THE IMPACT OF SEX SEGREGATION BY ECONOMIC ACTIVITY ON THE GENDER PAY GAP ACROSS EUROPE

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Abstract:
The gender pay gap is a complex issue caused by a number of interrelated factors and has inevitable impact on the status of women in their economic and social life.The objectives of this paper are concentrated in investigating the sex-segregation by economic activity in the labour market and its relationship to the gender pay gap across Europe. Dissimilarity index is calculated and sectoral gender based segregation in EU during 2010 was on average 0.30, meaning that 30% of the employed population would need to change economic activity in order to have an equal distribution of men and women. The findings of cluster analysis showed the paradox that some countries like Luxemburg, Belgium, Poland have high dissimilarity indices and lowest percentage of gender pay gap or Scandinavian with the highest dissimilarity indices have gender pay gap around the mean on the European level.

Keywords: gender inequality, dissimilarity index, cluster analysis, horizontal sex-segregation, labor market

JEL classification: J16, J31, N30

INTRODUCTION

The differences in the labour market between the two sexes are recorded in various levels: men are getting paid more than women, they work more hours and their jobs are more highly esteemed than those of the women (Reskin and Bielby, 2005). The terms, sex-segregation and Gender Pay Gap (GPG) are dominating the area of gender inequality in the labour market and they are highly correlated between each other.

Sex-segregation is defined as the unequal distribution of men and women based on demographic characteristics across and within occupations, jobs or economic activities. In the literature, sex-segregation can be vertical (or hierarchical segregation) or horizontal. Vertical sex-segregation is defined as inequalities in the gender distribution between different responsibilities within the same sector or occupation. Horizontal sex-segregation is defined as the unequal distribution of women and men across various sectors of economic activities or occupations. For this study and from now on sex-segregation will denote horizontal sex-segregation across economic activities in EU. The unadjusted gender pay gap at EU level is defined as the difference between average gross hourly earnings of male paid employees and of female paid employees as

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a percentage of average gross hourly earnings of male paid employees. According to
Eurostat (2013) "for the economy as a whole, women's gross hourly earnings were on
average 16% below those of men in 2011 in the European Union (EU-27) as well as in
the euro area (EA-17)".

Bayard, Hellerstein, Neumark, and Troske (2003) claimed that sex-segregation in
the labour market accounts for high percentage of the wage differences between
women and men. According to Blau and Hendricks (1979) this phenomenon is viewed
as a type of inequality between the two sexes. Since inequalities can only have negative
consequences there is a need to address the current situation and study the costs
created.

This work aims to present the results of the data analysis based on the Labour Force
Survey of Eurostat 2010 and is organized as follows: using the dataset created from
Labour Force Survey data of Eurostat 2010, we firstly calculated and studied the
Duncan and Duncan (1955) index for all economic activities across EU. Secondly, we
identified the relationship between the calculated Duncan and Duncan index and the
GPG of 2010. Finally, using cluster analysis we categorized the counties in EU.

The methodology used involves statistical tools such as cluster analysis and
fundamental descriptive indices for measuring sex-segregation such as Duncan and
Duncan dissimilarity index-D. These techniques helped us to formulate a
comprehensive picture of the sex-segregation by economic activity in Europe and the
reflection on gender inequalities.

The paper is structured with Section 2 presenting the literature review on sex-
segregation, Section 3 describing the methodology used and database, Section 4
outlining the analysis contacted and the results, and finally Section 5 is discussing the
conclusion.

1. LITERATURE REVIEW

The concentration of women and men in different professions or sectors of economic
activity differ. Horizontal segregation is understood as under (over) representation of a
certain group in occupations or sectors not ordered by any criterion (Bettio and
Verashchagina, 2009). But important for gender pay inequality is that women and men
tend to work in different sectors and occupations that are not valued equally. In that
way we can conclude that the over representation of man in a better paid occupations or
sectors refer to gender horizontal segregation. Horizontal segregation is a constant in
the labour market in all OECD countries (Rubery and Fagan, 1993; Anker, 1998;
OECD, 1998). Jonung (1998) anticipates a maintaining or even an accentuation of the
professional segmentation. According to Anker (1998) horizontal segregation is a
nearly immutable and universal characteristic of contemporary socio-economic
systems. It also explains a part of the gender pay gap (Blau and Ferber, 1987). The
debate on the root causes of gender segregation in employment dates back to the 1970s,
but it remains the point of reference to date despite the fact that so much has changed
since then (Bettio and Verashchagina, 2009). Productive potential is affected by human
capital broadly reflecting innate ability, education, training and work experience
(Becker, 1964) and by individual or household preferences affecting both the

