

Nikulin, Dagmara; Wolszczak-Derlacz, Joanna

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GVC involvement and the gender wage gap: Micro-evidence for European countries

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GDAŃSK UNIVERSITY OF TECHNOLOGY

FACULTY OF MANAGEMENT AND ECONOMICS

GVC INVOLVEMENT AND THE GENDER WAGE GAP: MICRO - EVIDENCE FOR EUROPEAN COUNTRIES

Dagmara Nikulin*, Joanna Wolszczak-Derlacz**

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*Gdansk University of Technology, Faculty of Management and Economics,
dagmara.nukulin@zie.pg.gda.pl (corresponding author)

**Gdansk University of Technology, Faculty of Management and Economics,
jwo@zie.pg.gda.pl

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GVC INVOLVEMENT AND THE GENDER WAGE GAP: MICRO - EVIDENCE FOR EUROPEAN COUNTRIES

Dagmara Nikulin* and Joanna Wolszczak-Derlacz**

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Abstract

In this paper we examine the linkages between involvement into global value chains (GVCs) and the gender wage inequalities. We use merged wide-ranging Structure of Earning (SES) and World Input Output Database (WIOD) for the years 2002, 2006, 2010 and 2014, covering manufacturing industries of 18 European countries. We employ a wealth of information on employees' personal and company characteristics as well as sectoral variable reflecting the involvement in GVC measured by foreign value added embodied in exports (FVA/Exp.) We augment the Mincerian regression with GVC variable and report gender wage discrimination among European employees. The results indicate that wages of workers employed in sectors more involved in GVC are lower. However, the relationship between GVC and wages differs in respect to gender; women are more affected by the negative impact of greater trade involvement in comparison to men. There is some education/skill/occupation heterogeneity with workers with middle education level and middle skills being most affected. Finally, our results show the different patters across concentrated and competitive industries: the wage drop due GVC intensification is observed for the former ones.

JEL: J16, J31, F16

Keywords: gender wage gap, gender inequalities, micro data, European countries

*Gdansk University of Technology, Faculty of Management and Economics, Narutowicza 11/12; 80-233 Gdańsk, Poland, e-mail dagmara.nukulin@zie.pg.gda.pl (corresponding author)

**Gdansk University of Technology, Faculty of Management and Economics, Narutowicza 11/12; 80-233 Gdańsk, Poland, e-mail: jwo@zie.pg.gda.pl

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1. Introduction

The international production fragmentation processes shape the current landscape of labor market outcomes. It is widely adopted to understand the changing nature of global production and distribution processes through the lenses of Global Value Chains (GVCs). The bulk of research is devoted to the impact of global production links on the demand of skills, labor force structure and the polarization on the labor market. Against this background, the social issues in GVC concept begin to go to the forefront of GVC analysis in recent years. Apart from the economic upgrading related to the strengthening position of firms, sectors and countries within the global chains, also the social upgrading (defined as “the process of improvements in the rights and entitlements of workers as social actors, which enhances the quality of their employment” (Barrientos, Gereffi & Rossi, 2011, p. 324)) gains increasing importance (among others: Barrientos, Gereffi, Posthuma, Mayer & Pickles, 2011; Posthuma, 2010; Rainnie, Herod & McGrath-Champ, 2011; Selwyn, 2013). However, still not much is said about the quality of work, including the issue of social upgrading regarding the European countries (Smith & Pickles, 2015) since the main focus is on the benefits for developing countries (see e.g. countries Barrientos, Gereffi & Rossi, 2011; Gereffi & Lee, 2016; Milberg & Winkler, 2011). Regarding the gender issues, GVC participation is claimed as a positive driver of women empowerment in developing countries (Said-Allsopp & Tallontire, 2015). However, if we take into account gender inequalities like gender segregation in types of occupations and activities, gender gaps in terms of wages and working conditions, and gender-specific constraints in access to productive resources, infrastructure and services the positive impact of global trade intensification remains no further obvious (Bamber & Staritz, 2016). Recent studies show indeed, that the access to benefits coming from integration into GVC may be limited due to the gender issues. In other words, the opportunities related to GVCs diversify for men and women what results from gender-based segregation (Bamber & Staritz, 2016). The growing interest on gender issues using the GVC framework is reflected in numerous studies on women participation in GVC, women working conditions and finally the gender wage gap (GWG) (among others: (Barrientos, 2014; Ben Yahmed, 2012; Juhn, Ujhelyi, & Villegas-Sanchez, 2014)). However, most of available studies are country specific and still less is examined in international setting.

In this paper we aim to go deeper into the gender dimensions of GVC participation. In particular we examine to what extent men and women may gain from upgrading within the global production processes. Our main research question is therefore to what extent the differences in wages between men and women may be influenced by the level of sectoral trade intensification. The main contribution of our research is the international evidence of the extent to which involvement in global production links may explain the gender wage gap (hereafter GWG). To do this we use combined dataset including the employee-employer Structure of Earnings Survey (SES) and international trade

data from World Input-Output Database (WIOD). Our final sample consists of over 6 million observations for 18 European countries in the years 2002, 2006, 2010 and 2014. To explain the wage inequalities we employ standard Mincerian wage equation augmented with information of involvement in GVC at the sectoral level. Our results show gender wage discrimination among European employees regardless the model specification. The impact of foreign value added embodied in export (FVA/Exp) as the proxy measure of GVC intensifications on wages is negative and statistically significant. Moreover, the influence of GVCs on wages differs regarding the gender. Women are more affected by the negative impact of greater trade involvement in comparison to men. Predominantly, workers with medium education level and medium skills are affected.

The structure of this paper is as follows. Section 2 compile the recent evidence on the linkage between GWG and international trade involvement. Section 3 describes the data and methodology used. In section 4 we present results of the econometric estimations. Section 5 concludes.

2. Gender wage gap and international trade: past evidence

The implications of trade on the gender issue widely explained by the trade theory varies across countries and sectors. Several theoretical settings try to explain whether globalization impact on narrowing or widening the GWG. According to the neoclassical theory, the international competition pressure rising along with the trade liberalization should lead to the narrowing of discrimination and make them more costly (Becker, 1957). Another possible scenario asserts that more profitable companies, such like exporting ones, are more willing to use costly discrimination to achieve wage gains (Melitz, 2003). Moreover, trade liberalization create different employment opportunities for women and women. On the one hand, as export oriented companies aiming to cut labor costs, are more willing to employ women in labor intensive sectors. But, on the other hand, companies engaged in global production networks and using more advanced technologies, prefer to employ men than women (Coniglio & Hoxhaj, 2018). Therefore, it is postulated that FDI inflows and trade liberalization may influence the female labor market in different ways, depending on the skill level, sector and country of employment (Barrientos, 2014). Existing evidence show that as women are over presented in the labor-intensive and export-oriented industries, they may be more affected by precarious working conditions (Seguino, 2005). In particular, globalization may impact negatively on the bargaining power of female workers (Coniglio & Hoxhaj, 2018) as women dominate in labor-intensive sectors. Moreover the global intensification of trade may also results in lower wages since women as perceived as less committed due to the households responsibilities (Bøler, Javorcik, & Ulltveit-Moe, 2015).

Importantly, achieving the gender equality on the labor market is one of the goals postulated by the United Nations' 2030 Agenda for Sustainable Development (United Nations, 2015). In particular, the fifth goal to “achieve gender equality and empower all women and girls” assumes

among others that adopting and strengthening policies and enforceable legislation is needed to promote equal chances for women as well as ensure women's effective participation in economic life. Against this background, it is postulated that the extension of export opportunities provides to women empowerment through an entry into formal market and providing an independent income (among others (Bamber & Staritz, 2016; Shepherd, 2018; Tallontire, Dolan, Smith, & Barrientos, 2005; Tejani & Milberg, 2016). Having in mind, that the share of women among employees is higher in trade involved companies and the growth of GVCs is mainly related to the increase in trade in services where the share of women employment is higher than in manufacturing (Shepherd & Stone, 2017), a possible upgrading opportunities for women may be created. However, considering the wage gender nexus in developing countries through the social upgrading opportunities lenses results in ambiguity of women well-being (Barrientos, Gereffi, & Rossi, 2011; Rossi, 2013). Since the women are over presented in labor intensive value chains and therefore located in lower value-added components in GVCs their working conditions including wages may be lower than those for men (World Trade Organization, 2019, p. 67). Therefore the quality of women's jobs creating in GVCs remains not clear (Tallontire et al. 2005).

Reviewing the relevant literature it turns out, that most trade-gender nexus empirical evidence is based on the country case studies. At the same time, the major difference of global trade engagement occurs between developed and developing countries, while for the last one is better documented. As the main focus of this paper is on the impact of engagement into global production fragmentation processes on the gender wage inequalities we recall existing literature narrowing to the GVC related. As far as developing countries are concerned, the role of women in GVC are mainly analyzed from the empowering point of view (among others: Shepherd & Stone(2017); Staritz & Reis (2013); Tallontire et al. (2005)). Moreover, recently, the significance of female social upgrading reflected in decent remuneration and fair working conditions is underlined (M. Christian, Evers, & Barrientos, 2013). Unfortunately, the female integration into GVCs may be also related to gender-intensified constraints reflecting in discrimination in compensation, working conditions, access to training and even sexual harassment (Staritz & Reis, 2013). Against this background GVCs are perceived as accelerator of GWG as women are typically employed in unskilled stages of the GVCs in low payed jobs, what is used as a competitive advantage (Barrientos, 2014). Moreover, the involvement in GVC may be related to greater flexibility of workers due to the pressure to meet delivery schedules and women noticed as less flexible may receive lower wages than men (Bøler, Javorcik, & Ulltveit-Moe, 2018). The impact of trade openness and involvement into GVC on the gender wage inequalities is mainly attributed due to the differences in the workers characteristics like the skill level, task composition and occupation type (Ben Yahmed, 2012; Juhn et al., 2014), but also the industry position in GVC (Chen, 2017) and the export structure (Busse & Spielmann, 2006). Empirical study conducted in Taiwan by Berik (2000) confirms

that the greater export orientation of companies results in lowering wages both for women and men, while the wage penalty is greater for women than for men. Although, the relation between production fragmentation and GWG is broadly discussed and empirically examined (among others: Christian, Evers, & Barrientos, 2013; Frederick & Staritz, 2012), the links between trade integration and gender wage gap remains ambiguous resolved. On the one hand the positive relation between GWG and the general international trade involvement is confirmed. Menon & Van der Meulen Rodgers (2009) using merged households and production data for India's manufacturing sectors for the years 1983-2004 find that the higher openness is connected with increasing gender wage gap. Similar results obtained Berik et al. (2004) using data for Taiwan (China) and Korea during the 1980s and 1990s. Other studies confirming the greater wage penalty for women in export oriented firms are conducted by (Domínguez-Villalobos & Brown-Grossman, 2010) for Mexico. Coniglio and Hoxhaj (2018) analyzing Vietnamese labor market find that the greater involvement into international trade(measured by global market orientation and export shares in total turnover) results in narrowing the gender wage gap for unskilled workers, while for skilled ones the impact is limited. On the other hand Black & Brainerd (2004) using US data for the time period 1976-1993 found that the increasing competition resulting from international trade may reduce the GWG. Similarly, Hazarika & Otero (2012) examined the Mexican economy and found a negative relation between trade linked competition and GWG. Juhn et al. (2014), in turn, using micro data for Mexican economy, found that the decline in export tariffs results in increased wages for blue-collar women, while no effect is observable for white-collar workers. Similar results indicating positive impact of globalization on the GWG reduction for the Chinese economy found (Chen, Ge, Lai, & Wan, 2013). Recalling recent studies, Robertson et al. (2019) found a positive relation between trade liberalization and gender wage gap in apparel industry in Sri Lanka and Cambodia.

