Working Paper Series
No. 22

Wage effects of motherhood: a double selection approach

Cécile Wetzels
Aslan Zorlu

June 2003

Núcleo de Investigação em Microeconomia Aplicada
Universidade do Minho

Wage Effects of Motherhood:

A Double Selection Approach

Cécile Wetzels[1]

FEE, Universiteit van Amsterdam

&

Aslan Zorlu

NIMA, Universidade do Minho

JEL Code: J13, J16, J71

Abstract

Wage differentials between mothers and childless women are estimated correcting for the selectivity bias resulting from two double selection processes: firstly, the motherhood decision and the employment decision, and secondly the motherhood decision and the decision to be employed in a less demanding job. We use Dutch data on women's wages and construct an indicator for less demanding jobs. Our estimations indicate that the motherhood decision is strongly correlated with both employment and having a less demanding job. This suggests that ignoring these correlations will lead to inconsistent parameter estimations of wage equations. The selectivity corrected estimation of women's wage differentials indicate that a large part of the wage differential is composed by discrimination compared to estimations without correction for selectivity

Draft version, June 13, 2003.We are grateful to Hans van Ophem for valuable comments.

---

[1] All correspondence to Cecile Wetzels, Faculty of Economics, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands, phone 31 20 525 4203, fax 31 20 525 4254; email: cwetzels@fee.uva.nl

1 Introduction

An increasing number of studies analyses labour market consequences of motherhood while the participation rate of (married) women, in particular mothers, increases in advanced countries. The tenor of these studies is whether working mothers experience wage penalties compared to childless women, called child gap in pay. Studies conducted in various countries exhibit a wide variation in child gap, which is motivated by both differences in institutional arrangements across countries and estimation strategies. A frequently mentioned issue in the literature is the selectivity problem that may lead to inconsistent estimations. The selectivity problem may occur when working mothers are not a random sample of the potential female population having children or when job-choices of mothers are not a random process.

Some of these studies estimate wage differentials correcting for selection into employment, and indicate that the selection problem does not necessarily occur for every country (Harkness and Waldfogel forthcoming, Datta Gupta and Smith 2002, Joshi et al 1999, Waldfogel 1994, Waldfogel 1995)[2]. For the Netherlands, no study on a possible child gap has been conducted.

This paper examines wage differentials between childless women and mothers in the Dutch labour market in 2001 focussing on double selectivity with respect to two main underlying decision processes: the decision to have a child and the decision to have a paid job considering segregation into less and more demanded jobs. Since having a child can be postponed and its timing can be (easily) manipulated due to developments in medical technology, women's decision to have a child and its timing are possibly related to their participation decision in the labour market. In addition, the job choices of women are strongly influenced by numerous factors associated with the role of women in the household, alternative household help opportunities and childcare facilities. It is considered not to be unrealistic that women are tended to choose certain types of jobs that are easy to combine with other family activities but provide a poor prospect in terms of wage and job promotion (Gronau 1988). To deal with this problem, we identify less demanding jobs by factor analysis, and model the double selection into having a child and the choice for being employed in a less demanding job explicitly.

We discuss the decision of motherhood in relation to paid-employment and motivate our methodology to measure the child gap in section 2. In section 3 we model two alternative double selection models from which selectivity coefficients are obtained. Furthermore we decompose wage differentials. Section 4 describes the datasets employed in this study. In section 5, we develop a bivariate indicator for less demanding jobs. The indicator makes use of several characteristics of the job such as working hours, type of contract, managerial tasks, possibility to do part of the job at home, job requiring additional training, overtime and commuting. Sections 6 presents and interprets the empirical results. The paper ends with a conclusion in section 7.

2 Background

After the seminal works of Heckman and Lee in the late 1970s, there is an increasing awareness about the selectivity bias that may occur if the participating women are not a random sub-sample of the original sample. Consistently, many studies correct wage estimations for the selectivity bias applying the original Heckman-Lee two-step procedure assuming that the wage sample results from a single censoring process: obtaining a selectivity coefficient (lambda) by estimating a univariate probit and including this selectivity variable in

[2] See Wetzels 2002 for a review on the family gap in pay. Gupta and Smith 2001 did find a selection effect for Denmark. Harkness & Waldfogel (1999) found a significant selectivity bias for the United States, and not for the other 6 industrialised countries in their analyses. Selection bias was not found by Waldfogel (1994, 1995). Albrecht et al 1999 did not correct for sample selection.

OLS wage regressions. However, if wages are determined by two underlying decision processes, the sample selectivity problem remains unsolved. In case of multiple decision rules that are correlated to each other, a joint estimation of these decision functions generates asymptotically more efficient estimators (Meng and Schmidt 1985; Tunali 1986). Consistently, the single selection rule was extended to double selection rule by later studies that model two underlying decision processes in a bivariate framework (Poirier 1979; Van de Ven and Van Praag 1981; Fishe et al. 1981; Abowd and Farber 1982, Tunali 1986). In particular, Fishe et al. (1981) extend this two step procedure by modelling a joint decision process for women: the participation decision and the decision to attend college while Sorensen (1989) analyses wage differentials between typically female occupations and other occupations considering women's participation decision and their occupation choice in a sequential framework. However, studies that have focussed on the child gap or wages of mothers failed to control for women's decision whether or not to have a child and for their job choices. These studies implicitly assume that women, who become a mother, make their decision randomly, unrelated to any kind of labour market related issues. Women's employment decision is likely determined with shadow wages that are in turn determined by family structure, childcare facilities, supply of suitable jobs and own subjective preferences. Additionally, medical developments crucially allow the planning of maternity as well as childlessness. Such a random-motherhood assumption is unlikely to be true when we closely look at some demographic developments in the last 20 to 30 years.

Table 1 indicates that mothers have postponed the timing of children a couple of years, especially the timing of first birth. The percentage of mothers who are below 30 years has decreased from 53.7% to 37.4% in favour of mothers older than 30 years within one decade (1990 to 2000). Average age of women giving first birth has increased almost two years from 27.5 in 1990 to 29.2 in 2001[3]. Additionally, the estimated proportion of women remaining childless sharply increases[4] for the successive birth cohorts from 14.7% in 1950 to 19.5% in 1958, as shown in the panel b of Table 1 although in the Netherlands fertility rates show a quite stable pattern between 1990 en 2001, around 1.6.

(Delayed) maternity and voluntary ultimate childlessness are likely related to the view on mother's role in society and correspondingly government policies with respect to the combination of paid work and motherhood, since women's childbearing behavior strongly differs across countries[5]. This view differs historically between clusters of welfare states according to the typology of Esping-Andersen (1990), and according to the breadwinner thought in social policies (Sainsbury 1996). We characterize the Dutch welfare state till 1990 as coming close to the Christian democratic welfare state with policies designed in order to induce women to work in the home fulltime caring for young children. [6] However from 1990 social policies in the Netherlands have changed into facilitating the combination of work and family, which fits the social democratic model. [7]

---

[3] The mean age at maternity in the Netherlands started to increase in the 1970s from 24.3 years in 1970. The increase slows down as age at maternity remains 29.1 years between 1998 and 2001. (Statistics Netherlands 1994, 2002). The contribution of women who are 30 years of age or older to the period total fertility rate is 51.5 per cent in 1992.

[4] Kohler and Ortega (2002) suggest that childlessness in cohorts who have not yet completed childbearing as of the late 1990s will stabilize between 15-20% basing on the level of fertility observed during the 1990s.

[5] For example: the age at maternity in the United States is 24.7 in 2000 (United States' National Center for Health Statistics (www.cdc.gov-nchs-data-statatab.tab1).

[6] In 1965 only 7% of married women participated in the labour market. Women's participation rate (excluding jobs of less than 12 hours per week) has increased from 41% in 1988 to 54% in 1999.

The Childcare Stimulation Act of 1990 is the first government action which explicitly caters to the needs of the working mother rather than assigning priority to educational considerations for children. In international comparison leave arrangements to combine work and children are still limited. In 1990 maternity leave was extended to 16 weeks and each parent became eligible to an additional parental leave of 6 months. However as many as 90 percent of all employees are covered by a coolective labour agreement without payment of parental leave. Only the (CAO of the) public sector offers 75 percent of earnings. See Wetzels 2001.