development of human capital and the type of work done (Becker, 1981; Clark, 1997).
For example, women who anticipate a career interruption due to maternity would invest
less in education and formation. They accumulate less human capital than men which
could prevent them from having access to occupations up the professional hierarchy
(Mincer and Polacheck, 1974).Women and men differ, both in terms of the jobs in
which they work and in their responsibilities, but over time, women's skills have
become more similar to men's. The occupations and industries in which men and
women work have also become more similar. Given that women have caught up with
men and even surpassed them in terms of educational attainments, human capital theory
is no longer powerful. Women's skills have become more similar to men's and the
occupations and industries in which men and women work have also become more
similar. The explanatory power of human capital theory has been questioned by several
authors (England 1982, 1985; Corcoran et al.1984; Rosenfeld 1984; Rosenfeld and
Spenner 1992) for other reasons, despite the fact that the increase in women's
educational attainments has undermined. Advanced technological changes, such as the
expansion of information and communication technologies, have increased the growth
of the service sector and the decline of industry. Technology tends to increase
employment in the service sector where jobs are more accessible to women and to
reduce employment in blue-collar jobs in industry that are more associated with the
male workforce. The study "Education at a Glance 2009" shows that more women than
ever successfully complete higher education and that the average female graduation
rate in tertiary education in OECD countries is 46.9 percent, compared to 30.8 percent
of the male graduation rate (OECD 2009). Since women's level of education has
increased more than men's (and has even become superior to men's), the technological
evolution has had a favorable impact on women's employment and it has accelerated
their arrival in traditionally male careers.

Consequently, technological change has affected the professional composition of
the female workforce (Black and Juhn 2000). Effectively, the concentration of women
in some sectors tends to grow over time (Franco, 2007).

According to the ILO, women represent 40.4 percent of the worldwide workforce.
However, that proportion is not reflected when investigating occupational groups
within the various sectors: 46.3 percent of employed women work in the services
sector, 35.4 percent in the agricultural sector and only 18.3 percent in the
industrial sector (compared to 26.6 percent of employed men) (ILO 2009). The
specific sectors in which women employees are the vast majority – secretaries, teachers
and nurses – also are poorly paid work areas. And even within these jobs they are paid
less than their male colleagues (IWPR 2009). This fundamental under-evaluation of
women's work results basically from two facts. Firstly, women's primary responsibility
for unpaid care work such as children, education and basic family services seems
to channel them into similar working areas in the labour market (UNIFEM 2005).
Some researchers refer to differences in occupations between women and men as
the selection effect (Petersen and Snartland, 2004). The selection effect implies not
only that woman choose certain kinds of occupations, but that employers are favoring
men over women by not adapting the work environment to suit both genders.

Bettio and Verashchagina, (2009) analyses the past trends using Hakim's (1992) classification of occupations into male-dominated, female-dominated and mixed. The analysis puts some flesh on the statistical bones. In line with expectations, between 1997 and 2007 mixed occupations increased in all the countries where segregation indices declined, and conversely. Four exceptions are the Czech Republic, Finland and France — where the past decade witnessed a remarkable increase in female-dominated occupations — and Germany, where the increase mainly affected male-dominated occupations. Across countries, change was more pronounced for male-dominated occupations, whose share decreased proportionately more. Looking at sectoral rather than occupational segregation makes some, though limited, differences to the above findings. The overall IP (the standardised or Karmel and MacLachlan index) value for the EU-27 at sectoral level is lower than the corresponding figure for occupational segregation: 18.4 % in 2007 as opposed to 25.2 %. This drop in the value of the index is considerable, but it is also to be expected on account of the lower number of sectors than occupations. The 2007 ranking by countries shows that seven countries change group with respect to their ranking for occupational segregation, mainly from the 'high' to the 'middle' segregation group. However, the top four countries for occupational segregation are also found in the high sectoral segregation group, and conversely for the bottom four countries. Since 2001, sectoral segregation has displayed a somewhat more marked upward trend that has occupation segregation, with an overall increase for the EU-27 of 1.2 percentage points. Only seven countries record a decrease. Desegregating countries include Austria, Portugal, Malta, Denmark, Sweden, the UK, the Netherlands and Slovenia, all of which except for Portugal having also experienced near stability or fast de-segregation of occupations. Overall, these findings are not inconsistent with those for occupational segregation, but they confirm that not much information is gained by considering sectors (Bettio and Verashchagina, 2009).

