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DO WOMEN REALLY FACE WAGE DISCRIMINATION ON THE LABOUR MARKET? AN ANALYSIS USING INTRA-HOUSEHOLD SPECIALIZATION

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Abstract

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This study aims to estimate the gender pay gap, cleansed at least partially of the effect of intra-household specialization on productivity. The estimate is based on EU-SILC data for 19 member countries of the European Union. We use an estimate of the average treatment effect on the treated, supplemented by a matching procedure to estimate the unexplained part of the gender pay gap and use a subsample of employees earning more than their partners, thus minimizing the impact of child- and family-care on the gender pay gap. We conclude that the unexplained gender pay gap amounts approximately 10 percent working to the disadvantage of women. If we assume that the dominant role in family- and child-care is taken up by the partner earnings a lower wage, then this difference could neither be explained by differences in the observed personal and company characteristics nor by the dominant role of women in care for the household and children and could actually be due to wage discrimination against women.

Keywords: average treatment effect on the treated, matching, gender pay gap, wage differences, labour market

INTRODUCTION

In our society women predominantly take care of the household, family and children. The reason is in part due to tradition and in part due to the fact that women earn in many cases less than men and therefore men take on the role of breadwinners. Due to the responsibilities of women in the care for the household and for the children, it is reasonable to assume that women cannot devote as much time and effort to their jobs as men, which can be a legitimate reason for their lower wages. Do women face wage discrimination or are the existing gender wage differences only a reflection of the dominant position of women in the household and childcare? These questions are addressed in this paper.

A number of studies is devoted to the issue of wage inequality between men and women. Well known are the articles of Oaxaca (1973) and Blinder (1973). These authors focus on wage differences in the USA and decompose the existing wage differences into two parts: effects of the differences in the individual characteristics and effects of discrimination.[1] To explain the existing gender pay gap they use a wide range of personal and company characteristics. Despite this, more than one half of the wage gap stays unexplained. An estimate of the unexplained part of the gender

1 Currently, these effects are mostly referred to as the endowment and remuneration effect or the explained and unexplained part of the gender pay gap

pay gap for European countries is presented in the studies of Beblo *et al.* (2003) and Christofides, Polycarpou and Vrachimis (2013). Differences in the characteristics of men and women explain only a small part of the gender pay gap in EU countries, if any. To clarify the causes of gender wage differences these and other studies work with a large number of explanatory variables, which are available and which could be the cause for the existing wage gap between men and women. These are mostly age, work experience, education, company size, occupation, industry of employment, managerial position, contract (permanent or temporary), region and sometimes marital status and number of children. The unexplained part of the gender pay gap could largely reflect the dominant role of women in caring for the household, family and children and loss of human capital during maternity leave. Unfortunately, official data reflecting the absence of women at work due to maternity leave and caring for children, and their different productivity in comparison to men are not available. It is difficult to quantify the effect of this on the gender wage differences but despite these difficulties, this area does not remain unnoticed.

A number of empirical studies is devoted to the issue of the impact of motherhood on the female wage. These studies estimate the wage difference between working mothers and women with no children, this often being known as the family or motherhood wage gap. They mostly estimate the Mincer type of wage function for women, using children as an explanatory variable and conclude that working mothers earn less than women with no children (Felfe, 2012). Caring for the family and children may not only be the cause of a lower wage for women with children, it may also influence the earnings of men with children. The studies show that the family penalty for women ranges from 10 to 15 percent. On the other hand, marriage and a family increase the wage of men by 10–15 percent. (Waldfogel, 1998) Betrand, Godin and Katz (2010) confirm these results. They assess the gender pay gap for highly-educated workers in the U.S. corporate and financial sector. They conclude that the wages of men with children increase in contrast to a decline in the wages of women with children. They add that the wage differences between men and women depend on the level of earnings of the spouse of the women. Motherhood has a lower impact on the earnings of women with lower-earning spouses.