Table 1: Postponement of Giving Birth & Childlessness in the Netherlands

(a) Postponement: The distribution of mothers' age at giving birth in the Netherlands, in percentages:

Age group	1990	2000
35 years or older	11.7	20.3
30-34 years	34.8	42.2
25-29 years	38.9	27.8
Younger than 25 years	14.8	9.6
of which younger than 20	1.7	1.2
Mean age at giving first birth	27.5	29.1

Calculated on CBS 2002

(b) Childlessness

Proportion of childless women in 1990		The estimated proportion being ultimately childless in 1992	
Age group	Per cent	Birth cohort	Per cent
25-29 years	61.4	1950	14.7
30-34 years	30.3	1955	17.8
35-39 years.	18.6	1958	19.5

Source: Bosveld (1996)

In the 1990s, the specific public policies have been designed to increase the participation rate of (married) women by abolishing disadvantages of non-standard work in terms of lower wages, poor pension prospects etc. Specifically, it is legally determined that the social and economic rights of part-time work is equal to these rights of full-time work,[8] although more indirect negative effects of non-standard jobs on career prospects remain. Social policies aim to keep women in the labour market (in long part time jobs 28 hours and more) by encouraging fathers to share the care of children. Fathers are legally supported to adjust their working hours to care-intensivity of children needed. These changes in policies have led to more opportunities for mothers in the labour market while women's childbearing behaviour has been liberated from traditional forces predetermining women's role in society. Moreover, technical developments have made postponement and prevention possible. In this context motherhood and employment decisions are likely correlated. Consequently, we need to model this correlation explicitly.

2.1 Are mothers disadvantaged?

Leading question is whether mothers still have a relatively low wage rate after the correction for the duration of timeout due to birth, which can be interpreted as a stagnation or depreciation in human capital endowment relative to other female workers without children. We start to analyse this so-called child gap by estimation of wage regressions for all women in the sample including a child dummy in regressions. Appendix Table A1 shows the

[8] Beyond this the transfer from part time to fulltime and reverse has been in the center of the debate. The 1997 European Union Directive on Part-time Work states: "employers should give consideration to requests by workers to transfer from full-time to part-time work and the reverse when such work becomes available." The Netherlands has gone much farther than demanding that employers should "give consideration" to employees who wish to transfer between full-time and part-time work. The Act on Adjustment of Working Hours (Wet Aanpassing Arbeidsduur), which went into effect July 1, 2000, gives those employed by firms with more than 10 employees the right to shorten or increase work hours on request if they have been employed for at least one year, and have not asked for a change in working hours within the past two years. Within four months prior to changing work hours, the employee should indicate the date that the new working hours take effect, the number of working hours, and the preferred distribution of working hours during the week. The employer should, in principle, agree to the request and is obliged to indicate any reason for disagreement. The hourly wage remains the same.

alternative estimates of wage regressions. Firstly, we estimate wage regression by using only human capital covariates measured by calendar years and a child dummy (the upper part of table A1). The estimate indicates a significant child gap, *Kid,* 8.7 percent. If age is used in place of experience, this gap is even 9.3 percent. When this last model is extended, the child gap may be 6.7 percent at 10 percent significance level. On the other hand, the extended model with experience in calendar years generates insignificant coefficients for child gap. If age and experience variables are included at the same time, the child gap coefficient becomes smaller and insignificant. Finally, we calculate the full-time equivalent of experience, *Expfteq,* and include this and its quadratic form in the basic regression and extended regression, the child gap disappears convincingly in both cases. These results suggest that there would be no child gap in the Netherlands when we correct women's wage function for differences in human capital of childless women and mothers.[9] Our results also suggest that the number of hours worked is more important in raising human capital accumulation than the continuity of employment in the form of fewer hours distributed over time. On the other hand, the connection with labour market with small jobs may increase employment probability, which we do not verify in this paper. However, the absence of child gap is hard to believe because of sample selectivity, which we investigate in next section.

3 Empirical models with double sample selection

Career oriented mothers are expected to be more likely in employment compared with less-career oriented women. Therefore, the sample of employed mothers is expected to be biased upward. We also expect that employed mothers are more concentrated in less demanding jobs (see section 5 for the definition). This suggests that the sample of women employed in less demanding jobs is expected to be biased upward. In order to deal with these sample selection problems, we explicitly model underlying decision process of the motherhood and employment applying a bivariate probit model (Heckman 1979; Poirier 1979; Van de Ven and Van Praag 1981; Abowd and Farber 1982, Maddala 1983, Tunali 1986)). Firstly, we consider that the motherhood decision and the employment decision are simultaneously determined. Alternatively, motherhood and employment types, i.e. (less) demanding jobs are assumed to be jointly determined in a double selection framework (see Section 5 for the definition of less demanding job). These pairs of decision rules may be presented in a single standard bivariate probit model.

3.1 Simultaneous Decisions

We wish to correct our wage estimations for selectivity bias resulting from two alternative double selection processes: the motherhood decision and the employment decision on the one hand, and the motherhood decision and the type of job decision (the less demanding job decision) on the other hand. In the first model women simultaneously decide whether or not having a child and being employed. In the second model women simultaneously decide whether or not having a child and being employed in a less demanding job. The simultaneous double selection process is ill[10]ustrated by Figure 1

[9] See for an overview of the European literature Wetzels 2002. There is no other study analysing data on the Netherlands that uses actual experience in the labour market.

[10] In order to avoid repetition we illustrate both models in one Figure, since y_{1i} is the same in both models. However y_{2i} in model 1 denotes whether a woman is employed or not while y_{2i} in model 2 denotes whether a women is employed in a less demanding job or employed in a demanding job.

Figure 1

$$y_i = \begin{cases} y_{1i} = 1 \begin{cases} y_{2i} = 1 \\ y_{2i} = 0 \end{cases} \\ y_{1i} = 0 \begin{cases} y_{2i} = 1 \\ y_{2i} = 0 \end{cases} \end{cases}$$

Where y_{1i} and y_{2i} take a one when a woman is mother and is employed (in a less demanding job) respectively, and y_{1i} and y_{2i} take a zero when a woman is not employed (is employed in a demanding job) and is childless. The decisions may be written as reduced form equations

$$y_{1i}^* = x_{1i}\beta_1 + \varepsilon_{1i} \quad (1)$$

$$y_{2i}^* = x_{2i}\beta_2 + \varepsilon_{2i} \quad (2)$$

where y_{1i}^* denotes the preference function of a woman which is measured by the difference between the woman's expected benefit from motherhood and opportunity costs of motherhood. The woman becomes a mother if the expected benefit of motherhood exceeds the opportunity costs $\left(y_{1i}^* > 0\right)$. The y_{2i}^* is the difference between the woman's expected market wage and reservation wage when employment is considered. It is the difference between the expected benefit in demanding and less demanding jobs when employment type is considered. If the market wage is higher than the reservation wage, the woman will participate in paid-employment $\left(y_{2i}^* > 0\right)$. Alternatively, if the expected benefit in less demanding jobs is higher than the expected benefit in demanding jobs, the woman will participate in less demanding job. In equations (1) and (2), x_{1i} and x_{2i} denote a vector of characteristics that affect motherhood and employment decisions, β_1 and β_2 are the corresponding coefficients, and ε_{1i} and ε_{2i} are disturbance terms that are assumed to follow a bivariate standard normal distribution $E\left[\varepsilon_{1i}\right] = E\left[\varepsilon_{2i}\right] = 0$, $Var\left[\varepsilon_{1i}\right] = Var\left[\varepsilon_{2i}\right] = 1$ and the disturbance terms in the two equations are correlated: $Cov\left[\varepsilon_{1i}, \varepsilon_{2i}\right] = \rho$.

The dependent variables y_{1i}^* and y_{2i}^* are unobserved latent variables. We observe only a dichotomous variable indicating whether or not a woman is a mother (y_{1i}) and whether or not a woman is employed (y_{2i}).

$$\begin{aligned} y_{1i} &= 1 \text{ if } y_{1i}^* > 0 \\ &= 0, \text{ otherwise} \end{aligned} \quad (3)$$

$$\begin{aligned} y_{2i} &= 1 \text{ if } y_{2i}^* > 0 \\ &= 0, \text{ otherwise} \end{aligned} \quad (4)$$

The log likelihood function is given by (Greene, 1997, p907-908)

$$\ln L = \sum_{i=1}^{n} \ln \Phi_2\left(q_{1i}\left(x_{1i}\beta_1\right), q_{2i}\left(x_{2i}\beta_2\right), \rho_i^*\right) \quad (5)$$

where $\Phi_2(\ )$ is the cumulative normal bivariate distribution function,

$$q_{1i} = \begin{cases} 1 \text{ if } y_{1i} \neq 0 \\ -1 \text{ otherwise} \end{cases}, \qquad q_{2i} = \begin{cases} 1 \text{ if } y_{2i} \neq 0 \\ -1 \text{ otherwise} \end{cases} \quad \text{and} \quad \rho_i^* = q_{1i} q_{2i} \rho$$

3.2 Selectivity corrected wage equations

The bivariate probit models have four decision combinations represented by two dichotomous variables in each model. The possible outcomes of the selection processes are given in Figure 3 for both model where S_j denotes the set of individuals falling into the *j*th subsample: j=1,2,3,4. In the left hand-side table, S_1 represents the state that a woman has given birth to at least one child and is employed, S_2 gives the state that a women is childless and employed, S_3 represents the state that a mother is not employed and S_4 shows the state that a childless woman is not employed. Identically, the right-hand side table gives decision combinations between motherhood and less demanding job.

