Lower Wage Rates for Less Hours ?

A simultaneous wage-hours model for Germany

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Non-technical summary

Do part-time workers earn lower hourly wage rates than full-timers? If this is true, this wage dispersion would not only a¤ect the income distribution, but it would also decrease the labor supply for part-time jobs. A look at the gross hourly wage rates shows that indeed employees with fewer hours earn lower wages. To some extent, this is due to di¤erences in quali…cation, experience and other wage determining characteristics. But, even after controlling for these variables, a signi…cant wage di¤erential between part-time and full-time employees remain. Economic theory provides many reasons why and how the gross hourly wage rate can be determined by the working hours. However, the shape of the wage-hours pro…le is not clearly determined by the theoretical arguments. Therefore, in this paper the impact of working hours on the gross hourly wage rate of West German women is analyzed. We use a simultaneous wage-hours model which fully takes into account the labor supply decision. Furthermore, we relax the assumption that the e¤ect of working hours on wages is the same for all individuals.

Two primary observations should be made about our results. First, our estimates show that the hourly wage rate is strongly a¤ected by the working hours. Women who work less than 20 hours a week have to accept substantial wage di¤erentials. However, the hourly wage rate of jobs with 20 to 38 hours does not di¤er signi…cantly. Somewhat striking are the wage reductions for overtime hours. This result is due to the fact, that the majority of women working overtime are not compensated for these additional hours. Second, we detect di¤erent wage-hours pro…les for some speci…c groups. Women working in the trade or service sector experience a ‡atter wage-hours curve than those in other sectors. Also the previous labor market experience determines the shape of the wage-hours locus.

These results show that the wage distribution does not seem to be the driving factor for the marginal importance of part-time work. Thus, alternative explanations, such as the shortage of part-time jobs should be considered.

Lower Wages for Less Hours
A Simultaneous Wage-Hours Model for Germany

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Abstract:

In this paper the impact of working hours on the gross hourly wage rate of West German women is analyzed. We use a simultaneous wage-hours model which takes into account the participation decision. First, our estimates show that the hourly wage rate is strongly a¤ected by the working hours. In order to avoid any assumptions about the functional form, we estimate linear spline functions. Second, we detect di¤erent wage-hours pro…les for speci…c groups of individuals. Despite these di¤erences, the wage reduction for jobs with less than 20 hours a week and for overtime hours turns out to be a robust result. However, the hourly wage rate of jobs with 20 to 38 hours does not di¤er signi…cantly. Third, for West German women, the exogeneity assumption of working hours in the wage regression must be rejected if the wage-hours locus is assumed to be the same for all individuals. As a result of this the wage rate of full-time employees is overestimated in the standrad OLS estimation.

JEL classi…cation: J22, J24, J31

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1. Introduction

Do part-time workers earn lower hourly wage rates than full-timers? A look at the gross hourly wage rates shows that indeed employees with fewer hours earn lower wages. Partly, this is due to di¤erences in quali…cation, experience and other wage determining characteristics. But, what about the remaining wage di¤erencial? This is an often discussed issue by workers, employers and policy makers. On the one hand, part-time jobs[1] in Germany are often still regarded as lousy jobs. On the other hand, labor market policy is promoting part-time work as a means to reduce unemployment. So, how about the performance of the praised part-time jobs in Germany? Actually, the question about potential wage di¤erentials does not only concern people in marginal jobs, that is, employees who work below the threshold for social security coverage, but also those working less than the standard working hours, that are negotiated among the unions and the employers. Analyzing the existence and the size of the wage di¤erentials among jobs with di¤erent working hours is an interesting issue itself, but it becomes even more urgent since it has far-reaching implications for the labor supply decision of individuals. Negative wage premiums for part-time jobs, for example, may decrease the labor supply for those jobs. Compared to a situation with equalized wages, it is more likely that people work either full-time or leave the labor market.

In Germany, the part-time rate for women was about 33.9 percent in 1995, but substantial di¤erences between East and West Germany still exist. In East Germany, only 20.8 percent of the employed women worked part-time, in West Germany the part-time rate was 37.3 percent. Compared to women, the part-time rate of men is much lower and varies between 2.9 percent in East Germany and 3.2 percent in West Germany. Given that part-time work is not very widespread in Germany, the existence of a negative wage di¤erential between full-timers and part-timers seems to be a plausible explanation. Therefore, the object of this

[1] I de…ne all jobs with less than 35 hours a week as part-time jobs.

paper is to check whether Germans earn lower hourly wage rates when working fewer hours. We confine ourselves to West-German women, because the other groups of part-time workers are too small to draw convincing results.[2]

In the theoretical literature, we can find several explanations for a dependence of wages on hours. First, the labor costs of the firm do not increase proportionally with hours worked, because part-time jobs cause relatively higher fixed costs for the firm (e.g. recruiting and training costs, arranging a work-place and coordination costs). Therefore, Oi (1962) draws the conclusion that lower wage rates are paid for part-time jobs than for full-time jobs.

Second, the amount of working hours may also influence productivity. Given that the hourly wage rate equals marginal productivity of labor, or at least depends on the marinal productivity, wages may also react to changes in working hours. Barzel (1973) argued that productivity will first rise slowly due to "start-up" effects at the beginning of a working day. Thus, the productivity of the last hour of a "normal" working day still exceeds the average daily productivity, which leads to lower wage rates for part-time workers. Then, marginal productivity may decline at higher working hours, which results in a lower marginal wage rate for overtime hours. He starts from the assumption that the marginal productivity of labor is zero at between twelve and fourteen hours. Contrary to these conclusions, Tummers and Woittiez (1991) argue that reduced working hours may raise hourly productivity because they avoid the negative fatigue effect of a long working day or they may reduce unproductive time, or "slack". That is, marginal productivity reaches its maximum at less hours than the "normal" working hours. In this setting, gross part-time wages - given they are based on labor productivity - should be higher.

In Germany, most of the jobs without social security coverage, the so called marginal jobs, are taxed by a lump sum tax at the expense of the employer. The

[2] The share of part-time work among West German men is only 3.2 percent, that is about 100 observations in our sample. In East Germany, 270 of the individuals in the selected sample work less than 35 hours, of which 30 are men.

empirical results of Schwarze (1998) lead one to suppose that employers shift the entire tax burden (15 percent of the gross wage rate in 1995) on to the employees. As a result of this, the gross hourly wage rates of these jobs should be about 15 percent below those for comparable full-time jobs. Another explanation for wages dependent on hours is based on the idea of compensating wage di¤erentials or a potential lack of part-time jobs. In short, there are reasons for supposing that there exist substantial wage di¤erences between full-time and part-time jobs in Germany, and especially between jobs with and without social security coverage. According to the importance of the di¤erent e¤ects, the resulting wage di¤erentials could be either positive or negative.

However, most empirical labor market studies, especially for Germany, ignore that wages might be a¤ected by the weekly working hours. Recent exceptions include Schwarze (1998) and Wolf (1998) for Germany, Tummers and Woittiez (1991) for the Netherlands, Blank (1990) and Averett/Hotchkiss (1997) for the US, Main (1988) and Ermisch/Wright (1991) for Great Britain and Ilmakunnas/Pudney (1990) for Finland. The majority of the analyses come to the conclusion that jobs with less hours are paid by a lower hourly wage rate. Even so, there exist contradicting evidence. The results di¤er strongly between countries, gender and the various econometric methods. It turned out that in order to fully measure the e¤ect of working hours on wages, the labor supply decision must be taken into account. However, such a study that treats the working hours as endogenous does not exist for German data. The aim of this paper is to close this gap.

The paper is organized as follows. In the next section, we show how the impact of hours on wages can be captured empirically and in section 3, the data underlying the empirical part of the paper are described. Section 4 presents the econometric model. The estimation results are discussed in section 5. The last section summarizes the …ndings and concludes.

2. Empirical methodology

A simple way to capture the effect of hours on wages is to include the weekly working hours as an exogenous variable in the standard wage equation. Schwarze (1998), for example, used dummy variables to capture the effect of marginal jobs and part-time work on the hourly wage rate. The coefficients turned out to be significantly negative, that is, people with reduced working hours earn lower wages, even after controlling for differences in human capital and other wage determining characteristics. However, these results could be biased. In analyzing the impact of working hours on wages, we have to deal with two problems.

First, economic theory suggests that individuals share their time among leisure and working hours h in such a way that their utility function $U(h;Y)$ is maximized. Y describes the corresponding labor earnings plus the non-labor income. Even if employees cannot always freely choose their working hours, the assumption of exogenous hours is too restrictive. The labor supply decision depends, among others, on the opportunity costs of labor, that is, the offered wage rate. Thus, working hours themselves depend on the potential market wage rate. In this setting, the two variables of interest are mutually dependent. Ignoring this relation may produce misleading results.

