Poorly paid jobs or study fields? Gender pay gap of tertiary-educated employees in contemporary European labour markets

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Abstract:
This article examines the reasons for gender-based income inequalities of tertiary-educated people in European labour markets. In the 50 years since the adoption of the anti-discrimination law in many countries, several explanations for gender-based income inequalities have been proposed. Following a literature review, the author presents two hypotheses concerning the lower female income. Even after two massive expansions of the tertiary level of education, there are still male- and female-dominated fields of study. Hence, the first hypothesis suggests that women tend to enrol in less lucrative study fields. The second hypothesis proposes that women – regardless of their university study field – tend to work in less lucrative occupations. Using data from the European Union Labour Force Survey 2016 for 28 member countries, the author first confirms that women are structurally selected to different parts of the education system (i.e., different fields of study), and to different occupations. In the second part of the analysis, the author tests both hypotheses: gender segregation in the field of study has no negative impact on income, but the gender segregation of the occupation strongly impacts income. Therefore, the author rejects the first hypothesis, supports the second hypothesis, and concludes that – in contemporary European societies – income differences arise not in the education system but in the labour market.

Keywords: education, occupation, gender pay gap, income inequality, occupational and educational segregation

Why do women with university degrees receive lower financial returns on their investment in education than their male counterparts? The positive link between education and income is well established and has been thoroughly empirically tested both in social sciences (Blau and Duncan 1967; Breen 2004; Hout 2012) and in economics (Becker 1964; Mincer 1974). Despite this, existing findings show stark gender differences even after the educational expansion. Compared to men with the same education level, women tend to receive substantially lower rewards for their work. Importantly, this gender pay gap concerns not only lower levels of education but particularly tertiary attainment, which should, in theory, be the most conducive to good jobs with high income (cf. Bernardi and Ballarino 2016).

In 2018, after the unprecedented feminization of tertiary education, when the share of university-educated women more than doubled in the European labour markets, European women still had, on

average, 16% lower incomes[1] than European men (Eurostat 2018). For tertiary-educated women, the figure is even higher: 25% (OECD 2022). Many scholars have attempted to find an explanation for the persistent gender-based income inequalities (cf. Blau and Kahn 2003; Blau and Kahn 2017; O'Reilly et al. 2015). But in the years since the 1970s, all possible explanations have been thoroughly discussed, and many of them marked as unconvincing (Arulampalam, Booth, and Bryan 2007; Perugini and Selezneva 2015; Rubery, Grimshaw, and Figueiredo 2005).

According to one of the last persisting explanations, women are structurally selected for less lucrative study fields and therefore seek less competitive occupations rewarded by lower incomes. The two spheres, education and the labour market are interconnected and only vaguely separated. One of the aims of this study is to discover whether the problem of gender-based income inequality is embedded in the education system or in the labour market. If the analysis confirms the influence of female-dominated study fields, it will mean that income inequality is already determined at the education system level. On the other hand, if the analysis demonstrates the influence of female-dominated occupations, it will mean that income inequality in the labour market is an artefact of the labour market itself rather than education.

The article is based on survey data from the European Union Labour Force Survey. I use data from 2016 because of the limited availability of more recent income information. The first finding is that European men and women still study in different study fields and work in different occupations. After two massive educational expansions in the 1970s and 2000s, European women changed from an educationally marginalized group to the dominant one. However, they still have not penetrated male-dominated fields of study. Similar differences can be found in occupations. I found gender segregation both in the International Standard Classification of Occupations (ISCO) classes and in particular occupations. Using an ordinary least squares (OLS) regression, I show that graduating from a more feminized study field does not mean a substantially lower income for male or female graduates.

On the contrary, the link between women's share in the study field and income is only slightly negative for men and strongly positive for women. By contrast, if a higher number of women work in a particular occupation, it brings a moderate income penalty for men and a significant income penalty for women. The gender-based income inequalities in contemporary European societies are not caused by the educational system level; they are inherently incorporated in the labour market.

Using OLS regression with a set of control variables, I first performed an analysis across the European Union (EU), and then a set of separate analyses for individual countries. The obtained results made it possible to further examine the situation in the specific EU countries. According to the results, it is important to support women in obtaining a tertiary education, and not only in so-called lucrative STEM fields (cf. WiTEC 2021), because even graduating from less lucrative female-dominated fields of study does not usually mean an income penalty. Even more important are changes in social policy to ease the burdens of household work and childcare and value changes concerning the roles of men and women.

Devaluation of women's work or different gender roles?

Ochsenfeld (2014) categorized various attempts to explain lower female incomes into three theories: human capital theory, devaluation theory, and gender roles theory.

[1] I use the term 'income' as a synonym for the terms 'wage', 'pay', 'salary', and 'earnings' with the meaning of 'the financial compensation obtained as a reward for the work in the primary employment'.

Lower incomes for women have historically been explained[2] by the notion of women having lower human capital (Becker 1964; Mincer 1974), particularly regarding work experience and education. After giving birth, women typically suspended their careers for some time. Depending on the number of children, these interruptions had an increasingly strong negative effect on the amount of work experience gained, which affected income level according to human capital theory (Chevalier 2007; Lips 2013). However, this argument has gradually weakened in accord with decreasing births during and after the second demographic transition (Zaidi and Morgan 2017). Women continue to interrupt their career trajectories because of childbirth, but the overall interruption period is decreasing significantly, especially for tertiary-educated women (Kim 2016).

