Gender Earnings Gap in German Firms: The Effect of Firm Characteristics and Institutions

Anja Heinze and Elke Wolf
Centre for European Economic Research (ZEW Mannheim)

Very preliminary results – please do not quote

Abstract

Most existing analyses on the gender wage gap (GWG) have neglected the establishment as a place where the inequality between male and female arise and is maintained. The availability 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 effect of various firm characteristics and the institutional framework on the gender wage gap 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 gender wage gap within firms is smaller than the mean overall gender wage gap. Furthermore we can show that firms with formalized co-determination (works councils) and those covered by collective wage agreements are more likely to have smaller gender earnings gaps. A high share of trained women tend to diminish the GWG – at least in smaller firms. It is also interesting to note that the wage differential between men and women decreases with firms size and increases with the wage level.

JEL Classification: J16 and J31

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

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 the 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 further more. 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, became more and more popular during the last decade (see e.g. Baron, 1984; Acker, 1990, 1992). According to their 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. While it is well accepted that 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.

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 employee-employer 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 based on linked employee-employer data for other countries. Reilly and Wirjanto (1999) as well as Datta Gupta and Rothstein (2001) include both personal and establishment-level information to point out the effect of segregation on the gender wage gap 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 gender wage gap. Meng (2004) and Meng and

Meurs (2004) extend the traditional decomposition of the observed gap in an endowment and a remuneration effect to 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 discrimination. In a second step, the impact of firm characteristics on the gender wage differential denoted as discrimination is determined.

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 human resource policies and the institutional framework on the gender wage gap *within* establishments. Given the rich information on the establishments in our survey, we can control for many other firm characteristics. In the following study, we will focus on the impact of further training, unions, work council and the market power. To investigate the theoretical hypotheses regarding the effect of human resource practices and institutional characteristics on wage inequality, we define two alternative measures describing the firm-specific gender wage gap. First, we use the observed wage gap as the difference between the mean wages of males and females within a firm. One important factor explaining this observed wage are difference in human capital 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 gender wage gap as dependent variable in the second step, we can determine the impact of selected human resource practices and the institutional framework on the wage inequality within firms. 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 preliminary results are presented. We end our paper with a short conclusion.

2. Theoretical Background

So far, there exists no theory which explicitly deals with gender wage difference 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'sr 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. This hypothesis can be tested by a variable describing the competition in the market as it are notices by the firms. Alternatively, we want to test Becker's model by a variable describing the export quota of the firm. The idea is that firms operating on the world market are more subject to competition than the 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.

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 female employees in total employment.

Perhaps one of the most important factors influencing wage determinants within firms is whether wages are subject to collective bargaining or not (Elvira and Saporta 2001). While the overall impact of unions on the gender wage gap is not obvious, collective bargaining

models provide several reasons for arguing that collective agreements tend to reduce the gender wage gap within organizations. 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). As a consequence, unionization should reduce the gender wage gap 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[1]. 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 predicable wages for male and female employees. That way the potential of discrimination and the gender wage gap 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 women is increasing, but they still represent a minority among the 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% 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 not obvious that unions actively aim at reducing the gender wage gap in general. Regardless of the motivation, such pay equity policies would raise the wage in mostly female jobs relative to predominantly male, thereby narrowing the gender gap jobs (Acker 1989).

In order to examine the effect of unionization on the gender wage gap we include variables describing whether a firm applies collective agreements or not. More precisely, we distinguish between industry-wide collective wage agreements, firm-specific collective wage agreements as well wage determination without collective bargaining coverage. Industry-wide collective wage agreements are negotiated between and industry-specific union and employers' association. The wage rates set by collective agreements are legally binding for all firms being members of respective employers' association. Note that in Germany the

[1] 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)

employers do 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 firm's requirements than industry-wide collective wage agreements[2].

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.[3] 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 gender wage gap 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 gender wage gap in general, or whether this effect is only driven by unions with high female shares.

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 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 gender wage gap is not unambiguous, too. To see whether the effect of works councils depend upon the female

[2] 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)

[3] Information on the share of women among the union members are published in http://www.dgb.de/dgb/mitgliederzahlen/mitglieder.htm

share among the staff, we further include an interaction term between the works council-dummy and the firm-specific share of women.

Finally, we will investigate the importance of firm-specific training. In most occupations the human capital acquired during the vocational training needs to be maintained and updated from time to time. Hence, the education level describes only parts of the labor market relevant skills. Another important factor represents the training activities offered by the employer. As it is well known from many other studies, not all employees can benefit from these proposals in the same way (Pischke 2001). In general, highly educated and male workers are more likely to be trained than women or employees with a lower level of education. If, for example, an establishment in our sample invests particularly in the human capital of men, the firm-specific gender wage gap is expected to be high than in a comparable firm whose training activities are more equally advised to men and women. In contrast, a high share of women participating in on-the-job-training is supposed to reduce the gender differences in skills and hence diminish the gender wage gap. The validity of this hypothesis will be tested by a variable measuring the share of female employees taking part in the firm-specific training program.