Second, provided that wage differentials among jobs with different working hours do exist, they also effect the decision to enter the labor market. These two considerations suggest that the labor supply decision must be fully taken into account.

Third, this approach assumes that all individuals follow the same wage-hours profile. But, it may be argued that the fixed costs or the productivity curves differ among qualification groups, firm sizes or industry sectors. As a result, the impact of working hours on wage rates could depend on individual characteristics. The extended standard wage equation ignores the compositional differences between part-time and full-time workers. Thus, the traditional single-equation wage function has some shortcomings that we want to overcome in our model.

Whereas several economists attempt to tackle the problem of endogeneity, only Blank (1990) allows for different wage-hours profiles for specific groups of individuals. The bunch of new approaches differ in that the hours equation is specified either as a discrete choice model or as a continuous model and whether selection in the labor market is explicitly taken into account. I will now briefly discuss three empirical methods applied in the literature..

An easy methodology to account for the endogeneity of hours is to generate an instrumental variable (IV) representing the expected working hours of each employee. This instrument can be created using a set of variables that are correlated with the working hours but not with the hourly wage rate. Since hours and wages are mutually dependent, it is extremely difficult to find appropriate instruments. However, if the instrument is only weakly correlated with the hours, the IV-approach can produce biased estimates of the coefficients in the wage equation (Staiger/Stock, 1997). Biddle and Zarkin (1989) applied the IV-approach to estimate a wage-hours model for American men. Their empirical results strongly reject the neoclassical assumption that wages are independent of hours worked. Instead, their estimates imply that the wage-hours relation is dome shaped with a peak at about 2500 annual hours. In addition they find that OLS estimates are biased. However, both the problem of selectivity bias and the compositional differences between part-time and full-time workers are ignored. Given the high participation rate of American men, the former simplification should not cause a severe problem. Averett and Hotchkiss (1997) criticize further that the IV-approach fails to account for a discontinuous budget curve. Therefore, they suggest to estimate a sequentially ordered response selectivity model. By this means they switch to a discrete choice method for the hours estimation and obtain selectivity-corrected full-time and part-time wages for all observations.

The second approach is a joint wage-hours model. Moffit (1984) combines a discrete labor supply model with a wage-hours locus offered by the employer. These two functions are estimated simultaneously. The results confirm Barzel's hypothesis of an S-shaped budget constraint. Hourly wages of older women in the US rise with hours at a slowing rate and peak at about 34 hours per week. The drawback of this model is that the working hours and the participation decision are determined by the same set of variables. In view of the …xed costs of work and involuntary unemployment one would expect that the worker's choice of hours is separately determined from the (partly involuntary) decision to work or not to work. Tummers and Woittiez (1991) tackle this problem by estimating a simultaneous wage and labor supply model with hours restrictions. They show that in the Netherlands the before-tax hourly wage rate is highest for women working 28 hours a week and slopes downwards for additional hours.

Finally, a two stage discrete choice approach was estimated by Simpson (1986) and Main (1988). They adopt a model for wage comparison with selection bias which is extensively used for union and non-union wage di¤erentials (Lee, 1978). Separate wage equations are estimated for full-time and part-time workers - including an inverse Mills ratio capturing the potential selection bias. The results indicate that the wage di¤erential between part-time and full-time workers in Canada decreases from 13 to 10 percent after adjusting for the selectivity. Main (1988) concludes that full-time jobs of British women are paid 15 percent more than part-time jobs - half of the total di¤erential is due to the di¤erential way in which part-time jobs paid less for the same characteristics than full-time jobs. A comparable study for British women establish smaller di¤erentials between full-time and part-time workers (Ermisch/Wright, 1991). Even so, the analysis indicates that the di¤erences in women's expected wage o¤ers are a crucial determinant of wether they work part-time or full-time. Blank (1990) extends this switching regression model to a simultaneous model which contains three endogenous variables, that is, participation, part-time work and the wage rate. This enables her to measure the e¤ect of part-time work on wages in such a way that the selection into part-time work is fully taken into account. In contrast to other studies, her results indicate that once the choices to enter the labor market and to work part-time are accounted for, female part-time workers in the

US appear to earn higher wages across all occupations than equivalent full-time workers. The fact that accommodating the selection into part-time jobs reverses the outcome implies that those women who work part-time would also receive lower wages if they held a full-time job. Furthermore, the endogenous switching regression model of Blank (1990) provides different coefficients of the wage equation for part-timers and full-timers.

We generalize the model of Blank (1990) with respect to the hours equation by assuming that people choose among all possible number of working hours not only between part-time and full-time work.[3] Compared to the discrete approach, this allows for computation of any differentials related to hours worked, not just among part-time and full-time work. Furthermore, doing this we avoid the required assumption about the frontiers between different labor market regimes. We estimate the effect of hours on the wage rate using a simultaneous model of wages, working hours and the selection to enter the labor market. In order to estimate the effect of working hours on wages, we include hours in the wage equation in three alternative ways. Further, we use interaction terms between working hours and other exogenous variables to allow for different effects of working hours for different education levels, experience groups, firm sizes and industries. Doing this overcomes the drawbacks of the OLS-wage-equation discussed above all at once. We first present a model which enables to estimate different wage-hours profiles for all labor supply regimes, taking into account the complete labor supply decision.

3. The data and some descriptive figures about working hours and wages in West Germany

The empirical part of the paper is based on the German Socio-economic Panel (GSOEP) for the year 1995. The GSOEP is a yearly household panel which has

[3] Since, in this paper we focus on wage differentials, potential hours restrictions on the labor supply are not taken into account.

been conducted since 1984 in West Germany and since 1990 in East Germany. The first wave in 1984 contains almost 6000 households. In this sample about 4500 are sampled randomly from the population of West Germany. Due to the domestic concept, this random sample also contains some households of other nationalities. The other sub-sample of about 1500 households is a stratified sample of immigrants and guest-workers from Italy, Spain, Turkey, Yugoslavia and Greece who lived in Germany in the period during which information was collected. In this study, we left out the sample of immigrants and guest-workers and the Non-European households of the first sample, because their labor supply behavior and the wage determination may be substantially different from those of Germans. Since we are interested in the wage structure of the German labor market, we dropped all self-employed women and those working in the farming sector. Our selected sample contains only women between the ages of 20 and 60 who are not in apprenticeship. There remain 2415 observations of West German women, which provide all necessary information. The descriptive statistics of the sample are given in table A1 in the Appendix.

Figure 1 provides a histogram of weekly working hours and mean hourly wage rates in the sample[4]. We generated nine categories of working hours from 1 to 60 hours a week[5] and another group for all people out of work. Women who do not participate in the labor market represent almost 48 percent of the sample. The distribution of the weekly working hours has a peak at 36-40 hours, which mainly represents standard full-time jobs. Women with reduced hours are spread

[4] The information about the earnings is based on the question: "What was your labor income including the payments for overtime hours last month?" The number of working hours refer to the question: "How many hours per week including the overtime hours do you usually work?" Provided that the employee can use up the excess hours of work by taking time off or the employee is not compensated for additional working hours, we use the reported contractual working hours. This applies to about 50 percent of the West German women. The hourly wage rate is then defined as monthly earning divided by the monthly working hours. Thus, differences in the number of days of holiday and absenteeism are not taken into account.

[5] A few women claimed that they work more that 60 hours a week. In view of the legal limit of 60 working hours a week, we censored the weekly hours at the legal threshold.

over the range of 5 to 35 hours, but many of them work between 16 and 20 hours a week. In view of the fact that agreed working hours never exceed 40 hours a week by collective agreement, about 6 percent of all employed women in the sample work overtime.