The second argument refers to the level of achieved education. Until approximately the 1980s, women, on average, attained lower education levels than men. However, with the advance of female emancipation and increasing incomes in general, this situation has changed; i.e., parents no longer favour boys' educational aspirations, and families no longer have to limit the number of children who will study (DiPrete and Buchmann 2013). In all European countries, tertiary education now has a slightly higher share of women than men. After adopting the Bologna Declaration in 1999, a massive expansion in the education system's tertiary level took place across Europe. Between 2000 and 2016, the share of people aged 25-64 with university degrees rose from 21.3% to 29.1%. Women profited from this expansion more than men: the proportion of women with university degrees increased from 19.8% to 30.9%; the proportion of men with university degrees in the same age group increased from 22.8% to 27.3%.[3]

Rubery, Grimshaw, and Figueiredo (2005), Perugini and Selezneva (2015), and Arulampalam, Booth, and Bryan (2007) pointed out that women have already caught up with respect to both the qualification gap and the experience gap, and that it is necessary to seek other explanations. Several scholars analyzed the influence of macroeconomic variables (Rubery, Grimshaw, and Figueiredo 2005; Perugini and Selezneva 2015; Arulampalam, Booth, and Bryan 2007), unionization (Meara, Pastore, and Webster 2020), pipeline and glass ceiling concepts (Blau and Kahn 2007), voluntary opting for precarity in exchange for less demanding employment (Standing 2011), lower female career aspirations (Nirderle and Vesterlund 2005; Manning and Saidi 2010), and gender differences in work-related values (Fortin 2005). Many authors have asserted that it is possible to assume gender discrimination on the part of employers, who still tend to pay women less than men despite anti-discrimination legislation (Blau and Kahn 2003; Chevalier 2007). Goldin (2014), Cha (2013), and Meara, Pastore, and Webster (2020) showed the importance of full-time employment, at least in the United States. Women often work fewer hours per week than men and are penalized by a lower hourly income.

Another explanation deals with the concept of specialized human capital (Becker 2005; Garcia-Aracil, Mora, and Vila 2004; Perales 2013; Cooper and Gubler 2000; Tam 1997). Different kinds of tertiary education (i.e. different fields of study) influence income in different ways. Some skills obtained during education are more applicable in the labour market than others. Many occupations require some specific knowledge obtainable in particular fields of study. According to this concept, not only the level of education, but also the field of study affect income.

According to the devaluation theory (cf. Mande, 2013), female work is less valued than male work, and female-dominated occupations are thus remunerated worse, regardless of whether the employee is male or female. Auspurg, Hinz, and Sauer (2017) performed a vignette-based experiment with labels

[2] For a comprehensive review of 40 years of attempts to explain the gender pay gap, cf. O'Reilly, et al. (2015).

[3] The presented values are my own calculations from the European Union Labour Force Survey of 2016.

describing various employee characteristics. Both male and female respondents were asked to evaluate the adequacy of the income assigned to each employee. The results showed that both men and women regarded lower female incomes as just and expected that men would have higher incomes than women with the same characteristics such as age, education, or length of work experience. Perales (2013) proved that in the United Kingdom, the low pay in female-dominated occupations could be explained as evidence of the devaluation of female work. Levanon, England, and Allison (2009) tested the devaluation theory and the employer's preference for men (gendered queuing) on US census data and found strong evidence for the devaluation theory.

Using Swedish data, Magnusson (2008) analyzed how an occupation's prestige depends on feminization in particular businesses. He rejected devaluation theory for the labour market in Sweden, where even occupations that are almost exclusively female-dominated are highly prestigious. The relationship between the degree of the feminization of the occupation and prestige is nonlinear. Occupations in which 41-60% of the employees are women are the most prestigious. Murphy and Oesch (2015) analyzed data from the United Kingdom, Switzerland, and Germany. They aimed to find how the degree of the feminization of an occupation affected male and female incomes. In all three countries, they confirmed the validity of the devaluation theory, which was the only theory that explained the ascertained differences. The exact dependence of salary on the degree of the feminization of occupation varies among countries. The authors noted that in the United Kingdom, the most significant pay gaps were in occupations where women constituted 50-60% of employees. In Switzerland, the greatest pay gaps were in occupations in which women constituted 70-80% of employees; in Germany, the greatest pay gaps were in occupations in which women constituted 90-100% of employees. In the UK, both men and women obtained the highest incomes in occupations in which women constituted 40-50% of employees. In Switzerland, the same was true for occupations where women constituted 20-30% of employees. In Germany, the same was true for occupations where women constituted just 10-20% of employees. From this point onwards, the salary level decreases for both genders at different rates. These findings are coherent with the evolution of gender-based occupational segregation, which explained 27% of the gender pay gap in 1980 and 49% in 2010 (Blau and Kahn 2017).

The gender roles theory assumes that women choose to study fields that provide more cultural than economic capital and are therefore valued less in the labour market. Social norms and ideas about certain occupations being more appropriate for men or women lead to female structural selection into less lucrative study fields. Men are socialized into the breadwinner role and thus have to opt for more lucrative study fields. Women are socialized to have lower career expectations (cf. Becker 1986; Esping-Andersen 2009). Empirical testing on German data showed that the gender role theory is the strongest and explains the majority of correlations between the degree of a study field's feminization and lower income (Ochsenfeld 2014). Although Goldin (2014) assumed the convergence in university study fields between men and women for the US educational system, this assumption does not hold for European countries.

The devaluation theory and gender roles theory are confounding and interconnected. For example, if men are socialized into the roles of breadwinners, they would tend to search for more renumerated occupations. In this case, society would consider the lower remuneration for women to be fair.

Based on these theories, I formulate two hypotheses that will be tested in the analytical part on the tertiary-educated employees:

H1: The higher the proportion of women among graduates in a particular tertiary field of study, the lower the income of both men and women who have graduated in the same field.

H2: The higher the proportion of tertiary-educated women working in a particular occupation, the lower the income of men and women working in the same occupation.

