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ORIGINAL ARTICLE

Wage differences according to workers' origin: The role of working more upstream in GVCs

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Abstract

This article examines the impact of a firm's position in Global Value Chains (GVCs) on wages according to workers' origin. Based on a unique linked employer–employee dataset regarding the Belgian manufacturing industry covering the 2002–2010 timespan, our estimates show that firms that are more upstream in the value chain pay on average significantly higher wages. However, the wage premium associated with upstreamness is also found to be unequally shared among workers. Unconditional quantile regressions and decomposition methods suggest that high-wage workers born in developed countries benefit the most from being employed higher up the value chain, while workers born in developing countries appear to be unfairly rewarded.

JEL CLASSIFICATION

J15, J31, F16

1 | INTRODUCTION

Wage differences according to workers' origin are well documented in the literature (Borjas, 1985; Nanos & Schluter, 2014; OECD, 2017) and may occur for different reasons. First, they may be partly due to productivity differentials resulting from human capital discrepancies attributed to immigrants' language abilities (e.g., Carnevale et al., 2001; Chiswick & Miller, 1995; Dustmann & van Soest, 2002), literacy skills (Ferrer et al., 2006; Himmler & Jäckle, 2018), schooling quality (Sweetman, 2004), job tenure attainment (McDonald & Worswick, 1998), and different school-to-work transitions (e.g., Baert & Cockx, 2013; Euwals et al., 2010). Another

reason may be occupational and sectoral segregation: migrant workers may be unequally distributed across occupations and industries, tending to be confined to specific jobs with lower remuneration (e.g., Elliott & Lindley, 2008; Peri & Sparber, 2009). Wage differences according to workers' origin may also result from discriminatory behaviours (e.g., Aydemir & Skuterud, 2008; Barrett et al., 2012).

A more recent strand of the literature focuses on the specific role of globalization, and more particularly global value chains (GVCs), in explaining wage differences according to workers' origin (Chen, 2017; Lopez Gonzalez et al., 2015; Shepherd, 2013). Over the last 30 years, production processes have indeed become increasingly fragmented and divided into ever smaller parts, considered as separate activities (OECD, 2013). This increasing fragmentation of production among multiple firms and geographical areas, driven in part by employers' desire to take advantage of lower labour costs, is often associated, in high-income countries, with increased vulnerability and insecurity for certain categories of workers, such as the low-skilled, women and immigrants (Rossi, 2013; Tejani & Fukuda-Parr, 2021). A few studies have tested the relationship between different aspects of firms' globalization (e.g., offshoring, participation and degree of involvement in GVCs) and workers' wages. In general, results suggest that firms' participation in GVCs has a positive impact on wages (Lu et al., 2019; Shingal, 2015). However, when testing the moderating role of workers' origin, the results show differences in the returns to these different aspects of GVCs, often to the detriment of immigrant workers (Abd Rahman et al., 2019; Farole, 2016).

One aspect of globalization that is receiving increasing attention is the relative position of firms in GVCs, measured for example by their level of upstreamness (i.e., the average distance from final use, to be understood as the average number of steps/transactions before firms' production of goods and/or services meets either domestic or foreign final demand). Indeed, as highlighted by Farole (2016, p. 6): 'the gains to GVC participation in terms of wages and working conditions in all likelihood depend on the position of the firm in the value chain'. From a product market perspective, the reasons why firms' upstreamness may influence wages stem from its impact on productivity. More precisely, upstreamness is likely to influence the value added generated by firms, which can then be shared between profits and wages depending on labour market characteristics.