An original method of estimation of the gender wage differences is used by Montag (2014), where the effect of the difference in the individual levels of unobserved characteristics of men and women is taken into account. He estimates the unexplained gender pay gap using a subsample of same-sex couples, assuming that the intra-household division of labour and its effects on market productivity cannot be sex-determined in this subpopulation. He concludes that the gender pay gap among gays and lesbians is much smaller than among the heterosexual population. According to these findings, intra-household division seems to be an important factor driving wage differences between men and women on labour market.

This study aims to estimate the gender pay gap, cleansed at least partially of the effect of intra-household specialization on productivity. To achieve this, we use a subsample of employees earning more than their partners.

We assume that the larger part of care for the household and children is taken up by the partner earning less. In cases, where the woman is earning more than the man, either the man assumes the role of the parent taking a larger share in the care for the children and household, or these families utilize the facilities of a day-care centre or nanny for the children and household (see Bertrand, Goldin and Katz (2010)). Women having a higher income than their partner can therefore be fully involved in work. This approach enables us to detect the unexplained part of the gender pay gap, which is at least partially adjusted for the care of the household and children. To estimate the unexplained part of the gender pay gap, we use an estimate of the average treatment effect on the treated (ATT), supplemented by matching.

The first section of the paper describes the data upon which the paper is based and the methods used. To estimate the unexplained part of the gender pay gap we calculate the average treatment effect on the treated. In order to improve the quality of the estimate the matching procedure is used, specifically coarsened exact matching. The estimate is based on data for 19 member countries of the European Union from EU-SILC 2011. The second part of the paper reports the obtained results and compares these with the findings of selected studies dealing with the same issue. The final section summarizes the obtained findings.

DATA

We use data from European Union Statistics on Income and Living Conditions (EU-SILC). EU-SILC contains multidimensional micro-data on income, poverty, social exclusion and living conditions.[2] We use cross-sectional data for 2010, which can be found in EU-SILC 2011 and covers

2 EU-SILC provides two types of data: cross-sectional and longitudinal. The former includes data to the given time or a certain time period, the second contains individual-level changes over time. The reference populations in EU-SILC are all private households and their current members residing in the territory of the countries at the time of data collection. The personal data comes from household members aged sixteen and plus.

data from 30 European countries.[3] Our study is based on EU-SILC data for 19 member states of the European Union (Austria, Belgium, Cyprus, Czech Republic, Germany, Estonia, Greece, Spain, Croatia, Italy, Luxembourg, Latvia, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, United Kingdom), which contains all the required information. EU-SILC data does not contain information on hourly wages. It was therefore necessary to narrow down the sample to be able calculate the hourly wage using the available data. We narrowed down the reference population sample to persons who: were employees during the reference period, worked all twelve months in a full-time job, had no other jobs and earned an income. We excluded the self-employed, as we are interested in wages and the potential different evaluation of male and female employees by the employer.

We use data based on the selected personal and company characteristics of the employee: education level (highest attained education level according to ISCED-97), sickness (temporary inability to work due to sickness during the income reference year), partnership (having a partner living in the same household), dependent children (having at least one economic inactive child under 24 years), occupation (according to the classification ISCO-88), sector (economic activity using the classification NACE Rev.2), company size (number of persons working at the local unit), contract (having a work contract of limited duration), managerial position (having a formal responsibility supervising a group of other employees), work experience (number of years spent in paid work), gross hourly wage and gross hourly wage of the partner. The gross hourly wage is calculated as the employee's cash and non-cash incomes per year divided by the number of hours usually worked per year (including overtime).

A brief overview of the data set and the individual subsamples is presented in Tab. I. Tab. I firstly shows the average of selected observed characteristics of men and women using the whole sample. We then went on to choose a subsample of men and women, who earn more than their partners. The average characteristics of men and women in the defined subsample are shown in the fourth and fifth columns of Tab. I.

