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Abstract

Most existing analyses on the gender wage gap (GWG) have neglected the establishment as a place where inequality between male and female employees arises and is maintained. The use of linked employee-employer data permits us to move beyond the individual and consider the importance of the workplace to explain gender pay differentials. That is, we first provide a comprehensive study on the effects of various firm characteristics and the institutional framework on the GWG in Germany. The innovation of our research is that we do not just compare average male and female wages (of specific groups of employees), but look at within-firm gender wage differentials. Our results indicate that the mean GWG within firms is smaller than the average overall GWG. Furthermore, we can show that firms with formalized co-determination (works council) and those covered by collective wage agreements are more likely to have smaller GWG. It is also interesting to note that the wage differential between men and women decreases with firm size and increases with the wage level.

JEL Classification: J16 and J31

Keywords: gender wage gap; unions, works councils, discrimination, within-firms wage differentials.

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Non-technical summary

Most studies analyze gender pay differentials by focusing primarily on differences in the wage-determining characteristics of men and women and how these characteristics are rewarded. The goal of our research is to move beyond the individual and consider the importance of the workplace to explain gender pay differentials. The innovation of our research approach is that we do not just compare average male and female wages (of specific groups of employees), but look at within-firm gender wage differentials. In the following study, we will focus on the impact of works council and the collective bargaining coverage. An attempt to explain the wage differences between men and women would not be comprehensive and convincing, if Becker's theory on discrimination were not considered at all. We hence propose alternative concepts to test the hypotheses derived from the discrimination model. The empirical analysis is based on the German LIAB data, a representative linked employer-employee panel including information on all employees of firms covered by the IAB establishment survey.

To investigate the theoretical hypotheses regarding the effect of firm and institutional characteristics on wage inequality, we define two alternative measures describing the firm-specific gender wage gap (GWG). First, we use the observed wage gap as the difference between the mean wages of males and females within an establishment. One important factor explaining this observed wage gap is the difference in the human capital endowment and other labor market relevant characteristics of the employees. As a second measure, we therefore calculate a wage gap under the assumption that male and female employees would have the same characteristics within each firm.

Our results indicate that the mean GWG within firms is smaller than the mean overall GWG. Furthermore, the findings suggest that firms bargaining their wages within the framework of collective agreements exhibit a smaller gender pay gap. Given that most unions are still dominated by men, this result is not self-evident. An additional effect of unions with a higher female share is not empirically detectable. The results also point to a gender equalizing effect of formalized co-determination (works councils). Again, the hypothesis that works councils only realize the interests of women if they represent a larger part of the staff is not supported by the data. Finally, we tested Becker's hypothesis on discrimination using various alternative variables. In summary, we can not find consistent evidence for the discrimination model, though.

1. Introduction

The gender earnings differential is an intensely studied issue in labor economics and other social sciences. Most studies analyze gender pay differentials by focusing primarily on differences in the wage-determining characteristics of men and women and how these characteristics are rewarded. Differences in the return to specific human capital measures are generally denoted as discrimination and not analyzed any further. The idea that firms play an important role in creating and maintaining gender inequality by the way they define and reward jobs as well as by their recruiting and training practices, have become more and more popular during the last decade (see e.g. Baron 1984; Acker 1990, 1992). According to this approach, firms are no sex-neutral organizations. Looking closely at the design of work processes, pay systems, internal qualification activities and firm philosophy often reveals the firm's image of male and female employees and its attitude towards gender equality. In Germany, the wage setting process is not just the result of free negotiations between the individual and its employer, but also subject to various legislations. In this vein, pay differentials between men and women also depend upon the way the right of co-determination is implemented and put into practice and whether firms are subject to collective wage agreements or not. While it is well accepted that these firm characteristics affect the wage level as well as the wage distribution (see e.g. Davis and Haltiwanger 1991; Bronars and Famulari 1997; Abowd, Kramarz and Margolis 1999), most empirical studies do not examine how firm characteristics and the institutional environment affect the gender earnings differentials within firms.[1]

The goal of our research is to move beyond the individual and consider the importance of the workplace to explain gender pay differentials. The empirical analysis is based on the German LIAB data, a representative linked employer-employee panel including information on all employees of firms covered by the IAB establishment survey. The LIAB merges annual survey data (the IAB-establishment panel) and process generated individual data (the Employment Statistical Register of the IAB, which is based on administrative social security records).

There already exist some studies analyzing the effects of firm-specific characteristics on the gender wage gap (GWG) based on linked employer-employee data for other countries.

[1] However, there are international studies like Blau und Kahn (1995) which analyses the impact of institutions on the gender wage gap in a cross-country comparison.

Reilly and Wirjanto (1999) as well as Datta Gupta and Rothstein (2005) include both personal and establishment-level information to point out the effect of segregation on the earnings differences between men and women in Canada and Denmark. Drolet (2002) investigates how much of the Canadian pay gap can be attributed to specific workplace characteristics, such as high-performance workplace practices or training expenditures. Datta Gupta and Eriksson (2004) analyze the relationship between new workplace practices and the GWG. Meng (2004) and Meng and Meurs (2004) extend the traditional decomposition of the observed gap in an endowment and a remuneration effect by an additional firm effect. In this setting, the firm effect represents the difference between the firm's premiums paid to male and female employees and can be interpreted as employer discrimination. In a second step, the impact of firm characteristics on this discrimination term is determined. Simón and Russell (2005) analyze the GWG in a set of EU countries with a cross-national survey of matched employer-employee data. They show that workplace characteristics are very relevant in explaining wage differences between males and females in all countries.

The innovation of our research approach is that we do not just compare average male and female wages (of specific groups of employees), but look at within-firm gender wage differentials. Provided that the distribution of women among firms is not random, the results of this approach may differ tremendously from traditional analyses looking at overall wage differentials. The aim of our study is to analyze explicitly the impact of firm characteristics and the institutional framework on the GWG *within* establishments. Given the rich information on the establishments in our survey, we can control for many firm-specific attributes and features, such as size, wage level, female share or qualification level of the staff. In the following study, we will focus on the impact of works council and the collective bargaining coverage. An attempt to explain the wage differences between men and women would not be comprehensive and convincing, if Becker's theory on discrimination were not considered at all. We hence propose alternative concepts to test the hypotheses derived from the discrimination model.

To investigate the theoretical hypotheses regarding the effect of firm and institutional characteristics on wage inequality, we define two alternative measures describing the firm-specific GWG. First, we use the observed wage gap as the difference between the mean wages of males and females within an establishment. One important factor explaining this observed wage gap is the difference in the human capital endowment and other labor market relevant characteristics of the employees. As a second measure, we therefore calculate a wage gap under the assumption that male and female employees would have the same

characteristics within each firm. Note that in both cases the censoring of our wage variable is accommodated by a Tobit model. Using these two measures for the GWG as dependent variable in the second step, we can determine the impact of selected firm characteristics and the institutional framework on the wage inequality within firms using regression analyses. Based on our results, we provide new insights into the nature and the sources of gender wage inequality in Germany.

The remainder of the paper is organized as follows: Section 2 discusses the theoretical background of our empirical analysis. The econometric methodology is expounded in Section 3. Section 4 describes our data source and in the following section the results are presented. Section 6 concludes.

2. Theoretical Background

So far, there exists no theory which explicitly deals with the gender wage differences within firms. However, hypotheses about the impact of selected firm characteristics or institutional settings on wage inequality within firms can be derived from deliberations in other theories like collective bargaining models or the model of employer discrimination (Becker 1957).

According to the discrimination model gender earnings differentials may be attributed to two sources. First, differences in labor productivity between men and women and second, direct discrimination by employers, employees and customers against women. As Gary Becker himself puts it:

If an individual has a "taste for discrimination", he must act as if he were willing to pay something, either directly or in the form of a reduced income, to be associated with some persons instead of others. When actual discrimination occurs, he must, in fact, either pay or forfeit income for this privilege. This simple way of looking at the matter gets at the essence of prejudice and discrimination.(p. 14)

Employers with "taste of discrimination" against women will hire fewer than the profit-maximizing number of women and consequently employ more men who are equally skilled yet more highly paid. However, in a competitive market discrimination is costly and restricts the employer's scale and profitability. Hence, Arrow (1973) and Cain (1986), among others, argue that under strong product market competition firms may not be able to afford discrimination and will therefore behave more egalitarian. Assuming that larger firms are more likely to have market power than smaller firms, this hypothesis can be tested by the firm size. Furthermore, we use the relative firm size to test the hypothesis that firms with

more market power may be able to afford more discrimination. The relative firm size is measured by the number of employees within the firm relative to the number of employees within the industry sector. Alternatively, we test Becker's model by a variable describing the export quota of the firm. The underlying idea is that firms operating on the world market are more subject to competition than firms operating only on the local or national market. Hence, exporting firms are more likely to pay male and female workers the value of their marginal products, which is assumed not to differ by sex.