Hypothesis H1 works on the assumption that women are structurally selected into less lucrative study fields (gender roles theory). However, it is assumed that if a man graduates from the same college major, his income will be lower than if he graduated from a more lucrative (and thus less female-dominated) study field (human capital theory). Hypothesis H2 is based on the expectation of the social devaluation of female work theory. It presumes that if some occupations start to be held increasingly by women, lower incomes in these occupations will occur.

Both hypotheses can be interconnected through the weakening but still a persistent link between the field of education and the occupation. Graduates from female-dominated fields of study will more probably work in female-dominated occupations, which will be tested in the following part.

Data and Methods

To answer the research question, I perform a secondary data analysis of the European Union Labour Force Survey (EU-LFS). EU-LFS is a quarterly survey conducted in 28 EU-member countries and three countries involved in the European Free Trade Association (Iceland, Norway, and Switzerland). It is focused on all people over 15 years of age who live in private households. At the time of the survey, people in institutions (hospitals, prisons, dorm rooms), military, or other similar services are excluded from the research. EU-LFS, therefore, covers employees, as well as people who do not participate actively in the labour market– pupils and students of all types of schools, people on maternity or parental leave, the unemployed, self-employed people, and seniors.

In 2016, the data file contained about 1.5 million respondents for each quarter. The respective national statistical offices were responsible for the respondent selection and the translation of questionnaires and data collection. The management of the whole survey and data harmonization were then undertaken by the European agency Eurostat. The acquired information was comparable across European countries due to standardized indicators (NACE, ISCO, ISCED, NUTS and others). In some member countries, the EU-LFS survey has been conducted since 1983; the number of countries and the number of variables has increased gradually over the years (Eurostat 2020).

Eurostat releases income data with a 21-month delay; 2016 was thus the last year available at the time of article preparation. For this reason, I used data from 2016 in my analysis. Respondents who did not correspond to the age range of 25-64 years – which, in social stratification literature, are usually used for actively participating in the labour market – were removed from the data file (comp. (Breen 2004; Erikson and Goldthorpe 1992)). Due to this limitation, active students and fresh graduates who had only started to enter the labour market through various part-time jobs or who were artificially increasing the unemployment rate by travelling after graduation were not included in the analysis. People of pensionable age were also excluded from the analysis. Standing (2011) emphasizes that the borderline between work and retirement from the labour market is not very sharp. Various countries have varying ages of retirement, often different for men and women, just for diverse birth cohorts. Also, more than a small percentage of employees do not leave the labour market completely, but instead work part-time for several years or work on temporary contracts. For these reasons, a standard age limit of 64 years was chosen for all European countries. Respondents who were not employed at the time of the survey were also removed from the data file.

The final data set contained information about respondents from 28 countries in 2016. Altogether, there were 1,600,453 respondents, out of whom 52.7% were men and 47.3% were women. One-third of the

respondents (32.7%) had received tertiary education; one-third of the respondents (35.9%) had completed secondary education. Only 517,375 employed respondents with tertiary education were used for the following descriptive and multivariate analyses.

Dependent Variable

In my analysis, I explain the impact of gender segregation in study fields and occupations on income. Individual income from the main job is a dependent variable. Eurostat provides income information only in the form of national income deciles for particular years and countries on the international and year-on-year comparability. Income in the form of hourly gross wage medians in euros would be more convenient; however, it would require at least conversion to purchasing power parity in respective countries and the inclusion of the individual years' inflation rate. By contrast, the interpretation of national deciles of particular years allows the relative intervals between analyzed groups to be easily compared (e.g. according to the respondent's education or sex). For example, if there were a decrease in financial returns to tertiary education, it would be manifested by the tertiary-educated starting to move from the highest deciles into the lower deciles. The income information is distorted by approximately 20% missing values (19.1% for tertiary-educated), which is much better than similar surveys.

Independent Variables

The degree of the feminization of the field of study and the degree of the feminization of occupation were used as independent variables. The degree of the feminization of the field of study is a constructed variable that determines the share of women graduating in a given field of tertiary education. Secondary and primary level graduates were excluded from the analysis because, especially at lower levels, there is often no point in determining whether the education is general or focused on a specific field. The study field was coded according to the ISCED recommendation and distinguished into eight fields.[4] To calculate the share of female graduates, countries, years, and gender were taken into consideration. Each respondent was assigned a number from 0 to 100 that expressed the percentage of women graduating from the same field, in the same country, and the same year as the respondent.

The share of women working in a given occupation was calculated using the three-digit ISCO code. Thus, theoretically, there were 1,000 diverse occupation codes available. However, the real number according to which occupations were represented in national samples was much lower. For calculation, country, year, ISCO code, and gender were taken into account. Each respondent was then assigned a number from 0 to 100 that expressed the percentage of women working in the same occupation in a given year and the same country.

Control Variables

Control variables are divided into three blocks. The first block is closely connected to human capital theory. Since the analysis involves only university-educated people, the only control variable in this block is the length of possible work experience (calculated as the difference between the year of data collection and the year of attaining the highest level of education).[5] The second block contains variables connected to the respondent's personal and family characteristics, such as gender, marital status (married vs other), and presence of own children in the household (at least one child vs no child). Meara, Pastore,

[4] These are: teacher training; humanities, languages, and arts; social sciences, business, and law; science; engineering, manufacturing, and construction; agriculture and veterinary; health and welfare; and services.

[5] This means that the negative influence of career breaks caused by maternity is omitted. Information about the length of maternity leave is not available, neither in individual birth cohorts nor in the respective countries. Owing to the decreasing number of children attributable to one woman, the resulting error is smaller.

Webster (2020), Blau and Kahn (2003) and others showed that the returns to education are different for married and unmarried people and for married men and married women. At least one child in the household could strengthen a respondent's gender roles and impact men's and women's incomes differently. The third block contains variables concerning the labour-relation characteristics: permanency of employment contract (temporary vs permanent), supervisory responsibilities over other employees (yes vs no), and the number of hours usually worked per week. According to Goldin (2014), most of the US gender pay gap can be explained by the different number of hours worked weekly by men and women. Table 1 shows the basic statistical characteristics of the variables used.