Apart from the firm characteristics describing the inner life of an organisation, 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 exist no or little competition on the product 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 enhance his profit. For instance, gender can be one dimension along which the employer may differentiate. It is conceivable to assume that female labor supply is more inelastic than male labor supply because of job immobility due to family responsibilities. In case of monopsonistic power, women will hence earn less then men relative to their productivity. We would like to test this hypothesis but we have no information which could reflect the issue. The idea in new models developed by Burdett and Mortensen (1998) and Manning (1994) that each employer faces its own individual labor supply curve can also not be tested because the right information fail.

To control for firm heterogeneity with respect to industry and region, we also include a set of dummy variables.

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 employee-employer 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 true 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 gender wage gap in firm j ($Gap1_j$) taking into account that w_{ij} is censored from above.

The source 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. In the literature the wage gap due to difference 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 characteristics:

[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 explaining variables and a different sample are used to explain the wages.

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

X_{ij} includes characteristics of the individual *i* at firm *j* and β_j^m is a vector of wage coefficients of the individual characteristics X_{ij} 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 – separate wage equations for each firm:

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

The dependent variable describes the daily log wage rate. We restrict the wage equation to a standard Mincer equation because we want to adjust the observed wage rate by difference 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 include potential experience (squares), dummy variables for different education levels and job tenure. The right-censoring of the dependent variable requires again 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.[5] 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) $$\ln w_{ij}^m = \beta^m X_{ij}^m + \varepsilon_{ij}^m$$

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 equation 5 respectively, we can calculate Gap2 which describes the gender wage gap within firms assuming that men had the same human capital endowment as women within a firm. Note, however, that there might be a discriminating

[5] To check the sensitivity of our results, we will also run wage equations for different groups firms (by sector, firms size or bargaining regime)

element in the selection of employees such that observed characteristics of employees as well as estimated coefficients are not distributed randomly across firms.[6]

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 gender wage gap 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 if the corresponding explanatory variables. As mentioned in Section 2, the set of explaining variables is derived from several theories. To investigate the hypotheses derived from Becker's discrimination model, we use the export quota, the proportion of female employees and self-reported degree of competition. Implications from the bargaining model might 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 also include the female quota of union members in the relevant union 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. Unfortunately we do not exactly know, which union is involved in the collective bargaining of firm j. We therefore assume that each firm negotiates with an industry-specific union and assign the unions accordingly to the industry affiliation of the firm. This implies, for example, that a firm in the construction sector is supposed to negotiate with the union called "IG-Bau". In order to test whether the work council acts in favor of the majority of the workforce we interact the existence of a work council with the female quota in the firm. Finally, we use the quota of female employees within a firm who participate in professional training in order to check whether gender-specific training activities might also cause wage differentials between men and women within the same firm. Other than the mentioned variables we use also some control variables such as industry and firm size.

As described in the following section, we use data from 1997 to 2001. In the second estimation step we can exploit the panel structure of the data by applying a random effect

[6] In order to correct for this selection we 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.

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, we are not able to apply a fixed effects panel estimation because part of the variables in the wage regression is not varying over time. Even if it would be straightforward to apply a random effects tobit model, we currently refrain from this approach because of computer time restrictions. An estimation in two step is necessary because of the amount of the data.

4. Data

The present analysis of the effect 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. The IAB establishment panel is an annual survey of Germany establishments, which started in West-Germany in 1993 and was extended to East Germany in 1996.[7] The data is collected 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 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. This procedure ensures a response rate above 70 % which is high compared with other non-official German establishment panel studies (Kölling, 2000). The sample unit is the establishment as the local business unit. 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

[7] Detailed information on the IAB-establishment panel is given by Kölling (2000).
[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.

sample. The data set is a representative sample of German establishments employing at least one employee who pays social security contributions.[9] 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 personnel measures, 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.[10] 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.[11] During this 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.[12] If the wage rate exceeds the upper earnings limit ("Beitragsbemessungsgrenze"), the daily social security threshold is reported instead.[13] 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.

[9] Note, about 80% of all employed persons in Germany are covered by the social security system.
[10] Information on the Employment Statistics Register is given by Bender, Haas and Klose (2000)
[11] 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).
[12] To deal with the problem of overlapping spells, we apply a hierarchical order of activities where employment trumps all other activities.
[13] 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.

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 who participated in the IAB-establishment panel in at least two years 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 and therefore a common investigation of both regions would not be very meaningful.[14] We exclude firms which employ only women or only men because the gender wage gap 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 skip much firms and information on the determinants of the firm-specific gender wage gap. 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.

The following table 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. Table A1 and A2 present these figures separately for small and large establishments in the appendix. The number of different firms entering our estimation is 4,520, if which 2,479 establishments belong to the group of smaller firms and 2,041 are large firms.

Table 1 also includes information about the gender wage gap 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 in the data set 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 gender wage gap within firms. In order to correct for the right-censoring of the wage information, we estimate equation (2) with tobit-model. The average of the true raw wage gaps within firms is

[14] A separate analysis for East Germany is not possible due to the small number of firms with enough male employees.

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 bit 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. However, this segregation process does not seem to be very important in our sample.