The empirical evidence from developed countries shows that the impact of international trade on the gender wage gap differs along the skill distribution. Theoretical setting established by Yahmed (2012) indicates that the trade openness lowers the GWG at the lower part of the distribution but increases the gender wage gap among high-skill workers. The gender wage gap for European workers in relation to trade intensification is much rarer analyzed. Bøler, Javorcik, & Ulltveit-Moe (2018) using Norwegian manufacturing employer-employee data find that the firm's involvement in exporting activities increase the GWG by 3 percentage points for college educated workers, what confirms the preliminary assumption. Another study for Norwegian manufacturing sector conducted by Bøler et al. (2015) reveals that women perceived as less committed workers than men, may be more wage discriminate in export connected companies than in non-exporters. However, the changes in institutional settings (like the lightening of parental leave) narrow the difference between the GWG in exporting and non-exporting firms. Gagliardi, Mahy, & Rycx (2018), in turn, based on Belgian

manufacturing firm level data combined with the firm's position measure in GVC, report inequalities in social upgrading of workers resulting in an unfair remuneration of women in comparison to men at any level of earnings. Even fewer studies examine the impact of involvement into GVC on the GWG in the international setting. The cross-country empirical evidence gives mixed results. Study of Oostendorp (2009) using ILO data for the period 1983-99 covering 80 countries around the world found a heterogeneous impact of international trade on GWG depending on the skill level. In particular, GWG in low-skill occupation may be narrowed thanks to the trade intensification, but in case of high skill occupations this direction is maintained only in richer countries. An opposite impact is witnessed in case of high skilled workers in poor countries. Further, Wolszczak-Derlacz (2013) performing the analysis at the sectoral level of 18 countries underlines the different effect for concentrated versus non-concentrated industries. Specifically she finds a lower (higher) growth of the high-skilled (medium- and low-skilled) gender wage gap in concentrated trade-affected industries; the opposite is true for competitive industries.

3. Data and methodology

This study relies on two large data sets which were combined. The first one is the Structure of Earnings Survey (SES) containing individual employee-employer data from European countries. SES is a large enterprise survey containing detailed information on the wages, individual characteristics of workers (sex, age, occupation, tenure, education level) and the characteristic of an enterprise (size, economic sector). The survey coverage includes enterprises with at least 10 employees from economic sectors B to S (excluding O) according to NACE Rev. 1.1 (2002 and 2006 wave) and NACE Rev.2 (2010 and 2014 wave)¹. Given the availability of the data, our final dataset covers detailed information on the firms and workers characteristics for 18 European countries (listed in Table A1 in the Appendix) embedded in the years 2002, 2006, 2010 and 2014.² In order to examine the impact of GVC involvement on the GWG we merge the SES data with the industry-level statistics on GVCs based on the World Input-Output Database (WIOD) released in November 2016 (Timmer, Dietzenbacher, Los, Stehrer, & De Vries, 2015). The WIOD covers input-output data for 43 countries and 56 sectors according to the ISIC Rev. 4 classification. We match therefore the SES data with those from WIOD according to the statistical classification of economic activities. Moreover, we add country level data

¹ Information on public administration (NACE Rev. 1.1 Section L until 2006 and NACE Rev. 2 Section O from 2010) as well as enterprises with less than 10 employees is also available from some countries on a voluntary basis (<https://ec.europa.eu/eurostat/web/microdata/structure-of-earnings-survey> access on 29th May 2019)

² SES is a large four-yearly cross-country cyclical enterprise survey, the recent available data are from 2014. The micro-level SES data was obtained from Eurostat on an individual request (research proposal 225/2016-EU-SILC-SES). Methodological aspects of SES and the microdata access procedures are available on: <https://ec.europa.eu/eurostat/web/microdata/structure-of-earnings-survey>.

including the coordination of wage setting³ derived from ICTWSS database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (Visser, 2016) in order to check whether national labour market arrangements may influence the relationship between GVC measure and gender wage inequalities. Additionally, to control for the influence of country openness to the interaction between global trade involvement and GWG we add country level data from Penn World Table version 9.0 (R. C. Feenstra, Inklaar, & Timmer, 2015). In particular, we include the share of merchandise exports in real GDP at current PPPs (alternatively share of merchandise imports in real GDP at current PPPs) as measures of country openness. In this way, we obtain a valuable dataset enabling to assess the impact of involvement in global production links on the gender wage inequalities. After harmonizing and cleaning data process⁴ the final dataset results in 6,431,017 observations (64% are males and 36% females) from manufacturing sector⁵ containing on the one hand a wealth of information on employees' personal characteristics (sex, age, education level, tenure, type of employment contract, occupation as well as company characteristics (size, form of economic and financial control, bargaining scheme coverage) and on the second hand the information on the industry position and involvement in GVCs. The latter, is simplified by an use of the measure of foreign value added embodied in exports (FVA/Exp) of a given industry proposed by Feenstra (2017). Higher the FVA/Exp means that the export of given country is more depended on inputs that were previously imported. Foreign value added to total export is commonly used as a measure of production fragmentation and is obtained from export decomposition into domestic and foreign component (among others: Johnson & Noguera, 2017; Koopman, Wang, & Wei, 2014). Figure 1 presents noticeable cross-country variability in FVA embodied in export in the years 2002, 2006, 2010 and 2014.

[Figure 1 about here]

As is shown in Fig. 1 international trade involvement assessed via the share of foreign value added in export varies among countries and years. The highest values for FVA/Exp is reported for Luxembourg, Hungary and Slovak Republic, while the lowest for Romania and Norway (for the year 2014). The greatest increase in FVA/Exp over the time period 2002-2014 is recorded for Czech

³ We use variable Coord: coordination of wage-setting derived from (Visser, 2016) and recode it into a 0-1 variable. 0 is for countries with mixed industry and firm-level bargaining, little or no pattern bargaining and relatively weak government coordination through minimum wage or indexation or for fragmented wage bargaining, confined largely to individual firms or plants. The value 1 stands for centralised or industry level bargaining.

⁴ In particular we focus on eliminating the extreme observations and outliers from the dataset which may distort our results. For the wage variable, as well as the GVC related variables we do a correction at the top and at the bottom of the distribution using the winsor2 package for STATA (Yu-jun, 2014). In this way we cut the observations below 1st and above 99th percentile and replace them with the values for 1st and 99th percentile.

⁵ After compiling the SES with the WIOD file we got 22 manufacturing sectors, among them some are at on a more highly aggregated level. Detailed description of the aggregation procedure is available upon request.

Republic (47.7%) and for Finland (44.8%), while the Romania is the only country with decrease of the FVA/Exp (see Fig. A1 in the Appendix).

In our wage regressions, as dependent variable, we use average gross hourly wage in the reference month. The nominal wages in national currency are converted to USD using the exchange rates from OECD⁶ and expressed in real terms with the use of inflation rates from Eurostat⁷. Figure 2 present the distribution of wages by gender for the pooled sample.

[Figure 2 about here]

The distribution of wages shown in Fig. 2 indicates gender inequalities at every level of wages. Importantly, the wages for men are apparently higher than those for women, what brings motivation for further investigation of this problem. Additionally in Appendix we present the distribution of wages by skill and educational level as well as for separate years (Fig. A2-A5).

To seek out the determinants which may explain the differences in wages between women and men we employ a set of individual, company and country level characteristics. Table 1 shows the detailed descriptive statistics of variables used in the estimation process.

[Table 1 about here]

As shown in Table 1 we consider a wide range of individual, company and country level characteristics in order to explain the differences in wages between men and women. To do this we use traditional Mincer-type wage equation, employing OLS weighted⁸ estimation methods with robust standard errors clustered at industry. In this way we examine how the national industry's involvement in the global productions may affect the gender wage disparities

4. Empirical analysis

4.1 Model specification

In our analysis we want to check the association between involvement in GVC and wages of individual workers. Specifically, our main aim is to investigate the potential differences between female and male wages in this aspect. In order to check whether women and men are equally impacted (benefit or loose equally) from GVC, we estimate the following regression:

⁶ doi: 10.1787/037ed317-en, accessed on 25 April 2019

⁷ in particular we use the HICP for the year 2010 (<https://ec.europa.eu/eurostat/web/hicp/data/database> access on 25 April 2019). First, we deflated the wages into the real terms from 2010, and then convert into USD using the exchange rate from 2010.

⁸ Specifically, we recalculate the grossing-up factor for employees (from SES) in such a way that for the pooled sample of 18 countries, the observations from each country sum to 10 000 in order to give each country equal weight in the model. We thank Piotr Paradowski for the Stata codes; see more in: LIS Self Teaching Package 2018, Stata version: <http://www.lisdatacenter.org/wp-content/uploads/files/resources-stata-Part-II.pdf>

$$\ln w_{ijc,t} = \alpha + \beta_1 \text{Sex}_i + \beta_2 \text{GVC}_{jct-1} + \beta_3 \text{Sex}_i \times \text{GVC}_{jct-1} + \beta_4 \text{Ind}_{it} + \beta_5 \text{Firm}_{it} + \beta_6 \text{Sector}_{jct} + \beta_7 \text{Country}_{ct} + D_t + D_j + D_c + \varepsilon_{ijct} \quad (1)$$

where: i denotes workers, j refers to the sector of employment, c is country, t – time. The dependent variable $w_{ijc,t}$ is the wage of individual worker. Ind is set of individual and job characteristics (three dummies for age, three dummies for education: low, medium and high education, four dummies for skills classified according to occupation, dummy for full time employment), $Firm$ refers to firm characteristics (size of the company, form of economic and financial control, type of collective pay agreement), $Sector$ (size of the sector measured by number of employees, sectors' concentration referring to price-cost margin (PCM)). We measure PCM at the sectoral level following Aghion et al. (2008) as the proportion of the difference between output and labour and capital compensation to the gross output of a given sector. The values of PCM ranges from (0, 1), where the higher the score, the greater the sector's concentration. Country (dummy for the level of collective wage bargaining, measure of country's openness: export or import to GDP and the country's development: GDP per capita). Additionally, we control for time effects - D_t (having the pooled sample from 2002, 2006, 2010 and 2014), industry effects D_j (considering all the remaining industry-specific characteristics); and country effects D_c (picking up all other country-specific labour market conditions that can have effects on wages). Our main variable of interest GVC is sector's involvement in global value chains measured as the ratio of foreign value added embodied in export (FVA/Exp) included in the regression as the lagged variable in order to allow the effect to materialise⁹. We assume that effect of GVC on individual wages can be different for female and male workers, because of that, except the plain measure of Sex and GVC , we incorporate the interaction: $\text{Sex} \times GVC$, where variable Sex is a dummy variable equalling 0 for females and 1 for males. The marginal effect of GVC on female workers equals: $\frac{\delta \ln wage}{\delta GVC} = \beta_2$, while for males: $\frac{\delta \ln wage}{\delta GVC} = \beta_2 + \beta_3$.

4.2 Results

Table 2 present our baseline estimations. It can be seen that all coefficients for workers' individual characteristics are of expected sign and statistically significant. In particular younger people, those with low and medium level of education, having temporary type of employment, with shorter tenure in enterprise and performing lower skilled occupation predominantly earn less.

