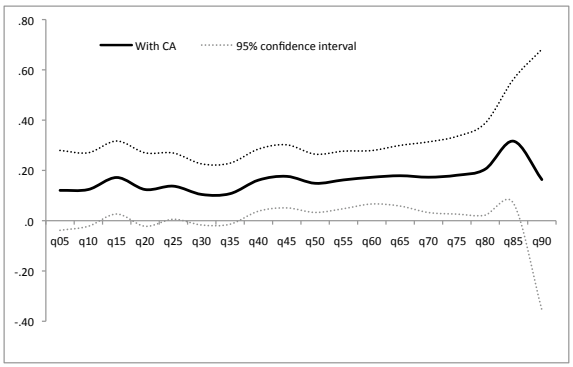
Figure 2: RIF Coefficients of the Treatment Effect (DDD) on log Hourly Wages for East and West Germany

East Germany

(a) without CA

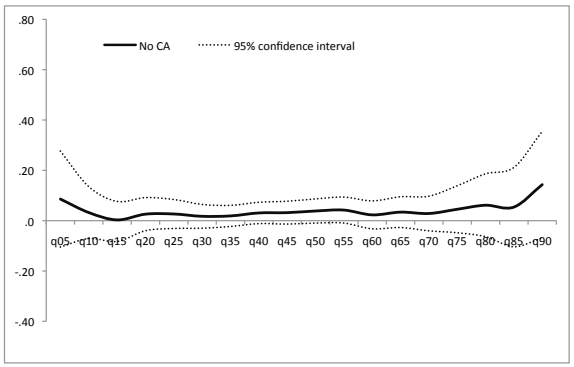


(b) with CA

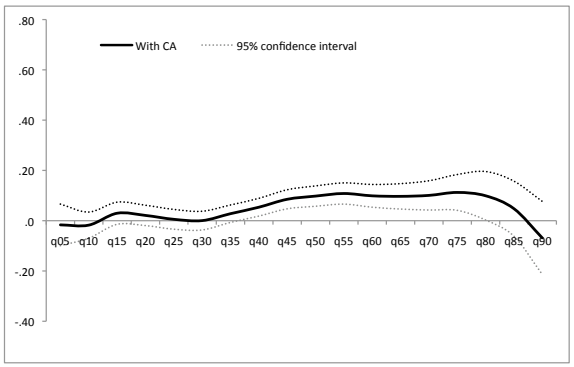


West Germany

(c) without CA



(d) with CA



Notes: standard errors clustered on the establishment level in parentheses (3000 repetitions). Results from RIF regressions along the quantiles of the distribution of log hourly wages of the differences-in-differences-in-differences specification. "CA" refers to collective, firm or establishment agreement. For details on the specifications and full estimation output at selected quantiles refer to Table 10.

The treatment effect for blue-collar workers under individual contracts in East Germany is positive along the whole distribution. It is highest between the 5%- and the 25%-percentile and remains quite stable for the higher quantiles. It thus decreased inequality in the lower part of the distribution. The picture of treatment effects for workers under CA is less clear cut. Estimated coefficients are positive and the size of effects is quite stable across the distribution. Yet, in the left tail estimated coefficients are only on the brink of significance on the 95%-level and just beyond the 40%-percentile coefficients are clearly significant. If observations under firm- and establishment level contracts are left out the magnitude of effects in this range is somewhat lower and significance also decreases. Taken together RIF-regression treatment effects tentatively suggest a homogeneous location shift for workers bound by collective, firm or establishment agreement in their wages contracts.

RIF regression results thus complement the information on mean effects. While OLS regressions for West Germany suggested that the MW did exert no impact at all on wages, RIF regressions reveal that for observations under CA a sizable and clearly significant effect in the upper part of the wage distribution took place. For East Germany RIF regressions illustrated that the positive mean effect for workers under individual contracting is associated with a large positive treatment effect at the bottom of the distribution and still positive yet lower effects further up the distribution, altogether decreasing wage dispersion. For blue-collar workers in the treated sectors under CA a generally positive effect of the MW can be observed yet with lower significance just as in the OLS regressions.