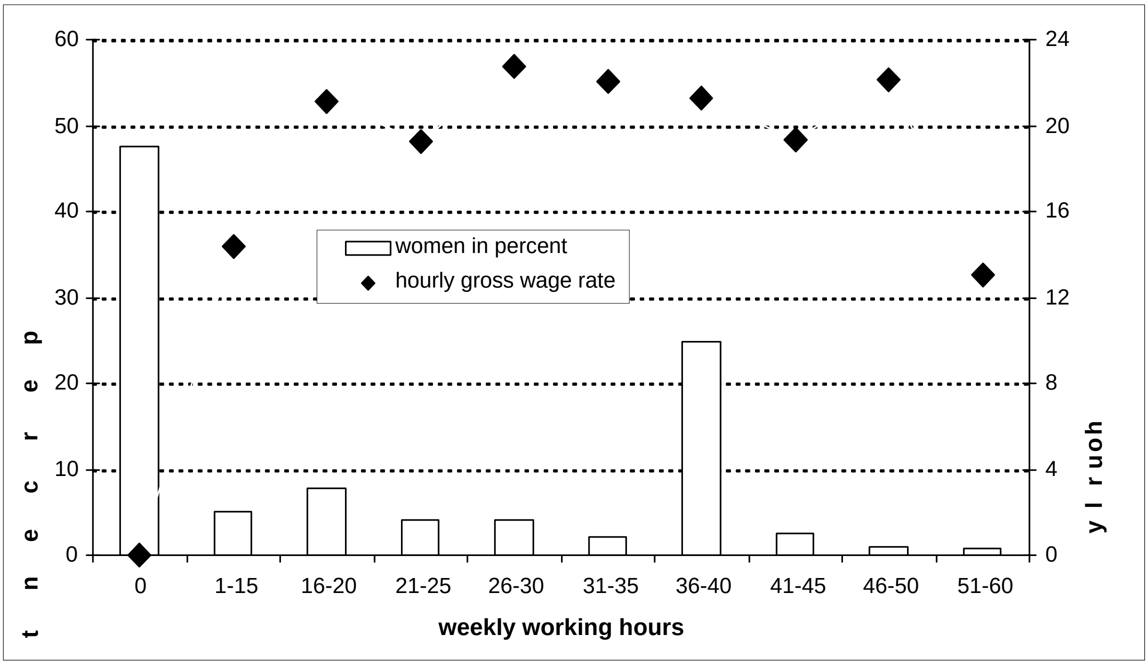
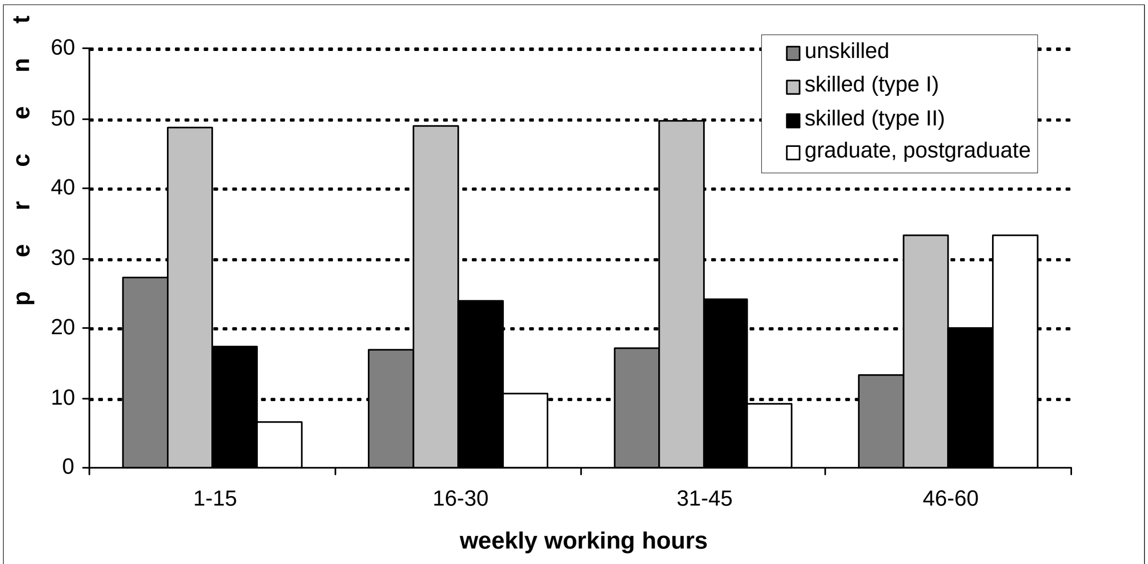


Figure 1: Distribution of weekly working hours and hourly wage rates

The average hourly wage rates vary between 13 DM for women working 50 or more hours and almost 23 DM for the employees with 26 to 30 hours a week. That is, women who work more than 10 overtime hours a week su¤er high wage reductions. In Germany, overtime hours are in principle compensated with an additional wage premium. Otherwise, overtime work occurs mainly in salaried jobs. Figure 1 leads one to suggest that either the overtime premiums are avoided or that the wage for jobs with "unpaid" overtime work are not as high as expected. Howe

Figure 1 further shows that jobs with less hours are paid by lower wages than full-time jobs or extended part-time jobs (26-35 hours). This picture may give rise to the supposition that part-time jobs are more often chosen by less qualified and experienced women, so that the wage differentials are caused by selectivity. Therefore, Figure 2 presents the share of each qualification level in four different labor supply regimes.[6]



Note: Unskilled: not completed any vocational training; skilled (type I): apprentices (type II) vocational or technical college; (post-)graduated: university degree.

Figure 2: Share of education level by weekly working hours

Apart from the women working overtime hours, the skilled women (type I) are the most important group. They represent almost 50 percent of all employees in the first three labor supply categories. In contrast, the shares of the other qualification levels vary more with the number of weekly working hours. 27 percent of the employees who work less than 15 hours are unskilled, but only 13 percent of those working overtime hours.[7] Thus, the share of unskilled declines with increasing working hours. The opposite seems to be true for the graduated

[6] In contrast with the nine categories in Figure 1, we now create larger groups because of the small number of observations in some cells.

[7] These figures are based on very few observations and should therefore be interpreted with caution.

women. The share of graduated women rises from 6.6 percent (< 15 hours) to 10 percent for the standard full-time jobs. As a result, the simple selectivity hypothesis can not fully explain the wage structure. The differences with respect to the qualification level appear to be one possible explanation for the observed wage differentials between very small part-time jobs and full-time jobs. However, the wage reductions of over-time jobs must be caused by other factors, such as individual characteristics of the employees. Another reason could be that the actual working hours do not exactly refer to the reported earnings of the previous month. If the payments for the reported overtime hours are not included in the wages, the hourly wage rate is biased downwards. Hence we will now turn to the econometric model which enables us to detect the wage-hours profiles for different groups of individuals and to check whether the measurement error of the hourly wage rate influences the results.

4. The econometric model

4.1 Participation

The decision to enter the labor market (P) is modeled by a binary choice approach. The equation of the continuous latent variable is given by:

$$P^* = Z'\gamma + v; \tag{4.1}$$

Given involuntary unemployment, the actual labor market participation cannot be interpreted strictly as an individual decision. Thus, the matrix of exogenous variables Z contains both factors which determine the labor supply, such as qualification and the number of small children, and the labor demand, such as the regional unemployment rate. γ presents the parameter vector to be estimated. The assumptions on the properties of the error term v and all other residuals of the model are given below (see section 4.4). P^* is unobservable but relates to the observable dichotomous variable P (participation status) as:

$$P = \begin{cases} 0 \text{ if } & P^{*} \leq 0 \\ 1 \text{ if } & P^{*} > 0 \end{cases}$$

4.2 Working Hours

The second equation describes the hours decision. We use a linear specification with actual weekly working hours as dependent variable.

$$h = Y'\beta + u \tag{4.2}$$

where Y is a vector of explanatory variables and β the parameters to be estimated. The error term u adds linearly to the hours function. We specify the reduced form equation of hours worked in a very flexible way, so that it is consistent with almost any structural labor supply model, or is at least a good approximation. The vector Y also includes variables describing the household context, such as the number of small children, the marital status and the other household income. These covariates capture both the opportunity costs of working and the effect of taxation on labor supply. Thus, the coefficients of this equation should not be interpreted in a structural way.

4.3 Wage rates

We estimate a single wage equation for all employees, irrespective of wether they work full-time, part-time or any other number of hours:

$$\ln w = \alpha_0 + \alpha_1 \cdot X + \alpha_2 \cdot h + \alpha_3 \cdot h^2 + \alpha_4 \cdot X \cdot h + \alpha_5 \cdot X \cdot h^2 + e \tag{4.3}$$

The dependent variable is the log gross hourly wage rate of the employed women. X is the vector of explanatory variables and α_0 to α_5 are elements of the parameter vector. The unexplained part of the hourly wage rate is captured by the error term e: In order to estimate the effect of working hours on wages, we also include hours (h) in the wage equation. Most of the previous studies suggest that hours affect the wage quadratically (Moffit, 1984; Tummers/Woittiez, 1991). As a first approach, we also use the quadratic specification of the working hours, which arises from the fixed costs of work on the one hand and the declining marginal productivity at high hours on the other hand (Barzel, 1973). Further, we use interaction terms between the hours and the exogenous variables $\left[(X \cdot h) \text{ and } (X \cdot h^2)\right]$ to allow for different effects of working hours for different education levels, experience groups or firm sizes. If the coefficients $\alpha_2; \alpha_3; \alpha_4$ and α_5 turn out to be zero, our wage function is consistent with the standard Mincer earnings function, that is, working hours do not affect the hourly wage rate.

