

Global value chains and wages under different wage setting mechanisms

Joanna Wolszczak-Derlacz, Dagmara Nikulin and Sabina Szymczak

Faculty of Management and Economics, Gdańsk University of Technology

Joanna Wolszczak-Derlacz, ORCID ID: 0000-0002-3392-5267, e-mail: jwo@zie.pg.gda.pl
(corresponding author)

Dagmara Nikulin, ORCID ID: 0000-0002-0534-4553, e-mail: dnikulin@zie.pg.gda.pl

Sabina Szymczak, ORCID ID: 0000-0001-8690-0891, e-mail: sabina.szymczak@pg.edu.pl

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Abstract

This study examines whether, and how, differences in wage bargaining schemes shape the relationship between global value chains (GVCs) and the wages of workers while considering both GVC participation and position in GVC. Our dataset is derived from the European Structure of Earnings Survey (SES), containing employee–employer data from 18 European countries, merged with sectoral data from the World Input-Output Database (WIOD). The results of an augmented Mincer-type regression show that under national and industry wage bargaining schemes, greater participation in GVCs is associated with lower wages, whereas no adverse impact from GVCs is observed for workers under enterprise bargaining schemes. Finally, numerous extensions and instrumental variable estimations confirm that the type of collective pay agreement may alter the response of wages to both GVC participation and position.

Keywords: wage bargaining, wages, global value chains, collective bargaining, enterprise bargaining

1. Introduction

Labour market institutions significantly influence the determination of workers' wages. Collective wage bargaining, trade union density, active labour market policies, and the minimum wages are among the key factors in the complex wage-setting mechanism in developed and developing countries. In Europe, about two-thirds of workers are covered by collective bargaining schemes, implying that their wages are impacted by those institutional mechanisms (Schulten, 2016). From a global perspective, there is significant heterogeneity in institutional settings, including wage bargaining structures across countries. Card and Cardoso (2022) note the major difference between European countries and the United States. If a wage increase is negotiated in the United States, it results in a wage increase for all employees in the same job. By contrast, in European countries,



pay agreements are often established for different occupational groups, and only a wage floor is set. The wages proposed by an employer may thus be higher than those established by a collective pay agreement, with such ‘wage cushions’ resulting in considerable wage flexibility but greater wage inequality (Card and Cardoso, 2022).

After the global financial crisis in 2007, emphasis was placed on decentralising the wage bargaining process in Europe, resulting in greater flexibility in wage determination. The primary objective was to enable local bargaining, which could respond to rising global competition more efficiently than the national one (Eurofound, 2015, 2020). However, trade unions argued that only centralised bargaining schemes guaranteed fair competition as well as decent wages and working conditions (Eurofound, 2015). Against this background, the development patterns across European countries differ, although a visible trend towards organised decentralisation is observed, with higher-level collective pay agreements supported by company-level agreements (Eurofound, 2020).

Furthermore, changes in international trade processes, including the fragmentation of global production captured by global value chains (GVCs), impact labour market outcomes, including wages (Bernhardt and Pollak, 2016; Geishecker et al., 2010; Parteka and Wolszczak-Derlacz, 2019). As Flecker (2009) argues, on the one hand, industrial relations in the labour market may be significantly affected by fragmented production processes because outsourcing activities facilitate deregulation and decentralised bargaining schemes. On the other hand, institutions may moderate the GVC–wages link and either enhance or diminish the impact of GVCs on wages (Boeri et al., 2001; Nickell and Layard, 1999; Nunziata, 2005) following, for instance, international economic shocks and changes in domestic labour market conditions.

This study investigates the relationships among GVCs, wage bargaining schemes, and wages to determine how GVC participation and GVC position affect wages across different wage bargaining schemes. Although many studies have examined the associations between wage bargaining schemes and wages (e.g. Card and Cardoso, 2022; European Commission, 2015;

OECD, 2014) and between GVCs and wages (e.g. Bernhardt and Pollak, 2016; Geishecker et al., 2010), there is relatively little evidence that simultaneously links these three variables (see: Las Heras, 2018; Luo and Yang, 2020). Moreover, the existing evidence is country-specific or based on value chains from one industry.

In contrast to previous studies, we conduct a cross-country study. We use a rich database derived from the 2014 European Structure of Earnings Survey (SES) containing employee–employer data from 18 European countries and almost nine million observations (Table 1 lists the sample countries). To investigate the association between GVCs and wages, we merge the SES database with sectoral data from the 2016 World Input-Output Database (WIOD). Moreover, because we are interested in the role of wage bargaining schemes in the above association, we focus on different levels of collective pay agreements (measured at the worker level and obtained from SES) and country-level data describing the wage bargaining scheme derived from the Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts (ICTWSS) database. We also control for the potential endogeneity of the GVC measures, using the instrumental approach proposed by Autor et al. (2013). Additionally, we perform several robustness checks to observe the patterns for different groups of countries, and to control for both sectoral characteristics (capital intensity) as well as country level variables (national minimum wage, minimum wage setting, and trade union density).

Based on the literature (see next section) and different associations among wages, GVCs, and wage bargaining schemes, we formulate the following research questions:

- i. What is the association between workers' wages and different wage bargaining schemes?
- ii. What is the impact of GVC participation on wages? Does it depend on the degree of wage coordination?
- iii. Do the linkages among wages and wage bargaining schemes depend on the position in the GVC (e.g. the upstreamness of a given sector)?

Our results show the different effects of GVCs on wages when wage bargaining schemes are considered. In general, for national collective pay agreements, a negative association between participation in GVCs and wages is observed. In turn, for less centralised bargaining such as those based on enterprise-level agreements, higher GVC participation is positively associated with wages. Moreover, we find some evidence for an unequal ('smile curve'-shaped) wage distribution along the GVC; however, its presence depends on the type of collective pay agreement and is observed only for more centralised systems.

The remainder of this paper is organised as follows. First, we provide the theoretical background and describe previous studies on the relationships among wage bargaining schemes, wages, GVC participation, and GVC position. Next, we present the data and methodology applied to address the research questions, followed by the baseline results, extensions, and robustness checks. Finally, we conclude the study with recommendations for future research.

2. Wages, wage bargaining schemes, and GVCs

Institutional factors may impact wages through different channels, including the bargaining power of trade unions and degree of coordination in wage bargaining (Nunziata, 2005). As this study focuses on wage bargaining schemes (different collective pay agreements) and their association with wages and GVCs, the literature review is limited to these aspects.

