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Selection Bias and Unobservable Heterogeneity applied at the Wage Equation of European Married Women

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Abstract

This paper utilizes a panel data sample selection model to correct the selection in the analysis of longitudinal labor market data for married women in European countries.

We estimate the female wage equation in a framework of unbalanced panel data models with sample selection. The wage equations of females have several potential sources of bias so in this paper a panel data estimator, a test for selection bias and a correction procedure are used.

JEL. classification: *J2, J3, C2, C3*

Keywords: *Female participation, labor supply, family benefits, unbalanced panel data*

Introduction

If equation of interest is only defined for non random sub-sample of population while the parameters of interest are defined for the whole population, OLS estimation could lead to inconsistence premier estimates, due to unobservable heterogeneity and selection bias.

The wage equation of females have the following potential sources of bias: first, unobserved heterogeneity for unobserved worker characteristics (ability); second, sample selection bias which occurs if unobservable characteristics, that affect the work decision, are correlated with characteristics that affect the process determining the wage.

In this paper we calculate the female wage equation in a structure of panel data models with sample selection. Due to the increased availability of longitudinal data and recent theoretical advances, panel data are now usually used in applied work in micro-econometrics.

The hourly wage is taken from the supporting equation which is a standard Mincer wage equation with independent variables containing experience, experience squared and the education level. First we assume that there isn't sample selection so we use an OLS estimate. Then we fit the wage equation with the Heckman model in a framework of panel data sample selection.

The objective of this paper is to demonstrate, using the panel data applied to the European female wage equation, the impact of selection bias on the estimated coefficients.

Recently some estimators have been proposed to solve the problem of estimation bias using the panel data technique. Verbeek and Nijman (1992) proposed two tests for selection in panel data.

Wooldridge (1995) proposed a test to correct the selection bias that occurs when unobserved effects are correlated with explanatory variables. Kyriazidou (1997) proposed a semiparametric approach to correct the selection bias. Both the selection term and the unobserved effect are removed by difference between two periods. Rochina and Dustmann (2000) take into account that the non-strict exogeneity of regressors can be violated. Semykina and Wooldridge in 2006 have estimated panel data models in presence of endogeneity and selection they have proposed a new estimator of panel data. We use this estimator combined with the the test for selection proposed by Wooldridge in 1995, but with a small modification in the model because we don't have endogeneity in our covariant variables.

The paper is organized as follows. In section 1 we discuss the data set used in the analysis. In Section 2 we estimate the participation equation and the wage equation for married women, testing for selection bias and using a correction procedure for this bias as proposed by Wooldridge-Semykina (2006). Finally we present the results and conclusion.

1 Sample characteristics

The data analyzed in this work come from a survey by the European Community Household Panel (ECHP), a multi-country annual longitudinal survey which collected data since 1994[1] in 15 European Union Member States under the coordination of EUROSTAT(Statistical Office of the European Communities).
The data set covers about 130,000 individuals from 60,000 households in the fifteen countries which were EU members in 2000, reflecting population changes over time through a continuous evolution of the sample. The panel data cover a wide range of subjects such as demographics, labour force behavior, income, health, education and training, housing, poverty and social exclusion, etc. The survey is structured in the form of annual interviews with a particular representative sample of household members in each country. Interviews are conducted following a standardized questionnaire, although each country can modify the questionnaire's wording to some extent, to reflect their own institutional arrangements.
The sample is constructed as an unbalanced panel of all women between the ages of 25 and 55 years, who are married with or without children, and who are old enough to have finished their formal education and too young to retire. The size of this sample varies across the countries.

The explanatory variables that we take in consideration for our analysis reflect the opportunity and the constraint that could affect the labour supply of females.

The variables refer to the personal characteristics of the individual (age, work experience [2], education, etc), household income family (family income without wife's earnings), family characteristics (children with different levels of age, house size) and husband characteristics such as if he is active or not, if he receives an employment benefits or not and his level of education.

All variables of income are measured in local currency units deflated by the average exchange rate in the sample year, and we take them in logarithm [3].

In Table 1 we present the estimate of the labour force participation rate of married women in $1994 - 2001$ calculated by dividing the number of economically active women (at work or seeking a work) by their total number. There is a large difference between Mediterranean European countries and Scandinavian countries like Finland and Denmark. The range varies from

[1] Belgium, Germany, the Netherlands, the U.K., Denmark, France, Greece, Ireland, Portugal, Italy and Spain started in 1994 (wave 1), Austria joined in 1995 (wave 2), Finland joined in 1996 (wave 3).