Second, we apply a more flexible approach to estimate the wage effect of working hours using a linear spline function (Suits et al., 1978). This piece-wise linear regression does not require any pre-specification of the functional form of the relation between hours and wages and still allows us to estimate different wage-hours profiles for specific groups if individuals. The resulting wage equation can be written as:

$$\ln w = \alpha_1 \cdot X + \left(\sum_{j=1} [\pi_j + \delta_j (h - H_{j-1}) \cdot D_j] \right) \cdot D_x + e; \qquad (4.4)$$

where H_j with $j \in \{0; ...; n-1\}$ are the frontiers of the different segments of the function, the so called knots and D_j with $j \in \{1; ...; n\}$ are dummy variables whose value is 1 for all observations such that $H_{j-1} \leq h < H_j$ and is 0 otherwise. However, this wage equation will be discontinuous at H_j: Therefore we constrain the values of the coefficients π_j for $j \geq 2$ so that $\pi_j = \pi_{j-1} + \delta_{j-1}(H_{j-1} - H_{j-2})$: In order to allow for different wage-hours profiles for specific groups of individuals we interact this spline function with additional dummy variables (D_x):

We estimate the system of the three equations 4.1 to 4.3 (respectively 4.4) simultaneously by maximum likelihood.

4.4 Properties of the error terms

The error terms of the three equations $(e; u; v)$ are assumed to be trivariate normally distributed with mean zero and covariance Σ. The variance of v

($Var(v) = \Sigma_{3;3}$) is normalized to one. The three covariances between the error terms are identified by the simultaneous maximum likelihood estimation.

4.5 Measurement error in the hours variable

One reason for the high wage reductions of overtime hours (see figure 1) could be that the reported working hours do not refer to the earnings in the previous month. Let's assume that a woman usually works 5 paid overtime hours a week. If the employer pays for the overtime hours every month, thus the declared earnings include the payments for the five additional hours, the hourly wage rate is measured exactly. However, this is only one possible agreement about the timing of the overtime reward. There also may be firms which remunerate the overtime hours after they exceed a certain threshold as a result of which the usual working hours do not correspond to the hours for which earnings have been reported. The same problem arises if the additional hours occur very irregularly. Since we do not have any information about whether the reported earnings actually include overtime premiums, the match between the observed working hours and earnings is not absolutely reliable.

In order to check whether these measurement problems reinforce the strong decline in hourly wage rates for long working hours, we slightly modify the econometric model described above. In contrast to the hours equation 4.2 we now take the weekly working hours in logs. Let's assume that the true hours[8] h^* relate to the observed hours h as:

$$\log(h) = \log(h^*) + \xi\,; \tag{4.5}$$

where ξ is the measurement error. Since in our model the hourly wage rate is a function of the working hours, the definition of the wage rate converts into:

$$\log(w) = \log(y) - \log(h) = \log(y) - \log(h^*) - \xi = \log(w^*) - \xi\,: \tag{4.6}$$

[8] That is, the working hours which actually refer to the earnings of the previous month.

Applying these changes to the wage and hours equation discussed above results in the following model:[9]

$$\log(w) = \alpha_1 \cdot X + \alpha_2 \cdot \log(h) + e - \alpha_2 \xi - \xi = \alpha_1 \cdot X + \alpha_2 \cdot \log(h) + \varepsilon \quad (4.7)$$

$$\log(h) = Y'\beta + u + \xi = Y'\beta + \nu : \quad (4.8)$$

We can see that the measurement error ξ adds linearly with opposite signs to the two equations and enters the new error terms ε and ν. As a result, the measurement error ξ causes a negative correlation between the wage and the hours equation.[10] Assuming that the measurement error matters, one would expect that the correlation between the two equations is negative, or at least smaller compared to the correlation ρ_{eu}.

5. Estimation results

Before discussing the estimation results, we will briefly address the identification problem. We estimate reduced-form equations of the participation and the hours equation. The wage function is the only structural equation.[11] Therefore, the question is whether the wage equation can be distinguished from a linear combination of all other functions in the simultaneous model. In principle the model is identified by the functional form. In addition to that, we insert several

[9] As the participation equation is not affected by these modifications, we refrain from the repeated presentation of the complete model. For simplicity, we assume that the wage rate is lineary dependent on log(h). However, including other hour variables $\log(h)^2$ or any interactions does not impair the correction of the measurement error.

[10] This also holds for the previous model. However, the error term e of the wage equation 4.3 is not a linear function of the measurement error ξ, thus the correlation of the measurement errors in the wage and hours equation should be smaller. The measurement errors are accounted for exactly only if log(h) enters linearly in the wage equation.

[11] This means, that the three equations are resolved such that the hours- and participation decision depends only on explanatory variables which are not determined within this model. However, the wage equation contains among others the number of working hours.

exclusion restrictions. First, we exclude all family characteristics, such as the number of children, from the wage equation. Thus, it is assumed that children a¤ect the wage rate only through the employment breaks, which are captured by the experience variable. The information about the children living in the household enters the hours and the participation equation in two di¤erent ways. For the participation function, we use one variable indicating the age of the youngest child and another for the number of children in the household. This speci…cation serves as a measure of the time needed for the children. In the hours equation, we use the number of children by age groups, because the age structure is more likely to measure the …scal burden of the children in the household. Second, the marital status, participation status of the partner[12], and the other household income are excluded from the wage equation. In contrast to the wage equation, we do not use actual years of employment but potential experience in the participation and hours equation in order to avoid endogeneity. Furthermore, the …xed costs of working, measured by a dummy variable indicating whether at least one member of the household is in need of care[13] or whether the observed individual is a single mother with a child younger than 4 years, enter the participation equation. In order to capture the labor demand restrictions, we also include the regional unemployment rate.

In a …rst step, we estimate the simultaneous model based on the equations 4.1 to 4.3. We present four models with di¤erent restrictions concerning the correlation between the error terms of the three equations and the structure of the wage equation. Model 1 is the most restrictive framework. It is assumed that working hours do not a¤ect the wage rate and that participation, hours worked

[12] Bernasco (1994) points out that the employment status of the husband a¤ects the participation of Dutch wives. Women whose husband is employed have a higher participation probability than wives of inactive men. However, the female occupational prestige, which is among others a function of income, does not depend on the employment status of the men.

[13] Persons who care for their old parents or other relatives face high entrance costs to the labor market, because they would have to pay for a geriatric nurse or an old people's home, which can be extremely expensive according to the state of health.

and wages are mutually independent. Model 2 drops the later restriction. Model 3 includes hours and hours squared in the wage equation, imposing that the impact of working hours on the wage rate is just a shift effect, which is the same for all individuals. It also allows for correlation among the error terms $e; u$ and v: Finally, we check in Model 4 whether the wage structure, such as the returns to education or experience, is determined by the hours worked. After that we compare the estimation results of the final specification with the corresponding model with log(hours) and the model using a spline function for the working hours in the wage equation (4.4).

Presenting the estimation results, we give most attention to the wage equation, because the auxiliary equations of hours and employment status are reduced-form estimates. The estimation results of equation 4.1 and 4.2 are given in table A2 in the Appendix.

The wage function is modeled on the basis of an extended human capital approach. The education level is measured by three dummy variables.[14] The actual labor market experience is described by two continuous variables, the number of years in full-time employment and the years in part-time work. However, the returns to part-time experience turned out to be insignificant in all wage regressions and therefore we excluded them from the set of explanatory variables. One explanation could be that part-time employees participate less in training programs such that their learning by doing is much slower.[15] In addition to these human capital variables, we include dummy variables to control for the firm size and the industry sector of the employed women. The estimation results of the

[14] The different qualification levels are defined in figure 2. An alternative approach is to include occupational dummies instead of or in addition to the vocational training. We refrain from this specification, because the occupational status involves some risk of an endogeneity problem.

[15] Whether firm specific human capital creates additional wage growth is still an open question. Mincer/Jovanovic (1981) and Topel (1991), as two prominent examples, concluded that there are large returns to seniority. In contrast to theses results, recents studies for the US (Altonji/Williams, 1997) and for Germany (Dustmann/Meghir, 1998) do not confirm that tenure generates additional wage growth.

wage equation (see 4.3) of the four models described above are presented in Table 1.

