

# YOUNG WORKERS, MARITAL STATUS AND WAGE GAP\*

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This paper analyses whether marital status has a significant effect on wages and whether it is a determinant of the gender gap. We use the stochastic frontier approach to explain the differences between the potential and the observed wage that an individual could obtain, given his or her human capital endowment. We construct a balanced panel of wage earners from the European Community Household Panel Survey (ECHP), from 1995 to 2001. The sample is of young workers that remain seven consecutive years in the labour market. Our results show that a significant part of the gender wage gap (distance to the frontier) suffered by married women in Germany, Italy, Spain and the United Kingdom is not attributable to differences in human capital endowment or personal and job-related characteristics.

*Key words:* wage differentials, marital status, Europe.

*JEL Classification:* J24, J31, J71.

It is well established by the literature that women earn less than men. This result persists even when controlling for human capital endowment and other personal characteristics. The huge gender gap literature<sup>1</sup> has tried to explain the factors that account for this difference in earnings. In particular, the literature has shown that differences in human capital accumulation could explain part of the earnings gender gap. Different decisions with respect to education, commitment to the labour market and types of occupation lead women to work fewer hours and accumulate less experience than men, reducing their human capital endowment and their potential wage and explaining part of the earnings gender gap.

Some theories explain these differences by arguing that men and women differ in their preferences for market and non-market work<sup>2</sup> and these differences affect their human capital endowment. From this point of view, women are more

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(1) See Altonji and Blank (1999) for a survey.

(2) See Escriche *et al.* (2004).

committed to household production and childcare and, hence, invest less in education and training, decide to work fewer hours than men, more frequently interrupt their participation in the labour market and choose low-effort occupations. Since differences in human capital cause differences in productivity and since, in a competitive equilibrium, marginal productivity equals wages, women obtain lower salaries [see Becker (1985)].

The relevance of these factors has diminished in recent decades. In all European countries, differences in educational attainment between men and women have diminished, women's participation ratio has augmented and a major commitment in the labour market has been observed and, thus, the gender gap has reduced over time. Women's effort to increase their human capital in recent decades explains the observed reduction in the gender gap. However, wage differences between men and women, although decreasing, persist in all countries, even when controlling for differences in human capital and personal characteristics [see Blau and Kahn (2003)].

This unexplained gender gap could be considered as discrimination. Discrimination could arise because employers prefer a particular group of workers, the idea of a "taste" for discrimination from Becker (1957), because of imperfections in the labour market or because it is difficult to measure the productivity of workers (statistical discrimination). Also, it has been argued that the existence of discrimination in the labour market could influence women's decisions about their education, training and preferred jobs. In this sense, there would be a pre-market discrimination against women.

To sum up, the gender gap could be attributed to a lower productivity of women or to a lower market return on their characteristics, usually related to the discrimination component or to unobserved variables. Thus, discrimination could be defined as a situation in which equally productive individuals receive different wages because of some observable characteristic such as their race or gender<sup>3</sup>.

Although the gender gap and the existence of gender discrimination have been widely studied by the literature, differences among women have not received the same attention. In particular, our interest is in married women, whose behaviour in the labour markets presents some special features that justify a separate study. Our aim is to show whether the earning differences of married women with respect to single women and men, due to discrimination, still persist for young workers.

Married women earn less than single ones. This fact has usually been explained by their lower human capital accumulation. Firstly, married women show lower participation rates than those of women as a whole. This lower participation has been traditionally associated not only to their personal characteristics but also to their family characteristics, particularly, their husband's labour status. Secondly, they are more committed within the household. This produces a reallocation of time and effort towards home production and, so, married women tend to interrupt their labour market attachment with periods of non-participation, reduce the

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(3) Economic discrimination refers not only to differences in wages in the same job but also to lower opportunities to be hired or to be promoted, or to receive specific skills by training inside the firm.

hours worked and choose lower earnings occupations. It also reduces their possibilities of training inside the firm. All of these factors lead to a lower human capital accumulation and a lower productivity. The expected career interruptions have, in turn, a negative impact on the human capital investment of young women. The reason is that the incentives to accumulate human capital are directly proportional to the time one expects to work over one's lifetime<sup>4</sup>.