Figure 3. Possible outcomes of the selection processes

Figure 3a

		Motherhood (y_{1i})	
		1	0
Employment (y_{2i})	1	S_1	S_2
	0	S_3	S_4

Figure 3b

		Motherhood (y_{1i})	
		1	0
Less demanding job (y_{Li})	1	S_1	S_2
	0	S_3	S_4

The probabilities of these sub-samples can be formally written as:

$$\begin{aligned} S_1 &= \Pr\left(y_{1i}=1, y_{2i}=1\right) = \Pr\left(y_{1i}^* > 0, y_{2i}^* > 0\right) = \Pr\left(\varepsilon_{1i} > -C_1, \varepsilon_{2i} > -C_2\right) \\ &= \Phi_2\left(C_1, C_2; \rho\right) \end{aligned} \tag{6}$$

$$\begin{aligned} S_2 &= \Pr\left(y_{1i}=1, y_{2i}=0\right) = \Pr\left(y_{1i}^* > 0, y_{2i}^* \leq 0\right) = \Pr\left(\varepsilon_{1i} > -C_1, \varepsilon_{2i} \leq -C_2\right) \\ &= \Phi_2\left(C_1, -C_2; -\rho\right) \end{aligned} \tag{7}$$

$$\begin{aligned} S_3 &= \Pr\left(y_{1i}=0, y_{2i}=1\right) = \Pr\left(y_{1i}^* \leq 0, y_{2i}^* > 0\right) = \Pr\left(\varepsilon_{1i} \leq -C_1, \varepsilon_{2i} > -C_2\right) \\ &= \Phi_2\left(-C_1, C_2; -\rho\right) \end{aligned} \tag{8}$$

$$\begin{aligned} S_4 &= \Pr\left(y_{1i}=0, y_{2i}=0\right) = \Pr\left(y_{1i}^* \leq 0, y_{2i}^* \leq 0\right) = \Pr\left(\varepsilon_{1i} \leq -C_1, \varepsilon_{2i} \leq -C_2\right) \\ &= \Phi_2\left(-C_1, -C_2; \rho\right) \end{aligned} \tag{9}$$

where $C_t = x_{ti}\beta_t,\ t=1,2$ These probabilities will determine the structure of earnings equations. In case of non-employment, wages of women in S_3 and S_4 are not observed because they are not employed. In case of employment types, y_{Li} in Figure 3, all four cells are observed.

Since wages are observed only for employed labour, the conventional earnings functions for mothers and childless women have the form

$$\ln w_{1i} = \psi_1 z_{1i} + \varepsilon_{1wi} \;\; iff \;\; i \in S_1 \tag{10}$$

$$\ln w_{2i} = \psi_2 z_{2i} + \varepsilon_{2wi} \;\; iff \;\; i \in S_2 \tag{11}$$

when less demanding jobs are considered, wages are also observed for the other two cells, S_3 and S_4

$$\ln w_{3i} = \psi_3 z_{3i} + \varepsilon_{3wi} \;\; iff \;\; i \in S_3 \tag{12}$$

$$\ln w_{4i} = \psi_4 z_{4i} + \varepsilon_{4wi} \;\; iff \;\; i \in S_4 \tag{13}$$

where $\ln w_i$ denotes the natural logarithm of *i*th worker's wage, z_i denotes of the vector of exogenous variables that explain the worker's wage, ψ_i and ε_{wi} denotes the normally distributed disturbance term with zero mean, $E(\varepsilon_{wi}) = 0$ and $Var(\varepsilon_{wi}) = \sigma_w^2$. However, the expected value of the disturbance term is not necessarily zero if there is a selectivity bias due to relevant explanatory variables that are not available in the data (omitted variable bias) or due to individual self-selection. In this case, ordinary least squares estimates will generate inconsistent parameter estimates (Lee 1978; Heckman 1979). Following Heckman's procedure, these earnings equations derived as follows

$$E\left(\ln w_{1i} \middle| i \in S_1\right) = \psi_1 z_{1i} + \delta \, E\left(\varepsilon_{1wi} \middle| i \in S_1\right) \tag{14}$$

$$E\left(\ln w_{2i} \middle| i \in S_2\right) = \psi_2 z_{2i} + \delta \, E\left(\varepsilon_{2wi} \middle| i \in S_2\right) \tag{15}$$

$$E\left(\ln w_{3i} \middle| i \in S_3\right) = \psi_3 z_{3i} + \delta \, E\left(\varepsilon_{3wi} \middle| i \in S_3\right) \tag{16}$$

$$E\left(\ln w_{4i} \middle| i \in S_4\right) = \psi_4 z_{4i} + \delta E\left(\varepsilon_{2wi} \middle| i \in S_4\right) \tag{17}$$

Thus, the Heckman procedure suggests that the two selectivity variables should be included in earnings equation to correct for selectivity bias (Tunali 1985).

$$\ln w_{1i} = \psi_1 z_{1i} + \alpha_1 \lambda_{11i} + \delta_1 \lambda_{12i} + u_{1i} \tag{18}$$

$$\ln w_{2i} = \psi_2 z_{2i} + \alpha_2 \lambda_{21i} + \delta_2 \lambda_{22i} + u_{2i} \tag{19}$$

$$\ln w_{3i} = \psi_3 z_{3i} + \alpha_3 \lambda_{31i} + \delta_3 \lambda_{32i} + u_{3i} \tag{20}$$

$$\ln w_{4i} = \psi_4 z_{4i} + \delta_4 \lambda_{41i} + \delta_4 \lambda_{42i} + u_{4i} \tag{21}$$

where δ_1 and δ_k denotes the coefficients of selectivity variables λ_{1i} and λ_{1i} that are defined as

$$\lambda_{11} = \frac{\phi(C_1)\Phi(M_2)}{S_1}; \lambda_{12} = \frac{\phi(C_2)\Phi(M_1)}{S_1}; \lambda_{21} = \frac{\phi(C_1)\Phi(-M_2)}{S_2}; \lambda_{22} = -\frac{\phi(C_2)\Phi(M_1)}{S_2}$$

$$\lambda_{31} = -\frac{\phi(C_1)\Phi(-M_2)}{S_3}; \lambda_{32} = -\frac{\phi(C_2)\Phi(-M_1)}{S_3}; \lambda_{41} = -\frac{\phi(C_1)\Phi(-M_2)}{S_4}; \lambda_{42} = -\frac{\phi(C_2)\Phi(-M_1)}{S_4}$$

where $M_1 = \frac{C_1 - \rho C_2}{\sqrt{1-\rho^2}}$; $M_2 = \frac{C_2 - \rho C_1}{\sqrt{1-\rho^2}}$

ϕ is the univariate standard normal density function, Φ is the cumulative standard normal distribution and Φ_2 is the bivariate standard normal distribution function.

3.3 Wage differentials

Logarithmic wage differentials are decomposed into two main parts, following standard Oaxaca & Blinder method (Blinder 1973, Oaxaca 1973). First mean log wage differentials between mothers and childless women are decomposed as follows.

$$\overline{\ln W_N} - \overline{\ln W_M} = \hat{\beta}_N \left(\bar{X}_N - \bar{X}_M \right) + \bar{X}_M \left(\hat{\beta}_N - \hat{\beta}_M \right) \qquad (22)$$

where subscripts *N* and *M* refer to childless women and mothers respectively, beta-hat's denote estimated coefficients and X-bar's denote the mean of characteristics. The first term at the right hand side measures wage differentials due to worker characteristics, and second term measures the unexplained part of wage differentials between childless women and mothers. Note that disturbances are not included in the decomposition.