A general question is whether greater centralisation or decentralisation of wage bargaining helps improve labour market outcomes. A starting point in this matter is provided by the theoretical frameworks developed by Calmfors and Driffill (1988), who hypothesise that economic performance (in the form of country employment level) is better in decentralised or centralised collective bargaining structures, while the intermediate degrees of centralisation worsen performance. Moreover, based on a sample of OECD countries with data from the 1970s and 1980s, the authors confirm the hump-shaped relationship between the aggregate real wage level and the extent of centralisation. In other words, they argue that industry level pay agreements

schemes are least conducive to wage restraints, thereby assuming that ‘extremes work the best’. This is because in centralised bargaining schemes, inflation and unemployment may restrict wages, whereas for agreements at the firm/plant level, the market and competitive power may affect wages. This results in higher wages in economies that set pay agreements at the industry level. According to Boeri et al. (2001), a hump-shaped relationship between the degree of coordination/centralisation and wages is just one of two hypotheses presented in the literature, both of which are supported by empirical evidence. The second one, called the monotonic relationship hypothesis, states that higher coordination moderates wages, as ‘a number of negative externalities of wage increases in individual bargaining areas can be internalized’¹ (Boeri et al., 2001, p. 7). For instance, given a wage increase in one part of the economy, the price of the consumption basket will increase, resulting in externalities for the remainder of the economy, whose real wages will fall. Therefore, if wages are coordinated centrally, these externalities are minimised. In summary, a link between high centralisation/coordination and wage moderation is expected, while the theoretical and empirical literature is inconclusive about the effects of lower levels of pay agreements.

Following the assumption of Calmfors and Driffill (1988), many empirical studies have attempted to verify their hypotheses. However, to draw conclusions, empirical evidence must be read in light of the sample countries and study period. For European countries, wages are supposed to rise along with the decentralisation of wage bargaining schemes (for a review, see European Commission, 2015), particularly if sectoral agreements are implemented; thus, closer links with productivity may result in higher wages (Eurofound, 2014; Gerlach and Stephan, 2006). Using a sample of OECD countries between 1960 and 1994, Nunziata (2005) shows that the wages of workers covered by sectoral agreements tend to differ, as employers have the flexibility to set wage cushions for certain employees, which enhances wage gaps (see Card and Cardoso, 2022 for Portugal). Furthermore, the evidence from France (Avouyi-Dovi et al., 2013) shows that most industry-level pay agreements are made in small companies, where wages are lower (and closer to

the national minimum wage). In other words, wages are higher if negotiations occur at the enterprise level, which usually occurs in large firms (Avouyi-Dovi et al., 2013). Based on a sample of 24 European countries, Schäfer and Gottschall (2015) reveal that in countries with more centralised bargaining schemes, hourly gross earnings for full-time employees are higher. Hence, drawing a straightforward conclusion on the linkages between wage bargaining schemes and wage determination is not possible owing to the different associations between particular bargaining mechanisms and economic outcomes by country and the study period (European Commission, 2015).

Next, extensive empirical evidence of how GVCs affect European wages is available both for developed and developing countries (e.g. Bernhardt and Pollak, 2016; Geishecker et al., 2010; Szymczak and Wolszczak-Derlacz, 2022; Lee and Gereffi, 2013). One finding is that the impact of GVCs on wages is not straightforward and that differences in the response of wages to GVC participation can be explained by country-, sector-, and occupation-specific features. Interestingly, Szymczak and Wolszczak-Derlacz (2022) shows that the GVC's effect on the labour market (earnings and employment) differs from that of traditional trade, where the production process does not cross national borders. They argue that the effect of GVCs on earnings and employment is more complex than that of traditional trade, where the decrease (increase) in employment and domestic workers' wages due to a decrease (increase) in demand for work is explained by, for instance, increased imports (exports) and substitution effects (scale effects).

Although the mechanisms linking the degree of centralisation in wage bargaining and wages are well described in the literature, empirical studies (especially quantitative studies) that consider GVC linkages are scarce. For internationally competing firms, collective bargaining is just one of the many forces shaping wages, as those firms must also consider, for example, factors such as wage competition from foreign firms. Fairtrade initiatives adapted by brand name companies may force suppliers in the value chain to respect certain standards of working conditions, such as for instance, allowing effective collective bargaining (Miller and Williams, 2009). Thus, wage

bargaining can also be an important intervening factor in the impact of GVCs on wages and a factor that should be considered in obtaining a true picture of the GVC–wage nexus.

Indeed, empirical evidence linking the impact of wage bargaining mechanisms with wage determination and GVC participation is rather fragmented. Nickell and Layard (1999) relate higher wage bargaining coordination/centralisation² to more resistance of company/industry-level wages to company/industry-level economic shocks, which are more likely to occur in firms/industries engaged in GVCs. Moreover, wage setting at the national level makes average wages more dependent on the general conditions of the domestic labour market, which may again weaken the wage impact of GVC activities by a firm or sector. Here, the relationship is twofold, implying that increased international competition forces companies to consider wage competition from foreign firms as well; hence, the benefits of higher-level (national or sectoral) collective pay agreements may lose some of their relevance (Boeri et al., 2001). Felbermayr et al. (2014) indicate the possible negative effect of exports on workers' wages under collective pay agreements (at the industry and firm levels). This mechanism, derived from previous theoretical contributions and confirmed in their study of German employer–employee data, is explained by wage bargaining demands being lowered owing to the threat of job losses. In general, the greater fragmentation of the production process weakens the impact of wage bargaining due to increased competition and the greater distance between the leading firm (which has the power to share profits) and its suppliers (Milberg and Winkler, 2010). In a qualitative study of firms in southern China, Luo and Yang (2020) observe another example of the GVC–wages–institutions nexus. They find that the effectiveness of collective bargaining may depend on the value chain structure. For less critical suppliers³, collective bargaining may have a lesser impact on wages than that for the critical participants of a GVC⁴.

Referring to the measure of upstreamness proposed by Antràs et al. (2012), which approximates the sector's average distance from final demand in the global production chain, the relative position in the GVC may play an important role in wage determination. Originally, the concept of the 'smile curve' is related to the fact that the value-added of a firm/sector is

concentrated higher upstream (at the beginning of the production process) or at a downstream position in the chain (close to final demand) because of the different characteristics of the stages along the production chain. The ends of the chain (close to either the producer or the consumer) often involve more R&D activities, whereas the middle parts contain fewer intense but relatively uncomplex manufacturing tasks such as assembly. This concept of the unequal distribution of value-added can be applied in studies of wages (Gagliardi et al., 2021; Mahy et al., 2019; Szymczak et al., 2022). This is because a higher value-added in a given stage of production may translate to higher wages for those employees engaged in this part of the production process. Gagliardi et al. (2021) analyse the case of Belgian manufacturing using a firm-level measure of upstreamness and find a positive relationship between more upstream positions and wages; however, differences are also found by gender and wage levels. Similar settings and findings are presented by Mahy et al. (2019). Szymczak et al. (2022) investigate the ‘smile curve’ assumption for workers in central and eastern European countries. They obtain the characteristic U-shape in wages using the sectoral measure of upstreamness. However, the abovementioned studies do not examine how the position in GVCs may interact with the wage–wage bargaining linkage.