However, it seems that the relevance of these factors has diminished over recent decades in all European countries. The participation rates of married women have risen, differences in schooling, experience and training have decreased and marital status appears to be of declining significance for productivity and labour supply decisions<sup>5</sup>. Despite this fact, differences in wages, although decreasing, persist in all countries. Married women earn less than single ones, just as both married and single women earn less than men.

Our paper aims to analyse whether these differences in wages reflect discrimination or could be explained by differences in their human capital endowment. We use the stochastic frontier approach as an alternative to the traditional method of measuring discrimination that follows the work of Oaxaca (1973) and Blinder (1973).

The stochastic frontier approach is an alternative method that includes a one-sided error term to capture the possibility of the inefficient behaviour of an economic unit when trying to reach an economic objective<sup>6</sup>. The frontier approach is usually applied to the analysis of inefficiency in firms' production. Adapting this methodology to the analysis of wage differentials allows us to explain the differences between the potential and the observed wage that an individual could obtain, given his or her human capital investment. The earnings frontier will describe the highest potential income associated with a given stock of human capital. If a worker earns less than the potential wage, the difference in wages indicates inefficiency in the transformation of human capital variables (schooling, experience and tenure) into earnings, and we can analyse which factors explain these differences between the potential and the effective wage<sup>7</sup>.

Discrimination could be one of the possible reasons for these differences in earnings. The existence of discrimination affects the position of each individual with respect to the frontier: individuals will receive lower returns in the labour market than they should, according to their human capital and job-related characteristics.

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(4) Mincer and Polachek (1974).

(5) See Lundberg and Rose (2000), Prieto-Rodríguez and Rodríguez-Gutiérrez (2003) and Olivetti (2006)

(6) See Lovell (1993)

(7) There is a growing literature in which the stochastic frontier approach is used to estimate earnings functions. Attempts to measure discrimination include, among others, the work of Robinson and Wunnava (1989), Robinson (1993), Hunt-McCool and Warren (1993), Slottje *et al.* (1994), Dawson *et al.* (2001) and Bishop *et al.* (2007). Others, including Herzog *et al.* (1985), Hofler and Polachek (1985), Polachek and Yoon (1987, 1996), Hofler and Murphy (1992), Groot and Oosterbeek (1994) and Polachek and Robst (1998), use stochastic frontier analysis to study incomplete worker information.

Compared to other methodologies, the stochastic frontier approach contributes to a better estimation of the wage gap and discrimination in the following ways. When estimating an earnings equation, the stochastic frontier approach establishes a relationship between the maximum wage attainable by an individual and her human capital, and other personal characteristics, according to the neo-classical theory, rather than considering the average wage. In addition, it allows an evaluation to be made of the individual earnings gap (the distance to the frontier) and makes it possible to analyse the variables that could explain the estimated wage inefficiency.

In this paper, we analyse whether a gender gap exists due to marital status in Germany, Italy, Spain, and the United Kingdom. We choose a reduced sample of young men and women with the following characteristics: they work for, at least, seven consecutive years without interruptions; they are younger than 40 and work 15 or more hours per week. Our objective is to make men and women more comparable and for this reason we select a sub sample of individuals who have revealed a strong commitment to the labour market. In particular, women who, despite their marital status or their maternity, remain continuously employed during the period analysed. We use panel data to estimate a wage frontier and the inefficiency model that allows us to analyse the variables that cause wages to deviate from their potential value. Here, we introduce marital status, and we will define wage discrimination as the difficulties experienced by married women in transforming their human capital endowments into market wages.

Our results showed that there are differences between potential and effective wages not attributable to differences in human capital investment. Moreover, when analysing the factors that could explain these differences, we found a significant effect of workers' marital status in almost all the countries analysed. The results show that married women are far from achieving their potential wage compared to single workers and married men with the same endowments in human capital. In contrast, married men are the ones most likely to approach their potential wage compared to women, married or single, and to single men. The most important aspect of this result is that this analysis is performed for workers under 40, which means that, in spite of the anti-discriminatory measures undertaken in the European countries during recent decades, we still observe these differences for young workers.

The paper is organised as follows. Section 2 analyses the stochastic frontier methodology and its application to the earnings functions. Section 3 shows the data and variables. Section 4 provides a discussion of the results. Finally, in Section 5, we present the concluding remarks.