4 Data

We use the Work & IT 2001 survey, which derives from the computerized Telepanel collected by Center Data hosted by Tilburg University. This panel is a representative sample of the Dutch population. For our purpose, only women aged 16 to 64 have been selected. Data includes rich information on women who are employed and women who are not employed and not participating in the labor market. The questionnaire addresses current labor force status, actual and contractual hours of work, commuting, 13 questions address characteristics of the workplace, and remaining questions address individual and household characteristics. More specifically, data have information on actual labor market experience and tenure. Most research on Dutch women's wages lacks this important information. As regards employment experience the following questions are posed to persons who indicate that they have been engaged in employment: 'How many years have you been employed (excluding holiday jobs and weekend jobs). Please fill out each category that applies to you. If you do not know exactly the number of years, please estimate." The categories the respondent may choose are: number of years worked fulltime (more than 35 hours per week), number of years in part-time job with less than 12 hours per week, number of years in part-time work between 12 and 20 hours per week, number of years in part-time work between 20 and 30 hours per week, number of years in part-time work between 30 and 35 hours per week. These data have been used to construct actual experience in full-time equivalents (expfteq in Table 2). Furthermore the questionnaire addresses the calendar year of first employment, the calendar year in which first exit from the labor market for at least one year, the calendar year of first re-entry after the first exit, the calendar years of last exit for more than one year and corresponding re-entry, and the calendar years of exit and re-entry of the longest period of non-employment if at least one year. These data have been used to construct actual experience in calendar years (expcal in Table 2 below).

The relative small sample size of data used imposes an important restriction on analyses. We must conduct our analyses on mothers and childless women for a pool of all age categories although women from various birth cohorts would have different child bearing and

participation behaviour as argued in section 2. It may be expected that the existence and direction of sample selection bias can differ across birth cohorts. This restriction is partly relaxed by using three cohort dummies in regressions.

Table 2 Variable definitions

Variable Name	Definition
Dependent variables	
Employment decision	1 if works for pay, zero otherwise.
Motherhood decision	1 if children[11], zero otherwise
Type of employment decision: Less demanding job decision	1 if "clustered group variable" indicates less demanding job; zero otherwise. See for the definition of clustered group variable ***A***
Ln wage	The natural log of hourly wage from current job in NLG of 2001, excludes overtime pay, shift premium, bonus, commission, or allowances, but includes 8 per cent holiday premium in case such a premium is reported.[12]
Explanatory variables	
Age, Age2	Age in years; Age squared
Agecat1	1 if age>=20 and age<=36, zero otherwise
Agecat2	1 if age>36 and age<=46, zero otherwise
Agecat3	1 if age>46 and age<=64, zero otherwise
Education	Years of education (constructed from highest level completed (2: primary school, resp. 8: university))
Expcal	Years of employment experience in number of calendar years in which employed
Expfteq	Years of employment experience in fulltime full years equivalents
Tenure	Years worked for current employer
Situ02	1 if working hours are between 20 and 35; zero otherwise
Situ03	1 if working hours are less than 20, zero otherwise
Permanent	1 if permanent contract and temp preceding permanent; zero otherwise
Partner	1 if married/cohabiting, zero otherwise
Durpartn	Duration of current marital status in yrs.
Partnernw	1 if partner works >=30 hours pw, zero otherwise (incl no partner)
Paiddomhelp	1 if paid domestic help, zero otherwise
Urbanisation	Degree of urbanisation, 1 to 5; 1=highest, 5=lowest degree
Maincities	1 if lives in the three major cities, zero otherwise
Wishchild	1 if wish for (another) child in the next 3 years, zero otherwise
Fem80	1 if 80% of employees in establishment are female, zero otherwise

[11]. We have information on children living at home, and therefore lack information on children living independently or with a divorced parent other than the mother. However we have information on whether women were not employed for more than one year for the reason of caring for children. The reason caring for children is separated from caring for the household. We assume these women to be mothers, which is very likely, in the Dutch situation.

[12] In order to compare wages, the wages have been converted into hourly rates based on the number of hours per week and corrected for the period covered by the payment, which is usually one month, but could be four weeks or one week. In case the reported contractual hours per week was zero or close to zero, the actual worked hours have been used for the calculations. Furthermore we exclude self-employed and freelancers.

Fsize10	1 if number of employees less or equal to 10; zero otherwise.
Health_physical	1 if feels physically healthy; zero if not
Health_mental	1 if feels mentally healthy; zero if not
Volunteer[13]	1 if works as an unpaid volunteer, zero otherwise

A Clustered group variable uses the information on the following variables:

1. Hours	1 if <28 hrs pw, zero otherwise
2. Temp	1 if temporary contract[14], zero otherwise
3. No-supjob	1 if not employed in managerial job, zero otherwise
4. No-workhome	1 if not doing part of the job at home, zero otherwise
5. No-crsjob	1 if not attended courses or training in the past year because job does not require courses or training.
6. Fem80	1 if 80% of employees in establishment are female, zero otherwise
7. No-job3yrs	1 if expects not (sure) to be employed three years from now, zero otherwise.
8. No-ovtimewkly	1 if not working more than contractual hours on a weekly basis, zero otherwise
9. Commuteless	1 if commuting time less than half an hour to work place (one way), zero otherwise

Selection variables*

λ_{11} (S_1)	Measures the possible selection bias from the employment (type of employment) decision for mothers
λ_{12} (S_1)	Measures the possible selection bias from the motherhood decision for mothers
λ_{21} (S_2)	Measures the possible selection bias from the employment (type of employment) decision for childless women
λ_{22} (S_2)	Measures the possible selection bias from the motherhood decision for childless women
λ_{31} (S_3)	Measures the possible selection bias from type of employment decision for mothers
λ_{32} (S_3)	Measures the possible selection bias from the motherhood decision for mothers
λ_{41} (S_4)	Measures the possible selection bias from type of employment decision for childless women
λ_{42} (S_4)	Measures the possible selection bias from the motherhood decision for childless women

* Corresponding selections as in Figure 3 between brackets. S_3 and S_4 are only considered in the type of employment and motherhood decisions as in Figure 3b.

5 Determining less demanding jobs

We are interested in whether mothers are more likely to be in a type of job that is to be considered as less demanding as compared with more demanding jobs. With this relative concept of a type of job we aim to create a job category that cover jobs providing less attractive opportunities for earnings and promotion, and requiring relatively less effort. Less demanding jobs are approximated by available information in our data on time spent at work,

[13] An individual can be engaged in volunteer work on top of paid work, but not necessarily so. Volunteer work mostly involves sport clubs, churches, schools, care for elderly.

[14] This category excludes the temporary contracts that precede a permanent contract. In The Netherlands a person hired in a permanent position will dependent on negotiation between employer and employee, start with a temporary contract with a formal intention of changing the temporary contract into a permanent contract after one or two years. This period is different from the probation period of two months.

career effort and flexibility since there is no single indicator of less demanding jobs. Indeed, recent studies show that part-time jobs are paid similarly compared to full time jobs in the Dutch part-time economy.[15] An immediate implication of this evidence is that less demanding jobs cannot be constructed solely in terms of wage rates and working hours.

We distinguish between less demanding and other jobs by use of cluster analysis. The variables used are defined and reported in Table 2. Since all variables are binary, a simple Jaccard binary similarity index may be an appropriate measurement for less demanding jobs (Stata manual)[16]. This index, like many other indexes, is based on the four values from the cross tabulation of the two observations, *i* and *j*.

		Obs. *J*	
		1	0
Obs. *i*	1	a	b
	0	c	d

Every cell represents the number of variables where observations *i* and *j* have a combination of one or zero values. Jaccard index is defined as

$$\frac{a}{a+b+c}$$

which is the proportion of matches when at least one of the observations has a one. When both observations have a zero (cell *d*), this index is undefined. In this case, the index takes a one, which is a perfect match.

Using this similarity index, we split up the aggregate sample of employed workers into two categories: those who have a demanding job and those who have a less demanding job. As a starting variable we use the dummy variable (part-time) that takes a one if women work less than 28 hours in a week, and takes a zero if they work more than 28 hours. This critical point of working hours is in effect not arbitrary. It is determined by a policy that facilities workers who work more than 28 hours with equal rights as full-time workers, in order to keep both women and men employed in long part time jobs. Upon part-time, the definition of less demanding jobs is extended by additional variables in a rank order from more to less important (numbers 2-8 in Table 2). These additional variables are intuitively chosen on the basis of their expected unambiguous negative effort on career prospects. Temporary jobs do not provide a stable labour market career and will not be desired by career oriented employees. Jobs without any supervisory tasks may also be less demanding than jobs with supervisory tasks. We have information from earlier studies (Peters et al 2002) that taking work home is associated with high level knowledge workers rather than unskilled manual workers in the Netherlands. These knowledge workers are rewarded on the basis of the quality of their work rather than on their presence at the work place during business hours. Therefore we classify workers who take work home for a part of their working week as having a demanding job, whereas those workers who do not take work home as having less demanding jobs. Jobs that require no additional courses or training are supposed to be routine jobs demanding no additional hours out of working time or no additional effort per hour during working time. Jobs in a female dominated environment are known as less promising jobs with respect to promotion and earnings profile. Expectations on employment continuity

[15] 67.6% of employed women working part-time i.e. less than 35 hours per week. Also with respect to parttime employment among men the Netherlands ranks 1 with 18 per cent (Gustafsson, Kenjoh and Wetzels, 2002). The effect of working part-time on hourly wages is small. However, the sign and significance are not unambiguous (see Gustafsson et al 2002; Wetzels 2002; Zorlu 2002: Dekker et al 2000).

