Rising Wage Inequality, the Decline of Collective Bargaining, and the Gender Wage Gap

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Abstract: This paper investigates the increase in wage inequality, the decline in collective bargaining, and the development of the gender wage gap in West Germany between 2001 and 2006. Based on detailed linked employer-employee data, we show that wage inequality is rising strongly – driven not only by real wage increases at the top of the wage distribution, but also by real wage losses below the median. Coverage by collective wage bargaining plummets by 16.5 (19.1) percentage points for male (female) employees. Despite these changes, the gender wage gap remains almost constant, with some small gains for women at the bottom and at the top of the wage distribution. A sequential decomposition analysis using quantile regression shows that all workplace related effects (firm effects and bargaining effects) and coefficients for personal characteristics contribute strongly to the rise in wage inequality. Among these, the firm coefficients effect dominates, which is almost exclusively driven by wage differences within and between different industries. Labor demand or firm wage policy related effects contribute to an increase in the gender wage gap. Personal characteristics tend to reduce wage inequality for both, males and females, as well as the gender wage gap.

Keywords: Wage Distribution, Gender Wage Gap, Collective Bargaining, Quantile Regression, Sequential Decomposition

JEL-Classification: J31, J51, J52, C21

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Contents

1 Introduction

Wage inequality has been increasing in many industrialized countries over the past decades. Parallel to this trend, coverage by collective wage bargaining has declined strongly in many economies (OECD, 2004). The gender wage gap has also declined in most of these countries. However, these three developments have rarely been investigated jointly in a systematic way. This paper therefore investigates the link between the recent increase in wage inequality between 2001 and 2006, the decline in collective wage bargaining, and the development of the gender wage gap using linked-employer-employee data for West Germany. Applying a sequential decomposition analysis, we analyze the importance of firm-specific and personal-specific variables as well as of collective bargaining for changes in wage inequality. There exists a vast literature concerning all three of the mentioned developments separately. Without being able to provide a comprehensive summary of this literature, we discuss some selected references for these trends.

First, wage inequality has been rising in Germany during the last 25 years (Kohn, 2006; Gernandt and Pfeiffer, 2007; Dustmann et al., 2009; Antonczyk et al., 2009). However, compared to the strong increases in wage inequality in the US and the UK since the early 1980s, the increase in wage dispersion in Germany was restricted to the top of the wage distribution in the 1980s while wage inequality at the bottom of the wage distribution only started to grow in the mid 1990s (Fitzenberger, 1999; Dustmann et al., 2009). The long-term development towards higher inequality at the bottom of the wage distribution started in Germany about one and a half decades later than in the US. It has frequently been argued that labor market institutions such as unions and minimum wages prevented an increase in wage inequality at the bottom of the wage distribution before the mid 1990s (Fitzenberger, 1999; Fitzenberger et al., 2008; Dustmann et al., 2009). In addition, Antonczyk et al. (2009) show that the recent increase of wage dispersion among German male workers cannot be explained by changes in tasks performed at the workplace. This result suggests to analyze the importance of institutions.

Second, coverage by collective wage bargaining (i.e. union wage contracts) in West Germany plummeted between 2001 and 2006 by 16.5 percentage points (pp) for male workers and by 19.1 pp for female workers as reported in the German Structure of Earnings Survey (see section 5). Union membership of male employees also dropped sharply in the past decades in Germany, whereas that of female employees has been more stable – albeit at a much lower level (Card et al., 2003; Schnabel, 2005, p.185; Kohn and Lembcke, 2007). Since collective bargaining is typically associated with wage compression (Fitzenberger et al., 2008; Burda et al., 2008), the weakening of collective bargaining is likely to contribute to the increase in wage inequality.[1] For the US about 20% of the increase in

[1]For an international perspective, see Card (2001); Card et al. (2003); Addison et al. (2007); de la

wage inequality can be attributed to deunionization (Card, 2001; Addison et al., 2007). For Germany, Dustmann et al. (2009) estimate that about 28% of the increase in lower tail inequality (measured by difference between 50% and 15% quantile of log wages) is due to the decline in union coverage compared to only 11% at the top of the distribution (85% minus 50% quantile).[2] Again considering the US, Card (2001) shows that characteristics as well as the returns to those characteristics are compressed under collective bargaining.[3] However, the latter effect is smaller for women.

Third, the gender wage gap has been falling in most industrialized countries over the past decades (Blau and Kahn, 1996, 2000; Arulampalam et al., 2007), including Germany (Lauer, 2000; Fitzenberger and Wunderlich, 2002; Sohr and Stephan, 2005; Antonczyk, 2007; Black and Spitz-Oener, 2007). Nevertheless, women still earn about 20% less than men at the median. Blau and Kahn (1997) and Black and Spitz-Oener (2007) conclude that skill-biased technological change has worked in favor of women, contributing to the decline of the gender wage gap. A number of recent studies analyze the gender wage gap along the entire distribution and find an increase over the distribution (the so-called "glass-ceiling", see Arulampalam et al., 2007; de la Rica et al., 2008; Albrecht et al., 2003). Furthermore, some studies report an enlarged gender wage gap at the bottom of the wage distribution (Arulampalam et al., 2007; Fitzenberger and Wunderlich, 2002), in particular for low-skilled women.[4] Notwithstanding, Antonczyk (2007), Black and Spitz-Oener (2007), and Gartner and Hinz (2009) observe a stagnation of the decline of the gender wage gap in Germany over the last years and the reasons being this stagnation remain an open question.

Despite the high relevance of these three developments, only a small literature investigates them jointly in a systematic way. For the US and Canada, several studies suggest that deunionization affects men more strongly than women, thereby contributing to the closing of the gender wage gap (DiNardo et al., 1996; Fortin and Lemieux, 1997; Blau and

Rica et al. (2008); Fortin and Lemieux (1997); DiNardo et al. (1996), and for Germany: Fitzenberger (1999); Gerlach and Stephan (2006); Fitzenberger and Kohn (2005); Kohn and Lembcke (2007).

[2]The results by Dustmann et al. (2009) are based on linked employer-employee data (LIAB). These data link the establishment panel survey of the IAB and individual earnings information from social security records. The coverage information is self reported by the firm which may be subject to measurement error. Using the reweighting approach of DiNardo et al. (1996), Dustmann et al. (2009) calculate the counterfactual earnings distribution holding union coverage rates constant between 1995 and 2004. The difference between the implied counterfactual changes in earnings inequality and the actual change in earnings inequality is attributed to the decline in union coverage. The reweighting approach implemented by Dustmann et al. (2009, section 4.1) does not distinguish between changes in other covariates, which are correlated with the decline in union coverage, and the ceteris paribus effect of the decline in union coverage. This is something our decomposition approach described below accounts for. Anticipating our empirical results, the total union coverage effect tends to be somewhat larger than the partial coverage effect.

[3]See Fitzenberger and Kohn (2005) for evidence on Germany.

[4]Analogous to "glass-ceiling", this phenomenon is frequently referred to as "glass floor" (see e.g. de la Rica et al., 2008) or "sticky floor" (see e.g. Drolet and Mumford, 2009).

Kahn, 1997; Doiron and Riddell, 1994). Edin and Richardson (2002) document that wage compression as implied by unions reduces within-industry wage differences. However, considering the case of Sweden, this comes along with higher between-industry differences which in turn partly counteract the closing of the gender wage gap. Meng and Meurs (2004) analyze France and Australia and argue, based on a decomposition analysis, that firms in both countries use their scope in wage setting as a mean to reduce the gender wage differential. This scope is higher in a less centralized system like in Australia; consequently, countries with stronger institutions like France display higher gender wage gaps. For Germany, Heinze and Wolf (2006) and Gartner and Stephan (2009, 2004) find that the gender wage gap is lower within firms compared to the overall wage differential – suggesting a certain degree of homogeneity of workers within a firm. At the same time, the existence of a works council or coverage by collective wage bargaining agreements reduces the gender wage gap.

To the best of our knowledge, only one study is rather close to ours: Felgueroso et al. (2008) analyze the gender wage gap and its link to collective bargaining along the entire distribution for Spain. Centralized collective wage bargaining shows an increasing gender wage gap over the wage distribution. This is because more centralized wage bargaining (unions) exerts less control regarding the positive gap between actual wages and negotiated wages ("wage cushion") and regarding bonus payments. In contrast, when collective wage bargaining takes place at the firm level, unions have a stronger control on actual wages, which in turn explains why the gender wage gap does not increase over the distribution. In contrast to our study, Felgueroso et al. (2008) do not separate firm-specific from personal-specific effects in a detailed sequential decomposition analysis.

The present study describes the gender specific changes in wage inequality for Germany. We address the following questions: How does the gender wage gap change as a result of the strong overall increase in wage inequality? What is the impact of the decline of union coverage on the evolution of the gender wage gap? What is the impact of firm-level variables and personal variables on the evolution of the gender wage gap?

This is the first study to use the two cross-sections of the large German Structure of Earnings Survey in 2001 and 2006 for an analysis of the increase in wage inequality. In a quantile regression framework, we analyze wage changes by gender and the gender wage gap over the entire wage distribution and we employ a decomposition technique building upon Machado and Mata (2005) and Melly (2005). We distinguish between personal characteristics, firm characteristics, and the bargaining regime in a sequential decomposition. Analogous to the recent study by Chernozhukov et al. (2008), we define the different effects on changes of the wage structure as differences between clearly defined counterfactual wage distributions. Our sequential decomposition takes account of the observed joint sample distribution of the covariates.

Traditionally in Germany, wages are determined by collective bargaining between unions and employers' associations at the industry level (sectoral collective contract or "Flächentarifvertrag"). Bargaining at the firm or plant level ("Firmentarifvertrag" or "Betriebsvereinbarung") exists as well but covers a much smaller share of employees and firms. Discrimination against non-union-members is legally forbidden, thus all employees in a firm recognizing a bargaining contract – and not only union members in this firm – benefit from the outcome of the collective agreements. Moreover, a firm may recognize a bargaining contract without being legally required to do so. This implies that coverage by wage bargaining is much higher than union density among employees (Fitzenberger et al., 2010).

Our results show that wage inequality is rising strongly both for males and females, driven not only by wage increases at the top of the distribution, but even more so by real wage losses below the median. At the same time, we find a sharp decline in coverage by collective bargaining. Both coverage by sectoral-level bargaining and coverage by firm-level bargaining is falling over time. Our sequential decomposition results show that all workplace related effects (firm effects and bargaining effects) contribute to the strong rise in wage inequality. We find evidence that the reduction in bargaining coverage contributes in a sizeable way to rising wage inequality and that the bargaining outcomes allow for higher wage flexibility. Nevertheless, these effects are dominated by the firm coefficients effect, which is almost exclusively driven by the sector coefficients effect, meaning that between- and within-industry wage differences drive the observed rise in wage inequality. The drop in collective bargaining coverage takes place almost exclusively within sectors but hardly contributes to the observed wage changes. In addition, personal coefficients contribute to some degree to the increase in wage inequality, again reinforcing the dominance of labor demand effects. In contrast, personal characteristics change in a way to reduce wage inequality. All this adds up to a very small change in the overall gender wage gap, and only the strong improvement in personal characteristics of females results in a fall of the gender wage gap at the bottom of the wage distribution.

The remainder of the paper is organized as follows: The next section reviews the economic background of our analysis. Section 3 describes the data and presents first descriptive results. In section 4, the sequential decomposition technique based on quantile regression is explained before presenting the corresponding empirical results in section 5. Finally, section 6 provides some concluding remarks. The appendix contains further information on the data and detailed estimation results including a robustness check of those.

2 Economic background

This section describes the recent development of wage inequality and discusses the link between union coverage and the gender wage gap. Skill-biased technical change (SBTC) is the most prominent explanation for the increase in wage inequality since the 1980s in the US and other industrialized countries. It results in an increasing demand for more highly skilled labor (see the survey by Katz and Autor, 1999) under the assumption that the increase in demand is stronger than the parallel increase in the supply of more highly skilled labor. The simple SBTC hypothesis predicts rising wage inequality over the entire wage distribution. This is consistent with the evidence for the US for the 1980s but not for the 1990s (Katz and Autor, 1999; Autor et al., 2008) as during the later decade inequality stopped to grow at the bottom of the wage distribution. For West Germany, Dustmann et al. (2009) show that wage inequality began to rise at the top of the wage distribution during the 1980s (see also Fitzenberger, 1999) whereas wage inequality at the bottom of the wage distribution only started to increase during the 1990s. These developments in Germany for the 1980s are consistent with the SBTC hypothesis (Fitzenberger, 1999; Dustmann et al., 2009), if one allows for the possibility that growing wage inequality at the bottom of the wage distribution is prevented by labor market institutions such as unions and minimum wages as implied by the welfare state. In a similar vein, DiNardo et al. (1996) and Fortin and Lemieux (1997) argue for the US that increasing wage inequality in the 1980s and the early 1990s may partly be explained by changing labor market institutions, i.e. falling real minimum wages and deunionization. Card (2001) and Addison et al. (2007) find that about 20% of the increase in wage inequality in the US can be attributed to deunionization. For West Germany, Dustmann et al. (2009) find that among male workers about 28% of the increase in lower tail inequality between 1995 and 2004 is associated with the decline in bargaining coverage compared to only 11% at the top of the distribution. The authors use linked employer-employee data where the bargaining status is self-reported by the establishment and the cross-section dimension is smaller than in the German Structure of Earnings survey used here (see section 3). While Dustmann et al. (2009) analyze a longer time period up to 2004, our study focuses on the first half of the 2000s, a time period with strong growth in wage inequality and a large decline in bargaining coverage. If SBTC raises wage inequality, this can have effects on the gender wage gap as will be discussed shortly.

A nuanced version of the SBTC hypothesis is provided by the task-based approach (Autor et al., 2003). It operationalizes the way technology affects the labor market through the tasks performed at a job. This task-based approach argues that technological change results in a substitution of routine tasks by computers and other machines. In principle, it allows to rationalize differences in the development of wage inequality

along the wage distribution (Autor and Dorn, 2009). Occupations are distinguished by the composition of the different tasks. However, Antonczyk et al. (2009) find that a task-based approach cannot explain the rise in wage inequality among male workers in West Germany during the first half of the 2000s. In contrast, analyzing the reduction in the gender wage gap between 1979 and 1999 in Germany, Black and Spitz-Oener (2007) provide evidence that the change in task inputs partly explains the reduction of the gender wage gap, suggesting that the demand for tasks disproportionately performed by women has increased over time. Although our data do not contain information on tasks, it is interesting to analyze the relationship between workplace related variables and the evolution of the gender wage gap for a more recent time period.

It has been widely studied that collective bargaining compresses the wage distribution, partly by compressing the returns to productivity relevant characteristics and partly by compressing the distribution of workers' characteristics (Card, 1996, 2001; Card et al., 2003; OECD, 2004; Fitzenberger and Kohn, 2005; Gerlach and Stephan, 2006; Burda et al., 2008). This compression effect is attributed to the preference of unions for greater wage equality. In contrast, there exists only a small literature linking the level and the evolution of the gender wage gap to the wage bargaining regime (Gartner and Stephan, 2009, 2004; Felgueroso et al., 2008; Blau and Kahn, 2003, 1996; OECD, 2004). Our paper contributes to this literature and we now discuss the theoretical arguments for this link.

If collective wage bargaining compresses the wage distribution and women earn lower wages than men, a decline in bargaining coverage is likely to increase the gender wage gap (Blau and Kahn, 2003; Edin and Richardson, 2002). Moreover, wage compression tends to be strongest at the bottom of the wage distribution, so that the gender wage gap is expected to increase over the wage distribution (Felgueroso et al., 2008). Even if firms pay a "wage cushion" (Cardoso and Portugal, 2005), i.e. the effective wage exceeds the collectively negotiated wage, wage bargaining provides group specific minimum wages, which are more likely to be binding at the bottom of the wage distribution. Wage compression could be achieved via different channels which are of course strongly interrelated.

On the one hand, wage compression is achieved by lower returns to human capital or other productivity relevant characteristics. Therefore, coefficients in a Mincer earnings equation will be specific to the bargaining regime. Since, on average, female workers have lower formal education levels than male workers, the attenuation of the wage returns under collective bargaining reduces the gender wage gap.[5] Furthermore, Bartolucci

[5]However, reduced returns to human capital could entail a repercussion effect on skill acquisition, whose direction is ambiguous from theory (Blau and Kahn, 2003, p. 112). On the one hand, lower returns to human capital discourage skill acquisition and women may be more sensitive to these disincentives. On the other hand, the resulting lower gender wage gap could induce more women to participate in the labor market. Quantifying this repercussion effect is impossible with our cross-sectional data on employees only.

(2009) finds that a large share (82%) of the gender wage gap in Germany is accounted for by productivity differences between male and female workers and 12.5% by gender differences in bargaining power (in Nash bargaining on rents between individual firms and individual employees).[6] This evidence suggests that there is a lot of heterogeneity in wage setting, which collective wage bargaining is likely to reduce. Along this line, Gartner and Stephan (2009) argue that the standardization of collectively negotiated wages restricts the opportunities for wage discrimination, e.g. with respect to gender. In addition, it is commonly argued that women are more risk averse than men and therefore prefer less variable remuneration schemes (Dohmen and Falk, 2010). This would suggest that women select themselves to a larger extent than men into jobs covered by collective bargaining involving less variable pay. Furthermore, female workers should resist more strongly the erosion of wage bargaining. If a growing use of variable remuneration schemes causes the increase in wage inequality, it is likely that the decline in wage bargaining should be weaker for females than for males.

On the other hand, collective bargaining is likely to reduce the heterogeneity of employees, due to the minimum wage character of negotiated wages or due to self-selection into covered firms (Heinze and Wolf, 2006; Gartner and Stephan, 2004). This might stem from the fact that firms adapt their hiring standards to the productivity level required for paying the collectively negotiated wage and train employees with a lower productivity (Gartner and Stephan, 2009; Gerlach and Stephan, 2006). Then, highly productive workers may opt out of covered firms (Gartner and Stephan, 2009) or demand payment above the collectively negotiated (minimum) wage level. The higher homogeneity of employees should reduce the gender wage gap in covered firms (Heinze and Wolf, 2006). At the same time, the gender wage gap should differ across bargaining regimes and personal characteristics should explain a part of the gap. Furthermore, the gender wage gap has been found to increase at the bottom of the unconditional wage distribution (this is a version of the "glass floor" effect, see e.g. de la Rica et al., 2008). The minimum wage character of bargained wages should reduce the "glass floor" effect for covered firms compared to firms without union coverage.

So far, we have discussed a positive association between coverage by collective bargaining and the relative wages of females. However, it is conceivable that unions represent more strongly the interests of male employees – e.g. because males display higher membership rates or because they are working more frequently full-time (Booth and Francesconi, 2003, Arulampalam et al., 2007, p.179). Thus, the median voter in the union is likely to be a male employee and therefore the design of union wage policies may result in

[6]Bartolucci (2009) estimates these results based on a structural search and matching model not distinguishing between full-time and part-time employment. When correcting for hours of work, the productivity related share of the gender wage gap falls to 77% and the share associated with differences in bargaining power increases to 16.4%.

an increase in the gender wage gap, e.g. by favoring blue-collar workers who are predominantly male. However, this view stands in contrast to Blau and Kahn (1996) and Felgueroso et al. (2008) who suggest that equal pay policies can be better enforced by more centralized bargaining. In this vein, Felgueroso et al. (2008) argue that unions represent more strongly the interests of employees at the bottom of the wage distribution (in Spain), where there is a disproportionately higher number of females. Another possible implication of the median voter argument is that the gender wage gap may be larger under firm-level bargaining, where male union members in the firm have a stronger say, than under industry-wide bargaining, where general equality goals of the union are likely to play a stronger role. This implication is in line with the common finding that more decentralized wage bargaining is associated with higher wage inequality (OECD, 2004).