7 Conclusion

This study analyzes the impact of the introduction of the first sectoral MW in 1997 in Germany on hourly wages and their distribution. The reform was aimed at setting a lower wage floor for blue-collar workers in the construction sector but was not implemented across all sub-sectors due to institutional peculiarities in the wage bargain. I use this as a natural experiment to differentiate between treatment and control group on the 4-digit-industry classification level. Based on two cross sections of a linked employer-employee data set, the GSES, blue-collar workers in non-treated parts of the construction industry and white-collar workers serve as

control groups in the differences-in-differences-in-differences regression framework. Unconditional quantile (RIF) regression complements estimated mean effects and gauges the impact heterogeneity along the wage distribution.

Descriptive results reveal that the MW bit strongly in East Germany and a lot less in West Germany. Estimation results confirm that on average blue-collar workers in the covered sectors in East Germany experienced a wage increase of 8% while I find no significant mean effect for West Germany. There is heterogeneity along the wage regime and along the distribution. In East Germany mean treatment effects for those under the collective area contract are insignificant. Along the distribution the impact is highest for the lower quartile of East German blue-collar workers bunching up the distribution from below while the effect decreases but does not die out over the rest of the distribution. For workers under collective area contracts the evidence hints at a location shift yet coefficients are on the margins of significance. In West Germany the treatment effect is insignificant along the entire distribution for employees under individual wage bargaining. Yet in the upper part of the wage distribution there can clearly be observed a positive effect of treatment interacted with collective (and firm or establishment level) wage bargaining status that brings about a dispersion of wages.

Altogether these results suggest that the introduction of the MW had a sizable impact on wages and distribution of blue-collar workers in the treated sectors particularly in East Germany. But the effect did not take place homogeneously across the wage distribution and the pay scheme. Apart from sizable spillover effects evidence for West Germany points to the fact that the MW introduction also affected wages of those paid under a collective, firm or establishment agreement despite the fact that the nominal pay scale was not bound by the MW. The pivotal role played by unions in the setting of the MW and the strive to maintain to wage hierarchies and/or the collective bargaining wage premium may serve as explanations for this somewhat unexpected result. The identification of the particular mechanisms in the interaction of wage bargaining and MWs are beyond the scope of this study but pose interesting questions for future research in economic theory as much as empirical work. Policy makers should be aware that MWs may hold consequences not only for the lowest part of the wage distribution and that benefits may also accrue to employees that were actually not the policy's target group.

References

Blau, F. D. and L. M. Kahn (1999). Chapter 25 institutions and laws in the labor market. Volume 3, Part 1 of *Handbook of Labor Economics*, pp. 1399 – 1461. Elsevier.

Card, D. E. and A. B. Krueger (1995). *Myth and measurement: the new economics of the minimum wage*. Princeton University Press.

Dickens, R. and A. Manning (2004a). Has the national minimum wage reduced UK wage inequality? *Journal of the Royal Statistical Society. Series A (Statistics in Society) 167*(4), 613–626.

Dickens, R. and A. Manning (2004b). Spikes and spill-overs: The impact of the national minimum wage on the wage distribution in a low-wage sector. *The Economic Journal 114*(494), C95–C101.

DiNardo, J., N. M. Fortin, and T. Lemieux (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica 64*(5), 1001–1044.

Dittrich, M. and A. Knabe (2010). Wage and employment effects of non-binding minimum wages. CESifo Working Paper 3149, CESifo.

Dolado, J. J., F. Felgueroso, and J. F. Jimeno (1997). The effects of minimum bargained wages on earnings: Evidence from spain. *European Economic Review 41*(3-5), 713 – 721. Paper and Proceedings of the Eleventh Annual Congress of the European Economic Association.