When looking at the whole sample we can see that the gender pay gap calculated as the difference in the logarithm of the gross hourly wage amounts to 0.35 (35 percent). When we reduce the sample, choosing only the subsample of individuals who earn more than their partners, the wage differences between men and women significantly decrease. In such a subsample gender wage differences are negligible. The gender pay gap is approximately 0.03 (3 percent). This data indicates that the dominant role of women in caring for the household and children could play an important role in the explanation of the gender wage differences. On the other hand, the decrease in gender pay differences could be to some extent caused by the better characteristics of women compared to men in the subsample. The representation of men and women in the age categories, occupations and sectors is very similar in both samples. It is important to note that in comparison to the whole sample, in the subsample of employees earning more than their partner a larger proportion of women attained tertiary education, worked in larger companies and attained managerial positions. In order to take this into account, we estimate the part of the wage gap that cannot be explained by different characteristics of men and women in our subsample using an estimate of the average treatment effect on the treated.

METHODS

To estimate the unexplained part of the gender pay gap we use an estimate of the average treatment effect on the treated. '*The average treatment effect on the treated is the mean effect for those who actually participated in the programme*'. (Wooldridge, 2002, p. 605) In our case, the ATT will be the mean effect for women in the form of a lower wage resulting from being a woman. We use this formula for the calculation of the average treatment effect on the treated

$$ATT = E(y_i(1) - y_i(0) | T_i = 1). \quad (1)$$

Where T is the binary treatment indicator, T = 1 denotes treatment and T = 0 otherwise, y(1) is the potential outcome with treatment and y(0) is the potential outcome without treatment. In our case, to be treated means to be a woman. We can rewrite the ATT as

$$ATT = E(y_i(1) | T_i = 1) - E(y_i(0) | T_i = 1). \quad (2)$$

Where ATT represents the gender pay gap, which cannot be explained by the different characteristics of men and women. The term is the sample average of the logarithm of the gross wage of women and the term is the sample average of the logarithm of the gross wage of women, should they be men. From our sample we know the first term on the right-side of equation 5, which is the sample average of the logarithm of the gross hourly wage of women. The second term, the average of the logarithm

3 Austria, Belgium, Bulgaria, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Croatia, Hungary, Iceland, Italy, Luxembourg, Lithuania, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia, United Kingdom.

I: *Average of characteristics of men and women (in percent unless otherwise stated)*

	Whole sample		Earning more than partner	
	men	women	men	women
Log gross hourly wage	2.32	1.97	2.24	2.21
Age	44.58	43.23	43.39	42.10
Education (ISCED-97)				
Pre-primary education	0.10	0.04	0.06	0.03
Primary	1.60	3.96	4.94	2.90
Lower secondary	11.72	8.45	9.20	6.29
Upper secondary	50.65	47.01	51.98	40.93
Post-secondary non tertiary	3.90	4.45	3.30	4.81
Tertiary education	28.23	36.09	30.97	45.03
Sickness	14.55	15.08	12.36	13.58
Partnership (having partner)	95.54	95.18	93.69	95.51
Children (having dependent children)	77.08	72.17	75.82	72.15
Occupation (ISCO-88)				
Legislators, senior officers and managers	8.61	4.88	9.28	6.65
Professionals	14.90	21.59	15.78	28.8
Tech. and associate professionals	15.97	21.20	17.18	23.75
Clerks	7.48	17.48	6.62	16.19
Service and sales workers	7.21	16.60	6.95	11.37
Skilled agricultural and fishery workers	1.50	0.58	0.85	0.50
Craft and related trades workers	21.76	4.22	21.24	3.35
Plant and machine operators and assemblers	16.64	4.71	16.25	3.69
Elementary occupations	5.96	9.16	4.27	6.26
Armed forces	1.25	0.12	1.57	0.16
Sector (NACE Rev. 2)				
Agriculture, forestry and fishing (A)	2.50	1.42	2.38	1.29
Mining, manufacturing, …(B–E)	29.26	16.68	30.52	14.87
Construction (F)	11.68	1.70	10.88	1.97
Wholesale and retail trade… (G)	10.49	13.74	9.76	10.85
Transportation and storage (H)	9.21	3.23	9.53	3.39
Accommodation and food service …(I)	1.96	3.86	1.92	2.80
Information and communication (J)	3.23	1.70	3.21	2.10
Financial and insurance activities (K)	3.69	4.55	4.9	6.41
Real estate activities, professional… (L–N)	6.2	6.76	5.35	6.40
Public admin. and defence, …(O)	11.47	11.6	12.10	12.25
Education (P)	4.74	17.19	4.97	19.3
Human health and social activities (Q)	3.40	14.44	3.17	15.64
Art, entertainment, recreation …(R–U)	2.34	3.68	2.11	3.1
Company size				
0–10 employees	17.74	21.87	15.94	17.16
11–19 employees	12.40	13.30	12.39	12.84
20–49 employees	15.87	18.5	16.00	17.78
50 + employees	49.27	42.87	50.59	48.69
Unknown but less than 11	1.22	1.00	1.20	0.80
Unknown but more than 10	3.50	2.91	3.88	2.72
Contract (temporary)	5.60	6.60	4.94	6.18
Managerial position	32.67	20.29	33.20	24.42
Work experience (years)	24.08	20.94	22.73	20.05
N	35371	23886	13006	6753