Furthermore, it is likely that coverage is an increasing function of union membership in the relevant segment of the labor market (Fitzenberger et al., 2010). Differences in union membership rates between female and male employees may lead to gender differences in coverage even though within the same firm there is no gender difference in coverage. Therefore, the share of female employees may be one determinant of coverage and explain the different union strengths over different industries. This argument implies that the industry composition shifts away from manufacturing towards the service sector over time is associated with a decline in coverage and overall wage inequality is expected to increase. Because labor demand in segments with a large share of females increases, the gender wage gap is likely to fall (similar to Black and Spitz-Oener, 2007).

Finally, the so-called "wage cushion" may affect the gender wage gap. The extent to which firms pay extra wage components such as bonuses ("wage drift" or "wage cushion", see Cardoso and Portugal, 2005) can add to the gender wage gap and is potentially related to the degree of centralization of collective bargaining (Felgueroso et al., 2008). The underlying reason is that more decentralized collective bargaining is likely to have already taken account of the specific conditions in a firm. In consequence, this implies a lower gender wage gap for firm-level bargaining compared to sectoral bargaining.

Based on these opposing considerations, the direction of the link between coverage and the gender wage gap is theoretically ambiguous, which provides a motivation for our empirical analysis.

3 Data and descriptive statistics

We use the 2001 and 2006 repeated cross-sections of the German Structure of Earnings Survey (GSES; "Gehalts- und Lohnstrukturerhebung"), a large mandatory linked employer-employee data set, which is very reliable due to its compulsory character. This is one of the first studies to use the 2006 cross-section of the GSES while the 2001 wave of

the GSES (and earlier waves) has been frequently used to analyze wage differences across bargaining regimes.[7] These data allow for a very detailed analysis of the wage distribution because of the link between employer-specific information and employee information and because of its large size. Two further advantages of the GSES, standing in contrast to the IAB linked employer-employee data set (LIAB; used e.g. by Dustmann et al., 2009), are that hours of work are reported and that earnings are neither truncated nor censored (Kohn and Lembcke, 2007; Fitzenberger and Reize, 2002). Moreover, even though the sampling design asks firms to provide data only on a fraction of their workforce, many firms in 2006 prefer to supply data on all employees. The data set is based on a random sample of all German firms with at least ten employees and the focus is on the private sector (comparable to Drolet and Mumford, 2009). We limit our analysis to those industries for which data are available in both years.[8] Sampling weights are provided to be able to make the sample representative for all employees in the included industries.

This study focuses on prime age employees in West Germany. We drop employees currently taking part in vocational training or an internship as well as all employees younger than 25 or older than 55 years of age. Given the heterogeneity in wage trends between West and East Germany, (see e.g. Kohn and Lembcke, 2007; Gernandt and Pfeiffer, 2007; Orlowski and Riphahn, 2009), we restrict our analysis to West Germany. In addition, we only analyze employees working full time, i.e. those paid at least 30 hours per week including overtime in October 2001 or 2006.[9] The final sample involves 440,000 employees in some 17,000 establishments in 2001 and 750,000 employees in 22,600 establishments in 2006.

The GSES provides precise information on whether an employee is covered by one of the collective bargaining regimes, i.e. sectoral or firm-level bargaining: Following Burda et al. (2008), we define a covered employee as anybody working in a covered establishment, i.e. an establishment that pays at least one percent of its employees according to a collective wage agreement.[10]

The wage is defined as October earnings including overtime pay and bonuses for Sunday or shift work, divided by hours paid in October including overtime hours (similar to e.g. Drolet and Mumford, 2009). It is important to include premia as those are often regular and important wage components (Fitzenberger et al., 2008). For plausibility, we

[7] See among others Stephan and Gerlach (2005); Gerlach and Stephan (2006, 2005); Heinbach and Spindler (2007); Fitzenberger et al. (2008); and Burda et al. (2008).

[8] Most of all, this excludes the educational and the health sector.

[9] On the one hand, this selection of individuals makes the sample more homogeneous and comparable, see e.g. Hinz and Gartner (2005). On the other hand it abstracts from the selectivity aspect, see Beblo et al. (2003).

[10] The negotiated wages in the collective agreements act as minimum wage for non-covered individuals in covered firms, see Fitzenberger et al. (2008) for evidence along this line.

limit working hours to a maximum of 304 hours per month[11] and the hourly wage to values between 4 and 70 euro per hour.[12] We use the CPI to deflate the 2006 wages to the price level in 2001. As outcome variable, we use the log gross real hourly wage.

We observe some notable changes in the wage distribution from 2001 to 2006 (figure 1 and table 2 in the appendix): Real hourly wages drop below the median, for both males and females, whereas they increase for the quantiles above the median, leading to an overall increase in wage dispersion. The increase in wage dispersion has also been found by Gartner and Stephan (2009) who note that wage dispersion is lower for females compared to males.[13,14] Considering the interquartile range of log-wages as a measure for wage dispersion, males and females in West Germany experienced an increase in wage dispersion of 7 log percentage points (ppoints). Figure 1 further shows that the increases in wage dispersion are mainly driven by real wage losses at the bottom of the wage distribution, as has also been found by Gernandt and Pfeiffer (2007). We observe an increase in wage inequality within the different bargaining regimes for both male and female employees. Moreover, the bottom panels in table 2 show that wage dispersion is largest in establishments not being covered by collective wage bargaining.

The unconditional gender wage gap displays a U-shaped pattern with largest values at the upper and the lower end of the distribution (figure 5 and table 2). This is *prima facie* evidence of a "glass-ceiling" as well as of a "glass floor" effect for female employees. The same U-shaped pattern is documented by Arulampalam et al. (2007) for the private sector in Germany on the basis of pooled ECHP data from 1994-2001. Our data show that from 2001 to 2006, women are able to gain most relative to men in the lower part of the wage distribution.[15]

Further descriptive statistics can be found in table 5 in the appendix. The results show that women have on average lower age, tenure, and education than men, whereas male employees more often worked extra shifts involving additional bonuses.

In line with international evidence (Card et al., 2003), collective bargaining coverage fell in Germany between 2001 and 2006, see table 1. Similar results for Germany are found e.g. by Kohaut and Ellguth (2008). Distinguishing between industry-wide and firm-specific collective bargaining, the decline is larger for sectoral bargaining (in absolute as well as in relative terms). While industry-wide collective bargaining covers more than

[11] This corresponds to an average of 70 hours per week and to less than 0.2% of the workforce in 2006.

[12] In 2001 prices. Both bounds together correspond to less than 0.3% of the wage distribution in 2006.

[13] Many other studies document the rise in wage inequality in Germany as well (see e.g. Dustmann et al., 2009; Kohn, 2006; Gernandt and Pfeiffer, 2007; Antonczyk et al., 2009).

[14] Al-farhan (2010, p. 17) discusses that the strong changes in wage inequality were accompanied by very mild changes in wage *levels* and therefore the former is more interesting to study.

[15] Additional results stratified by education levels (not shown here) reveal that, over time, relative wages rise most strongly for low-educated women, whereas the gender wage gap widens or stagnates for the high-skilled individuals. The results for medium-skilled employees are mixed.

Table 1: Individual coverage rates

	2001		2006		Δ2006-2001	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
No Coll. Barg.	28.7	32.8	45.2	51.9	16.5	19.1
Industry-wide Barg.	63.1	59.6	46.8	41.1	-16.3	-18.5
Firm-level Barg.	8.3	7.6	8.0	7.0	-0.3	-0.6

60% of the workforce in 2001, this share plummets to 46.8% for males and to 41.1% for females in 2006. Coverage under a firm-level collective contract also decreases, albeit only to a small degree. Still, this drop is notable as it stands in contrast to expectations in the past that firms would use more firm-level bargaining to achieve more flexibility. However, our results suggest that many firms dropped out of collective bargaining altogether. As a consequence, in 2006 about half of the workforce considered in our data set is not covered by collective agreements anymore. Note, that the drop in collective bargaining coverage is more pronounced for females than for males, especially in relative terms for firm-level bargaining.

There are some notable differences in wage levels and wage trends by bargaining regime and gender (table 2 and figures 2 to 4). For males, highest wages are paid over the entire distribution in the firm-level bargaining regime. For females, this holds only for the upper half of the wage distribution, whereas in the lower half industry-wide bargaining provides highest wages. For males, the wage distribution under firm-level bargaining clearly dominates the wage distribution of employees under industry-wide bargaining in a first order stochastic sense. In turn, the latter dominates the wage distribution of uncovered employees (see also Burda et al., 2008).

A comparison of the different bargaining regimes shows that in 2001 the gender wage gap under industry-wide bargaining is higher in most parts of the distribution than without collective bargaining coverage. However, this ordering is reversed in 2006. The higher level of the gender wage gap under collective bargaining in 2001 is in contrast to the results reported by Gartner and Stephan (2009), who do not provide a full distribution and use top-coded daily wages from 2001. At the mean, their results imply that the gender wage gap under collective bargaining is about 6 to 8 ppoints lower than without a collective bargaining agreement. Interestingly, the results by Felgueroso et al. (2008, p. 307) for Spain in 2002 are very similar to our results for 2006. This even holds for the peculiar shape of the gender wage gap under firm-level bargaining. In particular the authors document a rise in the gender wage gap at the top of the distribution, which we also find. In addition, our data show an increased gender wage gap at the bottom of the distribution ("glass floor") for both types of collective wage bargaining in both 2001 and

2006.[16] Over time, we find that the gender wage gap decreases under sectoral bargaining, while it *increases* at the top the wage distribution without bargaining coverage, and even more so under firm-level bargaining. A possible interpretation is that the reduction in coverage might have prevented a further decline of the gender wage gap. This issue will be explored in more detail by the sequential decomposition approach developed in the next section.

4 Methodology

To analyze effects on the *entire wage distribution*, the empirical investigation uses a set of linear quantile regression estimates. This allows to describe wage compression due to collective bargaining (Fitzenberger et al., 2008; Burda et al., 2008) and its impact on the difference between wage distributions by gender. We specify the τth quantile of log hourly wages w conditional on the set of covariates X as:

$$(1) \quad q_w(\tau|X) = X'\beta(\tau) \, .$$

We estimate such quantile regressions separately for each year, for each wage bargaining regime, and for male and female workers on the basis of an extended Mincer-type wage equation.

Analogously to an OLS regression, a quantile regression uses sampling weights and inference should account for clustering at the employer level. Standard errors of the quantile regression coefficients therefore need to be adjusted appropriately.[17] We implement a pairwise (design-matrix) bootstrap and we account for the sampling weights by resampling the weights as part of the observation vector. We estimate clustered standard errors by applying a block bootstrap procedure where we resample all observations within an establishment to account for correlation within establishments.[18]

4.1 Decomposition of unconditional distributions by quantiles

We first decompose the change in the wage distribution over time by gender over the entire wage distribution. Then, we decompose the change in the gender wage gap. We investigate the differences in the wage distribution by quantile τ of the respective unconditional wage distribution. We use the Machado and Mata (2005) decomposition approach for quantile

[16] Note that one should be cautious not to overinterpret a cross-country comparison of the gender wage gaps, as selection processes might differ (see Albrecht et al., 2009b).

[17] Fitzenberger et al. (2008) show how to estimate the asymptotic covariance matrix $\widehat{VAR}(\hat{\beta}(\tau))$ accounting for weights and cluster effects.

[18] Due to the large size of the data set and the sequential nature of the estimation, bootstrapping is extremely slow. Therefore, the present results rely on 50 bootstrap replications only.

regression which is an extension of the standard Blinder-Oaxaca decomposition technique (Oaxaca, 1973; Blinder, 1973).

For the analysis of the gender wage gap, one can decompose the difference of the unconditional sample quantile functions for the τ^{th} quantile between male and female employees (denoted by $\hat{q}_{male}(\tau)$ and $\hat{q}_{female}(\tau)$) as follows:[19]

$$(2) \quad \hat{q}_{male}(\tau) - \hat{q}_{female}(\tau) = \left[\hat{q}_{male}(\tau) - \hat{q}_{\beta_f, x_m}(\tau)\right] + \left[\hat{q}_{\beta_f, x_m}(\tau) - \hat{q}_{female}(\tau)\right] .$$

The first term on the right hand side of equation (2) denotes the coefficients effect. The second term captures the effect of workers' characteristics. $\hat{q}_{\beta_f, x_m}(\tau)$ is the estimated counterfactual quantile function.[20] This is the quantile function of wages that would be generated for female workers had they male characteristics (x_m: male characteristics) but were still paid according to female coefficients (β_f: female coefficients across all quantiles).[21] We use this counterfactual because it is the more policy relevant one (as compared to using a counterfactual distribution using female characteristics and male coefficients) for the following reason. The characteristics of the female population may be altered over time by policy interventions (e.g. through additional education), while the coefficients, which we interpret as prices (specific wage policies) and as the impact of unobservables,[22] are more difficult to be influenced in a market economy. Analogous to the gender wage gap, we decompose the changes in the gender specific wage distributions and the implied changes in the gender wage gap between 2001 and 2006. For this case, we focus on counterfactual wage distributions based on 2006 characteristics and 2001 coefficients.

The crucial underlying assumption for the estimation of a counterfactual wage distri-

[19]For ease of notation, we discuss the decomposition approach explicitly for the gender wage gap. The decomposition of the changes over time by gender works in an analogous way, where *male* should be replaced by the year *2006* and *female* should be replaced by the year *2001*. Our empirical analysis also combines the two decompositions by analyzing the change in the gender wage gap over time. This corresponds to the difference of the period-specific gender wage gaps over time and is analogous to the difference in the gender-specific changes over time.

[20]Comparing the quantile regression based approach to DiNardo et al. (1996), the collection of quantile specific coefficients measures the pricing function given characteristics, i.e. it measures how the conditional distribution of wages is affected by changes in characteristics. The regression setup allows to estimate different counterfactual wage distributions based on the respective sample (estimated counterfactual, see section 4.2 below) distribution of characteristics. This is analogous to the reweighting approach of DiNardo et al. (1996).

[21]These female coefficients model the female conditional wage distribution for given characteristics. Analogously, the counterfactual $\hat{q}_{\beta_f, x_m}(\tau)$ can be interpreted as the quantile of the hypothetical wage distribution of male workers (x_m) were they paid like female employees (β_f).

[22]In a quantile regression framework, the differences in coefficients across quantiles reflect the conditional distribution of the dependent variable given the covariates, thus reflecting the distribution of unobservable characteristics of individuals with given covariates. Constant wage returns (prices) of covariates imply constant coefficients across quantiles. However, the heterogeneous coefficients across quantiles do not explicitly measure the distribution of wage returns.

bution is that a change in the covariates X will not change the parameters of the conditional distribution of w given covariates X (e.g. Chernozhukov et al., 2008). Hence, our decomposition technique ignores general equilibrium effects by assuming that changes in quantities (characteristics effect) do not affect changes in prices (coefficients effect). This is similar to alternative decomposition techniques used in the literature (e.g. DiNardo et al., 1996; Fairlie, 2005).

To implement the Machado and Mata (2005) decomposition, we use the approach proposed by Melly (2005) for greater ease in computation. We estimate the counterfactual quantile function as

$$(3) \quad \hat{q}_{\beta_f, x_m}(\tau) = \inf \left(q : \frac{1}{N_{male}} \sum_{j:male} \hat{F}_{female}(q|X_j) \geq \tau \right) ,$$

where N_{male} is the number of male employees in the sample $\{j : male\}$. $\hat{F}_{female}(q|X_j)$ is the conditional distribution function of wages in the sample of females evaluated at the characteristics X_j of the male worker j.

To estimate the *unconditional* counterfactual distribution based on these conditional quantiles, we should aggregate the conditional distribution function in the sample of interest based on the estimated conditional quantiles $\hat{q}_w(\tau|X_j)$ according to equation (3). We resort to an approximation suggested in the literature (Machado and Mata, 2005; Melly, 2005), because an exact aggregation is feasible but computationally very demanding.[23] We arrange the predicted conditional quantiles for a large number of equispaced quantiles and all individuals and then take the τth sample quantile of this augmented sample. This way, we approximate the conditional distribution $F_{female}(q|X_j)$ by a discrete uniform distribution on the set of equispaced quantiles. More precisely, we estimate 49 equispaced quantile regressions starting at the 2%-quantile.[24] We use this technique to decompose the gender wage gap for the total wage distribution in each year before isolating the contribution of different components in a more detailed sequential decomposition explained in the following.

4.2 Sequential Decomposition

To assess the importance of various components of the characteristics and coefficients effect, we suggest to estimate a sequence of counterfactual wage distributions. We do so by changing incrementally the distribution of subsets of covariates for the characteris-

[23] Albrecht et al. (2009a) show that the results are the same.

[24] Instead of treating τ as a uniformly distributed random variable on $[0, 1]$, τ is treated as uniformly distributed on the 49 even percentiles. This way, we avoid estimation of the entire process of quantile regression coefficients, which in our case involves a very large number of break points (Melly, 2005).

tics effects and of subsets of the corresponding coefficients, respectively, holding all other components constant. For the estimation of counterfactual combinations in the joint distribution of the characteristics, we account for the observed joint sample distribution of characteristics in the reference year. The decomposition results depend upon the sequence of decompositions implemented (DiNardo et al., 1996; Chernozhukov et al., 2008). This is unavoidable because each sequence stands for a different series of counterfactual wage distributions. We suggest an order of decomposition for which we think the sequence of counterfactuals is of interest.[25] We also estimate an alternative sequence of our decomposition, in reversed order, as a robustness check and we provide an interpretation of the differences in results.

Even though there have been various approaches to estimating the impact of single covariates or their coefficients in a decomposition analysis, none of these approaches is suitable for our analysis. The literature on measuring inequality typically considers inequality measures which are additively decomposable such as the Theil inequality measure or the variance of log incomes (see e.g. Fields, 1979 or, as a recent application, Cholezas and Tsakloglou, 2007). In an analysis of the variance, one can decompose the effects of subsets of covariates into main effects and interaction effects in an additive way. It is, however, not possible to divide the interaction effects without further assumptions. In contrast, no additive decomposition is available if one is interested in broad features of a distribution reflected in various quantiles or quantile differences. We will now discuss two potential approaches and their drawbacks before turning to our suggested decomposition.

Fairlie (1999, 2005) suggests to decompose differences in first moments estimated as nonlinear functions of the covariates into the characteristics effect and the coefficients effect. This is done by constructing the sample means of the fitted values based on the characteristics in one sample and the coefficients in another sample.[26] For a sequential decomposition of the contribution of subsets of covariates, Fairlie (2005) suggests to order observations in both samples by the fitted values of the estimated nonlinear functions. Then, to construct the counterfactuals involving combinations of covariates from different samples, the observations in the two samples are matched one-to-one by the ranks in the two samples. This procedure requires both samples to be of the same size and, if this is not the case, Fairlie suggests using a random subsample of the larger sample. However, this procedure does not explicitly take account of the joint distribution of the covariates in the two samples which is likely to be relevant for constructing a set of counterfactual wage distributions. Furthermore, the procedure disregards available information by only using a subsample of the larger sample.