[16] The choice of the Jaccard similarity index is arbitrary since there are many similarity measures.

given by no job in three years time is taken as an indication for a weak commitment to have a continuous labour market career. Similarly we interpret limiting the work effort by contractual hours and restricting commuting time as indications confirming less time and effort to work.

Table 3 presents the summary of statistics for (less) demanding jobs resulting from the cluster analysis and used as a dependent variable in our analyses.

Table 3: Type of employment: summary of statistics for (less) demanding jobs

	Employment		Less demanding jobs		Demanding jobs	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1. Hours	0.519	0.50	0.920	0.27	0	0
2. Temp	0.088	0.28	0.136	0.34	0.027	0.16
3. No-supjob	0.802	0.40	0.868	0.34	0.716	0.45
4. No-workhome	0.666	0.47	0.753	0.43	0.554	0.50
5. No-crsjob	0.163	0.37	0.272	0.45	0.023	0.15
6. Fem80	0.232	0.42	0.258	0.44	0.198	0.40
7. No-job3yrs	0.098	0.30	0.164	0.37	0.014	0.12
8. No-ovtimewkly	0.749	0.43	0.819	0.39	0.658	0.48
9. Commuteless	0.774	0.42	0.847	0.36	0.680	0.47
N	509		287		222	
Lnhrlywage	3.261	0.40	3.187	0.46	3.349	0.30
N	459		250		209	

Data: Work&IT 2001, Variable definitions in Table 2. Mean parameter values for employment are equal to the weighted average of mean values for demanding and less demanding jobs.

We expect more mothers in less demanding jobs because passive fathering styles are still the dominant pattern, childcare is highly rationed, and school hours do not fit fulltime career schedules or even long part time career schedules. Additionally, Dutch mothers are tended to put their children in paid childcare for a maximum of 3 days per week and to care for their own children for the rest of week. Therefore, more employed mothers will seek part-time jobs that require less commuting, with fixed hours of work, with possibilities to take leave easily for reasons of care in case of illness and other unexpected events. Furthermore, we expect more mothers in jobs that are less stressful since mothers may already experience more stress from their child-related responsibilities compared to childless women and men.

6 Results and interpretation

We estimate two double selection models separately. The first model describes a double selection process on motherhood and employment decisions which we assume to be taken simultaneously, and the second model concerns a simultaneous selection on the decisions on motherhood and employment in a less demanding job (as described in section 3). Our results from both models are presented in Table 4.

6.1 Motherhood and employment decisions

The left panel of Table 4 shows the estimated coefficients for the motherhood and employment decisions that are simultaneously estimated by bivariate probit model. The parameter vectors in the first and second equation are identified since at least one variable is included in one of the variable vectors (X or Z) but not in the other (Abowd and Farber 1982). The correlation between the disturbances of employment decision and motherhood decision in

the simultaneous bivariate probit model, given by (ρ), is significantly negative which implies that bivariate probit model provide efficient results in our estimations, and an estimation procedure relying on a binomial probit model would have left the sample selection problem unsolved. This negative rho indicates that mothers who are employed have more favorable characteristics than mothers who are not employed, and childless women (both in paid work and not in paid work), which is in line with human capital theory.

Women from older birth cohorts have a significantly low probability of participation while they are more likely a mother, suggesting the decreasing fertility rate. The accumulation of human capital, represented by education and experience, has a positive effect on employment probability and a negative effect on motherhood confirming earlier studies (Blossfeld and Rower (1995), Gustafsson, Kenjoh and Wetzels 2002, Wetzels 2002). It is notable that the first effect is larger than the second in absolute terms, which suggests a relatively strong labour market orientation of well-educated women. Also women involved in voluntary work are more likely employed while physical health problems significantly lower the employment probability. The employment inclination of women is not affected by whether or not their partner is employed. It is obvious that the presence of partner has the largest impact on the probability of being mother. Living in residential areas with a low degree of urbanization increases the probability of being mother. This supports the assumption that people prefer to live or to move toward less urbanized residential areas when they have or want to have child(ren).[17]

6.2 Motherhood and less demanding job decisions

The simultaneous decisions for employment in a less demanding job and motherhood are estimated by bivariate probit model. The right panel of Table 4 presents the estimated coefficients of this double selection model. The estimated correlation between the disturbances of the two selection equations, *rho,* is highly significant and positive. This indicates that mothers are more likely employed in less demanding jobs compared to childless women[18]. Since a vast majority of mothers are employed in part-time jobs, mothers are more likely employed in a less demanding job than employed childless women.

Table 4 Bivariate probit estimates: Motherhood and (type of) employment decisions

	Motherhood Decision		Motherhood decision	
	Coeff.	T	Coeff.	t
Agecat2	0.716	4.85	0.900	4.92
Agecat3	0.426	2.42	0.751	2.56
Partner	1.595	10.07	1.424	7.80
Expcal	-0.017	-2.47	-0.020	-1.77
Yrseduc	-0.077	-2.52	-0.095	-2.79
Wish_Child	-0.302	-1.57	-0.149	-0.80
Urbanis.	0.178	3.98	0.148	2.91
Constant	-0.474	-0.93	-0.158	-0.27
Employment Decision			Less Demanding Job Decision	
Agecat2			0.659	4.03
Agecat3			0.713	3.18
Expcal	0.051	6.01	-0.009	-0.99
Yrseduc	0.212	6.22	-0.081	-2.46

[17] see Murphy & O'Sullivan (1985) analysing this assumption in Britain, and Mulder and Wagner (2001) in The Netherlands and Germany.

[18] This correlation does not give any indication for which decision is made first. Whether mothers choose to work in less demanding jobs or whether women employed in less demanding jobs become mother are investigated in section 7.

Partnw	0.005	1.64		0.016	4.71
Health_Phys	-0.893	-6.18		0.047	0.22
Volunteer	0.530	4.63	Paiddomhelp	-0.558	-3.45
Constant	-3.075	-5.21		0.712	1.23
Rho	-0.250	-2.81		0.509	7.68
N	719			503	

Data: Work&IT 2001, Variable definitions in Table 2.

The likelihood that older age cohorts (36-45 and 46-64) are mothers and employed in less demanding jobs is significantly larger compared to the women below 36 years. The relatively low coefficient for age cohort 46-64 in motherhood equation and a bigger coefficient in the less demanding job equation implies a low employment rate of women from this cohort and at the same time a high concentration in less demanding jobs. The estimated coefficients of motherhood model are similar to the coefficients in the earlier double selection model presented in section 6.1. Education decreases the likelihood of employment in less demanding jobs but experience and physical health have no effect on this likelihood. Also paid domestic help significantly lowers the likelihood of having a less demanding job. However, this relationship might be the other way around: women employed in less demanding jobs may have less frequently paid domestic help, which we do not verify here.

6.3 Selectivity corrected wage regressions

Wage equations for mothers and childless women are estimated separately twice: with and without the selection correction terms (lambda's). The estimates are presented in Table 5.

6.3.1 Wages of Mothers and childless women

It is notable that the highest obtained level of education has a larger effect on mothers' gross hourly wage than childless women's, 6.3% versus 4%. Years of experience increases the wages of childless women by 3% at a decreasing rate but it has no effect on mothers' wage which seems, instead, to be affected by tenure. No other explanatory variable is significant in the wage regression of childless women while some other variables are significant in the mothers' wage regression. Mothers who are employed in firms with less than 10 employees and who live in the three largest Dutch cities earn respectively 14.3% and 26.3% less hourly wages than other mothers. On the other hand, mother earn significantly higher wages (32.5%) when they have a permanent employment contract.

The selectivity correction variables, which are our main interest, are not significant in the wage regression of childless women, as expected since these variables are based on underlying correlation between the disturbances of the employment and the motherhood decisions. However, first and second selectivity variables are significant at 10 and 5 percent levels respectively in mothers' wage regressions.