To summarise, our study builds on two branches of the theoretical literature. The first relates to the impact of international trade on wages. The theory here mentions a number of channels that may raise wages (e.g. productivity and scale effects) or lower wages (e.g. the substitution effect), leaving the final outcome unknown. The other stream of the literature includes studies addressing institutional factors, particularly wage bargaining schemes, and their significance in shaping wages. As noted above, the degree of centralisation of agreements may modify the response of wages to both macro- and micro-economic determinants, including issues related to firms’ activity in international markets. As the impact from wage bargaining agreements on wages is postulated to be strong (Nunziata, 2005) and the impact on wages caused by fragmented production processes may be moderated by institutional factors (Nickell and Layard, 1999), we discuss the interaction of these three concepts in our research.

3. Data and methodology

The data for this study is obtained from the SES,⁵ which provides harmonised microdata on earnings in European countries based on enterprise surveys collecting information on workers (e.g. sex, age, occupation, tenure, education) and the characteristics of firms (e.g. economic activity, size, location). We use the 2014 version of the SES (the latest survey available) and merged it with sectoral statistics based on factors such as the employee's industry and GVC measures derived and calculated from the 2016 release of the WIOD (Timmer et al., 2015). The matched data represent 46 (manufacturing and services) sectors⁶. Our final sample covers almost nine million workers from 18 European countries. GVC participation is measured in three ways: (i) through foreign value-added divided by exports (FVA_{exp}) following Wang, Wei and Zhu (2013); (ii) through the traditional offshoring measure, as proposed by Feenstra and Hanson (1999) and others; and through the global import intensity of production (GII), as formulated by Timmer et al. (2016).

Two measures are commonly used in the empirical studies of global value chains. Wang et al. (2013) decompose gross exports (of services and goods, both intermediate and final) separating the part dependent on foreign value added⁷. This is the value-added that crosses borders at least twice. Hence, it may be a good proxy for country-sector involvement in production fragmentation when used as a share of gross exports. The traditional offshoring measure (OFF) is the ratio of the value of imported intermediates to the industry's output. It can be interpreted as the share of imports used at the last stage of production in the value of the final product. Because of its simplicity, it may overlook a large part of the production fragmentation if it occurs at production stages further away from the final demand (Timmer et al., 2016). Therefore, we additionally employ GII , accounting for imports needed at all the production stages in the value chain and thus it is more adequate for measuring complex production processes⁸. The value of the index, ranging between 0 and 1, is interpreted as the share of all imports needed to produce the final product.

Additionally, we employ upstreamness (*UP*) as a measure of GVC position (Antràs et al., 2012). It is the average industry position in the GVC. It indicates how far a given sector is from final demand: in other words, the higher the upstreamness, the further away the industry is from final demand. Upstreamness is 1 in a strictly downstream industry (one whose output is the final good)⁹.

Among the SES variables, the ‘collective pay agreement’, which is the type of pay agreement covering 50% of the employees in the local unit, is used to represent the type of wage bargaining scheme. We recode the original seven classes of the variable (provided in the SES; see Eurostat, 2014) into the following four categories:

- i. National agreements (*Nationagr*), defined as agreements at the national level or interconfederation agreements covering the employees of more than one industry and usually signed by one or more trade union confederations as well as by one or more national employer organisations;
- ii. Industry agreements (*Industryagr*), defined as agreements that set the terms and conditions of employment for all or most workers in an industry or agreements for industries in certain regions;
- iii. Enterprise agreements (*Enterpagr*), defined as enterprise or single-employer agreements covering only the employees of that employer, agreements applying only to the employees in one local unit, and any other types of agreements;
- iv. No agreement (*Noagr*).

Approximately 41% of all workers in our sample work under no collective pay agreement, 28% under an enterprise agreement, 22% under an industry agreement, and 9% under a national agreement.

Table 1. Cross-country differences in collective pay agreements, % of workers under a particular agreement

	National	Industry	Enterprise	No agreement
Total	8.7	22	28.2	41
Belgium	13.3	67.1	19.6	0
Bulgaria	0	10.3	21.1	68.7
Czechia	0	3.9	63.4	32.8
Estonia	4.5	1.9	7.8	85.9
France	8.1	75.7	15	1.2
Germany	0	45.3	4.7	50
Hungary	0	1	3.2	95.8
Italy	100	0	0	0
Latvia	0.1	3.6	35.2	61.1
Lithuania	0	1.4	30.2	68.4
Netherlands	76.2	0	0	23.8
Norway	20.4	42.3	0	37.3
Poland	3.7	0	37.2	59.1
Portugal	41.4	1.1	41.2	16.2
Romania	17.8	6.8	69.8	5.6
Slovak Republic	0	41	36.4	22.6
Spain	0	65.8	24.9	9.4
United Kingdom	0	21	21.9	57

Source: own compilation based on SES 2014.

Table 1 presents the cross-country differences in this respect. In Italy, the Netherlands, and Portugal, national agreements are predominant; industry agreements cover the largest share of employees in Belgium, Spain, France, Norway, and Slovakia; and enterprise agreements dominate in the Czech Republic and Romania. However, most of the surveyed workers in Bulgaria, Germany, Estonia, Hungary, Lithuania, Latvia, Poland, and the United Kingdom are not covered by any agreement. Importantly, in some countries, there are two main types of collective pay agreements. For example, German workers are either covered by an industry agreement (45.3%) or not covered at all (50%). By contrast, in the Czech Republic, Lithuania, Latvia, and Poland, most workers are employed under an enterprise agreement or no pay agreement.

