Time Pay versus Piece Rates: The Gender Aspect

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Abstract: Why do women work under piece rates disproportionately often? Three hypotheses to account for this gender-specific phenomenon are considered:
(1) Women are more likely to be found in pay-for-performance schemes, because they have a shorter expected tenure than men.
(2) A greater demand for flexibility between work and home attracts women to work place technologies suitable for variable pay based on individual performance.
(3) Female blue-collar workers prefer being paid by piece rates, because they are subject to less wage discrimination when objective performance measures are available.
These hypotheses are tested using a German matched employer-employee data set. The empirical results do not support the first hypothesis. The second hypothesis is partially confirmed by the result that especially women with children are more likely to receive piece rates. The finding that piece rates raise hourly wages more for women than for men is consistent with the third hypothesis.

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1 Introduction

Not only the level of wages, but also the method of pay seems to differ systematically by gender for blue-collar workers. There has been some ambiguity on this topic in the literature. International studies based on establishment data show that firms with a high percentage of women are more likely to use piece rates (USA: Goldin 1986; Brown 1990; Australia: Drago and Heywood 1995; United Kingdom: Heywood, Siebert and Wei 1997; Hong Kong: Heywood and Wei 1997; West Germany: Heywood, Hübler and Jirjahn 1998; Heywood and Jirjahn 1999). In contrast some recent investigations based on individual data obtain the result that women do not to receive incentive pay disproportionately often (Cowling 1998; Booth and Frank 1999) – but these studies rely on broader measures of variable pay which also include commissions and bonus schemes (see Geddes and Heywood 2000).

We add some new insights to the existing evidence, using a German matched employer-employee data set that contains a precise measure of variable pay. The results confirm that a higher proportion of female blue-collar workers compared to male blue-collar workers is working under piece rates. Furthermore, we test three explanations of the relationship between gender and method of pay:

1. Women have a shorter expected tenure than men do. Hence they are more likely to receive contemporaneous incentives instead of incentives through deferred compensation.
2. Household production responsibilities attract women to jobs, which are characterized by a low cost of measuring individual performance and which are thus suitable for variable pay.
3. Women may be attracted to variable pay schemes because pay discrimination is less likely to occur when remuneration is based on objective performance measures.

To test for the first and second hypothesis, we examine if a significant relationship between gender and payment scheme remains even controlling for tenure and the existence of children. To test for the third hypothesis, we analyze if variable pay has a differing

impact on the wage levels of men and women. A novel feature of our analysis is that we are able to take into account that error terms for workers from the same firm are likely to be correlated.

Section 2 gives a more detailed discussion of the three hypotheses. Section 3 describes the data set and discusses variables and methods. Section 4 presents the results of the empirical investigation while section 5 concludes.

2 Hypotheses on Gender and Variable Pay

Why do female blue-collar workers receive piece rates more often than male blue-collar workers do? The first and second hypotheses on the importance of tenure and flexibility stress the responsibility of women for household production, but differ in the time horizon referred to. The focus of the first hypothesis is on long-term interruptions of individual work careers. The second hypothesis is related to short-term absence from work. The third hypothesis concentrates on the fact, that the gender wage gap may be smaller under piece rates.

Tenure

Different payment schemes provide different incentives. One important difference is between contemporaneous incentive schemes as piece rates and deferred compensation schemes as seniority wages. In deferred compensation schemes earnings profiles are rearranged in such a way, that pay rises from below to above the marginal value product while workers accumulate tenure (Lazear 1979; 1981). Deferred compensation schemes provide an incentive to exert effort since a worker caught shirking looses his job and hence looses realized or prospective wage rises.

What determines which kinds of workers are found in which scheme? One important factor is expected tenure: Workers with short expected tenure are not likely to sort themselves in deferred compensation schemes, because they do not expect to reach the payoff period. Since women are more likely to take a period of home time and thus have a shorter expected tenure, Goldin (1986) argues that women choose jobs with contemporaneous incentives more often than men do. The results of Heywood and Wei (1997), however, do not support this hypothesis: Even controlling for the mean tenure of the

workforce, establishments with a high share of women are significantly more likely to use piece rates.

Flexibility

Heywood and Wei (1997) offer an alternative explanation for the relationship between gender and variable pay. Women do traditionally bear more responsibilities for current household production than men do - for example, they are more likely to take time off to care for a sick child - and thus prefer jobs with allow for more flexibility between work and home.

At this point it is important to note, that firms will set contracts depending, amongst other things, on the technology the firm is operating under and workers will then respond to these contracts. If firms differ in terms of their technological structure they will also face different costs of absenteeism. From the viewpoint of the firm absence of an employee is less costly if production is characterized by few production interdependencies across workers (Barmby and Stephan 2000). In contrast, absence of a team worker affects the productivity of other team members, and the firm risks to loose output of the entire team.

The conclusion is that women demanding flexibility between work and home tend to work in jobs where individual contribution can be measured rather easily, which in turn facilitates the use of piece rates. This hypothesis is supported by Heywood and Jirjahn (1999), who find a significant positive impact of the share of women within a firm on the use of individual incentive pay, but not on the use of group incentive pay.