Table 1. Description of Dependent and Independent Variables.

Variable	Mean	SD	Min.	Max.
Dependent variable				
Income decile	7.159	2.633	1	10
Independent variables				
Share of female graduates	52.882	15.174	7.2	100
Share of female workers	52.281	24.414	0.5	100
Control variables				
Gender (1=female)	.529	-	0	1
Temporary job (1=yes)	.093	-	0	1
Hours worked per week	38.867	10.702	0	80
Marital status (1=married)	.599	-	0	1
Managerial role (1=yes)	.274	-	0	1
Children in household (1=yes)	.537	-	0	1
Work experience (years)	16.832	10.669	0	45

Source: EU-LFS 2016, own calculations, N=272,869

The analysis is threefold. Through descriptive analysis, I examine whether women and men are indeed structurally selected into different fields of study within the education system and into different areas of the labour market. In the second step, I estimated the OLS regression model for the impact of gender segregations and other determinants of income. In the third step, I estimated the set of OLS regression models for each country to show an international difference.

To test how both independent variables are interconnected, I performed a correlation analysis. The correlation between study field and occupation is very weak (Pearson's r=0.030). The correlation between the feminization of the study field (in %) and the feminization of occupation (in %) is moderate (Pearson's r=0.444). This result suggests that both independent variables might be collinear, and further testing is necessary. The variance inflation factor[6] for both variables is lower than 10 (2.490 for the feminization of the study field and 3.000 for the feminization of occupation), and all the estimations are made *caeteris paribus*. Both independent variables can be carefully used.

The analysis may suffer from the problem of selection. For example, women graduating from female-dominated study fields can be more or less effective in the labour market than women graduating from male-dominated study fields. These differences would affect the interpretation of the OLS model because the impact of the feminization would be, in fact, the impact of the selection. To test this, I performed a set of correlation analyses. Suppose there are differences among women according to the feminization of their study fields and occupations that affect their fate in the labour market. In that case, there would be a strong correlation between both feminization ratios and some indicators, such as length of work experience and the number of hours usually worked per week.

[6] I used the estat vif command in Stata 16 IC

There is a weak negative correlation between the feminization of the occupation (in %) and the number of hours usually worked per week (Pearson's r=-0.228), and a non-existing correlation between the feminization of the study field (in %) and the number of hours usually worked per week (Pearson's r=-0.077). The same test for the length of work experience returns complementary results. The feminization of the study field correlates with the work experience very weakly (Pearson's r=-0.143), and the feminization of occupation is characterized by a non-existing correlation (Pearson's r=-0.010). Occupations with a higher share of women are slightly more likely to offer part-time jobs, and people graduating from more feminized fields of study have slightly shorter work experience (probably because of parental leave). This difference can affect the regression coefficient; therefore, the number of hours usually worked per week, and the work experience have to be used as control variables.

For data analysis involving multiple countries, it would have been possible to use multilevel modelling; however, McNeish and Stapleton (2016) highlight the risks associated with the small number of cases in the second-level model (i.e., countries). The ICC (intraclass correlation) indicator was only 0.018, which is, according to Maas and Hox (2005), insufficient to justify the use of a multilevel model. For these reasons, I use dummy variables for the analysis of the influence of particular countries. I also considered the ordered logit model because the income variable is in the form of a national decile. Because the dependent variable has a reasonably long scale (1-10) and, therefore, can be regarded (with some precautions) as semi-continuous. The ordered logit model is also hard to interpret, especially with marginal effect predictions. For these reasons, I hold on to the OLS regression.

Results

Different Male and Female Positions in the Labour Market

In the first step of the analysis, I aimed to identify how education, together with gender, determines employee status in the labour market. For this, I used unemployment rates and the numbers of hours usually worked per week. I then verified gender segregation in particular groups of occupations (ISCO classes) and fields of study (ISCED).

In 2016, 81.11% of women and 87.84% of men with tertiary education participated in the labour market across all European countries. Meanwhile, 68.16% of women and 80.98% of men with secondary education participated in the labour market. Finally, 48.83% of women and 68.14% of men with an education lower than secondary level participated in the labour market.[7] The odds of a woman with tertiary education participating in the labour market were thus 1.19 times higher than that of a woman with secondary education. In 2016, tertiary-educated women worked, on average, 35.480 hours per week (SD 10.341), while tertiary-educated men worked, on average, 40.548 hours per week (SD 10.464).[8] Though differences between men and women decrease as the attained education level increases, it is evident that even tertiary-educated women work less often and for fewer hours than equally educated men.

Table 2 presents the segregation of men and women into various occupations according to one-digit ISCO 08. Women predominate over men in services, professionals, clerical support workers, and elementary occupations. In contrast, men predominate in classes such as managers, craftsmen and tradesmen, plant and machine operators, and assemblers.

Table 2. Shares of Tertiary Educated Men and Women in ISCO Classes.

[7] The presented values are my own calculations from the European Union Labour Force Survey of 2016.
[8] European Union Labour Force Survey of 2016, own calculations.

ISCO groups	Male share	Female share
Managers	64.81	35.19
Professional	47.03	52.97
Technicians and associate professionals	49.08	50.92
Clerical support workers	30.35	69.65
Service and sales workers	38.66	61.34
Skilled agricultural, forestry and fishery workers	73.26	26.74
Craft and related trades workers	87.26	12.74
Plant and machine operators, and assemblers	83.09	16.91
Elementary occupations	43.21	56.79

Source: EU-LFS 2016, own calculations, N=272,869

Table 3 shows the segregation of men and women according to fields of graduation. There were significantly more women among pedagogical, medical, humanities, and social sciences graduates and considerably more men graduating in information technologies, engineering, manufacturing, and construction.