Mahy et al. (2022) identify several channels through which upstreamness can affect productivity, either positively or negatively. First, upstreamness can foster productivity by increasing the market power of firms and allowing them to set higher prices for their products. Second, it can be argued that leading firms, which are mainly upstream due to their innovation and R&D activities, tend to keep a strong control over high-value-added downstream activities such as marketing, which strengthens their productivity. Moreover, it is reasonable to assume that exporting firms, which are generally found to be more productive (Baldwin & Yan, 2017; Berthou et al., 2015), are more likely to operate at higher stages of the value chain (Amador & Cabral, 2016; Dhyne & Duprez, 2015). According to Serpa and Krishnan (2018), upstreamness can also enhance productivity through upstream spillovers in the form of knowledge transfers from large, highly productive customers to suppliers. However, being more upstream might also lead to lower productivity. A first argument is related to the potential inability of some firms positioned further upstream to control the entire value chain and engage in high-value-added downstream activities (de Vries et al., 2021; Rungi & Del Prete, 2018), whereas a second is that productivity may be lower for upstream firms when they are only producers in the value chain, as opposed to more downstream ones that benefit from being both producers and buyers (Giovannetti & Marvasi, 2018). In sum, there are arguments for both a positive and a negative

relationship between upstreamness and productivity. Whether the former outweighs the latter, or vice versa, is obviously an empirical question.

A couple of recent empirical papers have been able to investigate whether firm-level upstreamness matters for the creation of value. Rungi and Del Prete (2018), using cross-sectional firm-level data for the European Union, show the existence of a *smile curve*, indicating that the creation of value tends to be the highest for tasks at the top (e.g., R&D) and at the bottom (e.g., marketing and retail) of the supply chain. A related study is that of Ju and Yu (2015), who use Chinese data and find that firms that are higher up in the value chain are more productive. Dhyne et al. (2015) and Mahy et al. (2022), using Belgian panel data, provide a similar conclusion and confirm De Backer and Miroudot (2013) assertion that companies need to *move up the value chain*. Specializing in more upstream activities, according to the OECD, is also likely to increase firms' control over high-value, downstream stages of the production process and thus to promote economic growth. Overall, the existing empirical studies, therefore, tend to support the theoretical arguments that being positioned further upstream improves productivity.

With regard to wages, while the effect of firms' participation in GVCs has already been examined in several studies, little is known about whether the productivity gains associated with upstreamness (as estimated in the empirical studies) are shared with workers through higher wages. Szymczak et al. (2019), using industry-level data on Central and Eastern European countries, show that workers earn higher wages when employed in sectors located either at the top or at the bottom of the value chain. Mahy et al. (2022) examine a similar question using firm-level data for the Belgian private sector, which is characterized by strong collective bargaining and a high level of union coverage (Garnero et al., 2020; Kampelmann & Rycx, 2013). Their findings suggest that the higher productivity gains achieved by firms operating more upstream in GVCs are shared equally between profits and labour costs. Yet, the study by Gagliardi et al. (2021), also focusing on Belgium, indicates that women benefit much less than men from being employed in more upstream firms. Chen (2017) studies the extent of wage inequality across heterogeneous industries holding different positions in China's domestic manufacturing value chains. The author finds that wage inequality is more pronounced in upstream than in downstream industries. Another study is that of Shen and Silva (2018), who show that the rise in value-added exports from China to the U.S. has affected average wages in the U.S. and that the impact depends on the position of the Chinese exporting industry in the GVC.

To the best of our knowledge, the moderating role of workers' origin in the relationship between upstreamness and wages has not been studied so far. However, considering the unequal distribution of native and immigrant workers across sectors, jobs and stages of supply chains (Barrientos et al., 2011; Gereffi & Luo, 2014), as well as arguments related to unequal information, power and authority, among others, between these workers' categories (Cattaneo et al., 2015; Tomaskovic-Devey et al., 2015), it is very likely that firm-level upstreamness plays a significant role in explaining wage gaps according to workers' origin. Using detailed matched employer–employee data for Belgium, the present article aims to fill this gap in the literature by providing the first evidence of the impact of a direct measurement of firm-level upstreamness on wages according to workers' origin (i.e., workers born in developed countries versus workers born in developing countries) and on whether it varies depending on the workers' level of compensation. We also add to the existing literature by assessing the role of firm-level upstreamness in the explanation of the origin-based wage gap at the mean of the earnings' distribution, but also at different quantiles.