Source: Eurostat: EU-SILC microdata 2011, rev. 1, August 2013

of a woman's gross hourly wage if she were a man, needs to be somehow estimated. There are more ways to estimate this. For more details see Wooldridge (2002) and Ho *et al.* (2007). We estimate this using the regression model.

First, we estimate the coefficients of the wage function of men

$$(y_i | T_i = 0) = \beta_0.X_i + u_i, \qquad i = 1, \ldots, n_m. \tag{3}$$

Where, is the logarithm of the male gross hourly wage, is the vector of the coefficients of the wage function, X is the vector of the chosen observed characteristics of men and u is a disturbance term. As explanatory variables we use country, education level, work experience, sickness, partnership, dependent children, occupation, sector, company size, contract and managerial position.

We then use the estimated coefficients of the male wage function to calculate the average of the logarithm of the gross hourly wage of women, should they be men

$$E(y_i(0) | T_i = 1) = E(\beta_0.X_i), \qquad i = 1, \ldots, n_f. \tag{4}$$

Where is the mean of the predicted wages (the logarithm of the gross hourly wage) of every woman in the sample. Finally, we estimate the average treatment effect on the treated as the difference between the average of the logarithm of the gross hourly wage of women and the average of the predicted values of the wages calculated from the male wage function

$$ATT = E(y_i(1) | T_i = 1) - E(\beta_0.X_i | T_i = 1). \tag{5}$$

The calculated unexplained part of the gender pay gap could not perfectly reflect the level of wage discrimination against women. This is due to the fact that the estimate of the unexplained gender pay gap is based only on the observed characteristics of women and men, which are available. One of the reasons for the lower wage of the individual could be due to the responsibilities in the care for the household and children. It is reasonable to assume that working women or men, caring for a household and children, cannot devote as much time and effort to their job as individuals without or with a smaller portion of these obligations. This may be a legitimate reason for their lower earnings. We assume that the partner who earns less takes on a larger responsibility for the household and child-care. We estimate the ATT using the subsample of individuals, who earn more than their partners. This enables us to detect the unexplained part of the gender pay gap, which is at least partially adjusted for the care for the household and children. To be able to make a comparison, we also estimate the ATT for the entire sample of men and women.

To reduce potential bias resulting from the samples of men and women being too different, we use in this case matching as a preprocessing procedure as proposed by Ho *et al.* (2007). Many matching procedures exist. We use coarsened exact matching (CEM), which performs exact matching on coarsened data. It coarsens variables into groups and goes on to exclude untreated units, whose coarsened characteristics do not match with any treated units and vice versa. Finally, it returns uncoarsened data from observations that were matched. (Blackwell *et al.*, 2009) The matching procedure, in our case coarsened exact matching, enables us to create subsamples of men and women, these being as homogeneous as possible.