Table 3. Shares of Tertiary Educated Men and Women in the Fields of Study.

Field of study	Male share	Female share
General programmes	40.80	59.20
Education	24.09	75.91
Arts and humanities	36.69	63.31
Social sciences	35.92	64.08
Business, administration and law	45.64	54.36
Natural sciences, mathematics and statistics	50.70	49.30
Information and communication technologies	84.19	15.81
Engineering, manufacturing, and construction	80.25	19.75
Agriculture and veterinary	55.74	44.26
Health and welfare	25.54	74.46
Services	52.82	47.18

Source: EU-LFS 2016, own calculations, N=272,869

Further, I determined whether there are any gender differences in the quality of occupation. If these differences existed – for example, due to a greater aversion of women towards a competitive environment – women would obtain lower quality occupations, despite having an education at the same level as respective male workers. The quality of occupation is expressed by the international socio-economic index (ISEI), which ranges from 16 to 90, where a higher value means a higher quality of occupation. Tertiary-educated women work in occupations with an average ISEI score of 61.783 (SD 18.171), which is almost the same for tertiary-educated men, precisely 61.857 (SD 19.059).[9]

The descriptive analysis showed that women and men were segregated into different positions in the labour market. Men worked more than women, both in terms of the number of hours worked and overall labour market participation. However, both differences decreased as the level of educational attainment increased. In all European countries, men and women tend to graduate from different fields and, further, tend to work in different occupations. In the next part of the analysis, I will verify how much these differences affect their income.

Determinants of Male and Female Income

In the second step of the analysis, I used OLS regression to analyze, which determinants affect male and female income. As mentioned in the Data and Methods section, I preferred OLS regression over multilevel modelling or ordered logistic modelling because of the simpler interpretation of single-level

[9] European Union Labour Force Survey of 2016, own calculations.

linear models and unacceptably low value of ICC of the multilevel model.

The results are summarised in Table 4. Model M1 contains the personal characteristics of respondents. The dependent variable, the income decile, is explained using gender, age, marital status, and a child's presence in the household. According to Blau and Kahn (2003), both marital status and the presence of a child in the household positively impact men but negatively impact women, so both of these variables were added into the model also in interaction with gender. Country dummies were used to differentiate between influences on respective countries. Also the variables concerning employment conditions – permanency of contract, the number of hours usually worked per week and managerial role above other employees were added.

Model M2 includes, in addition to all these variables, information about the proportions of women graduating in particular fields of tertiary education and working in specific occupations. In final model M3, both female ratios also interacted with gender because I expected the different influence on men and women.

Table 4. The dependency of National Income Deciles on Female Ratios for Tertiary Educated Employees (OLS regression).

Independent variables	Model M1	Model M2	Model M3a linear	Model M3b nonlinear
Constant	2.185 (0.035) ***	2.746 (0.038) ***	2.710 (0.039) ***	2.351 (0.140) ***
Country dummies		(not reported)		
Personal characteristics				
Gender (woman)	-0.487 (0.013) ***	-0.254 (0.014) ***	-0.041 (0-035)	-0.299 (0.487)
Work experience	0.082 (0.002) ***	0.081 (0.002) ***	0.085 (0.002) ***	0.087 (0.002) ***
Work experience ^2	-0.001 (0.000) ***	-0.001 (0.000) ***	-0.001 (0.000) ***	-0.001 (0.000) ***
Marital status (married)	0.293 (0.015) ***	0.274 (0.015) ***	0.274 (0.015) ***	0.276 (0.015) ***
Marital status * Gender (married woman)	-0.250 (0.019) ***	-0.221 (0.019) ***	-0.214 (0.019) ***	-0.230 (0.019) ***
Child in household	0.270 (0.014) ***	0.261 (0.014) ***	0.275 (0.014) ***	0.283 (0.014) ***
Child * Gender (woman with child)	-0.310 (0.019) ***	-0.280 (0.019) ***	-0.279 (0.019) ***	-0.308 (0.019) ***
Labour market characteristics				
Temporary contract	-1.340 (0.014) ***	-1.329 (0.014) ***	-1.328 (0.014) ***	-1.328 (0.014) ***
Hours usually worked	0.101 (0.000) ***	0.098 (0.000) ***	0.097 (0.000) ***	0.095 (0.000) ***
Managerial roles	0.874 (0.009) ***	0.799 (0.009) ***	0.787 (0.009) ***	0.734 (0.009) ***
Gender segregation				
Study fields [%]		0.003 (0.000) ***	-0.003 (0.000) ***	(not reported)
Occupations [%]		-0.014 (0.000) ***	-0.006 (0.000) ***	(not reported)
Study fields * Gender (woman)			0.012 (0.000) ***	(not reported)
Occupations * Gender (woman)			-0.016 (0.000) ***	(not reported)

N	272,869	272,869	272,869	272,869
R^2	0.1387	0.3575	0.3614	0.3767

Source: EU-LFS 2016, own calculations, statistical significance: *** p < .001, Standard Errors in parentheses
Note. The following variables: Female share (study), Female share (occupation), and Countries; and the interactions between Gender segregation and Gender were excluded to maintain the table's clarity. Their influence is presented in graphical form in Figures 1 and 2.

The influence of the feminization ratio of the study fields was slightly negative for men and convincingly positive for women. The greater the proportion of women that studied a particular field, the higher the income of its female graduates, whereas the income of male graduates stays almost unchanged. In contrast, the link between women's share in a certain occupation and income is strongly negative for both men and women. The greater the number of women that worked in a particular occupation, the lower the income of the employees working in it. The estimated linear coefficients are presented as model M3a and showed marginal effects in Figure 1 and Figure 2 (the linear lines).