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)	Within-firm GWG (in logarithm) (5)	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

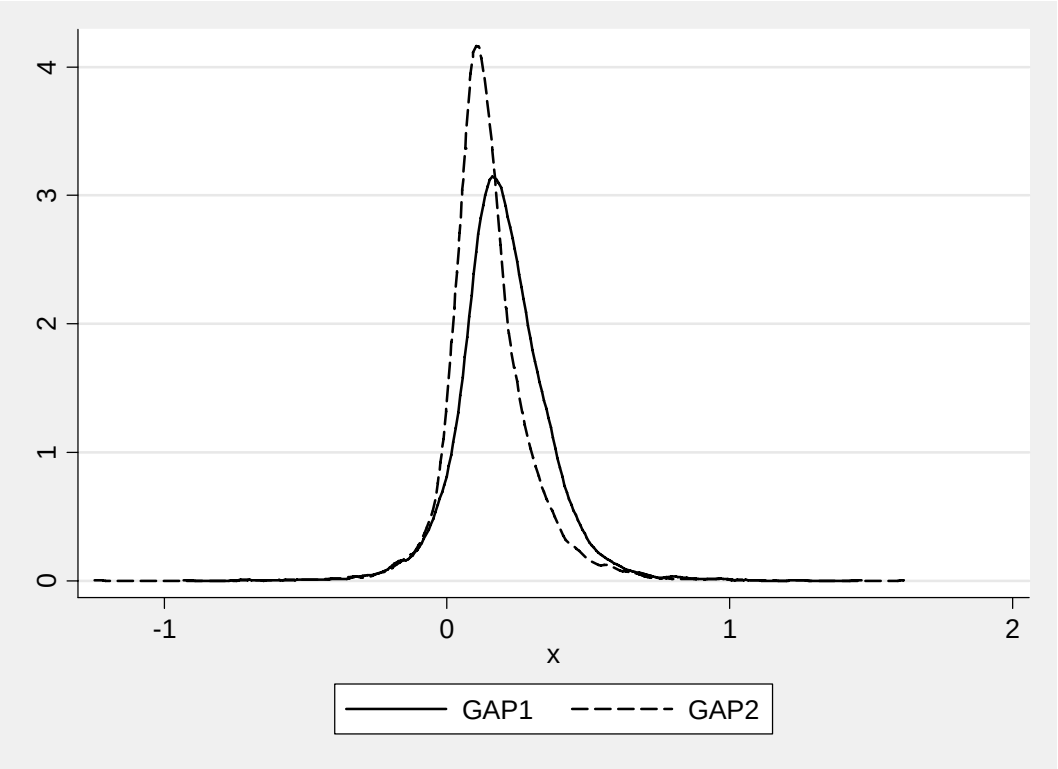
Note: The results refer to firms with at least 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

Figure 1 shows the distribution of Gap1 and Gap2 in all firms. The peak of both measures is right of zero, which illustrates that fact that in most firms men earn higher wages than women. Since Gap 2 controls for the differences in human capital and hence much of the heterogeneity between firms, the distribution of Gap 2 is steeper and the peak appears to be at a lower level than the one of Gap 1.

Table 2 shows some descriptive statistics on the relationship between same firm characteristics and the gender wage gap 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 gender wage gap. 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 in 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.

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: Correlation between Gap1 respectively Gap2 and selected firm characteristics

Variables	Raw Gender Wage Gap (Gap1)	Adjusted Gender Wage Gap (Gap2)
Number of employees	-0.079	-0.104
Export quota (in % of all sales)	0.004	-0.037
Female quota (in % of all employees)	0.108	-0.007
Industry-wide wage agreement	-0.050	-0.037
Firm-specific wage agreement	-0.065	-0.068
Works council	-0.136	-0.209
Wage bill per employee	0.044	-0.029
Female training quota (in % of female employees)	-0.050	-0.084

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

In the appendix, we present the summary statistics of all variables entering the wage estimation and the gender wage gap estimation. In addition we also show these summary statistics separately for large and small firms.

5. Results

5.1 First estimation step: wage regression

To calculate the within-firm gender wage gap 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 and use the firm-specific wage coefficients to determine Gap2. For firms with fewer employees this estimation strategy is not applicable, because the within-firm estimation would yield no reliable results. In this case, we estimate a pooled wage equation across all male employees. Our wage equation is a Mince-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 could not be displayed in detail, we present a summary of the estimation results in larger firms in Table 3. Column 1 describes the number of observations 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. 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 of experience. In order to receive an exacter impression of the significance of the estimated coefficient, column 4 shows the shares of the estimated coefficients which are significant on the 5%-level. We can see that about 80 to 90 percent of the estimated coefficients are significant. Furthermore, the table includes the standard deviation of the estimated coefficients to illustrate the range of the estimated coefficients 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 relative variation of coefficients across the firms. High values of this quotient indicate that the

variation of specific coefficients is small. Small values are signaling moderate heterogeneity of wage returns to the corresponding characteristic across firms. The results in table 3 point out that the remuneration of job tenure varies more across firms than the coefficients for experience. In consideration of the varying coefficients, the wage estimation in each firm seems to be necessary to determine the correct remuneration of the characteristics.

Table 3: Coefficients of the wage estimations in a tobit-model in large firms

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	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
Second. school (with and without vocational training)	1,248	2.160	48.400	0.852	2.142	0.992
Collage of higher education or university	1,598	2.046	51.483	0.870	2.075	1.014

Note: The regressions run in firms with a 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 significant estimated coefficients 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

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 wage level.