We calculate the ATT after the matching procedure is complete, using the original samples and subsamples.

RESULTS AND DISCUSSION

We calculate the ATT using the subsample of individuals earning more than their partners and for the purpose of comparison we also estimate this for the whole sample of men and women. The results are shown in Tab. II.

II: *Unexplained gender pay gap: Estimate of the average treatment effect on the treated*

	Without matching	Coarsened exact matching	Coarsened exact matching_1
Whole sample			
Average treatment effect on the treated	–0.1777*** (0.0042)	–0.1517*** (0.0076)	–0.1504*** (0.0054)
N	59257	10310	21816
Men	35371	5363	11675
Women	23886	4947	10141
Employees earning more than their partners			
Average treatment effect on the treated	–0.1128*** (0.0068)	–0.1017*** (0.0164)	–0.0913*** (0.0108)
N	19759	1964	4641
Men	13006	1071	2598
Women	6753	893	2043

Note: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level, robust standard errors in brackets

Firstly, we estimate the wage function for men using equation 3. As explanatory variables we use country of residence, education, work experience, sickness, partnership, dependent children, occupation, sector, company size, contract and managerial position. We then go on to estimate the ATT from equation 5 as the difference between the average female wage and the female wage should women be men. The results are shown in the second column of Tab. II.

The unexplained part of the gender pay gap calculated for the whole sample of men and women amounts to –0.18. Women earn 18 percent less than men and this wage difference cannot be explained by differences in the observed personal and company characteristics (country of residence, education, work experience, sickness, partnership, dependent children, occupation, sector, company size, contract and managerial position). The legitimate reason for a lower female wage can be attributed to the dominant role of women in caring for the household and family. To minimize this effect we calculated the ATT for the subsample of men and women earning more than their partners. The unexplained gender pay gap amounts to –0.11. This implies that women from this group earn approximately 11 percent less than men.

To reduce potential bias resulting from the samples of men and women being too different, we use coarsened exact matching as a preprocessing procedure to be able to work with a more homogenous sample of men and women. We first match men and women in the sample using a wide range of observed characteristics, which could affect the wage: age, work experience, country, education, sickness, partnership (only for the whole sample), dependent children, occupation (1digit), sector, contract, company size and managerial position.[4] This coarsened exact matching procedure is referred to as Coarsened exact matching. Due to the fact that strict matching by use of a wide range of observed characteristics causes a big reduction of the samples we also match the samples using only key personal and company observed characteristics: age, work experience, country, education, occupation (1digit) and sector.[5] This coarsened exact matching procedure is referred to as Coarsened exact matching_1. We apply this procedure on both samples (the whole sample and the subsample of employees earning more than their partners).

Matching caused the unexplained gender pay gap to decrease. The unexplained gender pay gap calculated for the subsample of men and women earning more than their partners decreased by 1–2 percentage points. The women in this group earn approximately 10 percent less than the men. A similar decrease in the ATT is achieved when the whole sample of men and women is used. The ATT, which indicates the unexplained gender pay gap, amounts to –0.15 percent.

A number of studies deals with the issue of the unexplained part of the gender pay gap in countries of the European Union. Christofides, Polycarpou and Vrachimis (2013) apply the Oaxaca-Ransom decomposition and estimate the unexplained gender pay gap for 24 of the member countries of the European Union. They use EU-SILC 2007 data and identify an unexplained gender pay gap of 0.33, where the advantages for males amount to 0.15 and the disadvantages for females to 0.18. Beblo *et al.* (2003) use The European Community Household Panel 1998 data and apply several methods to decompose the gender pay gap. Using the Oaxaca-Blinder decomposition they find an unexplained gender pay gap of 0.16. Compared to these studies, we identify a significantly smaller unexplained gender pay gap, especially after the adjustment for family and child-care. The differences in the estimate are due to the use of alternative methods, the used data, the number of explanatory variables including the wage function and mainly due to the consideration of family and child-care.