Table 5 Wage regressions by motherhood

	Childless women		Mothers		Childless women		Mothers	
	coeff	t	Coeff	t	coeff	t	coeff	t
Yrseduc	0.040	3.20	0.063	4.55	0.046	3.90	0.064	4.49
Expcal	0.030	3.90	0.019	1.60	0.028	3.72	0.005	0.41
expcal2	-0.000	-2.76	-0.000	-0.73	-0.000	-2.55	0.000	0.12
Tenure	0.006	1.77	0.012	3.31	0.006	1.73	0.013	3.47
Health_phys	0.046	0.55	-0.067	-0.67	0.033	0.39	0.048	0.51
Fsize10	-0.016	-0.23	-0.143	-2.41	-0.011	-0.16	-0.127	-2.12
Health_mental	0.046	0.47	-0.103	-0.76	0.054	0.55	-0.099	-0.72
Maincities	0.021	0.39	-0.263	-2.29	0.047	0.90	-0.169	-1.52

Parttime short	-0.109	-1.23	-0.011	-0.22	-0.146	-1.70	-0.008	-0.16
Perm	-0.031	-0.38	0.325	4.39	-0.018	-0.22	0.332	4.48
Fem80	-0.096	-1.57	-0.086	-1.62	-0.095	-1.54	-0.080	-1.48
Lambda21	0.014	0.27	0.072	1.81				
Lambda22	0.058	0.90	0.373	2.86				
Constant	2.404	8.68	1.752	5.47	2.281	8.68	1.965	6.19

Data: Work&IT 2001, Variable definitions in Table 2.

6.3.2 Wages of Mothers and childless women in (less) demanding jobs

The estimates of the wage equations for mothers and childless women who are employed in less demanding jobs or demanding jobs are presented in Table 6. Both selectivity correction terms are significantly positive for mothers in less demanding jobs while they are significant for childless women in demanding jobs (having different signs).

It is notable that only the coefficient for permanent contract is significant at a 10 percent level, indicating a 35.4% lower wage rate relative to those who have a permanent contract. On the contrary, mothers earn 29.8% higher hourly wage if they have a permanent contract. Also tenure has a small positive effect on mothers' wage. Mothers employed in small firms (less than 10 employees) have an 18.6% lower wage rate.

Considering demanding jobs, return to education is similar for mothers and other women around 5% while experience has significant positive effect on the wages of childless women. Again mothers with a permanent contract earn substantially higher wages than mothers with a temporary contract, (46.2%) while having a mental health problem and living in the three largest cities drastically lower the hourly wages of mothers.

Table 6 Wage regressions by type of employment and motherhood

	Childless wo.		Mothers		Childless women		Mothers	
Less demanding job	Coeff	t	Coeff	t	Coeff	t	Coeff	t
Yrseduc	-0.027	-1.17	0.034	1.56	-0.009	-0.47	0.058	2.92
Expcal	0.050	1.60	0.005	0.25	0.042	1.37	-0.003	-0.14
expcal2	-0.001	-1.58	0.000	0.18	-0.001	-1.29	0.000	0.47
Tenure	0.007	0.93	0.015	3.63	0.006	0.64	0.016	3.86
health_phys	0.333	1.44	-0.034	-0.47	0.352	1.42	0.008	0.09
fsize10	-0.145	-0.72	-0.186	-2.48	-0.169	-0.84	-0.176	-2.29
health_mental	0.227	1.17	-0.083	-0.77	0.178	0.89	-0.101	-0.86
Maincities	-0.048	-0.30	-0.203	-1.60	0.061	0.42	-0.132	-1.10
parttime_short	-0.059	-0.33	0.019	0.36	-0.062	-0.35	0.021	0.38
perm	-0.354	-1.93	0.298	2.27	-0.223	-1.23	0.305	2.38
Fem80	-0.214	-0.99	-0.095	-1.42	-0.217	-0.92	-0.097	-1.44
Lambda21	0.120	1.05	0.124	2.68				
Lambda22	0.014	0.21	0.364	2.17				
Constant	3.131	5.19	2.232	5.50	2.620	4.58	2.128	5.15
Demanding jobs								
Yrseduc	0.051	4.29	0.057	3.02	0.060	4.98	0.052	2.74
Expcal	0.026	3.13	0.022	1.55	0.023	2.76	0.020	1.48
expcal2	-0.000	-1.91	-0.000	-0.69	-0.000	-1.58	-0.000	-0.64
Tenure	0.002	0.68	0.000	0.04	0.002	0.70	-0.001	-0.12
health_phys	-0.154	-1.82	0.017	0.13	-0.151	-1.60	0.057	0.41
fsize10	0.052	0.67	0.116	0.87	0.026	0.32	0.106	0.82
health_mental	-0.068	-0.64	-0.416	-2.67	-0.053	-0.47	-0.420	-2.44

maincities	0.036	0.67	-0.242	-4.08	0.012	0.23	-0.256	-4.54
Parttime_short	-0.225	-3.67	-0.078	-0.45	-0.162	-3.14	-0.045	-0.26
Perm	0.019	0.15	0.462	3.28	0.039	0.30	0.454	3.00
fem80	-0.046	-0.90	-0.131	-1.25	-0.058	-1.15	-0.131	-1.29
Lambda41	0.287	3.54	0.017	1.00				
Lambda42	-0.169	-2.91	-0.079	-1.06				
Constant	2.612	7.72	2.172	4.25	2.379	6.80	2.316	4.57

Data: Work&IT 2001, Variable definitions in Table 2.

6.4 Wage differentials

Wage differentials between childless women and mothers are decomposed in two alternative ways using the standard Oaxaca & Blinder decomposition technique, given in equation 22. The first decomposition is based on wage regressions that are corrected for the selectivity from bivariate probit model for employment and motherhood decisions. Second decomposition is based on the wage regressions that are corrected for the selectivity from bivariate probit model for motherhood and type of employment decisions. In order to show the efficiency of correction for double selectivity, all decompositions are repeated using wage regressions without any correction.

Note that including selection correction terms leads to large changes in all components of decomposition although absolute extend of wage differentials remain similar (see table 7). It is obvious that the discrimination component of decompositions is substantially larger when the selectivity correction terms are included in wage regressions compared to the decomposition without the correction. Most striking result is that the mothers in less demanding jobs earn 37 percent lower wages than childless women due to discrimination while mothers in demanding jobs earn, however, 20.5 percent higher wages than childless women. As the estimates of wage regressions are not corrected for sample selection, wage differentials due to discrimination is negligible for mothers employed in demanding jobs while in less demanding jobs mothers are disadvantaged by a 4 percent.

Table 7 Decomposition of wage differentials between childless women and mothers in percentages

	EMPLOYMENT		LESS DEMANDING		DEMANDING	
	with correction for selectivity	without correction	with correction for selectivity	without correction	with correction for selectivity	Without correction
Total attributable (A+B)	9.2	9.0	6.5	5.8	-4.5	-4.5
A. due to endowments	-5.8	4.2	-30.6	1.7	16.0	-4.1
B. due to discrimination	15.0	4.8.0	37.1	4.1	-20.5	-0.4
B.1 coefficients	-50.2	-26.8	-52.8	-45.1	-64.6	-6.7
B.2 unexplained (constant)	65.2	31.6	89.9	49.2	44.1	6.3

	Endow.	Coeff.	Endow.	Coeff.	Endow.	Coeff.	Endow.	Coeff.	Endow.	Coeff.	Endow	Coeff.
Yrseduc	4.2	-31.8	4.8	-24.5	-3.0	-82.9	-1.1	-91.6	1.6	-8.6	1.9	12.4
Expcal	-7.4	18.3	-7.1	40.8	0.3	77.4	-0.6	75.1	-10.8	7.3	-9.5	6.4
expcal2	0.7	-9.9	0.7	-17.6	-11.2	-35.2	-8.0	-32.3	3.8	-3.9	3.1	-2.5
Tenure	-0.5	-5.1	-0.6	-5.8	0.1	-5.7	0	-7.9	-0.5	1.8	-0.5	2.9
health_phys	0.2	12.1	0.1	-1.6	2.3	38.9	2.4	36.6	0	-18.7	0	-22.8
fsize10	0.2	3.0	0.1	2.8	0.9	1.0	1.1	0.2	-0.3	-1.2	-0.2	-1.5
health_mental	-0.2	14.4	-0.2	14.8	-0.5	29.9	-0.3	26.8	0.4	34.1	0.3	36.1
Maincities	0.4	1.4	1.0	1.0	-1.1	0.9	1.3	1.1	0.8	0.5	0.3	0.5
parttime_short	3.3	-3.8	4.4	-5.4	1.0	-3.9	1.0	-4.1	0.3	-0.3	0.2	-0.2
Perm	0	-31.4	0	-30.9	4.4	-56.1	3.1	-45.4	0	-42.7	-0.1	-40
fem80	1.0	-0.3	1.0	-0.4	2.7	-3.5	2.8	-3.5	0.3	2.2	0.4	1.9
lambda21	-1.5	-2.8			-24	-0.1			31.3	-45.4		
lambda22	-6.0	-14.4			-2.8	-13.5			-10.9	10.3		
SUB-total	-5.8	-50.2	4.2	-26.8	-30.6	-52.8	1.7	-45.1	16	-64.6	-4.1	-6.7

Data: Work&IT 2001, Variable definitions in Table 2.