Another hypothesis derived from Becker's model is that employers who hire more women are expected to have less prejudice against women and hence are more likely to pay equal wages to men and women. In order to examine this point we include the percentage of female employees in total employment.

Perhaps one of the most important factors influencing wage determination within firms is whether wages are subject to collective bargaining or not (Elvira and Saporta 2001). This insight is particularly true for Germany, where unions still play an important role in the wage setting process. While the overall impact of unions on the GWG is not obvious, collective bargaining models provide several reasons for arguing that collective agreements tend to reduce the GWG within establishments. First of all, it is argued that unions generally reduce the wage dispersion among employees covered by the same collective bargaining agreement, especially those working in the same occupation (Freeman and Medoff 1984, Fitzenberger and Kohn 2005). As a consequence, unionization should reduce the GWG for women performing the same activity as male colleagues in the same firm. Furthermore, Freeman (1980) exposes that unions tend to reduce the wage differentials within and across establishments regardless of occupation by setting fixed wage levels for specific jobs.[2] Therefore, the gap between segregated female and male jobs should also narrow.

Cornfield (1987) points out that in the case of layoffs bureaucratic rules consequently reduce the potential of discrimination. Elvira and Saporta (2001) apply the same logic to the wage setting process. They argue that the management of unionized firms are more likely to adhere to such bureaucratic wage setting rules, reducing the arbitrariness in wage rates and generating more predictable wages for male and female employees. That way the potential of discrimination and the GWG should be reduced.

But aren't these arguments too innocent considering the distribution of men and women among the union members? According to Koch-Baumgarten (2002), the importance of

[2] That means, „uniform piece or time rates among comparable workers across establishments and impersonal rates or ranges of rates in a given occupational class within establishments" (Freeman, 1980, p.4).

women is increasing, but they still represent a minority among the union members in Germany. Among the members of the DGB (Deutscher Gewerkschaftsbund), that is the umbrella organization of all unions (Federation of German Trade Unions), 30.4% of all members are female in 1999. Even if some unions have adopted pay equity as a strategic policy goal – maybe in order to attract new members in times of massive union withdrawals – it is hence not obvious that unions actively aim at reducing the GWG in general. Regardless of the motivation to foster women's wages, the existence of such pay equity policies would raise the wage in female dominated jobs relative to predominantly male jobs, thereby narrowing the gender gap (Acker 1989).

In order to examine the effect of unionization on the GWG we include variables describing whether a firm is subject to collective agreements or not. More precisely, we distinguish between industry-wide collective wage agreements, firm-specific collective wage agreements as well as wage determination without collective bargaining coverage. Industry-wide collective wage agreements are negotiated between an industry-specific union and an employers' association. The wage rates set by collective agreements are legally binding for all firms being members of the respective employers' association. Note that in Germany employers do in general not differentiate between unionists and non-unionists because non-unionized employees who would receive a lower wage are expected to join the union anyway in order to benefit from higher union wage. The firm-specific collective wage agreements are negotiated between an individual firm and the sector-specific trade union. Those agreements should offer more flexibility to adjusting the wage structure to the firm's economic situation and requirements than industry-wide collective wage agreements.[3]

Assuming that unions aim at representing the preferences of their members, we also exploit information of the female share among the members of the different German unions. We would expect that collective agreements with a union whose female share is high (e.g. unions bargaining in the retail sector) are more likely to reduce the firm-specific GWG than a collective agreement with a union that is still dominated by men, such as the IG BAU (union for the construction, agriculture and forestry sector). Based on this background information which is merged to our firm-level data, we can test whether unions tend to reduce the GWG in general, or whether this effect only occurs in unions with high female shares.

[3] In recent years, contractual opting-out clauses or hardship clauses have become a widespread element of central agreements. In general the adoption of such clauses requires the approval of collective bargaining parties (Hassel 1999).

Furthermore, not only collective wage contracts, but also works councils affect the wage distribution within firms (Hübler and Jirjahn 2003). Note that works councils can not directly engage in the wage bargaining but they may influence the firm's wage structure by the right of co-determination to negotiate about the placing of workers in different wage groups. Therefore, we control also for existence of works councils in firms. In general it is assumed that employees' representations follow up the aim of reducing inequality among employees within firms. As a result, the existence of a works council should counteract wage inequality within firms. More differentiated hypotheses about the objectives of works councils can be derived from the Insider-Outsider theory (Lindbeck and Snower 1988). According to this approach, works councils act in favor of the majority of the workforce while interests of the fringe group are neglected. In this setting, works councils foster equal treatment of male and female employees only in firms with a high female quota. A male dominated work force is presumably associated with a male dominated works council which is unlikely to promote wage equality. Therefore, the effect of employees' representation on the GWG is not unambiguous, too. To see whether the effect of works councils depend upon the female share among the staff, we further include an interaction term between the works council-dummy and the firm-specific share of women.

3. Methodology

In this study we examine the interaction between firm characteristics, institutions, market effects and gender specific earnings inequality on the firm level. The empirical analysis of the gender wage differential *within* firms is only feasible with linked employer-employee data.

To investigate the theoretical hypothesis we define two measures reflecting the degree of wage inequality within a firm. First, we use the observed wage gap:

$$(1) \quad Gap1_j = \overline{\ln w_{ij}^m} - \overline{\ln w_{ij}^f}$$

where w_{ij} denotes the earnings for individual i at firm j; superscripts m and f refer to male and female observations. Since the wage information in our data set is right-censored (see Section 4 for more details), the observed wage gap defined in equation (1) underestimates the actual raw wage differential. In order to determine the actual observed wage gap we

apply a simple Tobit model.[4] By estimating the following equation for each firm, we can directly derive the wage differential between male and female employees:

$$(2) \quad \ln w_{ij} = \alpha_j + \gamma_j fem_{ij} + \mu_{ij},$$

where α is an absolute term measuring the average wage rate in firm *j*, *fem* is a dummy variable reflecting the gender of individual *i* and μ_{ij} denotes the error term. The estimated coefficient $\hat{\gamma}_j$ then represents the raw GWG in firm *j* ($Gap1_j$) taking into account that w_{ij} is censored from above.

The sources of the observed wage gap can be manifold. On the one hand male and female employees differ with regard to their human capital endowment and other labor market relevant characteristics. On the other hand the endowments of men and women are remunerated in different ways. Finally, firm policy may effectively determine the size of the GWG. From an economic viewpoint the wage gap due to differences in occupational skills shall be deemed to be justified and comprehensible. Therefore, we calculate a second measure of the gender pay differential which is adjusted by the difference in human capital of employees:

$$(3) \quad Gap2_j = Gap1_j - \left(\hat{\beta}_j^m \overline{X_{ij}^m} - \hat{\beta}_j^m \overline{X_{ij}^f}\right)$$

$\overline{X}_{ij}$ includes mean characteristics of the individuals *i* at firm *j* and $\hat{\beta}_j^m$ is a vector of estimated coefficients – derived from wage regressions – of the individual characteristics X_{ij} of male employees in firm *j*. Hence, Gap2 reflects the difference in the rewards for individual human capital characteristics and unobserved wage effects between male and female employees within each firm *j*. The calculation of this measure requires the estimation of wage equations for male employees only. In order to allow for the heterogeneity and complexity of the wage setting process we estimate – as far as possible – a separate wage equation for each firm:

$$(4) \quad \ln w_{ij}^m = \beta_j^m X_{ij}^m + \varepsilon_{ij}^m$$

The dependent variable describes the daily log wage rate. We restrict the wage equation to a standard Mincer equation aiming to adjust the observed wage rate by differences in human capital endowments between men and women. Since other possible wage determinants, such as the occupational status and the occupational group are determined by the human capital, we exclude them from our wage equation. Hence, X_{ij}^m includes potential experience

[4] Alternatively, we could use imputed wage information which is available in the data. However these wage rates are estimated in a different model. Thus other explanatory variables and a different sample are used to explain the wages.

(squares), dummy variables for different education levels and job tenure. The right-censoring of the dependent variable again requires the estimation of a Tobit model. In order to make sure that our firm-specific wage estimations are reliable, we only take into account firms with at least hundred male employees. This procedure is most suitable to take into account the heterogeneity among firms. This benefit is, however, only feasible at the expense of the number of considered firms. In order to exploit the information of firms with less than hundred male employees, we run pooled regressions for all establishments with twenty up to ninety-nine male employees:

$$(5) \quad \ln w_{ij}^{m} = \beta^{m} X_{ij}^{m} + \varepsilon_{ij}^{m}$$

In contrast to equation (4), where we determine firm-specific coefficients (β_j), we now estimate the average impact of the human capital characteristics in all smaller firms (β). By applying different strategies for smaller and larger firms, we are able to determine the adjusted wage gap for the vast majority of the establishments in our sample.