Eichhorst, W. (2005). Equal pay for equal work in the same place? the posting of workers in the European Union. *Journal for Labour Market Research 38*(2/3), 197–217.

Firpo, S., N. M. Fortin, and T. Lemieux (2009). Unconditional quantile regressions. *Econometrica 77*(3), 953–973.

Fitzenberger, B., K. Kohn, and A. C. Lembcke (2008). Union density and varieties of coverage: The anatomy of union wage effects in Germany. ZEW Discussion Paper 08-012, Zentrum für Europäische Wirtschaftsforschung Mannheim.

Gerlach, K. and G. Stephan (2006). Bargaining regimes and wage dispersion. *Jahrbücher für Nationalökonomie und Statistik 226*(6), 629 – 645.

Grossman, J. B. (1983). The impact of the minimum wage on other wages. *The Journal of Human Resources 18*(3), pp. 359–378.

Hafner, H.-P. and R. Lenz (2007). Gehalts- und Lohnstrukturerhebung: Methodik, Datenzugang und Forschungspotential. *FDZ-Arbeitspapier 18*.

Haucap, J., C. Wey, and U. Pauly (2006). *Institutions in perspective: festschrift in honor of Rudolf Richter on the occasion of his 80th birthday*. Mohr Siebeck.

Katz, L. F. and A. B. Krueger (1992). The effect of the minimum wage on the fast-food industry. *Industrial and Labor Relations Review 46*(1), pp. 6–21.

Kluve, J. and C. M. Schmidt (2007). Mindestlöhne ohne Reue - eine aussichtsreiche Option für Deutschland? *Gastbeitrag Handelsblatt, 10. Dezember 2007*.

Koenker, R. and J. Bassett, Gilbert (1978). Regression quantiles. *Econometrica 46*(1), 33–50.

König, M. and J. Möller (2007). Minimum wage effects of the worker posting law? A micro data analysis for the German construction sector. IAB Discussion Paper 30, Institute for Employment Research, Nuremberg, Germany.

Lee, D. S. (1999). Wage inequality in the united states during the 1980s: Rising dispersion or falling minimum wage? *The Quarterly Journal of Economics 114*(3), pp. 977–1023.

Lemos, S. (2008). A survey of the effects of the minimum wage on prices. *Journal of Economic Surveys 22*(1), 187–212.

Machin, S., A. Manning, and L. Rahman (2003). Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector. *Journal of the European Economic Association 1*(1), 154–180.

Machin, S. and J. Wilson (2004). Minimum wages in a low-wage labour market: Care homes in the UK. *The Economic Journal 114*(494), C102–C109.

Manning, A. (2003). *Monopsony in Motion - Imperfect Competition in Labor Markets*. Princeton University Press.

Meier, V. and S. Munz (2008). Beschäftigungseffekte von Mindestlöhnen unter Vernachlässigung der Hauptbetroffenen: Kommentar zu König und Möller. *ifo Schnelldienst 61(5)*, 30–32.

Metcalf, D. (2004). The impact of the national minimum wage on the pay distribution, employment and training. *The Economic Journal 114*(494), C84–C86.

Müller, K.-U. (2010). Employment effects of a sectoral minimum wage. semiparametric estimations for germany. DIW Discussion Paper 1061, German Institute for Economic Research.

Müller, K.-U. and V. Steiner (2010). Labor market and income effects of a legal minimum wage in Germany. *Journal of Income Distribution, forthcoming*.

Neumark, D. and W. L. Wascher (2008). *Minimum wages*. MIT Press.

OECD (2004). Wage-setting institutions and outcomes. In *OECD Employment Outlook 2004*, Chapter 3, pp. 127–171. OECD.

OECD (2010). Minimum wages relative to median wages.

Pettengill, J. (1981). The long-run impact of a minimum wage on employment and the wage structure. In *Report of the Minimum Wage Study Commission*, Volume 6, pp. 63104. US Government Printing Office, Washington, DC.