The wage function of Model 1 corresponds to the standard OLS wage regression with log hourly wage rate as dependent variable. Wages increase with the education level and the …rm size. Also the experience variables generate the expected dome shaped curve, that is, wages rise with labor market experience up to 28 years in full-time employment. The estimated wage reduction for additional years in full-time employment may be partly due to age or cohort e¤ects for which we do not control. Comparing the …rst two models illustrates that allowing for correlation between the error terms of the three equations improves the …t of the model signi…cantly.[16] However, the coe¢ cients change only slightly. Albeit the correlation between wages and hours is positive, it is very small and insigni…cant. In other words, unobserved characteristics which rise the gross wage rate also tend to increase the working hours, but the e¤ect is not very important. However, the negative correlation with the error terms of the participation equation is surprising. Presuming that the unobserved variables are personal characteristics, such as ambition, motivation or the thirst for action, one would expect that the residuals of the participation equation and the wage and hours equations, respectively, are correlated positively. In our case the opposite is true. Women who have a high unexplained probability to work earn ceteris paribus lower wages and work less hours. One explanation could be that women in precarious economic situations, for which we cannot precisely control, are more likely willing to accept jobs with lower wages and less hours. Especially recipients of social welfare may avoid to earn too much additional income in order to stay entitled to their bene…ts. Another consideration is that women with small children, who have a low predicted probability of working intend to take up working after the child break. In the long term is seems rational that

[16] The test statistic of the likelihood ratio test is 14.5 and the critical value of $\hat{A}_3^2$ is 7.8. Furthermore, the Wald-test of the three correlation coe¢ cients is signi…cant as well (see Table 1).

they temporally accept a job with less hours and a lower wage rate in order to keep in touch with the labor market. Thus, the negative correlation with the participation equation may be due to the life cycle maximization of the individuals. Finally, the negative correlation between the hours and the participation equation could be caused by the bimodal distribution of the working hours.

Table 1: Estimation results of the wage functions

	Model 1		Model 2		Model 3		Model 4	
	coe¤.	t	coe¤.	t	coe¤.	t	coe¤.	t
constant	2.749	72.80	2.807	65.53	2.588	16.08	2.724	16.59
hours					0.030	5.78	0.022	2.54
hours^2					-0.061	-9.48	-0.055	-3.88
unskilled	-0.132	-5.32	-0.103	-3.85	-0.076	-2.46	-0.092	-3.19
skilled (type II)	0.052	2.26	0.055	2.35	0.059	2.51	0.056	2.48
(post-)graduate	0.346	10.85	0.337	10.45	0.376	11.36	0.375	11.85
ft. experience	0.026	7.80	0.023	6.94	0.021	5.90	-0.045	-2.68
ft. experience^2	-0.045	-4.66	-0.040	-4.04	-0.033	-3.22	0.188	3.48
20-200 empl.	0.018	0.70	0.016	0.63	0.031	1.23	0.026	1.06
201-2000 empl.	0.159	6.53	0.153	6.28	0.143	6.00	0.138	5.90
>2000 empl.	0.205	8.33	0.204	8.30	0.193	8.14	0.193	8.23
energy, mining	-0.031	-0.51	-0.036	-0.59	-0.023	-0.38	-0.020	-0.34
metal industry	-0.027	-0.53	-0.026	-0.53	-0.039	-0.81	-0.044	-0.91
other industry	-0.119	-2.53	-0.113	-2.41	-0.127	-2.82	-0.130	-2.91
trade, service	-0.214	-6.16	-0.207	-5.96	-0.185	-5.54	-0.204	-1.86
transport	-0.039	-0.73	-0.031	-0.57	-0.039	-0.77	-0.041	-0.81
banking	0,060	1,33	0,060	1,33	0,060	1,40	0,064	1,49
education, health	0,049	1,44	0,055	1.63	0.052	1.58	0.051	1.58
public service	-0.019	-0.47	-0.010	-0.25	-0.021	-0.54	-0.023	-0.62
other sectors	-0.075	-0.87	-0.062	-0.72	-0.060	-0.72	-0.047	-0.57
interactions:								
exp.¤ hours							0.004	2.99
exp.^{2} ¤ hours							-0.012	-3.58
exp. ¤ hours^2							-0.004	-1.91
exp.^{2} ¤ hours^2							0.014	2.62
trade/service ¤ h.							-0.005	-0.59
trade/service ¤ h.^{2}							0.015	1.13
½$_{wage;hours}$			0.06	1.49	0.261	2.24	0.141	1.23
½$_{wage;participation}$			-0.28	-3.02	-0.495	-2.87	-0.362	-2.08
½$_{hours;participation}$			-0.29	-2.20	-0.312	-2.96	-0.276	-2.53

Table 1 (continued):

	Model 1	Model 2	Model 3	Model 4
mean log likelihood	-2.567	-2.564	-2.545	-2.539
likelihood ratio Test		$Â^2_3 = 14:5$	$Â^2_2 = 91:3$	$Â^2_6 = 32:7$
Wald-Test statistics:				
hours, hours^2 ($Â^2_2 = 5:99$)			96.72	26.52 .
experience ¤ h. ($Â^2_4 = 9:49$)				26.11
trade,services¤ h. ($Â^2_2 = 5:99$)				6.41
$½_{w;h}; ½_{w;p}; ½_{h;p}$ ($Â^2_3 = 7:82$)		14.19	11.16	7.87
number of observations	2415	2415	2415	2415

Note: the reference group are skilled women (type I) who work in the chemical or electrical goods industry or in the engineering sector and are employed by a …rm with less that 20 employees. The de…nition of the other quali…cation levels are given in …gure 2. The experience is measured by the years in full-time employment. The variables hours^2 and full-time experience^2 are divided by 100. The likelihood ratio test compares the actual with the preceding model.

In the next step we relax the assumption that the amount of working hours does not a¤ect the hourly wage rate (Model 3). Hence we include hours and hours squared in the wage equation, which are highly signi…cant and improve the …t of the model. According to previous studies our estimates lead to a S-shaped budget curve. The hourly wage rate increases up to the peak of 25 hours a week and starts to decrease afterwards. Thus, our results are consistent with the …ndings in other countries (Mo¢t, 1984; Tummers/Woittiez, 1991). Although we control for various variables, we can still …nd a signi…cant decline of wages for women working overtime hours. If we take a look at the estimated covariance matrix, we realize that taking the labor supply decision into account becomes more important now. The positive correlation between wages and hours increases and is signi…cant. To put it di¤erently, there are some unobserved characteristics which in‡uence the wage rate and the hours decision in the same way. This implies that ignoring the endogeneity of the working hours leads to lower estimated wage rates for jobs with reduced working hours and higher wage rates for people working more hours (see …gure 6 in the Appendix).

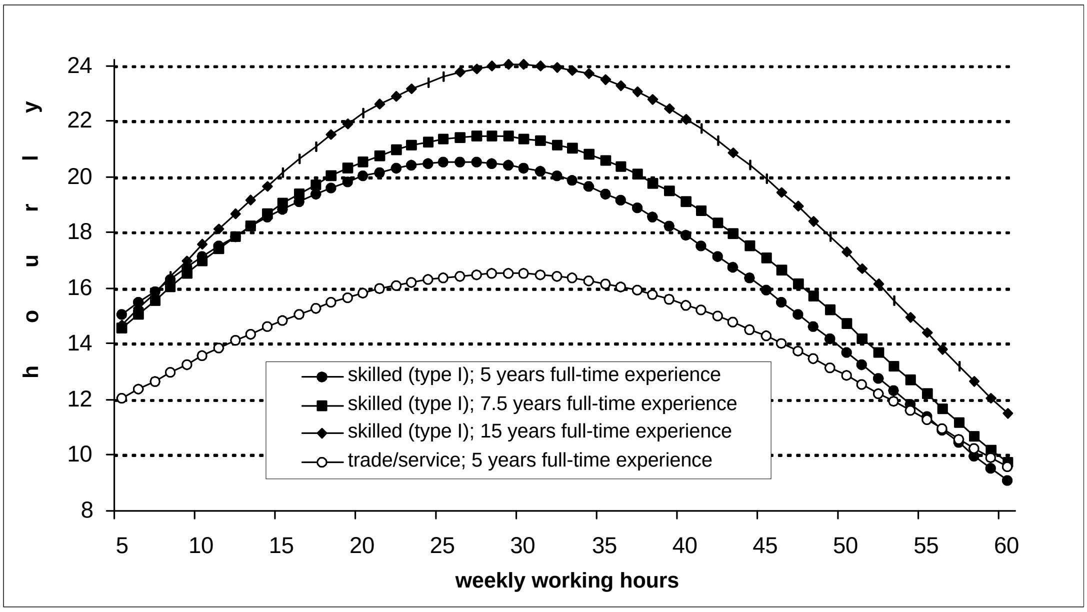


Figure 3: Wage-hours curves for selected groups

Up to this point it has been assumed that the impact of the amount of working hours on the wage rate is the same for all individuals. Even if the way how the working hours in‡uence the hourly wage rate should be independent of quali…-cation level, experience, …rm-size or industry sector, the intensity of the e¤ect could vary among di¤erent groups of employees. We ran a variety of regressions and identi…ed di¤erent hours e¤ects for employees in the service and trade sector and for di¤erent experience levels (Model 4). The education level and the …rm size turned out to be irrelevant for the shape of the wage-hours pro…le. Two primary observations should be made about these results. First, the assumption that the impact of working hours on wages is the same for all individuals must be strongly rejected.[17] Second, the correlation among the equations of the simultaneous model decrease and one of three correlation coe¢cients becomes insigni…cant again.