Hypotheses testing

The graphs already show the general trend of the respective coefficients, and we can assume the fate of both hypotheses. Hypothesis H1, which presumed a decrease of income due to the higher feminization of the field of study, should be rejected. Hypothesis H2, dealing with the impact of feminization ratio in an occupation on income, seems to be valid. Nevertheless, I performed the formal one-sided t-tests from model M3a for both hypotheses.

Hypothesis H1 presumes the decrease in income due to the higher feminization of the college major, i.e. the OLS coefficient for the gender segregation in study fields should be negative. The null hypothesis $H1_0$ is that the coefficient is greater than or equal to zero. One-sided t-test showed values F (1, 272831) = 49.70, t-value = 7.05, p-value = 0.000. The zero hypothesis could be rejected, and we can conclude that the decrease of income due to the higher feminization of the college major is statistically significant.

Hypothesis H2 presumes the decrease of income due to the higher feminization of the occupation, i.e. the OLS coefficient for the gender segregation in occupation should be negative. The null hypothesis $H2_0$ is that the coefficient is greater than or equal to zero. One-sided t-test showed values F (1, 272831) = 435.52, t-value = 20.87, p-value = 0.000. The zero hypotheses could be rejected, and we can conclude that the decrease in income due to the higher feminization of the occupation is statistically significant.

The tests mentioned above do not consider the different influence of the feminization ratio for men and women. I estimated the M3a model separately for both genders and formally tested both hypotheses after each estimation. For men, both hypotheses stay valid: the more feminized the field of study and the occupation are, the lower the income is.[10] For women, hypothesis H1 is rejected, hypothesis H2 stays valid.[11] There is no statistically significant link between the feminization of the study field and income; the decrease is influenced by the feminization of the occupation.

[10] H1: F (1, 120190) = 11.71, t-value = 3.42, p-value = 0.000; H2: F (1, 120190) = 713.09, t-value = 26.70, p-value = 0.000

[11] H1: F (1, 152613) = 504.23, t-value = 22.46, p-value = 1.000; H2: F (1, 152613) = 4824.92, t-value = 49.46, p-value = 0.000

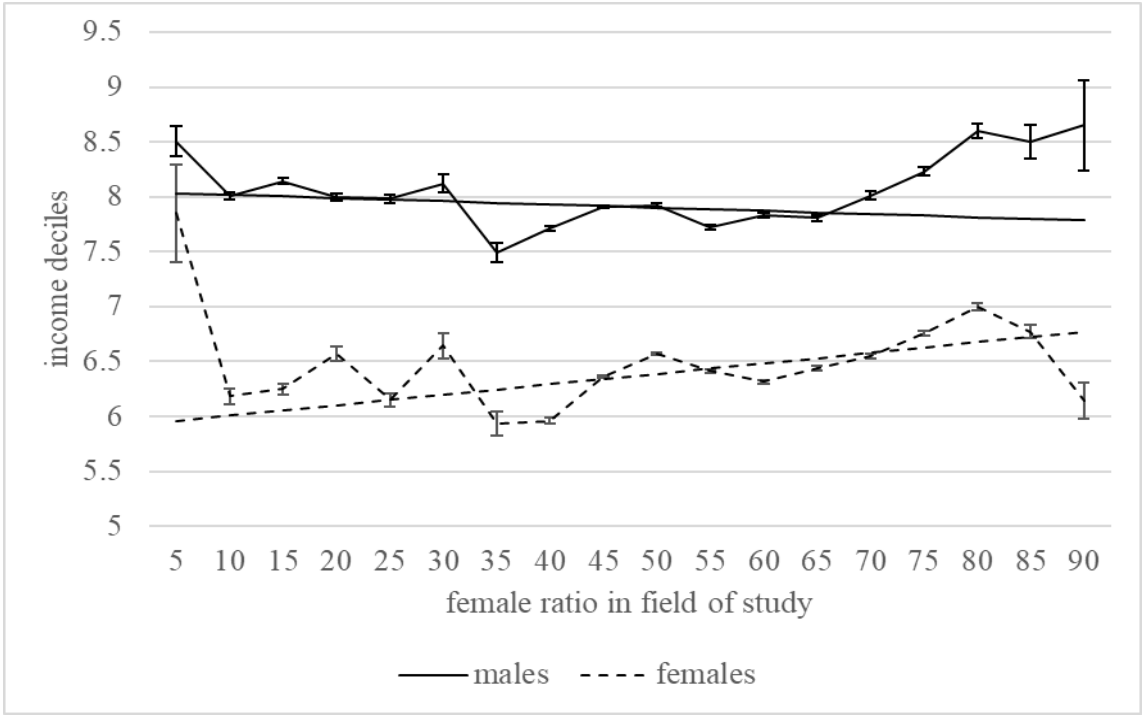
Non-linearity of the model

Further testing showed that the relationships between feminization and income were not linear, though the established trend stayed essentially the same. I categorized both variables so that they showed the feminization ratios to be accurate to 5%. Both variables may thus have 20 values: 0%, 5%, 10%, 15%, … 100%. Feminization ratios adjusted this way may be used in regression models in categorized form, allowing for non-linearity. The coefficients are presented as model M3b.

This approach places considerable demands on presentation of results. The categorization of both variables adds 40 more lines to the regression table. As I assume that the influence of these variables are different for men and women, I added the interactions of both feminization ratios with gender into the model. Thus another 40 lines appeared in the table. Such a table is uninterpretable without further calculations. Therefore, I present only the fundamental regression coefficients and statistical characteristics in Table 4 and exclude the 80 regression coefficients for the sake of greater clarity. The complete results are presented in the form of marginal estimations[12] in Figures 1 and 2 (nonlinear curves).[13]

Figure 1 shows – in the form of marginal effects – the dependence of respondent income on the share of women who graduated from the same field of study as the respondent in a given year and given country. The dependence is, with only slight deviations, almost constant for men and moderately increasing for women.