Table 4: Coefficients of the pooled wage estimations in a tobit-model in small firms

	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	0.00002	0.00000	99.28000
Low education without vocational training	-0.26575	0.00164	-161.61000
Vocational training (reference group)	-	-	-
Second. school (with and without vocational training)	0.20290	0.00258	78.73000
Collage of higher education or university	0.44774	0.00227	197.57000
No. of Observations	242,304		
Log likelihood	-48419.521		

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

The table 4 includes the estimation results of the pooled tobit-regression for smaller firms. Note that the education level *vocational training* serves as the one and only references 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.

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 gender wage gap, Gap2. In order to derive conclusions on the impact of firm characteristics and the institutional framework on the gender wage gap, we regress firm characteristics on the raw wage gaps (Gap1) and on the adjusted wage gaps (Gap2). We use the export quota, degree of competition and the firm size to test whether firms with market power discriminate more and therefore reveal a higher gender wage gap or not. In order to check the hypothesis that collective wage agreements entail smaller gender wage gaps we distinguish between industry-wide, firm-specific and no wage agreement. We also include the female quota of union members in the relevant union 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. 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. Apart from unions, the impact of the institutional framework on the gender wage gap is investigated by a including a dummy variable for the existence of a works council. Furthermore we use the quota of female employees within a firm who participate in professional training in order to check whether gender-specific training activities might also cause wage differentials between men and women within the same firm. Finally we include the wage bill per employee to control for differences between high and low wage firms. Differences between regions, industries and years are captures by several control variables. Table 5 shows the effects of the selected variables on our two measures of the gender earnings gap. Table A10 and A11 in the appendix contain the separate regressions for larger and smaller firms. The estimated coefficients of the control variables region, industry and year dummies are not presented here.

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

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0096**	0.0024	-0.0102**	0.0023
(Number of employees)^2, centered	0.0003**	0.0001	0.0003**	0.0001
Wage bill per employee/10000	0.0415**	0.0094	0.0141	0.0091
Export quota (in % of sales)	0.0000	0.0001	-0.0002**	0.0001
Female quota (in % of all employees)	0.1278**	0.0204	0.0646**	0.0194
Works council	-0.0177**	0.0077	-0.0297**	0.0073
Works council * Female quota	-0.0188	0.0214	-0.0081	0.0203
Industry-wide wage agreement	-0.0278**	0.0067	-0.0269**	0.0065
Firm-specific wage agreement	-0.0282**	0.0075	-0.0266**	0.0072
Wage agreement * Female quota of involved union (in % of union members)	0.0003*	0.0001	0.0003**	0.0001
Observations	9,062		9,062	
R^2	0.1187		0.1065	

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 show that the gender wage gap decreases with the firm size, which is measured by the deviation of the number of employees from the average number of employees in the

sample. However, the positive coefficient of the quadratic term yields to another result. The gender wage gap increase with the number of employees in firms with more then 380 employees. This implies that the Becker's hypothesis saying that larger firms can afford more discrimination due to their market power works for firms with more than 380 employees. The separate regressions in small and large firms support this conclusion. There are a significant negative relation between the number of employees and the gender wage gap in small firms while in the large firms the coefficient is insignificant.

The export quota, which may be interpreted as the degree of market competition, has a significant negative impact on Gap2, which is also in accordance with Becker's model. A look at Table A10 and A11, presenting the separate results for small and large firms, reveals that this impact is driven by the larger firms.[15] Surprisingly, the export quota has no significant effect on Gap1. 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 firms hold almost all managing positions and the mass of women work in lower positions. For instance, in the retail trade a lot of women are employed as shop assistants while males work as shop manager. 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.[16]

The significant positive coefficients of the wage bill per employee in regression of Gap1 exposes that the gender wage gap is higher 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 in the right tail of the earnings distribution is higher than at the mean. Provided that there exists a notional income barrier, the wage rate between men and women tends to be higher in a high wage firm. In the regression of Gap2, which control for different

[15] Note, however, that the export quota of large and small firms is not that different (see Table A7 and A8 in the Appendix)

[16] We also use a variable describing the competition in the market as it is perceived by the firm in order to test whether stronger competion prevents discrimination against women. This variable is only available for 1998, though. Since the impact of this variable is insignificant in all regressions and also the coefficients of all other variables do not chance, we refrain from presenting the results.

human capital endowment, the effect is insignificant. We therefore conclude, that this glass ceiling effect can be explained by differences in human.

Concerning the effect of the institutional setting, we find pretty clear and convincing results. The estimates indicate that the industrial relations as well as the wage bargaining regime are linked to the gender wage gap. 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 in both estimations that the null hypothesis $\delta_{industry} = \delta_{firm-specific}$ cannot be rejected at conventional levels[17]. As 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 the conditions negotiated in the corresponding industry agreement in order to lower transaction costs.

The hypothesis that unions with more female members act more in favor of the female interests and tend to reduce the gender wage gap can not be approved by our regressions. Instead of this, the results show a positive relationship between the number of women involved in the union and the wage differential within firms. One explanation for this surprising result may be that women who work in industries and firms which are dominated by women but where men and women are treated very unequal are more likely to engage in unions in order to actively influence the wage structure. Or the female union members are more interested in better compatibility of family and job.