[2] We use potential experience as a difference between the age of women and the year when she started the first job

[3] For France and Austria the wage and the unemployed benefits are in gross amount, we need to use the net/gross ratio.

50% for the first group to 90% for the second group, this may be caused by substantial differences in the organization of the welfare state. In the last two years, while Europe was in a recession, the rate declined in most countries. Ireland seems to be an exception because its employment rate is more similar to the Mediterranean countries, which can be interpreted as the result of cultural differences. Another exception is Portugal where the female participation rate is very high. The sample varies across years and across countries, allowing that the panel is unbalanced panel.

Summary statistics are presented in Table 2. The average age is around 38 years in all countries. We have three dummy variables for children depending on the age, between 0 and 13, to consider children that may be are need more attention in this age. Northern countries have a greater number of babies with age under 3 years old compared to Southern countries. The variable of experience is around 20 years in average in all countries, while for education we find a difference between countries and between husbands and wives. Countries such as Portugal, the Netherlands or Italy have and higher percentage of females with tertiary education, while husbands are less educate compared to wives.

2 Model of Panel Data Sample Selection

Sample selection is more frequently used in studies for cross-section and less common to estimate with panel data. Maddala (1993) defines panel data as data sets on the same individual for different period of time. When we want to estimate the wage equation for married women we face different problems: selection bias, heterogeneity and eventually endogeneity.

We have selection bias because the dependent variable of the wage equation can be measured only if the individual participates to the labour market. The literature offers estimators for correcting this problem (Heckman 1979, Powell 1994).

Heterogeneity is associated with the unobserved ability and motivation of an individual (e.g. education), and if this unobserved individual effects are correlated with the regressor of the model, the simple estimations with OLS are inconsistent, while panel data solve this problem.

The observation in panel data has two dimensions: a cross-section dimension indicated by i and a time series dimension indicated by t.
Panel data have some benefits as: control for individual heterogeneity, less collinearity among variables, more variability, large numbers of available instruments, study for dynamics of adjustment, etc. Limitations of panel data are a problem for non response, attrition, measurement of errors, design and data collection problems, etc.

Most panels are incomplete, especially when the panel concerns the household, because some of them move outside the panel for different causes.

In this case the panel is called unbalanced. More forms of selection bias and heterogeneity present in the panel data are eliminated by the fixed effects estimator under the assumption of strictly exogenous explanatory variables (see Verbeek and Nijman 1992). Recent papers have introduced some endogenous regressors as explanatory variables with selection bias and a source of heterogeneity in the equation of interest.

Consider the following model:

$$w_i t = x_{it}\beta + \gamma_i + \mu_{it} \tag{1}$$

$$\varpi^*_{it} = Z_{it}\gamma + \alpha_i + \varepsilon_{it} \tag{2}$$

$$\varpi_{it} = 1 \; if \; \varpi^*_{it} > 0 \tag{3}$$

where i, (i=1,......,N) denotes the individual and t,(1,....,T) denotes the panel. The dependent variable in the primary equation, $w_i t$, is only observed if $\varpi^*_{it} > 0$, so selection bias is introduced. The errors are decomposed in individual effects (α_i, γ_i), and idiosyncratic errors $(\varepsilon_{it}, \mu_{it})$, while x_{it} is a $1xK$ vector that may contain both exogenous and endogenous explanatory variables and β is a $Kx1$ vector of unknown parameters. We allowed a correlation between the unobserved effects and the regressor, and some of the elements of x_{it} are correlated with the idiosyncratic errors ε_{it}.

Given the distributional assumptions, it's possible to estimate the unbalanced panel data with a standard probit or Tobit regression for each time period followed by a multivariate linear regression. These are methods of extended regression to cover models which violate ordinary least squares (OLS) regression's assumption of recursively.

To test the sample selection Wooldridge in 1995 proposed a semi-parametric method with respect to the main equation. It doesn't required joint normality of the error in both equations. Starting with the model of Mundlak (1978), where if there is a correlation in the selection equation between the individual α_i and Z_i, we need a set of individual exogenous instruments ξz_i, so α_i can be written as:

$$\alpha_i = \eta + \xi_i \bar{z}_i + f_i \tag{4}$$

where $\bar{z}_i$ is a vector of individual exogenous variables averaged across period time t. The selection indicator ϖ_i is rewritten as:

$$\varpi_{it} = 1[Z_{it}\gamma + \xi_i \bar{z}_i + \upsilon_{it} > 0] \tag{5}$$

where $\upsilon_{it} = fi_i + \epsilon_{it}$ has zero means normal distribution.