## 1. THE STOCHASTIC FRONTIER

We use the stochastic frontier approach developed by Aigner *et al.* (1977) and Meeusen and Van der Broeck (1977) to estimate an earnings frontier, adding an asymmetric error term representative of wage inefficiency to the standard earnings equation. Specifically, we use a panel data version of this approach, following the random effect model of Pitt and Lee (1981) who showed how a time invariant

composed error model could be extended to a panel data version of the stochastic frontier model. Moreover, we include heterogeneity in the mean of the inefficiency term that has a truncated normal distribution, as suggested by Stevenson (1980). That is, we estimate the wage inefficiency and simultaneously explain this inefficiency by a set of variables<sup>8</sup>. This approach avoids the inconsistency problems of the two-stage procedure when analysing the inefficiency determinants<sup>9</sup>.

We adopt a standard semi-logarithmic earnings equation [see Mincer (1974)] but assume that the potential or theoretical wage could differ from the observed wage, that is, workers might not be able to transform the whole of their human capital stock into earnings. We call this difference “wage inefficiency” and it is included in the analysis through the addition of a one-sided error term to the standard earnings function, obtaining a frontier. Simultaneously we estimate the determinants of this wage inefficiency (the inefficiency model).

The estimated model is:

$$\ln W_{it} = \ln W_{it}^* - u_i = \alpha + \beta' X_{it} + v_{it} - u_i \quad [1]$$

Equation 1 shows the earnings frontier, which describes the highest potential income associated with a given stock of human capital.  $W^*$  is the potential or theoretical wage,  $\beta$  the set of parameters and  $X$  the set of human capital variables. We include a composed error term: the first component,  $v_{it}$ , is a two-sided term representing the random error, assumed to be iid  $N(0, \sigma_v^2)$  and the second component,  $u_i$ , is a non-negative random variable representing the inefficiency, which is assumed to be distributed independently as  $N^+(\mu_i, \sigma_u^2)$ .

The difficulty of transforming individual characteristics into outcomes is measured by the ratio of observed wage over the maximum or potential wage obtainable for an individual (when there is no inefficiency); the efficiency (EF) of an individual is<sup>10</sup>:

$$EF = \frac{f(X_{it}; \beta) \exp(v_{it} - u_i)}{f(X_{it}; \beta) \exp(v_{it})} = \exp(-u_i) \quad [2]$$

The scores obtained from Equation [2] take value 1 when the individual totally transforms his or her characteristics into earnings and less than 1 otherwise.

The mean of the inefficiency term ( $\mu$ ) is a function of variables that could explain the difficulties of transforming human capital into market earnings.

$$\mu_i = \delta_0 + \delta' Z_i \quad [3]$$

(8) We use the Limdep statistical package to estimate the stochastic frontier and the inefficiency determinants [see Greene (2002)].

(9) In a two-stage procedure, firstly, a stochastic frontier function is estimated and the inefficiency scores are obtained on the assumption of independently and identically distributed inefficiency effects. However, in the second step inefficiency effects are assumed to be a function of some firm-specific variables, which contradicts the assumption of identically distributed inefficiency effects.

(10) Individual efficiency scores  $u_i$ , which are unobservable, can be predicted either by the mean or the mode of the conditional distribution of  $u_i$  given the value of  $(v_i - u_i)$  using the technique suggested by Jondrow *et al.* (1982).

Here,  $Z_i$  is a  $(M \times 1)$  vector of variables that could explain the degree of inefficiency in the transformation of human capital into earnings, and  $\delta'$  is a  $(1 \times M)$  vector of parameters to be estimated.

We then estimate the earnings function, adding a term of inefficiency whose mean is a function of a set of inefficiency determinants. The function coefficients ( $\beta$ ) and the inefficiency model parameters ( $\delta$ ) are estimated using a panel data technique to control for unobserved heterogeneity. From the estimation, we also obtain the variance parameters:  $\sigma_u$  and  $\lambda = \sigma_u / \sigma_v$  and we calculate  $\gamma = \sigma_u^2 / \sigma^2$  where  $\sigma^2 = \sigma_v^2 + \sigma_u^2$ , which allows us to know the relative relevance of the inefficiency with respect to the random noise in explaining differences between the potential and the obtained wage.