Also works councils have a significant negative impact on Gap1 and Gap2. It seems that employees' representations foster equal treatment of male and female employees within firms. However, the separate regressions for large and small firms show no significant coefficients. This gives rise to the assumption that the negative coefficients in the regression across all firms could reflect size effects and not the causal effect of co-determination. Note, however, that once the interaction term between works councils and female quota within firms is left out, we detect a negative impact of works councils in smaller firms (see table A12 and A13). Given that 95 % of all large firms have a works council, the insignificant effect is not surprising. We can therefore conclude that the negative coefficients of works councils in table 5 do not only reflect a size effect.

[17] The p-values are 0.9290 for the raw wage gap and 0.9454 for the adjusted wage gap.

The interaction between works councils and the female quota within a firm has no significant impact in any regression. It seems that works councils tend to reduce the inequality between men and women irrespective the gender relations in the firm. Even if a high share of female employees does not foster this effect, it may be conceivable that the female quota among the works councils member influences the goals of the staff association. Given that we have no individual information on the membership in works council, we can not test this hypothesis.

Finally, we investigate the importance of firm-specific training for the within-firm gender wage gap. To see whether a high share of women participating in on-the-job-training reduces the gender differences in skills and hence diminishes the gender wage gap, we add a variable measuring the share of female employees taking part in the firm-specific training program. Since our data set provides this information only for the years 1997, 1999 and 2001, we run the regressions on Gap1 and Gap2 in a restricted sample of these years. The results for all firms are presented in Table 6, and for the large and small firms in Table A14 and A15.

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

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0106**	0.0029	-0.0109**	0.0027
(Number of employees)^2, centered	0.0003**	0.0001	0.0003**	0.0001
Wage bill per employee/10000	0.0803**	0.0145	0.0304**	0.0137
Export quota (in % of sales)	-0.0001	0.0001	-0.0003**	0.0001
Female quota (in % of all employees)	0.1222**	0.0272	0.0430*	0.0254
Works council	-0.0418**	0.0099	-0.0550**	0.0093
Works council * Female quota	0.0223	0.0282	0.0247	0.0264
Industry-wide wage agreement	-0.0370**	0.0095	-.0037**	0.0090
Firm-specific wage agreement	-0.0345**	0.0109	-0.0325**	0.0104
Wage agreement * Female quota of involved union (in % of union members)	0.0002	0.0002	.0000*	0.0002
Quota of females in training (in % of female employees)	-0.0080	0.0054	-0.0113**	0.0052
Observations	5,057		5,057	
R^2	0.1333		0.1206	

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

The regressions show an insignificant impact of the female share in training programs on Gap 1, while there is a significant negative impact in Gap 2. Even if the sign of the coefficients is in line with our expectation, the results are somewhat puzzling. Given that Gap2 controls for difference in the human capital endowment, which is correlated with the training intensity, we would expect a larger coefficient in the regression of Gap1. The separate regressions for small and large firms reveal that the training effect is mainly driven by the small firms. Table A14 shows that there is no significant impact of the variable on Gap1 and Gap2 in large firms. In small firms (see Table A15) the negative impact on Gap1 and Gap2 is akin. One possible explanation for these differences may be that the training programs in small firms are better aligned with the requests of women and hence help female employees to diminish the pay gap between men and women. Large firms are more likely to provide general training programs for all employees with a rather institutional character that do not explicitly accommodate the individual situation of female employees.

6. Conclusions

This study provides a first comprehensive analysis on the effect of various firm characteristics and the institutional framework on the gender wage gap 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. The empirical analysis is based on the German LIAB data, a representative linked employee-employer 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 gender wage gap. First we use the observed gender wage gap 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 separately wage equations for male employees in each firm separately.

Our results indicate that the mean gender wage gap within firms is smaller than the mean overall gender wage gap. 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. 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 cynical 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. Furthermore, it turns out that part of the firm-specific gender wage gap can be due to the training activities in smaller establishments. We can not find consistent evidence for Becker's discrimination model or the supposition that the gender wage gap rises with the monopsononistic power of the employee, though.

References

Abowd, J. M., Kramarz, D. und D. N. Margolis (1999): High Wage Workers and High Wage Firms, *Econometrica*, Vol. 67(2), 251-333.

Acker, J. (1989): *Doing comparable worth: Gender, class, and pay equity*, Temple University Press, Philadelphia.

Acker, J. (1990): Hierarchies, Jobs, Bodies: A Theory of Gendered Organizations, *Gender & Society 4*, 139 – 158.

Acker, J. (1992): Gendering Organizational Theory, in Mills, A. J. und Tancred, P. (Hrsg.): *Gendering Organizational Analysis*, Newbury Park, London, 248 – 260.

Arrow, K.J. (1973): The theory of discrimination, In O. Ashenfelter (ed.), *Discrimination in labor markets*, 3-33, NJ: Princeton University Press, Princeton.

Baron, J. N. (1984): Organizational Perspectives on Stratification, *Annual review of sociology*, Vol. 10, 37 – 69.

Becker, G.S. (1957): *The economics of discrimination*, University of Chicago Press, Chicago.

Bender, S.; A. Haas and C. Klose (2000): IAB Employment-Subsample 1975-1995. Opportunities analysis provided by the anonymised subsample, *IZA Discussion Paper*, No.117, IZA, Bonn.