7 Conclusions

It is evident that mothers earn lower wages than childless women. Academic debate focuses on the question to what extent wage differentials between childless women and mothers can be explained by strictly human capital depreciation due to timeout during childbearing and caring, and what other factors play a role in explaining this wage gap. This paper analyzes this wage gap correcting the sample selection bias arising from two alternative bivariate selection processes: motherhood and employment decisions, and motherhood and less demanding job decisions. It is shown that the motherhood decision is significantly correlated with the employment decision and the employment decision in less demanding jobs. Correcting the wage function for these underlying double selection processes provides more efficient results compared the estimates without correction for sample selection bias. Although the overall wage gap between mothers and childless women remains similar across both estimation strategies, the estimates based on selectivity corrected wage functions generates a significantly higher discrimination component of the wage gap. Our results suggest that estimation of the wage gap should take into account the selectivity bias arisen from double selection rules.

8 References

Abowd, J.M. and Farber 1982 Job queues and the union status of workers. *Industrial and Labor Relations Review*, 43, 354-367

Albrecht James W., Per-Anders Edin, Marianne Sundström and Susan B. Vroman 1999, Career Interruptions and Subsequent Earnings: A Reexamination Using Swedish Data, *Journal of Human Resources* XXXIV 2, 295-311.

Anderson Deborah J., Melissa Blinder and Kate Krause 2002a, The motherhood wage penalty revisited: experience, heterogeneity, work effort and work schedule flexibility, *Industrial and Labour Relations Review*, forthcoming.

Anderson Deborah J., Melissa Blinder ad Kate Krause 2002b, The motherhood wage penalty: which mothers pay it and why? *American Economic Review*, papers and proceedings (May) vol 92.No 2. pp 354-358.

Blinder A. Wage discrimination: reduced form and structural estimates, *Journal of Human Resources*: 8, 436-455.

Blossfeld H.P. and G. Rower 1995. New developments in family and women's improvement in educational attainments in the Federal Republic of Germany. In: H.P> Blossfeld The new role of women in family formation in modern society, Boulder: Westview Press 56-76.

Bosveld, W. 1996. *The Ageing of Fertility in Europe: A Comparative Demographic-Analytic Study*. PDOD. Amsterdam: Thesis Publishers.

Datta Gupta Nabanita and Nina Smith 2002, Children and Career interruptions: The Family Gap in Denmark, *Economica* vol.69, no 276, pp 609-629.

Esping Andersen G. 1990, *The Three Worlds of Welfare Capitalism*. Princeton: Princeton University Press.

Fische R.P.H., R.P. Trost, P.M. Lurie 1981, Labor force earnings and college choice of young women: an examination of selectivity bias and comparative advantage, *Economics of Education Review*, 1, 2,169-191.

Gronau Rueben 1988, Sex related wage differentials and women's interrupted labor careers- the Chicken or the Egg", *Journal of Labor Economics*, 6(3) 277-301.

Gustafsson Siv, Eiko Kenjoh and Cecile Wetzels, Employment Choices and Pay Differences between Non-Standard and Standard Work in Britain, Germany, Netherlands and Sweden, Paper prepared for Houseman, S. and Osawa, M. (eds.) *Nonstandard Work Arrangements in Japan, Europe, and the United States*, Upjohn Institute for Employment Research.

Gustafsson, S.S., Kenjoh, E. and Wetzels, C.M.M.P., 2002. The Role of Education on Postponement of Maternity in Britain, Germany, the Netherlands and Sweden. In Ruspini, E. and Dale, A. (eds.) *The Gender Dimension of Social Change: The Contribution of Dynamic Research to the Study of Women's Life Courses*. Policy Press, Bristol, p. 59-84.

Harkness Susan and Jane Waldfogel Forthcoming, The family gap in pay: Evidence from seven industrialised countries. *Journal of Labour Research* previously circulated as Center for Analysis of Social Exclusion paper 30, London School of Economics, November.

Heckman, James, 1979 Sample selection bias as a specification error, *Econometrica* 47, 153-61.

Joshi Heather, Pierella. Paci and Jane Waldfogel 1999, The wages of motherhood: better or worse? *Cambridge Journal of Economics*, 23, 543-564.

Kohler Hans-Peter and Jose Antonio Ortega 2002, Tempo-Adjusted Period Parity Progression Measures: Assessing the Implications of delayed childbearing for cohort fertility in Sweden, The Netherlands and Spain, *Demographic Research*, volume 6, Article 7, Published March. Max Planck Gesellschaft. www.demographic-research-org.

Lee L 1978, Unionism and wage rates: a simultaneous equations model with qualitative and limited

dependent variables, *International Economic Review* 19: 415-433.

Maddala G.S. 1983 *Limited dependent and qualitative variables in econometrics*, Econometric Society Monographs, Cambridge University Press.

Meng C.L. and P. Schmidt 1985 On the cost of partial observability in the bivariate probit model, *International Economic Review*, 26,1-19.

Oaxaca, R. L. 1973, Male-female wage differentials in urban labour markets, *International Economic Review* 14, 693-709.

Peters, P., Tijdens K.G. and C.M.M.P. Wetzels 2002, Employees' opportunities, preferences and practices in telecommuting adoption, submitted.

Poirier D. 1980, Partial Observablity in bivariate probit models, *Journal of Econometrics* 12, 209-217.

Sainsbury, D. 1996. *Gender, Equality and Welfare States*. Cambridge: Cambridge University Press.

Sorensen Elaine (1989) Measuring the pay disparity between typically female occupations and other jobs: A bivariate selectivity approach, *Industrial and labor relations review* Volume 42, issue 4 (July) 624-639.

Statistics Netherlands 2002, *Statline*.

Tunali Insan (1986) A General Structure for Models of Double Selection And An Application To A Joint Migration/Earnings Process With Remigration, *Research in Labour Economics*, volume 8, part B, pages 235-282.

Van Ven, W.P.M.M. and B.M.S. van Praag (1981). The demand for deductibles in private health insurance. A probit model with sample selection. *Journal of Econometrics,*17, 229-252

Waldfogel Jane 1995, The price of motherhood: family status and women's pay in a young British cohort, *Oxford Economic Papers* 47, 584-640.

Wetzels, C.M.M.P. 2001. *Squeezing Birth into Working Life, household panel data analysis comparing Britain, Germany, the Netherlands and Sweden*. Ashgate Publishing Ltd. Aldershot, Hampshire.

Wetzels, C.M.M.P. 2002. A Review on Motherhood and Wages, in: State of the Art Report to the European Commission, The Rationale of Motherhood Choices: Influence of Employment Conditions and of Public Policies, September.

Wetzels, C.M.M.P. 2002. Does motherhood really make women less productive? The case of the Netherlands, Working Paper presented to EALE 2002 conference, Paris.

Zorlu, Aslan 2002, Absorption of Immigrants in European Labour Markets, The Netherlands, United Kingdom and Norway, doctoral dissertation, Tinbergen Institute Research Series no 279.

Appendix Table A1: Wage regressions: All Women

	Coeff	t	Coeff	t	Coeff	t
Age					-0.006	-2.05
Yrseduc	0.061	6.80	0.060	6.62	0.061	6.71
Expcal	0.022	3.40	0.020	3.07	0.024	3.56
Expcal2	-0.000	-2.40	-0.000	-1.94	-0.000	-1.84
Tenure	0.013	4.94	0.010	3.82	0.010	3.89
Health_phys			0.032	0.51	0.031	0.50
Fsize10			-0.092	-2.04	-0.086	-1.90
Health_mental			-0.022	-0.28	-0.016	-0.20
Maincities			-0.014	-0.29	-0.017	-0.34
Parttime_long			-0.006	-0.16	-0.024	-0.59
Perm			0.215	4.08	0.199	3.76
Fem80			-0.093	-2.29	-0.089	-2.20
Kid	-0.087	-2.36	-0.062	-1.64	-0.042	-1.04
Constant	2.110	13.87	1.991	9.93	2.142	10.12
R^2	0.21		0.27		0.280	
Age	0.050	3.65	0.042	3.05		
Agesq	-0.001	-3.54	-0.000	-2.85		
Yrseduc	0.058	6.42	0.056	6.17		
Tenure	0.017	7.03	0.014	5.63		
Health_phys			0.043	0.68		
Fsize10			-0.093	-2.05		
Health_mental			-0.034	-0.42		
Maincities			-0.001	-0.01		
Parttime_long			-0.002	-0.05		
Perm			0.204	3.80		
Fem80			-0.086	-2.11		
Kid	-0.093	-2.50	-0.067	-1.76		
Constant	1.374	4.52	1.395	4.26		
R^2	0.21		0.26			
Age					-0.006	-2.57
Yrseduc	0.064	7.30	0.062	6.99	0.064	7.17
Expfteq	0.032	4.75	0.028	4.17	0.034	4.79
Expft2	-0.001	-2.74	-0.000	-2.19	-0.000	-2.38
Tenure	0.009	3.69	0.007	2.87	0.008	3.25
Health_phys			0.017	0.28	0.016	0.26
Fsize10			-0.096	-2.18	-0.093	-2.12
Health_mental			-0.029	-0.37	-0.020	-0.26
Maincities			-0.005	-0.1	-0.004	-0.08
Parttime_long			-0.007	-0.21	0.010	0.25
Perm			0.194	3.74	0.178	3.43
Fem80			-0.082	-2.07	-0.074	-1.87
Kid	-0.050	-1.40	-0.025	-0.67	-0.002	-0.04
Constant	2.035	14.07	1.974	10.37	2.102	10.56
R^2	0.25		0.300		0.31	