## 2. DESCRIPTION OF THE DATA

The European Community Household Panel (ECHP) is a harmonized cross-national longitudinal survey focusing on household income and living conditions. It is a standardized questionnaire that involves annual interviewing of a representative panel of households and individuals in each country. We analysed the corresponding balanced panel of wage earners currently working 15 or more hours per week, from 1995 to 2001. The number of observations by country is: Italy with 1,484 (212 individuals), Spain with 1,169 (167), Germany with 3,745 (535 individuals) and the United Kingdom with 2,653 (379 individuals).

These samples were of young employed people with ages ranging from 18 to 40 who have been working for at least seven consecutive years. The dependent variable is the logarithm of gross hourly wage. We removed from the sample the observations with extremely high or low hourly wage.

The percentages of female workers in the sample ranged from Germany (37.6%), which had the highest percentage, to Spain (16.8%), which had the lowest. The average age, ranged from 31.6 years for Italy to 33.1 for Spain. We made a sample selection of young working people and this selection increased the average level of education for both men and women. The proportion of workers with a higher education degree in the sample ranged from the United Kingdom (54.8%), which had the highest percentage, to Italy (8.4%), which had the lowest. Mobility allows workers to obtain a better fit in the labour market, so this variable contributes to explaining the potential wage. We found that, on average, 58.5% of young workers in the United Kingdom were willing to relocate, followed by Spain with 50%, while the percentages were lower for Germany (38.7%) and Italy (40.2%). When we compared the differences in type of contract, we found that Spain had the lowest percentage of permanent workers. In the ECHP, seniority is defined as the number of years working for the same employer and here the values are: the UK with a mean of 6, Germany 7.8, Italy 10.7 and Spain 11.10 years.

### 3. WAGES DIFFERENTIALS: DISCUSSION OF THE RESULTS

The maximum-likelihood estimates of the earnings frontier parameters, defined in equation [1], given the specification for the inefficiency effects, defined in equation [3], are presented in Table 1. At the end of Table 1 we show the average level of wage inefficiency and the variance value component estimated by the statistical package. We tested the relevance of the inefficiency effects using the generalised likelihood ratio (LR) test<sup>11</sup>.

The lambda parameter indicates that inefficiency is stochastic and, thus, the frontier model cannot be reduced to a mean-response wage equation (OLS estimation). We also calculated the part of the distance to the frontier that can be explained by inefficiency as  $\gamma = \sigma_u^2/\sigma^2$ , where  $\sigma^2 = \sigma_v^2 + \sigma_u^2$ . In our estimation, these variance parameters are a significant component of the total error term variance for all the countries analysed and, hence, deviations from the potential wage are not simply due to random factors.

The first generalised likelihood ratio test reported in Table 1 reinforces the relevance of the inefficiency effects in the model. Our results reject the null hypothesis, which considers that inefficiency effects are not present in the model.

During the period analysed, the estimated degree of wage inefficiency is around 7% for Italy, 20% for Germany, 36% for Spain and 10% for the UK. This means that, on average, these young European workers obtained a salary that was lower than the salary they could have achieved given their human capital and other personal characteristics.

#### 3.1. *The young workers' wage equation*

Human capital variables were significant and had the expected sign. Here we had two sets of variables that showed the effect of age and education in relation to the potential wage of the individuals.

Age is only significant in the case of Germany, where being older than 30 years increased the potential wage by 2.1% with respect to being younger than 30. For Spain and the UK, this variable is not significantly different from zero, which means that it has no impact on the determination of wages for young workers. In contrast, we obtain a negative and significant impact for Italy.

Also, as expected, having primary or secondary education reduced the potential wage that an individual could obtain with respect to higher education. In Italy, Germany, Spain and the United Kingdom, to have secondary education reduces the expected wage around 24%, 14%, 5% and 2.6%, respectively. In these countries, to have primary education reduces the potential wage around 28% for Italian, around 18% for German and 6% for Spanish but is not significant for young British workers.

With the occupational variables, we controlled for wage differentials generated by differences in occupations. The reference category was elementary occupations. We obtained the expected sign; the potential wage was higher as the occupational skills increased.