We find that family and child-care play an important role in the explanation of the wage differences between men and women but despite this the part of gender pay gap, which amounts to approximately 0.1, stays unexplained. The cause for the unexplained gender wage differences could be loss of human capital during maternity leave, an unobservable difference in productivity or work effort of men and woman or the differences could be a reflection of the wage discrimination against women (see for example Felfe, 2012 and Hedija, 2014).

CONCLUSION

The raw gender pay gap, calculated as the difference in the logarithm of the female average hourly wage and the male average hourly wage and counted for the whole sample of employees, amounts to 0.35 and, calculated for the subsample of individuals earning more than their partners, to 0.03. This implies that on average women earn approximately 35 per cent less than men, and women, who earn more than

4 The variable 'age' is coarsened into nine conventional groups (< 20, 20–24, 25–29, 30–34, 35–39, 40–44, 45–50, 50–54, 55–60 and 60+) and the variable 'company size' into two groups (less than 11 employees and more than 10 employees). To coarsen 'work experience' we apply Sturgen's rule. The variables: country, education, occupation, sector, partnership, dependent children, contract, managerial position, and sickness are matched exactly.

5 The variable 'age' is coarsened into nine conventional groups (< 20, 20–24, 25–29, 30–34, 35–39, 40–44, 45–50, 50–54, 55–60 and 60+). To coarsen 'work experience' we apply Sturgen's rule. The variables: country, education, occupation and sector are matched exactly.

their partners, earn only approximately 3 percent less than men. Part of the wage differences can be explained by the differences in the characteristics of men and women in the sample. To take this into account we calculate the average treatment effect on the treated, which indicates the unexplained part of gender pay gap. To get a more homogenous sample of men and women we use coarsened exact matching as a preprocessing procedure.

These calculations show that the ATT counted for the subsample of employees earning more than their partners is significantly lower than the ATT calculated for the whole sample of men and women. The ATT calculated for the subsample of employees earning more than their partners ranges from –0.09 to –0.11, depending on the applied method. The ATT counted for the whole sample of men and women is higher by approximately 6 percentage points. There can be more reasons for this. Firstly, this could be due to the effect of children and family-care, where the key role in family-care is taken up by the partner who earns less. Secondly, the women who earn more than their partners could act more like men or can be on average more capable and productive when compared to other women independent of family-care. Whatever the reason may be, 10 percent of the wage gap between men and women remains unexplained. Under the assumption that the dominant role in family-care is taken up by the partner earning less and the knowledge and abilities of women and men in our subsample are on average equal, then we can safely say that this pay gap can be attributed to wage discrimination against women on the labour market.

SUMMARY

This paper addresses the issue of wage differences between men and women. It aims to estimate the gender pay gap cleansed at least partially of the effect of intra-household specialization on productivity. We use data from EU-SILC 2011 and assume that the larger part of household and child-care is taken up by the partner earning less. To minimize the impact of the household and children on the wage differences, we estimate the unexplained part of the gender pay gap using a subsample of employees, who earn more than their partners. We calculate the average treatment effect on the treated to estimate the part of the gender pay gap, which could not be explained by different observed characteristics of men and women in this subsample. To minimize potential bias resulting from a greater difference in the composition of the group of men and women, we use matching as the preprocessing procedure, specifically coarsened exact matching. We conclude that the average treatment effect on the treated amounts to –0.1. This implies that in our subsample the earnings of men are on average approximately 10 percent higher than those of women. This difference could not be explained by differences in the observed personal and company characteristics, specifically country of residence, education, work experience, sickness, dependent children, occupation, sector, company size, contract and managerial position nor the dominant role of woman in the care for the household and children. If we assume that the dominant role in family and child-care is taken up by the partner earning less and the knowledge and abilities of women and men in our subsample are on average at least equal, then this pay gap can be attributed to wage discrimination against women on the labour market.

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