If $E(\upsilon_{it}|\mu_{it})$ is linear, then we have:

$$E(\mu_{it}|z_i, \gamma_i, \varpi_i) = \rho E(\upsilon_{it}|z_i, \varpi_{it}) \tag{6}$$

Wooldridge imposes two assumptions on the selection equation: the regression function of ξ_i and Z_i is linear, and the error term in selection equation, υ_{it} is independent of z_i and x_i and normal$(0, \sigma_t^2)$. There are two other assumption concerning the relationship between α_i and e_{it}. First the regression function α_i on x_i and υ_{it} is linear. Second, e_{it} is means independent of (z_i and x_i) conditional on υ_{it} and its conditional mean is linear.

Under these assumption the wage equation becomes:

$$w_{it} = x_{it}\beta + \gamma_i + \rho E(\upsilon_{it}|z_i, \varpi_{it}) + e_{it} \tag{7}$$

where e_{it} is an idiosyncratic error term uncorrelated with the regressor, the unobserved effect and the selection indicator.

If ϖ_{it} is equal to one, using a probit estimation at each period t we obtain the estimation of $E(\upsilon_{it}|z_i, \varpi_{it} = 1)$ that is equal to $\lambda(\eta + \xi_i \bar{z}_i + Z_{it}\gamma)$, where $\lambda(\cdot)$ is the inverse Mills ratio. We put the estimation of $\hat{\lambda}_{it}$, in the wage equation and estimate this with a simple regression model or with the $2SLS$ model if we have endogenous regressor. We use t-statistic for testing the null hypothesis $H_0 : \rho = 0$.

To add more flexibility to the model it's possible to calculate the interaction terms to λ with time dummies, and test the selection with a Wald test. This procedure for correcting the bias and the inverse Mills ratio is a consistent estimator of the parameters.

If the null hypothesis is true, so there isn't selection, then OLS has a consistent estimator for the primary equation provided there aren't endogenous variables. We applied this procedure to estimate the wage equation for married women in the ECHP.

3 Empirical estimates

Given the panel structure of data set, we start analyzing the determinants of the equation participation of married women. We estimate this equation with a probit random effects model for panel data, because if we try to estimate the probit with fixed effects we have serious problems due to the large number of incidental parameters that make the estimator inconsistent, but a large T can solve this problem (see Arellano-Hanhn, 2006). The participation equation was written before as:

$$q_{it}^* = a_i + \beta X_{it} + \tau_i + \upsilon_{it} \tag{8}$$

$$\mathbf{q_{it}} = 1[q_{it}^* \geq 0] \tag{9}$$

where $q_{it}(active)$, is a dummy variable which takes 1 if the woman participates in the labourmarket and 0 if she doesn't. We excluded self-employed married women. The participation equation, q_{it}^*, is positive only if the dummy variable (eq. 2) equals one. The decision to participate depends on a vector of explanatory variables X_{it}. This vector includes the personal and family characteristics of the woman: age, education, children, household income without her wage income, and the characteristics of her husband (status of work -unemployed or not-, education and if he receives unemployed benefits); β is a vector of unknown parameters and τ_i and v_{it} are respectively time invariant effects specific to individual and individual time-varying error.

Table 3 displays the estimations of the panel probit participation equation for each country.

Interest parameters estimates have an effect on the probability of women to participate in the labour market, and the convexity of the age is conforms at the empirical literature with a temporal effect. Probably the participation increases until women assume more family responsibilities.

The presence of children with age less than six years old has a negative effect and is significant in all countries, while children with age after 13 years old don't have an effect and the sign is positive in the probability.

Concerning education, we find that the propensity to participate in the labour market of female increases with their level of education and the level of her husbands.

All income variables are deflated with CPI (Consumer Price Index) so a comparison among years is possible, and at the same time we use the PPP (Purchasing Power Parity) that allows a comparison among countries.

Our estimates show that the coefficients of the income variable are significant and have the expected signs in several countries. The woman's labour participation decreases when her non-labour income increases especially in Northern countries.

Having an unemployed husband who receives benefits doesn't encourage women to participate in the labour market except in Germany, Belgium Denmark , The Netherland and Finland. While if the husband is unemployed wife has a positive incentive to increase the probability to participate in the labour market.

4 Women's wage equation

Now we estimate the wage equation with panel data sample selection, with OLS and Heckman two step models for panel data.

We have pooled all the observations for the different countries, and allowed the coefficients to vary among countries both in the hourly wage equation and in the selection (participation) equation.