Given the results of equation (4) and (5) respectively, we can calculate Gap2 which describes the GWG within firms assuming that men had the same human capital endowment as women within a firm. Note, however, that part of the differences in characteristics may be caused by inequality with respect to access and the encouragement to education, though. Furthermore, there might be a discriminating element in the selection of employees such that observed characteristics of employees as well as estimated coefficients are not distributed randomly across firms.[5]

Using these two measures for the firm-specific wage differential as dependent variable allows us to analyze the effect of firm characteristics and institutional framework on the wage inequality within firms.

$$(6) \quad GapK_j = \delta Z_j + \varepsilon_j, \qquad K = 1,2.$$

The observed wage gap (Gap1) as well as the GWG which is adjusted for the difference in human capital characteristics (Gap2) is assumed to depend on the vector Z_j including firm characteristics and information to the institutional framework of firm j. δ captures the impact of the corresponding explanatory variables, derived from the theories expounded in Section 2. To investigate the hypotheses based on Becker's discrimination model, we use the relative firm size within the sector, the export quota and the proportion of female employees.

[5] In order to correct for this selection we would have to estimate employment probabilities (Datta Gupta, 1993). Due to the lack of information on the household context and the individual background, it is difficult to implement this procedure which requires convincing exclusion restrictions.

Implications from the bargaining model are tested by variables like "application of collective wage agreements" and "existence of a works council". To see whether the naive notion of collective bargaining, that is, unions aim at rising wages at the lower tail of the wage distribution – irrespective of the sex – , holds, we add the female quota of union members in the relevant union to vector Z_j in equation (6). A positive coefficient of the female share in the corresponding union would suggest that unions with a high female quota are more successful in reducing the wage gap between men and women. In order to test whether the works council acts in favor of the majority of the workforce, we interact the existence of a works council with the female quota in the firm. Other than the mentioned variables we use also some control variables such as regions, industry and firm size.

In this second estimation step we can exploit the panel structure of the data by applying a random effects model. As a result, firm specific heterogeneity is captured by the random effect determined by the estimation model. In the first estimation step, that is the wage estimation, it is not possible to apply fixed-effects panel estimation in a Tobit model. Even if it would be straightforward to apply a random effects Tobit model, we currently refrain from this approach because of computer time restrictions. In principle, one could include both estimation steps within one model equation. We refrain from doing so due to the huge amount of data.

4. Data

The present analysis of the effects of firm characteristics and institutional framework on the wage inequality within firms requires individual and firm information. For that reason we use a representative German employer-employee linked panel data set. This data set is constructed by merging the IAB-establishment panel and the employment statistic of the German Federal Services based on a unique firm identification number. To test the hypothesis concerning the effect of the female share among union members, we further merged union membership data on the sector level. Information on the share of women among the union members is published on the homepage of the Federation of German Trade Unions.[6]

The IAB- establishment panel is an annual survey of German establishments, which started in West-Germany in 1993 and was extended to East Germany in 1996.[7] The data is collected

[6] http://www.dgb.de/dgb/mitgliederzahlen/mitglieder.htm.
[7] Detailed information on the IAB-establishment panel is given by Kölling (2000).

by personal interviews with the owners or senior managers of smaller establishments and personnel managers in larger establishments. It is performed by specially trained professional interviewers from a well-known market research institute. As far as possible, the survey is carried out by the same interviewer and interviewee each year. This procedure ensures a response rate above 70% which is high compared to other non-official German establishment panel studies (Kölling 2000) and helps to reduce panel attrition to less than 20% per year.[8] In order to keep the panel representative and correct for panel mortality, exits, and newly-founded units, additional establishments are drawn each year, yielding an unbalanced panel. These additional establishments are stratified with respect to ten categories of establishment size and 34 economic sectors.

The sample unit is the establishment as the local business unit. Note that firm and establishment are used as synonyms in this paper, though. The establishments asked in the survey are selected from the parent sample of all German establishments that employ at least one employee covered by social security. Thus, self-employed and establishments that employ only people not covered by social security (mineworkers, farmers, artists, journalists, etc.) as well as public employers with solely civil servants do not belong to the original sample. The data set is a representative sample of German establishments employing at least one employee who pays social security contributions. The establishments covered by the survey have been questioned every year about turnover, number of employees, personnel problems, industrial relations, wage policies, apprenticeship training, investments, innovations, and business strategies. From time to time, additional topics, such as training and human resource policies, were added to the questionnaire.

The employment statistic of the German Federal Services, so-called Employment Statistics Register, is an administrative panel data set of all employees in Germany paying social security contributions.[9] The Employment Statistics are collected by the social insurance institutions for their purposes according to a procedure introduced in 1973. These data cover the period between 1975 and 2002, that is, every person who was employed for at least one day from 1975 to 2002 and/or with claims to pension benefits is included.[10] During this

[8] The establishments are first approached by a letter indicating the goals of the survey. This letter is accompanied by separate letters of recommendation by the president of the Federal Employment Services and the leader of the German employer's association. Some weeks after this announcement letter, the establishment is contacted by telephone in order to arrange an individual appointment for the interview.

[9] Information on the Employment Statistics Register is given by Bender, Haas and Klose (2000).

[10] These are people who, as employees, have paid contributions to the pension system or who have been covered by the pension system through contributions by the unemployment insurance or by being a parent (depending on the birth year of the child, a fixed number of years is counted as child caring time during which the non-working parent becomes entitled to receive pension benefits).

time, social security contributions were mandatory for all employees who earned more than a lower earnings limit. Civil servants, self employed and people with marginal jobs, that is, employees whose earnings are below a lower earnings limit or temporary jobs which last 50 working days at most, are not covered by this sample. Altogether, the Employment Statistics Register represents about 80 percent of all West German employees. According to the statutory provisions, employers have to report information for all employed contributor at the beginning and end of their employment spells. In addition an annual report for each employee is compulsory at the end of a year. This report contains information on an employee's occupation, the occupational status, qualification, sex, age, nationality, industry and the size of the employer. Also the available information on daily gross earnings refers to employment spells that employers report to the Federal Employment Service.[11] If the wage rate exceeds the upper earnings limit ("Beitragsbemessungsgrenze"), the daily social security threshold is reported instead.[12] Note that the daily wage rate is therefore censored from above – mostly relevant for men – and truncated from below, which concerns women's wages in particular.

Both data sets contain a unique firm identifier which is used to match information on all employees paying social security contributions with the establishment in the IAB-establishment panel. We restrict our sample to West German establishments of the private sector who participated in the IAB-establishment panel in one year from 1997 to 2001. East German firms are not considered in the analysis, because both the wage level as well as the wage setting process is still very different. Given the small number of union members in East Germany and the limited application of co-determination, the effect of the institutional framework is supposed to be less relevant. Therefore, a common investigation of both regions would not be very meaningful. Furthermore, the GWG is much smaller in East Germany. A separate analysis for East Germany is not possible either, because the number of firms employing at least 100 male employees is too small to derive reliable results. Apart from that, the wage setting process and the resulting GWG in East German establishments is likely to be driven by internal processes, which can not be captured by our data, such as the devaluation of female labor as well as the crowding out of women in the labor market and particularly women in occupations which were dominated by females in East Germany before unification.

[11] To deal with the problem of overlapping spells, we apply a hierarchical order of activities where employment trumps all other activities.

[12] Fitzenberger and Wunderlich (2000) show that this affects particularly the wage rate of high-skilled employees. According to their results, about 50 percent of high-skilled men earn wages above the upper earnings limit. Among high-skilled full-time females, this share amounts to at least 20 percent.

We exclude firms which employ only women or only men because a GWG is not observable in these organizations.

One innovation of our study is the firm-specific estimation of the wage equations. Based on these results, we can calculate an adjusted wage gap (Gap2) accommodating the firm-specific wage setting process. To guarantee the reliability of our estimation results, we restrict this procedure to larger firms. These are firms employing at least 100 full-time employed German men who are subject to social insurance contributions and are aged between 20 and 60 years. Since this condition does not hold for many smaller establishments, we would have to skip many firms and information on the determinants of the firm-specific GWG. To maximize the number of establishments in the second estimation step, we apply an alternative estimation strategy for smaller firms. The employees of firms employing twenty to ninety-nine full-time employed German men are considered in a pooled wage estimation. Firms with less than 20 employees are excluded from the analysis, because in most cases the calculation of the firm-specific GWGs as well as their regression on the firm characteristics derived in Section 2 is not very meaningful.