[25] Our sequential decomposition involves seven components. It would be beyond the scope of this paper to report all the conceivable $7! = 5040$ permutations of the sequence of decompositions.

[26] Fairlie discusses probit and logit estimates. His analysis, however, also applies to more general nonlinear estimation approaches.

Yun (2004) suggests a decomposition of the contribution of individual covariates and their coefficients.[27] He discusses this for the case where first moments are estimated as nonlinear functions of a linear index function of the covariates without interaction terms. Yun suggests to assign the characteristics effect and the coefficients effect to the individual covariates according to weights implied by the relative differences in the means of the linear index. This method is restricted to functions of separable linear indices and it ignores the dependence between different covariates. Even in the case of linear quantile regression with different separable linear specifications at different quantiles, the Yun weights are not defined unambiguously.

We now describe an alternative sequential decomposition approach suitable for the estimation of quantile regression. As discussed in section 2, wage bargaining, firm characteristics, and personal characteristics might influence the wage structure through various channels which we are trying to capture. Our approach is based on the sequential decomposition suggested in DiNardo et al. (1996) and developed further in Chernozhukov et al. (2008) and Antonczyk et al. (2009).

The quantiles of the observed wage distributions for the two cross-sections of data in 2001 and 2006 are expressed as follows:

$$(4) \quad q_\tau^{01}(\alpha_P^{01}, \alpha_F^{01}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) \quad \text{and} \quad q_\tau^{06}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{06}, P^{06}) \ ,$$

where P and F denote sets of personal and firm characteristics and α_P and α_F refer to the corresponding sets of coefficients. Furthermore, B is an indicator for the collective bargaining regime with B $\in$ {no, general, firm}. α_0^B are the intercepts from the 3 different regressions for the 3 different bargaining regimes and $\bar{\alpha}_0 = \frac{1}{3}\left(\alpha_0^{no} + \alpha_0^{general} + \alpha_0^{firm}\right)$ and $\alpha_B = \alpha_0^B - \bar{\alpha}_0$.[28,29] The superscripts 01 and 06 indicate the years. These different components set the foundation for the following sequential decomposition, where we separately analyze the contribution of each of the arguments in order to explain the change in the wage distributions by gender over time (similar to Antonczyk et al., 2009). For a meaningful analysis of the change in intercepts, we normalize all covariates with respect to their 2001 means.

Our goal is to explain the observed wage structure in the most recent available year, i.e. in 2006. In order to do so, we take the perspective of individuals in 2006 and successively transfer them 'back in time' to the labor market in 2001. This is why we will first alter the returns (coefficients) to labor market characteristics. Thereafter, we quantify the effect

[27] A very recent application of this method can be found in Al-farhan (2010).

[28] Note that α_P, α_F, and α_B may differ by the type of bargaining regime. For each individual we employ the coefficients which correspond to her bargaining status B.

[29] We use the observed wage distributions in 2001 and 2006 for q_τ^{01} and q_τ^{06} in equation 4. However, as discussed by Melly (2005), one could also estimate the observed distribution based on the quantile regression estimates.

of reduced bargaining coverage and of changes in the firm characteristics. The final step consists in changing the individual-specific characteristics from their 2006 levels to their counterparts from 2001. We acknowledge that the order of the sequential decomposition steps matters. A different order corresponds to a different sequence of counterfactuals and our interpretation of results is specific to our chosen sequence of counterfactuals.

Our sequence of counterfactuals reads as follows:

$$
\begin{aligned}
(5)\quad \Delta^1_\tau &= q^{06}_\tau(\alpha^{06}_P, \alpha^{06}_F, \alpha^{06}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{\mathbf{01}}_{\mathbf{P}}, \alpha^{06}_F, \alpha^{06}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) \\
\Delta^2_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{06}_F, \alpha^{06}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{01}_P, \alpha^{\mathbf{01}}_{\mathbf{F}}, \alpha^{06}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) \\
\Delta^3_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{06}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{\mathbf{01}}_{\mathbf{B}}, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) \\
\Delta^4_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{06}_0, B^{06}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{\mathbf{01}}_{\mathbf{0}}, B^{06}, F^{06}, P^{06}) \\
\Delta^5_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, B^{06}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, \mathbf{B^{01}}, F^{06}, P^{06}) \\
\Delta^6_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, B^{01}, F^{06}, P^{06}) - q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, B^{01}, \mathbf{F^{01}}, P^{06}) \\
\Delta^7_\tau &= q^{06}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, B^{01}, F^{01}, P^{06}) - q^{01}_\tau(\alpha^{01}_P, \alpha^{01}_F, \alpha^{01}_B, \bar{\alpha}^{01}_0, B^{01}, F^{01}, \mathbf{P^{01}})
\end{aligned}
$$

The first component of our sequence of decompositions is Δ^1_τ estimating the impact of changes in the returns to observable individual-specific characteristics. Recall at this point that the decomposition does not account for the effect of changes in characteristics on coefficients (absence of general equilibrium effects). Note that we know that union coverage reduces returns to productivity relevant characteristics and that this effect is captured through the bargaining regime specific coefficient estimates of α_P. Therefore, it is accounted for by the first component. However, these bargaining regime specific changes in coefficients could be caused by the decline in union coverage because the outside option of low–productivity employees regarding rent sharing within firms deteriorates (Bartolucci, 2009). This is a characteristics effect which our decomposition attributes to the personal coefficients effect.

The next step changes the returns to firm characteristics, thereby estimating the counterfactual wage distribution for individuals in 2006, as if they were exposed to the labor market remunerations in 2001 in terms of personal and firm coefficients (Δ^2_τ). After having controlled for changes in the coefficients of personal and firm characteristics, we quantify the impact of the changes in the wage premia related to the three different types of wage bargaining (Δ^3_τ). Recall that the coefficients reflecting the bargaining premia

are constructed as deviations from the mean of the bargaining-regime-specific intercepts. The change of the average constant $\bar{\alpha}_0$ from $\bar{\alpha}_0^{01}$ to $\bar{\alpha}_0^{06}$ represents the residual change in the overall wage level over time which cannot be explained by the variables included in our model. Here, the new counterfactual represents the wage distribution implied if all individuals had retained their 2006 characteristics and bargaining regime, but would have been paid as in 2001.

The sum $\Delta_\tau^1 + \Delta_\tau^2 + \Delta_\tau^3 + \Delta_\tau^4$ represents the (total) coefficients effect in a Blinder-Oaxaca type decomposition. Next, we consider the corresponding characteristics effect.

So far, simply plugging in the 2001 coefficients in combination with 2006 characteristics has been sufficient to calculate the corresponding counterfactual wage distributions. However, changing the characteristics sequentially is not straightforward.

We start with what would have happened if bargaining coverage was still at its 2001 level but all other characteristics remained at their 2006 levels. The contribution of the decline in bargaining coverage is denoted by Δ_τ^5. In order to model the link between the bargaining regime and other characteristics, we run a sequential probit of the bargaining regime on 2001 characteristics.[30] The first step of the sequential probit models the coverage by collective bargaining versus no coverage. The second step models the decision between industry-wide and firm-level bargaining conditional on coverage. We account for the correlation between the error terms in the two equations. Using the resulting estimates, we then simulate the bargaining regime in 2001 conditional on firm and personal characteristics from 2006.[31] Hence, Δ_τ^5 aims at quantifying the effect of the decline of bargaining coverage for given firm and person characteristics. Note that bargaining coverage varies strongly by firm size and industry. Changes in firm characteristics could be associated with further changes in bargaining coverage, so that Δ_τ^5 presents a rather conservative estimate.

The next step of the decomposition involves the change in firm characteristics F (Δ_τ^6). To mimic the firm characteristics from 2001 for individuals from 2006, we use exact one-to-one matching with replacement on the basis of personal characteristics, in order to assign to each individual from 2006 a statistical twin in 2001. This takes account of the selection process of individuals into firms based on observable characteristics.

So far we have taken the perspective of individuals from 2006. As final step, we estimate the contribution of changes in personal characteristics by subtracting the wage distribution in 2001 from the last counterfactual wage distribution (Δ_τ^7).

The complete sequential decomposition of the changes between 2001 and 2006 can be

[30] Similarly, DiNardo et al. (1996) use a probit model and Chernozhukov et al. (2008) use a logit model in order to account for the correlation between the covariates and the union status.

[31] The detailed probit estimates are available upon request. To simulate the counterfactual bargaining regime which would have prevailed in 2001, we calculate for each individual the implied wage bargaining regime based on the probit coefficient estimates and randomly drawn error terms.

summarized as follows:

$$(6) \quad \Delta_\tau^{06/01} = q_\tau^{06}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{06}, P^{06}) - q_\tau^{01}(\alpha_P^{01}, \alpha_F^{01}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01})$$

$$= \underbrace{\underbrace{\underbrace{\Delta_\tau^1}_{Personal} + \underbrace{\Delta_\tau^2}_{Firm} + \underbrace{\Delta_\tau^3}_{Coverage}}_{Coefficients} + \underbrace{\Delta_\tau^4}_{Residual} + \underbrace{\underbrace{\Delta_\tau^5}_{Coverage} + \underbrace{\Delta_\tau^6}_{Firm} + \underbrace{\Delta_\tau^7}_{Personal}}_{Characteristics}}$$

We implement the decomposition separately for female and male employees. The gender differences by quantiles of the components of the decomposition quantify the decomposition of the change in the gender wage gap over time.

5 Decomposition results

This section discusses the results of the decomposition of the changes in the wage distribution over time by gender. The difference between the developments of the male and the female wage distributions is equivalent to changes in the gender wage gap which will be discussed as well. As described in the previous section, we implement a detailed sequential decomposition analysis to estimate the specific contribution of personal characteristics, firm characteristics, and the bargaining regime as well as their corresponding coefficients. The detailed results of the decomposition analysis are presented in the appendix in form of tables, reporting results at selected quantiles, and graphs, representing the entire wage distribution. For the interpretation of the results, note that an upward (downward) sloping line in such a graph represents a situation where the corresponding component of the decomposition is associated with an increase (decrease) in overall wage inequality. This is because the implied change in wages is greater (smaller) at higher quantiles as compared to lower quantiles.

Results for the decomposition of the level of the gender wage gap into the total characteristics and coefficients effect, using the standard approach introduced by Machado and Mata (2005) separately for 2001 and 2006, are given in figure 5. The characteristics effect and the coefficients effect explain approximately the same share of the gender wage gap in the lower half of the distribution. In contrast, in the upper half, the contribution of the coefficients effect grows much stronger which is in line with the findings presented by Felgueroso et al. (2008, p. 313) for Spain, whereas the results from Arulampalam et al. (2007) for the German private sector exhibit a much flatter shape. This contributes to the higher gender wage gap in the upper half, often referred to as "glass ceiling". Over time, the U-shaped pattern of the gender wage gap and of the coefficients effect flattens. In 2006, the coefficients effect explains a larger share of the overall gender wage gap in the upper part of the wage distribution compared to 2001, i.e. the importance of coefficients

increases over time.

Now, we turn to the sequential decomposition results which allow us to assess the specific contribution of various components. Table 3 provides a representative set of results at the first decile, the median, and the ninth decile. For males, wage growth at the median amounts to 1 log percentage point (ppoint), while the change in bargaining coefficients and the change in the bargaining regime would have implied a fall of 1.3 and 1 ppoints, respectively. However, this is overcompensated by the changes in personal coefficients (+1.1), firm coefficients (+1.1), and firm characteristics (+1.3). Residual wage growth (-.5) and changes in personal characteristics (+.3) only play a minor role. In contrast to the median, wages at the first decile decrease by 8.8 ppoints, implying a 9.8 ppoints increase in the 50-10 differential. As the largest component, changes in firm coefficients contribute 3.6 ppoints to this decline. In addition, the change in bargaining coefficients (-1.8) and the change in the bargaining regime (-1.6) contribute significantly to this fall. At the ninth decile, wages increase by 4.3 ppoints and again changes in firm coefficients contribute the largest share with 2.1 ppoints. Shifts in the returns to personal characteristics contribute 1.7 ppoints to the increase. However, changes in personal characteristics would have implied a loss of 2.3 ppoints at the ninth decile. For females, general trends are similar. Overall wage growth at the median is slightly negative (-.8) and the decline of wages at the first decile is more pronounced (-6.8) compared to the median. Personal coefficients contribute to a fall in female wages both at the median (-1.4) and at the first decile (-3.5). The components reflecting wage bargaining and firm-related covariates and coefficients thereof also contribute to a fall of wages at the first decile. However, this is mitigated strongly for females by the changes in personal characteristics (+5.3). Without this effect, wages at the first decile for females would have fallen even more strongly than for males. The ninth decile of female wages increases by 4.6 ppoints. Residual wage growth (+2.1) contributes the single largest component to this increase, and there are positive contributions of all three coefficients effects, with the bargaining-specific returns being strongest. There is evidence for a strong increase in wage inequality by gender, i.e. the 90-10-, 90-50-, and 50-10-differentials all increase. For instance, the 90-10-differential increases by 13.1 ppoints for males and by 11.3 ppoints for females (see bottom panel of table 3). The decomposition shows that the changes in firm coefficients are the single most important component of this increase in wage inequality and this is driven by the strong impact of firm coefficients on the 50-10-differential.[32] Changes in bargaining coverage and changes in bargaining coefficients also play an important role, but surprisingly, these effects are stronger in the upper part of the wage distribution. Furthermore changes in

[32]Gernandt and Pfeiffer (2007), using the decomposition technique proposed by Juhn et al. (1993), provide evidence that between 1994 and 2005 almost half of the increase of the 50-10-differential is explained by price effects. This result can be thus in line with our finding, stemming from a more detailed approach.

personal coefficients and residual wage changes contribute to the rise in wage inequality whereas changes in personal characteristics strongly work against it.

Next, we discuss the sequential decomposition along the *entire distribution*. The results are displayed separately for the male and female wage distributions (figures 6 and 7) as well as for the gender wage gap (figure 8).

The personal characteristics involve age, tenure, education, and an indicator for working extra shifts. The first component of the decomposition quantifies the contribution of changes in coefficients of the personal characteristics to the total change between 2001 and 2006 (see top right graph). These individual-specific coefficients add to wage inequality particularly for females, but the effect is hardly ever significant. Moreover, these effects tend to increase the gender wage gap – particularly at the bottom. The same result has been found by Gartner and Hinz (2009) at the mean.

The firm characteristics involve firm size, industry, region, a dummy for predominantly public ownership, as well as the shares of male and less than full-time working employees in that establishment. The changes in the coefficients of firm characteristics imply an increase in wage inequality – in particular at the bottom of the distribution. For males, this is the largest contribution to increasing wage inequality. As the firm coefficients effect is sizeable, we further decompose it into three components associated with (i) region, (ii) sector affiliation, and (iii) further specific firm characteristics, e.g. firm size (figure 10). The results show that changes in between- and within-industry wage differences mainly drive inequality upwards. In addition, different wage schemes according to firm size play a small role, whereas region coefficients are irrelevant. This suggests that the heterogeneity of firm wage policies has increased both between and within industries, possibly through the more widespread use of variably payment schemes Dohmen and Falk (2010). As the developments are very similar for males and females, there is only a small but nonnegligible effect of these firm-coefficients on the gender wage gap, except at the bottom.

Wage differences between the different bargaining regimes raise wage inequality slightly. Sectoral bargaining apparently drives this trend, as this regime displays the strongest real wage losses at the first decile (table 2). The changes in wage differences across the bargaining regimes tend to reduce the gender wage gap uniformly along the wage distribution by about 1 ppoint, but the effect is never pointwise significant.

Unexplained time trends tend to increase wage inequality for both males and females, with falling wages in the bottom of the distribution and rising wages in the top. The trend is more positive for females, resulting in a uniform reduction of the gender wage gap of about 1.3 ppoints which is, however, not pointwise significant.

Next, we consider the components of the characteristics effect and start with the change in collective bargaining coverage. Recall that we find a sharp drop in union coverage over the period of only five years. We expect that the strong reduction in collective bargaining

coverage results in an increase in wage inequality and that this effect is particularly strong at the bottom of the distribution. In fact, the qualitative pattern of our results is in line with this expectation for both genders. Put differently, the change in coverage is indeed associated with falling wages at the bottom of the wage distribution and increasing wages in the upper part. However, compared to the results reported in Dustmann et al. (2009), the effect is surprisingly small! As a further surprise, the effect of the change in bargaining coverage is convex along the distribution resulting in a stronger effect on rising dispersion at the top of the distribution.[33] As the results are nearly identical for males and females, the drop in bargaining coverage shows no discernible effect on the gender wage gap. Recall that the gender wage gap below the median falls both for uncovered workers and for workers covered by industry-wide bargaining. However, it increases strongly for firm-level bargaining and the increase is particularly strong at the bottom of the wage distribution. For the most part, these different effects cancel each other.

One may be concerned that changes in sector shares may spuriously capture some part of the reduction in bargaining coverage. To address this issue, we run bivariate probit regressions of coverage dummy variables (no coverage, sector-level bargaining, or firm-level bargaining) on all other firm characteristics and personal covariates. We pool the data for the years 2001 and 2006 and we add a dummy variable for 2006.[34] The estimated average marginal effects of the year dummy are very similar in size to the overall changes in coverage reported in the last two columns of table 1.[35] Thus, the reduction in bargaining coverage is almost exclusively taking place for given firm characteristics and personal characteristics. In particular, it occurs almost exclusively within sectors.[36] We conclude that changes in industry composition as measured by sector shares are not the main driving force for the drop in collective bargaining coverage.[37]

Changes in firm characteristics are associated with slightly higher wage inequality for both male and female employees. This component includes mechanical effects from

[33]Dustmann et al. (2009) report a larger effect of the decline in union coverage on changes in wage inequality for males, see footnote 2, and their results indicate a much stronger effect at the bottom of the wage distribution compared to the top. Their analysis does attribute changes in other covariates, which are correlated with the decline in union coverage, to the union coverage effect. Our sequential decomposition approach allows to estimate the partial effect of changes in union coverage, holding these other covariates constant.

[34]The detailed probit results are available upon request.

[35]The marginal effect for no collective wage bargaining coverage is 15.6 ppoints for males and 18.2 ppoints for females (both 0.9 ppoints below the corresponding numbers in table 1).

[36]To investigate this issue further in a systematic way, figure 12 plots the employment shares (in percent) by sector against the sector specific coverage rates and connects the data points for 2001 and 2006 for each sector. This evidence shows that there is no systematic link between coverage rates and employment shares or the changes thereof, and that sector 28 seems to be an outlier. The descriptive results reported in Tables 6 and 7 show that sector 28, comprising service sectors with low coverage, grows strongly between 2001 and 2006 potentially due to changes in the definition. The graphical evidence confirms that, on average, the reduction in coverage occurs within sectors.

[37]However, our data do not allow us to further distinguish between other explanations for this decline.

changes in the industry composition. The patterns are concave, i.e. the effect is significantly negative and stronger at the bottom of the distribution. For males, the effect is significantly positive at the top while for females it is negative and zero at the top. Put together, changes in firm characteristics are associated with an approximately 1.7 ppoints higher gender wage gap, an effect which is mostly significant along the distribution.