After testing the selection equation described in section 2, to estimate the hourly wage equation we calculate a probit on the selection participation equation for each year and we take the inverse Mill's ratio and put it in the wage equation. In particular, some variables appear in the selection equation, yet they do not appear in the hourly wage equation, so we have:

$$w_{it} = x_{it}\beta + \gamma_i + \hat{\lambda}_{it} + e_{it} \tag{10}$$

This equation is analyzed on a sample that is limited for married women born between 1941–1965, excluding those self-employed. We've dropped observations that are inconsistent, and excluded women when the years of experience exceeded the age, when experience was missing, and when they reported a positive number of hours of work and zero wage.

The dependent variable w_{it} is the logarithm of the real hourly wage of married women. The vector of explanatory variables x_{it} includes time dummies, experience and experience square, and education of women in two different levels (tertiary and secondary), time dummy (T*) and Inverse Mill's ratio (lam*). The experience has been calculated as the difference between the present age and the age when starting the first job.[4]. In the ECHP data set we can't observe any variables to calculate the actual experience, we only observe the potential experience.

We use both participants and non-participants married women to estimate the selection equation, while to estimate the wage equation we only use married women that participate to the labour market for at least two waves.

In Table 4 and 5 we represent the estimation of the wage equation using the Heckman model for panel data selection where we have corrected the sample selection, as well as the standard error and estimate the asymptotic variance as describe en procedure 4.1.1 in Wooldridge 1995.

Not all variables that affect the participation equation are also determinant to estimate the wage equation, and the magnitude of the effects is different. In Table 15 we report the selectivity correction term λ_{it} and the interaction terms between lambda and dummies for time t. We can see that the lambda terms are significant and sometimes negatively signed in most countries, which suggests that the error terms in the selection and primary equations are negatively correlated with the coefficient on lambda ($\rho_{eu}\sigma_u$), which means (unobserved) factors that make participation more likely tend to be associated with lower reservation wages.

In table 6 we have estimated the wage equation with the OLS method without the correction for selection. This model tends to overestimate the coefficients when the data set have a bias. The experience has a positive and significant effect for all European countries on the hourly wage equation. The square of the experience is negative and significant for both models in each country, but even so there exists a difference between the coefficients of the models.

[4]Similar regressions were also computed using experience calculated by age minus year schooling minus 6. The results do not vary with the measure of experience.

Regarding the effect of education we find that a higher education level increases the wage in several countries and the sign is statistically significant.

The magnitude of the effect of each variable is different across-countries in the Heckman model. In Northern countries education has a smaller effect than in Mediterranean countries. The effect of tertiary education is very large for Spain, Italy, Austria and Portugal.

5 Conclusion

This paper proposes an application of the estimation of panel data in presence of selection bias in the wage equation of European married women. Applying the Wooldridge and Semykina estimation we can control the phenomenon of unobservable individual heterogeneity and the selection bias.

We confirm the need to control for sample selection bias (as shown by the fact that the inverse of the Mills' ratio appears to be significant), because ignoring this selection the effect of education, kids and experience could be under or overestimated.

We find important differences among countries in the effect on the hourly wages, both the experience and a higher level of education have a positive effect on it. An elevate hourly wage increases the desire of women to participate in the labour market.

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Table 1: **Married women employment rate 1994-2001, ECHP data by country**

Country	1994	1995	1996	1997	1998	1999	2000	2001
Germany	68.37	67.61	69.4	68.85	69.29	71.18	73.12	73.13
Denmark	78.94	78.24	77.74	80.83	81.29	84.44	83.81	85.10
Netherlands	59.88	62.34	64.04	65.13	67.68	68.88	71.79	73.94
Belgium	66.23	66.13	66.18	67.57	69.41	70.63	71.46	74.29
France	58.93	60.48	61.27	57.41	60.82	60.45	63.18	64
U.K.	71.2	72.84	73.61	73.95	75.16	75.76	73.96	76
Ireland	42.55	45.72	50.36	53.03	55.39	57.77	57.79	57.14
Italy	39.13	39.12	39.91	40.03	41.4	42.19	42.23	42.62
Greece	30.34	30.86	31.71	32.55	35.73	33.38	36.7	37.61
Spain	29.77	32	32.03	35.03	37.48	39.41	41.69	45.18
Portugal	51.51	55.49	56.49	59.52	60.61	62.9	65.99	66.92
Austria		54.83	60.81	61.93	61.43	65.46	68.21	68.32
Finland			73	73.45	75.28	75.96	76.48	75.56