Wage discrimination

A third explanation for the relationship between gender and variable pay refers to the fact that women in average earn less than men do. This result holds even controlling for qualification, job, employer and segregation into certain firms and jobs (for Germany see Stephan 1997; Rouault, Kaukewitsch and Söll 1998). The remaining differential may result from gender-specific wage discrimination. One prominent explanation of discrimination is employer preference and prejudice (Becker 1957). Statistical discrimination is another explanation for the gender wage gap (Aigner and Cain 1977) - if the productivity

of women is in average lower or has a higher variance than the productivity of men, firms will cp. pay higher wages to men.

The interesting point for the topic investigated is the discretion regarding discrimination under different payment-schemes. Incentive systems as promotions, merit pay and piece rates are based on performance measures. Performance measures can be subdivided into objective and subjective measures (Baker, Jensen and Murphy 1988). Objective performance measures – for instance sales or the quantity of output - can be verified. Accordingly, piece rates present few opportunities for wage discrimination because units of output can be verified easily. But for more complex tasks – for instance building up long-term relationships with customers or asset maintenance - verification becomes more difficult and expensive. Suitable performance measures provide some discretion in performance appraisal and may rely on the subjective opinions and preferences of supervisors. If performance measures differ in the degree of discretion given to supervisors, women who are subject to discrimination by superiors will sort into pay schemes where performance measures are associated with less arbitrariness. This strategy provides some degree of protection from arbitrary supervisor ratings. However, this argument is valid only within a given job – women may still suffer from discriminatory job assignments (Chen 1996).

Surely, limits to the arbitrariness associated with subjective performance measures exist. One possibility to avoid opportunism is setting wages due to bureaucratic rules (Prendergast and Topel 1996), for example to condition promotions not only on superiors' appraisals but also on subordinates' seniority. Another mechanism is firms' concern about their reputation (Baker, Gibbons and Murphy 1994) if production and quality of production require a cooperative and trustful relationship with employees. Providing works councils with codetermination rights is a further way to restrict opportunism by managers (Smith 1991; Freeman and Lazear 1995). But these mechanisms do not totally avoid the arbitrariness associated with subjective performance measures as long as incentives for particular tasks are based at least partly on subjective performance measures. Finally it has to be noted that piece rates may also suffer from employer opportunism. A well-known example is the ratchet effect. Workers withhold effort when they expect the employer to alter the scheme according to the workers' past performance. However, this

kind of opportunism affects all workers receiving piece rates and does not restrict itself on particular groups of workers such as women or black workers. Moreover, a works council may prevent an employer from altering the terms of the piece rate scheme (Heywood, Hübler and Jirjahn 1998). Preventing the ratchet effect may be easier for works councils than preventing special superiors from favoritism, because the terms of a piece-rate scheme are - in contrast to idiosyncratic performance appraisals by superiors - easily observable.

Chen (1996) tests the wage discrimination hypothesis conducting a conventional Blinder decomposition to identify the discriminatory part of the gender wage gap. He obtains the result that unexplained gender wage differentials are slightly - but not significantly - smaller across Swedish blue-collar workers receiving performance pay than for workers receiving time pay. Obviously, a similar hypothesis also applies to discrimination against black workers and foreigners: Belman and Heywood (1988) find that piece rates have a stronger impact in increasing the wages of blacks compared to the wages of whites.

3 Data, Variables and Methods

The Data Set

The three hypotheses are examined using a data set from German Official Statistics, the Lower Saxonian Salary and Wage Structure Survey for the year 1995 (see Stephan 2001); Lower Saxony is one of the larger federal states of Germany. The data are drawn as a two-stage random sample from all establishments in the complete manufacturing sector and parts of the service sector. The percentage of employees included per firm depends on firm size (from 100 percent for small firms to 6,25 percent for large firms).

The wage structure survey includes a number of questions on wages and working time. Specifically interesting for us is that the method of pay is surveyed for blue-collar workers. The following analysis contrasts blue-collar workers receiving piece rates with blue-collar workers receiving time wages. While group piece rates may be paid in single cases, they are found pretty seldom in Germany (Heywood and Jirjahn 1999). The exclusion of workers under premium pay at this stage of the analysis facilitates a comparison

with the results of other studies. We exclude workers from sectors in which piece rates are not used at all; these are the whole service sector, mining, energy and water and construction. The reduced sample includes around 22.000 employees from 850 firms.

As personal characteristics gender, schooling, tenure, age, potential experience, presence of children and as a work place related feature the position of an employee are known.[1] Variables concerning the firm are sectoral affiliation and establishment size. One main advantage of the data set is that it is known which employees belong to a particular firm. The study restricts itself to workers with a contractual working time of at least 25 weekly hours and employed in firms with at least 10 employees. The hour restriction is chosen as a lower bound for full-time work (some Lower Saxonian plants has introduced a full-time week of 28 weekly hours in 1995).