Bronars, S. G. und M. Famulari (1997): Wage, Tenure, and Wage Growth Variation Within and Across Establishments, *Journal of Labor Economics* , Vol. 15(2), 285 – 317.

Cain, G.G. (1986): The economic analysis of labor market discrimination: A survey, In O. Ashenfelter and R. Layard (ed.), *Handbook of labor economics*, 693-785, Amsterdam: North- Holland.

Cornfield, D.B. (1987): Ethnic inequality in layoff chances: The impact of unionization on layoff procedures, In R.S. Lee (ed.), *Redundancy, layoffs, and plant closures: Their character, causes and consequences*, 116-140, Croom Helm, London.

Datta Gupta, N. (1993): Probabilities of job choice and employer selection and male-female occupational differences, *American Economic Review* 83(2), 57-61.

Datta Gupta, N. and D.S. Rothstein (2005): The impact of worker and establishment-level characteristics on male-female wage differentials: Evidence from Danish matched employee-employer data, *Labour*, Vol. 19(1), 1-

Datta Gupta, N. and T. Eriksson (2004): New workplace practices and the gender wage gap, *Working Paper*, 04-18, Aarhus.

Davis, S. J. und J. Haltiwanger (1991*):* Wage Dispersion Between and Within US Manufacturing Plants, 1963 – 1986, *Brookings papers on economic activity*, 115 – 180.

Drolet, M. (2002): Can the workplace explain Canadian gender pay differentials? *Canadian Public Policy*, Supplement May 2002, Vol. 28, S41-S63.

Elvira, M.M and I. Saporta (2001): How does collective bargaining affect the gender pay gap? *Work and Occupation*, Vol. 28, No. 4, 469-490.

Fitzenberger, B. and G. Wunderlich (2000): Gender Wage Differences in West Germany: A Cohort Analysis, *ZEW Discussion Paper No. 00-48*.

Freeman, R.B. (1980): Unionism and the dispersion of wages, *Industrial Labor Relations Review*, Vol. 34, No.1, 3-23.

Freeman, R.B. and J.L. Medoff (1984): *What do unions do?* Basic Books, New York.

Gartner, H. (2004): The imputation of wages above the contribution limit with the German IAB employment sample, *Technical Working Paper*, IAB, Nuremberg

Hassel, A. (1999): The erosion of the German system of Industrial Relations, *British Journal of Industrial Relations,* Vol.37, 483-506.

Hübler, O. and u. Jirjahn (2003): Works councils and collective bargaining in Germany: the impact on productivity and wages, *Scottish Journal of Political Economy*, Vol. 50, 471-491.

Koch-Baumgarten, S. (2002): Changing Gender Relations in German Trade Unions: From the Worker Patriarchy to Gender Democracy in the Network Union? In: Colgan, Fiona and Ledwith, Sue (Eds.): *Gender, Diversity and Trade Unions*, International Perspectives, London, p.132-153.

Kölling, A. (2000): The IAB establishment panel, *Applied Social Science Studies*, Vol. 120, Nr. 2, 291-300.

Lindbeck, A. und D. Snower (1988): *Cooperation, Harassment and Involuntary Unemployment: A Insider-Outsider Approach*, American Economic Review, 78(1), 167-188

Meng, X. (2004): Gender earnings gap: the role of firm specific effects, *Labour Economics,* Vol. 11, 555-573.

Meng, X. and D. Meurs (2004): The gender earnings gap: effects of institutions and firms – a comparative study of French and Australian private firms, *Oxford Economic Papers*, Vol. 56, 189-208.

Mincer, J. (1974): *Schooling, Experience, and Earnings*. National Bureau of Economic Research, New York.

Pischke, S. (2001): Continuous Training in Germany, *Journal of Population Economics*, Vol. 14, 523-548.

Reilly, K.T. and T.S. Wirjanto (1999): Does more less? The male/female wage gap and proportion of females at the establishment level, *Canadian Journal of Economics*, Vol.32, No.4, 906-929.

Appendix

Table A1: Description of the sample and the gender wage gap (large firms)

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 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

Table A2: Description of the sample and the gender wage gap (small firms)

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 at least 20 male employees.
Source: own calculation; LIAB-Data 1997-2001

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

Variables	Males		Females	
	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
second. school (with and without vocational training)	0.047	0.212	0.118	0.323
collage 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	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, large firms (pooled over 1997-2001)

Variables	Males		Females	
	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
second. school (with and without vocational training)	0.047	0.211	0.126	0.332
collage 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, small firms (pooled over 1997-2001)

Variables	Males		Females	
	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
second. school (with and without vocational training)	0.053	0.224	0.079	0.270
collage 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)