(11)  $LR = -2\{\ln[L(H_0)] - \ln[L(H_1)]\}$ , where  $L(H_0)$  and  $L(H_1)$  are the values of the likelihood function under the null and alternative hypotheses.  $LR$  has an approximately chi-square distribution with degrees of freedom equal to the number of restrictions.

Table 1: WAGE FRONTIER ESTIMATES FOR YOUNG WORKERS OF ITALY, GERMANY, SPAIN AND UK

	Italy		Germany		Spain		UK	
	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value
Wage frontier estimates								
Constant	8.121	27.801*	8.115	433.71*	12.871	16.533*	14.376	0.000
Trend	0.047	25.003*	0.025	15.888*	0.047	16.340*	0.059	27.574*
Age. Category of reference: Below or equal to 30								
Older than 30	-0.028	-2.536*	0.021	2.089*	0.008	0.531	0.007	0.647
Level of education by countries. Category of reference: Higher Education								
Primary	-0.279	-7.287*	-0.179	-13.782*	-0.062	-2.135*	-0.016	-1.120
Secondary	-0.243	-6.620*	-0.142	-16.237*	-0.052	-2.140*	-0.026	-2.178*
Occupation in current job. Category of reference: Elementary occupations								
Legislators, seniors officials and managers	0.052	0.781	0.155	11.110*	0.102	1.416	0.078	3.510*
Professionals	0.066	1.381	0.154	12.801*	0.107	2.926*	0.069	3.026*
Technicians and associate professionals	0.030	1.107	0.053	5.177*	0.070	2.284*	0.055	2.447*
Clerks	0.057	2.525*	-0.006	-0.488	-0.022	-0.611	-0.025	-1.174
Service workers and shop and market sales workers	-0.026	-1.217	0.066	2.936*	-0.026	-0.882	-0.047	-1.880**
Craft and related trade workers	0.004	0.213	-0.069	-6.937*	0.018	0.766	0.033	1.641
Plant and machine operators and assemblers	-0.005	-0.173	-0.041	-3.576*	-0.013	-0.407	0.033	1.540
Move from another place within this locality or another area of this country. Category of reference: Do not move								
Mobility	0.027	2.541*	0.028	4.235*	0.057	3.681*	0.026	2.530*
Type of contract. Category of reference: Non-permanent contract								
Permanent	0.033	2.022*	0.021	1.629	0.083	6.107*	0.025	1.897**

(\*) Significant at 1%; (\*\*) Significant at 10%.

Source: Own elaboration.

Table 1: WAGE FRONTIER ESTIMATES FOR YOUNG WORKERS OF ITALY, GERMANY, SPAIN AND UK (continuation)

	Italy		Germany		Spain		UK	
	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value	$\beta$ -Coefficient	t-value
Private sector of activity. Category of reference: Public sector								
Private sector	-0.020	-1.036	0.060	7.807*	-0.057	-2.385*	0.017	1.134
Number of regular paid employees in the local unit in current job. Category of reference: Less than 500 workers.								
More than 500 workers	-0.017	-0.845	0.069	11.028*	0.022	1.111	0.034	3.948*
Seniority with the same employer								
Seniority	-0.011	-2.596*	-0.010	-5.855*	-0.038	-4.980*	-0.013	-4.614*
Seniority <sup>2</sup>	0.001	2.940*	0.001	5.013*	0.002	4.035*	0.001	3.706*
Inefficiency model								
Constant	3.490	2.197*	0.663	2.967*	3.345	1.309	27.650	0.000
Married women. Category of reference: Non-married women								
Married women	0.560	2.526*	0.411	8.200*	0.600	1.824**	0.365	2.239*
Married men. Category of reference: Non-married men								
Married men	-0.709	-3.837*	-0.668	-11.808*	-0.256	-1.103	-0.460	-3.866*
Variance parameters for compound error								
Lambda	1.391	15.003	2.083	7.520	2.040	10.030	1.764	18.556
Sigma(u)	0.195	18.496	0.418	10.831	0.314	15.003	0.280	25.073
Average Inefficiency	0.07		0.20		0.36		0.10	
Null hypothesis, H0: Testing for the absence of inefficiency effects. H0: $\delta_1 = \delta_2 = 0$ ;								
LR test (Critical value at 1%: 9.21)	98.140		643.520		1062.99		2182.01	

(\*) Significant at 1%; (\*\*) Significant at 10%.