Determinants of Payment Schemes

In a first step we analyze the determinants of working under piece rates compared to receiving time pay by estimating probit equations. The structure of our data set implies that observations are not necessarily independent within firms. To account for the fact that error terms of workers from the same firm may be correlated we relax the independence assumption and require observations to be independent across firms only. This does in fact mean that we account for random firm effects by conducting robust variance estimates.

The most important explaining variable in our framework is gender. Theoretical consideration as well as recent empirical work suggests that women are more likely to be employed as pieceworkers than men are. To investigate the impact of seniority on the choice of payment schemes we control for years of tenure and additionally for tenure squared to cover non-linearity. The hypothesis of Goldin (1986) predicts a negative correlation between years of tenure and the probability of being paid by performance. Furthermore, the impact of gender should diminish controlling for tenure if firms substitute

1 The schooling information is taken from the social security card by the employer and is transformed into years of schooling by us. We calculate potential experience as the difference between age and schooling deducting six further years. The employer transmits the information about the presence of children from the tax payer cards. The status group is calculated by the Statistical Office on the basis of the wage group and the wage settlement.

contemporaneous incentives for deferred compensation. However, if flexibility between work and family or protection against discrimination is important, a significant impact of gender should remain even controlling for tenure.

The hypothesis that the demand for flexibility between work and family explains the relationship between gender and variable pay (Heywood and Wei 1997; Heywood and Jirjahn 1999) is tested concentrating on the presence of children. If women have disproportional high responsibilities for household production, it can be expected that especially female workers with children are more likely to receive piece rates. Thus a dummy variable on the presence of children is interacted with the gender dummy variable to allow for different impacts of children on the gender-specific choice of payment schemes.

A number of control variables is incorporated in the estimates. Pay for performance requires that individual output can be easily measured. The measurement of individual output is especially difficult if workers have to perform multi-dimensional tasks (Jirjahn 2000). Thus output-related-pay is more likely to be found for workers carrying out simple tasks. We take years of schooling and the status of employees (unskilled, semi-skilled, skilled, qualified skilled worker) as proxies for the complexity of tasks. Sectoral affiliation can be expected to have an impact on the choice of payment schemes, too, since technologies – which determine whether individual output can be identified – differ between sectors (Brown 1990). Furthermore the intensity of product market competition differs between sectors, and different studies have shown that product market competition has a positive impact on the probability of pay for performance (Drago and Heywood 1995; Heywood, Hübler and Jirjahn 1998; Heywood and Jirjahn 1999). Finally, we control for returns to scale. Implementing a pay-for-performance scheme involves a fixed cost, and the fixed cost per worker diminishes with the number of employees receiving variable pay. Returns to scale are approximated using dummy variables for firm size and for the utilization of capacity through variables for shift work, night work and work on Sundays.

Determinants of the Wage Level

We analyze if the relationship between gender and payment scheme may result partly from protection against wage discrimination running wage regressions. The dependent

variable is the logarithm of the hourly wage rate (without overtime payments). Again we perform robust variance estimates by relaxing the independence assumption for observations from the same firm.

If gender-specific wage discrimination exists, women can be expected to receive a lower hourly wage than men, even controlling for human capital, timing of work, firm size, and sectoral affiliation. We control for human capital as far as possible. Usually schooling and potential experience are taken as proxy variables for general human capital while tenure acts as a proxy for specific human capital. However, it has to be mentioned, that these controls are far from perfect. In particular potential experience does not cover interruptions of work careers of women. Furthermore, we control for the existence of children, since the literature suggests an impact of parenthood even on gross wages.

To determine the impact of pay for performance on the wage level a variable for the payment scheme is included in the wage regressions. There are two reasons why performance related pay schemes might have a positive impact on hourly wages. On the one hand they elicit additional effort (Paarsch and Shearer 1999). On the other hand they can induce self-selection by attracting more productive workers (Lazear 1996). However, if variable payment schemes such as piece rates provide a better protection against discrimination, a gender-specific impact of working under piece rates on the wage level of blue-collar workers can be expected. The gender wage gap should be smaller for employees receiving individual incentive pay. This can be tested including an interaction term for gender and payment scheme in the estimates. A similar approach has been used by Belman and Heywood (1988), who analyze the impact of payment schemes on the wages of black and white workers in the US.

Additional insights can be expected from Blinder-decompositions (Blinder 1973) of the gender wage gap for workers paid by time wages and workers receiving piece rates. Separate wage regressions by gender and payment scheme have to be conducted to decompose the percentage gender wage gap $\overline{w}_m - \overline{w}_f = \overline{X}_m\beta_m - \overline{X}_f\beta_f$ into

(1) $$\left(\overline{X}_m - \overline{X}_f\right)\cdot\beta_m + \left(\beta_m - \beta_f\right)\cdot\overline{X}_f$$

(2) $$\left(\overline{X}_m - \overline{X}_f\right)\cdot\beta_f + \left(\beta_m - \beta_f\right)\cdot\overline{X}_m$$

with m = men, f = women, w = logarithm of hourly wage rate, X = explaining variables in the wage equation, β = rates of return to these variables.