Table 2: **Sample characteristics**

Country	BE	DE	IT	NL	U.K.	AU	DK	FN	FR	GR	IR	PT	SE
Age	38.60	38.12	40.30	38.94	37.59	39.27	37.72	38.26	38.17	39.37	39.94	38.65	38.86
Age2	156.48	153.79	170.18	159.32	150.51	162.65	151.46	156.28	154.51	163.55	167.03	158.61	158.76
Kid 3-6	0.24	0.19	0.18	0.20	0.21	0.20	0.22	0.22	0.22	0.18	0.28	0.18	0.20
Kid 0-3	0.20	0.16	0.17	0.17	0.21	0.17	0.22	0.21	0.22	0.18	0.24	0.18	0.19
Kid 6-13	0.08	0.10	0.11	0.11	0.07	0.09	0.07	0.10	0.09	0.11	0.12	0.09	0.10
Tertiary Edu.	0.27	0.23	0.54	0.57	0.43	0.26	0.20	0.18	0.42	0.46	0.44	0.77	0.62
Secondary Edu.	0.31	0.60	0.37	0.31	0.14	0.64	0.46	0.40	0.29	0.33	0.40	0.11	0.18
Less Secondary Edu.	0.38	0.17	0.08	0.11	0.41	0.09	0.34	0.41	0.24	0.21	0.15	0.10	0.20
Experience	19.87	19.50	25.47	23.00	20.07	22.38	19.54	19.76	22.90	23.04	23.02	22.39	22.98
Income	13.70	10.61	10.10	10.68	9.52	12.70	12.14	11.39	11.75	14.95	9.62	14.22	14.47
House size	3.50	3.28	3.58	3.33	3.25	3.44	3.18	3.37	3.46	3.53	4.30	3.51	3.67
Husband Charact.													
Less Secondary Edu.	0.35	0.25	0.09	0.14	0.52	0.09	0.34	0.34	0.23	0.26	0.19	0.08	0.24
Secondary Edu.	0.33	0.58	0.36	0.31	0.13	0.79	0.48	0.46	0.32	0.33	0.35	0.12	0.18
Tertiary Edu.	0.27	0.17	0.53	0.54	0.33	0.11	0.18	0.20	0.41	0.41	0.45	0.79	0.58
Unemploy	0.88	0.87	0.82	0.92	0.86	0.86	0.91	0.83	0.86	0.80	0.82	0.88	0.84
Unemplo. Ben.													

Table 3: **Participation equation of Married Women in 1994-2001**

Country	Age	Age2	Kid 0-3	Kid 3-6	Kid 6-13	Ter-tiary Edu.	Sec-ondary Edu.	In-come	House size	Sec-ondary Edu. Hus.	Ter-tiary Edu. Hus.	Un-em-ploy Hus.	Un-em-plo. Ben. Hus.
Germany	0,045	-0,006	-0,151	-0,156	0,062	0,205	0,101	-0,159	-0,042	0,045	0,058	0,159	- 0,042**
Denmark	0,044	-0,005	-0,085	0,015	0,006	0,161	0,119	-0,212	0,010	0,030	0,056	0,242	- 0,039*
The Netherland	0,060	-0,009	-0,081	-0,131	0,027**	0,172	0,004	-0,093	-0,051	-0,094	-0,056	0,164	- 0,049*
Belgium	0,077	-0,011	-0,049	-0,071	0,068	0,338	0,126	-0,118	-0,034	0,025*	0,040	0,224	-0,161
France	0,096	-0,012	-0,078	0,003	0,086	0,247	0,114	-0,117	-0,092	0,036	0,007	0,180	-0,007
U.K.	0,058	-0,008	-0,235	-0,094	0,056	0,112	0,061	-0,057	-0,044	0,031**	-0,012	0,360	0,001
Ireland	0,047	-0,007	-0,095	-0,159	0,051**	0,350	0,136	-0,056	-0,040	0,063	0,061	0,186	-0,001
Italy	0,085	-0,011	-0,037	-0,037	0,030**	0,451	0,315	-0,057	-0,084	0,043	0,063	0,052	-0,016
Greece	0,052	-0,007	-0,079	-0,064	0,016	0,437	0,147	-0,059	0,004	-0,008	0,086	0,067	-0,048
Spain	0,047	-0,007	-0,117	-0,087	0,002	0,424	0,185	-0,045	-0,031	0,023**	0,058	0,004	-0,017
Portugal	0,071	-0,010	-0,052	-0,018	-0,005	0,355	0,159	-0,021	-0,072	0,049	-0,003	0,067	0,030
Austria	0,040	-0,007	-0,081	-0,156	0,048**	0,323	0,162	-0,062	-0,048	0,006	-0,105	0,086	0,008
Finland	0,063	-0,007	-0,153	0,044	0,000	0,126	0,044	-0,205	-0,009	0,021	0,094	0,177	- 0,063**