Source: Own elaboration.

As expected, when an individual moves from one place to another within the same locality or to another area inside the same country, the potential wage increased. This increment is higher in Spain (5.7%) and quite similar for Italy (2.7%), Germany (2.8%) and the UK (2.6%). This variable reveals the benefits of moving to obtain a better adjustment within the labour market. When we introduce seniority with the same employer, we obtain a very interesting result, namely, a negative and significant relation between seniority and potential wages. However, these negative impacts are smaller than the benefits of mobility. For Italy, Germany and the UK, the value is around -1% and, for Spain, around -4%.

We included the variable type of contract as another source of wage differentials. We established two categories: permanent contract and non-permanent contract, which is composed mainly of temporary contract, that is the category of reference. Spain is the country with the highest level of temporality especially for young workers (see, Diaz and Sánchez 2008). This explains why this is the country where this variable has the highest impact on wages (8%), followed by Italy (3.3%), the UK (2.6%) and Germany (2.1%).

Large firms tend to pay higher wages than small and medium-sized firms. Large firms might be more efficient in organising their work, in selecting employees and in adopting new technologies. This increases labour productivity, thus raising wages. Our dummy of firm's size affected the workers' potential wage positively and significantly in the case of Germany (7%) and the UK (3.4%). For Italy and Spain, we do not obtain a significant coefficient.

### 3.2. *The inefficiency model: young married workers*

The estimated frontier defines the highest wage that an individual could obtain according to his or her human capital investment (potential wage). The wage inefficiency measures the distance to the frontier for each individual, that is, the difference between the potential and the observed wage. We have assumed that this wage inefficiency is a function of gender and marital status and, so we have included a set of two dummies that reflect marital status by gender. The category of reference is not to be married. The estimated parameters of the inefficiency model indicate only the direction of the variables' effect on inefficiency. The value of these parameters is presented at the end of Table 1.

The inefficiency model shows that the coefficients of the married women dummies are positive and statistically significant in explaining wage inefficiency in all the countries analysed. The positive sign indicates an increment in the distance with respect to the stochastic frontier, that is, a rise in the difference between potential and effective wage. These dummies reflect the relevance of women's marital status in wages. The results obtained indicate that married women obtain lower wages than similar single women and men. On the contrary, the variable married men presents the opposite sign. For all the countries, this variable is statistically significant, with the exception of Spain. The negative sign indicates that, for men, being married reduces wage inefficiency and, so, the wages obtained by married men are closer to their potential wage than those of single men and women. They have a wage premium measured by its closeness to the wage frontier, compared to single workers with the same human capital investment. This result reflects the

perception of companies that married men are the main income earners in the household so firms attribute a greater commitment to the labour market to them. The positive signs that married men traditionally show, do not apply in Spain. Spanish married men do not reduce the distance to the frontier with respect to single men and women as happens with German, Italian and English workers.

We would like to emphasize that these results are obtained from a selected sub sample where individuals have been working for seven consecutive years and work 15 or more hours. The married women included in our sample are those who, despite their marital status and its implications, have remained active and employed. They have not suffered losses of human capital due to spells of non-employment, but, even so, they receive lower salaries. Thus, our results show evidence of discrimination against young married women. As, on average, married women are more likely to interrupt their careers and have longer interruptions of their working life, in a context of imperfect information, they are considered as a low productivity group and receive lower opportunities for training inside the firm and lower opportunities to be promoted.

#### 4. CONCLUDING REMARKS

The aim of this paper was to analyse the existence of discrimination in the labour market against young married women. We have analysed the earnings gender gap in four European countries using the stochastic frontier approach. Our sample was restricted to continuously employed individuals younger than 40. Our results show that a significant part of the gender wage gap is not attributable to differences in human capital investment or personal and job-related characteristics. We also obtain evidence of the existence of gender pay discrimination in young married women with respect to men and single women in all the countries analysed. Here, we obtained the opposite result for married men. They have a wage premium measured by its closeness to the wage frontier, when compared to married women or single workers with the same human capital investment.

#### APPENDIX 1: DESCRIPTION OF VARIABLES AND RESULTS OF THE STOCHASTIC FRONTIER MODEL

##### Variables:

The dependent variable used for estimation is the logarithm of gross hourly wage.