Finally, changes in personal characteristics tend to *reduce* wage inequality. This effect entails skill upgrading or the like. Interestingly, Al-farhan (2010, table 7) finds a similar result by using mainly person-specific covariates for West Germany 2002-2006. His results show large effects of education, potential experience, the occupational position and firm size, whereas in our study the latter is subsumed in the firm-specific effects. For both genders, we find a falling effect which is very strong for females at the bottom of the distribution. Thus, changes in personal characteristics by themselves would have resulted in a sizeable *decline* of the gender wage gap at the bottom and at the very top.[38] Hence, females have 'upgraded' their personal characteristics but this is counteracted to a very large extent by other components. The same result is found by Edin and Richardson (2002) for a time period where Sweden experienced a similar stagnation of the gender wage gap (1981-1991, see ibid. p. 139). Applying the wording of Blau and Kahn (1997), women are 'swimming against the stream' but not 'upstream' anymore.

To contrast the effects of workplace related characteristics with personal characteristics, we also provide evidence for the sum of bargaining and firm effects both for coefficients and characteristics effects (figure 9). We literally sum the terms from Δ_τ^1 and Δ_τ^2 for the combined coefficients effect and the terms Δ_τ^6 and Δ_τ^7 for the combined characteristics effects (see equation 5). The results show that both effects contribute in an important way to the increase in wage inequality along the entire distribution and that the contribution of the coefficients effect dominates the characteristics effect.

As a robustness check, we reversed the order of the decomposition (see appendix A and figures 13 to 15). The results remain qualitatively the same. Above all, the effects of collective wage bargaining remain of minor importance.[39] Merely, the importance of the personal characteristics increases and the firm coefficients effect decreases. These changes can be interpreted in a meaningful way because they are based on a different sequence of counterfactual wage distributions. The differences for personal characteristics imply that personal coefficients have changed between 2001 and 2006 in a way that the changes in personal characteristics matter more in 2006 than in 2001 for wage inequality.

[38] A similar result is obtained by Hinz and Gartner (2005), who however only analyze the mean.

[39] The fact that the results for the collective bargaining effects look slightly different under the reversed order has a simple explanation. In 2006 the gender wage gap under firm-level bargaining exhibits a particularly high level. This implies that the reduction in collective bargaining coverage would reduce the gender wage gap when measured at coefficients from 2006 (i.e. under the reversed order). Still, the key result remains the same namely that changes in collective bargaining coverage hardly contributed to changes in the gender wage gap.

Analogously, the difference for firm coefficients implies that firm characteristics, especially the sector composition, has changed such that between- and within-industry coefficients changes translate into stronger effects on wage inequality for 2006 firm characteristics compared to 2001 firm characteristics. Again, these differences emphasize that the effects of characteristics changes are stronger in the 2006 labor market than they would have been in the 2001 labor market.

Returning to our hypothesis about the relation between reduced collective bargaining coverage and the gender wage gap, we find hardly any effect. Moreover, the effects do not vary over the distribution.[40] Finding no effect on the gender wage gap is due to the fact that changes in collective wage bargaining increase wage inequality for males and females to a very similar extent. This is a justification for why we have analyzed in depth the wage distributions of males and females separately. Fortin and Lemieux (1997) find that deunionization raises wage inequality for males, but that no such effect exists for females. Instead, females are strongly affected by the minimum wage. For the comparison of this result to ours, one has to understand that the sharp distinction between union coverage and the minimum wage does not apply to Germany, because instead collectively negotiated wages act as a wage floor within covered establishments. Thus, our results are consistent with Fortin and Lemieux (1997). But how can our results be reconciled with the correlation between deunionization and the gender wage gap often found in the literature? Most studies in the literature are based on single cross-sections of data (Gartner and Stephan, 2009; Felgueroso et al., 2008; Meng and Meurs, 2004). Instead, we explicitly analyze the change in coverage and the change in the gender wage gap over time. We find the "deunionization" has quite a similar effect on male and female wage inequality. The dynamics appear to be different than cross-sectional evidence would suggest. This could be due to the following three reasons. First, there is a continued application time limit ("Nachwirkungsfrist") in Germany regulating how quickly formerly covered firms can stop the application of the terms of collective bargaining. Moreover, the majority of firms not applying a collective contract directly still use it as a guideline (Kohaut and Ellguth, 2008). For these reasons, the drop in collective bargaining can have a delayed effect. Second, the firm dynamics over time obviously have to be considered more closely as firm closures and start-ups are likely to reduce collective bargaining coverage (Kohaut and Ellguth, 2008). However, this changing firm structure could also affect the gender wage gap. Third, although bargaining coverage changes, the selection of individuals into firms may remain the same, explaining why we do not find any effect. Finally, it should be noted that there is very little to be explained in the first place as the change of the gender wage gap is zero on average.

[40]Note that few studies analyze the distributional aspect at all, which makes it difficult to "reconcile" our results with the literature.

Summing up, our decomposition analysis statistically explains a major part of the observed changes in the wage distribution by gender between 2001 and 2006. All workplace related effects (firm plus bargaining regime) contribute to the strong rise in wage inequality. We find evidence that the reduction in bargaining coverage has contributed in a significant way and that the bargaining outcomes (measured by the coefficients) allow for higher wage inequality (possibly indicating higher wage flexibility). However, these effects are dominated by the firm coefficients effect which results in a strong increase in wage inequality, especially at the bottom of the distribution. This effect is strongly driven by changes in sector coefficients, i.e. by changes in the between- and within-industry wage differentials. This evidence indicates that sectors differ strongly in the degree to which low wage employment is growing in importance over time. More specifically, it suggests stark differences in wage policies across industries, possibly reflecting between- and within-industry differences in the division of bargaining power between workers and firms (Bartolucci, 2009), differences in labor market conditions for low-skilled workers, or differences in the introduction of variable payment schemes (Dohmen and Falk, 2010; Lemieux et al., 2009). One potential reason may be that sectors differ in the degree by which they are affected by competition from low-wage countries abundant in low-skilled employees. Women have been affected more strongly by the changes in firm coefficients, which by themselves would have caused a slight increase in the gender wage gap in the middle and the top of the wage distribution. However, we find a small reduction of the gender wage gap at the bottom of the wage distribution, which is explained by changes in personal characteristics and changes in firm coefficients. Changes in personal coefficients are weakened at the bottom of the wage distribution. Thus, the mechanisms leading to a reduction of the gender wage gap dominate at the bottom of the wage distribution. Put differently, females have been able to "swim upstream at the very bottom", where males have been done extremely poorly, consistent with the stronger distaste of females for more variable wages (Dohmen and Falk, 2010). This holds for the uncovered sector and for industry-wide bargaining, who show a sizeable decline of the gender wage gap below the median. Only under firm-level bargaining, where male interests are most likely to dominate, the gender wage gap has increased strongly at the bottom of the wage distribution.

Overall, our results suggest that both firm-level effects and institutional changes regarding wage bargaining contribute significantly to the rise in wage inequality but that the firm-level effects clearly dominate, especially for the strong rise in wage inequality in the bottom of the wage distribution. Firm-level effects may be caused by changes in labor demand or by changes in firm-wage policies. In contrast, personal characteristics change in a way to reduce wage inequality and the gender wage gap. Notwithstanding, personal coefficients contribute to some degree to the increase in wage inequality, which

is likely to reflect labor demand effects (as in Albrecht et al., 2009a). These imply rising returns to labor market skills, which is in line with both the skill biased technical change hypothesis and the hypothesis that increasing international trade and outsourcing reduce the relative demand for low-skilled labor in Germany.[41]

6 Conclusions

Using the German Structure of Earnings Survey, this paper describes the stark increase in wage inequality between 2001 and 2006 and the associated strong decline in collective bargaining coverage. We investigate as to whether and to what extent the recent increase in wage inequality between 2001 and 2006 can be related to the decline in wage bargaining as well as to changes associated with firm characteristics and with personal characteristics. Our analysis is restricted to the private sector of the West German economy. We analyze changes in the wage structure for males and females separately to study the implications on the gender wage gap. Applying a quantile regression framework, we analyze wage changes and gender differentials along the wage distribution. In order to break down the changes in the wage distribution into those contributions stemming from characteristics and from coefficients effects, we employ the decomposition techniques proposed by Machado and Mata (2005) and Melly (2005) and we extend the analysis to a sequential procedure similar to DiNardo et al. (1996) and Chernozhukov et al. (2008). We emphasize that the results of a sequential decomposition depend upon the chosen sequence of counterfactuals analyzed and we argue why the applied sequence is meaningful.

Our descriptive results provide new results on trends in wage inequality by gender and on the gender wage gap. There are some amazing changes between 2001 and 2006. We quantify the recent rise in wage inequality, which is driven by real wage increases at the top of the wage distribution as well as by real wage losses below the median. During the five years analyzed, the 90-10 wage differential increases by 13.1 log percentage points for males and by 11.3 log percentage points for females. In addition, wage dispersion also increases within each of the different types of bargaining regime. The increase in wage inequality is particularly strong for male workers at the bottom of the wage distribution. During the same time period, coverage by collective wage bargaining drops by 16.5 percentage

[41] Although our data do not allow us to identify the type of tasks performed at the workplace, the heterogeneity of effects across firms (industries) driving the increase of wage inequality is not easy to rationalize with a simple task-based interpretation of labor market developments in line with Autor et al. (2003), unless one could show that the observed heterogeneity is driven by changes in tasks and task remunerations. Antonczyk et al. (2009), based on a different data set, find that a simple task based approach can not rationalize the recent increase in wage inequality because task changes would have worked towards a reduction in wage inequality. Nevertheless, in light of the importance of workplace variables, it would be of interest to analyze the link between the firm heterogeneity in wage trends and the tasks performed at the workplace by pooling the two data sets in future research.

points for males and by 19.1 percentage points for females. It comes as a surprise that not only coverage by sectoral-level bargaining but also coverage by firm-level bargaining falls over time. As a result, in 2006 only little more than half of West German employees are working in establishments still being covered by a collective bargaining agreement.

Our sequential decomposition results show that all workplace related effects (firm effects and bargaining effects) contribute to the strong rise in wage inequality. Although we find evidence that the reduction in bargaining coverage adds to this increase in a sizeable way and that the bargaining outcomes allow for higher wage flexibility, these effects are smaller than the firm coefficients effect, being almost exclusively driven by the sector coefficients effect. Moreover, the drop in collective bargaining coverage takes place almost entirely within the industries. Firm-level effects dominate regarding the strong rise in wage inequality at the bottom of the wage distribution. The changes in the sector composition over time reinforce the observed widening in between- and within-industry wage differences. In addition, personal coefficients add to some degree to the increase in wage inequality, reinforcing the dominance of labor demand effects. In contrast, personal characteristics change in a way to reduce wage inequality. All this adds up to minor changes in the overall gender wage gap, and only the strong improvement in personal characteristics of females results in a fall of the gender wage gap at the bottom of the wage distribution, which is, however, accompanied by small increases in the middle of the distribution. In fact, there are a number of compensating effects. Together, changes in personal characteristics and in bargaining coefficients, as well as residual wage changes, work towards a reduction of the gender wage gap. However, all firm-level effects act in favor of a higher gender wage gap. Women are 'swimming against the stream' but not 'upstream' anymore (Blau and Kahn, 1997; Sohr and Stephan, 2005), except at the bottom of the wage distribution, where males are doing extremely poorly.

Our results highlight that the stark decline in collective wage bargaining contributes to the strong rise in wage inequality in Germany, but that this is by no means the dominating effect. Firm-level effects (due to changing labor demand or changing wage policies) causing a stronger heterogeneity in wages (possibly through more variable payment schemes) are more important, especially across industries at the bottom of the wage distribution. Firm-level effects also appear to stop the further decline in the gender wage gap in the middle and the upper part of the wage distribution. Our results open the floor to explore in further research the specific contribution of international trade, the introduction of variable payment schemes on the evolution of wage inequality, and the role played by the labor market reforms. In light of our results, it may not come as a surprise after all that political calls in Germany for the introduction of a minimum wage for certain sectors have become more pronounced over the last years.

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Appendix

A Robustness Check

The results of our decomposition analysis depend upon the chosen order of sequence. As a robustness check we carry out the decomposition analysis in the inverted order compared to the one described in section 4.2 and contrast the corresponding results to those presented in section 5. We now take the perspective of individuals from 2001. We start by constructing the new counterfactual wage distribution which would have prevailed had individuals from 2001 worked in firms from 2006 and had been paid as in 2006. This counterfactual distribution is subtracted from the unconditional wage distribution in 2006. The resulting difference pins down the impact of changes in personal characteristics on changes of the entire wage distribution and thus on changes of the wage dispersion. We then proceed using this inverted order. As described in section 4.2 we take possible correlations between the covariates into account. The alternative sequence we apply reads as follows:

$$
\begin{aligned}
\Delta_\tau^1 &= q_\tau^{06}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{06}, P^{06}) - q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{06}, \mathbf{P^{01}}) \\
\Delta_\tau^2 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{06}, P^{01}) - q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, \mathbf{F^{01}}, P^{01}) \\
\Delta_\tau^3 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{06}, F^{01}, P^{01}) - q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, \mathbf{B^{01}}, F^{01}, P^{01}) \\
\Delta_\tau^4 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{06}, B^{01}, F^{01}, P^{01}) - q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_{\mathbf{0}}^{\mathbf{01}}, B^{01}, F^{01}, P^{01}) \\
\Delta_\tau^5 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{06}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) - q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_{\mathbf{B}}^{\mathbf{01}}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) \\
\Delta_\tau^6 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{06}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) - q_\tau^{01}(\alpha_P^{06}, \alpha_{\mathbf{F}}^{\mathbf{01}}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) \\
\Delta_\tau^7 &= q_\tau^{01}(\alpha_P^{06}, \alpha_F^{01}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01}) - q_\tau^{01}(\alpha_{\mathbf{P}}^{\mathbf{01}}, \alpha_F^{01}, \alpha_B^{01}, \bar{\alpha}_0^{01}, B^{01}, F^{01}, P^{01})
\end{aligned}
$$

Figures 13 to 15 display the corresponding results. Overall, they are qualitatively in line with those presented in section 5. For *male workers*, changes in personal coefficients now play a larger role in explaining higher wages above the median, as well as in explaining the increase in overall wage dispersion, compared to the results discussed in section 5. Changes in firm coefficients now contribute less to the decline of wages below the median. Changes in firm characteristics are no longer statistically different from zero, whereas they had slightly contributed to higher wages above the median before. Changes in the bargaining premia, the bargaining regime, the personal characteristics, and the residual component affect the wage distribution in a similar way as before.

Female workers profit slightly more above and slightly less below the median from changes in personal coefficients. These changes thus contribute to some degree more to the observed increase in overall wage inequality. Below the median, changes in the bargaining specific remuneration are now negative and slightly significant. On the contrary, shifts in the bargaining regime reduce wages considerably less; for most parts below the upper quartile, this effect is not significantly different from zero anymore. Changes in firm characteristics, which we argue are likely to present industry shifts, no longer work towards decreasing wages at the bottom of the distribution. In a small region around the upper quartile, these shifts become slightly negative. For workers below the median, shifts in personal characteristics are still positive, but to a smaller extent, and mostly this effect is no longer statistically significant. Changes in the residual component and changes in firm coefficients are very similar to the former decomposition presented above.

Changes in the *gender wage gap* can be described as the difference of changes in the gender specific wage distributions. Changes in personal and firm coefficients, as well as the residual component, contribute to changes in the gender wage gap in a similar way as before. Changes in bargaining specific remuneration schemes are relatively more negative for female workers when applying the alternative order of our decomposition, but are still not significant. Changes in bargaining coverage become statistically significant and counteract an increase of the gender wage gap. On the contrary, changes in firm characteristics now significantly contribute to a rising gender wage gap, uniformly along the wage distribution. Finally, females gain relativel to men below the lower quartile due to changes in personal characteristics.

B Graphs

Figure 1: Log-wages of males and females and development of gender wage gap

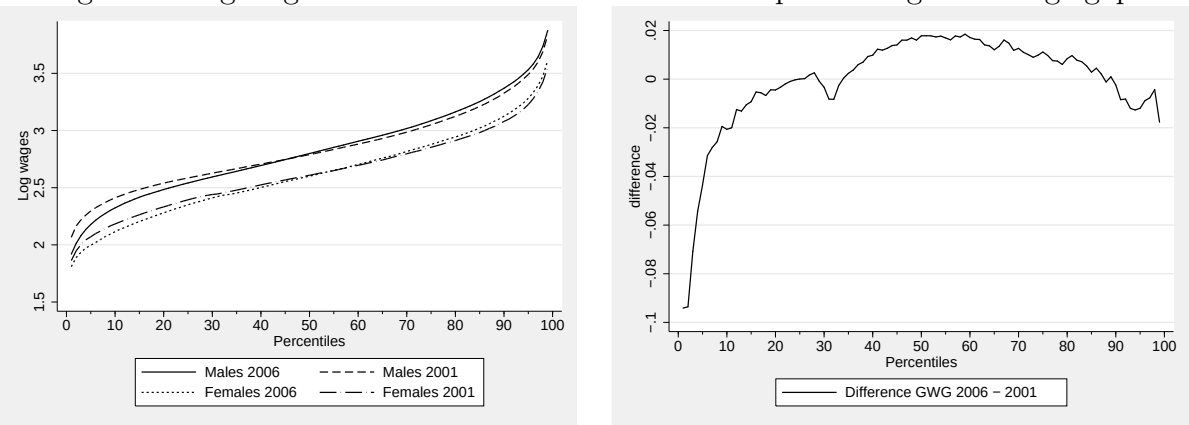


Figure 2: Unconditional log-wages and gender wage gap: Without collective bargaining