Figure 1. The Influence of Female Share in Study Field on Income (Marginal Effects).



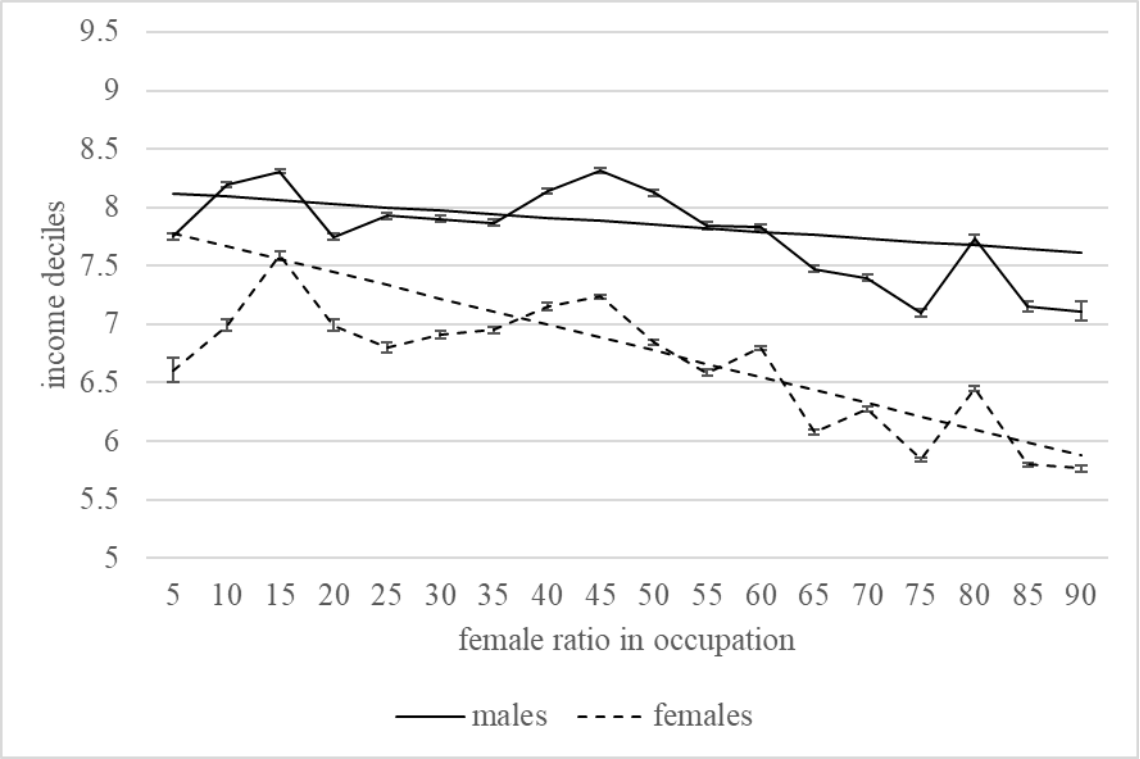
Source: EU-LFS 2016, own calculations, linear lines from model M3a, nonlinear curves from model M3b

[12] Marginal effects are the influence of the change in one independent variable of one unit, with all other independent variables kept constant.

[13] An alternative way to show non-linearity is to estimate non-parametric regression models. Given the poorer support for these models in statistical software and the less illustrative interpretation, I chose not to use this option.

Figure 2 presents – also in the form of marginal effects – the dependence of respondent income on the share of women who had the same occupation as the respondent in a given year and given country. The curve is, across most of the female ratios, decreasing both for men and women. Line segments in both graphs report 95% confidence intervals.

Figure 2. The Influence of Female Share in Occupation on Income (Marginal Effects).



Source: EU-LFS 2016, own calculations, linear lines from model M3a, nonlinear curves from model M3b

International Comparison

Though my analysis aims at all European countries, which may lead to excessive generalization, I estimated separate models M3b for individual countries and consistently achieved the same results. Although the growth rate or decline rate differed, as did the shift into different income deciles, the trends were still the same. The share of women graduating in a particular study field had no effect or a slightly positive effect on male and female incomes in all countries (the marginal effect of this coefficient differs from 0.003 to 0.005 with a mean 0.004). The share of women working in a certain occupation strongly negatively influenced both male and female incomes in all countries (the marginal effect of this coefficient differs from -0.017 to -0.013 with a mean -0.015).

Another indicator that can help to understand international differences is the inflection point, i.e., the share of women performing an occupation at which incomes started to decrease for both men and women. This indicator was estimated from the marginal effects as a global maximum point. The point was different in each country, from 15 % feminization in occupations in Slovenia to 70 % feminization in occupations in Croatia and Lithuania, with a mean of 44 %.

European countries can be divided into four groups according to this indicator. The first group consists of countries with lower values of the indicator: Slovenia, Poland, and Portugal. In these countries, occupations with a relatively small portion of women (15–20 %) are remunerated worse. The second group contains countries with almost average indicator values, such as Montenegro, Slovakia, Greece, Latvia, Cyprus, and the Netherlands. The inflexion point in these countries differs from 25 to 40 %. The

third group contains countries with the indicator varying around the mean: Bulgaria, Ireland, Italy, United Kingdom, Belgium, Spain, and Czechia, with the inflexion point from 45 to 55 % of the female share in occupation. The rest of the countries (such as Austria, Germany, France, Hungary, Estonia, Latvia) report the above-mean values of the indicator (from 60 to 70 %).