The explanatory variables of the wage equation are:

Age: This is a set of two dummy variables:

Age1: equal to 1 if individual is younger than 30, zero otherwise, (reference category).

Age2: equal to 1 if individual is older than 30 and 0 otherwise.

Education Classification: This is a set of three dummy variables:

Primary: Less than upper secondary education: equal to 1 if the individual has less than second stage of secondary education (ISCED 0-2).

Secondary: Upper secondary education: equal to 1 if individual has finished the upper secondary level of education (ISCED 3) and 0 otherwise.

Higher Education: Tertiary education: equal to 1 if individual has finished tertiary education (ISCED 5-7) and 0 otherwise, (reference category).

Occupation in current job: This is a set of eight dummy variables:

Legislators, senior officials and managers

Professionals

Technicians and associate professionals

Clerks

Service workers and shop and market sales workers

Craft and related trade workers

Plant and machine operators and assemblers

Elementary occupations (reference category)

Type of contract: Dummy variable equal to 1 if the worker has a permanent contract and 0 otherwise (fixed-term contract or a non-standard contract).

Mobility: Dummy variable equal to 1 if the individual has moved to another place, area or country and 0 otherwise.

Firm size: Large firms, equal to 1 if the firm has more than 500 workers and 0 otherwise.

Seniority: Number of years working with the same employer.

Seniority2: The squared value of seniority.

Trend: Time trend.

The inefficiency model:

Marital Status: This is a set of 2 dummy variables where we highlight the effect of being married for women and men.

Married Women: The category of reference is not being married and non-married men.

Married Men: The category of reference is not being married and non-married women.



## REFERENCES

- Aigner, D., Lovell, K. and Schmidt, P. (1977): "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics*, vol. 6, pp. 21-37.
- Altonji, J. and Blank, R. (1999): "Race and gender in the labor market", in Ashenfelter, O. and Card, D. (Eds), *Handbook of Labor Economics*, vol. 3C, Elsevier, B.V., pp. 3144-3213.
- Becker, G. (1957): *The Economics of Discrimination*, The University of Chicago Press, Chicago.
- Becker, G. (1985): "Human Capital, Effort and the Sexual Division of Labor", *Journal of Labor Economics*, vol. 3, n. S1, pp. 33-58.
- Bishop, J.A., Grodner, A., Liu, H. and Chiou, J.R. (2007): "Gender earnings differentials in Taiwan: A stochastic frontier approach", *Journal of Asian Economics*, vol. 18, pp. 934-945.