From a labour market perspective, the way in which productivity gains achieved by firms further up the value chain are shared with workers is likely to depend on the origin of the latter and their position in the earnings' distribution. Indeed, workers born in developing countries often have less human capital, suffer from sectoral/occupational segregation, and are discriminated against (Jacobs et al., 2021). All these features may contribute to explain why immigrants from developing countries may be more concentrated in less productive (and therefore probably less remunerative) firms further down the value chain. As these features are also likely to be correlated with workers' information, power and authority, they may also explain why immigrants from developing countries may benefit less from the productivity gains associated with firm's upstreamness. Another argument is related to wage-setting mechanisms. According to Dobbelaere and Vancauteren (2014), 90% of firms in Belgium operate in imperfectly competitive product markets. Moreover, among these firms, the type of competition in the labour market would be for 51% of them efficient bargaining, for 22% monopsony, and for the remaining 27% either right-to-manage or perfect competition. In the case of labour markets characterized by efficient or right-to-manage bargaining, origin-based differences in wage-upstreamness elasticities could be the result of less effective representation of workers born in developing countries by trade unions (Kampelmann, 2011). Next, in the case of monopsonistic labour markets, as labour supply tends to be more inelastic for workers born in developing countries, firms can be expected to discriminate against them to a greater extent (Hirsch & Jahn, 2015), especially when the degree of competition in the product market is low (as pointed out in the Belgian context by Fays et al. (2021)).

In addition, various arguments suggest that origin-based differences in wage-upstreamness elasticities may be more pronounced at the top of the earnings' distribution. As shown by Shen and Silva (2018), the impact of upstreamness on wages is likely to be most prominent for highly educated workers (who are generally at the upper end of the earnings distribution) due to their greater oligopolistic power on the labour market (Kampelmann et al., 2018). However, this increased wage-upstreamness elasticity may be less marked for workers when they originate from developing countries. A first reason is that, at given level of education, these workers may actually have less human capital than their counterparts from developed countries. A complementary explanation is that highly educated workers from developing countries may have less oligopolistic power than their developed country counterparts, especially if one assumes that the latter are better informed about the functioning of the host country and its institutions, and have a wider and more effective network (Nielsen, 2011). Furthermore, if, as in tournament theory (Lazear & Rosen, 1981), bonuses for highly educated workers are determined by their relative performance, the result might again be to the disadvantage of immigrants from developing countries (particularly, if their performance is under-estimated due to statistical or taste-based discrimination).

At the methodological level, in order to assess the role of firm-level upstreamness in explaining the origin-based wage gap along the earnings' distribution, we take advantage of our access to detailed matched employer–employee data (i.e., the Structure of Earnings Survey), covering almost 250,000 workers, which are representative of the Belgian manufacturing sector, merged with information on workers' origin, extracted from the Belgian National Register, and a unique firm-level upstreamness indicator derived from the National Bank of Belgium business-to-business (NBB-B2B) transactions dataset, developed by Dhyne et al. (2015). The latter provides a direct and accurate measurement of firm-level upstreamness for all years from 2002 to 2010. Our empirical strategy boils down to regressing individual workers' wages on upstreamness while controlling for time fixed effects and a large set of covariates reflecting

worker, and firm characteristics. We also provide estimates examining whether our findings are driven by variability in upstreamness between and/or within firms. The elasticity between wages and upstreamness by workers' origin and along the wage distribution is estimated using both conditional (CQR) and unconditional (UQR) quantile regressions (Firpo et al., 2009; Machado & Mata, 2005; Melly, 2005). Finally, to estimate how upstreamness contributes to the wage gap between workers born in developed and developing countries at each quantile, we apply an extension of the Oaxaca–Blinder decomposition (Blinder, 1973; Oaxaca, 1973) based on UQR techniques, namely the methodology developed by Fortin et al. (2011).