Schmidt, C. M. and K. F. Zimmermann (1991). Work characteristics, firm size and wages. *The Review of Economics and Statistics 73*(4), pp. 705–710.

Stephan, G. and K. Gerlach (2005). Wage settlements and wage setting: results from a multi-level model. *Applied Economics 37*(20), 2297–2306.

Storbeck, O. (2007). Ökonomenstimmen zur Mindestlohn-Studie von Möller und König. *Handelsblatt, 19. November 2007*.

Teulings, C. N. (2000). Aggregation bias in elasticities of substitution and the minimum wage paradox. *International Economic Review 41*(2), pp. 359–398.

Wagner, J. (1991). Gewerkschaftsmitgliedschaft und Arbeitseinkommen in der Bundesrepublik Deutschland. *Ifo-Studien 37*, 109–140.

Table 7: Descriptive Statistics for East and West Germany

		Treated Sectors				Control Sectors			
		Blue-collar		White-collar		Blue-collar		White-collar	
		Before MW	After MW	Before MW	After MW	Before MW	After MW	Before MW	After MW
East Germany	Average establishment size	43	31	46	33	28	19	29	20
	Percentage under (collective) agreement	54%	33%	54%	35%	40%	18%	41%	11%
	Percentage female	0%	0%	44%	37%	1%	1%	49%	49%
	Percentage working full-time	100%	98%	93%	89%	100%	99%	90%	83%
	Average Age	37	39	42	43	36	38	41	43
	Fraction low-skilled	30%	27%	14%	13%	15%	11%	22%	22%
	Fraction medium-skilled	59%	60%	55%	54%	73%	73%	47%	51%
	Average tenure in months	72	76	89	98	76	76	91	90
	Average hourly wage	9.93	10.48	14.36	15.90	9.03	9.32	11.56	12.85
	Average contracted monthly hours	169	168	166	161	171	171	166	158
	Number of employees (unweighted)	11595	3871	2886	983	4646	1902	1229	528
	Number of establishments (unweighted)	533	185	511	173	312	126	300	121
West Germany	Average establishment size	40	37	44	37	22	20	22	20
	Percentage under (collective) agreement	92%	77%	80%	58%	69%	53%	54%	40%
	Percentage female	0%	0%	32%	32%	2%	2%	47%	48%
	Percentage working full-time	100%	98%	90%	87%	99%	97%	85%	73%
	Average age	41	41	42	43	37	38	41	42
	Fraction low-skilled	26%	27%	15%	17%	16%	22%	22%	32%
	Fraction medium-skilled	50%	50%	49%	43%	55%	51%	50%	41%
	Average tenure in months	112	109	133	122	108	111	137	122
	Average hourly wage	13.13	14.29	18.48	20.79	12.95	13.51	16.22	16.83
	Average contracted monthly hours	168	167	161	157	164	163	153	141
	Number of employees (unweighted)	18254	9512	6275	3394	5956	5605	2173	2482
	Number of establishments (unweighted)	719	460	679	456	391	393	375	392

Notes: The calculations are weighted unless stated otherwise.
Source: GSES 1995 and GSES 2001.

Table 8: Differences-in-Differences-in-Differences Estimation Results for East Germany