Figure 3 presents the wage-hours curves for women with di¤erent experience

[17] The likelihood-ratio test between model 3 and model 4 generates a test statistic of 32.7. The critical value of $\hat{A}^2_6$ is 12.6.

levels and those working in the trade or service sector. If not defined otherwise, the characteristics of the reference group are valid. The previous labor market experience tends to increase the hump of the wage-hours curve. Furthermore, additional experience raises the hourly wage rate for any number of working hours. Skilled women with 5 to 15 years of full-time experience earn approximately the same hourly wage rate if they work less than 15 hours a week. Once they increase their labor supply, the wages of women with more experience rise much faster. This indicates that previous labor market experience becomes noticeable only if women work more hours. Unless they work more than 15 hours, their productivity does not seem to be increased by previous experience. The highest hourly wage rate for skilled women with 15 years of experience is paid to those working 30 hours a week. Less experienced women reach their maximum at less hours. For a standard full-time job (38 hours), the gross wage differential between skilled women with 5 and 15 year of experience, keeping all other characteristics constant, is 4.20 DM per hour, that is 686 DM per month. In contrast to these curves, wages in the service or trade sector grow very moderately with additional working hours. Furthermore, the wage-hours locus is on a significant lower level.

Despite the different shapes of the wage-hours curves, they all have in common that the hourly wage rate for over-time hours falls substantially. This result is in line with the findings of Tummers and Woittiez (1991) for the Netherlands. To check whether the shape of the wage-hours curve is biased due to the measurement error in hours, we reestimate Model 4 based on the modified equations 4.7 and 4.8. Apart from the variables which are interacted with the hours, the coefficients of the other variables differ hardly. The estimation results are presented in Table A3 in the Appendix.

Apart from the variables which are not interacted with the hours, the coefficients of the other variables differ significantly. To illustrate the effect on the wage-hours locus, Figure 4 presents the resulting profiles. Similar to the previous results, additional years in full-time employment shift the wage-hours profile up-

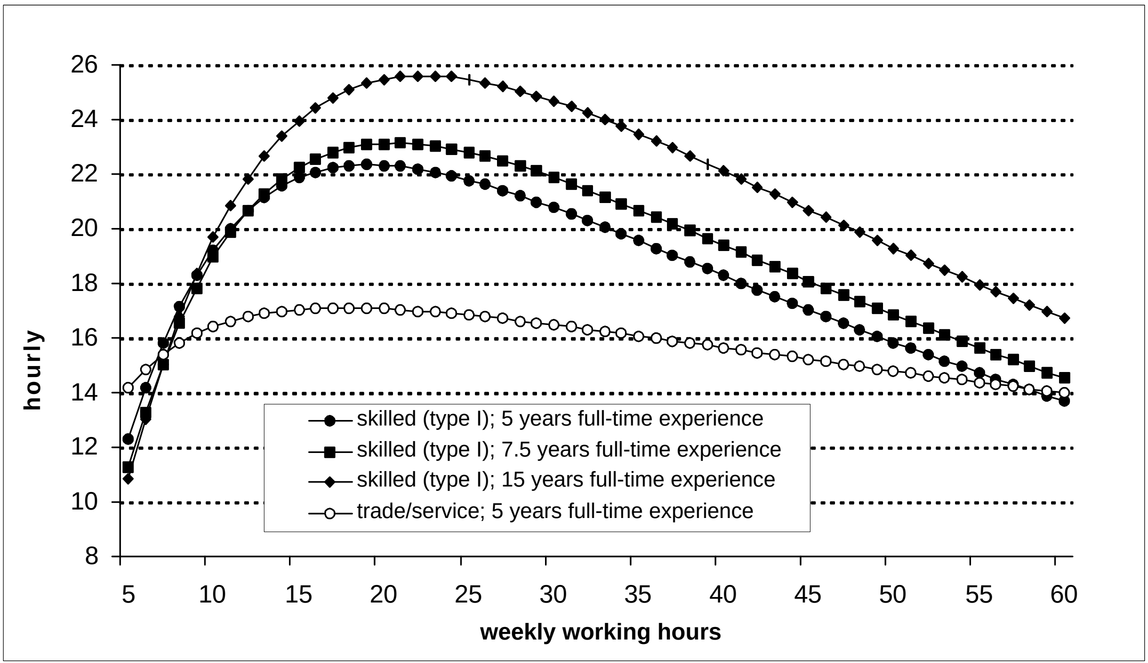


Figure 4: Wage-hours curves of the log(hours)-model

wards. Also the estimated wage rate for women who are employed in the service or trade sector is much lower and the curve is ‡atter.. In contrast to …gure 3, the hourly wages rise much faster at the beginning of the hours distribution. Also striking is that the decline of the wage rate for full-time jobs and overtime work is moderate. This leads one to suppose that for high number of working hours, the reported pre-month earnings do not include the rewards for these overtime hours, that is, the previous results are strongly driven by the measurement error. To check wether the potential measurement error is better captured in the log(hours)-model, we need to compare the correlation coe¢cients ½$_{wage;hours}$ in the two models. Contrary to our expectations, the correlation coe¢cient did not decrease. This indicates that the measurement error (»), provided it matters, does not add linearly to the log of the true hours (h$^{¤}$) as we assumed in 4.5.[18] Thus, the log(hours)-model is not better suited to get rid of measurement error.

[18] However, the sensitivity analysis shows that the size of the correlation coe¢cient in the two alternative models depends strongly on the speci…cation of the auxiliary equations.

Nevertheless, the log(hours)-model could provide a better fit of the entire model. Therefore, we apply a test for non-nested models (Vuong, 1989) which is based on the Kullbach-Leibler information criterion. The statistic used here is the adjusted difference of the log-likelihoods divided by an estimator for the variance of this difference. The test statistic is standard normal under the null of no divergence. We subtracted the transformed log-likelihood value of the log(hours)-model from our basic model (Model 4). Thus, a significant positive test statistic would point to superiority of the basic model. In fact, the value turned out to be significantly positive (11.8), that is, the log(hours)-model is rejected.

The previous results show that the shape of the wage-hours profiles depends strongly on the assumption of the functional form. Therefore, we use a linear spline function in order to estimate the impact of working hours on wage rates. First, we grouped the observed working hours into six categories (5-15 h; 16-20 h; 21-25 h; 26-37 h; 38-45 h; 46-60 h), that is, we define five knots.[19] It follows from this that if a woman works less than 16 hours a week, D_1 is set to one and $D_2, \ldots, D_6$ are equal to zero. Second, we defined two dummy variables for different experience levels. In order to allow for different wage-hours curves for specific groups of employees, we multiply these dummy variables with spline dummies $D_1, \ldots, D_6$. The estimation results are presented in the appendix and the corresponding wages are shown in figure 5.

Due to the linear splines, the computed wage-hours locus is not a smooth line. Striking is that the variance of the hourly wage rates is much smaller compared to the previous figures. They vary only between 12 and 20 DM per hour. Another special feature is that the wage curves differ very much in the category for jobs with less than 15 hours. Despite these differences to the previous findings, the wage reduction for overtime hours turns out to be a robust result, even if they are much smaller in this specification. A closer look into the data indicates that

[19] At the beginning we defined another knot at 30 hours. Since the slopes of the two adjointed splines did not differ significantly, we dropped this knot.