To address our research questions, especially considering that the type of pay agreement and GVC can impact wages, we propose the following augmented Mincer-type regression:

$$w_{ijsc} = \alpha + \beta_1 Ind_i + \beta_2 Firm_j + \beta_3 Sec_s + \beta_4 Nationagr_i + \beta_5 Industryagr_i + \beta_6 Enterpagr_i + \beta_7 GVC_{sc} + D_c + D_s + \varepsilon_{ijsc}, \quad (1)$$

where i represents the worker, j represents the company, s represents the employment sector, and c represents the country. The dependent variable is the logarithm (log) of average gross hourly earnings in the reference month expressed in USD. Ind is the vector of the employee's characteristics, including sex, age group, education, skill type, length of service in the enterprise, and type of contract (permanent/temporary, full-time job). $Firm$ represents the firm's characteristics (size, ownership (public/private)). Sec represents the sectoral variables, including log productivity, measured as value-added (VA_s) per hour worked ($HEMPE_s$): $VA_s/HEMPE_s$, and openness, calculated as exports to value-added. We include these additional sector covariates to ensure that when measuring the impact of GVCs, the results are not driven by other sector-specific characteristics and that these characteristics are cleaned out, (i.e. more open sectors with a higher share of exports to value-added may participate more in GVCs). The degree of collective pay agreement is a categorical variable with four categories: $Nationagr$, $Industryagr$, $Enterpagr$, and $Noagr$. This is incorporated into the regression as three dummies (no agreement is the reference category)¹⁰. GVC is one of the sectoral GVC measures (OFF , GII , or FVA_exp for GVC participation; UP for GVC position). Additionally, to limit omitted variable bias, we include country and sector fixed effects. Specifically, D_c gauges all other country-specific characteristics also connected with wage-setting mechanisms and institutional regulations, while D_s measures the remaining sectoral characteristics. Table 1A in the Online Appendix provides the descriptive statistics of the variables. Figure 1A presents the mean wages across the bargaining schemes, and Figure 2A illustrates wages against GVCs.

4. Results

We begin with OLS weighted regressions in which the weights are recalculated based on the grossing up factor in the SES. This is applied to the microdata to ensure population representativeness and aims to guarantee that employees from different countries are assigned the

same weight, ensuring that the estimations are not driven by countries with large numbers of observations, and that each country is equally represented.

Table 2. Estimation results – wage regression, dependent variable \ln_wage eq. (1)

	FVA_exp			OFF			GII		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Nationagr</i>	0.02 [0.016]	0.018 [0.015]	0.02 [0.016]	0.02 [0.016]	0.017 [0.016]	0.019 [0.016]	0.02 [0.016]	0.017 [0.015]	0.02 [0.016]
<i>Industryagr</i>	0.024*** [0.008]	0.019** [0.009]	0.021** [0.010]	0.022*** [0.008]	0.018* [0.009]	0.019** [0.009]	0.023*** [0.008]	0.018** [0.009]	0.020** [0.009]
<i>Enterppagr</i>	0.028* [0.014]	0.027* [0.014]	0.027* [0.014]	0.027* [0.014]	0.026* [0.014]	0.027* [0.014]	0.027* [0.014]	0.026* [0.014]	0.027* [0.014]
<i>GVC</i>	-0.051 [0.169]	-0.069 [0.171]	-0.067 [0.171]	0.116 [0.136]	0.118 [0.141]	0.118 [0.140]	0.028 [0.102]	0.032 [0.104]	0.032 [0.103]
R ²	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
N	8994939	8771189	8771189	9012265	8788515	8788515	9012265	8788515	8788515

Notes: Sectoral characteristics: log of productivity and export penetration included in all specifications. Personal characteristics (sex (1 if male), age: ageyoung (below 30), ageaverage (30-49), default/omitted category: ageold (50 and more), education (loweduc (less than primary, primary, lower secondary), mededuc (upper secondary and post-secondary), default: higheduc (tertiary education up to 4 years and more than 4 years)), Full time (1 if full-time employed), skills based on recoded occupation: skill_1 (elementary occupations), skill_2 (clerical support workers, service and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators, and assemblers), skill_3 (technicians and associate professionals), default: skill_4 (managers and professionals)) and firm characteristics (length of service in enterprise (shordur (less than 1 year), meddur (1-4 years), default: longdur (more than 4 years)), collective pay agreement (nationagr, industryagr, enterppagr, default: no agreement) included in all specifications, in Column (1), (4), (7) additional firm characteristics: size of the enterprise (small (1-49 employees), medium (50-249), default: large (250 and more)) in Column (2), (5), (8): small, medium, form of economic and financial control (public, default: private); in Columns (3), (6) and (9): small, medium, public, type of the employment contract (temporary, default: permanent). *GVC* represents *FVA_exp* in Columns (1) to (3); *OFF* in Columns (4) to (6); and *GII* in Columns (7) to (9). Constant, country and sector dummies included. Normalized weighted regression with robust standard errors clustered at the sector level (in parentheses), the weights are based on the grossing-up factor for employees (from SES) normalised by the number of observations per country (see main text for details); *p ≤ .10, **p ≤ .05, ***p ≤ .01.

Source: own elaboration based on data from SES and WIOD.

Table 2 presents the results of regression (1). Owing to space limitations, it presents only the variables of greatest interest (Table 2A in the Online Appendix presents the results for the full set of regressors). The characteristics of workers and company factors are significantly correlated with their wages; women and younger workers receive lower wages on average, as do those with a lower level of education and skills, in line with the human capital theory (Mincer, 1981). Further, those from smaller units, working part-time, working under temporary contracts, and with fewer years of experience in a particular enterprise, earn lower wages. Meanwhile, workers employed in more productive sectors obtain higher wages on average. Workers covered by any type of collective

pay agreement typically receive higher wages than those under no such agreement. However, for centralised bargaining schemes, this association is not statistically significant, and the largest impact is on wages negotiated at the enterprise level. These results are in line with the hypothesis of the monotonic relationship between centralisation and wages (Boeri et al., 2001). Indeed, under industry- or enterprise-level wage bargaining agreements, the wage increase tends to be higher than that in productivity (Meager and Speckesser, 2011). As none of the GVC measures are statistically significantly correlated with workers' wages, this may partially confirm the evidence provided by Rodrik et al. (2004), whereby the sole influence of trade on wages may be negligible when controlling for the institutional impact¹¹.

In addition, assuming that variations in the type of pay agreement shape the labour outcomes of GVCs, we augment regression (1) with the interaction between collective pay agreements and GVCs as follows:

$$w_{ijsc} = \alpha + \beta_1 Ind_i + \beta_2 Firm_j + \beta_3 Sec_s + \beta_4 Nationagr_i + \beta_5 Industryagr_i + \beta_6 Enterpagr_i + \beta_7 GVC_{sc} + \beta_8 GVC \times Nationagr_i + \beta_9 GVC \times Industryagr_i + \beta_{10} GVC \times Enterpagr_i + D_c + D_s + \varepsilon_{ijsc}, \quad (2)$$

where the effect of GVCs on wages varies with the type of collective pay agreement. Specifically, the partial (marginal)¹² effect of GVCs on wages (holding all the other variables fixed) under national agreements is $\frac{\delta w}{\delta GVC} = \beta_7 + \beta_8$; for industry agreements, it is $\frac{\delta w}{\delta GVC} = \beta_7 + \beta_9$; and for enterprise agreements, it is $\frac{\delta w}{\delta GVC} = \beta_7 + \beta_{10}$. Table 3 presents the results (the results for all the control variables are similar to those presented in Table 2A; we do not report them owing to space constraints). Based on the interactions, we can conclude that under national and industry agreements, workers employed in sectors that participate more in GVCs receive lower wages than those without collective pay agreements, whereas the opposite is true for those covered by enterprise agreements.