Data source: ECHP 1994-2001.

note: *** p¡0.01, ** p¡0.05, * p¡0.1

Table 4: **Wage Equation: Panel data Sample Selection 1994-2001**

Country	**Experience**	**Expe2**	**Kid 3-6**	**Kid 0-3**	**Kid > 13**	**Secondary Edu,**	**Tertiary Edu,**	**lambda**
Germany	0,071	-0,167	-0,053	-0,098	-1,080	0,075	0,293	-0,025
	9,29	*-8,78*	*-2,00*	*-2,30*	*-7,05*	*2,89*	*7,79*	*-0,23*
Denmark	0,005	-0,099	-0,044	0,010	-0,458	0,145	0,325	0,039
	0,00	*-8,82*	*-2,85*	*0,59*	*-3,89*	*6,55*	*14,07*	*0,56*
The Netherland	0,057	-0,118	-0,060	0,149	-0,302	0,043	0,257	-0,253
	7,76	*-6,36*	*-2,29*	*7,31*	*-4,79*	*2,24*	*10,94*	*-3,26*
Belgium	0,025	-0,032	-0,008	0,034	-0,071	0,141	0,464	-0,076
	3,64	*-1,74*	*-0,36*	*1,97*	*-0,50*	*5,16*	*13,99*	*-0,91*
France	0,070	-0,142	-0,139	0,035	-0,763	0,141	0,563	0,015
	7,37	*-6,04*	*-3,81*	*1,38*	*-5,31*	*5,34*	*15,81*	*0,12*
U.K.	0,009	-0,189	-0,200	-0,016	-1,368	0,207	0,423	0,017
	0,00	*-9,33*	*-6,20*	*-0,43*	*-7,45*	*7,30*	*14,27*	*0,17*
Ireland	0,035	-0,048	0,085	0,082	-0,533	0,288	0,845	-0,507
	2,70	*-1,64*	*1,90*	*2,21*	*-1,98*	*6,95*	*13,53*	*-3,89*
Italy	0,039	-0,061	-0,015	0,027	-0,086	0,367	0,751	-0,151
	3,04	*-1,85*	*-0,53*	*1,31*	*-0,70*	*11,63*	*16,01*	*-1,80*
Greece	0,061	-0,115	0,026	0,068	-0,185	0,281	0,716	0,261
	3,96	*-2,72*	*0,76*	*1,82*	*-0,88*	*7,13*	*11,70*	*2,19*
Spain	0,020	-0,182	-0,084	-0,001	-1,076	0,287	0,722	-0,175
	0,00	*-4,09*	*-1,86*	*-0,03*	*-2,99*	*6,03*	*9,15*	*-1,33*
Portugal	0,032	-0,195	-0,103	-0,033	-0,636	0,572	1,418	0,122
	0,00	*-2,47*	*-1,88*	*-0,63*	*-1,14*	*12,05*	*17,34*	*0,76*
Austria	0,085	-0,192	-0,123	-0,348	-1,667	0,307	0,824	0,371
	4,53	*-4,00*	*-2,00*	*-4,85*	*-3,56*	*5,40*	*7,30*	*1,23*
Finland	0,020	-0,034	-0,002	0,075	-0,164	0,061	0,287	-0,356
	3,19	*-2,39*	*-0,09*	*3,35*	*-1,42*	*3,22*	*12,24*	*-6,08*