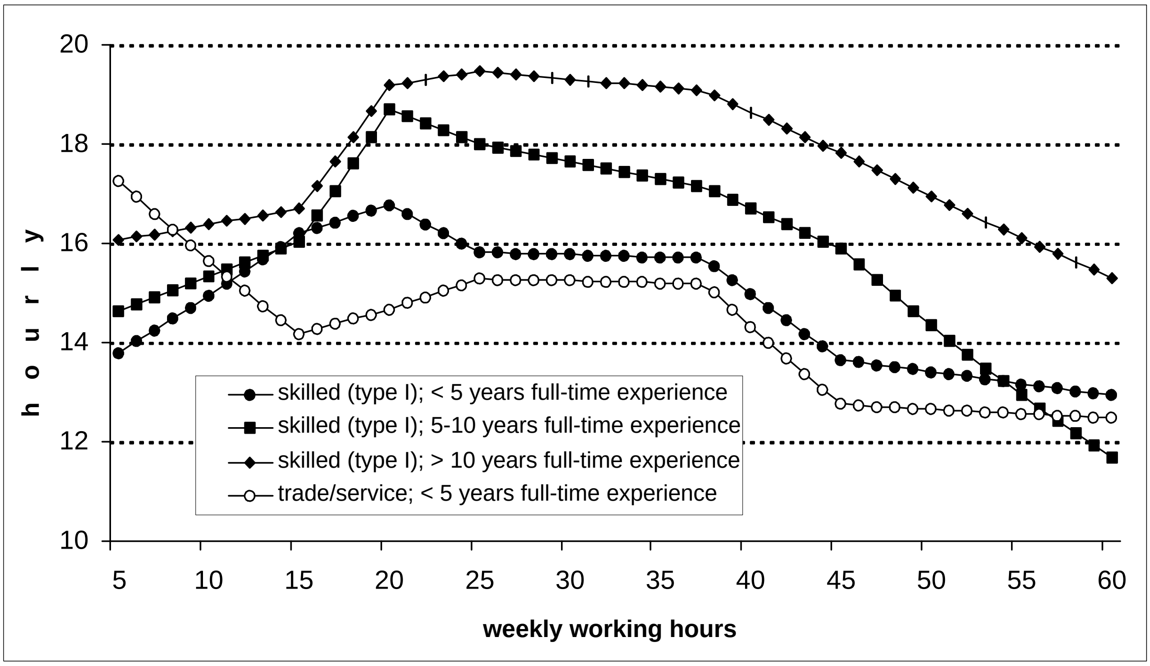


Figure 5: Wage-hours curves based on the spline functions

about 60 percent of those women who do overtime work are not compensated for their e¤ort. This may be due to the fact that in our sample only 17 percent are blue collar workers of which not all are covered by the collective agreement of the unions (see Table A4 in the Appendix). Thus, we can not observe the statutory overtime premiums for blue collar workers. One explanation for these unpaid overtime hours could be that people temporary invest much time in their job in order to be promoted for a higher position.

First, let's have a look at the wages of women with more than 10 years of full-time experience. The hourly wage rate increases moderately while these women work less then 15 hours a week and rises very fast thereafter. However, there exist no wage di¤erential between full-time jobs without overtime and part-time jobs with 20 or more hours a week. Less experienced women earn the highest hourly wage rates at about 20 hours a week. However, the decline of the hourly wage rate between 20 and 25 hours is only signi…cant on the 10%-level. Again, the returns to experience are higher in jobs with more working hours. For women who work in the trade or service sector, the hourly wage rate decreases up to the threshold of 15 hours. This unusual result may be due to the fact, that 84 percent of these women do not pay social security premiums.[20] Given they can not freely decide about the number of working hours in these jobs, they accept lower wages for a 15 hours job in order not to exceed the threshold of 580 DM per month. Thereafter, the hourly wage rate increases moderately and is similar to the wage-hours profile of the less experienced women in the other sectors.

6. Conclusion

Do part-time workers earn lower hourly wage rates than full-timers? In Germany, part-time jobs still have the image of lousy jobs. If this is true, the wage dispersion does not only affect the income distribution, but has also far-reaching implications for the labor supply decision of individuals. Negative wage premiums for part-time jobs, for example, would decrease the labor supply for those jobs. Economic theory provides many reasons why and how the gross hourly wage rate could be determined by the working hours. However, the shape of the wage-hours profile is not clearly determined by the theoretical arguments.

Empirical studies for different countries do not provide clear evidence about the wage structure. The different results may be partly due to the different econometric methods. Previous studies for Germany suggest that women with marginal or part-time jobs earn lower wages than full-time employed women even if the qualification level and other explanatory variables are controlled for. However, these studies have two shortcomings. First, the individual labor supply decision is assumed to be exogenous, which is not consistent with microeconomic theory. Second, the model does not allow for different wage-hours profiles for specific groups of individuals. Therefore, we use a simultaneous model which fully takes into account the labor supply decision. Furthermore, we relax the assumption that the effect of working hours on wages is the same for all individ-

[20] In the other sectors, this share is about 65 percent.

uals.

Three primary observations should be made about our results. First, for West German women, the exogeneity assumption of working hours in the wage regression must be rejected if the wage-hours locus is assumed to be the same for all individuals. As a result of this the wage rate of full-time employees is overestimated in the standard OLS estimates. However, if we allow for compositional wage di¤erences between part-timers and full-timers, the OLS estimates seem to do a rather good job. These results show that in principle the labor supply decision should be fully taken into account, because the unobserved characteristics may be crucial in the speci…c case.

Second, our estimates show that the hourly wage rate is strongly a¤ected by the working hours. But, the shape of the wage-hours pro…le depends strongly on the assumption about the functional form. Therefore, we estimate a linear spline function, which does not require any pre-speci…cation of the mathematical form of the relation between hours and wages. Third, we detect di¤erent wage-hours pro…les for some speci…c groups. Women working in the trade or service sector experience a ‡atter wage-hours curve than those in other sectors. Also the previous labor market experience determines the shape of the wage-hours locus. Despite these di¤erences, the wage reduction for jobs with less than 16 hours a week and for overtime hours turns out to be a robust result. However, the hourly wage rate of jobs with 20 to 38 hours does not di¤er signi…cantly.

These results show, that the wage distribution does not seem to be the driving factor for the marginal importance of part-time work for West Germany women. Especially jobs with 30 to 35 hours are very rare, even if the wage rate does not di¤er from other part-time or full-time jobs. Possibly, the creation of a 30-hour job causes more organizational e¤ort than just dividing a full-time job in two 20-hour jobs and can therefore only be carried out by very estimable employees. In this setting the employers would only grant a request for an extended part-time job, if the employee represents important human capital to the …rm and if there is a risk that the woman is leaving otherwise.

Another reason could be that a 30-hours job is less compatible with the available child care facilities so that women are forced to accept either a standard part-time job or to leave the labor market. Furthermore, they would have to spend much money on child rearing, which only makes sense if they have a high income. Further research is necessary to decide whether women are constraint with respect to extended part-time jobs or whether other factors prevent them to choose these high paid jobs.

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Appendix

In our framework, the multivariate econometric problem involves both continuous (wages and hours) and discrete variables (participation). Therefore, the likelihood function is made up by term which are probability densities with respect to the limited dependent variable and integrated probability functions with respect to the continuous variables. This composition is based on Bayes' theorem. Under normality assumptions, a joint density function can be decomposed in a partial density function and a conditional density function.

$$\varphi(Y^1; Y^2; \mu^1; \mu^2; \Sigma) = \underbrace{\varphi(Y^2; \mu^2; \Sigma^{22})}_{\text{p.d.f.}} \cdot \underbrace{\Phi(Y^1; \mu^*; \Sigma^*)}_{\text{c.d.f}}; \qquad (1)$$

where Y^1 and Y^2 are the discrete and continuous variables of interest and μ^1 and μ^2 are their expected values. The correlation matrix Σ is composed of $\Sigma^{11} = cov(Y^1)$, $\Sigma^{22} = cov(Y^2)$ and $\Sigma^{12} = cov(Y^1; Y^2)$. Then, the distribution of Y^1 conditional on Y^2 can be written as $Y^1 \mid Y^2 \sim N(\mu^*; \Sigma^*)$; where $\mu^* = \mu^1 + \Sigma^{12}(\Sigma^{22})^{-1}(Y^2 - \mu^2)$ and $\Sigma^* = \Sigma^{11} - \Sigma^{12}(\Sigma^{22})^{-1}\Sigma^{21}$:

The likelihood function of our model can be divided into the likelihood contribution of the non-participants and the part of the active workers.

$$L = P(P^* < 0) + f(\ln w; h) \cdot P(P^* > 0 \mid \ln w; h) \qquad (2)$$

The first part describes the probability of not working in the labor market and the second term describes the joint distribution of the observed wage rates and the corresponding working hours of the employed people. The likelihood contribution of these individuals is presented as a partially integrated normal density. In terms of the above specified model (see equation 4.1 to 4.3) the likelihood function can be rewritten as

$$L = (h = 0) \cdot P(v < -\gamma \cdot Z) + (h > 0) \cdot f(\ln w; h) \cdot P(v > -\gamma \cdot Z \mid \ln w; h)$$

$$= \quad (h = 0) \cdot \Phi(-\gamma \cdot Z) + (h > 0) \cdot \varphi(\ln w; \ln h; \mu; \sigma) \cdot \Phi\left(\frac{\mu^*}{\sigma^*}\right); \qquad (3)$$

where μ^* and σ^* are defined above.