Table 3. Estimation results – wage regression, including interaction between GVC and collective pay agreement as in eq. (2)

	FVA_exp			OFF			GII		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Nationagr</i>	0.059** [0.027]	0.056** [0.026]	0.060** [0.027]	0.042* [0.024]	0.040* [0.023]	0.043* [0.023]	0.051** [0.025]	0.049** [0.024]	0.053** [0.024]
<i>Industryagr</i>	0.046** [0.023]	0.050** [0.022]	0.054** [0.023]	0.037** [0.017]	0.038** [0.017]	0.041** [0.017]	0.043** [0.020]	0.046** [0.019]	0.050** [0.020]
<i>Enterpagr</i>	-0.003 [0.024]	0.00 [0.024]	0.002 [0.025]	0.005 [0.019]	0.007 [0.019]	0.008 [0.019]	-0.005 [0.021]	-0.002 [0.022]	0.00 [0.022]
<i>GVC</i>	-0.007 [0.178]	0.001 [0.182]	0.011 [0.182]	0.118 [0.142]	0.135 [0.147]	0.139 [0.146]	0.041 [0.105]	0.057 [0.107]	0.06 [0.107]
<i>GVC× Nationagr</i>	-0.330** [0.153]	-0.334** [0.147]	-0.351** [0.146]	-0.235* [0.134]	-0.240* [0.130]	-0.254* [0.130]	-0.147* [0.076]	-0.151** [0.073]	-0.160** [0.073]
<i>GVC× Industryagr</i>	-0.154 [0.134]	-0.218* [0.121]	-0.234* [0.123]	-0.114 [0.102]	-0.171* [0.091]	-0.181* [0.092]	-0.074 [0.060]	-0.107* [0.054]	-0.114** [0.055]
<i>GVC× Enterpagr</i>	0.189* [0.108]	0.157 [0.109]	0.15 [0.111]	0.158** [0.071]	0.131* [0.069]	0.125* [0.071]	0.106** [0.046]	0.090* [0.046]	0.085* [0.047]
R ²	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
N	8994939	8771189	8771189	9012265	8788515	8788515	9012265	8788515	8788515

Notes: as under Table 2.

Source: own elaboration based on data from SES and WIOD.

This is also shown in Figure 1, which presents the predicted wages over *FVA_exp* for the different wage bargaining agreements. The upper panel shows the predicted wages for national agreements compared with no agreement owing to changes in GVC participation, whereas the middle and lower panels illustrate the predicted wages for industry and enterprise agreements, respectively.

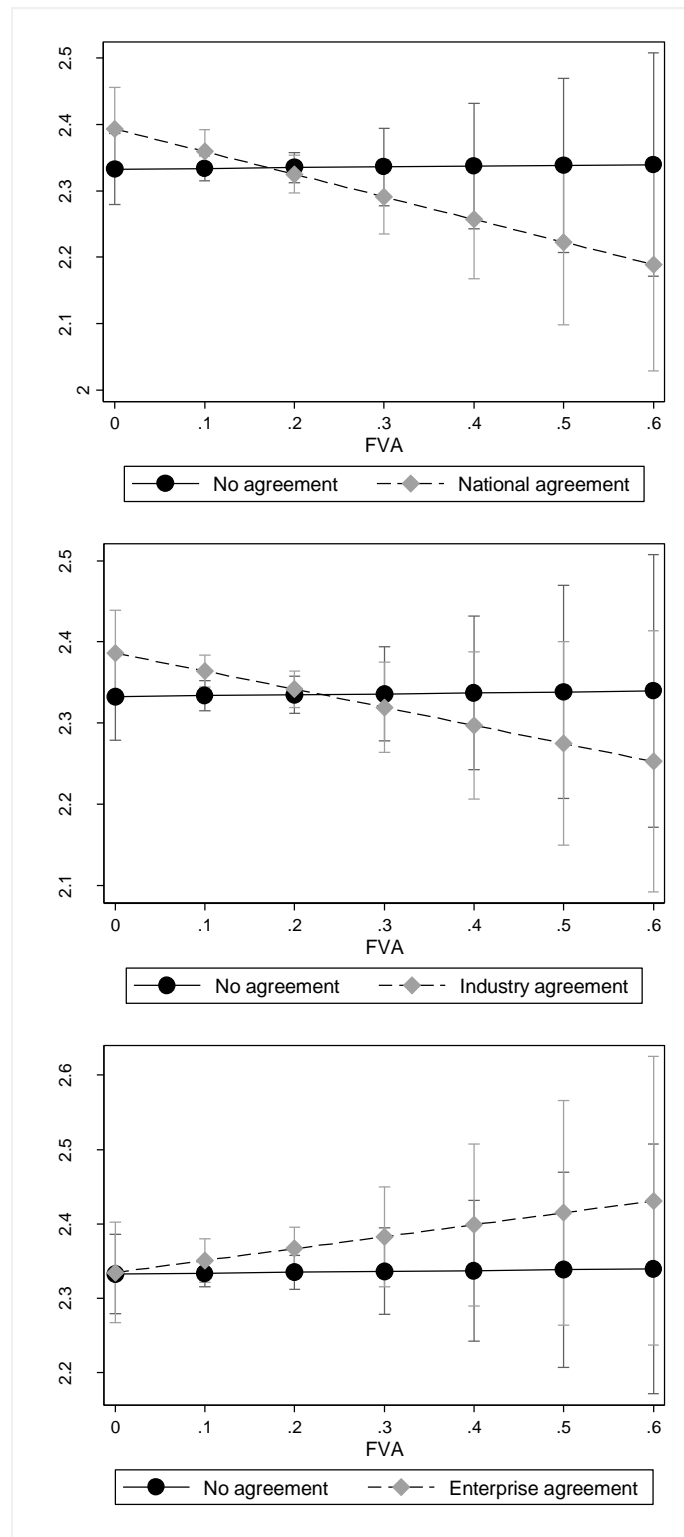


Figure 1. Predicted wages due to the changes in FVA_exp at different categories of collective pay agreements (illustrating the results from Table 3, Column (3))

Source: own elaboration based on data from SES and WIOD.