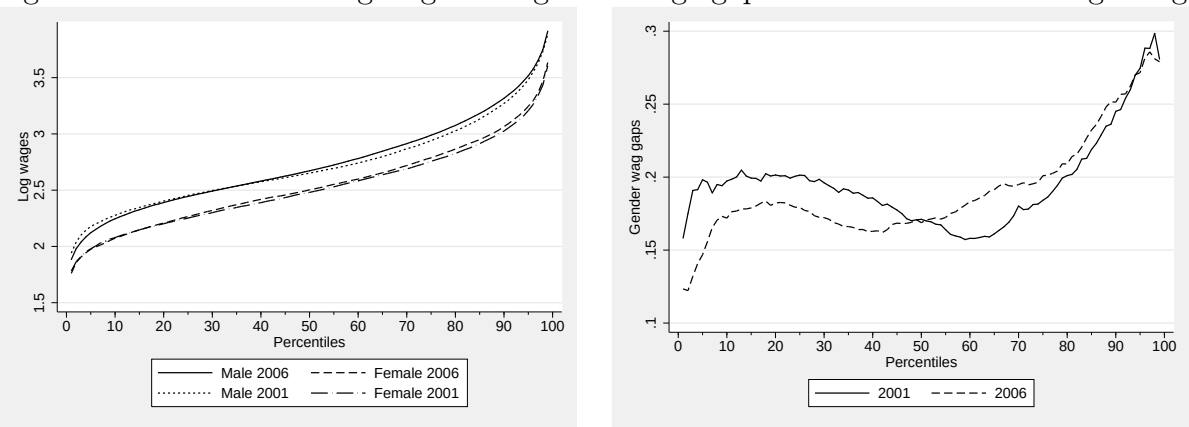


Figure 3: Unconditional log wages and gender wage gap: Sectoral agreements

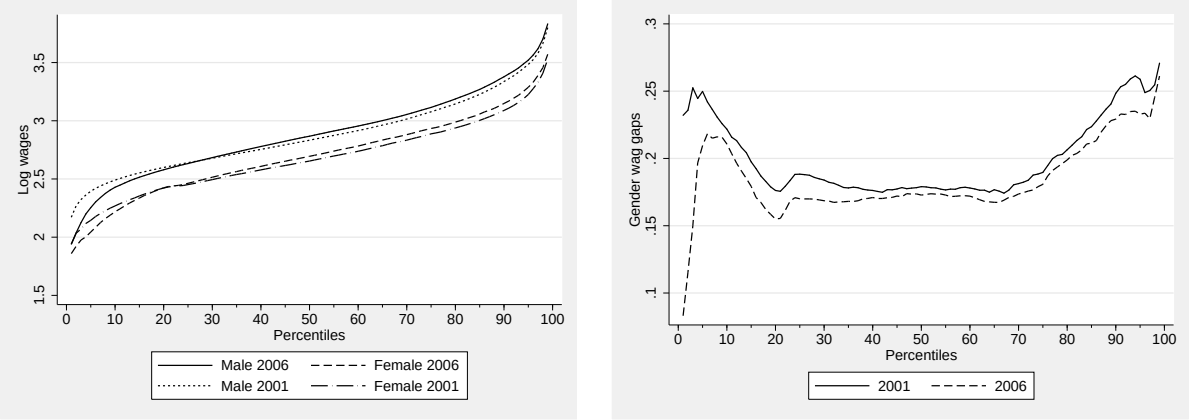


Figure 4: Unconditional log-wages and gender wage gap: Firm agreements

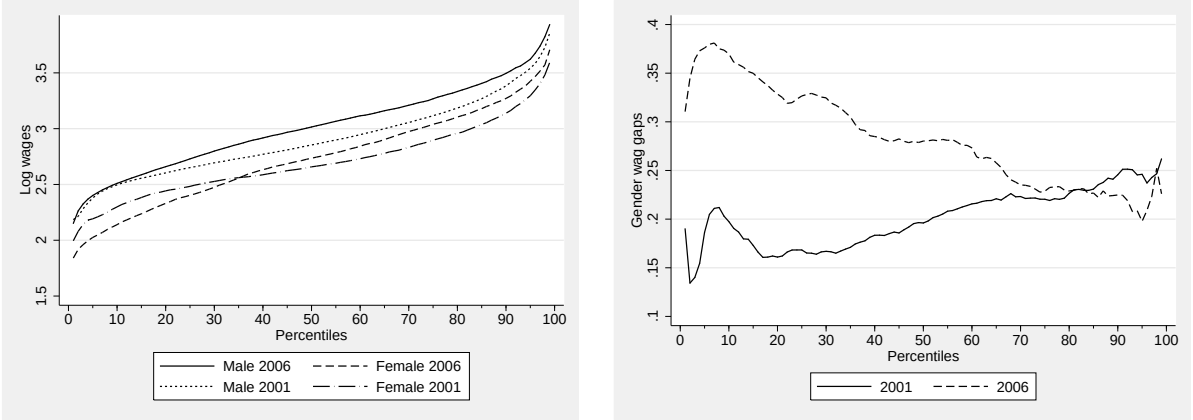


Figure 5: Overall gender wage gap

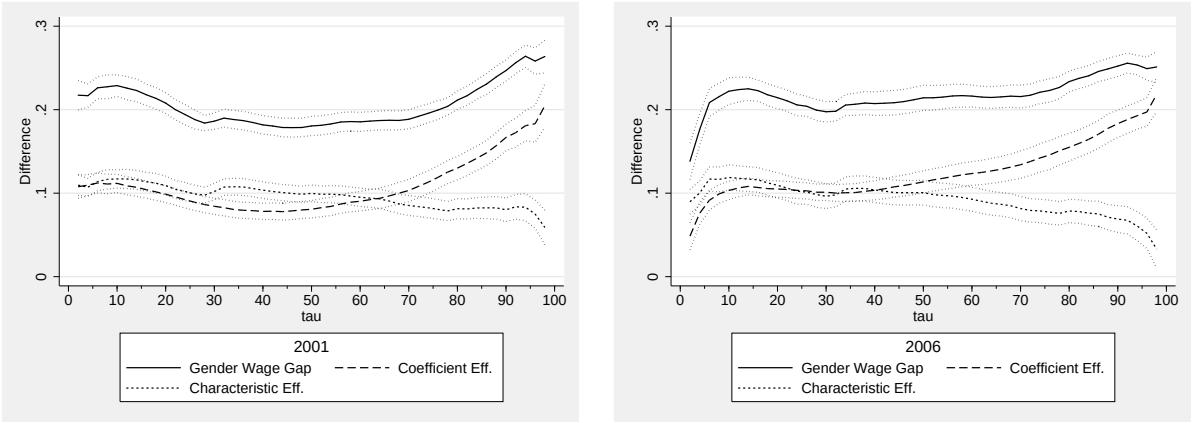
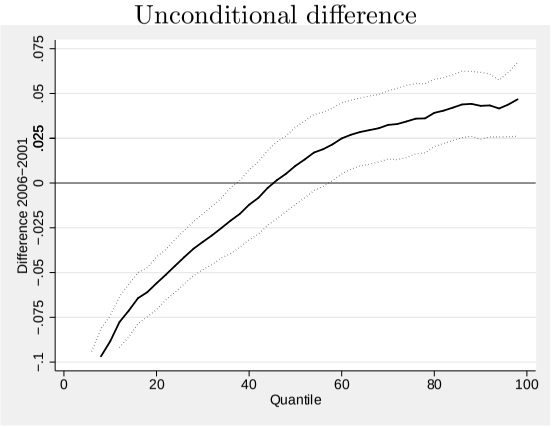
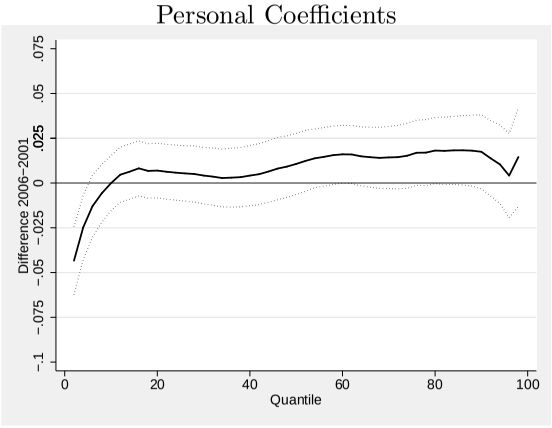


Figure 6: Sequential decomposition of change in male wage distribution

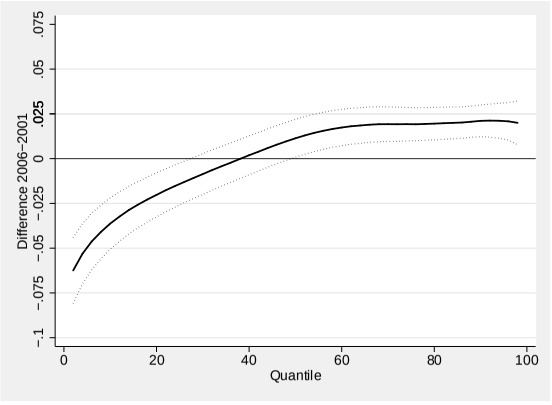
Unconditional difference



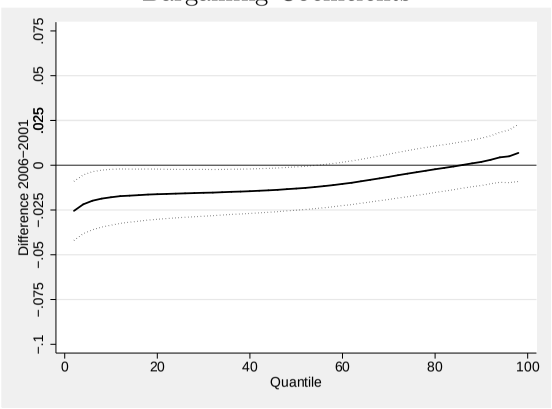
Personal Coefficients



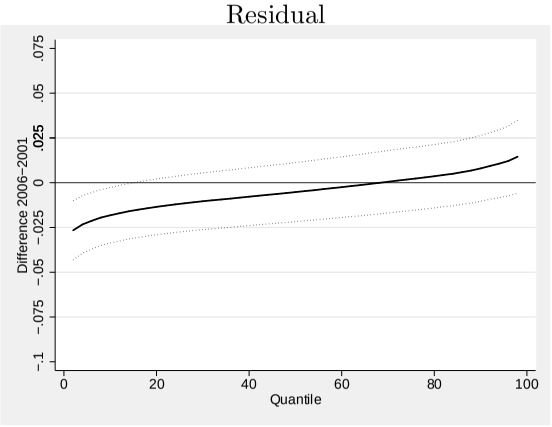
Firm Coefficients



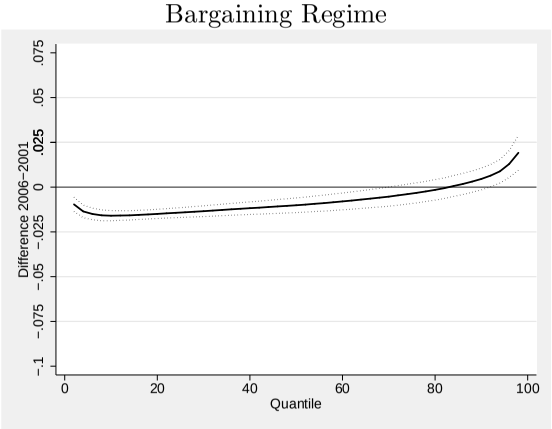
Bargaining Coefficients



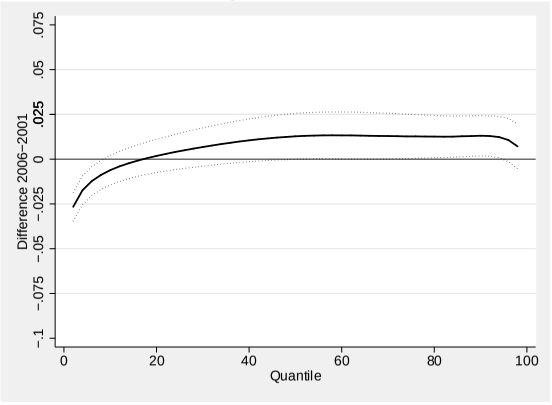
Residual



Bargaining Regime



Firm Characteristics



Personal Characteristics

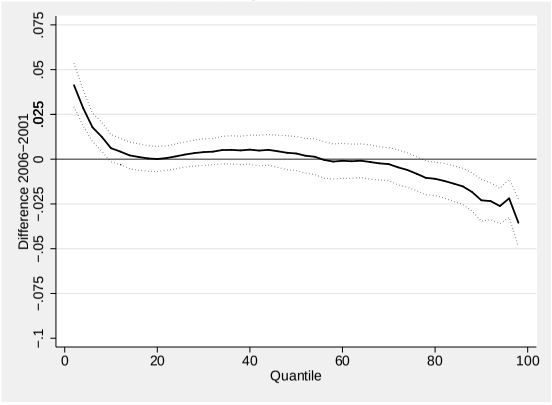


Figure 7: Sequential decomposition of change in female wage distribution

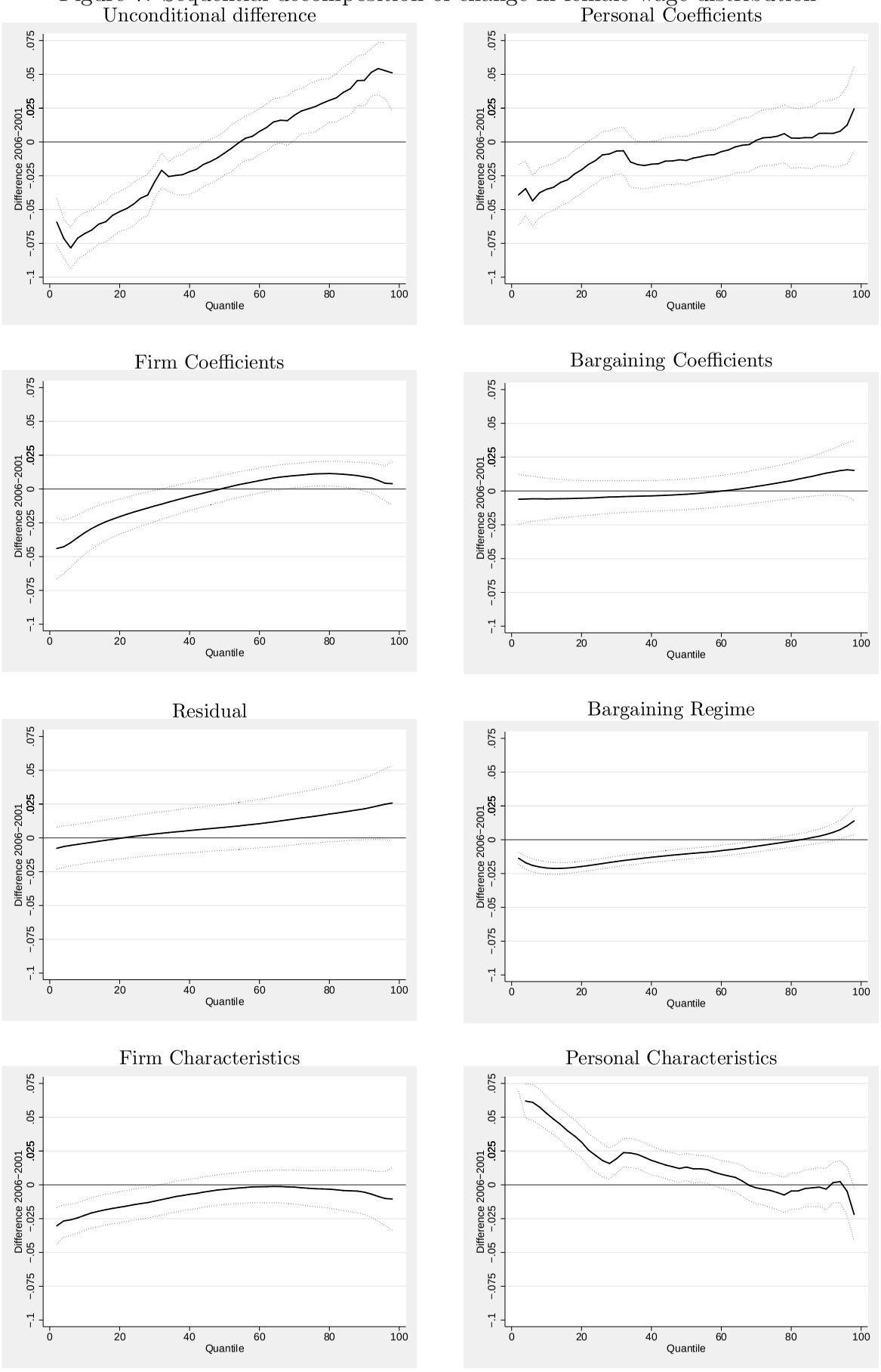


Figure 8: Sequential decomposition of overall gender wage gap

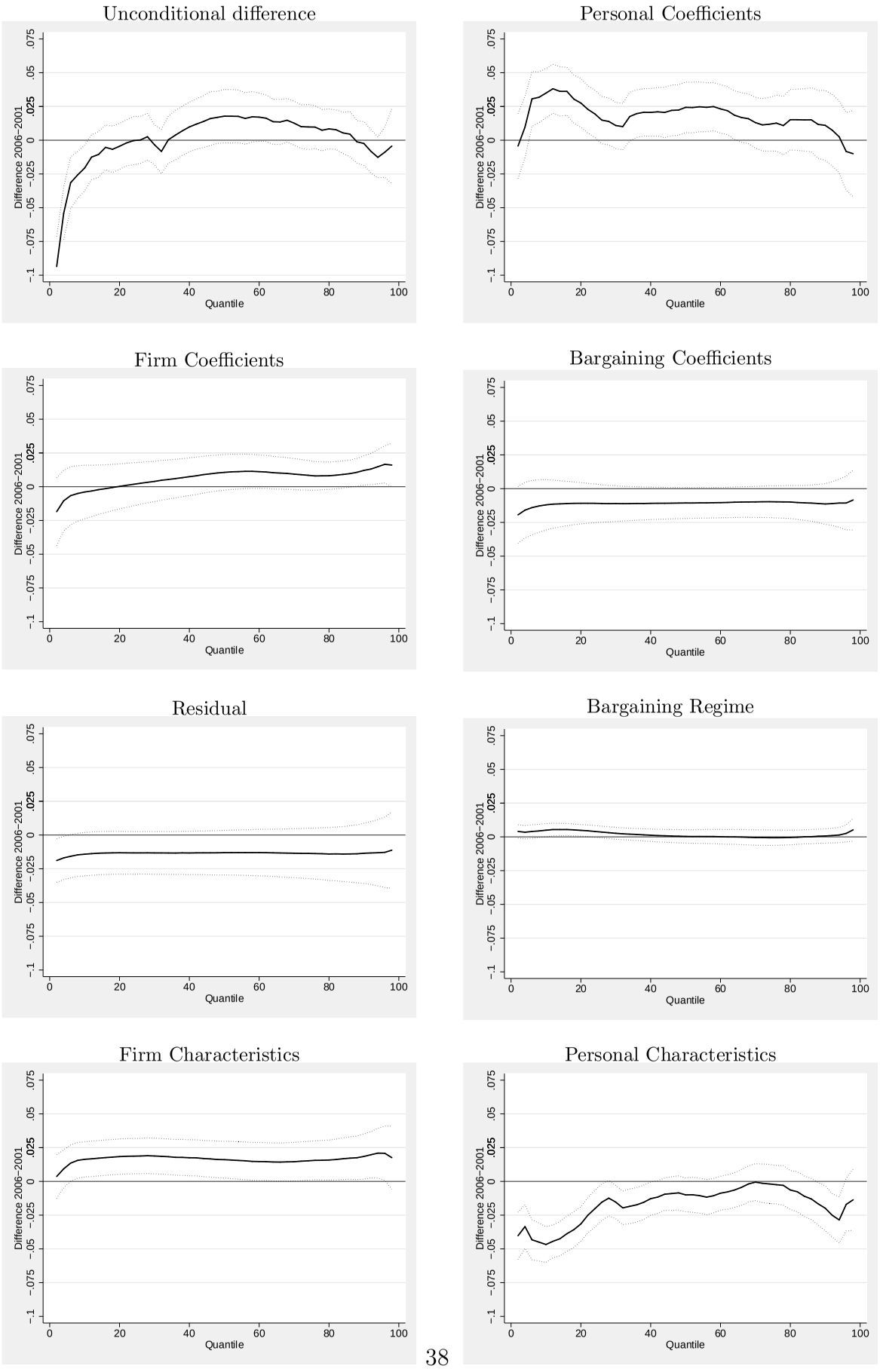
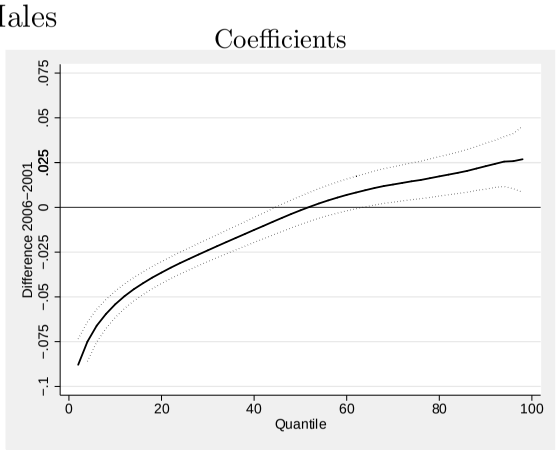
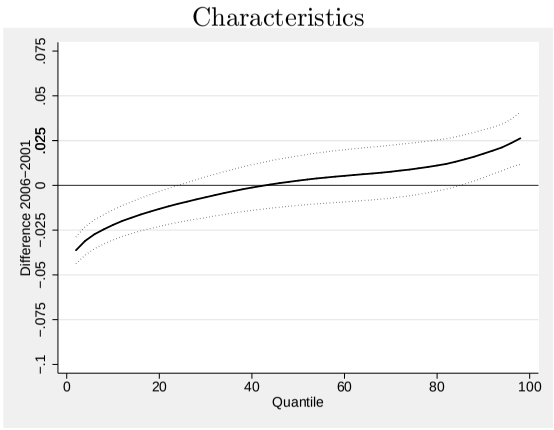