The existing literature suggests large and persistent gender differences in the distribution of jobs typically performed by men and women in all regions of the world although, the degree of occupational horizontal segregation by gender has exhibited a substantial decrease in recent decades (Deutsch et al., 2002; Tzannatos, 1999; Baunach, 2002; Anker et al.; 2003, Semyonov and Jones, 1999).

Blackburn and Jarman (2005) note the paradoxical case for some developed countries (e.g., Sweden and Finland) of high levels of horizontal segregation by gender co-existing with high degrees of gender equality and small gender pay gaps. In short, they explain that although women and men enjoy equal access to education and training opportunities, female career paths tend to specialize in female dominated jobs where their access to managerial positions is higher. In this way, high levels of horizontal segregation may be possible with high levels of gender equality in terms of gender pay gaps and female representation in managerial positions. During the last decade new patterns have emerged (Bettio and Verashchagina 2009). The Nordic welfare states can no longer be regarded as the strongest gender segregated labour markets (Ellingsaeter 2013).

Historically there is paradox that some countries like Scandinavian have high dissimilarity indices and low percentage of gender pay gap. We try to continue in

explanation by investigating official data, how much horizontal segregation can explain gender pay gap.

2. METHODOLOGY AND DATA

During this study we have implemented a variety of techniques and methods in order to map the current situation in EU concerning the sex-segregation in various economic activities and its relationship with GPG.

The dissimilarity index, D, firstly introduced by Duncan and Duncan (1955) is a measure of "employment dissimilarity" that can be used to analyze employment differences between any two groups of workers. The index D ranges between 0 to 1, with 0 indicating identical distribution of workers (men and women) across sector or occupational categories and 1 indicating complete dissimilarity in the distribution of workers. In addition, this quantitative measure indicates the percentage of men or women that have to change jobs for both groups to have the same inter-job distribution. The bigger the dissimilarity index, the bigger the sex-segregation.

In this study, D will denote the employment differences between men and women across economic activities in EU.

The index is defined as: $\quad D = \dfrac{1}{2} \sum\limits_{i=1}^{k} \left| \dfrac{W_i}{W} - \dfrac{M_i}{M} \right|$ (1)

Where:

W_i : is the number of women in the i economic activity

W : is the total number of women in the sample/population for which the index of dissimilarity is being calculated.

M_i : is the number of men in the i economic activity

M : is the total number of men in the sample/population for which the index of dissimilarity is being calculated.

k: is the number of economic activities under study.

Duncan and Duncan index has advantages and disadvantages. Even though the index can determine sex-segregation, on the other hand it shows the percentage of people who have to change their job to balance the distribution of the workers; this percent is only expressed to the number of people of the same sex and not to the total number of workers. In addition, it is based on the hypothesis that there should be an equal distribution of men and women in every sector or occupation. For more on pros and cons of the indices see for example Massey and Denton (1987), Karmel and Maclachlan (1988), and Watts (1992).

Apart from the Duncan and Duncan index, cluster analysis has been engaged to further study sex-segregation and gender pay gap. Generally, the main objective of cluster analysis is to classify cases into relatively homogeneous groups based on one or more variables considered. The cases in each cluster are expected to be relatively similar in terms of these variable(s) and different from cases in other clusters. The resulting clusters should exhibit high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity. Cluster analysis is a methodology for

quantifying the structural characteristics of a set of cases and is a descriptive rather than a statistical inference technique. No requirements on normality, linearity and homoscedasticity that are so important in other statistical techniques exist. The most important aspect that needs to be considered though is the representativeness of the sample, i.e., cluster analysis is only valid when the sample is representative of the population of interest.

The clustering procedure to be used here is the agglomerative hierarchical method (build-up method) where each object or case starts out as its own cluster and in subsequent steps, the two closest clusters (or cases) are combined into a new aggregate cluster, that reduces the number of clusters by one, step by step. The method to compute the clusters will be Ward's method and distance measure the Euclidean squared distance. Ward's method uses an analysis of variance approach by calculating the total sum of squared deviations from the mean of a cluster. As actually there is no best method to use for clustering, Ward's method and Euclidean squared distance has been chosen as the most efficient and used ones (Burns & Burns, 2009).

The main data source we have used to create the dataset is the Labour Force Survey (LFS) of 2010 Eurostat dataset. Specifically we have used 29 different economic activities coded in NACE Rev. 2 (General industrial classification of economic activities within the European Communities). The series used were the number of employees by sex, economic activity and collective pay agreement (earn_ses10_01) and the mean hourly earnings by sex, economic activity and collective pay agreement [earn_ses10_12]

3. ANALYSIS AND RESULTS

In this section we present the results obtained using Duncan and Duncan dissimilarity index and cluster analysis according to how these have been described in Section 3.