At a low level of GVC participation, workers covered by national and industry collective pay agreements receive higher wages than those without such agreements. However, there are no

distinct differences for wages of workers under enterprise agreements and no agreement. The situation changes with more intensive participation in GVCs. For workers covered by national and industry pay agreements, wages decrease along GVCs, whereas workers without pay agreements experience no changes. This trend is different for the wages of workers under enterprise agreements, as these improve alongside GVCs. Consequently, at the highest level of GVCs, workers' wages under national and industry agreements are lower, whereas those under enterprise agreements are higher. The main results are confirmed when GVCs are measured using either *OFF* or *GII* (see Figures 3A and 3B in the Online Appendix). The adverse effect of GVC participation is stronger for national agreements than industry agreements (note the magnitude of the coefficients). We find that the association between GVC participation and wages depends on the nature of the collective bargaining scheme, with enterprise agreements positively associated with wages caused by GVC participation. If agreements are more centralised (e.g. negotiations occur at the national level), workers have less power to negotiate their wages, especially in sectors that participate more in foreign production sharing with a threat of lower demand for domestic workers, meaning that they might have to accept lower wages (Felbermayr et al., 2014). Conversely, when pay agreements are made at the enterprise level, GVCs enhance productivity and the firms' competitiveness, and so, there is no downward pressure on wages. This result is in line with the suggestion by Boeri et al. (2001) that performance-related pay (here related to GVC productivity gains) is more likely to materialise under decentralised bargaining. The abovementioned dichotomous effects can also be observed as the difference between less centralised bargaining and more flexible labour markets.

On the contrary, following the argument by Nickell and Layard (1999) that wages are more resistant to company/industry-level shocks under centralised pay agreements (also related to GVC participation), our results do not provide empirical evidence for this. Given that we cannot measure participation in GVCs at the enterprise level based on our data, this remains an open question for future research.

In our baseline specifications, we employ three measures of GVC participation based on export or import decomposition, which provide similar results. To assess whether the upstream/downstream position in GVCs plays a role in determining wages and whether it depends on the collective bargaining scheme, we re-estimate the regression using upstreamness (UP). As in the previous specifications, we incorporate the interactions between the types of collective pay agreements and upstreamness. The results in Table 3A show that if the sector is further away from final demand, workers earn higher wages on average; again, the penalising effect of more centralised agreements (national and industry ones) is evident. We also add the square of upstreamness (UP^2) and the interactions with the respective collective pay agreements and check the possible non-linear relationship between upstreamness and wages. This is the hypothesis of the so-called ‘smile curve’ with higher value-added (and wages) at both ends of the chain (e.g. World Trade Organization, 2019). As shown in Table 3A (see column (2)) and Figure 5A, which plots predicted wages as a function of UP conditioned on the type of pay agreement, there is a non-linear relationship for national and industry agreements. In other words, wages decrease when moving further away from final demand. However, at the middle of the chain, the trend is reversed. Hence, wages are higher at the beginning of the chain (high UP) and at the end (low UP), and lower in the middle (e.g. $UP=2.5$). Interestingly, in the middle of the chain, workers under national and industry agreements also earn less than workers not covered by a pay agreement. This non-linear relationship is not confirmed for enterprise agreements: as sectors become more upstream, wages increase and along the whole chain, they are higher than those of workers without a pay agreement (at final demand, there is no difference between wages for workers under enterprise agreements and no agreement). Hence, we can draw two important conclusions from these results. First, there is an unequal (‘smile curve’-shaped) wage distribution along the GVC; therefore, participation in GVCs is important for the level of wages and position along the chain. This finding is in line with those of recent empirical studies such as Gagliardi et al. (2021) and Szymczak et al. (2022). However, we find some evidence that this ‘smile curve’ depends on the type of collective pay agreement and is present only for more

centralised systems. To provide a preliminary and ad hoc interpretation, we leave this as an open question to be addressed more thoroughly in future studies.

5. Extensions and robustness

5.1 Endogeneity

We are aware of the potential endogeneity issues in our OLS specifications owing to the two-way relationship between GVC and wages: firms may decide from where to source inputs or locate the assembly of their production process based on the cost of labour in the host country/sector. However, this problem is alleviated under our approach, as the wages of workers are merged with sectoral GVC measures; hence, it is hardly possible for an employee's wage to impact the fragmentation of sectoral-specific production processes.

Nevertheless, we repeat the estimation using the instrumental variable (IV) approach. The GVC measures (*FVA_exp*, *OFF*, *GII*) are instrumented by the contemporaneous indices of the sample countries that are geographically remote from the destination country following Autor, Dorn and Hanson (2013). This means that for each country in our sample and each of the GVC measures, we calculate an average of remaining countries of the sample, omitting countries that share a land border with the given country. The instruments assume that a country industry's endogenous GVC and its instrument is unrelated to the unobserved wage components in its labour market and neutralises the potential effects of demand. By excluding the direct neighbours, we prevent the situation that the instruments do not purge some shocks common for the given country and its neighbours and bias the estimations. Simultaneously, the reference group is built on a limited sample of European countries, that is, a group of countries with relatively similar characteristics. Hence, it is unlikely that the instrument will account for some additional independent effects¹³. Similar instrumenting approaches have been adopted in studies by Dauth et al. (2014) and Parteka and Wolszczak-Derlacz (2020), among others.

Table 4 presents the results. To assess the validity of the instruments, relevant tests are conducted, rejecting the hypothesis of under-identification; however, weak identification tests indicate some potential problems¹⁴. Nevertheless, the point estimates of the coefficients in which we are interested confirm the results obtained in the baseline estimations. Indeed, the interaction terms between GVCs and the respective agreements now become even more statistically significant.

Table 4. Estimation results – wage regression, including interaction between GVC and collective pay agreement, IV estimates.