[Table 2 about here]

Turning into company level variables, we report that those employed in small and medium size enterprises as well as in those with industry level collective pay agreement scheme are also exposed to have lower wages. Moreover, in countries with centralised level of wage coordination and greater extent

⁹ The inclusion of lagged variable of GVC can also solve the potential problems with endogeneity.

of openness, the wages turn to be higher. Controlling for these abovementioned factor, we mainly aim to indicate the wage gender discrimination. First of all, we report that the average hourly wages are lower for women than for men in all model specifications differing with respect to control variables (models 1-8 in Table 2). In this way we report a discrimination of women on the labor market with regard to wages. Turning into the core part of our analysis, focusing on the impact of sector's involvement into GVC on the gender wage inequalities two main patterns may be indicated. Firstly, the impact of FVA/Exp on wages is negative and statistically significant regardless the model specification. It means that the higher the share of the imported goods and services in the value of sector's export, the lower the wages of employees in given sector. Moreover, looking into the gender issue through GVC lenses, we observe that women and men may be affected in different ways. In particular, the coefficient for the interaction between sex and GVC suggests, that the negative effect of GVCs on wages is lower for men than for women. The figure 3 shows predicted wages due to the changes in FVA/EXP for females and males (illustrating the results from Column 3 and 7 of Table 2). Indeed, the wage drop for females is more noteworthy resulting in the larger GWG at the higher levels of FVA/EXP. In other words, in general, women are more negatively affected by the international production fragmentation than men. Our findings are indeed in line with previous evidence on positive impact of global trade involvement and gender wage gap documented in (Berik et al., 2004; Domínguez-Villalobos & Brown-Grossman, 2010; Menon & Van der Meulen Rodgers, 2009).

[Figure 3 about here]

In order to conduct deeper analysis of nexus between GVC and female/male wages we run additional estimations for distinct group of workers. Table 3 and 4 show the estimations results, with the same predictors – the same individual, job, firm, sectoral and country controls – as in model in Table 2¹⁰, but performed for labour of different education level (Table 3) and skills level (Table 4).

[Table 3 about here]

[Table 4 about here]

Male's premium is characterized for workers for all education and skills levels. The results indicate that the negative association between GVC and wages is sustained for medium educated workers with women being more hit. Similarly, the above pattern is most materialized for workers with medium skill level (skill level 2). Additionally, the wages of high educated men are positively correlated with the sector's involvement in international production sharing; the same applies to more skilled males (skill level 3).

Finally, we rerun the estimations separately for specific occupations: specifically for the nine different categories of the ISCO-08 1-digit classification. This should not only help to identify the different effects of GVC for specific groups of workers but also should address the issue connected

¹⁰ Personal, job, firm, sectoral and country controls included in all specifications but not reported. The detail results available from authors upon request.

with different distribution of female and male workers among different occupations (e.g. more feminist jobs) hence their possible heterogeneous remuneration due to the type of job they perform. The results are presented in Table 5.

[Table 5 about here]

When we compare the effects of GVC on female and male wages in the same occupation we obtain some interesting results. First of all, average hourly wages are higher for men for all different occupations but the male's premium is different across occupations – e.g. lowest for managers. GVCs are associated with lower wages of craft and related traded workers (occupation 7), and plant and machine operators, and assemblers (occupation 8) while for the latter the effect is less severe for male workers¹¹. Additionally for managers (occupation 1) and technicians and associate professionals (occupation 3) the production fragmentation measured by FVA embodied in export is associated with higher wages of male workers. We should note that those two types of occupations constitute 60% of all workers. This is partially in line with previous evidence Yahmed (2012) suggesting, that the trade intensification increase the GWG mostly among high-skill workers.

4.3. Extensions and sensitivity analysis

Based on the theory, the impact of trade on GWG can depend on the original concentration of the sector where the workers are employed (Berik et al., 2004; Menon & Van der Meulen Rodgers, 2009, Wolszczak-Derlacz, 2013). In the previous part we included the measure of sectors concentration (PCM) as one of the independent variables. In most of the specifications (see e.g. Columns 7 and 8 of Table 2) the coefficient for PCM was not statistically significant. However, in order to check this proposition more thoroughly we estimate the equation (1) augmented by three-way-interaction between Sex, GVC and sector concentration as at the following regression:

$$\begin{aligned} \ln w_{ijc,t} = & \alpha + \beta_1 \text{Sex}_i + \beta_2 \text{GVC}_{jct-1} + \beta_3 \text{PCM}_{jct} + \beta_4 \text{Sex}_i \times \text{GVC}_{jct-1} + \beta_5 \text{Sex}_i \times \text{PCM}_{jct} + \\ & \beta_6 \text{GVC}_{jct-1} \times \text{PCM}_{jct} + \beta_7 \text{Sex}_i \times \text{GVC}_{jct-1} \times \text{PCM}_{jct} + \beta_8 \text{Ind}_{it} + \beta_9 \text{Firm}_{it} + \beta_{10} \text{Sector}_{jct} + \\ & \beta_{11} \text{Country}_{ct} + D_t + D_j + D_c + \varepsilon_{ijct} \end{aligned} \quad (2)$$

Now, the conditional marginal effect of GVC is $\frac{\delta \ln wage}{\delta GVC} = \beta_2 + \beta_4 \text{Sex} + \beta_6 \text{PCM} + \beta_7 \text{Sex} \times \text{PCM}$ and depends both on the PCM and worker's sex.

The results of eq. 2 are presented in Table 6. In the regression (2) we include all the possible interactions between Sex, GVC and PCM in order to quantify the effect of GVC on wages in concentrated (versus competitive sectors) potentially differing by sex of the workers. Since the

¹¹ The coefficient of FVA/Exp is negative and statistically significant also for skilled agricultural, forestry and fishery workers (occupation 6) – but since we limit our analysis to manufacturing sectors the number of workers reporting agriculture type of job is negligible (0.08% of all observations).

augmented model comprises different interaction terms, to assess the impact of GVC on wages we must calculate the marginal conditional effects. For the easiest of interpretation of results, we present plots of the predicted wages for female and male workers from model (2) for different levels of sectors concentration (Figure 4). The upper panel shows the results from Colum 3 of Table 6. We can see that female wages drops due to the intensification of production fragmentation no matter what the level of sector concentration is, while for males the wages decreases for originally concentrated (e.g. PCM=0.9) sectors and increases for less concentrated (e.g, PCM=0.16). It is also illustrated by contour plot (upper panel of Figure 5). The highest male's wages (darkest colour) are found in sectors with low concentration and relatively high FVA/EXP and/or in sectors with high concentration and low level of international production fragmentation. When we add more control variables the distinct effect for concentrated versus non-concentrated sectors is seen not only for men but also for women. Lower panels of figure 4 and 5 present the results from Column 7 of Table 6. The results indicate that in concentrated sectors, the involvement in global value chains is associated with lower females' wages. This negative effect is not seen in the competitive sectors.

[Table 6 about here]

[Figure 4 about here]

[Figure 5 about here]

In order to check the stability of results, we performed number of robustness checks¹². First, we employ alternative measure of GVC, this time based on the traditional index of offshoring (OFF) calculated as import of intermediate inputs to the the industry's value added (Feenstra and Hanson, 1999). The correlation between FVA/Exp and OFF is high and the main results from the regression analysis referring to the negative association between intensity of offshoring and wages with females being more affected are sustained. The patterns from background regressions are also confirmed for groups of specific workers, classified on the bases of education, skills or occupation.

Next, as dependent variable we use average gross hourly wages this time expressed in common currency with the use of PPP as the conversion rate. The change in the method of wage conversion does not change our main conclusions: estimates are very similar to the benchmark ones.

Finally, we augment the specifications with additional measures of national labour market arrangements in order to control for their potential influence on the relationship between GVC and wages. We take into account the predominant level at which wage bargaining takes place (wage bargaining at company level versus industry-wide and centralised bargaining), whether in collective agreement opening clauses are present or not and articulation of enterprise bargaining¹³. When the

¹² Due to space constraints, the detail results for this part are available from the authors upon request, see Table S1-S9 in supplementary materials.

¹³ They are derived from ICTWSS database.

further measures of labour arrangements are added as independent variables, the results concerning the relationship between GVC and wages remain stable with respect to the benchmark ones.

5. Conclusions

In this paper we examine the linkages between involvement into GVCs and the gender wage inequalities. We use merged wide-ranging SES-WIOD data set for the years 2002, 2006, 2010 and 2014, covering 18 European countries. We employ a wealth of information on employees' personal characteristics (sex, age, education level, tenure, type of employment contract, occupation), company characteristics (size, form of economic and financial control, bargaining scheme coverage) derived from SES as well as sectoral variable reflecting the measure of foreign value added embodied in exports (FVA/Exp) proposed by Feenstra (2017) from WIOD (release 2016). Using OLS regressions with robust standard errors clustered at industry we estimate the impact of individual, company level, sectoral and country level determinants on the wage level. We report a gender wage discrimination among European employees regardless the model specification. Additionally, we find that lower wages are typical for younger people, those with low and medium level of education, having temporary type of employment, with shorter tenure in enterprise and performing lower skilled occupation. Moreover, employees from small and medium size enterprises as well as in those with industry level collective pay agreement scheme are also exposed to have lower wages. Moreover, in countries with centralised level of wage coordination and greater extent of openness, the wages turn to be higher. Analysing the influence of GVC involvement, significant patterns may be noticed. Firstly, the impact of FVA/Exp on wages is negative and statistically significant for our baseline estimations, based on pooled sample and this negative effect of GVCs on wages is lower for male workers. In view of this, we can conclude that involvement in GVC can indeed provoke higher gender wage differences. However, splitting the sample into workers with different education and/or skills level, it is noted that involvement into production sharing considers negatively mostly workers in the middle of distribution. On the other hand, when the sample is divided into high tech and low tech manufacturing sectors, we notice, that this effect is more noticeable in high tech manufacturing. Similarly as before, the influence of GVCs on wages differs regarding the gender. Women are more affected by the negative impact of greater trade involvement in comparison to men. This pattern is more noticeable in high tech manufacturing sectors. Finally, we try to assess whether the involvement in GVC causes similar effects in female/male wages in concentrated and non-concentrated sectors.

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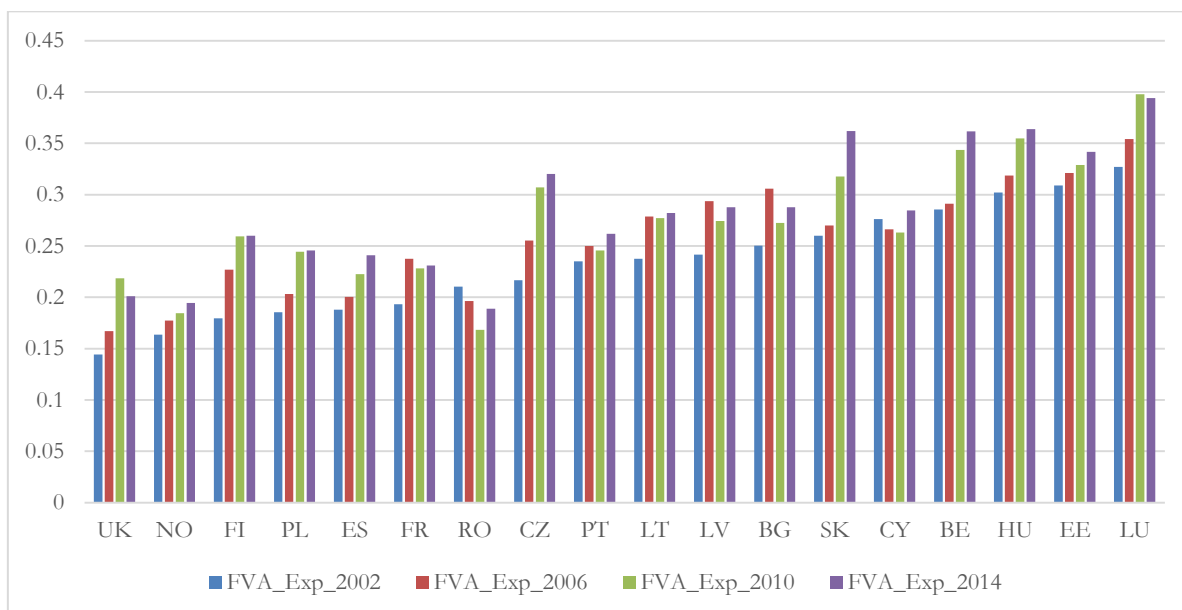
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Tables and Figures

Fig. 1. Foreign value added embodied in export(FVA/Exp) by countries and years.