The first component of each decomposition gives the proportion of the wage gap that is due to gender differences in observed characteristics. The second component indicates which proportion is due to potential discrimination, since it results from of a different remuneration of observed characteristics. Version (1) und (2) differ in the weights applied. We undertake both decompositions and take the mean of the respective components calculated. The limitations of this procedure are well known (for instance the discrimination component may be influenced by differences in unobserved characteristics across gender), but it is widely used to calculate a measure of potential discrimination.

We perform the decomposition separately for employees receiving time rates and employees in piecework. This allows us to test, if the discrimination component is smaller for women working in piece rate schemes.

4 Empirical Results

Descriptive Statistics

Table 1 gives an overview over the means of the variables used for both gender and payment schemes. In the sample investigated 23 percent of male blue-collar workers and 29 percent of female blue-collar workers are paid by piece rates. The mean wage is 20 percent higher for men as well as women working under piece rates. The mean gender wage gap is 31 percent – as well under piece rates as under time wages. According to the personal characteristics it is important to note that mean tenure of men is 2 to 3 years longer than mean tenure of women, and that mean tenure is longer for employees working under piece rates. Mean years of schooling and mean potential experience do not differ much between gender and payment schemes. A higher percentage of working men compared to women has children, but across women the percentage with children is higher for pieceworkers. Relatively more women than men are working as unskilled or semi-skilled workers. Mean contractual weekly working time is lower under piece rates compared to time pay. Night or Sunday work can be observed more often for piece

workers while this is not the case for shift work. Men do more often than women work in one of these working time schemes.

Regarding the characteristics of the firm it is noteworthy that the percentage of employees with pay for performance is disproportional high in large firms. In small firms especially women receive piece rates rather seldom. Two third of all male and one third of all female workers receiving piece rates are employed in the construction of machines and vehicles.

So far the statistics do not reveal if the use of piecework is concentrated in particular firms. Table 2 shows the mean share of blue-collar workers paid by piece rates in establishments by firm size and sectoral affiliation. The interesting feature of this calculation is, that less than one quarter of all establishments surveyed utilizes piece rates in remunerating blue-collar workers. Furthermore it can be seen, that larger firms are more likely to make use of piece rates, while there is no clear relation between firm size and the percentage of piece workers within firms offering piece rates. Especially in the leather and textile sector, where the share of women is high, disproportional many firms pay piece rates.

Determinants of Payment Schemes

What are the determinants of working in variable payment schemes? Table 3 shows the marginal effects on the probability to receive piece rates, calculated by probit estimates. In Model 1 gender, years of schooling, dummy variables for the timing of work, status, firm size and sectoral affiliation are considered as explaining variables. In Model 2 tenure and tenure squared are added. Model 3 tests if there is a relationship between having children and working under piece rates. In Model 4 and 5 the specification of Model 3 is estimated separately for men and women, while Model 6 applies the same specification to the subgroup of workers employed in firms offering piece rates.

The results for the control variables are in accordance with the theoretical considerations. Years of schooling and a higher status have a negative impact on the probability of piece work - performance related pay is more likely to be used for simple tasks, for which a worker’s output can be measured easily. The timing of work does not have a

significant impact on working in variable payment schemes. As expected, the probability of receiving piece rates increases with firm size.

The results for Model 1 show that women are more likely on pay-for-performance schemes, even controlling for a variety of personal and firm-specific characteristics. This confirms the findings of recent studies using firm data and contradicts those using individual data, like Cowling (1998) and Booth and Frank (1999). These studies use broader measures of variable pay (Geddes and Heywood 2000), while the matched employer-employee data set used in this paper has more precise information about payment schemes.

Controlling for tenure in Model 2 the results do not change qualitatively. Especially the impact of gender on the probability of receiving piece rates remains significant and the coefficient remains virtually identical in size. Moreover, employees with longer tenure are more likely to receive piece rates. The relationship is nonlinear, but positive in the relevant range. The gender specific estimates in Model 4 and 5 show that the effect is even stronger for women compared to men. These results clearly contradict Goldin's (1986) hypothesis. The relationship between gender and variable pay cannot be explained by the fact that women have a shorter expected tenure than men do. What about the other two hypothesis?

Estimates of Model 3 show no significant relation between parenthood and the pay scheme an employee is working under, but a significant impact of children on working under piece rates is found in the separate estimates for women. This supports the hypothesis, that the demand for flexibility may be a reason for women's' higher probability to receive pay for performance (Heywood and Wei 1997; Heywood and Jirjahn 1999). However, the gender impact on the choice of payment schemes diminishes only slightly controlling for the presence of children in the joint estimates. This indicates that further influences - as the protection against wage discrimination - may be important.

A further question is if the relationship between gender and payment scheme is a result of the fact that women sort themselves in firms offering variable pay. To test this Model 6 performs an additional estimate for only those employees working in firms with pay-for-performance schemes, which reduces the sample by more than half. This proce-

dure offers the possibility to discriminate between self-selection in certain firms and the choice of payment schemes within firms.