Table 1 shows the number of firms as well as the number of their male and female employees in each observation year which enters the wage estimations. The rather small share of female employees results from our sample definition, which excludes the public sector and all part-time employees. Table A1 and A2 present these figures separately for firms employing 20 to 99 full-time employed men and firms employing at least 100 full-time employed men in the appendix. The number of different firms entering our estimation is 4,520, of which 2,479 establishments belong to the group of smaller firms and 2,041 are large firms.

Table 1: Description of the sample and the gender wage gap

Year	Number of firms (1)	Number of male employees (2)	Number of female employees (3)	Within-firm GWG based on reported value (in logarithm) (4)	Adjusted Within-firm GWG (in logarithm) (5)	Adjusted overall GWG (in logarithm) (6)
1997	1,570	690,371	193,220	0.190	0.204	0.197
1998	1,681	644,703	185,064	0.188	0.201	0.206
1999	1,708	584,101	167,953	0.184	0.198	0.207
2000	2,743	678,777	192,904	0.187	0.200	0.208
2001	3,090	753,536	216,638	0.184	0.199	0.208

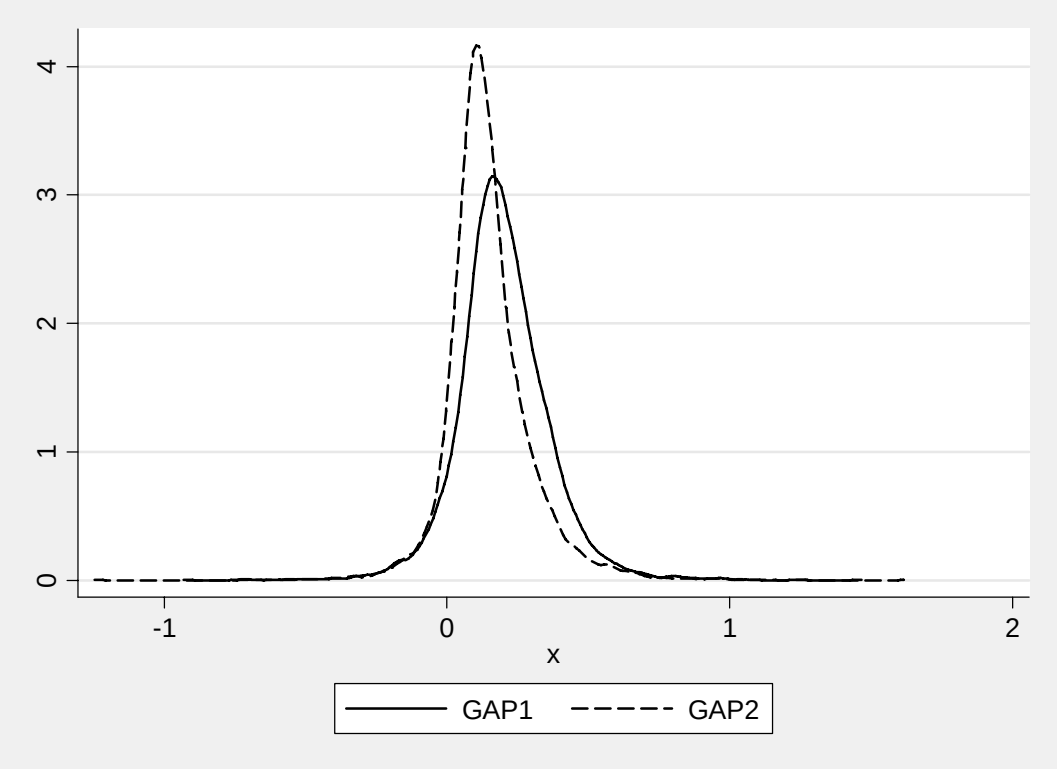
Note: The results refer to firms with at least 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table 1 also includes information about the GWG in the sample. The 4th column contains the average of the observed gender wage gaps within firms as defined in equation (1). This figure is based on the reported wage rates and ignores that the actual values could be higher. In our sample, 14 percent of the male employees earn wage rates above the upper earnings limit while this is true for only 3 percent of the female employees. As a result, the measure based on equation (1) underestimates the true GWG within firms. In order to correct for the right-censoring of the wage information, we estimate equation (2) with a Tobit model. The average of the estimated raw wage gaps within firms is presented in the 5th column. As expected, the actual raw wage gap is higher then the calculated values in column 4.

The average wage gap in the last column is corrected for the censoring, but compares the wage rates of males and females across all firms. That is, equation (2) is estimated by a pooled Tobit model across all employees. Apart from 1997, the overall wage gap is a little higher than the wage differential within firms. The difference between these two measures of gender wage differential indicates that women tend to select into lower paying firms. A look at Table A1 and A2 in the appendix reveals that the difference between the within-firm GWG and the overall GWG is larger in establishments with at least 100 male employees. The average difference amounts to almost 5 percentage points. This result indicates that the segregation process is more pronounced in large firms.

Figure 1 shows the distribution of Gap1 and Gap2 in all firms. Gap1 has a mean of 0.2 and a standard deviation of 0.16. Gap2 is smaller on average with a mean of 0.16. The corresponding standard deviation amounts to 0.15. The peak of both measures is right of zero, which illustrates the fact that in most firms men earn higher wages than women. Since Gap2 controls for the differences in human capital and hence much of the heterogeneity between firms, the distribution of Gap2 is steeper and the mode appears to be at a lower level than the one of Gap1.

Figure 1: Kernel estimation of Gap1 and Gap2



Note: Gap 1 denotes the observed wage differential between men and women within the same firm. Gap 2 describes the gender wage gap under the assumption that male employees would have the same characteristics as female employees. Both measures accommodate the censoring of our wage variable by applying Tobit estimates.
Source: own calculation; LIAB-Data 1997-2001

Table 2 shows some descriptive statistics on the relationship between selected firm characteristics and the GWG within firms. The results indicate that establishments covered by industry-wide wage or firm-specific wage agreements pay more equal wages to men and women than establishments without any collective wage agreements. Accordingly, the existence of a works council seems to reduce the within-firm GWG. It is interesting to note that the share of female employees is differently correlated with Gap1 and Gap2. Since Gap1 includes the wage gap caused by differences in the human capital endowment of men and women, it is rather obvious that the correlation is positive in this case. The result reverses once differences in observed characteristics are taken into account. That is, establishments employing comparatively many women seem to provide more equality among men and women than those with a small share of female workers.

Table 2: Correlation between Gap1 respectively Gap2 and selected firm characteristics

Variables	Raw Gender Wage Gap (Gap1)	Adjusted Gender Wage Gap (Gap2)
Industry-wide wage agreement	-0.050	-0.037
Firm-specific wage agreement	-0.065	-0.068
Works council	-0.136	-0.209
Female quota (of all employees)	0.108	-0.007
Number of employees	-0.079	-0.104
Export quota (of all sales)	0.004	-0.037
Wage bill per employee	0.044	-0.029
Relative firm size (employees relative to total employment in the industry sector)	-0.045	-0.060

Note: The results refer to firms with at least 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

In the appendix, we present summary statistics of all variables entering the wage estimation and the GWG estimation. In addition, we show separate summary statistics for firms with less and more than 200 employees.

5. Results

5.1 First estimation step: wage regression

To calculate the within-firm GWG under the assumption that male employees had the same characteristics as female employees within each firm (Gap2), we first have to determine wage estimates for all establishments in our sample. For firms with at least 100 male employees, we estimate 2,041 wage equations with a Tobit model in order to account for the censoring. The estimated firm-specific wage coefficients are used to determine Gap2 according to equation (3). This estimation strategy is not applicable for firms with fewer employees, because the within-firm estimation would yield no reliable results. For this reason, we estimate a pooled wage equation across all male employees in firms with less than 100 male employees. Our wage equation is a Mincer-type specification, hence we suppose that the individual wage rate is determined by potential experience, potential experience squared, job tenure and the education level.

Since the estimated coefficients from the 2,041 large firms can not be displayed in detail, we present a summary of the firm-specific estimation results in larger firms in Table 3.