Notes: mean values weighted by sectors' value added

Source: own elaboration based on WIOD 2002, 2006, 2010, 2014.

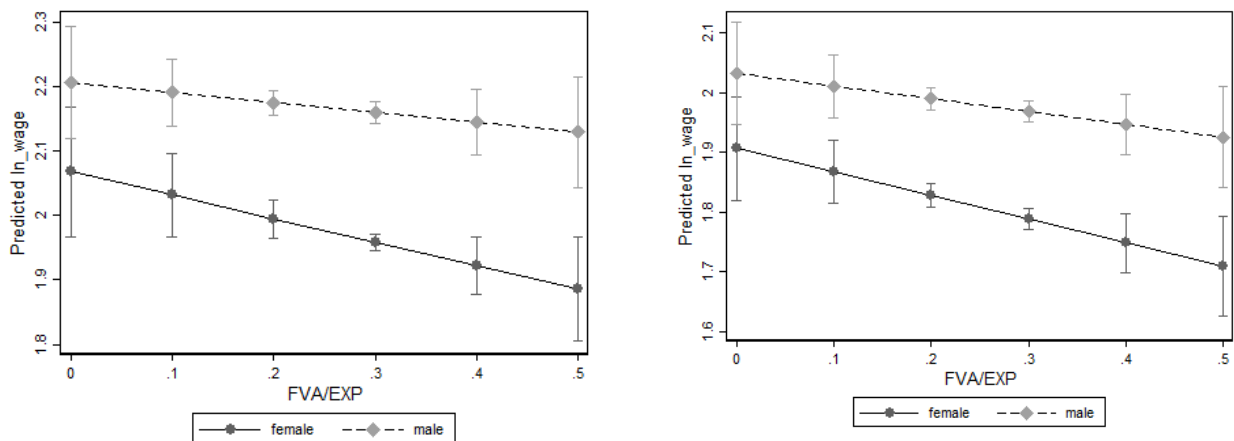
Fig. 2. Distribution of logarithm of hourly wages by gender.



Notes: weights applied, based on grossing-up factor for employees (from SES).

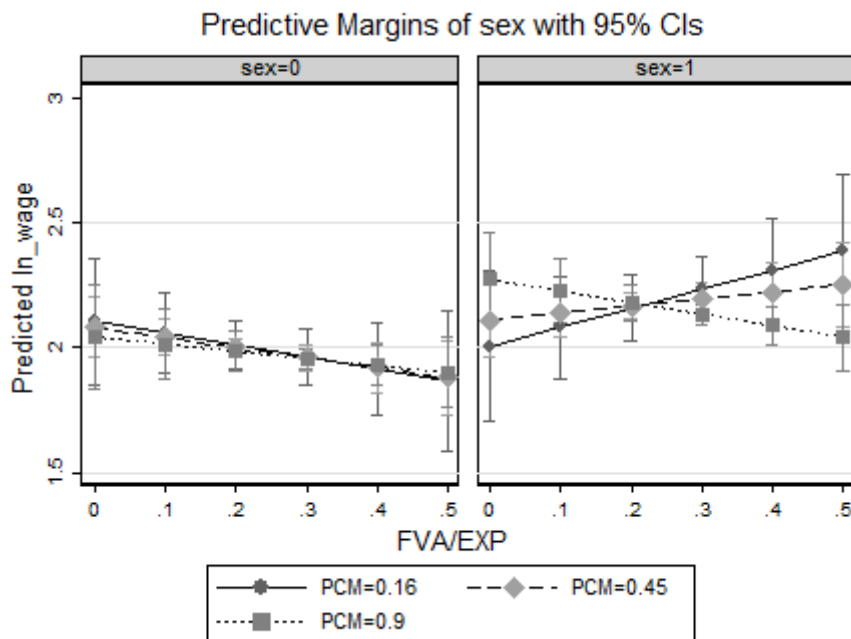
Source: own elaboration based on pooled SES data.

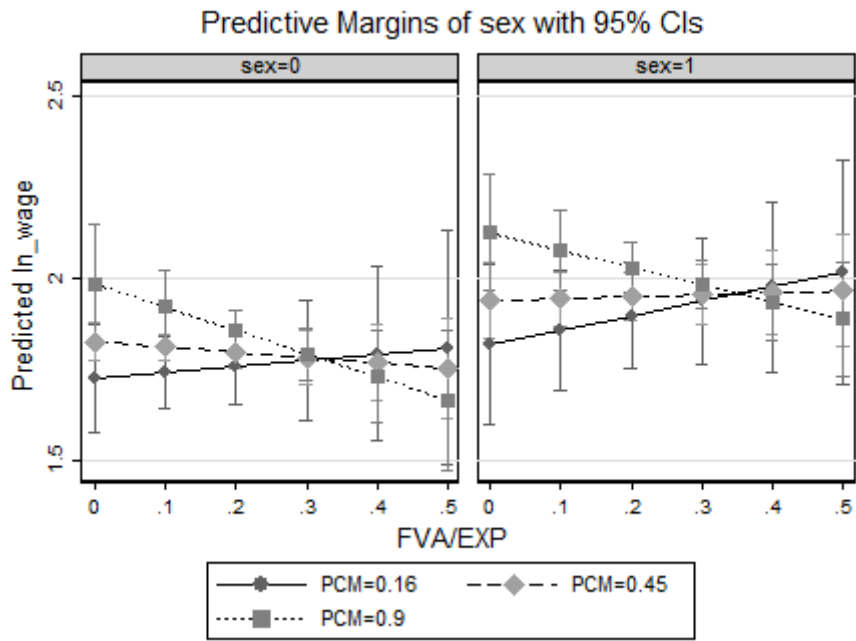
Fig. 3 Predicted wages due to the changes in FVA/EXP for females and males (illustrating the results from Table 2, Column 3 (left panel) and Column 7 (right panel))



Source: own elaboration based on data from SES and WIOD

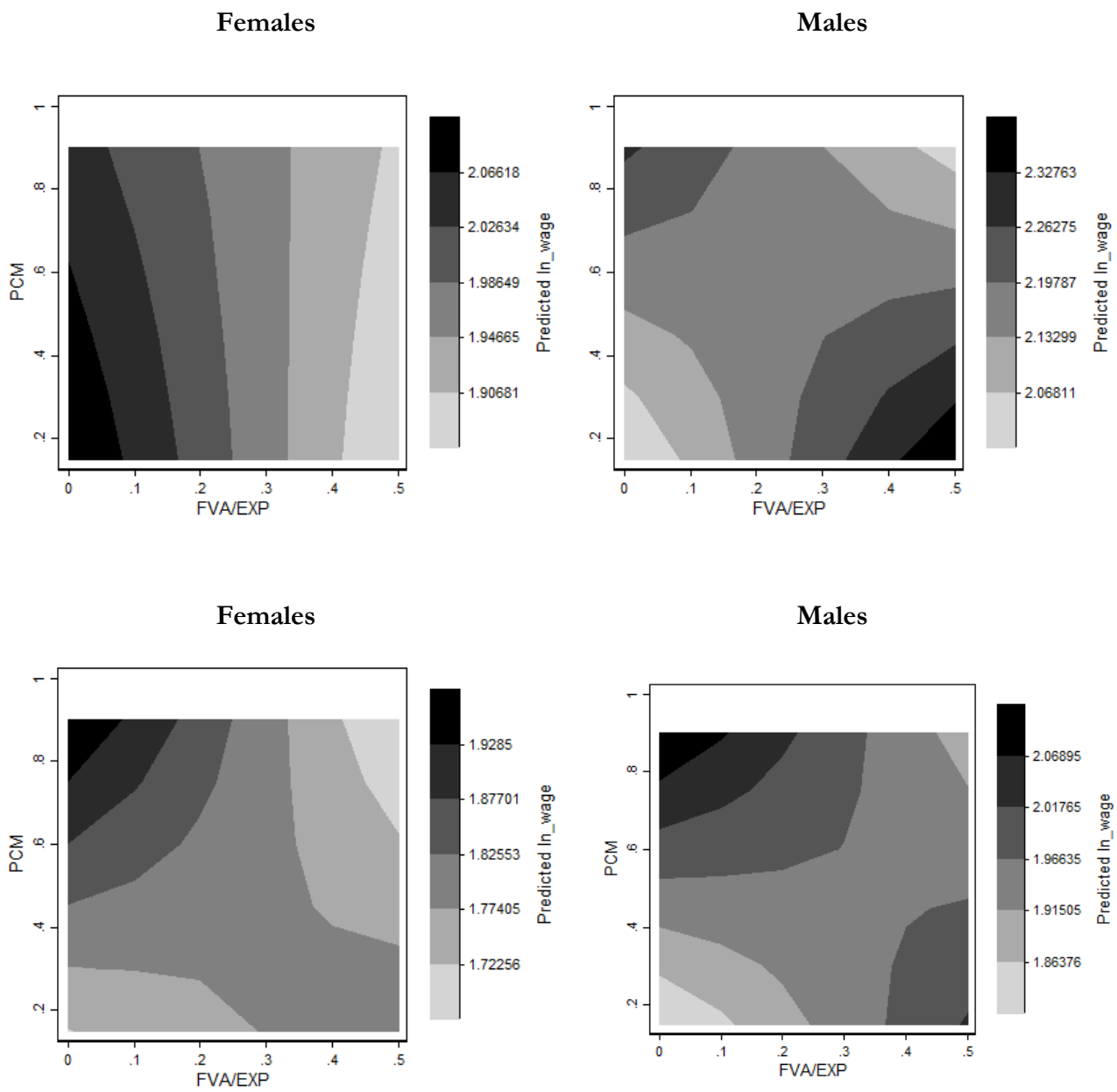
Fig. 4 Predicted wages due to changes in FVA/EXP at different values of sectors concentration (PCM), for females and males (illustrating the results from Table 6, Column 3 (upper panel), Column 7 (lower panel))





Source: own elaboration based on data from EU-SES and WIOD

Fig. 5 Contour plots with log hourly wage (illustrating the results from Table 6, Column 3 (upper panel) and Column 7 (lower panel))



Source: own elaboration based on data from EU-SES and WIOD

Table 1. Descriptive statistics of variables.