Data source: ECHP 1993-2001. T-distribution in italics

Table 5: **Wage Equation: Panel data Sample Selection 1994-2001**

Country	lam2	lam3	lam4	lam5	lam6	lam7	lam8	T2	T3	T4	T5	T6	T7	T8
Germany	0,124	0,212	0,067	0,117	0,075	0,139	0,067	0,090	0,047	0,122	0,089	0,096	0,082	0,092
	1,40	*2,26*	*0,68*	*1,17*	*0,74*	*1,27*	*0,61*	*1,26*	*0,65*	*1,60*	*1,15*	*1,21*	*1,03*	*1,12*
Denmark	0,018	0,006	0,002	-0,130	-0,144	-0,011	0,007	0,060	0,074	0,109	0,192	0,203	0,161	0,168
	0,24	*0,07*	*0,02*	*-1,43*	*-1,51*	*-0,12*	*0,08*	*1,53*	*1,68*	*2,65*	*4,04*	*4,42*	*3,60*	*3,93*
The Netherland	0,050	0,215	0,180	0,235	0,278	0,353	0,338	-0,116	-0,223	-0,204	-0,156	-0,253	-0,225	-0,251
	0,84	*3,35*	*2,47*	*2,89*	*3,45*	*3,87*	*3,01*	*-2,36*	*-4,43*	*-3,55*	*-2,48*	*-4,19*	*-3,34*	*-3,40*
Belgium	0,100	0,169	0,170	0,092	0,098	0,106	0,082	-0,007	-0,049	-0,042	-0,009	0,007	0,009	0,043
	1,46	*2,11*	*2,05*	*1,17*	*1,15*	*1,24*	*0,93*	*-0,14*	*-0,83*	*-0,70*	*-0,15*	*0,11*	*0,15*	*0,69*
France	0,029	0,175	0,117	0,007	-0,005	-0,061	0,043	-0,034	-0,142	-0,006	0,092	0,213	0,273	0,231
	0,26	*1,48*	*1,00*	*0,06*	*-0,04*	*-0,45*	*0,34*	*-0,31*	*-1,26*	*-0,06*	*0,78*	*1,71*	*2,11*	*1,80*
U.K.	0,086	0,086	-0,052	0,002	0,107	-0,117	0,043	0,123	0,152	0,274	0,202	0,194	0,346	0,364
	0,99	*0,85*	*-0,51*	*0,02*	*1,09*	*-1,04*	*0,41*	*1,96*	*2,30*	*3,81*	*2,75*	*2,70*	*4,59*	*4,84*
Ireland	0,184	0,204	0,240	0,287	0,319	0,441	0,311	-0,198	-0,202	-0,247	-0,275	-0,257	-0,243	-0,121
	1,57	*1,76*	*1,99*	*2,36*	*2,54*	*3,26*	*2,40*	*-1,44*	*-1,44*	*-1,78*	*-1,90*	*-1,75*	*-1,60*	*-0,80*
Italy	0,135	0,177	0,179	0,161	0,186	0,160	0,181	-0,140	-0,189	-0,152	-0,123	-0,148	-0,171	-0,191
	2,07	*2,54*	*2,51*	*2,24*	*2,50*	*2,14*	*2,33*	*-1,59*	*-2,07*	*-1,64*	*-1,33*	*-1,56*	*-1,78*	*-1,98*
Greece	0,000	-0,127	-0,177	-0,329	-0,344	-0,403	-0,368	0,229	0,476	0,640	0,878	0,923	0,913	0,850
	0,00	*-1,19*	*-1,64*	*-3,04*	*-3,15*	*-3,56*	*-3,30*	*1,47*	*2,96*	*3,87*	*5,32*	*5,66*	*5,49*	*5,24*
Spain	0,060	0,111	0,197	0,209	0,124	0,220	0,195	0,042	0,011	-0,077	-0,050	0,009	-0,125	-0,076
	0,67	*1,21*	*1,99*	*2,05*	*1,25*	*2,12*	*1,96*	*0,31*	*0,08*	*-0,54*	*-0,35*	*0,06*	*-0,84*	*-0,51*
Portugal	0,098	0,001	0,118	0,161	0,242	0,272	0,447	0,097	0,131	0,109	0,019	-0,003	0,002	-0,088
	1,05	*0,01*	*1,03*	*1,22*	*1,63*	*1,83*	*2,61*	*0,75*	*1,18*	*0,94*	*0,17*	*-0,03*	*0,02*	*-0,81*
Austria	-	-0,138	0,010	0,196	0,033	0,134	0,087	-	0,063	0,084	0,004	0,094	0,015	0,066
		-0,61	*0,04*	*0,83*	*0,13*	*0,56*	*0,38*		*0,26*	*0,34*	*0,02*	*0,35*	*0,06*	*0,25*
Finland	-	-	0,176	0,165	0,081	0,163	0,197	-	-	-0,126	-0,085	-0,056	-0,061	-0,063
	-	-	*3,18*	*2,80*	*1,27*	*2,45*	*3,11*	-		*-3,74*	*-2,40*	*-1,48*	*-1,56*	*-1,64*

Data source: ECHP 1993-2001. T-distribution in italics.

Lam* is the Inverse Mill's Ratio calculate for each year.