Discussion

Hypothesis H1 proposes that if the proportion of women among graduates of a particular study field is higher, the income of both men and women who graduated from this field is lower. As Figure 1 and formal tests show, this hypothesis can be rejected, at least for women. With a growing share of women in a field of study, men's income remains almost unchanged while women's income even slightly increases. The structural selection of women into less lucrative study fields thus does not influence their income. The financial return on education in study fields with a higher female share of graduates is not statistically significantly lower than in study fields with a lower female percentage. Hypothesis H2 suggests that as the proportion of women working in a particular occupation is higher, women and men having the same occupation will have a lower income. The results of the analysis presented in Figure 2 confirm this hypothesis. Male and female incomes are getting higher in occupations in which women's share is lower than 15-20%. Then, the income of both genders remains more or less constant at a relatively high level. When the share of women is higher than 45%, both male and female incomes continually decrease. These results are coherent with the findings of Murphy and Oesch (2015). According to them, men and women have the highest incomes in occupations in which 10-40% of employees are women (depending on the particular country).

The separate analyses for individual countries showed the wider variance in point, from which the share of women in an occupation leads to the lower income for both men and women. The European countries formed four clusters, two with the indicator values below the average, two with average or above the average values of the indicator. Except for The Netherlands, all below the average countries are either post-socialistic (Slovenia, Poland, Slovakia) or poor according to their GDP per capita (Greece, Portugal). In these countries, women are enumerated worse in the occupation with a relatively small portion of women workers (less than 40 %). In the cluster with average and particularly in the above the average values of the indicator, the respective labor markets do penalize their workers for work in the female-dominated occupation only in the most feminized occupations (with more than 50 or even 70 % share of women). The women in these countries have wider opportunities when selecting their occupations. The countries are mainly from the former Western block (Germany, Austria, France, United Kingdom) and generally more prosperous (with some exceptions, such as Bulgaria, Hungary or Latvia).

It is important to emphasize that the higher values of this indicator do not imply the lower gender pay gap. The case of Germany or Austria, where the inflexion point for the income penalty is about 70%, but the unadjusted gender pay gap is one of the highest in the European Union, can serve as a cautionary example. The problem is multidimensional; the national GDP and the values setting (with the post-socialistic attribute as a proxy) are only a few determinants affecting the gender pay gap problem.

The possible limitation of the analysis may be the nature of the income information, acquired from respondents rather than from official registers. It thus suffers from potentially low reliability. This insufficiency is partially reduced by the use of rough categories in the form of national income deciles. Still, it is impossible to capture all the specifics of individual national performance schemes, such as non-financial bonuses.

The analyzed year 2016 reflects the situation after the educational expansion that took place approximately between 2000 and 2010. We can presume that in 2016 most graduates from the expansion period are in stable jobs. The results may have been affected by the global economic crisis that took place approximately from 2007 to 2010. However, the use of national income deciles, calculated each year separately, lowers the influence of current economic conditions on incomes. Even though there are increases in incomes in respective labour markets, income deciles express the relative positions of particular employee groups. The six-year distance should be sufficient to lower the immediate consequences of the financial crisis.

As Figure 1 and Figure 2 show, there are relatively wide 95% confidence intervals in extreme values. This is because fields of study or occupations in which there would be 0% of one gender are, in reality, very rare. Thus, for extreme values, the number of respondents entering statistical analysis was minimal. The fact that the 95% confidence intervals for men and women do not overlap, even in extreme values, supports the revealed trends' proposed explanation.

Conclusion

In this article, I show that women and men are structurally selected into different sectors of the education system and different sectors of the labour market, and that they tend to enrol in different study fields and work in different occupations. Women generally participate in the labour market less, and when they work, they work on average fewer hours per week than men. The difference in the degree of participation in the labour market and the average number of hours usually worked decreases for the higher educational levels.

In the introduction, I posed the main research question "Why do women with university degrees have a lower return on education in the labour market than men with university degrees?" Based on the empirical testing of hypotheses H1 and H2 for 28 European countries, I can answer that gender-based income inequality does not arise through the structural selection of women into different fields of study but through their structural selection into different occupations.

Therefore, the main contribution is the confirmation of the assumption that lower female income is not the result of women studying in non-lucrative study fields; it is the result of women working in non-lucrative professions. The finding contradicts one explanation for income inequalities between men and women (chosen study field) and appears to confirm another (choice of career). From the set of three theories presented by Ochsenfeld (2014), the devaluation of women's work and the gender role theories seem to be the most appropriate. Women get the same human capital (level of education) as men, even in its specialized conception.

These findings can lead to two contradictory social consequences. If Ochsenfeld's (2014) findings concerning gender role theory in Germany and Esping-Andersen's (2009) theory of the incomplete gender revolution are valid for all European countries, women are selected into less demanding (and therefore worse paid) occupations. The more significant burdens in childcare and domestic duties are still placed upon women, and they are therefore forced to opt for less-demanding occupations. In this case, only changes in the social perception of the gender division of labour in the family and the competition of the gender revolution may help to redress income inequality between men and women. If the devaluation theory is more likely correct, as Murphy and Oesch (2015) found to be the case in four countries, only changes in the social perception of the value of women's work would effectively create greater income equality. According to Mandel's metaphor of going 'up the down staircase', highly educated women will get better jobs that will become remunerated worse.

To determine which theory is more applicable to present-day Europe and to identify the exact mechanism driving gender income inequality are tasks for future research. Nevertheless, the policy implication stays the same, no matter which theory is true. National governments should support women in entering (and completing) the tertiary level of education, whether they choose so-called lucrative fields, such as STEM, or less lucrative fields, such as social sciences. The analysis shows that graduating from university is more important than the specific field of study. This is the necessary condition; it is not sufficient. The second step, which seems to be neglected, especially in the post-socialist and poorer countries, is to introduce social policy aiming to ease the burdens of childcare and household care and to support value changes leading to the equalization of male and female roles.

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