Belgium is a particularly interesting country to study the consequences of upstreamness on workers' wages, because it is a very open and integrated economy with increasingly diverse trading partners. This is notably illustrated by the GVC participation index, estimated at 60% (De Backer & Miroudot, 2013), which shows that Belgium sources more inputs from abroad and produces more inputs used in GVCs than most other OECD countries (OECD, 2013). Dhyne et al. (2015) further estimate that the average upstreamness of firms in Belgium amounted to 1.82 in 2011, while Antràs and Chor (2017) estimate the average world upstreamness to be equal to 2.11 in 2011. It thus seems that Belgium is a slightly more downstream country compared with the rest of the world. Moreover, the manufacturing industry, which is the focus of our study, is one of the most fragmented sectors in Belgium, with a particularly high rate of involvement in GVCs. According to Dhyne et al. (2015), 91.6% (99.5%) of the firms operating in this industry are found to be directly or indirectly involved in exports (imports), and the average value of upstreamness at the firm level is estimated at 2.17 steps in 2011. In comparison, Antràs and Chor (2017) estimated the upstreamness of goods industries (including the primary and manufacturing sectors) at 2.29 steps on average worldwide in 2011, this figure being pulled up by the fact that many primary sector firms tend to be higher up the value chain than manufacturing firms. It thus appears that the average level of upstreamness of firms in the Belgian manufacturing sector is comparable to the world average in this industry. Moreover, given the particularly strong involvement of Belgian manufacturing firms in GVCs, this industry is an ideal candidate for our investigation into the impact of upstreamness on workers' wages.

Belgium is also of particular interest when examining labour market inequalities according to workers' origin. At the end of 2018, foreign-born people accounted for more than 17% of the total population of Belgium (OECD, 2020). Accordingly, this country is one of the most multicultural in the OECD area (Martiniello, 2003). Unfortunately, it is also one of the worst OECD countries in terms of employment performance of immigrants. As regards the gross hourly wage gap between natives and immigrants in Belgium, the International Labour Organization (ILO) International Labour Organization (2020) estimated it at 12.7% in 2019, which is well above the European average of 8.6%. Focusing on the Belgian private sector, Kampelmann and Rycx (2016) further show that the wage penalty against immigrants born outside Western Europe still amounts to 6.1%, a result the authors interpret as discrimination. In addition, the estimates by Fays et al. (2021) and Grinza et al. (2020), also for the Belgian labour market, suggest that wage discrimination against immigrants ranges between 7 and 17.5% for those born in Africa and Asia, respectively, and that it is greater in firms with high workforce diversity and more limited in highly competitive product market situations.

To sum up, although substantial research has been devoted to estimating and explaining wage differences by workers' origin and educational attainment in OECD countries, with a growing number of studies addressing this issue in the Belgian context, little is known about

the role of global value chains (GVCs) and, more specifically, of firms' upstreamness in these wage differences. This last point is therefore at the heart of our analysis.

The remainder of this article is organized as follows. Section 2 presents the dataset and descriptive statistics. Section 3 describes our methodology and econometric results. Section 4 concludes.

2 | DATA AND DESCRIPTIVE STATISTICS

Our empirical analysis is based on a combination of three large datasets. The first is the Structure of Earnings Survey (SES), which provides information on a large representative sample of workers employed in the manufacturing industry (i.e., section C of the NACE Rev. 2 nomenclature) over the period 1999–2010.[1] The SES contains a wealth of information, provided by the human resources departments of firms, on the characteristics of both firms (e.g., sector of activity, level of collective wage bargaining, firm size) and the individuals working in those firms (e.g., age, level of education, tenure, gender, employment contract, working time, occupation, the gross hourly wage and its components). The gross hourly wage of workers is calculated by dividing the total gross wage, including premia for overtime, shift, weekend or night work, performance-related pay and bonuses and other premia, by the total number of hours actually paid.

The SES dataset has been merged by Statistics Belgium, in collaboration with the National Bank of Belgium, with a unique dataset derived from the NBB-B2B transactions dataset, developed by Dhyne et al. (2015). The latter, following the methodology presented in Antràs et al. (2012), enables us to have a direct measurement of the upstreamness of (almost) each manufacturing firm surveyed in the SES for each year.