It is noteworthy that the impact of gender on the conditional probability to receive pay for performance is significantly higher within firms making use of piece rates compared to the estimates for the whole sample. This indicates that the higher probability of women to be paid by performance is not only a result of their self-selection in firms offering these schemes, but there is also an additional sorting process into variable pay within firms. A surprising result is that the probability to be paid by performance diminishes in tendency with firm size. This means that the impact of firm size in the other models is mainly a result of larger firms being more likely to use pay for performance for some – but not all – employees.

Determinants of Hourly Wages

Does the gender wage differential induce women to work under piece rates? Table 4 shows the results of Ordinary-Least-Squares wage regressions with robust variance estimates. Model 1 controls for gender, human capital (measured by years of schooling, tenure and potential experience), children, work timing (weekly working time, work in shift, during nights or on Sundays) and for characteristics of the firm (firm size and sectoral affiliation). Model 2 tests the impact of pay for performance, interacted with gender, on the level of wages. Model 3 to 8 present the results of gender-specific estimates, jointly and separately for employees receiving time and piece rates. Model 9 restricts itself on observations from firms offering piece rates. Table 5 presents the results of the Blinder-decomposition.

The estimate of Model 1 obtains a remaining gender wage differential of 17 percent.[2]. Nearly all explaining variables are significant and have the expected sign. The hourly wage rises with human capital, children and firm size; employees doing shift-, night- or Sunday-work receive a wage premium.

Model 2 shows the most important result: Working under piece rates compared to time pay has a positive impact on the hourly wage rate. This impact is, however, significant for women only – female blue-collar pieceworkers receive a piece rate wage pre-

mium of about 11 percent. Women might thus in fact sort themselves into variable payment schemes to reduce the gender specific wage differential and to avoid gender-specific wage discrimination.

This hypothesis is confirmed by the results of the Blinder-decomposition of the gender wage gap: 21 percentage points of the gender wage gap are due to potential discrimination across workers receiving time wages, but only 13 percentage points across workers receiving piece rates. The difference is slightly larger if only workers from firms offering piece rates are included in the estimates.

While the impact of personal characteristics on wages does not change much controlling for the payment scheme, the impact of firm size on wages diminishes slightly and sectoral effects on wages are affected, too. This suggests, that firm size and sectoral effects on wages are partly a result of the fact, that larger firms and firms in certain sectors are more likely to piece rates. The gender-specific estimates reveal the additional feature that the firm size effect on wages is much lower for men compared to women. Furthermore, sectoral affiliation has a much stronger effect on women's wages.

The separate wage estimates by gender and payment scheme show that returns to human capital are somewhat smaller for pieceworkers, while the constant of the estimate is larger compared to employees receiving time rates. The conclusion is, that lower rates to return under piece rates restrict the possibilities for wage discrimination resulting from a differing remuneration of human capital. An additional result can be obtained by calculating the difference in rates of return across gender for both payment schemes investigated. The main difference is found for the constant - the difference in the constant across gender is much lower for pieceworkers.

Model 9 restricts itself on employees working in firms using piece rates. The gender wage differentials is of the same size as for the whole sample, while the positive impact of piece rates on pay is slightly smaller. The main difference between both Model 2 and Model 9 is again, that the constant of the wage equation is significantly higher in firms using piece rate schemes. The implication is, that women reduce the overall gender wage gap partly by working in firms offering piece rates and partly by choosing piece rates instead of time wages within these firms. Additionally, it has to be noted, that the impact

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2 Calculated as $e^{\beta} - 1$, with β as the estimated coefficient for gender.

of firm size on wages remains significantly positive, but is in tendency of smaller size compared to the whole sample. This strengthens the impression that the higher wages paid in larger firms are partly a result of the higher probability of using piece rates.

One puzzle remains: Wouldn't one have expected that incentives and therefore workers' performance and wages are significantly higher under piece rates for both genders? Uncontrolled wages have been shown to be 20 percent higher under piece rates than under time pay for men and women. Thus the individual and firm characteristics in Model 2 do obviously control nearly perfectly for the sorting process of men, but not of women, in certain payment schemes.

5 Conclusions

Why are women disproportionately often working on variable payment schemes as piece rates? One hypothesis is that women sort out of deferred compensation schemes and into contemporaneous incentive schemes because of their lower expected tenure. This hypothesis is not supported. Even controlling for tenure gender has a significant impact on the probability of being paid by performance. Moreover, tenure does not have a positive but a negative impact on the probability of receiving variable pay. The results confirm the hypothesis, that female employees demanding flexibility between work and family – measured by the existence of children - are more likely on pay for performance. However, a significant impact of gender remains even controlling for children. This suggests that there are additional reasons for the relationship between gender and payment scheme: Women may more often work in jobs with variable pay since output-related pay provides better protection against wage discrimination. This hypothesis is supported by the fact that the positive impact of variable pay on the wage level is stronger for women than for men.

Altogether the results suggest that women work more often in piece rate schemes, because these schemes allow flexibility between work and family and are less prone to wage discrimination. The price for higher flexibility and protection against wage discrimination is that pay for performance is mostly appropriate for simple tasks requiring not much qualification. The results therefore offer an alternative explanation for the segregation of women into jobs with low qualification demands.