	DDD all	DDD-CA all	DDD-CA ≤200	DDD-CA no firm CA	DDD-CA no foremen
Blue*post*sector	0.080***	0.130***	0.109***	0.130***	0.136***
	(0.028)	(0.036)	(0.038)	(0.036)	(0.038)
Blue*post*sector*CA		−0.013	0.004	−0.030	−0.016
		(0.076)	(0.079)	(0.083)	(0.078)
Blue*post*CA		−0.083	−0.057	−0.065	−0.085
		(0.068)	(0.071)	(0.076)	(0.071)
Blue*sector*CA		0.087***	0.059**	0.085***	0.090***
		(0.029)	(0.030)	(0.029)	(0.030)
Post*sector*CA		0.008	0.008	−0.001	0.011
		(0.075)	(0.064)	(0.079)	(0.079)
Blue*CA		−0.034	−0.026	−0.032	−0.029
		(0.025)	(0.026)	(0.025)	(0.026)
Post*CA		0.004	−0.028	0.013	0.006
		(0.066)	(0.054)	(0.070)	(0.070)
Sector*CA		−0.006	0.039	−0.001	−0.009
		(0.029)	(0.029)	(0.029)	(0.032)
Blue*post	−0.098***	−0.093***	−0.092***	−0.093***	−0.093***
	(0.023)	(0.027)	(0.028)	(0.027)	(0.028)
Blue*sector	−0.095***	−0.145***	−0.129***	−0.144***	−0.162***
	(0.013)	(0.020)	(0.021)	(0.020)	(0.022)
Post*sector	−0.064**	−0.071*	−0.050	−0.072*	−0.077**
	(0.032)	(0.037)	(0.039)	(0.037)	(0.039)
Blue	−0.296***	−0.280***	−0.282***	−0.280***	−0.279***
	(0.012)	(0.016)	(0.018)	(0.017)	(0.018)
Post	0.154***	0.153***	0.153***	0.154***	0.154***
	(0.026)	(0.029)	(0.029)	(0.029)	(0.030)
Sector	0.175***	0.181***	0.163***	0.181***	0.198***
	(0.015)	(0.020)	(0.021)	(0.020)	(0.022)
With CA	0.111***	0.110***	0.098***	0.109***	0.104***
	(0.008)	(0.025)	(0.025)	(0.025)	(0.028)
Female	−0.296***	−0.295***	−0.306***	−0.296***	−0.300***
	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)
Age	0.014***	0.014***	0.014***	0.013***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age*age	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Low-skilled	−0.303***	−0.306***	−0.313***	−0.311***	−0.304***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Medium-skilled	−0.187***	−0.191***	−0.195***	−0.194***	−0.190***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Full-time	0.152***	0.152***	0.141***	0.153***	0.152***
	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)
Tenure in months	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
20<size≤50	0.023**	0.025**	0.024**	0.025**	0.025**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
50<size≤100	0.033***	0.034***	0.030**	0.036***	0.036***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
100<size≤200	0.053***	0.052***	0.046***	0.049***	0.052***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Size>200	0.097***	0.093***	0.000	0.101***	0.094***
	(0.015)	(0.015)	(0.000)	(0.015)	(0.015)
Constant	2.145***	2.151***	2.155***	2.156***	2.145***
	(0.026)	(0.028)	(0.030)	(0.028)	(0.028)
R^2	0.579	0.585	0.548	0.591	0.571
N	27640	27640	21986	26903	26873
Blue*post*sector + blue*post*sector*CA		0.117*	0.112*	0.100	0.120*
		(0.063)	(0.064)	(0.070)	(0.066)
F-Test for differential effects across coverage by a CA					
... on intercept & slopes		31.88	33.51	34.63	30.46
... p-value		0.000	0.000	0.000	0.000
... on slopes		5.60	6.33	4.86	5.85
... p-value		0.000	0.000	0.000	0.000

Source: GSES 1995 and 2001.
Notes: standard errors clustered on the establishment level in parentheses. ***significant at 1% level, **significant at 5% level, *significant at 10% level. The dependent variable is log hourly wages. The reference category for establishment size variables ("# <size≤ #") is 20 or less employees. CA refers to collective, firm or establishment agreement. "DDD-CA" stands for least squares estimation of the differences-in-differences-in-differences specification differentiated along union status. "<200" restricts the sample to observations in establishments with up to 200 employees; "no firm CA" estimates based on all observations except for those under firm or establishment level agreements; "no foremen" excludes foremen and head masons from the white-collar workers control group.