Table 3: Coefficients of the wage estimations in a Tobit model (firms ≥ 100 male employees)

Coefficients	No. of Obs. (1)	Mean of the coeff. (2)	Mean of the t-value (3)	Share of significant coeff. (4)	Standard deviation of coeff. (5)	Quotient (5)/(2)
Potential experience	2,041	0.023	6.930	0.857	0.015	0.653
(Potential experience)^2/100	2,041	-0.038	-5.470	0.770	0.029	-0.752
Job tenure (in days)	2,041	0.000	6.631	0.801	0.000	2.088
Low education without vocational training	1,570	1.405	35.659	0.910	2.167	1.542
Vocational training	2,025	1.338	38.888	0.818	2.039	1.524
Secondary school (with and without vocational training)	1,248	2.160	48.400	0.852	2.142	0.992
College of higher education or university	1,598	2.046	51.483	0.870	2.075	1.014

Note: Coefficients result from wage regressions in firms with at least 100 male employees. The first column contains the number of different estimated coefficients. The next two columns present the means of the estimated coefficients and the t-values over all wage equations. The 4th column shows the share of estimated coefficients which are significant at the 5%-level. The 5th column contains the standard deviation of the estimated coefficients from the mean coefficient of all firms. The last column includes a quotient between the mean of the coefficients and the corresponding standard deviation as absolute values.
Source: own calculation; LIAB-Data 1997-2001

Column 1 describes the number of estimated coefficients for each characteristic. Note that some characteristics are missing in some firms, such that specific coefficients can not be determined in every firm. The second column presents the mean of the estimated coefficients of the firm-specific wage estimations and column 3 shows the corresponding mean of the estimated t-values. Note that the table contains coefficients for all possible education levels because the left-out category differs from firm to firm. The means of the estimated coefficients show that the variables have the expected effect on the wage rate. That is, the wage rate increases with the education level and potential experience on average. As predicted by Mincer (1974), the squared term of potential experience is negative, hinting at diminishing returns to experience. In order to receive a more exact impression of the significance of the estimated coefficient, column 4 shows the shares of the estimated coefficients which are significant at the 5%-level. We can see that about 80 to 90 percent of the estimated coefficients are statistically different from zero. Furthermore, the table includes the standard deviation of the estimated coefficients to illustrate the heterogeneity of

the wage regressions across firms (see column 5). The last column includes a quotient of the standard deviation of the coefficients and the absolute value of the corresponding means. Hence, this figure illustrates the standardized variation of coefficients across the firms. High values of this quotient indicate that the variation of firm-specific coefficients is high, supporting our supposition that the wage setting process differs tremendously across firms. Small values are signaling moderate heterogeneity of wage returns to the corresponding characteristics. The results in Table 3 point out, for example, that the remuneration of job tenure varies much more across firms than the coefficients for experience. In consideration of the varying coefficients, the wage estimation in each firm seems to be advantageously to determine the correct remuneration of the characteristics.

In addition to these summary statistics, we also present the 25-, 50- and 75% percentiles of the estimated coefficients in Table A9 in the appendix. The results show that also the rather "extreme" values of the estimated coefficients indicate the well known fact that education, firm tenure and experience have a positive effect on the individual wage level.

Table 4: Coefficients of the pooled wage estimations in a Tobit model (firms with 20 to 99 male employees)

	Coefficients	Standard deviation of coefficients	t-value
Potential experience	0.03177	0.00026	124.43000
(Potential experience)^2/100	-0.05389	0.00054	-99.27000
Job tenure (in days)	0.00002	0.00000	99.28000
Low education without vocational training	-0.26575	0.00164	-161.61000
Vocational training (reference group)	-	-	-
Secondary school (with and without vocational training)	0.20290	0.00258	78.73000
College of higher education or university	0.44774	0.00227	197.57000
No. of observations	242,304		
Log likelihood	-48419.521		

Note: The regression includes male employees from firms with 20 to 99 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table 4 presents the estimation results of the pooled Tobit regression for smaller firms. Note that the education level *vocational training* serves as the one and only reference group in this setting. The estimated coefficients are highly significant and also exhibit the expected sizes

and signs. That way, male employees with higher education and more experience get higher wage rates. Longer spells within the same firm also cause positive effects on the wage rate.

5.2 Second estimation step: explaining the firm-specific gender wage gap

As mentioned in Section 2, the estimated coefficients are used to calculate the adjusted GWG, Gap2. In order to derive conclusions on the impact of firm characteristics and the institutional framework on the GWG, we regress selected firm-level and industry-level variables on the raw firm-specific wage gaps (Gap1) and on the adjusted firm-specific wage gaps (Gap2). We use the export quota, the firm size as well as the relative firm size to test whether firms with market power discriminate more and therefore reveal a higher GWG or not. The impact of the institutional framework on the GWG is investigated by including a dummy variable for the existence of a works council. Furthermore, we use an interaction term between this dummy and the quota of female employees within a firm to test whether the effect of employees' representations depend upon the female share among the staff. In order to check the hypothesis that collective wage agreements entail smaller GWGs, we distinguish between industry-wide, firm-specific and no wage agreements. In one model specification, we also include the female quota of union members in the relevant union, to see whether the naive notion of collective bargaining holds. A positive coefficient of the female share in the corresponding union would suggest that unions with a high female quota are more successful in reducing the wage gap between men and women. Unfortunately, our data do not provide any information about which collective bargaining agreement is relevant for firm *j*. We therefore assign each firm to an industry-specific union according to the industry affiliation of the firm. This implies, for example, that a firm in the construction sector is supposed to be subject to the collective agreement of the union called "IG-Bau".[13] As a consequence, we assign the same female quota to all firms in the construction sector. For this reason, the error terms of firms negotiating with the same union are not independent. To adjust for the correlation within each union-cluster, we calculate clustered standard errors. Due to the decreasing number of unions[14], we can distinguish between seven clusters for different unions and one cluster for firms without a wage agreement, only. Since the estimation approach requires that firms remain in the same cluster during the whole observation period, we lose 943 observations of firms which change their status with respect

[13] In case of a firm-specific wage agreement, the firm is supposed to negotiate directly with the corresponding union. The female share of the union members is merged in the same way as in the case of industry-wide wage agreements.

[14] For instance, five separate unions covering the service sector merged to the large union called "ver.di" in 2001 and other small unions entered to more powerful unions like the "IG Metall".

to the application of wage agreements. A switch between industry-wide or firm-specific wage agreements has no effect on the number of observations. In order to make sure that we use as much information as possible and to avoid that our estimation results are affected by the restriction of the sample, we include this variable only in an additional model specification.

In all regressions differences between regions, industries and years are captured by several control variables. Apart from that, we include the wage bill per employee to control for differences between high and low wage firms. Table 5 shows the effects of the selected variables on our two measures of the gender earnings gap. The results rely on the whole sample as the female share among union members does not enter this baseline specification. The estimated coefficients of the control variables region, industry and year dummies are not presented here and are available on request. In order to check the robustness of our results we also run separate regressions for firms with less than 200 employees and for firms with at least 200 employees. Table A10 and A11 in the appendix contain the corresponding results.

Table 5: Determinants of the firm-specific gender wage gap

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-0.0107**	0.0027	-0.0117**	0.0025
(Number of employees/1000)^2	0.0003**	0.0001	0.0003**	0.0001
Relative firm size (employees relative to total employment in the industry sector)	0.4470	0.5640	0.0313	0.0542
Wage bill per employee/100000	0.4143**	0.0094	0.1402	0.0909
Export quota (of sales)/10	0.0436	0.0879	-0.1722**	0.0837
Female quota (of all employees)	0.1278**	0.0204	0.0644**	0.0194
Works council	-0.0178**	0.0077	-0.0298**	0.0073
Works council * Female quota	-0.0180	0.0214	-0.0070	0.0203
Industry-wide wage agreement	-0.0186**	0.0045	-0.0163**	0.0043
Firm-specific wage agreement	-0.0192**	0.0056	-0.0161**	0.0054
Observations	9,062		9,062	
R^2	0.1182		0.1052	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997-2001

The results reveal a negative relation between the number of employees and the two measures of the GWG, which is in contrast to Becker's hypothesis that large firms can afford more discrimination due to their superior market power. However, the positive coefficient of the quadratic term points out that the negative impact of the number of employees decreases at a certain firm size. The GWG starts to rise with the number of employees once the firm employs more than 18,520 men and women.[15] This implies that the Becker's hypothesis saying that very large firms can afford more discrimination due to their market power only holds for firms with more than 18,520 employees, which applies to 0.002 % of the sample only. The relative firm size in terms of establishment employment relative to the number of employees in the industry sector does not seem to support this hypothesis, either.[16]

However, the assumption that large firms are more likely to have market power could be too simple. Considering, that large firms are more in the focus of the public and suppose that the public pressure tends to lower the GWG, then the negative coefficients become plausible. The larger effect of firm size on the adjusted GWG supports this explanation. This indicates the smaller potential to remunerate equal characteristics differently in large firms due to public pressure. Another reason for the smaller GWG in large firms may be the fact, that male and female employees are more likely to work in comparable job positions (unless jobs are not fully segregated) in large firms. In this case it is more difficult to enforce different wage rates for equal jobs because employees can easily compare their tasks and wage rates.