Psychological studies stress gender-specific differences in the self-conscience of workers and a stronger risk aversion of women as the main causes of gender-specific segregation (Subich et al. 1989). If women were more risk averse than men were, they would be expected to work less often in variable payment schemes. The empirical results do, however, support the contrary relationship. The choice of occupation and an appropriate payment scheme seems to be influenced by role-specific factors with women taking more responsibilities for household production.

Regarding the relationship between discrimination and segregation the empirical results suggest causality in contrast to Bergmann's overcrowding-hypothesis (1974). The segregation of women in jobs, which require low qualification and are paid by piece rates may not be the cause but the result of discrimination. Women may sort into variable payment schemes because of the better protection against wage discrimination, compared to jobs with a high importance of subjective performance appraisals by supervisors.

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Table 1: Means of variables

TW = Time wages, PR = Piece rates

		Men			Women		
	All	All	TW	PR	All	TW	PR
Wage							
Nominal hourly wage rate	26,14	27,29	25,99	31,62	20,43	19,10	23,62
Logarithm of hourly wage rate	3,23	3,28	3,23	3,44	2,99	2,93	3,13
Personal characteristics							
Years of tenure	12,09	12,52	12,32	13,16	9,98	9,28	11,66
Years of potential experience	21,81	21,63	21,86	20,85	22,69	23,06	21,81
Years of schooling	11,35	11,49	11,52	11,37	10,64	10,63	10,66
Children*	0,45	0,50	0,49	0,52	0,22	0,21	0,25
Unskilled worker*	0,12	0,07	0,06	0,10	0,38	0,39	0,34
Semi-skilled worker*	0,28	0,25	0,26	0,20	0,44	0,44	0,43
Skilled worker*	0,46	0,52	0,48	0,64	0,17	0,15	0,23
Qualified skilled worker*	0,14	0,16	0,19	0,06	0,01	0,01	0,00
Working time							
Weekly working time in hours	35,62	35,57	36,46	32,62	35,86	36,31	34,80
Shift work*	0,19	0,21	0,22	0,17	0,13	0,16	0,08
Night work*	0,37	0,40	0,37	0,52	0,22	0,19	0,28
Work on sundays*	0,17	0,19	0,18	0,22	0,06	0,04	0,09
Firm characteristics							
Firm size 10-49*	0,07	0,07	0,09	0,01	0,07	0,10	0,00
Firm size 50-99*	0,07	0,06	0,08	0,01	0,08	0,09	0,04
Firm size 100-499*	0,47	0,45	0,51	0,23	0,56	0,60	0,48
Firm size 500-999*	0,15	0,15	0,16	0,11	0,14	0,14	0,13
Firm size >= 1000*	0,24	0,26	0,15	0,63	0,15	0,06	0,35
Chemical and mineral oil industry*	0,07	0,07	0,10	0,01	0,06	0,09	0,01
Rubber industry*	0,11	0,10	0,10	0,12	0,11	0,09	0,16
Soil, ceramics and glass industry*	0,04	0,05	0,06	0,01	0,02	0,03	0,02
Metal industry*	0,08	0,09	0,09	0,07	0,03	0,03	0,03
Construction of machines and vehicles*	0,32	0,36	0,27	0,67	0,13	0,06	0,30
Electrotechnics, fine mechanics and optics*	0,10	0,08	0,09	0,05	0,20	0,20	0,19
Wood, paper and printing industry*	0,11	0,11	0,12	0,06	0,11	0,14	0,03
Leather and textile industry*	0,04	0,02	0,02	0,01	0,14	0,12	0,19
Food industry*	0,13	0,12	0,15	0,01	0,20	0,24	0,08
Observations	21973	18306	14079	4227	3667	2587	1080
Percentage of observations	1,00	0,83	0,64	0,19	0,17	0,12	0,05

*) Dummy variable.

Table 2: Mean share of blue-collar workers with piece rates within firms

	All firms		Firms with PR	
	Mean	Obs.	Mean	Obs.
Firm size 10-49	0,02	199	0,70	#
Firm size 50-99	0,06	106	0,42	#
Firm size 100-499	0,12	413	0,53	93
Firm size 500-999	0,16	89	0,51	28
Firm size >= 1000	0,29	50	0,63	23
Chemical and mineral oil industry	0,01	76	0,23	#
Rubber industry	0,16	86	0,62	22
Soil, ceramics and glass industry	0,04	45	0,33	#
Metal industry	0,10	83	0,55	#
Construction of machines and vehicles	0,16	170	0,59	47
Electrotechnics, fine mechanics and optics	0,09	89	0,49	#
Wood, paper and printing industry	0,09	121	0,49	23
Leather and textile industry	0,24	54	0,52	25
Food industry	0,03	133	0,47	#
Observations		857		117

#) Less than 20 observations

Table 3: Estimated marginal effects on the probability of receiving piece rates

Dependent variable: Payment scheme (0 = time wage, 1 = piece rate)