Table A1: Descriptive statistics of the sample

	mean	std. dev.	min.	max.
log(wages)	2.99	0.4	1.6	4.0
working hours	31.46	10.8	6.0	60.0
years in full-time experience (in years)	8.60	8.0	0.0	43.0
potential years of experience (in years)	21.38	11.7	0.0	45.0
other household income (in 1000 DM)	3.28	2.2	0.0	19.4
income of the spouse (in 1000 DM)	1.86	2.2	0.0	14.0
regional unemployment rate	9.26	1.8	7.0	14.0
taste for work	-1.62	9.9	-46.7	20.0
	freq.	percent		
participation	1262	52.3		
unskilled	586	24.3		
skilled (type I)	1084	44.9		
skilled (type II)	544	22.5		
(post-)graduated	201	8.3		
< 20 employees	457	36.2		
20 - 200 employees	224	17.7		
201 - 2000 employees	270	21.4		
> 2000 employees	311	24.6		
chemical/electrical ind., engineering	119	9.4		
energy mining	34	2.7		
metal industry	57	4.5		
other industry	71	5.6		
trade, service	290	23.0		
transport	50	4.0		
banking	84	6.7		
education, health	405	32.1		
public service	137	10.9		
other sectors	15	1.2		
kids in the household (Y/N)	1081	44.8		
lone mother, relative in need of care	87	3.6		
married	1637	67.8		
participation of the spouse	1289	53.4		
# observations	2415	100		

Table A2: Hours equation and participation probability (Model 4)

hours			participation		
	coe¤.	t-value		coe¤.	t-value
constant	40.523	31.99	constant	1.181	5.85
# kids < 3 year	-6.712	-2.50	kids	-1.309	-8.72
# kids 4-6 year	-9.159	-4.08	AGEKID	0.099	8.34
# kids 7-16 years	-6.774	-3.02	KIDS16	-0.390	-1.92
unskilled	0.632	0.84	unskilled	-0.314	-4.27
skilled (type II)	1.160	1.82	skilled (type II)	-0.001	-0.02
(post-)graduated	1.725	1.76	(post-)graduated	0.103	0.82
pot. experience	-0.070	-0.55	pot. experience	0.072	5.41
pot. experience^2=100	-0.212	-0.74	pot. experience^2=100	-0.193	-7.02
married	-2.568	-3.78	married	-0.126	-1.62
OINC	-0.006	-0.03	OINC	-0.270	-7.74
OINC^2=1000	-0.260	1.25	OINC^2=1000	0.173	5.19
OINC * KIDS16	-0.309	-1.86	SPINC	0.337	4.24
SPINC	-0.371	-0.96	SPINC^2=100	-3.917	-4.00
SPINC^2=100	-5.293	-0.736	PART_SP	-0.304	-1.90
taste for work	0.074	2.69	taste for work	0.010	3.47
KIDS16 * experience	0.031	0.55	KIDS16 * experience	-0.002	-0.41
KIDS16 * SCHOOL	0.220	1.63	KIDS16 * SCHOOL	0.023	1.94
			regional unempl. rate	-0.051	-3.31
			CARE	-0.128	-1.45

Note: OINC: other net household income (in 1000 DM); SPINO: income of the spouse (in 1000 DM); KIDS16: number of children up to the age 16; SCHOOL; years of education; AGEKID: age of the youngest kid in the household; PART_SP: participation of the spouse; CARE: lone mothers with children up to 3 years or existence of people in need of care in the household; the variable "taste for work" is created by a factor analysis from the question "How important are the following thinks for your life". Among the topics which are evaluated by the individuals are (1) to ful…l oneself, (2) success on the job, (3) to have children, (4) to be happily married or (5) to be able to a¤ord something. These items are used to create a factor named taste for work.

Table A3: Estimation results of alternative models

	log(hours)-model			Model with spline function							
				I		II		III		IV	
	coe¤.	t		coe¤.	t	coe¤.	t	coe¤.	t	coe¤.	t
constant	0.797	0.83		2.583	19.47						
log(hours)	1.664	2.98		-	-						
log(hours)^2	-3.052	-3.55		-	-						
unskilled	-0.070	-2.00		-0.089	-3.22						
skilled (type II)	0.057	2.33		0.054	2.44						
(post-)grad.	0.354	10.60		0.379	11.92						
full-time exp.	-0.327	-2.53		0.015	2.42						
full-time exp.^{2}	1.218	2.81		-0.023	-1.56						
20-200 empl.	0.009	0.34		0.026	1.06						
201-2000 empl.	0.138	5.62		0.131	5.66						
>2000 empl.	0.196	8.22		0.179	7.68						
energy, mining	-0.025	-0.43		-0.026	-0.45						
metal industry	-0.038	-0.79		-0.037	-0.78						
other industry	-0.120	-2.69		-0.118	-2.68						
trade, serv.	2.134	2.66		0.225	1.82						
transport	-0.043	-0.83		-0.035	-0.69						
banking	0.066	1.54		0.069	1.61						
educ., health	0.052	1.61		0.059	1.84						
public service	-0.027	-0.70		-0.023	-0.62						
other sectors	-0.052	-0.62		-0.040	-0.50						
interactions:			spline dummies								
exp.¤ log(h)	0.185	2.22	D1	0.016	2.43	-0.007	-1.42	-0.012	-1.91	-0.036	-3.88
exp.^{2} ¤ log(h)	-0.672	-2.47	D2	0.007	0.84	0.024	2.14	0.021	1.56	0.017	1.47
exp. ¤ log(h)^2	-0.239	-1.80	D3	-0.012	-1.76	0.004	0.43	0.015	1.60	0.020	2.29
exp.^{2} ¤ log(h)^2	0.884	2.10	D4	-0.001	-0.25	-0.003	-0.98	-0.001	-0.31	0.000	0.04
TS ¤ log(h)	-1.575	-3.01	D5	-0.019	-2.69	0.009	0.93	0.010	1.21	-0.005	-0.66
TS ¤ log(h)^2	2.581	3.07	D6	-0.004	-0.51	-0.017	-1.95	-0.007	-0.85	0.002	0.35
½$_{w;h}$	0.247	1.51		0.143	1.29						
½$_{w;p}$	-0.597	-2.84		-0.381	-2.55						
½$_{h;p}$	-0.336	-2.00		-0.283	-2.41						
? log likelih.	-0.856			-2.529							

Note: See Table 1. The …rst column of the spline-model refers to skilled (type I) women with less than …ve years of full-time employment. The third and …fth column presents the spline function for women with 5 to 10 years and for those with more than 10 years of full-time employment. The last two columns describe the wage-hours pro…le of women working in the service sector.

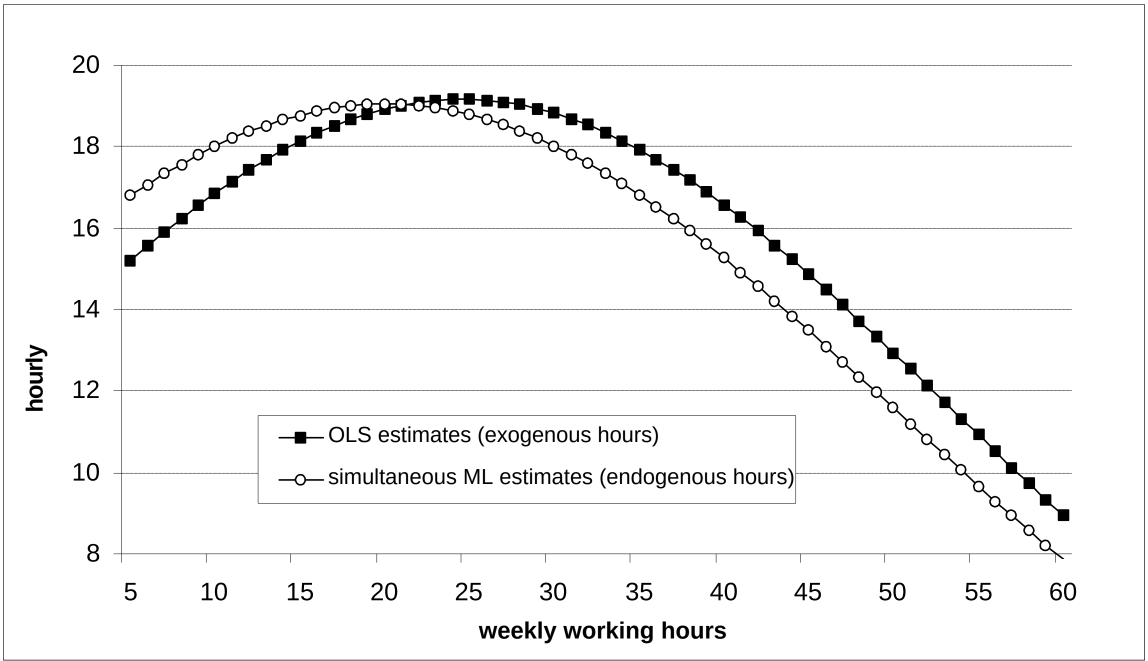

Figure 6: Wage-hours pro…les with exogenous and endogenous hours (model 3)

wage

Table A4: Employees with pay agreement by a union

	no overtime work		overtime work[a]	
	blue collar	white collar	blue collar	white collar
# observations	231	924	18	89
in percent	20.0 %	80.0 %	16.8 %	83.2 %
with pay agreement	164	699	15	59
in percent	19.0 %	81.0 %	20.3 %	79.7 %

[a] Women who work more than 38 hours a week and also more than their contractual working hours.

rate