Variables	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.200	0.160
adjusted gender wage gap (Gap2)	0.148	0.147
number of employees	729.860	1,805.010
number of employees (centered)	0.000	1.797
number of employees (centered), squared	3.229	49.285
wage bill per employee/10000	0.486	0.161
female quota (in % of all employees)	0.307	0.229
industry-wide wage agreement	0.747	0.434
firm-specific wage agreement	0.098	0.298
export quota (in % sales)	15.589	23.969
works council	0.823	0.381
works council * female quota (in % of all employees)	0.263	0.245
wage agreement (industry-wide or firm-specific)	0.846	0.361
wage agreement * female quota in union	28.598	21.935
quota of females in training (in % of female employees)	0.246	0.341
degree of competition	3.667	0.649
agriculture and forestry; electricity, gas and water supply, mining	0.030	0.170
manufacturing I	0.157	0.364
manufacturing II	0.335	0.472
construction	0.060	0.237
wholesale and retail trade	0.096	0.294
transport and communication	0.053	0.225
financial intermediation	0.073	0.261
real state, renting and business activities	0.059	0.236
education	0.022	0.148
other service activities	0.114	0.318
Berlin-West	0.055	0.228
Schleswig Holstein	0.019	0.137
Hamburg	0.064	0.244
Niedersachsen	0.124	0.330
Bremen	0.037	0.190
North Rhine-Westphalia	0.233	0.423
Hesse	0.086	0.280
Rhineland-Palatinate	0.068	0.252
Baden-Wuerttemberg	0.148	0.355
Bavaria	0.145	0.352
Observations	?	

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

Table A7: Summary statistic of firm characteristics, large firms (pooled over 1997-2001)

Variables	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.180	0.123
adjusted gender wage gap (Gap2)	0.120	0.105
number of employees	1,251.726	2,436.530
number of employees (centered)	0.501	2.430
number of employees (centered), squared	6.153	69.965
wage bill per employee/10000	0.523	0.150
female quota (in % of all employees)	0.264	0.196
industry-wide wage agreement	0.805	0.396
firm-specific wage agreement	0.112	0.316
export quota in % of what?)	22.874	26.939
works council	0.953	0.212
works council * female quota (in % of all employees)	0.255	0.201
wage agreement (industry-wide or firm-specific)	0.917	0.275
wage agreement * female quota in union	27.949	19.947
quota of females in training (in % of female employees)	0.298	0.377
degree of competition	3.710	0.621
agriculture and forestry; electricity, gas and water supply, mining	0.043	0.204
manufacturing I	0.205	0.404
manufacturing II	0.416	0.493
construction	0.036	0.187
wholesale and retail trade	0.056	0.231
transport and communication	0.049	0.217
financial intermediation	0.089	0.284
real state, renting and business activities	0.038	0.191
education	0.018	0.134
other service activities	0.048	0.215
Berlin-West	0.052	0.222
Schleswig Holstein	0.017	0.129
Hamburg	0.052	0.222
Niedersachsen	0.108	0.310
Bremen	0.023	0.151
North Rhine-Westphalia	0.267	0.443
Hesse	0.087	0.282
Rhineland-Palatinate	0.066	0.248
Baden-Wuerttemberg	0.153	0.360
Bavaria	0.162	0.369
Observations	?	

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

Table A8: Summary statistic of firm characteristics, small firms (pooled over 1997-2001)

Variables	Mean	Std. Dev.
raw gender wage gap (Gap1)	0.220	0.188
adjusted gender wage gap (Gap2)	0.174	0.175
number of employees	219.283	332.807
number of employees (centered)	-0.491	0.358
number of employees (centered), squared	0.369	0.478
wage bill per employee/10000	0.451	0.163
female quota (in % of all employees)	0.350	0.250
industry-wide wage agreement	0.691	0.462
firm-specific wage agreement	0.084	0.278
export quota in % of what?)	8.789	18.375
works council	0.696	0.460
works council * female quota (in % of all employees)	0.271	0.282
wage agreement (industry-wide or firm-specific)	0.017	0.129
wage agreement * female quota in union	0.110	0.313
quota of females in training (in % of female employees)	0.256	0.436
degree of competition	0.083	0.275
agriculture and forestry; electricity, gas and water supply, mining	0.135	0.341
manufacturing I	0.057	0.232
manufacturing II	0.058	0.234
construction	0.080	0.271
wholesale and retail trade	0.026	0.160
transport and communication	0.179	0.383
financial intermediation	0.058	0.234
real state, renting and business activities	0.021	0.144
education	0.075	0.264
other service activities	0.141	0.348
Berlin-West	0.051	0.220
Schleswig Holstein	0.200	0.400
Hamburg	0.085	0.278
Niedersachsen	0.071	0.256
Bremen	0.143	0.350
North Rhine-Westphalia	0.128	0.334
Hesse	0.776	0.417
Rhineland-Palatinate	29.233	23.703
Baden-Wuerttemberg	0.199	0.296
Bavaria	3.608	0.682
Observations	?	