Data: Work&IT 2001, Variable definitions in Table 2.

	all		Mothers		Employed		Less demanding job		Demanding jobs	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
kid	0.615	0.49	1	0.00	0.564	0.50	0.780	0.41	0.284	0.45
Age	41.004	11.07	42.805	9.90	38.289	9.76	39.547	9.48	36.662	9.90
agecat1	0.384	0.49	0.281	0.45	0.470	0.50	0.390	0.49	0.572	0.50
agecat2	0.298	0.46	0.378	0.49	0.310	0.46	0.380	0.49	0.221	0.42
agecat3	0.318	0.47	0.341	0.47	0.220	0.41	0.230	0.42	0.207	0.41
Yrseduc	13.826	2.05	13.425	1.79	14.155	1.98	13.782	1.82	14.639	2.08
Expcal	14.102	9.95	14.084	8.75	16.102	9.92	16.707	9.44	15.320	10.49
Expfteq	11.395	8.26	10.668	6.48	11.956	8.31	11.266	7.38	12.845	9.33
Tenure	7.650	7.93	8.094	7.37	7.697	7.96	7.728	8.08	7.658	7.83
situ01	0.207	0.41	0.069	0.25	0.305	0.46	0.045	0.21	0.640	0.48
situ02	0.265	0.44	0.266	0.44	0.387	0.49	0.425	0.50	0.338	0.47
situ03	0.177	0.38	0.236	0.43	0.261	0.44	0.453	0.50	0.014	0.12
Perm	0.769	0.42	0.727	0.45	0.843	0.36	0.777	0.42	0.928	0.26
Partner	0.818	0.39	0.959	0.20	0.788	0.41	0.909	0.29	0.631	0.48
Partnw	27.817	18.73	33.331	15.55	27.487	19.05	32.231	16.23	21.376	20.64
Durprtn	3.207	4.51	4.067	4.21	2.513	2.22	3.174	2.11	1.658	2.05
Wish_child	0.089	0.28	0.069	0.25	0.112	0.32	0.098	0.30	0.131	0.34
Paiddomhelp	0.160	0.37	0.142	0.35	0.171	0.38	0.122	0.33	0.234	0.42
Urbanization	3.032	1.29	3.322	1.20	2.935	1.30	3.094	1.29	2.730	1.29
Maincities	0.125	0.33	0.060	0.24	0.147	0.35	0.118	0.32	0.185	0.39
fem80	0.158	0.37	0.167	0.37	0.232	0.42	0.258	0.44	0.198	0.40
fsize10	0.135	0.34	0.152	0.36	0.196	0.40	0.237	0.43	0.144	0.35
Health_phys	1.141	0.35	1.133	0.34	1.084	0.28	1.077	0.27	1.095	0.29
Health_mental	0.937	0.24	0.951	0.22	0.953	0.21	0.962	0.19	0.941	0.24
Volunteer	1.692	0.46	1.644	0.48	1.741	0.44	1.700	0.46	1.793	0.41
N	758		466		509		287		222	
Ln wages for employed			3.220	.43	3.261	0.40	3.187	0.46	3.349	0.30
N if employed			251		459		250		209	

Appendix Table A2: Descriptive Statistics: Motherhood & (Type) of employment. Data: Work&IT 2001, Variable definitions in Table 2.

Working Papers - NIMA series

No.

1. Lígia Pinto , Glenn Harrison, *Multilateral negotiations over climate change policy*, May 2000

2. Paulo Guimarães, Douglas Woodward, Octávio Figueiredo, *A tractable approach to the firm location decision problem*, May 2000

3. Miguel Portela , *Measuring skill: a multi-dimensional index*, September 2000

4. Rosa Branca Esteves , Paulo Guimarães, *Price discrimination and targeted advertising: a welfare analysis*, November 2000

5. Anabela Botelho , Lígia Pinto , *Has Portugal gone wireless? Looking back, looking ahead*, December 2000

6. Pedro Barros, Clara Dismuke , *Hospital production in a national health service: the physician's dilemma*, December 2000

7. Anabela Botelho , Mark A. Hirsch, Elisabet E. Rutström, *Culture, nationality and demographics in ultimatum games*, December 2000

8. Miguel Portela , *The impact of segregation on wage inequality: a look at recruitment and pay policies at the firm level*, January 2001

9. Pedro Portugal, Ana Rute Cardoso, *Disentangling the minimum wage puzzle: an analysis of job accessions and separations from a longitudinal matched employer-employee data set*, April 2001

10. Ana Rute Cardoso, Priscila Ferreira , *The dynamics of job creation and destruction for University graduates: why a rising unemployment rate can be misleading*, May 2001

11. Octávio Figueiredo, Paulo Guimarães, Douglas Woodward, *Asymmetric information and location*, July 2001

12. Anabela Botelho , Lígia Pinto , *Hypothetical, real, and predicted real willingness to pay in open-ended surveys: experimental results*, September 2001

13. Anabela Botelho , Lígia Pinto , Miguel Portela , António Silva, *The determinants of success in university entrance*, September 2001

14. Anabela Botelho , *Strategic behavior at trial. The production, reporting, and evaluation of complex evidence*, September 2001

15. Paulo Guimarães, *The state of Portuguese research in economics: an analysis based on publications in international journals*, September 2001

16. Anabela Botelho , Glenn Harrison, Marc Hirsch, Elisabet E. Rutström, *Bargaining behavior, demographics and nationality: a reconsideration of the experimental evidence*, December 2001

17. João Cerejeira da Silva , *Identification of the Portuguese industrial districts*, February 2002

18. Octávio Figueiredo, Paulo Guimarães, Douglas Woodward, *Modeling industrial location decisions in U.S. Counties*, April 2002

19. Aslan Zorlu , Joop Hartog, *The effect of immigration on wages in three European countries*, October 2002

20. Elvira Lima , David K. Whynes, *Finance and performance of Portuguese hospitals*, February 2003

21. Aslan Zorlu , *Do ethnicity and sex matter in pay? Analyses of 8 ethnic groups in the Dutch labour market*, June 2003

22. Cécile Wetzels , Aslan Zorlu , *Wage effects of motherhood: a double selection approach*, June 2003

23. Natália Barbosa , *What drives new firms into an industry? An integrative model of entry*, October 2003

24. Elvira Lima , Teresa Josefina Lopes Esquerdo , *The economic costs of alcohol misuse in Portugal*, October 2003

25. Anabela Botelho , Lígia Pinto , Isabel Rodrigues , *How to comply with environmental regulations?The role of information*, October 2003

26. Natália Barbosa , Helen Louri, *Corporate performance: does ownership matter? A comparison of foreign - and domestic - owned firms in Greece and Portugal*, October 2003

27. Anabela Botelho , Lígia Pinto , *Students' expectations of the economic returns to college education. Results of controlled experiment*, December 2003

28. Paula Veiga , *Income-related health inequality in Portugal*, July 2005

29. Anabela Botelho , Glenn Harrison, Lígia Pinto , Elisabet E. Rutström, *Testing static game theory with dynamic experiments: a case study of public goods*, November 2005

30. Anabela Botelho , Glenn Harrison, Lígia Pinto , Elisabet E. Rutström, *Social norms and social choice*, November 2005

31. Anabela Botelho , Glenn Harrison, Lígia Pinto , Elisabet E. Rutström, Paula Veiga , *Discounting in developing countries: a pilot experiment in Timor-Leste*, November 2005

32. Paula Veiga , Ronald P. Wilder , *Maternal smoking during pregnancy and birthweight - A propensity score matching approach*, January 2006

The Working Papers of the Applied Microeconomics Research Unit (NIMA) can be downloaded in PDF format from http://nima.eeg.uminho.pt

---