	(1)	(2)	(3)
	FVA_exp	OFF	GII
<i>Nationagr</i>	0.069*** [0.023]	0.051** [0.022]	0.056** [0.023]
<i>Industryagr</i>	0.073*** [0.018]	0.050*** [0.016]	0.056*** [0.016]
<i>Enterpagr</i>	-0.013 [0.026]	-0.004 [0.018]	-0.015 [0.021]
<i>GVC</i>	-0.36 [0.588]	-0.179 [0.419]	-0.172 [0.226]
<i>GVC</i> × <i>Nationagr</i>	-0.434*** [0.140]	-0.332** [0.146]	-0.176** [0.079]
<i>GVC</i> × <i>Industryagr</i>	-0.354*** [0.122]	-0.235*** [0.087]	-0.127*** [0.045]
<i>GVC</i> × <i>Enterpagr</i>	0.243** [0.123]	0.214*** [0.072]	0.135*** [0.048]
N	8771189	8788515	8788515
Under-identification	0.00	0.00	0.00
Weak identification	0.97	3.62	6.21

Notes: Model with a full set of personal, firm and sectoral characteristics as in specifications (3), (6) and (9) in Table 2. *GVC* represents *FVA_exp* in Column (1); *OFF* in Column (2); and *GII* in Column (3). Other notes as under Table 2. The figures reported for the under-identification test are the p-values and they refer to the Kleibergen-Paap rk LM test statistic, where a rejection of the null indicates that the instruments are not under-identified. The weak identification test refers to the Kleibergen-Paap Wald rk F statistic test for the presence of weak instruments.

Source: own elaboration based on data from SES and WIOD.

5.2 Country level collective pay agreements

Thus far, we have focused on the microdata of collective pay agreements measured at the workers' level. Next, we turn to the variables describing different aspects of country-specific wage bargaining agreements obtained from the ICTWSS database (Visser, 2019). Specifically, we include two recoded variables, namely, *Coord* and *Levels*. *Coord* stands for the degree of the coordination of wage

setting, where countries with centralised or industry-level bargaining are coded 1, and all the other countries are coded 0. The variable *Level* describes the level at which the wage bargaining predominantly occurs. It is coded 1 if bargaining predominantly occurs at the central or cross-industry level and centrally determined binding norms or ceilings respected by agreements are negotiated at lower levels; if bargaining occurs at the middle level or alternates between the central and industry levels; and if bargaining predominantly occurs at the industry level. By contrast, it is coded 0 if bargaining predominantly occurs at the local or enterprise level and at the middle level or alternates between sector- and enterprise-level bargaining. Table 4A in the Online Appendix presents the results when country-specific wage bargaining schemes are included together with their interactions with GVCs. The results confirm that workers from countries with predominantly centralised or industry-level bargaining obtain higher earnings (when individual, country, and sectoral characteristics are controlled for) on average. This impact of collective bargaining on individual wages is consistent with previous studies. For example, Schäfer and Gottschall (2015) find that hourly gross earnings for full-time employees are higher by examining a sample of 24 European countries characterised by economies with a highly centralised level of bargaining. However, our baseline analysis uses more detailed information on wage bargaining schemes, as we possess data at the level of the worker, rather than at the country level. Additionally, our results indicate that using the fragmented production processes of GVCs as a proxy for countries in which collective bargaining occurs predominantly at the national and industry levels result in negative labour outcomes with respect to wages.

5.3 Country division

Furthermore, we extend our estimations by dividing the sample into two groups of countries: old EU member states (OMS) and new EU member states (NMS). The results in Table 5A show that the negative impact of fragmented production processes under a national- or industry-level bargaining scheme is maintained mainly in OMS and, to some extent, in NMS. By contrast, under enterprise-level collective pay agreements, their role in the positive interplay between GVCs and

wages only materialises in NMS, whereas this relationship is not statistically significant in OMS. In OMS, workers under enterprise pay agreements have higher wages on average than those without any agreement, regardless of whether they work in a more or less GVC-intensive sector, whereas this extra premium is realised only for those working in more GVC-dependent sectors in NMS. One explanation may be that enterprise-level bargaining schemes are more prevalent in NMS than in OMS (see the shares of the wage bargaining schemes in Table 1); therefore, their effect on positive GVC–wage linkages may be stronger than that of other bargaining schemes. This may also be an indication that labour markets work differently in less developed countries (here: NMS, global South from the trade theory perspective). However, our results for NMS cannot be generalised to other developing countries.

5.4 Additional covariates

Moreover, we conduct further robustness checks, the results of which are presented in Tables 6A–10A in the Online Appendix. In Table 6A, among the sectoral covariates, we employ capital intensity (measured as the log of capital in real USD per hours worked) instead of productivity. Tables 7A and 8A show the results after the elimination of observations by each country and sector to check whether the results are driven by a specific country or sector. Consequently, the main findings are confirmed. We then add country-specific wage setting characteristics such as the national minimum wage, minimum wage setting, and trade union density (Table 9A), taken from the ICTWSS database (Visser, 2019). In general, in countries with a statutory minimum wage, wages are lower (controlling for the individual, firm, and sectoral characteristics), which may be surprising given the clear positive impact of the minimum wage on factors such as smoothing income inequality (Schäfer and Gottschall, 2015). However, following the view that links the process of the determination of statutory minimum wages and labour market outcomes (Garnero et al., 2015), we find that a higher level of governmental intervention in setting the minimum wage leads to lower wages. As a centrally imposed minimum wage is predominantly lower than that when external partners are consulted (Garnero et al., 2015), its positive spillover effects may thus be

limited. For trade union density, the relationship is more straightforward: the higher the level of unionisation in a country, the higher the wages. The adverse interactions between GVCs and minimum wage setting/trade union density indicate that wages are lower for GVCs under a more centralised wage setting method. We also augment the regression using other country-specific macroeconomic variables (the country fixed effects used in all the previous specifications are now omitted due to multicollinearity) such as GDP per capita, country openness, measured as the exports/GDP or imports/GDP ratio (source: Penn World Table 9.0), and the unemployment rate (source: Eurostat). However, our main findings do not change when we control for these variables (see Table 10A).

6. Conclusions

The impact of trade and GVCs on wages cannot be analysed without considering institutional, political, and sociological factors. As the differences in the response of wages to GVC participation may be explained by wage bargaining schemes, labour market institutions may neutralise or reduce the impact of international trade participation on wages (Kramarz, 2008). Given the variations in institutional backgrounds across countries, the response of wages to GVC involvement seems to be conditioned by labour market institutions. This study conducted a multi-country analysis to find the linkages between involvement in GVCs and wage determination by assuming different wage-setting mechanisms. Our dataset covers almost nine million observations from 18 European countries, containing employee-level data merged with sectoral measures of GVCs. In addition to the socioeconomic characteristics of workers, we use firm-, country-, and sector-relevant covariates to examine wage determination.