- Blau, F. and Kahn, L.M (2003): "Understanding international differences in the gender pay gap", *Journal of Labor Economics*, vol. 21, pp. 106-144.
- Blinder, A. (1973): "Wage discrimination: Reduced Form and structural variables", *Journal of Human Resources*, vol. 8, pp. 436-455.
- Dawson, P., Hinks, T. and Watson, D. (2001): "German wage underpayment: an investigation into labor market inefficiency and discrimination", *Vierteljahrshefte zur Wirtschaftsforschung*, vol. 70, pp. 107-114.
- Diaz, M.A. and Sánchez R., (2008): "Temporary contracts and Young women in Spain", *Applied Economics*, vol. 40-11, pp. 1435-1442.
- Escriche, L., Olcina, G. and Sánchez, R. (2004): "Gender discrimination and intergenerational transmission of preferences", *Oxford Economic Papers*, vol. 56, pp. 485-511.
- Greene, W. (2002): "Econometric modelling guide: Limdep Version 8.0", Econometric Software, Inc., Castle Hill.
- Groot, W. and Oosterbeek, H. (1994): "Stochastic reservation and offer wages", *Labour Economics*, vol. 1, pp. 383-390.
- Herzog, H.W., Hofler, R.A. and Schlottmann, A.M. (1985): "Life on the frontier: migrant information, earnings and past mobility", *Review of Economics and Statistics*, vol. 67, pp. 373-382.
- Hofler, R.A. and Murphy, K.J. (1992): "Underpaid and overworked: measuring the effects of imperfect information on wages", *Economic Inquiry*, vol. 30, pp. 511-529.
- Hofler, R.A. and Polacheck, S.W. (1985): "A new approach for measuring wage ignorance in the labor market", *Journal of Economics and Business*, vol. 37, pp. 267-276.
- Hunt-McCool, J.C. and Warren, R.S. (1993): "Earnings frontiers and labor market efficiency", in Fried, H. (Ed.), *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford University Press, USA, pp. 197-209.
- Jondrow, J., Lovell, K., Materov, I.S. and Schmidt, P. (1982): "On the estimation of technical inefficiency in the stochastic frontier production function model", *Journal of Econometrics*, vol. 19, pp. 233-238.
- Lovell, K. (1993): "Production frontiers and productive efficiency", in Fried, H. (Ed.), *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford University Press, USA, pp. 3-67.
- Lundberg, S. and Rose, E. (2000): "Parenthood and the earnings of married men and women", *Labour Economics*, vol. 7, pp. 689-710.
- Manning, A., and Swaffield, J. (2008): "The gender gap in early-career wage growth", *The Economic Journal*, vol. 118, pp. 983-1024.
- Mincer, J. (1974): *Schooling, Experience and Earnings*, Columbia University Press, New York.
- Mincer, J. and Polachek, S. (1974): "Family Investment in Human Capital: Earnings of women" *Journal of Political Economy*, vol. 82(2), pp. 76-108.
- Oaxaca, R. (1973): "Male-female wage differentials in urban labour markets", *International Economic Review*, vol. 14, pp. 693-709.
- Olivetti, C. (2006): "Changes in women's hours of market work: The role of the returns to experience", *Review of Economic Dynamics*, vol. 9, pp. 557-587.
- Pitt, M. and L. Lee (1981): "The Measurement and Sources of Technical Inefficiency in Indonesian Weaving Industry", *Journal of Development Economics*, vol. 9, pp. 43-64.
- Polachek, S.W. and Robst, J. (1998): "Employee labor market information: comparing direct world of work measures of workers' knowledge to stochastic frontier estimates", *Labour Economics*, vol. 5, pp. 231-242.

- Polachek, S.W. and Yoon, B.J. (1987): "A two-tiered earnings frontier estimation of employer and employee information in the labour market", *Review of Economics and Statistics*, vol. 69, n. 2, pp. 296-302.
- Polachek, S.W. and Yoon, B.J. (1996): "Panel estimates of a two-tiered earnings frontier", *Journal of Applied Econometrics*, vol. 11, pp. 169-178.
- Prieto-Rodriguez, J. and Rodriguez-Gutierrez, C. (2003): "Participation of married women in the European labour markets and the "added worker effect", *Journal of Socio-Economics*, vol. 32, pp. 429-446.
- Robinson, M. (1993): "Measuring discrimination against females: is the 'non-discriminatory' wage the male or the female wage?", *The American Economist*, vol. 37, n. 1, pp. 45-50.
- Robinson, M.D. and Wunnava, P.V. (1989): "Measuring direct discrimination in labor markets using a frontier approach: evidence from CPS female earnings data", *Southern Economic Journal*, vol. 56, n. 1, pp. 212-216.
- Slottje, D.J., Hirschberg, J.G. and Hayes, K.J. (1994): "A new method for detecting individual and group labor market discrimination", *Journal of Econometrics*, vol. 61, n. 1, pp. 42-64.
- Stevenson, R. (1980): "Likelihood Functions for Generalized Stochastic Frontier Functions," *Journal of Econometrics*, vol. 13, pp. 57-66.

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#### RESUMEN

En este trabajo analizamos los determinantes de las diferencias salariales entre hombres y mujeres según su estado civil. Utilizando la metodología de frontera estocástica, estudiamos las diferencias entre el salario potencial y el salario que percibe un individuo dada su inversión en capital humano y sus características socioeconómicas. Para ello, construimos un panel de datos, de jóvenes trabajadores, que permanecen en la muestra siete años consecutivos. Los datos que utilizamos son el Panel de Hogares Europeo (EHP) para el periodo 1995-2001. Nuestros resultados indican que las diferencias salariales, de mujeres casadas con respecto a mujeres solteras y hombres, para Alemania, España, Italia y Reino Unido no se pueden atribuir a diferencias en capital humano.

*Palabras clave:* diferencias salariales, estado civil, Europa.

*Clasificación JEL:* J24, J31, J71.