The firm-level upstreamness variable measures the steps (weighted distance) before the production of a firm j at period t meets either domestic or foreign final demand. More precisely, Dhyne and Duprez (2015) have first built a firm-level input–output table for each year based on the values of transactions between enterprises. They have then applied the methodology suggested by Antràs et al. (2012), which models the upstreamness of the production of a given firm as the number of steps/transactions (made by firms in Belgium and abroad before being imported or after being exported) that are needed, on average, for all the production of that firm to meet final demand. The upstreamness of a firm is computed as a sum of terms, (i) the first of these representing the share of the firm's output directly sold to final demand, (ii) the second being the share of its output that reaches final demand after only an additional transformation by other firms, multiplied by the factor 2 (as two transactions are needed to meet final demand) and (iii) the third being the share of its output that reaches final demand after only two transformations by other firms, multiplied by the factor 3, and so on [see Dhyne et al. (2015) for more details].

Dhyne and Duprez (2015) have computed an upstreamness index for all firms in Belgium taking part in value chains, whether purely domestic or not. These firms either (1) purchase goods from foreign or domestic firms in order to process them and sell them to foreign or domestic firms/final customers, and/or (2) produce goods that are sold to other domestic or foreign clients. The estimates of Dhyne et al. (2015) further indicate that 91.6% (99.5%) of enterprises in the Belgian manufacturing sector produced (consumed) goods and services that were directly or indirectly exported (imported) between 2002 and 2012. Accordingly, virtually all manufacturing enterprises in Belgium participated in international, i.e., global, value chains

(GVCs) over the timespan of our study (2002–2010) and for almost all of them an upstreamness index is available in the NBB-B2B transactions dataset.[2]

The third dataset contains information on the workers' country of birth. This information was extracted from the Belgian National Register (NR) and merged with the first two datasets by Statistics Belgium. In our analyses, we divided workers into four groups: (i) those born in Belgium, (ii) those born abroad (i.e., outside Belgium), (iii) those born in a developed country (including Belgium) and (iv) those born in a developing country. To distinguish between workers born in developed and developing countries, we relied on the nomenclature provided by United Nations Conference on Trade and Development (UNCTAD) (2020), which is built on basic economic conditions such as geographical location and similarities in economic structure.[3]

Information on firm upstreamness is not available prior to 2002 in the NBB-B2B dataset. Hence, our merged sample covers all years from 2002 to 2010. Our final sample consists of a pooled cross-sectional dataset with 245,418 observations, which is representative of all workers employed in manufacturing firms (employing at least 10 workers) over the period 2002–2010.

Table 1 presents the means and standard deviations of selected variables for the overall sample in column (1), for workers born in Belgium and abroad, respectively, in columns (2) and (3), and for workers born in developed and developing countries, respectively, in columns (4) and (5). While average gross hourly wages are fairly similar for workers born in Belgium and abroad (16.6 vs. 16.2 €), we observe a large difference (of almost 15%) between the average hourly wages of workers born in developed countries and those born in developing countries (16.6 vs. 14.7 €). The descriptive statistics also show that workers born in Belgium are on average employed in firms located higher up the value chain than those born outside Belgium (2.72 and 2.64 steps from the final consumer, respectively). Similarly, the average upstreamness is higher for workers born in developed countries than for those born in developing countries (2.71 and 2.57 steps, respectively). Among workers born outside Belgium, just over half (52.6%) are from developed countries, and among those from developing countries, about 37% were born in North Africa, 17% in Sub-Saharan Africa, 23% in the Near and Middle East, 10% in Asia, 10% in Eastern Europe, the Balkans and the former Soviet Union, and 3.5% in Latin America. Compared with workers born in Belgium, we find that those born abroad are more likely to be prime-age adults, low educated, male, work part-time and have less tenure. In contrast, the proportion of workers with open-term contracts, in high- and medium-skilled occupations (according to the ILO; International Labour Office and International Labour Organization, 2012, classification), covered by a firm-level collective agreement and employed in larger firms is higher among workers born in Belgium. These statistical differences are further magnified in most cases when comparing workers born in developed and developing countries.