T* are time dummy variables

Table 6: **Wage Equation: OLS 1994-2001**

Country	Experi-ence	Expe2	Kid 3-6	Kid 0-3	Kid > 13	Sec-ondary Edu,	Tertiary Edu,	T2	T3	T4	T5	T6	T7	T8
Germany	0,023***	- 0,054***	- 0,075***	0,035*	- 0,073***	0,080***	0,281***	0,042**	0,054***	0,043**	0,039**	0,022	0,031*	-0,004
	0,002	0,005	0,010	0,021	0,014	0,012	0,014	0,018	0,018	0,018	0,018	0,018	0,018	0,019
Denmark	0,027***	- 0,050***	- 0,019**	0,032***	0,003	0,152***	0,333***	0,022*	0,030**	0,063***	0,092***	0,107***	0,107***	0,125***
	0,002	0,004	0,008	0,009	0,013	0,011	0,011	0,013	0,013	0,013	0,014	0,014	0,014	0,014
The Netherland	0,023***	- 0,048***	- 0,033***	0,143***	- 0,090***	0,064***	0,295***	-0,043**	- 0,064***	- 0,075***	0,015	-0,053***	0,020	-0,026
	0,002	0,004	0,009	0,012	0,014	0,014	0,015	0,018	0,018	0,018	0,021	0,020	0,021	0,021
Belgium	0,024***	- 0,039***	-0,018	0,020	-0,018	0,123***	0,434***	0,065***	0,058***	0,063***	0,059***	0,079***	0,084***	0,108***
	0,002	0,006	0,011	0,013	0,017	0,014	0,013	0,019	0,019	0,019	0,019	0,020	0,020	0,020
France	0,019***	- 0,030***	-0,003	0,043***	- 0,054***	0,147***	0,518***	-0,094***	- 0,109***	-0,006	0,021	0,074***	0,082***	0,098***
	0,002	0,005	0,012	0,016	0,019	0,014	0,014	0,022	0,022	0,022	0,023	0,024	0,023	0,023
U,K,	0,029***	- 0,070***	- 0,156***	0,091***	- 0,073***	0,185***	0,359***	0,040*	0,067***	0,110***	0,073***	0,119***	0,179***	0,229***
	0,002	0,005	0,012	0,015	0,019	0,016	0,012	0,022	0,022	0,021	0,022	0,022	0,022	0,022
Ireland	0,038***	- 0,077***	0,001	0,090***	- 0,071***	0,357***	0,979***	0,088***	0,115***	0,105***	0,141***	0,183***	0,276***	0,337***
	0,004	0,010	0,018	0,021	0,026	0,020	0,023	0,034	0,034	0,034	0,034	0,035	0,036	0,037
Italy	0,023***	- 0,037***	-0,012	-0,006	0,032**	0,342***	0,709***	0,021	0,010	0,046**	0,062***	0,061***	0,019	0,018
	0,002	0,005	0,009	0,012	0,013	0,010	0,014	0,018	0,018	0,019	0,019	0,019	0,019	0,019
Greece	0,032***	- 0,065***	0,030*	0,030	0,011	0,260***	0,685***	0,092***	0,198***	0,321***	0,422***	0,457***	0,410***	0,384***
	0,003	0,009	0,016	0,021	0,023	0,021	0,020	0,034	0,034	0,035	0,035	0,035	0,035	0,035
Spain	0,038***	- 0,060***	0,011	0,048***	-0,004	0,339***	0,737***	0,058**	0,100***	0,078***	0,082***	0,079***	0,052*	0,071**
	0,003	0,007	0,014	0,018	0,022	0,018	0,015	0,029	0,029	0,029	0,029	0,029	0,029	0,029
Portugal	0,050***	- 0,112***	- 0,086***	- 0,039**	-0,038*	0,470***	1,246***	0,055*	0,031	0,079***	0,028	0,031	0,051*	0,050*
	0,003	0,006	0,014	0,018	0,023	0,019	0,019	0,029	0,029	0,029	0,029	0,029	0,029	0,029
Austria	0,022***	- 0,041***	- 0,056***	- 0,205***	-0,011	0,195***	0,571***	-	-0,047	- 0,062**	-0,049*	-0,066**	- 0,062**	- 0,065**
	0,004	0,008	0,017	0,023	0,026	0,019	0,027	-	0,029	0,028	0,029	0,029	0,029	0,030
Finland	0,019***	- 0,033***	0,012	0,014	0,019	0,056***	0,328***	-	- 0,115***	- 0,094***	- 0,055***	-0,055***	-0,013	-
	0,002	0,005	0,010	0,014	0,015	0,014	0,014	-	0,016	0,015	0,016	0,016	0,016	-

Data source: ECHP 1993-2001. Standard error in second line.
T* are time dummy variables
note: *** p¡0.01, ** p¡0.05, * p¡0.1

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