	Male					Female				
	N	mean	sd	min	max	N	mean	sd	min	max
Gross hourly wage (USD)	4120291	15.01	12.93	0.90	57.96	2310726	9.00	9.75	0.90	57.96
Age										
ageyoung	4120291	0.19	0.39	0.00	1.00	2310726	0.17	0.38	0.00	1.00
ageaverage	4120291	0.54	0.50	0.00	1.00	2310726	0.58	0.49	0.00	1.00
ageold	4120291	0.27	0.44	0.00	1.00	2310726	0.25	0.43	0.00	1.00
Education level										
loweduc	4120133	0.23	0.42	0.00	1.00	2310707	0.23	0.42	0.00	1.00
mededuc	4120133	0.59	0.49	0.00	1.00	2310707	0.60	0.49	0.00	1.00
higheduc	4120133	0.18	0.38	0.00	1.00	2310707	0.17	0.37	0.00	1.00
indefinite	4006520	0.92	0.27	0.00	1.00	2249668	0.91	0.29	0.00	1.00
temporary	4006520	0.08	0.26	0.00	1.00	2249668	0.09	0.28	0.00	1.00
apprentice	4006520	0.00	0.07	0.00	1.00	2249668	0.00	0.06	0.00	1.00
Tenure										
shortdur	4120291	0.12	0.32	0.00	1.00	2310726	0.13	0.34	0.00	1.00
meddur	4120291	0.31	0.46	0.00	1.00	2310726	0.34	0.47	0.00	1.00
logdur	4120291	0.35	0.48	0.00	1.00	2310726	0.35	0.48	0.00	1.00
vlongdur	4120291	0.23	0.42	0.00	1.00	2310726	0.18	0.38	0.00	1.00
FT	4120291	0.96	0.20	0.00	1.00	2310726	0.91	0.29	0.00	1.00
Skill level										
skill_1	4091521	0.09	0.28	0.00	1.00	2303893	0.13	0.34	0.00	1.00
skill_2	4091521	0.63	0.48	0.00	1.00	2303893	0.62	0.48	0.00	1.00
skill_3	4091521	0.12	0.33	0.00	1.00	2303893	0.13	0.33	0.00	1.00
skill_4	4091521	0.08	0.26	0.00	1.00	2303893	0.05	0.21	0.00	1.00
Company size										
small	4083261	0.20	0.40	0.00	1.00	2293094	0.19	0.39	0.00	1.00
medium	4083261	0.30	0.46	0.00	1.00	2293094	0.33	0.47	0.00	1.00
large	4083261	0.50	0.50	0.00	1.00	2293094	0.48	0.50	0.00	1.00
public	4100502	0.03	0.17	0.00	1.00	2301600	0.02	0.15	0.00	1.00
private	4100502	0.97	0.18	0.00	1.00	2301600	0.98	0.15	0.00	1.00
nationagr	3896324	0.13	0.34	0.00	1.00	2212276	0.11	0.32	0.00	1.00
industagr	3896324	0.23	0.42	0.00	1.00	2212276	0.19	0.39	0.00	1.00
enterpagr	3896324	0.34	0.47	0.00	1.00	2212276	0.32	0.47	0.00	1.00
noagr	3896324	0.30	0.46	0.00	1.00	2212276	0.38	0.49	0.00	1.00
Coordination of wage setting	4120291	0.34	0.47	0.00	1.00	2310726	0.27	0.45	0.00	1.00
Share of merchandise import in real GDP at current PPPs	4120291	0.57	0.30	0.20	1.46	2310726	0.54	0.25	0.20	1.46
Share of merchandise export in real GDP at current PPPs	4120291	0.47	0.29	0.08	1.36	2310726	0.44	0.26	0.08	1.36

Notes: weights applied, based on grossing-up factor for employees (from SES). Variable Age is divided into cohorts: 14-19, 20-29, 30-39, 40-49, 50-59 and 60+ recoded into: *ageyoung* (below 30), *ageaverage* (30-49) and *ageold* (50 and more). The

education variable means the highest completed level of education according to the ISCED-1997 (for the years 2002, 2006 and 2010) and ISCED-2011 (for the year 2014). We recode this variable into three binary variables: *loweduc*, *mededuc* and *higheduc*, using the “Correspondence between ISCED 2011 and ISCED 1997 levels” tables available at https://ec.europa.eu/eurostat/documents/1978984/6037342/Comparability_ISCED_2011_ISCED_1997.pdf. Type of employment contract is represented by 3 variables: *indefinite*, *temporary*, and *apprentice*. Tenure in the enterprise is recoded into 4 variables: *shortdur* for less than 1 year, *meddur* for 1 to 4 years, *longdur* for 5 to 14 years and *vlongdur* for 15 years and more. Variable *FT* represents 1 for full-time employees and otherwise. Skill level is divided into 4 groups derived from occupation variable (b23) and using transformation according to mapping of ISCO major groups to skill level available in (ILO, 2012). Company size is recoded into 3 variables: *small*, *medium* and *large* for enterprises with respectively 1-49, 50-249, and 250 or more employees. Collective pay agreement level is divided into *nationagr* "National level or interconfederal agreement", *industagr* "Industry agreement or agreement for individual industries in individual regions", *enterpagr* "Enterprise or single employer agreement; agreement applying only to workers in the local unit; any other type of agreement",

Source: Own elaboration based on SES data.

Table 2. Estimation results – wage regression, including the interaction between Sex and FVA/EXP (eq.1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _{<i>i</i>}	0.129***	0.154***	0.138***	0.135***	0.132***	0.139***	0.126***	0.127***
	[0.025]	[0.017]	[0.016]	[0.014]	[0.011]	[0.012]	[0.010]	[0.010]
FVA/Exp _{<i>i,t-1</i>}	-0.422*	-0.370*	-0.364**	-0.360**	-0.523***	-0.509***	-0.396**	-0.410**
	[0.213]	[0.185]	[0.173]	[0.172]	[0.144]	[0.147]	[0.161]	[0.161]
Sex _{<i>i</i>} ×FVA/Exp _{<i>i,t-1</i>}	0.252***	0.180***	0.211***	0.156***	0.153**	0.127**	0.183***	0.181***
	[0.081]	[0.057]	[0.052]	[0.046]	[0.053]	[0.054]	[0.051]	[0.051]
ageyoung _{<i>it</i>}		-0.220***	-0.119***	-0.078***	-0.064***	-0.063***	-0.061***	-0.061***
		[0.015]	[0.010]	[0.006]	[0.007]	[0.008]	[0.008]	[0.008]
ageaverage _{<i>it</i>}		-0.043***	-0.020***	-0.009**	0.000	0.000	0.003	0.003
		[0.007]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
loweduc _{<i>it</i>}		-0.541***	-0.531***	-0.227***	-0.219***	-0.217***	-0.217***	-0.217***
		[0.018]	[0.017]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
mededuc _{<i>it</i>}		-0.408***	-0.406***	-0.158***	-0.149***	-0.148***	-0.150***	-0.149***
		[0.016]	[0.016]	[0.010]	[0.009]	[0.009]	[0.009]	[0.009]
indefinite _{<i>it</i>}			0.086***	0.066***	0.084***	0.081***	0.079***	0.079***
			[0.011]	[0.011]	[0.011]	[0.011]	[0.010]	[0.010]
shortdur _{<i>it</i>}			-0.217***	-0.191***	-0.147***	-0.149***	-0.153***	-0.152***
			[0.013]	[0.012]	[0.007]	[0.007]	[0.008]	[0.008]
meddur _{<i>it</i>}			-0.134***	-0.118***	-0.084***	-0.084***	-0.085***	-0.085***
			[0.012]	[0.012]	[0.007]	[0.008]	[0.008]	[0.008]
full time _{<i>it</i>}			0.067***	0.044***	0.007	0.008	0.008	0.007
			[0.010]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
skill_1 _{<i>it</i>}				-0.698***	-0.704***	-0.709***	-0.712***	-0.712***
				[0.013]	[0.013]	[0.013]	[0.012]	[0.012]
skill_2 _{<i>it</i>}				-0.567***	-0.571***	-0.575***	-0.575***	-0.575***
				[0.012]	[0.011]	[0.012]	[0.011]	[0.011]
skill_3 _{<i>it</i>}				-0.357***	-0.372***	-0.374***	-0.371***	-0.371***
				[0.012]	[0.011]	[0.011]	[0.011]	[0.011]

size_small _{it}					-0.305***	-0.307***	-0.313***	-0.314***
					[0.024]	[0.024]	[0.022]	[0.022]
size_medium _{it}					-0.128***	-0.130***	-0.133***	-0.133***
					[0.014]	[0.014]	[0.013]	[0.013]
public _{it}					0.017	0.02	0.035	0.036
					[0.026]	[0.026]	[0.025]	[0.025]
nationagr _{it}						0.021	-0.015	-0.018
						[0.019]	[0.017]	[0.017]
industagr _{it}						-0.032***	-0.033***	-0.034***
						[0.008]	[0.008]	[0.008]
ln_H_EMPE _{jt}							-0.025**	-0.026**
							[0.011]	[0.011]
PCM _{jt}							0.116	0.118
							[0.122]	[0.118]
Coordination of wage-setting _{it}							-0.066***	-0.070***
							[0.011]	[0.012]
ln_GDPpc _{it}							0.681***	0.684***
							[0.027]	[0.029]
Exp/GDP _{it}							0.196***	
							[0.045]	
Imp/GDP _{it}								0.263***
								[0.043]
R ²	0.803	0.835	0.843	0.862	0.868	0.864	0.869	0.869
N	6431017	6430840	6256011	5806414	5737973	5603915	5603915	5603915

Notes: Country, industry and time dummies included. Normalised weighted regression with robust standard errors, clustered at industry, the weights are based on grossing-up factor for employees (from SES) normalised by the number of observation per country (see main text for the details); Default categories: ageold, higheduc, temporary, longdur and vlongdur; skill_4, large, enetrprise agreement, *p ≤ .10, **p ≤ .05, ***p ≤ .01.

Source: own elaboration based on data from SES and WIOD

Table 3. Estimation results– wage regression, workers with different education levels

	Low education		Medium education		High education	
	(1)	(2)	(3)	(4)	(5)	(6)
Sex _i	0.134***	0.172***	0.132***	0.123***	0.105***	0.090***
	[0.017]	[0.016]	[0.013]	[0.010]	[0.021]	[0.018]
FVA/Exp _{jt-1}	-0.094	-0.042	-0.453**	-0.506***	-0.146	-0.175
	[0.178]	[0.192]	[0.177]	[0.159]	[0.176]	[0.154]
Sex _i ×FVA/Exp _{jt-1}	0.194***	-0.003	0.181***	0.205***	0.141*	0.184**
	[0.058]	[0.066]	[0.047]	[0.049]	[0.073]	[0.069]
Personal and job controls	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes
R ²	0.875	0.882	0.877	0.876	0.783	0.791
N	1068089	1018340	4190660	4064459	547665	521116

Notes: Country, industry and time dummies included. Normalised weighted regression with robust standard errors, clustered at industry, the weights are based on grossing-up factor for employees (from SES) normalised by the number of observation per country (see main text for the details). Personal controls: ageyoung, ageaverage, indefinite, shortdur, meddur, full time, skill_1, skill_2, skill_3. Firm controls: size_small, size_medium, public, nationagr, industagr. Sector controls: ln_H_EMPE, PCM. Country controls: coordination of wage-setting, ln_GDPpc, Exp/GDP. Default categories as under Table 2. *p ≤ .10, **p ≤ .05, ***p ≤ .01.