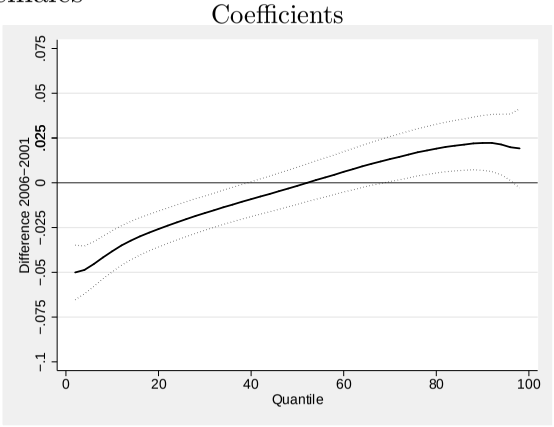
Figure 9: Sum of firm and bargaining effects

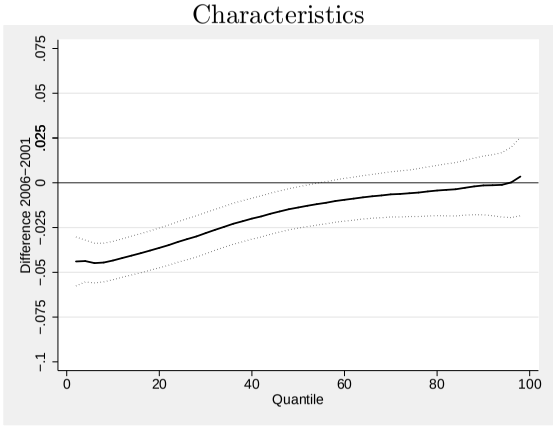
Males



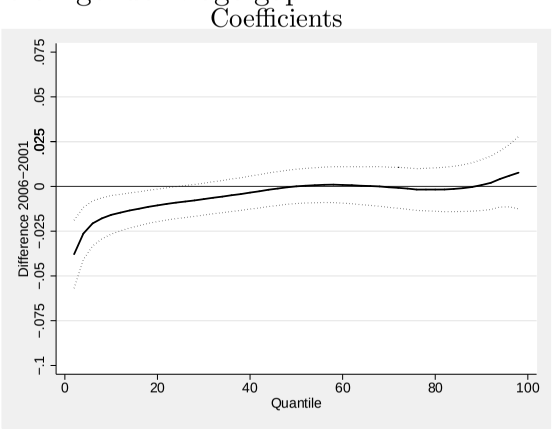


Females





Overall gender wage gap



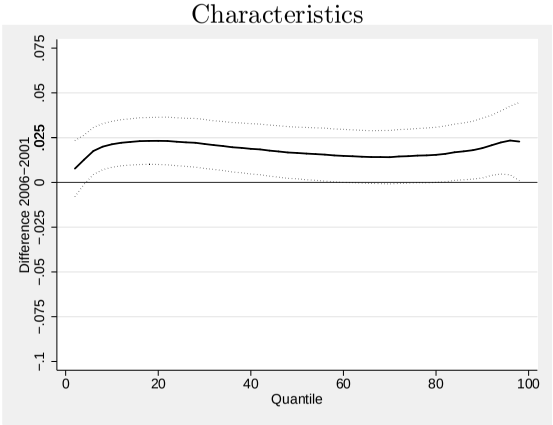
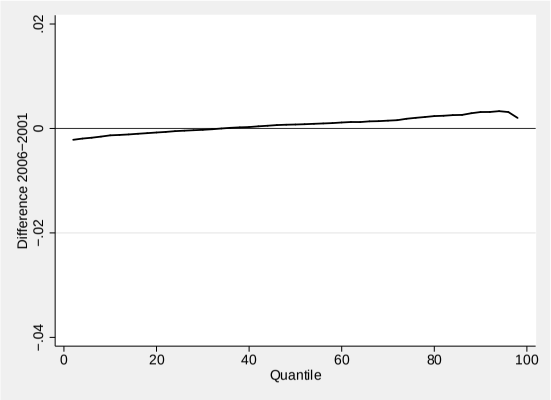
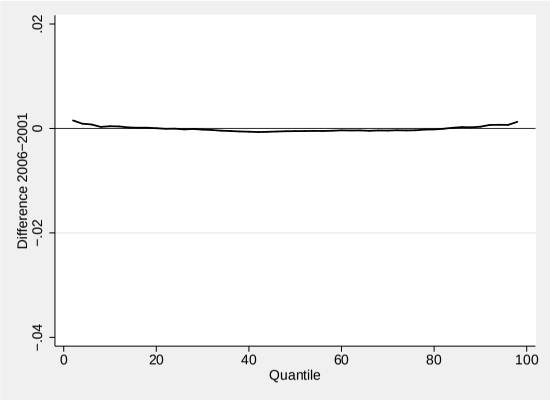


Figure 10: Further decomposition of firm coefficients effect

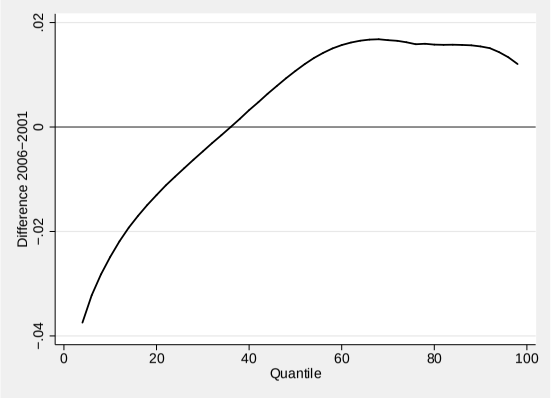
Males Females

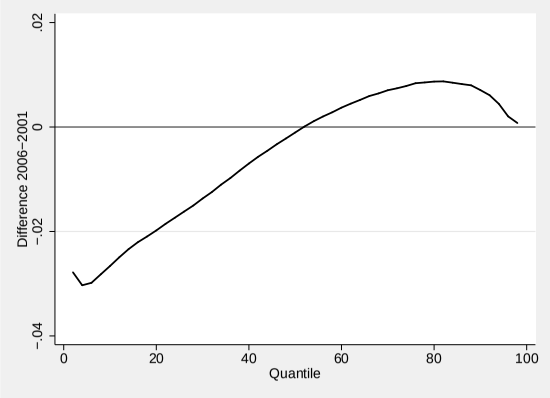
(i) Region



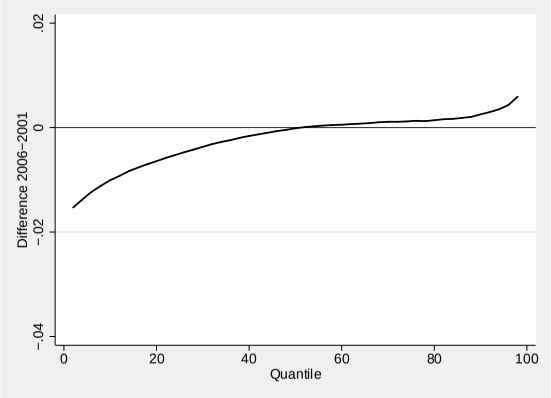


(ii) Sector Affiliation





(iii) Firm size and employee composition



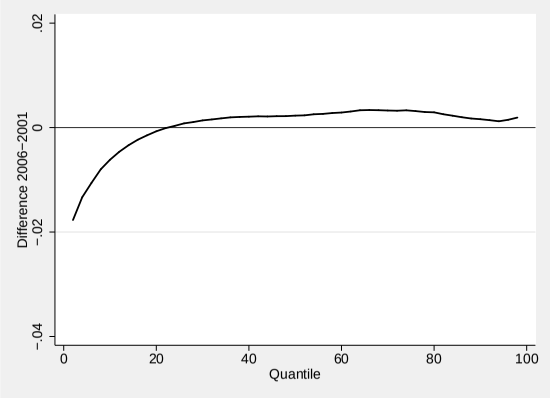
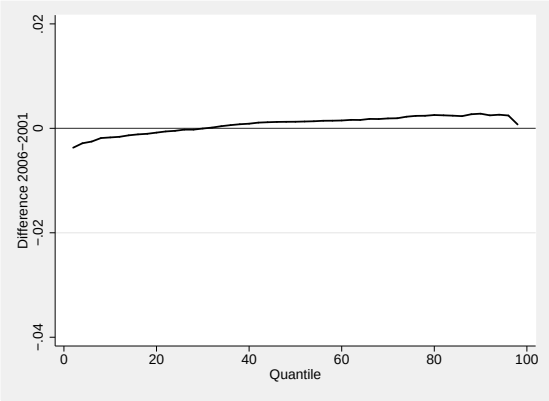
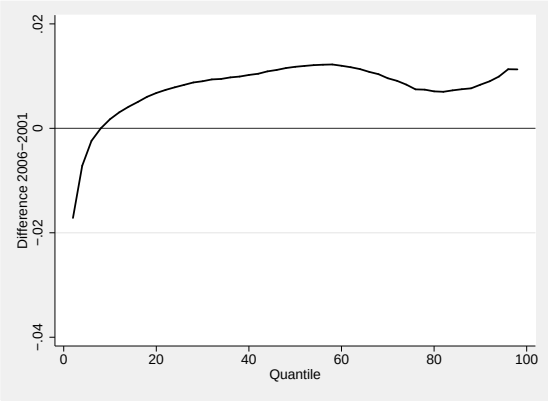


Figure 11: Further decomposition of firm coefficients effect for gender wage gap

(i) Region



(ii) Sector Affiliation



(iii) Firm size and employee composition

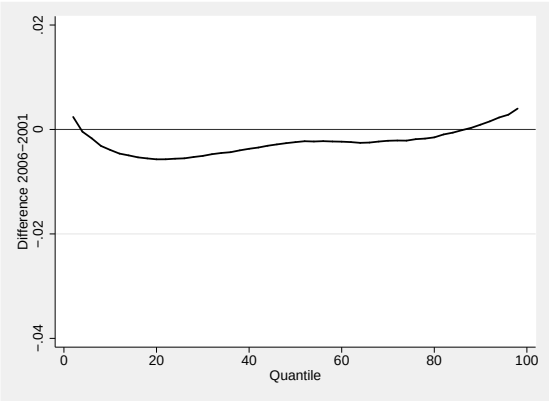


Figure 12: Employment shares and coverage by sector

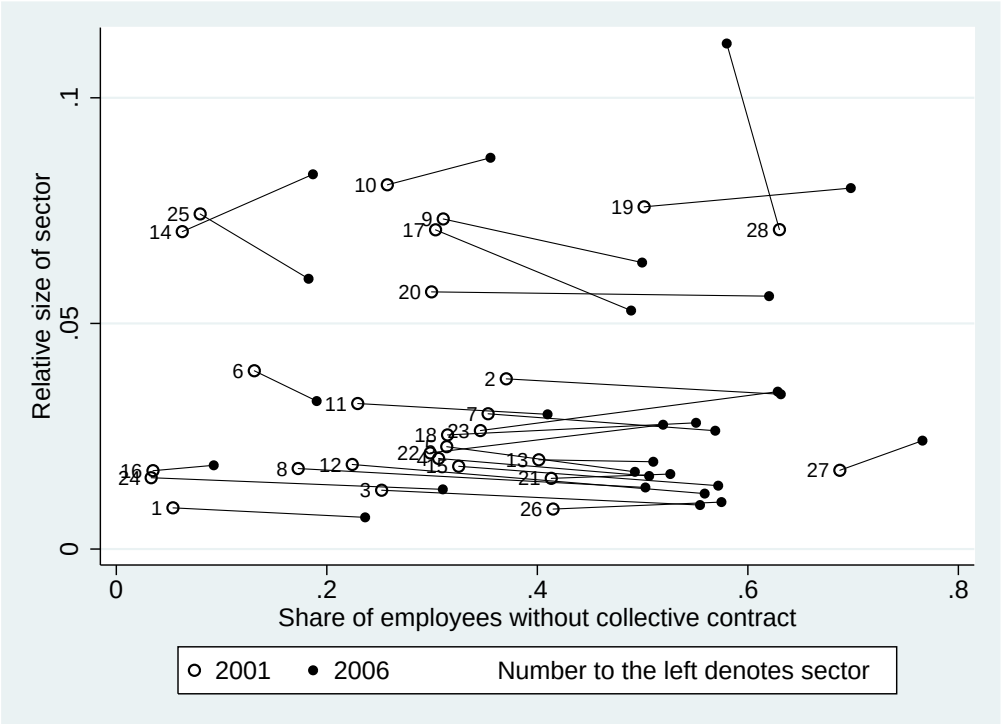


Figure 13: Sequential decomposition of change in male wage distribution: Reversed order

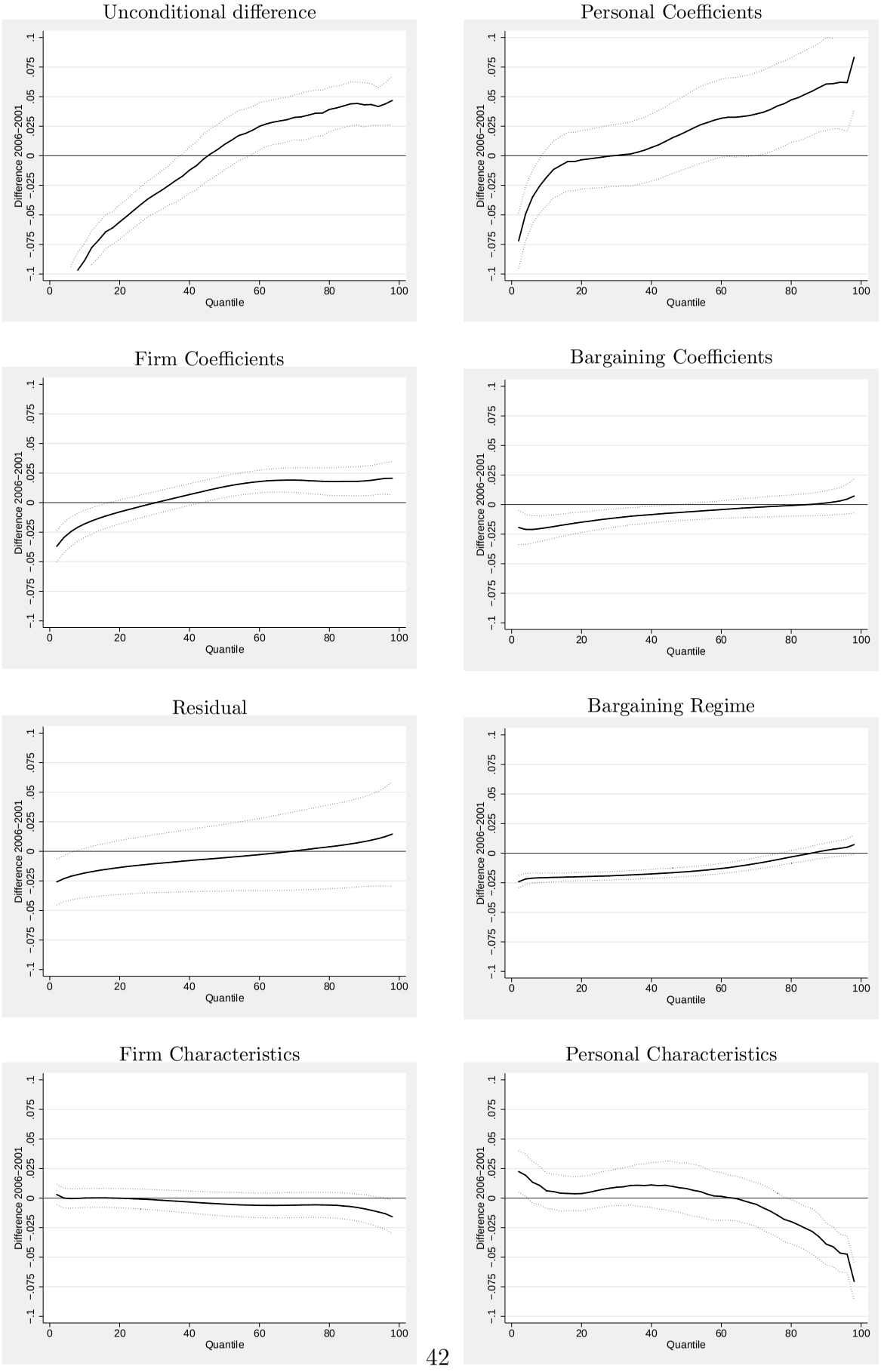


Figure 14: Sequential decomposition of change in female wage distribution: Reversed order