Table S1 shows descriptive statistics according to firms' level of upstreamness and by workers' region of birth (i.e., for workers born in developed and developing countries, respectively). The threshold between low and high level of upstreamness has been set at its sample median value (2.86 steps). Results show that the average gross hourly wage is slightly higher for workers employed in more upstream firms (16.9 vs. 16.2 €). In contrast, the wage gap between workers born in developed and developing countries is found to be less pronounced among firms that are further away from the final consumer (11.2 vs. 13.2%). The distribution of workers wherever they come from with respect to age, education, type of employment contract and working time is quite similar among more and less upstream firms. However, more upstream firms employ relatively fewer (more) craft and related trades workers (plant and

TABLE 1 Means and standard deviations of selected variables, for workers (overall and by origin) and firms.

Variables	All workers (1)	Workers born in Belgium (2)	Workers born outside Belgium (3)	Workers born in developed countries (4)	Workers born in developing countries (5)	All firms (6)
Gross hourly wage (€, at constant 2004 prices)	16.52 (7.62)	16.55 (7.36)	16.17 (9.54)	16.61 (7.61)	14.74 (7.53)	14.88 (3.31)
Upstreamness	2.71 (0.89)	2.72 (0.89)	2.64 (0.91)	2.71 (0.89)	2.57 (0.89)	2.68 (0.87)
Length of the global value chain	5.5	5.5	5.3	5.5	5.3	5.4
Workers born in developed countries (%)	95.1	100	52.6	100		95.7
Workers born in developing countries (%)	4.9		47.4		100	5.3
North Africa	1.8		17.4		36.7	2
Sub-Saharan Africa	0.9		8.2		17.3	0.9
Near and Middle East	1.1		10.8		22.8	1.2
Asia	0.5		4.8		10.1	0.6
Eastern European	0.5		4.5		9.6	0.5
Latin American	0.1		1.7		3.5	0.1
Age (%)						
Younger than 30	18.4	19	13	18.5	16	19.2
Between 30 and 49	62.4	62.2	64	62	69.9	62.7
Older than 49	19.2	18.8	23	19.5	14	18.1
Education (%)						
No degree, primary/lower secondary	32.3	30.9	44.5	31.4	49.7	33.5
General upper secondary, technical/artistic/professional upper secondary	45.4	46.3	37.2	45.8	36.7	46.2
Higher non-university, university and post-graduate	22.3	22.8	18.3	22.8	13.6	20.3
Tenure (%)						
Up to 1 year	16.4	15.7	21.8	15.9	25.7	17.6
2–4 years	18.5	18.2	21.6	18.2	24.9	19.8

TABLE 1 (Continued)

Variables	All workers (1)	Workers born in Belgium (2)	Workers born outside Belgium (3)	Workers born in developed countries (4)	Workers born in developing countries (5)	All firms (6)
5–9 years	19.9	19.9	20.3	19.8	21.4	21
10 years and more	45.2	46.2	36.3	46.1	28	41.6
Female workers (%)	22.7	23.2	18.8	23.1	14.2	22.7
Type of employment contract (%)						
Open-term contracts	96.4	96.6	95.8	96.5	93.6	97.1
Fixed-term contracts	2.9	2.8	4.6	2.8	5.8	2.5
Apprenticeship and interim contracts	0.7	0.6	0.6	0.7	0.6	3.5
Part-time work (%)	15.8	15.6	17.3	15.7	19	11.4
Occupations (%)						
Managers	3.8	3.8	4	3.8	2.1	3.6
Professionals	7.8	7.8	7.3	7.9	5	6.6
Technicians and associate professionals	8.8	9	6	9	4.7	7.8
Clerical support workers	13.4	14	7.7	13.8	5.1	13.6
Craft and related trades workers	27.3	26.6	34	26.9	36.2	30.4
Plant and machine operators and assemblers	30	30.2	28.5	29.9	32.6	28.3
Services and sales workers	1.8	1.9	1.5	1.9	1.2	2
Elementary occupations	7.1	6.7	11	6.8	13.1	7.7
Compensations for overtime work (Yes, % workers)	5.8	5.9	5.1	5.8	5.4	–
Premia for shift/weekend/night work (Yes, % workers)	22	21.9	23.3	21.8	26	–
Firm size (in full-time equivalent)	403.3	408.7	356.2	405.7	355.8	182.7
Firm-level collective agreement (%)	37.3	37.6	34.5	37.5	32.6	27.7