The export quota – hinting at increased competition on the global markets – has a significant negative impact on Gap2, which is in line with Becker's model. Surprisingly, the export quota has no significant effect on Gap1. A look at Table A10 and A11, presenting separate results for small and large firms, reveals that the impact on Gap2 is driven by larger firms. In firms up to 200 employees the export quota has a weakly positive significant impact on Gap1 and there is no effect on Gap2. The overall conclusion with respect to the export quota is hence at strife.

Also the positive impact of the female quota on Gap1 and Gap2 is not in line with the hypothesis derived from Becker's theory. The regressions show that establishments employing comparatively many women seem to provide less equality among men and women than those with a small share of female workers. One explanation could be that the few men working in female dominated establishments mostly hold managerial positions and

[15] By calculating this number of employees we assume that the total number of employees in the industry sector is constant and for simplification we use the average of the total number of employees in the industry sector.
[16] Alternatively, we calculated the relative firm size in terms of turnover. Again, the results did not provide empirical evidence for the hypotheses derived in Section 2.

the mass of women perform simple tasks in lower paid positions. A typical example for this type of work sharing is the retail industry, where most women are employed as shop assistants or cashiers while men mostly work as shop managers. Note that the effect is smaller but still significant in the estimation of Gap2. This implies that part of the female effect is driven by the gender differences in human capital endowment.

The significant positive coefficients of the wage bill per employee in regression of Gap1 exposes that the GWG is larger in high wage firms. This may be due to the so-called glass ceiling effect. According to this phenomenon, the wage rate of women is capped at a certain threshold, partly because women do not reach the top positions in most firms. As a result, the GWG at the right tail of the earnings distribution is higher than at the mean. In the regression of Gap2, which controls for differences in the human capital endowment, the effect of the firm-specific wage level is insignificant. We therefore conclude that controlling for human capital partly explains the larger gender pay differences in high wage establishments. A look at Table A10 and A11 reveals that the described pattern holds irrespective of the firm size.

Concerning the effect of the institutional setting, we find pretty clear and convincing results in accordance with Gartner and Stephan (2004). The estimates indicate that the industrial relations as well as the wage bargaining regime are linked to the GWG. The existence of a works council has a significant negative impact on Gap1 and Gap2. It seems that employees' representations foster equal treatment of male and female employees within establishments. The separate regressions for large and small firms (see Table A10 and A11 in the appendix) show that this is particularly true for firms with at least 200 employees. Given that establishments with at least 200 employees have to exempt at least one member of the works council from work, which allows him or her to put more effort in the internal work, it is comprehensible that the impact of works councils is more pronounced in firms operating beyond this threshold. But even if the linear effect of works councils is statistically not different from zero in smaller firms, the Wald-test shows that the works council dummy together with the interaction term with the female quota within firms are significantly different from zero.

The interaction between works councils and the female quota within a firm has no significant impact in any regression. We therefore conclude that works councils tend to reduce the inequality between men and women irrespective of the gender relations within the establishment. Even if a high share of female employees does not seem to foster the effectiveness of co-determination in terms of wage equality, it may be likely that the female

quota among the works council's members influences the goals of the staff association. Given that we have no individual information on the membership in works councils, we can not test this hypothesis.

As the collective bargaining model suggests, firms under collective agreements tend to have lower pay gaps between males and females than those without wage agreements. The results on the effect of alternative wage bargaining regimes show that the impact of the industry-wide and firm-specific wage agreements are very similar. A Wald-test indicates that the null hypothesis $\delta_{industry} = \delta_{firm-specific}$ cannot be rejected at conventional levels in both estimations.[17] Since firm-specific contracts are generally bargained by sector-specific unions, one possible explanation might be that a considerable fraction of the firm-specific contracts simply adopts most conditions negotiated in the corresponding industry agreement in order to lower transaction costs.

Even if these results support the naive notion of unions' goals, there might be differences in the effect on the GWG with respect to the gender composition among the union members. We therefore investigate the hypothesis that unions with more female members act more in favor of the female interests and hence exhibit a larger effect on the firm-specific wage gap. Union membership data are merged on an aggregated sector level (7 categories according to the sector classification of the unions) and interacted with a dummy variable indicating whether the firm is subject to a collective agreement or not. Table 6 presents the results of the clustered regression. Note that the number of observations is somewhat smaller due to firms switching their union status. Our regressions can not approve the hypothesis. Instead of this, the results show a positive relationship between the number of women involved in the union and the wage differential within firms. The coefficient of the interaction term is not significant, though. The separate regressions for small and large firms reveal that this result does not depend on the firm size (see Table A12 and A13 in the appendix). One explanation for this surprising result may be that women who work in industries and firms where men and women are treated very unequal are more likely to engage in unions in order to actively influence the wage structure. Alternatively one may argue that wages are not the most important criterion for female union members, but that they are more interested in improving the compatibility of family and job by means of family friendly work practices, such as child care facilities, human resource measures easing the integration of mothers after employment breaks, promotion of part-time employees or flexible work time schedules.

[17] The p-values are 0.9046 for the raw wage gap and 0.9730 for the adjusted wage gap.

Note that the results of the restricted sample differ in some respect compared to our baseline models presented in Table 5. For example, works councils have no significant impact on Gap1 anymore. In contrast, the importance of the relative firm size is more evident in the clustered regression based on the reduced sample. Given that the explanatory power of the union member information is very limited, we rely on the results presented in Table 5.

Table 6: Determinants of the firm-specific gender wage gap (restricted sample)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-0.0103**	0.0025	-0.0109**	0.0028
(Number of employees/1000)^2	0.0003*	0.0001	0.0003	0.0002
Relative firm size (employees relative to total employment in the industry sector)	0.1002**	0.0241	0.1020**	0.0179
Wage bill per employee/100000	0.4032**	0.1741	0.1456	0.1045
Export quota (of sales)/10	-0.0534	0.0482	-0.2261	0.0361
Female quota (of all employees)	0.1077**	0.0509	0.0551	0.0431
Works council	-0.0150	0.0153	-0.0270**	0.0126
Works council * Female quota	-0.0027	0.0446	-0.0032	0.0309
Industry-wide wage agreement	-0.0448**	0.0102	-0.0338**	0.0119
Firm-specific wage agreement	-0.0504**	0.0084	-0.0406**	0.0010
Collective agreement * Female quota of involved union	0.0124	0.0078	0.0184	0.0115
Observations	8,231		8,231	
R^2	0.1234		0.1040	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997, 1999 and 2001

6. Conclusions

This study provides a first comprehensive analysis on the effect of various firm characteristics and the institutional framework on the GWG in Germany. The specific benefit of our research is that we move beyond the individual and consider the importance of the workplace to explain gender pay differentials within firms. The empirical analysis is based on the German LIAB data, a representative linked employer-employee panel including

information on all employees of firms covered by the IAB establishment survey. The data allows us to compare not only average male and female wages (of specific groups of employees), but to look at within-firm gender wage differentials.

To do so, we use measures to describe the firm specific GWG. First we use the observed GWG and second a wage gap, which is adjusted for the differences in human capital characteristics between men and women within establishments. In order to calculate the second measure, we estimate separate wage equations – as far as possible – for male employees in each firm.

Our results indicate that the mean GWG within firms is smaller than the mean overall GWG. Furthermore, the findings suggest that firms bargaining their wages within the framework of collective agreements exhibit a smaller gender pay gap. Given that most unions are still dominated by men, this result is not self-evident. An additional effect of unions with a higher female share is not empirically detectable. Note, however, that a high share of female union members is correlated with larger pay differentials, which may reflect the fact that the rather pronounced inequality in female dominated firms induces women to get involved with unions. The results also point to a gender equalizing effect of formalized co-determination (works councils). Again, the hypothesis that works councils only realize the interests of women if they represent a larger part of the staff is not supported by the data. Finally, we tested Becker's hypothesis on discrimination using various alternative variables. Apart from the results presented above, we used a variable describing the competition in the market as it is perceived by the firm in order to test whether stronger competition prevents discrimination against women. This variable is only available for 1998, though. Since the perceived competition has no significant effect in any regression and does not alter the coefficients of all other variables, we refrain from presenting the results. In summary, we can not find consistent evidence for the discrimination model, though.