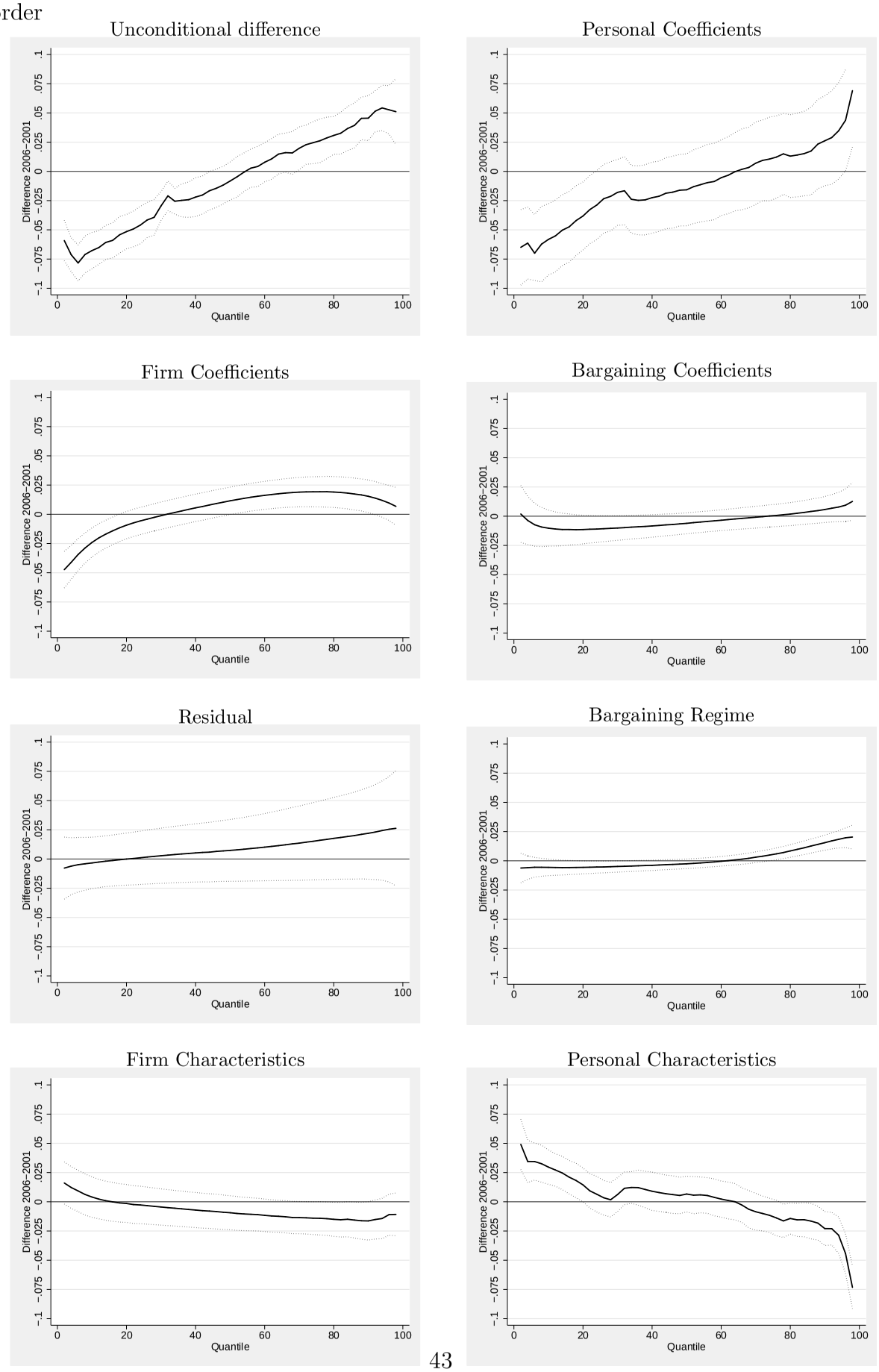
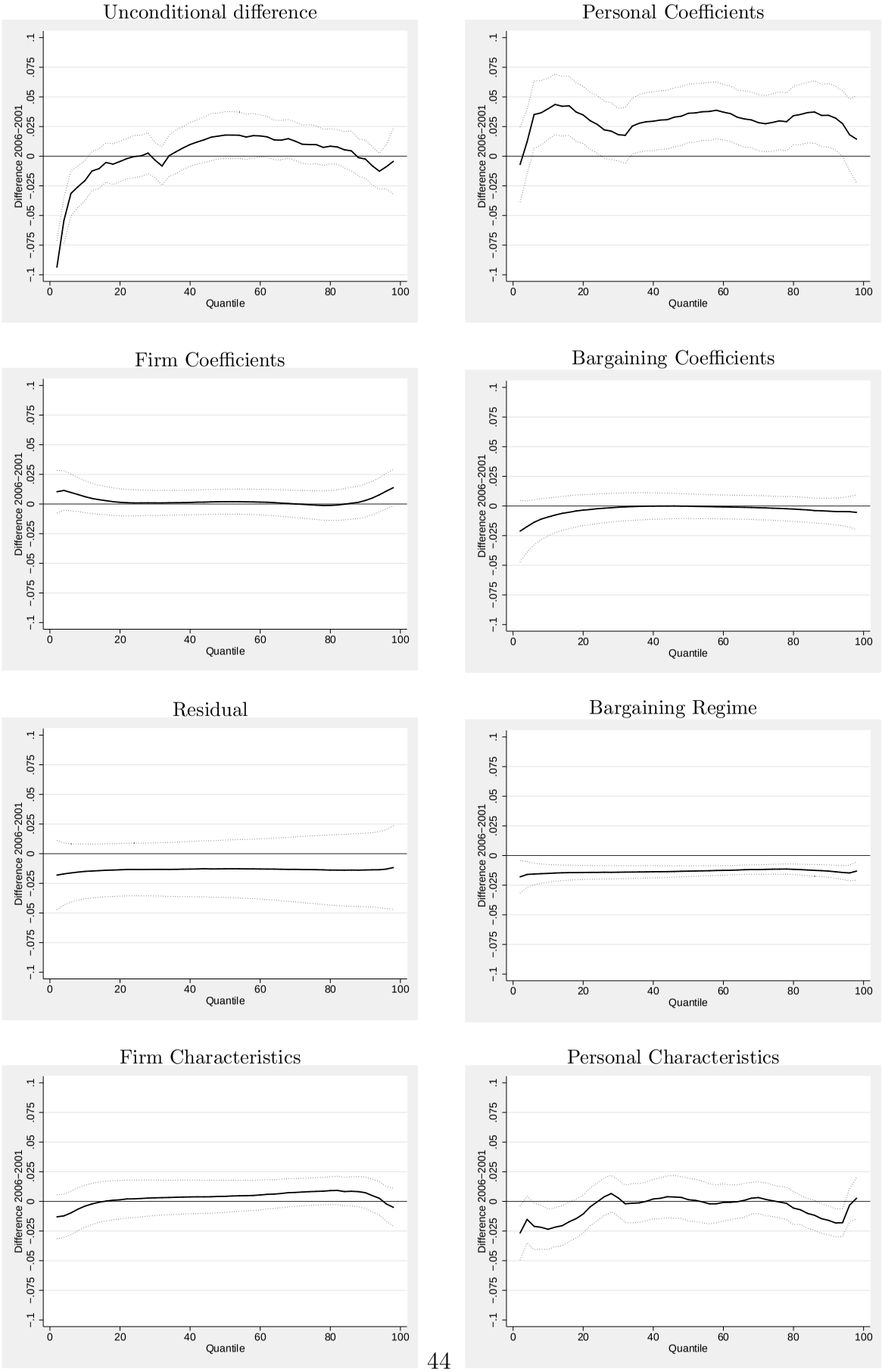


Figure 15: Sequential decomposition of overall gender wage gap: Reversed order



C Tables

Table 2: Real log wage distributions and gender differentials, selected quantiles

	2001		2006		Δ 2006-2001		GWG		Δ GWG
	Overall								
τ	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**2001**	**2006**	
10%	2.41	2.18	2.33	2.12	-0.08	-0.06	0.23	0.21	-0.02
25%	2.58	2.39	2.54	2.35	-0.04	-0.04	0.19	0.19	0.00
50%	2.79	2.61	2.80	2.60	0.01	-0.01	0.18	0.20	0.02
75%	3.05	2.85	3.08	2.88	0.03	0.02	0.20	0.21	0.01
90%	3.33	3.08	3.37	3.12	0.03	0.04	0.25	0.24	-0.00
	No Collective Bargaining								
	Male	**Female**	**Male**	**Female**	**Male**	**Female**			
10%	2.28	2.08	2.25	2.07	-0.03	-0.01	0.20	0.18	-0.02
25%	2.45	2.25	2.44	2.27	-0.01	0.02	0.20	0.17	-0.03
50%	2.65	2.48	2.67	2.50	0.02	0.02	0.17	0.17	0.00
75%	2.94	2.76	2.99	2.79	0.05	0.03	0.18	0.20	0.02
90%	3.27	3.03	3.32	3.07	0.05	0.04	0.24	0.25	0.01
	Sectoral Bargaining								
	Male	**Female**	**Male**	**Female**	**Male**	**Female**			
10%	2.49	2.27	2.43	2.22	-0.06	-0.05	0.22	0.21	-0.01
25%	2.64	2.45	2.63	2.46	-0.01	0.01	0.19	0.17	-0.02
50%	2.83	2.65	2.87	2.69	0.04	0.04	0.18	0.18	0.00
75%	3.08	2.89	3.11	2.93	0.03	0.04	0.19	0.18	-0.01
90%	3.34	3.09	3.38	3.15	0.04	0.06	0.25	0.23	-0.02
	Firm Bargaining								
	Male	**Female**	**Male**	**Female**	**Male**	**Female**			
10%	2.50	2.30	2.50	2.15	0.00	-0.15	0.20	0.35	0.15
25%	2.65	2.48	2.70	2.42	0.05	-0.06	0.17	0.28	0.11
50%	2.85	2.66	2.99	2.73	0.14	0.07	0.19	0.26	0.07
75%	3.12	2.90	3.25	3.02	0.13	0.12	0.22	0.23	0.01
90%	3.38	3.14	3.48	3.26	0.10	0.12	0.24	0.24	0.00

Table 3: Sequential decomposition at selected quantiles

	Males					
	10	**(s.e.)**	**50**	**(s.e.)**	**90**	**(s.e.)**
Overall 2006-2001	-0.088	(0.006)	0.010	(0.011)	0.043	(0.009)
Personal Coefficients	-0.000	(0.007)	0.011	(0.008)	0.017	(0.010)
Firm Coefficients	-0.036	(0.007)	0.011	(0.005)	0.021	(0.004)
Bargaining Coefficients	-0.018	(0.007)	-0.013	(0.006)	0.002	(0.007)
Firm and Bargaining Coefficients	-0.054	(0.003)	-0.002	(0.004)	0.023	(0.006)
Residual	-0.018	(0.007)	-0.005	(0.008)	0.008	(0.009)
Bargaining Regime	-0.016	(0.002)	-0.010	(0.002)	0.005	(0.003)
Firm Characteristics	-0.006	(0.004)	0.013	(0.007)	0.013	(0.005)
Personal Characteristics	0.006	(0.004)	0.003	(0.004)	-0.023	(0.006)
Firm Characteristics and Bargaining Regime	-0.022	(0.004)	0.003	(0.007)	0.018	(0.007)
	Females					
	10	**(s.e.)**	**50**	**(s.e.)**	**90**	**(s.e.)**
Overall 2006-2001	-0.068	(0.007)	-0.008	(0.007)	0.046	(0.009)
Personal Coefficients	-0.035	(0.009)	-0.014	(0.009)	0.006	(0.012)
Firm Coefficients	-0.032	(0.009)	0.001	(0.004)	0.009	(0.005)
Bargaining Coefficients	-0.006	(0.008)	-0.002	(0.006)	0.013	(0.009)
Firm and Bargaining Coefficients	-0.038	(0.006)	-0.002	(0.005)	0.022	(0.008)
Residual	-0.004	(0.008)	0.008	(0.009)	0.021	(0.012)
Bargaining Regime	-0.021	(0.002)	-0.010	(0.002)	0.004	(0.003)
Firm Characteristics	-0.023	(0.006)	-0.003	(0.006)	-0.005	(0.009)
Personal Characteristics	0.053	(0.006)	0.013	(0.005)	-0.003	(0.007)
Firm Characteristics and Bargaining Regime	-0.044	(0.006)	-0.014	(0.006)	-0.001	(0.009)
	Males					
	90-10	**(s.e.)**	**90-50**	**(s.e.)**	**50-10**	**(s.e.)**
Overall 2006-2001	0.131	(0.011)	0.034	(0.011)	0.098	(0.008)
Personal Coefficients	0.018	(0.008)	0.007	(0.006)	0.011	(0.004)
Firm Coefficients	0.057	(0.006)	0.010	(0.004)	0.048	(0.005)
Bargaining Coefficients	0.020	(0.005)	0.015	(0.003)	0.005	(0.003)
Firm and Bargaining Coefficients	0.077	(0.006)	0.025	(0.004)	0.052	(0.004)
Residual	0.026	(0.006)	0.013	(0.004)	0.013	(0.004)
Bargaining Regime	0.021	(0.003)	0.015	(0.002)	0.006	(0.002)
Firm Characteristics	0.019	(0.005)	0.000	(0.005)	0.019	(0.004)
Personal Characteristics	-0.029	(0.005)	-0.026	(0.005)	-0.003	(0.003)
Firm Characteristics and Bargaining Regime	0.040	(0.005)	0.015	(0.005)	0.025	(0.004)
	Females					
	90-10	**(s.e.)**	**90-50**	**(s.e.)**	**50-10**	**(s.e.)**
Overall 2006-2001	0.113	(0.010)	0.054	(0.007)	0.060	(0.006)
Personal Coefficients	0.041	(0.008)	0.020	(0.006)	0.021	(0.007)
Firm Coefficients	0.041	(0.008)	0.008	(0.004)	0.033	(0.007)
Bargaining Coefficients	0.019	(0.009)	0.016	(0.003)	0.003	(0.006)
Firm and Bargaining Coefficients	0.060	(0.009)	0.024	(0.004)	0.037	(0.006)
Residual	0.025	(0.009)	0.014	(0.004)	0.012	(0.005)
Bargaining Regime	0.025	(0.003)	0.014	(0.002)	0.010	(0.002)
Firm Characteristics	0.017	(0.008)	-0.002	(0.005)	0.019	(0.004)
Personal Characteristics	-0.056	(0.007)	-0.016	(0.005)	-0.040	(0.005)
Firm Characteristics and Bargaining Regime	0.042	(0.009)	0.012	(0.005)	0.030	(0.005)

Table 4: Definition of Variables

Label	Description
Individual level	
Age	Age in years
Tenure	Tenure in years
Low education	Low level of education: no training beyond a school degree
Medium education	Intermediate Level of education: vocational training
High education	High level of education: university or university of applied sciences
Education n/a	Missing information on the education level
Extra shifts	Individual worked night shifts, overtime, on Sundays or on holidays
Firm level	
Schleswig-Holstein, HH	Firm is located in Schleswig Holstein or Hamburg
Lower Saxony, Bremen	Firm is located in Lower Saxony or Bremen
NRW	Firm is located in North Rhine-Westphalia
Hesse	Firm is located in Hesse
RLP, Saarland	Firm is located in Rhineland-Palatinate or Saarland
Baden-Württemberg	Firm is located in Baden-Württemberg
Bavaria	Firm is located in Bavaria
10 - 99 employees	Firm has between 10 and 99 employees
100 - 199 employees	Firm has between 100 and 199 employees
200 - 999 employees	Firm has between 200 and 999 employees
1000 - 1999 employees	Firm has between 1000 and 1999 employees
2000 - 9999 employees	Firm has between 2000 and 9999 employees
Mainly publicly owned	Firm is mainly public-owned (>50%)
Share male employees	Share of male employees
Share not fulltime	Share of employees who do not work full-time
Mining, quarrying	Mining and quarrying
Manufact: Food	Manufacture of food products, beverages and tobacco
Manufact: Textiles	Manufacture of textile and textile products, leather and leather products
Manufact: Wood	Manufacture of wood and wood products
Publishing, printing	Publishing, printing and reproduction of recorded media
Manufact: Coke, chemicals	Manufacture of coke, refined petroleum products and nuclear fuel; chemicals and chemical products
Manufact: Rubber, plastic	Manufacture of rubber and plastic products
Manufact: Non-metallic	Manufacture of other non-metallic mineral products
Manufact: Metals	Manufacture of basic metals; fabricated metal products, except from machinery and equipment
Manufact: Machinery	Manufacture of machinery and equipment
Manufact: Electr. machinery	Manufacture of electrical machinery and apparatus
Manufact: Electr. equipment	Manufacture of electrical & optical equipment; radio, TV, & communication equipment & apparatus
Manufact: Instruments	Manufacture of medical, precision and optical instruments, watches and clocks
Manufact: Transport	Manufacture of transport equipment
Manufact: n.e.c.	Manufacture not elsewhere classified
Electricity, gas, water	Electricity, gas and water supply
Construction	Construction
Auto sales, repair	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
Wholesale trade	Wholesale trade and commission trade except of motor vehicles and motorcycles
Retail trade	Retail trade, except from motor vehicles and motorcycles; repair of personal and household goods
Hotels, restaurants	Hotels and restaurants
Transport	Land, water and air transport
Auxiliary transport	Supporting and auxiliary transport activities; activities of travel agencies
Post, telecommunications	Post and telecommunications
Finance, insurance	Financial intermediation, insurance and pension funding, except compulsory social security
Real estate	Real estate activities; renting of machinery and equipment without operator
Data processing	Data processing and information systems
Research, other services	Research and development and other services

As further controls we include: Age squared, tenure squared, and the interactions of age with education.

Table 5: Descriptive statistics

Label	Males				Females			
	2001		2006		2001		2006	
	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.
Individual level								
Age	39.63	(8.00)	40.62	(7.98)	38.94	(8.48)	39.65	(8.67)
Tenure	10.14	(9.18)	10.63	(9.13)	8.63	(8.38)	9.04	(8.24)
Low education	0.142	(0.349)	0.121	(0.326)	0.185	(0.388)	0.150	(0.357)
Medium education	0.681	(0.466)	0.654	(0.476)	0.667	(0.471)	0.642	(0.479)
High education	0.111	(0.314)	0.123	(0.329)	0.066	(0.248)	0.084	(0.278)
Education n/a	0.066	(0.249)	0.102	(0.302)	0.082	(0.274)	0.124	(0.330)
Extra shifts	0.275	(0.446)	0.281	(0.449)	0.142	(0.349)	0.149	(0.356)
Firm level								
Schleswig-Holstein, HH	0.055	(0.228)	0.060	(0.237)	0.068	(0.251)	0.073	(0.260)
Lower Saxony, Bremen	0.115	(0.319)	0.114	(0.318)	0.099	(0.299)	0.104	(0.305)
NRW	0.295	(0.456)	0.275	(0.447)	0.276	(0.447)	0.262	(0.440)
Hesse	0.094	(0.292)	0.100	(0.300)	0.106	(0.307)	0.118	(0.323)
RLP, Saarland	0.068	(0.252)	0.064	(0.244)	0.062	(0.241)	0.057	(0.232)
Baden-Württemberg	0.188	(0.391)	0.187	(0.390)	0.200	(0.400)	0.184	(0.388)
Bavaria	0.185	(0.388)	0.201	(0.401)	0.190	(0.392)	0.202	(0.401)
10 - 99 employees	0.342	(0.194)	0.336	(0.472)	0.344	(0.475)	0.341	(0.474)
100 - 199 employees	0.129	(0.335)	0.134	(0.340)	0.140	(0.347)	0.142	(0.349)
200 - 999 employees	0.267	(0.442)	0.270	(0.444)	0.281	(0.449)	0.301	(0.459)
1000 - 1999 employees	0.070	(0.256)	0.081	(0.272)	0.075	(0.264)	0.083	(0.276)
2000 - 9999 employees	0.192	(0.394)	0.180	(0.384)	0.159	(0.366)	0.133	(0.339)
Mainly publicly owned	0.039	(0.194)	0.035	(0.185)	0.043	(0.203)	0.052	(0.221)
Share male employees	0.759	(0.187)	0.755	(0.185)	0.524	(0.233)	0.518	(0.233)
Share not fulltime	0.095	(0.121)	0.126	(0.129)	0.165	(0.179)	0.202	(0.183)
Mining, quarrying	0.012	(0.107)	0.009	(0.094)	0.002	(0.044)	0.001	(0.035)
Manufact: Food	0.031	(0.175)	0.028	(0.164)	0.056	(0.231)	0.054	(0.225)
Manufact: Textiles	0.009	(0.093)	0.007	(0.083)	0.026	(0.159)	0.018	(0.133)
Manufact: Wood	0.023	(0.149)	0.018	(0.133)	0.012	(0.110)	0.011	(0.104)
Publishing, printing	0.020	(0.140)	0.015	(0.122)	0.031	(0.173)	0.023	(0.150)
Manufact: Coke, chemicals	0.040	(0.197)	0.033	(0.178)	0.037	(0.189)	0.033	(0.177)
Manufact: Rubber, plastic	0.031	(0.174)	0.028	(0.164)	0.026	(0.159)	0.022	(0.146)
Manufact: Non-metallic	0.021	(0.142)	0.015	(0.122)	0.010	(0.098)	0.009	(0.095)
Manufact: Metals	0.084	(0.278)	0.074	(0.261)	0.040	(0.197)	0.033	(0.178)
Manufact: Machinery	0.092	(0.290)	0.100	(0.300)	0.046	(0.208)	0.047	(0.212)
Manufact: Electr. machinery	0.032	(0.175)	0.030	(0.171)	0.034	(0.182)	0.029	(0.167)
Manufact: Electr. equipment	0.018	(0.133)	0.012	(0.109)	0.021	(0.142)	0.013	(0.113)
Manufact: Instruments	0.018	(0.134)	0.019	(0.135)	0.024	(0.154)	0.022	(0.145)
Manufact: Transport	0.084	(0.277)	0.100	(0.300)	0.030	(0.169)	0.032	(0.175)
Manufact: n.e.c.	0.019	(0.137)	0.015	(0.120)	0.016	(0.125)	0.012	(0.110)
Electricity, gas, water	0.020	(0.139)	0.021	(0.144)	0.010	(0.010)	0.011	(0.104)
Construction	0.088	(0.283)	0.066	(0.249)	0.019	(0.137)	0.013	(0.112)
Auto sales, repair	0.029	(0.167)	0.032	(0.176)	0.015	(0.121)	0.016	(0.127)
Wholesale trade	0.074	(0.262)	0.077	(0.266)	0.081	(0.274)	0.090	(0.286)
Retail trade	0.038	(0.191)	0.035	(0.185)	0.114	(0.318)	0.118	(0.323)
Hotels, restaurants	0.011	(0.103)	0.011	(0.105)	0.031	(0.172)	0.033	(0.179)
Transport	0.025	(0.155)	0.032	(0.176)	0.011	(0.105)	0.015	(0.120)
Auxiliary transport	0.026	(0.160)	0.035	(0.185)	0.026	(0.158)	0.033	(0.179)
Post, telecommunications	0.014	(0.118)	0.011	(0.104)	0.020	(0.142)	0.020	(0.141)
Finance, insurance	0.056	(0.231)	0.046	(0.208)	0.128	(0.334)	0.103	(0.304)
Real estate	0.008	(0.087)	0.009	(0.093)	0.013	(0.113)	0.016	(0.124)
Data processing	0.018	(0.132)	0.025	(0.157)	0.017	(0.128)	0.020	(0.141)
Research, other services	0.060	(0.237)	0.098	(0.298)	0.104	(0.305)	0.153	(0.360)
No. of observations	332,403		547,243		108,346		199,018	

All statistics are weighted by the inverse sampling probability.