Method: Probit-ML with robust variance estimates

	All						Men		Women		Firms with PR	
	1		2		3		4		5		6	
	dF/dx	P>|t|	dF/dx	P>|t|	dF/dx	P>|t|	dF/dx	P>|t|	dF/dx	P>|t|	dF/dx	P>|t|
Gender (0 = man, 1 = woman)	0,100	0,00	0,099	0,00	0,093	0,00					0,139	0,00
Years of tenure / 10			0,063	0,00	0,063	0,00	0,053	0,02	0,098	0,03	-0,016	0,72
Years of tenure squared / 100			-0,019	0,00	-0,019	0,00	-0,017	0,00	-0,019	0,13	-0,011	0,14
Male worker with children*					0,000	0,97	0,000	0,97			-0,001	0,95
Female worker with children					0,022	0,24			0,047	0,03	0,032	0,33
Years of schooling	-0,015	0,04	-0,014	0,11	-0,014	0,12	-0,018	0,06	-0,004	0,74	-0,034	0,10
Semi-skilled worker	-0,087	0,01	-0,089	0,00	-0,089	0,00	-0,114	0,00	-0,047	0,30	-0,149	0,02
Skilled worker	-0,098	0,01	-0,102	0,00	-0,102	0,00	-0,134	0,00	-0,070	0,19	-0,203	0,00
Qualified skilled worker	-0,160	0,00	-0,161	0,00	-0,161	0,00	-0,166	0,00	-0,151	0,08	-0,387	0,00
Shift work	-0,010	0,76	-0,009	0,79	-0,009	0,79	0,000	1,00	-0,100	0,05	0,159	0,02
Night work	0,042	0,12	0,041	0,13	0,041	0,13	0,041	0,12	0,064	0,18	0,090	0,06
Work on sundays	-0,004	0,95	-0,005	0,93	-0,005	0,93	-0,006	0,91	0,017	0,85	0,116	0,17
Firm size 50-99	0,107	0,17	0,104	0,18	0,104	0,18	0,058	0,45	0,417	0,01	-0,262	0,03
Firm size 100-499	0,204	0,00	0,202	0,00	0,202	0,00	0,147	0,01	0,455	0,00	-0,231	0,01
Firm size 500-999	0,324	0,00	0,319	0,00	0,318	0,00	0,263	0,00	0,595	0,00	-0,175	0,09
Firm size >= 1000	0,561	0,00	0,554	0,00	0,553	0,00	0,471	0,00	0,809	0,00	-0,085	0,37
Chemical and mineral oil industry	-0,198	0,00	-0,197	0,00	-0,197	0,00	-0,178	0,00	-0,262	0,00	-0,420	0,00
Rubber industry	-0,054	0,20	-0,054	0,20	-0,054	0,20	-0,058	0,15	-0,038	0,68	-0,124	0,14
Soil, ceramics and glass industry	-0,149	0,00	-0,148	0,00	-0,148	0,00	-0,139	0,00	-0,139	0,25	-0,373	0,00
Metal industry	-0,070	0,06	-0,068	0,07	-0,068	0,07	-0,065	0,07	-0,065	0,49	-0,128	0,09
Electrotechnics, fine mechanics, optics	-0,113	0,00	-0,112	0,00	-0,112	0,00	-0,095	0,01	-0,158	0,01	-0,226	0,00
Wood, paper and printing industry	-0,113	0,00	-0,111	0,00	-0,112	0,00	-0,082	0,02	-0,233	0,00	-0,111	0,20
Leather and textile industry	-0,029	0,52	-0,029	0,51	-0,029	0,52	-0,090	0,01	0,027	0,76	-0,144	0,03
Food industry	-0,193	0,00	-0,191	0,00	-0,191	0,00	-0,181	0,00	-0,230	0,00	-0,259	0,01
Pseudo-R2	0,28		0,28		0,28		0,30		0,25		0,12	

For dummy variables: Calculation of the effect of a discrete change from 0 to 1.

Comparison group: Unskilled worker, firm size 10-49, Construction of machines and vehicles, no shift-, night- or Sunday-work, mean values for years of schooling and tenure.

Table 4: See next page

Table 5: Blinder decomposition of the gender wage gap

Calculations based on Models 4, 5, 7, 8 from Table 4

	All			Firms with PR		
	Wage gap	Characteristics	Discriminiation	Wage gap	Characteristics	Discrimination
Time rates	0,31	0,11	0,21	0,39	0,22	0,18
Piece rates	0,31	0,18	0,13	0,31	0,18	0,13