Apart from the firm characteristics describing the inner life of an organisation in this study, the situation in the market may also be important to explain firm-specific wage differentials between male and female employees. Robinson (1933) first introduced the idea of monopsonistic discrimination in the labor market. According to this, a single employer may set wages below the marginal revenue product if there exists no or little competition on the factor market. The more inelastic the labor supply, the larger will be the gap between the achievable wage rate and the marginal revenue product. By differentiating wages between groups with differently elastic labor supply curves, the monopsonist may maximize his

profit. For instance, gender can be one dimension along which the employer may differentiate. Given the limited job immobility due to family responsibilities of women[18], it is theoretically conceivable that female labor supply is less elastic than male labor supply. In case of monopsonistic power, women will hence have to accept higher wage cuts then men relative to their productivity. Unfortunately, we must refrain from an empirical examination of this hypothesis, because we have no information which captures market power on the factor market. An empirical specification of the new models developed by Burdett and Mortensen (1998) and Manning (2003), saying that each employer faces its own individual labor supply curve, would be very promising, if the necessary information were available.[19]

[18] The reasons for the lower job mobility of women are manifold. First, the availability of family-friendly jobs is still limited. In this setting, wages become a less important job criterion compared to flexible working time regimes, commute or career perspectives for part-time employees. Second, since husbands earn higher wages in general, local mobility is mostly driven by men.

[19] In principle, one would need gender specific labor turnover rates, strictly speaking the resignation rate of men and women and the potential to recruit new male and female employees for each firm.

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Appendix

Table A1: Description of the sample and the gender wage gap in firms with at least 100 male employees

year	Number of firms (1)	Number of male employees (2)	Number of female employees (3)	Within-firm GWG based on reported value (in logarithm) (4)	Within-firm GWG (in logarithm) (5)	Overall GWG (in logarithm) (6)
1997	916	660,393	168,252	0.187	0.171	0.197
1998	930	610,578	158,840	0.183	0.166	0.206
1999	926	549,510	142,899	0.179	0.163	0.207
2000	1,230	613,558	154,185	0.177	0.161	0.208
2001	1,335	675,145	169,301	0.176	0.159	0.208

Note: The results refer to firms with at least 100 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A2: Description of the sample and the gender wage gap in firms with 20 to 99 male employees

year	Number of firms (1)	Number of male employees (2)	Number of female employees (3)	Within-firm GWG based on reported value (in logarithm) (4)	Within-firm GWG (in logarithm) (5)	Overall GWG (in logarithm) (6)
1997	654	29,978	24,968	0.227	0.217	0.197
1998	751	34,125	26,224	0.225	0.215	0.206
1999	782	34,591	25,054	0.220	0.209	0.207
2000	1,513	65,219	38,719	0.219	0.208	0.208
2001	1,755	78,391	47,337	0.216	0.203	0.208

Note: The results refer to firms with 20 to 99 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A3: Summary statistic of individual characteristics (pooled over 1997-2001)

Variables	Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.
log wage	4.580	0.253	4.392	0.304
low education without vocational training	0.126	0.331	0.202	0.401
vocational training	0.711	0.453	0.618	0.486
Secondary. school (with and without vocational training)	0.047	0.212	0.118	0.323
college of higher education or university	0.117	0.321	0.062	0.241
potential experience	21.959	9.665	20.039	10.733
(potential experience)^2/100	5.756	4.449	5.168	4.677
job tenure in days	4,147.084	2,866.909	3,460.537	2,696.860
censored wage rate	0.143	0.350	0.039	0.194
Observations	3,351,488		955,779	

Note: The results refer to firms with at least 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A4: Summary statistic of individual characteristics for the firm-specific wage regressions (pooled over 1997-2001)

Variables	Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.
log wage	4.591	0.245	4.426	0.291
low education without vocational training	0.125	0.330	0.201	0.401
vocational training	0.709	0.454	0.605	0.489
secondary. school (with and without vocational training)	0.047	0.211	0.126	0.332
college of higher education or university	0.120	0.324	0.068	0.252
potential experience	21.942	9.641	19.759	10.682
(potential experience)^2/100	5.744	4.434	5.045	4.626
job tenure	4,230.000	2,863.652	3,557.205	2,714.546
censored wage rate	0.147	0.354	0.044	0.206
Observations	3,109,184		793,477	

Note: The results refer to firms with at least 100 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A5: Summary statistic of individual characteristics for the pooled wage regression (pooled over 1997-2001)

Variables	Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.
log wage	4.437	0.311	4.227	0.310
low education without vocational training	0.138	0.344	0.208	0.406
vocational training	0.732	0.443	0.680	0.467
secondary. school (with and without vocational training)	0.053	0.224	0.079	0.270
college of higher education or university	0.078	0.267	0.033	0.179
potential experience	22.166	9.964	21.407	10.877
(potential experience)^2/100	5.906	4.634	5.766	4.874
job tenure	3,083.127	2,690.437	2,987.943	2,556.595
censored wage rate	0.085	0.279	0.013	0.114
Observations	242,304		162,302	

Note: The results refer to firms with 20-99 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A6: Summary statistic of firm characteristics (pooled over 1997-2001)

	Total Sample		Restricted Sample	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.200	0.160	0.196	0.158
adjusted gender wage gap (Gap2)	0.148	0.147	0.143	0.145
number of employees	729.860	1,805.010	760.155	1,873.212
relative firm size (employees relative to total employment in the industry sector)	0.014	0.032	0.014	0.032
wage bill per employee	4,863.420	1,606.213	4,883.921	1,609.065
female quota (all employees)	0.307	0.229	0.306	0.229
industry-wide wage agreement	0.747	0.434	0.784	0.412
firm-specific wage agreement	0.098	0.298	0.092	0.290
export quota (sales)	0.156	0.240	0.156	0.240
works council	0.823	0.381	0.839	0.368
works council * female quota (of all employees)	0.263	0.245	0.266	0.243
wage agreement (industry-wide or firm-specific)	0.846	0.361	0.877	0.329
wage agreement * female quota in union	0.286	0.219	0.297	0.216
agriculture and forestry; electricity, gas and water supply, mining	0.030	0.170	0.310	0.173
manufacturing I	0.157	0.364	0.153	0.360
manufacturing II	0.335	0.472	0.331	0.471
construction	0.060	0.237	0.063	0.243
wholesale and retail trade	0.096	0.294	0.095	0.293
transport and communication	0.053	0.225	0.056	0.229
financial intermediation	0.073	0.261	0.080	0.271
real state, renting and business activities	0.059	0.236	0.060	0.240
education	0.022	0.148	0.023	0.148
other service activities	0.114	0.318	0.109	0.312
Berlin-West	0.055	0.228	0.055	0.228
Schleswig Holstein	0.019	0.137	0.193	0.138
Hamburg	0.064	0.244	0.067	0.250
Niedersachsen	0.124	0.330	0.123	0.328
Bremen	0.037	0.190	0.038	0.191
North Rhine-Westphalia	0.233	0.423	0.234	0.424
Hesse	0.086	0.280	0.088	0.283
Rhineland-Palatinate	0.068	0.252	0.066	0.248
Baden-Wuerttemberg	0.148	0.355	0.145	0.352
Bavaria	0.145	0.352	0.143	0.351
Observations	10,792		9,797	

Note: The results refer to firms with at least 20 male employees. The restricted sample does not contain firms switching their union status.
Source: own calculation; LIAB-Data 1997-2001

Table A7: Summary statistic of firm characteristics in firms with less than 200 employees (pooled over 1997-2001)

	Total Sample		Restricted Sample	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.223	0.200	0.217	0.197
adjusted gender wage gap (Gap2)	0.182	0.189	0.176	0.189
number of employees	96.039	48.209	97.054	48.476
relative firm size (employees relative to total employment in the industry sector)	0.004	0.014	0.004	0.012
wage bill per employee	4,718.398	1,669.772	4,740.304	1,691.717
female quota (all employees)	0.251	0.195	0.252	0.198
industry-wide wage agreement	0.674	0.469	0.717	0.450
firm-specific wage agreement	0.083	0.275	0.074	0.261
export quota (of sales)	0.108	0.200	0.101	0.195
works council	0.647	0.478	0.667	0.471
works council * female quota (of all employees)	0.166	0.203	0.171	0.204
wage agreement (industry-wide or firm-specific)	0.757	0.429	0.791	0.407
wage agreement * female quota in union	0.250	0.227	0.263	0.227
agriculture and forestry; electricity, gas and water supply, mining	0.022	0.147	0.024	0.154
manufacturing I	0.144	0.352	0.135	0.342
manufacturing II	0.314	0.465	0.298	0.457
construction	0.108	0.311	0.117	0.322
wholesale and retail trade	0.138	0.345	0.140	0.347
transport and communication	0.060	0.238	0.064	0.244
financial intermediation	0.055	0.228	0.061	0.240
real state, renting and business activities	0.086	0.280	0.091	0.288
education	0.013	0.115	0.014	0.115
other service activities	0.057	0.233	0.056	0.230
Berlin-West	0.055	0.228	0.054	0.227
Schleswig Holstein	0.021	0.144	0.022	0.145
Hamburg	0.082	0.274	0.088	0.284
Niedersachsen	0.151	0.358	0.148	0.355
Bremen	0.059	0.235	0.061	0.239
North Rhine-Westphalia	0.194	0.395	0.195	0.400
Hesse	0.803	0.272	0.083	0.280
Rhineland-Palatinate	0.072	0.258	0.068	0.252
Baden-Wuerttemberg	0.139	0.344	0.131	0.338
Bavaria	0.121	0.326	0.117	0.322
Observations	4,508		3,935	