Table 1 shows in descending order the calculated Duncan and Duncan index for 31 countries using definition (1) and the dataset of 2010. From Table 1 it is clear that Netherland and Denmark lie in the median of the set with D index 0.33. On average, sex-segregation in EU during 2010 was 0.30. The latter number says that 30% of the employed population would need to change economic activity in order to have an equal distribution of men and women among all economic activities. The country with the smallest value is Greece (0.23) and the country with the largest is Finland (0.41). The difference between the highest and the lowest D index for the 31 countries under study is 18 percentage points and the skewness of the distribution is only 0.070.

On the bottom of the list with the lowest D index and therefore the lowest sex-segregation are the Southern European countries Greece and Cyprus and ex socialist countries Romania, Bulgaria and Hungary. What is worth noticed is the fact that Scandinavian countries such as Finland, Sweden, Norway, Luxemburg, Belgium, Iceland, Luxemburg, Poland and Austria that are considered quite progressive demonstrate the highest D index among all and are on the top of the list. The rest of the countries are in the middle two clusters.

In the last column of Table 1 is presented the Gender Pay Gap in unadjusted and percent form - NACE Rev. 2 (structure of earnings survey methodology) for the year

2010 (Eurostat 2014). Even though Eurostat provides more recent data on GPG such as 2012, this dataset includes provisional numbers and in addition, no comparison between dissimilarity index and GPG would make sense if we use data from two different years. Using these given figures for the 31 countries listed in Table 1, the median for the 2010 GPG was 15.6%, which corresponds to France, while the average was 15.09%. Slovenia was the country with the smallest GPG, only 0.90%, and the country with the largest was Estonia (27.70%). The difference between the highest and the lowest GPG for the 31 countries under study is almost 27 percentage units and the skewness of the distribution is -0.424.

Table 1 *Duncan and Duncan dissimilarity index by economic activity and unadjusted gender per gay

Country	[a]Duncan and Duncan Dissimilarity Index	[a]Cluster's Mean Dissimilarity Index	[b]Unadjusted GPG (%)
Finland	0,41	0,38	20,3
Sweden	0,40		15,4
Norway	0,39		16,1
Luxembourg	0,38		8,7
Belgium	0,38		10,2
Iceland	0,37		17,7
Poland	0,37		4,5
Austria	0,36		24,0
Slovenia	0,35	0.34	0,9
Ireland	0,35		13,9
Latvia	0,34		15,5
Croatia	0,34		15,5
Estonia	0,34		27,7
Italy	0,34		5,3
Netherlands	0,33		17,8
Denmark	0,33		15,9
Lithuania	0,32		14,6
Slovakia	0,31	0.30	19,6
Switzerland	0,31		17,8
Spain	0,31		16,2
Germany	0,30		22,3
France	0,30		15,6
Malta	0,30		7,2

Table 1. (continued)

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United Kingdom	0,30	19,5
Czech Republic	0,29	21,6
Portugal	0,29	12,8
Hungary	0,27	0.25	17,6
Bulgaria	0,27	13
Romania	0,25	8,8
Cyprus	0,25	16,8
Greece	0,23	15
Euro area (17 countries)	0.30	16.50
European Union (27 countries)	0.30	16.20

Source: Authors' calculations, Euro stat (2014)

Note: countries are grouped by level of the D-index

When trying to explain the gender pay gap, we usually suggest that the gap is due to the human capital (differences in education, experience, motherhood etc.) and due to the "unexplained" factor which reflects the explicit discrimination. Two factors though, the fact that women and men are not employed in the same economic activities and the fact that the jobs and sectors that women are employed in are less paid, are usually not considered. In other words, sex segregation is not taken in account when trying to explain the gender pay gap. Blau and Ferber (1987) claimed that horizontal sex-segregation explains a part of the gender pay gap. To find out if sectoral sex segregation can explain gender pay gap we perform cluster analysis using the hierarchical agglomeration Ward's method (distance measure: Squared Euclidean distance) with the two variables. Four clusters are differentiated. The first cluster differentiates the countries with the lowest GPG (mean GPG = 6.51) and high D index (mean = 0.34). In this group are countries with high D index like Luxemburg, Belgium, Poland and low GPG. In the second cluster are classified the countries with GPG around the mean on the European level (15.1) and D index starting with the highest 0.40 in Sweden and lowest in Greece 0.23. The third cluster differentiate the countries with the highest GPG (mean=23.9) and D index from 0.29 in Czech Republic and Austria with 0.36. The fourth cluster differentiates the countries with higher GPG than the mean (18.61) and D index starting from 0.27 for Hungary and Finland with the maximum D index of 0.41. The clusters are shown in Figure 1. To evaluate how dissimilar these four clusters are, we perform one way ANOVA. In order to do so a new variable is created in the data set which indicates the cluster that each country has been assigned. One way ANOVA that provides F-value 102.976 and p-value<0.0001 indicates that there is at least one significant difference among the groups' means and suggests that a post hoc analysis is needed to investigate which groups are similar and