Source: own elaboration based on data from SES and WIOD

Table 4. Estimation results– wage regression: workers with different skills levels

	Skill_1		Skill_2		Skill_3		Skill_4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _i	0.109***	0.112***	0.132***	0.134***	0.129***	0.119***	0.113***	0.128***
	[0.022]	[0.022]	[0.013]	[0.010]	[0.021]	[0.017]	[0.026]	[0.021]
FVA/Exp _{it-1}	0.125	-0.06	-0.449**	-0.444**	-0.194	-0.246	-0.275	-0.203
	[0.233]	[0.151]	[0.176]	[0.172]	[0.188]	[0.173]	[0.196]	[0.145]
Sex _i ×FVA/Exp _{it-1}	0.097	0.011	0.190***	0.172***	0.157**	0.187***	0.151	0.098
	[0.065]	[0.082]	[0.041]	[0.051]	[0.075]	[0.064]	[0.089]	[0.078]
Personal and job controls	yes	yes	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes	yes	yes
R ²	0.896	0.892	0.875	0.875	0.829	0.837	0.765	0.776
N	460475	443230	4162028	4018923	871006	841657	726899	702068

Notes: Personal controls: ageyoung, ageaverage, loweduc, mededuc, indefinite, shortdur, meddur, full time.. Other notes as under Table 3.

Source: own elaboration based on data from SES and WIOD

Table 5. Estimation results– wage regression: workers from different occupations

	Occupations: 1 – digit ISCO-08 classification								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sex _i	0.067**	0.139***	0.129***	0.137***	0.257***	0.164*	0.166***	0.107***	0.109***
	[0.029]	[0.021]	[0.021]	[0.018]	[0.028]	[0.091]	[0.028]	[0.025]	[0.022]
FVA/Exp _{<i>p,t-1</i>}	-0.334	-0.057	-0.194	-0.148	0.116	-1.676**	-0.450**	-0.569***	0.125
	[0.223]	[0.159]	[0.188]	[0.099]	[0.093]	[0.682]	[0.164]	[0.198]	[0.233]
Sex _i × FVA/Exp _{<i>p,t-1</i>}	0.227**	-0.042	0.157**	-0.001	-0.087	-0.524	0.115	0.281***	0.097
	[0.104]	[0.072]	[0.075]	[0.065]	[0.095]	[0.353]	[0.072]	[0.087]	[0.065]
R ²	0.735	0.824	0.83	0.861	0.897	0.877	0.866	0.888	0.896
N	312905	413994	871006	308776	113406	5388	1801823	1932635	460475

Notes: Personal, job, sector and country controls included – not reported. Other notes as under Table 3.

Occupation: 1 digit ISCO-08 classification: (1) – Managers, (2) – Professionals, (3) – Technicians and associate professionals, (4) – Clerical support workers, (5) – Services and sales workers, (6) Skilled agricultural, forestry and fishery workers, (7) – Craft and related traded workers, (8) – Plant and machine operators, and assemblers, (9) – Elementary occupations.

Source: own elaboration based on data from SES and WIOD

Table 6. Estimation results– wage regression with three-way interaction between: Sex, PCM and FVA/EXP, eq. 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
sex	-0.09	-0.156	-0.17	-0.219	0.169	0.149	0.081	0.084
	[0.165]	[0.148]	[0.131]	[0.152]	[0.102]	[0.106]	[0.116]	[0.114]
FVA/Exp	-0.098	-0.306	-0.516	-0.262	-0.127	-0.075	0.345	0.344
	[0.633]	[0.614]	[0.623]	[0.694]	[0.656]	[0.652]	[0.548]	[0.543]
Sex × FVA/Exp	1.329**	1.385**	1.544***	1.511**	-0.06	0.001	0.252	0.237
	[0.635]	[0.559]	[0.507]	[0.621]	[0.435]	[0.447]	[0.461]	[0.460]
PCM	0.011	-0.041	-0.083	-0.074	0.126	0.138	0.345*	0.350*
	[0.319]	[0.268]	[0.267]	[0.303]	[0.262]	[0.267]	[0.191]	[0.190]
Sex × PCM	0.307	0.452*	0.445**	0.516**	-0.053	-0.013	0.066	0.062
	[0.262]	[0.222]	[0.197]	[0.222]	[0.148]	[0.153]	[0.168]	[0.166]
FVA/Exp × PCM	-0.389	-0.051	0.255	-0.074	-0.575	-0.63	-1.07	-1.087
	[1.093]	[0.951]	[0.950]	[1.061]	[1.046]	[1.053]	[0.931]	[0.923]
Sex × FVA/Exp × PCM	-1.513	-1.743**	-1.915**	-1.962**	0.305	0.176	-0.101	-0.082
	[0.966]	[0.819]	[0.744]	[0.896]	[0.617]	[0.639]	[0.660]	[0.659]
r ²	0.803	0.835	0.843	0.862	0.868	0.864	0.869	0.869
N	6431017	6430840	6256011	5806414	5737973	5603915	5603915	5603915

Notes: Country, industry and time dummies included. Normalised weighted regression with robust standard errors, clustered at industry, the weights are based on grossing-up factor for employees (from SES) normalised by the number of observation per country (see main text for the details); Specifications (1) – (8) with different set of control variables as in Table 2. *p ≤ .10, **p ≤ .05, ***p ≤ .01.

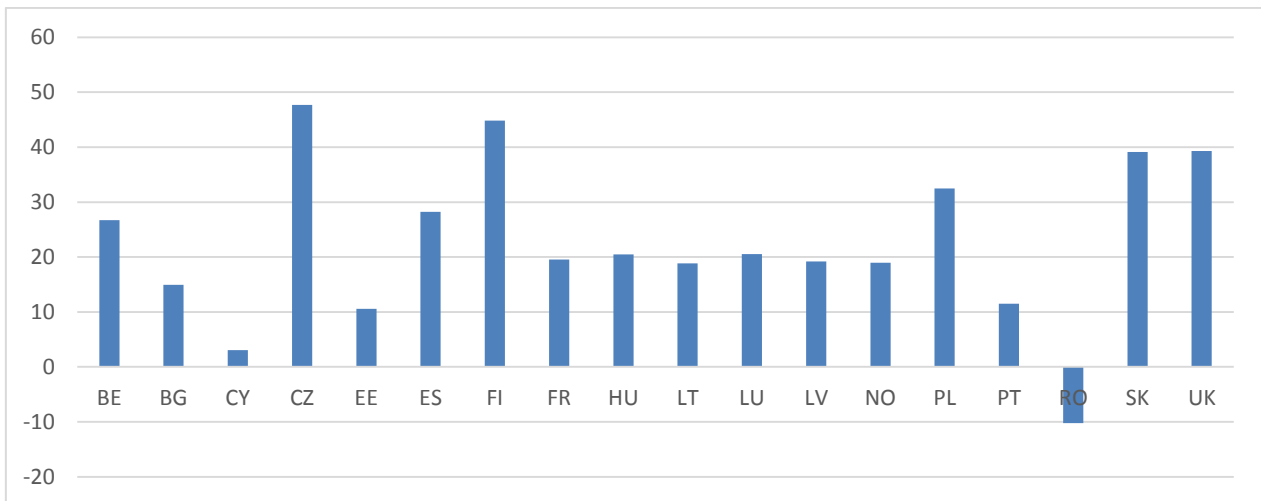
Source: own elaboration based on data from SES and WIOD

Appendix

Table A1. List of countries

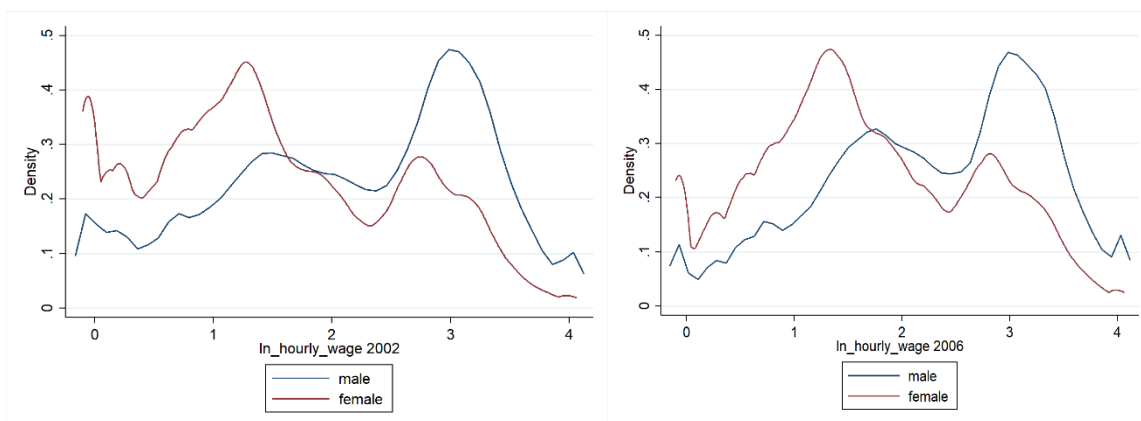
<i>Country code</i>	<i>Country name</i>	<i>Country code</i>	<i>Country name</i>
BE	Belgium	LT	Lithuania
BG	Bulgaria	LU	Luxembourg
CY	Cyprus	LV	Latvia
CZ	Czech Republic	NO	Norway
EE	Estonia	PL	Poland
ES	Spain	PT	Portugal
FI	Finland	RO	Romania
FR	France	SK	Slovak Republic
HU	Hungary	UK	United Kingdom

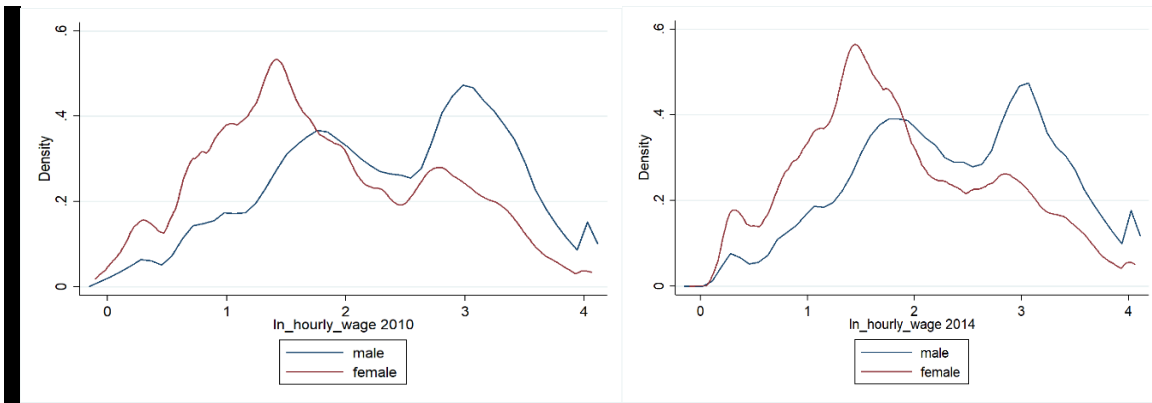
Fig. A1. Changes in the FVA/Exp over the time period 2002-2014 (in percentage).



Notes: mean values weighted by sectors' value added
 Source: own elaboration based on WIOD 2002, 2006, 2010, 2014.

Fig. A2. Distribution of logarithm of average hourly wage by gender and year.