Table 9: Differences-in-Differences-in-Differences Estimation Results for West Germany

	DDD all	DDD-CA all	DDD-CA ≤200	DDD-CA no firm CA	DDD-CA no foremen
Blue*post*sector	0.017	0.056	0.055	0.056	0.056
	(0.020)	(0.038)	(0.040)	(0.038)	(0.041)
Blue*post*sector*CA		−0.024	−0.046	−0.022	−0.022
		(0.044)	(0.044)	(0.044)	(0.047)
Blue*post*CA		−0.068**	−0.020	−0.069**	−0.081**
		(0.033)	(0.030)	(0.033)	(0.035)
Blue*sector*CA		0.074**	0.070**	0.075**	0.086***
		(0.030)	(0.033)	(0.030)	(0.032)
Post*sector*CA		0.059	0.061	0.056	0.056
		(0.040)	(0.040)	(0.041)	(0.044)
Blue*CA		0.050**	0.004	0.050**	0.058**
		(0.023)	(0.022)	(0.023)	(0.023)
Post*CA		0.051	0.011	0.054*	0.064*
		(0.032)	(0.029)	(0.032)	(0.034)
Sector*CA		−0.083***	−0.062**	−0.084***	−0.095***
		(0.027)	(0.030)	(0.027)	(0.028)
Blue*post	−0.003	0.037	−0.009	0.037	0.050*
	(0.018)	(0.027)	(0.027)	(0.027)	(0.029)
Blue*sector	−0.050***	−0.123***	−0.105***	−0.123***	−0.143***
	(0.013)	(0.028)	(0.031)	(0.028)	(0.030)
Post*sector	0.035*	−0.030	−0.027	−0.030	−0.030
	(0.020)	(0.036)	(0.038)	(0.036)	(0.039)
Blue	−0.315***	−0.347***	−0.306***	−0.347***	−0.353***
	(0.011)	(0.020)	(0.020)	(0.020)	(0.021)
Post	0.039**	0.013	0.062**	0.013	−0.000
	(0.018)	(0.027)	(0.027)	(0.026)	(0.029)
Sector	0.047***	0.124***	0.110***	0.124***	0.144***
	(0.012)	(0.026)	(0.028)	(0.026)	(0.028)
With CA	−0.037***	−0.064***	−0.024	−0.064***	−0.071***
	(0.006)	(0.021)	(0.021)	(0.021)	(0.021)
Female	−0.274***	−0.271***	−0.282***	−0.272***	−0.276***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)
Age	0.016***	0.016***	0.017***	0.016***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age*age	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Low-skilled	−0.293***	−0.290***	−0.280***	−0.290***	−0.289***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Medium-skilled	−0.142***	−0.140***	−0.127***	−0.140***	−0.138***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Full-time	0.119***	0.121***	0.132***	0.122***	0.121***
	(0.011)	(0.011)	(0.013)	(0.011)	(0.011)
Tenure in months	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
20<size≤50	0.033***	0.033***	0.031***	0.033***	0.033***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
50<size≤100	0.058***	0.056***	0.051***	0.057***	0.056***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
100<size≤200	0.089***	0.087***	0.000	0.088***	0.087***
	(0.008)	(0.008)	(0.000)	(0.008)	(0.008)
Size>200	0.051***	0.049***		0.049***	0.047***
	(0.009)	(0.009)		(0.009)	(0.009)
Constant	2.499***	2.513***	2.439***	2.512***	2.518***
	(0.022)	(0.026)	(0.028)	(0.026)	(0.027)
R^2	0.569	0.572	0.536	0.572	0.561
N	53651	53651	36939	53525	51680
Blue*post*sector + blue*post*sector*CA		0.033	0.009	0.035	0.034
		(0.024)	(0.023)	(0.024)	(0.026)
F-Test for differential effects across coverage by a CA					
... on intercept & slopes		11.03	3.01	11.02	11.96
... p-value		0.000	0.0023	0.000	0.000
... on slopes		8.01	1.78	8.16	9.23
... p-value		0.000	0.086	0.000	0.000

Source: GSES 1995 and 2001.
Notes: standard errors clustered on the establishment level in parentheses. ***significant at 1% level, **significant at 5% level, *significant at 10% level. The dependent variable is log hourly wages. The reference category for establishment size variables ("# <size≤ #") is 20 or less employees. CA refers to collective, firm or establishment agreement. "DDD-CA" stands for least squares estimation of the differences-in-differences-in-differences specification differentiated along union status. "<200" restricts the sample to observations in establishments with up to 200 employees; "no firm CA" estimates based on all observations except for those under firm or establishment level agreements; "no foremen" excludes foremen and head masons from the white-collar workers control group.