Our main results show that workers covered by industry and enterprise agreements receive higher wages than those not covered by any agreement. Furthermore, under national wage bargaining schemes, we find that greater participation in GVCs results in lower wages, which confirms previous evidence (Geishecker, Görg and Munch, 2010; Parteka and Wolszczak-Derlacz,

2019). However, this adverse impact of GVCs is not observed under enterprise-level bargaining schemes. Hence, the downward pressure on wages caused by participating in international trade may be weakened by institutional factors (Nickell and Layard, 1999). To check the robustness of our results, we use IV estimation, and the results confirm our baseline estimates. Moreover, as further extensions, we provide additional country-specific variables related to the institutional background of the labour market. In particular, we focus on variables describing the coordination of wage setting and find that if collective wage bargaining occurs mostly at the national or industry level, wages are lowered when production processes are fragmented. Furthermore, we find that the abovementioned adverse impact of GVCs on wages materialises mainly in OMS, while there is a positive association under the enterprise bargaining scheme in NMS. Additional robustness checks also confirm the baseline results. While testing for the relationship between GVC position and wages and the presence of the ‘smile curve’ in wage distribution along the GVC, we find that it only exists for more centralised bargaining systems (national and industry level).

Considering that European countries tend to move towards the decentralisation of wage bargaining, as postulated by many agencies and institutions such as the European Commission and European Central Bank, our results constitute an important empirical contribution. The main channels through which the drive towards decentralisation is observable are related to the unbundling of production along the value chain and the need to negotiate and optimise aspects of production at the firm level (Boeri, 2001). The economic reasoning of the obtained results may be related to the negotiation power of workers that may be limited in sectors more involved in GVC (due to the decreasing demand for domestic workers) and in centralised bargaining schemes. However, for enterprise level pay agreements where wages are more closely linked to the productivity performance, the downward pressure on wages is not observed. Importantly, because we include the impact of both GVC and wage bargaining mechanisms, our conclusions on wage determination provide practical insights for policymakers. As the degree of wage bargaining remains debatable (e.g. Gollbach and Schulten, 2000; Hein and Schulten, 2004; Traxler and Mermet,

2003), our analysis strengthens the argument that decentralisation has a positive impact on wage determination. Additionally, we show that the degree of participation in GVCs is important, and that collective bargaining effectiveness may depend on the country/sector's location within that chain.

Nevertheless, this study has some limitations. First, we focus only on one aspect of the labour market, namely, wages; however, the impact of GVCs can also materialise through employment channels (e.g. Acemoglu et al., 2016; Szymczak and Wolszczak-Derlacz, 2022). Second, our data are limited to employed individuals. Finally, the results need to be interpreted with caution owing to potential endogeneity issues (although we employ the IV approach).

Although production relations based on GVCs have recently slowed due to the spread of COVID-19, and it is unclear as to how quickly they will recover, the future of international relations may depend heavily on institutional factors. Antràs (2020, p.1) even argues that 'the main challenge for the future of globalisation is institutional and political in nature rather than technological (...)'. As every country has specific adjustment policies supporting workers (e.g. customised labour market policy measures), which are additionally catalysed by collective pay agreements, the effects of trade fragmentation on wages and their components are diverse. Hence, these issues provide a promising direction for further studies to fully explain the observed processes.

¹ In general, the negative external effects are related to the fact that higher wages for one group may have negative effects on other groups. To be more precise, the possible negative effects may include consumer prices, aggregate demand, input prices, and fiscal externalities, as described by Boeri (2001).

² We investigate the degree of the centralisation of wage bargaining (see the variable description in the Data and methodology section). However, given the scarcity of studies on wages, wage bargaining, and GVCs, we also draw from the literature on the coordination of wage bargaining, which is a more general concept. As argued by Nunziata (2005), these characteristics are often positively correlated and provide similar results when employed in wage models.

³ A critical supplier is one that 'has more crucial products and thus a more core position' (Luo and Yang, 2020, p. 488).

⁴ Although we do not focus on the governance and power relations of GVCs owing to the types of data used, we proxy for the structure of GVCs by average industry position. Please see the Extensions and robustness section.

⁵ Data access was granted based on research proposal no. 225/2016-EU-SILC-SES.

⁶ Industry-level indicators (e.g. sector productivity, GVC measures based on the WIOD) are matched with SES data according to the sector of activity (NACE Rev. 2). In some cases, we combine the original WIOD sectors into broader categories to ensure their correspondence with the sectoral information in the SES. For such non-standard industry groupings (e.g. NACE rev.2 sectors C19_C20_C21_C22_C23; C19_C20_C22_C23), we compute the average of the underlying industry indices (e.g. the share of foreign value-added).

⁷ The remaining components of gross exports are: domestic value added absorbed abroad, domestic value-added first exported then returned home, and pure double counted term. For the detailed matrix formulas, see the source article Wang et al. (2013). To calculate this measure, we use WIOD input-output tables (WIOT) and R package *decompR* by Quast and Kummitz (2015).

⁸ *GII* is a novel measure of production fragmentation relying on Leontief's input-output model. The matrix of *GII* values by country and sector is calculated as a sum of a sequence of matrices containing imports from *n*-tier suppliers, for $n=1,2,3,\dots$. We calculate *GII* based on WIOT data using the R code provided by Author (2022).

⁹ The vector of upstreamness values for each country-sector can be calculated as $\mathbf{UP}=\mathbf{G}\mathbf{u}'$, where *G* is the Ghosh inverse matrix and \mathbf{u}' is the transposed summation vector. We calculate upstreamness on WIOT with the help of Stata codes by Hagemeyer and Ghodsi (2017).

¹⁰ To incorporate the categorical regression variable with *n* categories, we transform it into (*n*-1) dummy variables (because of linear dependencies). Then, the omitted category is the reference one, and the interpretation of the remaining categories is relative to this omitted category. In our case, as *Noagr* is the reference category, the coefficients of *Nationagr*, *Industryagr*, and *Enterpagr* are interpreted in relation to no agreement.

¹¹ Additionally, sectoral export penetration is not statistically significant.

¹² In the function with an interaction term between independent variables, $y = \beta_1x_1 + \beta_2x_2 + \beta_3x_1x_2$, the impact of an instantaneous change in one variable (e.g. x_1) on the outcome variable (*y*), with all the other variables held constant, equals the partial derivatives, $\frac{\partial y}{\partial x_1} = \beta_1 + \beta_3x_2$ (Wooldridge, 2013, p. 198, 718).

¹³ The correlation coefficients for each pair of GVC measure and its instrument are as follows: 0.69 for *FVA_exp*, 0.80 for *GII*, and 0.76 for *OFF*.

¹⁴ The weak identification test refers to the Kleibergen–Paap Wald rk F statistic test for the presence of weak instruments. As a rule of thumb, the statistic should be at least 10 for weak identification for it to not be considered a problem (Staiger and Stock, 1997).

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