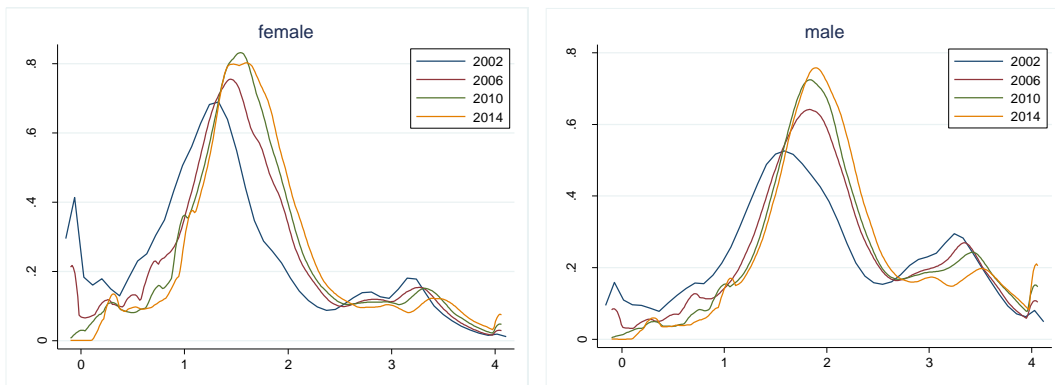




Notes: weights applied, based on grossing-up factor for employees (from SES).

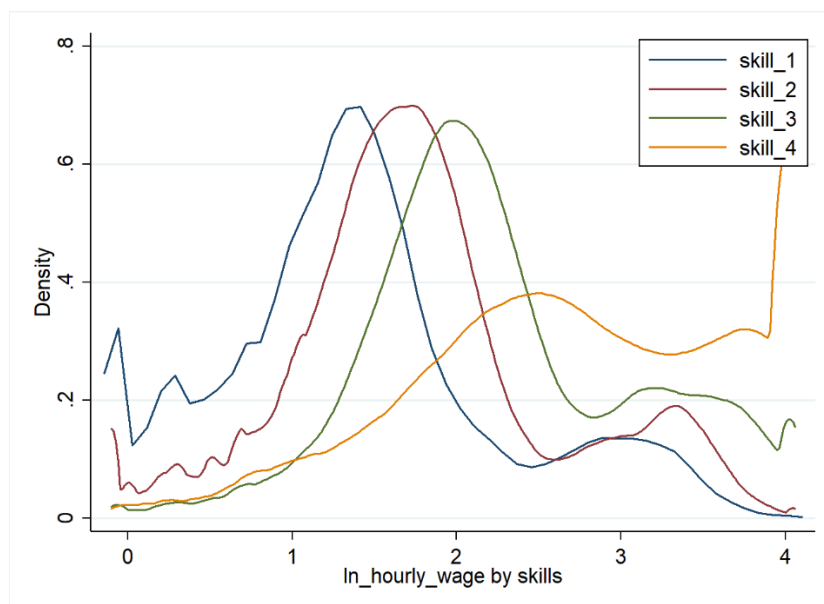
Source: own elaboration based on SES 2002, 2006, 2010, 2014.

Fig. A3. Distribution of the logarithm of hourly wage over the years, separately for men and women.



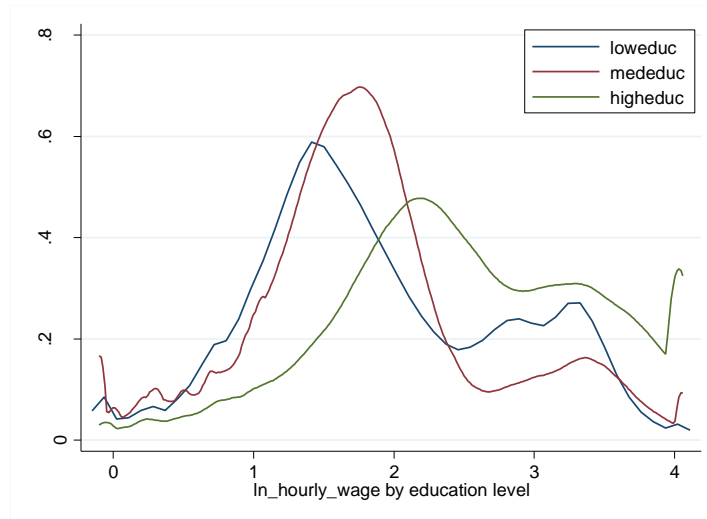
Source: own elaboration based on SES 2002, 2006, 2010, 2014.

Fig. A4. Distribution of the logarithm of hourly wage for different level of skills.



Source: own elaboration based on SES data for 2002, 2006, 2010 and 2014

Fig. A5. Distribution of the logarithm of hourly wage for different educational level.



Source: own elaboration based on SES data for 2002, 2006, 2010 and 2014

Supplementary materials to the paper:

“GVC involvement and the gender wage gap: micro - evidence for European countries”

[Not to be included in the main text]

Table S1. Estimation results – wage regression, including the interaction between Sex and OFF (eq.1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _{<i>i</i>}	0.173***	0.186***	0.176***	0.166***	0.141***	0.145***	0.140***	0.141***
	[0.027]	[0.022]	[0.021]	[0.019]	[0.010]	[0.010]	[0.010]	[0.010]
OFF _{<i>j</i>-1}	-0.098	-0.061	-0.046	-0.079	-0.237**	-0.238**	-0.181*	-0.188*
	[0.149]	[0.118]	[0.112]	[0.104]	[0.087]	[0.087]	[0.102]	[0.100]
Sex _{<i>i</i>} ×OFF _{<i>j</i>-1}	0.087	0.06	0.071	0.043	0.126***	0.112***	0.135***	0.134***
	[0.102]	[0.073]	[0.070]	[0.061]	[0.037]	[0.038]	[0.039]	[0.040]
ageyoung _{<i>it</i>}		-0.220***	-0.119***	-0.078***	-0.065***	-0.064***	-0.061***	-0.061***
		[0.015]	[0.010]	[0.006]	[0.008]	[0.008]	[0.008]	[0.008]
ageaverage _{<i>it</i>}		-0.043***	-0.020***	-0.009**	0.000	0.000	0.003	0.003
		[0.007]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
loweduc _{<i>it</i>}		-0.541***	-0.531***	-0.227***	-0.219***	-0.217***	-0.217***	-0.217***
		[0.018]	[0.018]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
mededuc _{<i>it</i>}		-0.408***	-0.406***	-0.158***	-0.149***	-0.148***	-0.150***	-0.149***
		[0.016]	[0.016]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
indefinite _{<i>it</i>}			0.086***	0.066***	0.084***	0.081***	0.079***	0.078***
			[0.011]	[0.011]	[0.011]	[0.011]	[0.010]	[0.010]
shortdur _{<i>it</i>}			-0.217***	-0.191***	-0.147***	-0.149***	-0.153***	-0.153***
			[0.013]	[0.012]	[0.007]	[0.007]	[0.008]	[0.008]
meddur _{<i>it</i>}			-0.135***	-0.118***	-0.084***	-0.084***	-0.085***	-0.085***
			[0.012]	[0.012]	[0.007]	[0.008]	[0.008]	[0.008]
full time _{<i>it</i>}			0.067***	0.044***	0.006	0.008	0.008	0.007
			[0.010]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
skill_1 _{<i>it</i>}				-0.698***	-0.704***	-0.709***	-0.712***	-0.712***
				[0.013]	[0.013]	[0.013]	[0.012]	[0.012]
skill_2 _{<i>it</i>}				-0.568***	-0.571***	-0.575***	-0.575***	-0.575***
				[0.012]	[0.011]	[0.012]	[0.011]	[0.011]
skill_3 _{<i>it</i>}				-0.357***	-0.372***	-0.374***	-0.371***	-0.371***
				[0.012]	[0.011]	[0.011]	[0.011]	[0.011]
size_small _{<i>it</i>}					-0.304***	-0.307***	-0.313***	-0.314***
					[0.024]	[0.024]	[0.022]	[0.022]
size_medium _{<i>it</i>}					-0.128***	-0.130***	-0.133***	-0.133***
					[0.014]	[0.014]	[0.013]	[0.013]
public _{<i>it</i>}					0.017	0.02	0.035	0.036
					[0.026]	[0.026]	[0.025]	[0.025]

nationagr _{it}						0.02	-0.015	-0.018
						[0.018]	[0.016]	[0.016]
industagr _{it}						-0.033***	-0.033***	-0.034***
						[0.008]	[0.008]	[0.008]
ln_H_EMPE _{jt}							-0.027**	-0.027**
							[0.011]	[0.011]
PCM _{jt}							0.04	0.038
							[0.131]	[0.126]
Coordination of wage-setting _{ct}							-0.068***	-0.072***
							[0.011]	[0.012]
ln_GDPpc _{ct}							0.687***	0.691***
							[0.026]	[0.029]
Exp/GDP _{ct}							0.194***	
							[0.045]	
Imp/GDP _{ct}								0.256***
								[0.045]
R ²	0.803	0.835	0.843	0.862	0.868	0.864	0.869	0.869
N	6431017	6430840	6256011	5806414	5737973	5603915	5603915	5603915

Notes: as under Table 2

Source: own elaboration based on data from SES and WIOD

Table S2. Estimation results– wage regression, including the interaction between Sex and OFF, workers with different education levels

	Low education		Medium education		High education	
	(1)	(2)	(3)	(4)	(5)	(6)
Sex _i	0.164***	0.171***	0.165***	0.133***	0.156***	0.128***
	[0.017]	[0.013]	[0.022]	[0.011]	[0.024]	[0.020]
OFF _{jt-1}	-0.1	-0.052	-0.166	-0.276**	0.151	0.092
	[0.134]	[0.148]	[0.111]	[0.101]	[0.094]	[0.104]
Sex _i ×OFF _{jt-1}	0.084	0.004	0.062	0.173***	-0.055	0.037
	[0.058]	[0.066]	[0.047]	[0.049]	[0.073]	[0.069]
Personal and job controls	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes
R ²	0.875	0.882	0.877	0.876	0.783	0.791
N	1068089	1018340	4190660	4064459	547665	521116

Notes: as under Table 3

Source: own elaboration based on data from SES and WIOD

Table S3. Estimation results– wage regression, including the interaction between Sex and OFF, workers with different skills levels

	Skill_1		Skill_2		Skill_3		Skill_4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _i	0.130***	0.103***	0.164***	0.143***	0.164***	0.141***	0.158***	0.161***
	[0.018]	[0.009]	[0.019]	[0.009]	[0.018]	[0.014]	[0.024]	[0.024]
OFF _{jt-1}	-0.05	-0.114	-0.168	-0.235*	0.133	0.036	0.174	0.104
	[0.154]	[0.117]	[0.114]	[0.113]	[0.106]	[0.111]	[0.119]	[0.104]
Sex _i ×OFF _{jt-1}	0.015	0.052	0.074	0.145***	0.023	0.103**	-0.024	-0.029
	[0.035]	[0.032]	[0.056]	[0.034]	[0.065]	[0.044]	[0.069]	[0.069]
Personal and job controls	yes	yes	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes	yes	yes
R ²	0.896	0.892	0.875	0.875	0.83	0.837	0.767	0.778
N	460475	443230	4162028	4018923	871006	841657	726899	702068

Notes: as under Table 4

Source: own elaboration based on data from SES and WIOD

Table S4. Estimation results– wage regression, including the interaction between Sex and OFF, workers from different occupations