Table 10: Differences-in-Differences-in-Differences Results in the RIF Framework

	East Germany			West Germany		
	q25	q50	q75	q25	q50	q75
Blue*post*sector	0.128***	0.080***	0.111***	0.027	0.038	0.045
	(0.036)	(0.031)	(0.037)	(0.029)	(0.024)	(0.048)
Blue*post*sector*CA	0.009	0.068	0.069	−0.021	0.059*	0.067
	(0.079)	(0.070)	(0.087)	(0.036)	(0.032)	(0.058)
Blue*post*CA	−0.141*	−0.079	−0.028	−0.004	−0.023	−0.049
	(0.075)	(0.064)	(0.077)	(0.026)	(0.024)	(0.047)
Blue*sector*CA	0.096***	0.123***	0.083**	0.042	−0.008	−0.087**
	(0.031)	(0.028)	(0.037)	(0.026)	(0.021)	(0.044)
Post*sector*CA	−0.055	−0.057	0.005	0.026	0.016	−0.005
	(0.045)	(0.042)	(0.071)	(0.021)	(0.020)	(0.048)
Blue*CA	0.055**	−0.002	−0.078**	−0.039**	−0.033**	0.004
	(0.026)	(0.024)	(0.034)	(0.019)	(0.016)	(0.037)
Post*CA	0.028	0.010	−0.018	−0.007	−0.001	0.060
	(0.042)	(0.038)	(0.065)	(0.019)	(0.017)	(0.042)
Sector*CA	−0.024	0.007	−0.003	−0.024*	−0.012	0.024
	(0.020)	(0.020)	(0.033)	(0.013)	(0.013)	(0.033)
Blue*post	0.016	−0.043*	−0.100***	0.051***	0.035**	−0.012
	(0.026)	(0.023)	(0.027)	(0.019)	(0.016)	(0.034)
Blue*sector	−0.016	−0.039**	−0.111***	−0.001	−0.007	−0.058
	(0.023)	(0.019)	(0.022)	(0.023)	(0.017)	(0.037)
Post*sector	−0.043*	−0.032	−0.068**	−0.002	−0.001	−0.022
	(0.023)	(0.022)	(0.034)	(0.015)	(0.015)	(0.037)
Blue	−0.167***	−0.203***	−0.311***	−0.090***	−0.177***	−0.544***
	(0.019)	(0.016)	(0.022)	(0.015)	(0.013)	(0.033)
Post	0.073***	0.082***	0.116***	0.025**	0.026**	0.034
	(0.019)	(0.018)	(0.026)	(0.013)	(0.012)	(0.030)
Sector	0.083***	0.074***	0.134***	0.017	0.011	0.085***
	(0.016)	(0.015)	(0.021)	(0.011)	(0.011)	(0.027)
With CA	0.077***	0.080***	0.117***	0.045***	0.024**	−0.045
	(0.018)	(0.017)	(0.030)	(0.011)	(0.011)	(0.030)
Low-skilled	−0.180***	−0.239***	−0.335***	−0.295***	−0.239***	−0.290***
	(0.011)	(0.012)	(0.015)	(0.008)	(0.007)	(0.011)
Female	−0.110***	−0.116***	−0.250***	−0.085***	−0.117***	−0.391***
	(0.008)	(0.008)	(0.011)	(0.005)	(0.005)	(0.014)
Age	0.017***	0.014***	0.007***	0.021***	0.015***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age*age	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled	−0.073***	−0.097***	−0.206***	−0.045***	−0.101***	−0.191***
	(0.007)	(0.009)	(0.013)	(0.003)	(0.004)	(0.008)
Full-time	0.117***	0.094***	0.103***	0.054***	0.030***	0.058***
	(0.016)	(0.014)	(0.014)	(0.009)	(0.007)	(0.012)
Tenure in months	0.000***	0.000***	0.000	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
20<size≤50	0.029**	0.016	0.008	0.022***	0.024***	0.037***
	(0.014)	(0.011)	(0.010)	(0.007)	(0.007)	(0.010)
50<size≤100	0.044***	0.023*	0.011	0.033***	0.041***	0.075***
	(0.016)	(0.013)	(0.012)	(0.008)	(0.007)	(0.011)
100<size≤200	0.061***	0.043***	0.027*	0.032***	0.047***	0.085***
	(0.015)	(0.013)	(0.014)	(0.007)	(0.007)	(0.010)
Size>200	0.091***	0.093***	0.067***	0.057***	0.069***	0.117***
	(0.016)	(0.016)	(0.017)	(0.008)	(0.008)	(0.011)
Constant	1.714***	2.043***	2.548***	2.051***	2.418***	2.946***
	(0.038)	(0.028)	(0.030)	(0.024)	(0.019)	(0.034)
R^2	0.273	0.349	0.414	0.280	0.356	0.478
N	27640	27640	27640	53651	53651	53651
Blue*post*sector*CA	0.137	0.149**	0.181**	0.006	0.098**	0.112**
+ Blue*post*sector	(0.067)	(0.059)	(0.079)	(0.020)	(0.021)	(0.036)