Note: The results refer to firms with less than 200 employees. The restricted sample does not contain firms switching their union status.
Source: own calculation; LIAB-Data 1997-2001

Table A8: Summary statistic of firm characteristics in firms with at least 200 employees (pooled over 1997-2001)

	Total Sample		Restricted Sample	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.184	0.124	0.182	0.124
adjusted gender wage gap (Gap2)	0.123	0.101	0.121	0.100
number of employees	1,184.549	2,258.100	1,205.277	2,317.286
relative firm size (employees relative to total employment in the industry sector)	0.021	0.038	0.021	0.038
wage bill per employee	4,969.686	1,549.551	4,982.443	1,542.268
female quota (all employees)	0.348	0.243	0.343	0.241
industry-wide wage agreement	0.800	0.400	0.828	0.377
firm-specific wage agreement	0.109	0.312	0.106	0.308
export quota (of sales)	0.192	0.260	0.019	0.026
works council	0.950	0.219	0.954	0.210
works council * female quota (of all employees)	0.333	0.250	0.330	0.250
wage agreement (industry-wide or firm-specific)	0.910	0.287	0.934	0.248
wage agreement * female quota in union	0.312	0.210	0.319	0.206
agriculture and forestry; electricity, gas and water supply, mining	0.035	0.185	0.035	0.184
manufacturing I	0.166	0.372	0.166	0.372
manufacturing II	0.350	0.477	0.353	0.478
construction	0.025	0.156	0.026	0.160
wholesale and retail trade	0.065	0.247	0.065	0.246
transport and communication	0.048	0.214	0.050	0.218
financial intermediation	0.087	0.281	0.092	0.290
real state, renting and business activities	0.040	0.196	0.040	0.195
education	0.029	0.167	0.029	0.166
other service activities	0.155	0.362	0.145	0.352
Berlin-West	0.055	0.228	0.055	0.229
Schleswig Holstein	0.017	0.131	0.018	0.132
Hamburg	0.051	0.220	0.052	0.223
Niedersachsen	0.110	0.307	0.110	0.310
Bremen	0.022	0.147	0.023	0.148
North Rhine-Westphalia	0.261	0.439	0.261	0.439
Hesse	0.090	0.286	0.091	0.288
Rhineland-Palatinate	0.066	0.248	0.065	0.246
Baden-Wuerttemberg	0.156	0.362	0.153	0.360
Bavaria	0.162	0.368	0.161	0.368
Observations	6,284		5,862	

Note: The results refer to firms with at least 200 employees. The restricted sample does not contain firms switching their union status.
Source: own calculation; LIAB-Data 1997-2001

Table A9: Coefficients of the wage estimations in Tobit models in large firms, percentiles

Coefficients	Number of Obs.	Percentile 25 %	Percentile 50 %	Percentile 75 %
Potential experience	2,041	0.012	0.021	0.031
(Potential experience)^2/100	2,041	-0.054	-0.034	-0.019
Job tenure (in days)	2,041	0.000	0.000	0.000
Low education without vocational training	1,570	-0.445	-0.161	3.939
Vocational training	2,025	-0.210	0.111	4.061
Secondary school (with and without vocational training)	1,248	0.126	0.634	4.347
College of higher education or university	1,598	0.272	0.599	4.507

Note: The results refer to firms with at least 100 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A10: Determinants of the firm-specific gender wage gap in firms with less than 200 employees

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-0.7723**	0.3274	-0.6024*	0.3208
(Number of employees/1000)^2	2.5417*	1.4518	1.8571	1.4228
Relative firm size (employees relative to total employment in the industry sector)	-0.1169	0.1786	-0.0726	0.1763
Wage bill per employee/100000	0.7550**	0.1863	0.3080*	0.1840
Export quota (of sales)/10	0.3562*	0.1839	-0.0016	0.1796
Female quota (of all employees)	0.1730**	0.0314	0.1007**	0.0307
Works council	-0.0077	0.0118	-0.0162	0.0115
Works council * Female quota	-0.0393	0.0357	-0.0389	0.0349
Industry-wide wage agreement	-0.0188**	0.0076	-0.0190**	0.0075
Firm-specific wage agreement	-0.0182*	0.0103	-0.0143	0.0102
Observations	3,895		3,895	
R^2	0.089		0.080	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997-2001

Table A11: Determinants of the firm-specific gender wage gap in firms with at least 200 employees

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-0.0059**	0.0021	-0.0068**	0.0018
(Number of employees/1000)^2	0.0020**	0.0001	0.0022**	0.0001
Relative firm size (employees relative to total employment in the industry sector)	0.0751*	0.0414	0.0875**	0.0366
Wage bill per employee/100000	0.1546*	0.0860	0.0388	0.0760
Export quota (of sales)/10	-0.0709	0.0784	-0.1667**	0.0688
Female quota (of all employees)	0.0618**	0.0284	0.0287	0.0249
Works council	-0.2617**	0.0123	-0.2230**	0.0109
Works council * Female quota	-0.0434	0.0283	-0.0367	0.0250
Industry-wide wage agreement	-0.0162**	0.0048	-0.0092**	0.0042
Firm-specific wage agreement	-0.0155*	0.0056	-0.0103*	0.0050
Observations	5,167		5,167	
R^2	0.1905		0.1175	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997-2001

Table A12: Determinants of the firm-specific gender wage gap in firms with less than 200 employees, restricted sample

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-1.0346	0.7524	-0.7216	0.8600
(Number of employees/1000)^2	3.6174	2.9396	2.3084	3.2964
Relative firm size (employees relative to total employment in the industry sector)	0.0426	0.1222	0.0832	0.1293
Wage bill per employee/100000	0.7374**	0.3541	0.3090	0.1991
Export quota (of sales)/10	0.0977	0.1299	-0.1731	0.1107
Female quota (of all employees)	0.1448**	0.0616	0.0911**	0.0529
Works council	-0.0055	0.0179	-0.0143	0.0185
Works council * Female quota	-0.0056	0.0556	-0.0252	0.0408
Industry-wide wage agreement	-0.0358**	0.0141	-0.0231	0.0143
Firm-specific wage agreement	-0.0430**	0.0097	-0.0280**	0.0078
Wage agreement * Female quota of involved union (of union members)	0.0063	0.0110	0.0017	0.0112
Observations	3,407		3,407	
R^2	0.093		0.0802	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997-2001

Table A13: Determinants of the firm-specific gender wage gap in firms with at least 200 employees, restricted sample

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees/1000	-0.0057**	0.0024	-0.0063**	0.0031
(Number of employees/1000)^2	0.0002	0.0002	0.0002	0.0002
Relative firm size (employees relative to total employment in the industry sector)	0.1037**	0.0287	0.1112**	0.0273
Wage bill per employee/100000	0.1967	0.1479	0.0699	0.1030
Export quota (of sales)/10	-0.0696	0.0605	-0.161**	0.0518
Female quota (of all employees)	0.0620	0.0410	0.0201	0.0379
Works council	-0.0238	0.0194	-0.0207	0.0138
Works council * Female quota	-0.0445	0.0370	-0.0434	0.0271
Industry-wide wage agreement	-0.0449**	0.0047	-0.0331**	0.0071
Firm-specific wage agreement	-0.0492**	0.0077	-0.0396**	0.0093
Wage agreement * Female quota of involved union (of union members)	0.0064	0.0111	0.0221	0.0154
Observations	4,824		4,824	
R^2	0.1984		0.1237	

Note: The dummy variables for the years, regions and industry are also included in the estimation. The results are available on inquiry. ** significant on 5%-level, * significant on 10%-level.
Source: own calculation; LIAB-Data 1997-2001