	Occupations: 1 – digit ISCO-08 classification								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sex _i	0.131***	0.133***	0.164***	0.148***	0.267***	0.097***	0.171***	0.116***	0.130***
	[0.038]	[0.014]	[0.018]	[0.014]	[0.026]	[0.029]	[0.029]	[0.016]	[0.018]
OFF _{jt-1}	0.083	0.258**	0.133	0.165**	0.067	-0.483	-0.225*	-0.355***	-0.05
	[0.170]	[0.116]	[0.106]	[0.075]	[0.119]	[0.646]	[0.125]	[0.124]	[0.154]
Sex _i ×OFF _{jt-1}	-0.02	-0.023	0.023	-0.042	-0.153**	-0.311	0.111	0.255***	0.015
	[0.126]	[0.036]	[0.065]	[0.049]	[0.067]	[0.187]	[0.075]	[0.052]	[0.035]
R ²	0.735	0.824	0.83	0.861	0.897	0.875	0.865	0.888	0.896
N	312905	413994	871006	308776	113406	5388	1801823	1932635	460475

Notes: as under Table 5

Source: own elaboration based on data from SES and WIOD

Table S5. Estimation results – wage regression, wages expressed in USD PPP (eq.1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _i	0.130***	0.154***	0.139***	0.136***	0.133***	0.140***	0.127***	0.127***
	[0.024]	[0.017]	[0.015]	[0.014]	[0.011]	[0.011]	[0.010]	[0.010]
FVA/Exp _{jt-1}	-0.423*	-0.372*	-0.366**	-0.361**	-0.524***	-0.510***	-0.385**	-0.398**

	[0.212]	[0.184]	[0.172]	[0.171]	[0.144]	[0.146]	[0.161]	[0.161]
Sex _{<i>i</i>} ×FVA/Exp _{<i>jt-1</i>}	0.243***	0.172***	0.203***	0.148***	0.145**	0.120**	0.177***	0.175***
	[0.080]	[0.056]	[0.051]	[0.045]	[0.052]	[0.053]	[0.049]	[0.050]
ageyoung _{<i>it</i>}		-0.219***	-0.118***	-0.078***	-0.065***	-0.064***	-0.061***	-0.061***
		[0.014]	[0.009]	[0.006]	[0.007]	[0.008]	[0.008]	[0.008]
ageaverage _{<i>it</i>}		-0.042***	-0.019***	-0.008**	0.000	0.001	0.004	0.004
		[0.006]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
loweduc _{<i>it</i>}		-0.535***	-0.525***	-0.224***	-0.215***	-0.213***	-0.213***	-0.213***
		[0.018]	[0.017]	[0.010]	[0.009]	[0.009]	[0.009]	[0.009]
mededuc _{<i>it</i>}		-0.402***	-0.401***	-0.154***	-0.145***	-0.145***	-0.146***	-0.146***
		[0.015]	[0.015]	[0.010]	[0.008]	[0.008]	[0.008]	[0.008]
indefinite _{<i>it</i>}			0.086***	0.065***	0.083***	0.081***	0.078***	0.078***
			[0.011]	[0.011]	[0.011]	[0.011]	[0.010]	[0.010]
shortdur _{<i>it</i>}			-0.217***	-0.192***	-0.148***	-0.150***	-0.154***	-0.153***
			[0.012]	[0.012]	[0.007]	[0.007]	[0.008]	[0.008]
meddur _{<i>it</i>}			-0.134***	-0.118***	-0.084***	-0.085***	-0.085***	-0.085***
			[0.012]	[0.012]	[0.007]	[0.007]	[0.008]	[0.008]
full time _{<i>it</i>}			0.068***	0.045***	0.008	0.009	0.009	0.008
			[0.010]	[0.011]	[0.009]	[0.009]	[0.009]	[0.009]
skill_1 _{<i>it</i>}				-0.688***	-0.695***	-0.699***	-0.702***	-0.702***
				[0.012]	[0.013]	[0.013]	[0.012]	[0.012]
skill_2 _{<i>it</i>}				-0.556***	-0.560***	-0.563***	-0.563***	-0.563***
				[0.011]	[0.011]	[0.011]	[0.011]	[0.011]
skill_3 _{<i>it</i>}				-0.344***	-0.360***	-0.361***	-0.358***	-0.358***
				[0.011]	[0.010]	[0.011]	[0.010]	[0.010]
size_small _{<i>it</i>}					-0.304***	-0.307***	-0.313***	-0.313***
					[0.024]	[0.024]	[0.021]	[0.021]
size_medium _{<i>it</i>}					-0.129***	-0.131***	-0.134***	-0.134***
					[0.014]	[0.014]	[0.013]	[0.013]
public _{<i>it</i>}					0.018	0.022	0.037	0.037
					[0.026]	[0.026]	[0.026]	[0.026]
nationagr _{<i>it</i>}						0.022	-0.014	-0.017
						[0.019]	[0.017]	[0.017]
industagr _{<i>it</i>}						-0.031***	-0.032***	-0.033***
						[0.008]	[0.008]	[0.008]
ln_H_EMPE _{<i>jt</i>}							-0.025**	-0.026**
							[0.011]	[0.011]
PCM _{<i>jt</i>}							0.104	0.105
							[0.118]	[0.115]
Coordination of wage-setting _{<i>ct</i>}							-0.067***	-0.071***
							[0.011]	[0.012]
ln_GDPpc _{<i>ct</i>}							0.174***	
							[0.043]	
Exp/GDP _{<i>ct</i>}							0.695***	0.696***
							[0.025]	[0.027]
Imp/GDP _{<i>ct</i>}								0.241***

								[0.043]
R ²	0.64	0.699	0.713	0.744	0.759	0.755	0.764	0.764
N	6431017	6430840	6256011	5806414	5737973	5603915	5603915	5603915

Notes: as under Table 2

Source: own elaboration based on data from SES and WIOD

Table S6. Estimation results– wage regression: workers with different education levels, wages expressed in USD PPP

	Low education		Medium education		High education	
	(1)	(2)	(3)	(4)	(5)	(6)
Sex _{<i>t</i>}	0.135***	0.173***	0.133***	0.124***	0.103***	0.087***
	[0.018]	[0.016]	[0.013]	[0.010]	[0.021]	[0.018]
FVA/Exp _{<i>t-1</i>}	-0.092	-0.037	-0.441**	-0.490***	-0.132	-0.158
	[0.179]	[0.193]	[0.177]	[0.160]	[0.171]	[0.147]
Sex _{<i>t</i>} ×FVA/Exp _{<i>t-1</i>}	0.192***	-0.006	0.175***	0.200***	0.129*	0.176**
	[0.058]	[0.066]	[0.047]	[0.049]	[0.072]	[0.068]
Personal and job controls	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes
R ²	0.763	0.778	0.761	0.768	0.645	0.662
N	1068089	1018340	4190660	4064459	547665	521116

Notes: as under Table 3

Source: own elaboration based on data from SES and WIOD

Table S7. Estimation results– wage regression: workers with different skills levels, wages expressed in USD PPP

	Skill_1		Skill_2		Skill_3		Skill_4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sex _{<i>t</i>}	0.110***	0.114***	0.133***	0.134***	0.130***	0.120***	0.111***	0.126***
	[0.022]	[0.023]	[0.012]	[0.010]	[0.020]	[0.017]	[0.024]	[0.020]
FVA/Exp _{<i>t-1</i>}	0.128	-0.053	-0.439**	-0.430**	-0.199	-0.249	-0.262	-0.193
	[0.230]	[0.151]	[0.177]	[0.173]	[0.186]	[0.171]	[0.153]	[0.139]
Sex _{<i>t</i>} ×FVA/Exp _{<i>t-1</i>}	0.09	0.002	0.187***	0.169***	0.150*	0.181***	0.134	0.085
	[0.067]	[0.085]	[0.041]	[0.051]	[0.075]	[0.063]	[0.085]	[0.077]
Personal and job controls	yes	yes	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes	yes	yes
R ²	0.792	0.788	0.75	0.758	0.663	0.68	0.606	0.629
N	460475	443230	4162028	4018923	871006	841657	726899	702068

Notes: as under Table 4

Source: own elaboration based on data from SES and WIOD

Table S8. Estimation results– wage regression: workers from different occupations, wages expressed in USD PPP

	Occupations: 1 – digit ISCO-08 classification								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sex _{<i>i</i>}	0.060**	0.140***	0.130***	0.137***	0.257***	0.159	0.169***	0.107***	0.110***
	[0.028]	[0.020]	[0.020]	[0.018]	[0.028]	[0.094]	[0.028]	[0.025]	[0.022]
FVA/Exp _{<i>i,t-1</i>}	-0.313	-0.061	-0.199	-0.145	0.128	-1.728**	-0.432**	-0.559**	0.128
	[0.218]	[0.159]	[0.186]	[0.099]	[0.092]	[0.689]	[0.167]	[0.200]	[0.230]
Sex _{<i>i</i>} × FVA/Exp _{<i>i,t-1</i>}	0.216*	-0.05	0.150*	-0.003	-0.088	-0.505	0.105	0.279***	0.09
	[0.107]	[0.068]	[0.075]	[0.064]	[0.094]	[0.362]	[0.071]	[0.087]	[0.067]
R ²	0.581	0.674	0.663	0.723	0.798	0.765	0.741	0.767	0.792
N	312905	413994	871006	308776	113406	5388	1801823	1932635	460475

Notes: as under Table 5.

Source: own elaboration based on data from SES and WIOD

Table S9. Estimation results – wage regression, with additional country variable describing labour market arrangements

	(1)	(2)	(3)	(4)	(5)	(6)
Sex _{<i>i</i>}	0.125***	0.126***	0.125***	0.126***	0.125***	0.125***
	[0.012]	[0.010]	[0.011]	[0.010]	[0.012]	[0.010]
FVA/Exp _{<i>i,t-1</i>}	-0.374**	-0.424**	-0.384**	-0.433**	-0.390**	-0.459***
	[0.164]	[0.152]	[0.164]	[0.154]	[0.166]	[0.152]
Sex _{<i>i</i>} ×FVA/Exp _{<i>i,t-1</i>}	0.198***	0.184***	0.198***	0.184***	0.200***	0.185***
	[0.038]	[0.049]	[0.038]	[0.049]	[0.038]	[0.049]
<i>Clauses in collective agreement</i>	-0.011	-0.019				
	[0.010]	[0.012]				
<i>Wage bargaining</i>			0.061***	0.064***		
			[0.019]	[0.018]		
<i>Articulation of enterprise bargaining</i>					0.035**	0.068***
					[0.015]	[0.012]
Personal and job controls	yes	yes	yes	yes	yes	yes
Firm controls	no	yes	no	yes	no	yes
Sector and country controls	yes	yes	yes	yes	yes	yes
R ²	0.867	0.869	0.867	0.869	0.867	0.869
N	5806414	5603915	5806414	5603915	5806414	5603915

Notes: as under Table 2. *Clauses in collective agreement*: 1 - agreements contain general opening clauses, defined as renegotiation of contractual provisions at lower levels, under specified conditions, 0 - agreements contain no opening clauses
Wage bargaining: 1 - wage bargaining at company level, 0 - predominantly industry-wide and centralised bargaining
Articulation of enterprise bargaining: 1- supplementary enterprise wage bargaining is informal and prohibited or restricted by law or sectoral agreement, or where it is recognized but under trade union control, 0 - additional enterprise wage bargaining, when it occurs, is formally or informally conducted also by non-union bodies or where the articulation does not apply.

Source: own elaboration based on data from SES and WIOD

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Gdańsk University of Technology, Faculty of Management and Economics
Narutowicza 11/12, (premises at ul. Traugutta 79)
80-233 Gdańsk, phone: 58 347-18-99 Fax 58 347-18-61
www.zie.pg.edu.pl