Source: GSES 1995 and 2001.
Notes: standard errors clustered on the establishment level in parentheses (3000 repetitions). ***significant at 1% level, **significant at 5% level, *significant at 10% level. The dependent variable is log hourly wages. The reference category for establishment size variables ("# <size≤ #") is 20 or less employees. "CA" refers to collective, firm or establishment agreement. Results from RIF regressions of the differences-in-differences specification differentiated along union status at the 25th, 50th and 75th quantile. See specification "DDD-CA" in Tables 8 & 8 for the least squares analogues.

Table 11: Summary of Effects from Differences-in-Differences-in-Differences RIF Regressions for East and West Germany

		q10	q20	q30	q40	q50	q60	q70	q80	q90
East	w/o CA	0.210***	0.195***	0.103***	0.104***	0.080***	0.076***	0.111***	0.124***	0.156
		(0.054)	(0.039)	(0.034)	(0.035)	(0.031)	(0.029)	(0.034)	(0.044)	(0.121)
	with CA	0.124*	0.124*	0.104*	0.161*	0.149*	0.173***	0.173**	0.205**	0.164
		(0.075)	(0.074)	(0.062)	(0.063)	(0.059)	(0.054)	(0.072)	(0.093)	(0.265)
West	w/o CA	0.032	0.026	0.017	0.031	0.038	0.023	0.028	0.061	0.143
		(0.053)	(0.034)	(0.024)	(0.022)	(0.024)	(0.028)	(0.035)	(0.064)	(0.108)
	with CA	0.018	0.021	0.000	0.054***	0.098***	0.099***	0.101***	0.099**	−0.068
		(0.027)	(0.021)	(0.019)	(0.018)	(0.021)	(0.023)	(0.030)	(0.050)	(0.074)

Source: GSES 1995 and 2001.
Notes: standard errors clustered on the establishment level in parentheses (3000 repetitions). ***significant at 1% level, **significant at 5% level, *significant at 10% level. Results from RIF regressions along the quantiles of the distribution of log hourly wages of the differences-in-differences-in-differences specification differentiated along whether wage was agreed upon in some kind of a collective, firm or establishment agreement or not (DDD-CA). "CA" refers to collective, firm or establishment agreement. Refer to Table 10 for full regression output at selected quantiles.