Table 6: Descriptive statistics: males

Label	No collective agreement				Sectoral Bargaining				Firm Bargaining			
	2001		2006		2001		2006		2001		2006	
	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.
Individual level												
Age	38.73	(7.91)	39.95	(7.99)	40.02	(8.01)	41.17	(7.97)	39.81	(8.06)	41.22	(7.77)
Tenure	6.53	(7.27)	8.14	(7.88)	11.54	(9.44)	12.51	(9.60)	11.99	(9.66)	13.96	(9.31)
Low education	0.138	(0.344)	0.117	(0.322)	0.144	(0.351)	0.130	(0.336)	0.140	(0.347)	0.087	(0.282)
Medium education	0.623	(0.485)	0.599	(0.490)	0.702	(0.457)	0.700	(0.458)	0.714	(0.452)	0.700	(0.458)
High education	0.110	(0.313)	0.115	(0.319)	0.111	(0.315)	0.125	(0.331)	0.113	(0.316)	0.162	(0.369)
Education n/a	0.129	(0.335)	0.168	(0.374)	0.042	(0.201)	0.045	(0.208)	0.034	(0.180)	0.051	(0.220)
Extra shifts	0.157	(0.363)	0.205	(0.404)	0.307	(0.461)	0.327	(0.469)	0.440	(0.496)	0.450	(0.498)
Firm level												
Schleswig-Holstein, HH	0.078	(0.268)	0.066	(0.248)	0.045	(0.208)	0.052	(0.223)	0.046	(0.209)	0.067	(0.250)
Lower Saxony, Bremen	0.098	(0.297)	0.095	(0.294)	0.107	(0.309)	0.107	(0.309)	0.242	(0.429)	0.268	(0.443)
NRW	0.263	(0.440)	0.280	(0.449)	0.319	(0.466)	0.287	(0.452)	0.218	(0.413)	0.168	(0.373)
Hesse	0.106	(0.308)	0.104	(0.306)	0.089	(0.284)	0.094	(0.293)	0.091	(0.287)	0.108	(0.311)
RLP, Saarland	0.065	(0.247)	0.056	(0.230)	0.072	(0.259)	0.075	(0.263)	0.054	(0.225)	0.036	(0.187)
Baden-Württemberg	0.213	(0.410)	0.203	(0.402)	0.185	(0.388)	0.187	(0.390)	0.127	(0.332)	0.090	(0.286)
Bavaria	0.176	(0.381)	0.195	(0.396)	0.183	(0.387)	0.197	(0.398)	0.224	(0.417)	0.262	(0.440)
10 - 99 employees	0.637	(0.481)	0.514	(0.500)	0.237	(0.425)	0.201	(0.401)	0.120	(0.325)	0.097	(0.296)
100 - 199 employees	0.145	(0.352)	0.154	(0.361)	0.130	(0.337)	0.124	(0.330)	0.062	(0.241)	0.066	(0.248)
200 - 999 employees	0.171	(0.377)	0.222	(0.415)	0.310	(0.463)	0.317	(0.465)	0.266	(0.442)	0.269	(0.444)
1000 - 1999 employees	0.024	(0.154)	0.037	(0.188)	0.089	(0.285)	0.121	(0.326)	0.085	(0.278)	0.096	(0.294)
2000 - 9999 employees	0.023	(0.149)	0.073	(0.260)	0.233	(0.423)	0.237	(0.425)	0.467	(0.499)	0.472	(0.499)
Mainly publicly owned	0.004	(0.062)	0.010	(0.100)	0.040	(0.196)	0.051	(0.220)	0.154	(0.361)	0.091	(0.287)
Share male employees	0.653	(0.260)	0.732	(0.194)	0.769	(0.183)	0.772	(0.178)	0.767	(0.182)	0.786	(0.163)
Share not fulltime	0.117	(0.139)	0.141	(0.147)	0.084	(0.111)	0.111	(0.110)	0.100	(0.118)	0.126	(0.108)
Mining, quarrying	0.002	(0.046)	0.005	(0.067)	0.016	(0.126)	0.012	(0.107)	0.010	(0.099)	0.018	(0.134)
Manufact: Food	0.036	(0.187)	0.037	(0.189)	0.029	(0.167)	0.018	(0.132)	0.036	(0.185)	0.033	(0.179)
Manufact: Textiles	0.007	(0.081)	0.008	(0.087)	0.010	(0.101)	0.006	(0.080)	0.004	(0.066)	0.005	(0.072)
Manufact: Wood	0.024	(0.153)	0.020	(0.140)	0.023	(0.151)	0.017	(0.130)	0.013	(0.115)	0.010	(0.100)
Publishing, printing	0.020	(0.139)	0.016	(0.127)	0.022	(0.146)	0.016	(0.124)	0.006	(0.077)	0.005	(0.068)
Manufact: Coke, chemicals	0.014	(0.119)	0.012	(0.108)	0.056	(0.230)	0.055	(0.228)	0.012	(0.110)	0.019	(0.138)
Manufact: Rubber, plastic	0.036	(0.188)	0.034	(0.182)	0.029	(0.166)	0.023	(0.149)	0.034	(0.182)	0.018	(0.132)
Manufact: Non-metallic	0.012	(0.108)	0.017	(0.128)	0.023	(0.150)	0.015	(0.122)	0.032	(0.176)	0.007	(0.082)
Manufact: Metals	0.089	(0.285)	0.081	(0.273)	0.085	(0.279)	0.074	(0.262)	0.059	(0.236)	0.025	(0.155)
Manufact: Machinery	0.084	(0.277)	0.076	(0.266)	0.105	(0.306)	0.135	(0.341)	0.027	(0.163)	0.021	(0.144)
Manufact: Electr. machinery	0.023	(0.151)	0.026	(0.160)	0.035	(0.184)	0.036	(0.186)	0.033	(0.180)	0.018	(0.131)
Manufact: Electr. equipment	0.013	(0.113)	0.014	(0.119)	0.019	(0.136)	0.011	(0.104)	0.029	(0.167)	0.006	(0.074)
Manufact: Instruments	0.024	(0.154)	0.020	(0.141)	0.017	(0.129)	0.019	(0.136)	0.008	(0.089)	0.006	(0.078)
Manufact: Transport	0.018	(0.132)	0.040	(0.195)	0.098	(0.298)	0.123	(0.328)	0.202	(0.402)	0.323	(0.467)
Manufact: n.e.c.	0.020	(0.141)	0.018	(0.133)	0.020	(0.139)	0.013	(0.112)	0.010	(0.101)	0.007	(0.081)
Electricity, gas, water	0.002	(0.046)	0.004	(0.066)	0.027	(0.163)	0.030	(0.170)	0.024	(0.152)	0.068	(0.252)
Construction	0.092	(0.290)	0.071	(0.257)	0.097	(0.296)	0.071	(0.257)	0.004	(0.066)	0.006	(0.075)
Auto sales, repair	0.031	(0.174)	0.038	(0.191)	0.031	(0.173)	0.030	(0.172)	0.005	(0.070)	0.003	(0.055)
Wholesale trade	0.129	(0.335)	0.116	(0.320)	0.052	(0.223)	0.046	(0.210)	0.047	(0.212)	0.029	(0.168)
Retail trade	0.047	(0.211)	0.048	(0.214)	0.035	(0.184)	0.023	(0.151)	0.028	(0.165)	0.033	(0.178)
Hotels, restaurants	0.015	(0.122)	0.013	(0.114)	0.008	(0.091)	0.010	(0.098)	0.014	(0.116)	0.008	(0.091)
Transport	0.026	(0.158)	0.037	(0.188)	0.018	(0.135)	0.018	(0.132)	0.068	(0.252)	0.089	(0.285)
Auxiliary transport	0.032	(0.177)	0.050	(0.218)	0.022	(0.147)	0.021	(0.144)	0.038	(0.191)	0.036	(0.186)
Post, telecommunications	0.001	(0.039)	0.009	(0.094)	0.004	(0.060)	0.003	(0.052)	0.140	(0.347)	0.075	(0.364)
Finance, insurance	0.017	(0.128)	0.018	(0.135)	0.081	(0.273)	0.077	(0.267)	0.007	(0.082)	0.012	(0.108)
Real estate	0.010	(0.101)	0.011	(0.104)	0.005	(0.072)	0.007	(0.083)	0.016	(0.125)	0.007	(0.084)
Data processing	0.042	(0.201)	0.042	(0.201)	0.005	(0.073)	0.007	(0.082)	0.027	(0.162)	0.038	(0.192)
Research, other services	0.131	(0.338)	0.117	(0.321)	0.027	(0.161)	0.084	(0.277)	0.065	(0.247)	0.077	(0.266)
No. of observations	95,337		248,712		201,586		245,062		35,480		53,469	

All statistics are weighted by the inverse sampling probability.

Table 7: Descriptive statistics: females

Label	No collective agreement				Sectoral Bargaining				Firm Bargaining			
	2001		2006		2001		2006		2001		2006	
	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.	Mean	Stdd.
Individual level												
Age	38.46	(8.42)	39.29	(8.64)	39.26	(8.51)	39.97	(8.72)	38.52	(8.39)	40.46	(8.35)
Tenure	5.93	(6.81)	7.32	(7.08)	10.03	(8.81)	10.80	(9.08)	9.34	(8.32)	11.63	(8.28)
Low education	0.162	(0.369)	0.134	(0.341)	0.198	(0.399)	0.172	(0.378)	0.178	(0.383)	0.133	(0.339)
Medium education	0.630	(0.483)	0.605	(0.489)	0.685	(0.465)	0.685	(0.464)	0.694	(0.461)	0.668	(0.471)
High education	0.070	(0.255)	0.080	(0.272)	0.064	(0.245)	0.084	(0.278)	0.063	(0.243)	0.114	(0.318)
Education n/a	0.138	(0.345)	0.180	(0.384)	0.053	(0.224)	0.059	(0.235)	0.064	(0.245)	0.085	(0.279)
Extra shifts	0.093	(0.292)	0.121	(0.326)	0.146	(0.353)	0.160	(0.366)	0.312	(0.464)	0.308	(0.462)
Firm level												
Schleswig-Holstein, HH	0.087	(0.282)	0.075	(0.264)	0.059	(0.236)	0.069	(0.254)	0.053	(0.224)	0.076	(0.265)
Lower Saxony, Bremen	0.083	(0.277)	0.096	(0.295)	0.099	(0.299)	0.100	(0.300)	0.167	(0.373)	0.184	(0.388)
NRW	0.242	(0.429)	0.270	(0.444)	0.303	(0.460)	0.264	(0.441)	0.216	(0.412)	0.192	(0.394)
Hesse	0.123	(0.329)	0.120	(0.326)	0.095	(0.293)	0.109	(0.311)	0.112	(0.315)	0.158	(0.365)
RLP, Saarland	0.056	(0.231)	0.048	(0.214)	0.065	(0.246)	0.068	(0.252)	0.065	(0.247)	0.056	(0.230)
Baden-Württemberg	0.222	(0.415)	0.185	(0.388)	0.191	(0.393)	0.194	(0.395)	0.178	(0.382)	0.116	(0.321)
Bavaria	0.186	(0.389)	0.205	(0.404)	0.189	(0.391)	0.196	(0.397)	0.210	(0.407)	0.217	(0.412)
10 - 99 employees	0.589	(0.492)	0.480	(0.500)	0.235	(0.424)	0.199	(0.399)	0.143	(0.350)	0.135	(0.342)
100 - 199 employees	0.161	(0.368)	0.152	(0.359)	0.133	(0.339)	0.140	(0.347)	0.108	(0.310)	0.078	(0.268)
200 - 999 employees	0.198	(0.398)	0.247	(0.432)	0.331	(0.470)	0.363	(0.481)	0.246	(0.431)	0.332	(0.471)
1000 - 1999 employees	0.025	(0.157)	0.040	(0.197)	0.097	(0.296)	0.124	(0.329)	0.119	(0.324)	0.169	(0.375)
2000 - 9999 employees	0.026	(0.158)	0.080	(0.272)	0.204	(0.403)	0.175	(0.379)	0.384	(0.486)	0.285	(0.451)
Mainly publicly owned	0.005	(0.070)	0.011	(0.106)	0.044	(0.205)	0.065	(0.246)	0.202	(0.401)	0.242	(0.429)
Share male employees	0.490	(0.233)	0.480	(0.238)	0.540	(0.232)	0.557	(0.222)	0.538	(0.233)	0.579	(0.206)
Share not fulltime	0.176	(0.185)	0.217	(0.198)	0.161	(0.179)	0.187	(0.167)	0.158	(0.149)	0.170	(0.132)
Mining, quarrying	0.000	(0.021)	0.001	(0.030)	0.002	(0.050)	0.001	(0.036)	0.004	(0.062)	0.003	(0.055)
Manufact: Food	0.076	(0.264)	0.069	(0.253)	0.048	(0.213)	0.034	(0.180)	0.044	(0.205)	0.060	(0.237)
Manufact: Textiles	0.023	(0.149)	0.021	(0.144)	0.029	(0.167)	0.016	(0.124)	0.019	(0.136)	0.010	(0.099)
Manufact: Wood	0.012	(0.111)	0.011	(0.103)	0.013	(0.111)	0.011	(0.103)	0.008	(0.091)	0.013	(0.112)
Publishing, printing	0.035	(0.183)	0.022	(0.146)	0.031	(0.175)	0.027	(0.162)	0.011	(0.104)	0.008	(0.086)
Manufact: Coke, chemicals	0.025	(0.157)	0.017	(0.128)	0.046	(0.210)	0.054	(0.226)	0.014	(0.116)	0.021	(0.144)
Manufact: Rubber, plastic	0.033	(0.180)	0.025	(0.156)	0.021	(0.143)	0.019	(0.137)	0.035	(0.184)	0.016	(0.126)
Manufact: Non-metallic	0.007	(0.081)	0.009	(0.096)	0.010	(0.100)	0.010	(0.097)	0.019	(0.135)	0.007	(0.082)
Manufact: Metals	0.043	(0.203)	0.030	(0.172)	0.041	(0.199)	0.040	(0.196)	0.020	(0.139)	0.009	(0.094)
Manufact: Machinery	0.034	(0.180)	0.036	(0.187)	0.056	(0.230)	0.067	(0.249)	0.015	(0.122)	0.012	(0.108)
Manufact: Electr. machinery	0.029	(0.169)	0.025	(0.156)	0.038	(0.190)	0.037	(0.189)	0.032	(0.176)	0.007	(0.085)
Manufact: Electr. equipment	0.017	(0.129)	0.015	(0.123)	0.021	(0.142)	0.011	(0.104)	0.038	(0.192)	0.006	(0.075)
Manufact: Instruments	0.033	(0.179)	0.023	(0.149)	0.021	(0.142)	0.023	(0.149)	0.015	(0.121)	0.005	(0.073)
Manufact: Transport	0.007	(0.083)	0.015	(0.122)	0.037	(0.189)	0.041	(0.197)	0.068	(0.252)	0.106	(0.308)
Manufact: n.e.c.	0.019	(0.137)	0.015	(0.121)	0.015	(0.120)	0.010	(0.101)	0.011	(0.106)	0.005	(0.070)
Electricity, gas, water	0.002	(0.042)	0.002	(0.043)	0.014	(0.117)	0.019	(0.137)	0.016	(0.124)	0.032	(0.176)
Construction	0.020	(0.138)	0.012	(0.109)	0.021	(0.144)	0.015	(0.122)	0.001	(0.038)	0.002	(0.046)
Auto sales, repair	0.016	(0.124)	0.019	(0.135)	0.016	(0.125)	0.016	(0.125)	0.003	(0.053)	0.002	(0.040)
Wholesale trade	0.125	(0.331)	0.124	(0.330)	0.063	(0.244)	0.053	(0.224)	0.035	(0.183)	0.045	(0.207)
Retail trade	0.085	(0.279)	0.141	(0.348)	0.135	(0.342)	0.101	(0.301)	0.075	(0.264)	0.050	(0.218)
Hotels, restaurants	0.039	(0.194)	0.033	(0.178)	0.026	(0.160)	0.033	(0.179)	0.026	(0.158)	0.036	(0.185)
Transport	0.010	(0.101)	0.014	(0.116)	0.007	(0.084)	0.007	(0.082)	0.048	(0.215)	0.074	(0.261)
Auxiliary transport	0.026	(0.158)	0.038	(0.191)	0.021	(0.142)	0.020	(0.140)	0.066	(0.248)	0.081	(0.273)
Post, telecommunications	0.002	(0.050)	0.009	(0.093)	0.003	(0.052)	0.004	(0.070)	0.238	(0.426)	0.210	(0.407)
Finance, insurance	0.029	(0.167)	0.036	(0.185)	0.196	(0.397)	0.200	(0.400)	0.021	(0.142)	0.030	(0.170)
Real estate	0.018	(0.132)	0.017	(0.131)	0.009	(0.096)	0.013	(0.114)	0.019	(0.135)	0.016	(0.125)
Data processing	0.036	(0.185)	0.030	(0.172)	0.005	(0.068)	0.006	(0.078)	0.028	(0.164)	0.031	(0.173)
Research, other services	0.199	(0.399)	0.192	(0.394)	0.055	(0.227)	0.112	(0.316)	0.074	(0.262)	0.103	(0.304)
No. of observations	36,054		97,115		61,087		81,090		11,205		20,813	

All statistics are weighted by the inverse sampling probability.