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

Table A9: Coefficients of the wage estimations in tobit-models in large firms, percentile

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	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
Second. school (with and without vocational training)	1,248	0.126	0.634	4.347
Collage 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: Determinates of the firm-specific gender wage gap (Large firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0033*	0.0019	-0.0034*	0.0018
(Number of employees)^2, centered	0.0002**	0.0001	0.0001**	0.0094
Wage bill per employee/10000	0.0363**	0.0092	0.0193**	0.0094
Export quota (in % of sales)	0.0000	0.0001	-0.0002**	0.0001
Female quota (in % of all employees)	0.1101**	0.0461	0.0541	0.0454
Works council	-0.0115	0.0137	-0.0216	0.0454
Works council * Female quota	0.0330	0.0471	0.0392	0.0464
Industry-wide wage agreement	-0.0198**	0.0076	-0.0218**	0.0078
Firm-specific wage agreement	-0.0180**	0.0081	-0.0229**	0.0083
Wage agreement * Female quota of involved union (in % of union members)	0.0003	0.0002	0.0004**	0.0002
Observations	4,395		4,095	
R^2	0.1986		0.0927	

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: Determinates of the firm-specific gender wage gap (Small firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0367**	0.0154	-0.0373**	0.0144
(Number of employees)^2, centered	0.0182**	0.0084	0.0214**	0.0079
Wage bill per employee/10000	0.0573**	0.0164	0.0211	0.0155
Export quota (in % of sales)	0.0004**	0.0002	0.0000	0.0002
Female quota (in % of all employees)	0.1208**	0.0264	0.0591**	0.0248
Works council	-0.0058	0.0107	-0.0150	0.0100
Works council * Female quota	-0.0393	0.0284	-0.0280	0.0267
Industry-wide wage agreement	-0.0229**	0.0105	-0.0232**	0.0100
Firm-specific wage agreement	-0.0256**	0.0121	-0.0208**	0.0114
Wage agreement * Female quota of involved union (in % of union members)	0.0002	0.0002	0.0002	0.0002
Observations	4,667		4,667	
R^2	0.0942		0.0991	

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: Determinates of the firm-specific gender wage gap (Large firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0035*	0.0019	-0.0035**	0.0018
(Number of employees)^2, centered	0.0002**	0.0001	0.0001**	0.0001
Wage bill per employee/10000	0.0368**	0.0092	0.0199**	0.0094
Export quota (in % of sales)	0.0000	0.0001	-0.0002**	0.0001
Female quota (in % of all employees)	0.1413**	0.0131	0.0912**	0.0127
Works council	-0.0037	0.0090	-0.0120	0.0088
Industry-wide wage agreement	-0.0118**	0.0057	-0.0094	0.0058
Firm-specific wage agreement	-0.0100	0.0064	-0.0106	0.0065
Observations	4,395		4,395	
R^2	0.1969		0.0872	

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: Determinates of the firm-specific gender wage gap (small firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0393**	0.0153	-0.0394**	0.0143
(Number of employees)^2, centered	0.0194**	0.0084	0.0224**	0.0078
Wage bill per employee/10000	0.0569**	0.0164	0.0206	0.0155
Export quota (in % of sales)	0.0004**	0.0002	0.0000	0.0002
Female quota (in % of all employees)	0.0940**	0.0174	0.0404**	0.0163
Works council	-0.0165**	0.0072	-0.0225**	0.0067
Industry-wide wage agreement	-0.0160**	0.0065	-0.0148**	0.0062
Firm-specific wage agreement	-0.0186**	0.0090	-0.0124	0.0085
Observations	4,667		4,667	
R^2	0.0947		0.0992	

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 A14: Determinates of the firm-specific gender wage gap (Large Firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0046*	0.0024	-0.0041*	0.0022
(Number of employees)^2, centered	0.0001	0.0001	0.0001	0.0001
Wage bill per employee/10000	0.0539**	0.0148	0.0233	0.0147
Export quota (in % of sales)	-0.0001263	0.0001	-0.0003**	0.0001
Female quota (in % of all employees)	0.05956	0.0655	0.0181	0.0627
Works council	-0.0597**	0.0187	-0.0670*	0.0177
Works council * Female quota	0.1472*	0.0667	0.0959	0.0638
Industry-wide wage agreement	-0.0281**	0.0109	-0.0353**	0.0108
Firm-specific wage agreement	-0.0212*	0.0118	-0.0324**	0.0118
Wage agreement * Female quota of involved union (in % of union members)	0.0002	0.0002	0.0005**	0.0002
Quota of females in training (in % of female employees)	-0.0003	0.0049	-0.0022	0.0050
Observations	2,385		2,385	
R^2	0.2238		0.1166	

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 1997,1999,2001

Table A15: Determinates of the firm-specific gender wage gap (Small Firms)

	GAP1		GAP2	
Variables	Coefficients	Standard Errors	Coefficients	Standard Errors
Number of employees, centered	-0.0328*	0.0174	-0.0353**	0.0161
(Number of employees)^2, centered	0.0163*	0.0096	0.0206**	0.0088
Wage bill per employee/10000	0.1153**	0.0242	0.0524**	0.0225
Export quota (in % of sales)	0.0004*	0.0002	0.0001	0.0002
Female quota (in % of all employees)	0.1183**	0.0347	0.0416	0.0322
Works council	-0.0223*	0.0135	-0.0330**	0.0125
Works council * Female quota	-0.0160	0.0368	-0.0050	0.0341
Industry-wide wage agreement	-0.0259*	0.0150	-0.0272*	0.0139
Firm-specific wage agreement	-0.0260	0.0180	-0.0163	0.0167
Wage agreement * Female quota of involved union (in % of union members)	0.0000	0.0003	0.0002	0.0003
Quota of females in training (in % of female employees)	-0.0176*	0.0103	-0.0223*	0.0096
Observations	2,672		2,672	
R^2	0.1089		0.112	

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 1997,1999,2001