which are different. The most common post hoc test to use is Tukey's HSD (Honest Significant Difference) test. Given that the sample sizes of the four groups are unequal, the Harmonic Sample Size used is 6.395 and Tukey's HSD is found to be 0.01999. All mean differences between any two groups are greater than Tukey's HSD value and significant at 5% level of significance. Therefore all four groups are different between each other. Because the four group sample sizes are unequal and Tukey's test may not be reliable, we double check the results using also Scheffe's post hoc test. Scheffe's test as the most robust method of assessing the least significant difference between any two group shows again that all mean differences differ from zero significantly at 5% level of significance and therefore, as expected both post hoc tests' results coincide.
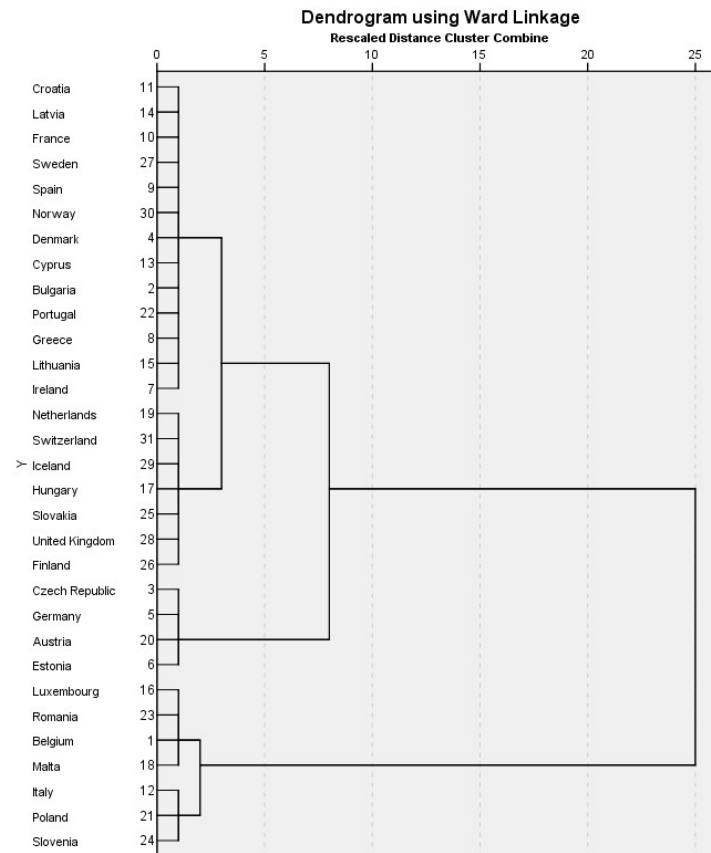
Figure 1. Dendrogram using Ward linkage
Source: Authors' calculations,
Note: countries are grouped by level of the D-index and GPG

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CONCLUSION

As a general conclusion this study shows that sex-segregation by economic activity persists in all European countries. For the EU as a whole the level of sectoral, gender-based segregation measured by most commonly used dissimilarity index ID remains high or about 30 % of all people employed in 2010 would need to change the sector in order to bring about a gender-even distribution of employment. However, differences among countries are wide or there is a gap of about 18 percentage points in the D index between the most segregated and the least segregated country. The Nordic welfare states are still regarded as the strongest gender segregated labour markets. The five high-segregation countries are Finland, Sweden, Norway, Luxemburg and Belgium and the five low-segregation countries are Greece, Cyprus, Romania, Bulgaria and Hungary.

We tried to continue in explanation by investigating official data, how much horizontal or sectoral, gender-based segregation can explain gender pay gap. Cluster analysis differentiated four clusters. There is paradox that some countries like Luxemburg, Belgium, Poland have high dissimilarity indices and lowest percentage of gender pay gap or Scandinavian with the highest dissimilarity indices and gender pay gap is around the mean on the European level. These findings do not give explanation that high gender based segregation can be cause of gender pay gap. In this way, high levels of horizontal, sectoral, gender-based segregation may be possible with high levels of gender equality in terms of gender pay gaps and female representation in managerial positions.

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