Table 4: Wage regressions

Dependent variable: Logarithm of hourly wage rate

Method: Ordinary-Least-Squares with robust variance estimates

	All				Men						Women						Firms with PR	
	All				All		TW		PR		All		TW		PR			
	1		2		3		4		5		6		7		8		9	
	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Gender (0 = man, 1 = woman)	-0,181	0,00	-0,206	0,00													-0,187	0,00
Male worker under piece rate			0,028	0,17	0,027	0,13											0,010	0,63
Female worker under piece rate			0,105	0,00							0,078	0,00					0,085	0,00
Years of schooling	0,032	0,00	0,033	0,00	0,035	0,00	0,039	0,00	0,018	0,00	0,025	0,00	0,029	0,00	0,010	0,05	0,024	0,00
Years of tenure / 10	0,091	0,00	0,088	0,00	0,091	0,00	0,093	0,00	0,057	0,00	0,064	0,01	0,073	0,02	0,040	0,04	0,064	0,00
Years of tenure squared / 100	-0,011	0,00	-0,010	0,00	-0,011	0,00	-0,011	0,00	-0,008	0,00	-0,009	0,18	-0,010	0,24	-0,007	0,27	-0,004	0,03
Years of potential experience / 10	0,032	0,00	0,032	0,00	0,046	0,00	0,057	0,00	0,017	0,05	-0,005	0,73	0,008	0,68	-0,022	0,17	0,014	0,04
Years of potential experience squared / 100	-0,008	0,00	-0,008	0,00	-0,010	0,00	-0,012	0,00	-0,005	0,01	0,000	0,88	-0,003	0,44	0,003	0,39	-0,006	0,00
Male worker with children	0,017	0,00	0,018	0,00	0,016	0,00	0,016	0,00	0,013	0,00							0,021	0,00
Female worker with children	0,032	0,00	0,027	0,00							0,015	0,02	0,017	0,04	0,018	0,05	0,021	0,04
Weekly working time in hours	-0,028	0,00	-0,027	0,00	-0,036	0,00	-0,037	0,00	-0,038	0,00	-0,010	0,00	-0,006	0,02	-0,023	0,00	-0,034	0,00
Shift work	0,027	0,00	0,028	0,00	0,035	0,00	0,034	0,00	0,041	0,01	0,040	0,03	0,041	0,05	0,009	0,71	0,032	0,03
Night work	0,038	0,00	0,036	0,00	0,028	0,00	0,027	0,00	0,033	0,00	0,061	0,00	0,071	0,00	0,046	0,03	0,027	0,00
Work on sundays	0,088	0,00	0,088	0,00	0,083	0,00	0,101	0,00	0,040	0,01	0,113	0,00	0,115	0,00	0,068	0,01	0,048	0,00
Firm size 50-99	0,011	0,45	0,009	0,52	-0,002	0,91	-0,010	0,51	0,105	0,01	0,031	0,29	0,036	0,23	0,028	0,72	0,012	0,81
Firm size 100-499	0,046	0,00	0,041	0,00	0,022	0,04	0,015	0,20	0,044	0,11	0,085	0,00	0,069	0,01	0,181	0,01	0,060	0,15
Firm size 500-999	0,078	0,00	0,071	0,00	0,038	0,00	0,030	0,04	0,055	0,06	0,176	0,00	0,185	0,00	0,239	0,00	0,085	0,05
Firm size >= 1000	0,134	0,00	0,118	0,00	0,069	0,00	0,068	0,00	0,069	0,08	0,201	0,00	0,183	0,00	0,245	0,00	0,127	0,01
Chemical and mineral oil industry	0,017	0,37	0,027	0,15	0,074	0,00	0,071	0,00	-0,088	0,06	-0,158	0,00	-0,098	0,04	-0,177	0,01	0,031	0,11
Rubber industry	-0,060	0,00	-0,061	0,00	-0,024	0,08	-0,015	0,36	-0,065	0,01	-0,213	0,00	-0,173	0,00	-0,201	0,00	-0,068	0,00
Soil, ceramics and glass industry	-0,040	0,03	-0,035	0,06	0,006	0,74	0,001	0,98	0,079	0,24	-0,205	0,00	-0,127	0,04	-0,256	0,00	-0,069	0,10
Metal industry	-0,031	0,03	-0,028	0,04	-0,012	0,37	-0,027	0,06	0,044	0,06	-0,093	0,04	-0,047	0,36	-0,064	0,42	-0,001	0,95
Electrotechnics, fine mechanics, optics	-0,034	0,02	-0,029	0,07	-0,008	0,54	-0,007	0,63	-0,029	0,43	-0,146	0,00	-0,065	0,15	-0,195	0,00	-0,076	0,00
Wood, paper and printing industry	-0,021	0,13	-0,015	0,28	0,004	0,75	-0,006	0,65	0,059	0,01	-0,118	0,00	-0,067	0,14	-0,066	0,36	-0,008	0,72
Leather and textile industry	-0,150	0,00	-0,155	0,00	-0,098	0,00	-0,095	0,00	-0,140	0,00	-0,277	0,00	-0,232	0,00	-0,258	0,00	-0,167	0,00
Food industry	-0,104	0,00	-0,094	0,00	-0,047	0,00	-0,049	0,01	0,060	0,41	-0,281	0,00	-0,212	0,00	-0,375	0,00	-0,171	0,00
Constant	3,696	0,00	3,674	0,00	3,959	0,00	3,940	0,00	4,301	0,00	3,048	0,00	2,788	0,00	3,727	0,00	4,066	0,00
Adjusted R2	0,68		0,68		0,65		0,56		0,77		0,59		0,38		0,80		0,81	

Comparison group: Firm size 10-49, Construction of machines and vehicles.