(Continues)

TABLE 1 (Continued)

Variables	All workers (1)	Workers born in Belgium (2)	Workers born outside Belgium (3)	Workers born in developed countries (4)	Workers born in developing countries (5)	All firms (6)
Region (%)						
Brussels	7.9	6.8	17.4	7.3	18.8	8
Flanders	66.2	68.4	46.8	66.7	56.3	64.3
Wallonia	25.9	24.8	35.8	26	24.9	27.7
More than 50% privately owned firms (%)	98	98.1	97.9	98	98.2	98.3
Number of observations	245,418	220,149	25,269	233,432	11,986	10,058

Note: By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification. Standard deviations are reported between parentheses.

machine operators and assemblers), are somewhat smaller, and are more often covered by a firm-level collective agreement.

3 | METHODOLOGY AND RESULTS

3.1 | Benchmark estimates

Our benchmark equation to estimate the impact of firm-level upstreamness on wages by workers' origin (i.e., for workers born in Belgium, outside Belgium, in developed countries [including Belgium] and in developing countries, respectively) is the following:

$$log\left(w_{i,j,t}\right) = \beta_0 + \beta_1 up_{j,t} + \beta_2 X_{i,j,t} + \beta_3 Y_{j,t} + \delta_t + \varepsilon_{i,j,t} \quad (1)$$

where $w_{i,j,t}$ is the gross hourly wage (including base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, as well as annual and irregular bonuses) of worker i in firm j at time t. Our variable of interest, $up_{j,t}$, is the level of upstreamness (upstreamness index) in firm j at time t. It measures the steps (weighted distance) before the production of firm j at time t meets either domestic or foreign final demand. $X_{i,j,t}$ is a vector of worker characteristics: two dummies for education (i.e., dummies for workers with upper secondary and higher education, respectively; workers with at most lower secondary education being the reference category), three dummies for tenure (i.e., dummies for workers with between 2 and 4, between 5 and 9, and at least 10 years of tenure, respectively; workers with at most 1 year of tenure being the reference category), two dummies for age (i.e., dummies for workers aged at most 29 and those over 49 years, respectively; workers aged between 30 and 49 being the reference category), a dummy for female workers, two dummies for the employment contract (i.e., dummies for workers with a fixed-term contract and under apprenticeship or with an interim contract, respectively; workers with an open-term contract being the reference category), a working-time dummy (full-time workers being the reference category), and seven occupational dummies (i.e., dummies for managers, professionals, technicians and associate professionals, clerical and support workers, craft and related trades workers, plant and machine operators and assemblers, and services and sales workers, respectively; elementary occupations being the reference category). $Y_{j,t}$ includes firm characteristics: a dummy for the presence of a collective agreement at the firm level, firm size (i.e., the logarithm of the number of full-time equivalent workers at the firm level), two dummies for the region in which the firm is located (i.e., dummies for being located in Brussels and Wallonia, respectively; Flanders being the reference category), and a dummy for the type of economic control (i.e., a dummy for firms that are more than 50% privately owned). δ_t is a set of 8-year dummies, and $\varepsilon_{i,j,t}$ is the error term.

The OLS estimates of Equation (1), reported in columns (1) to (5) of Table 2, show the impact of upstreamness first on the wages of all workers irrespective of their origin, then on the wages of workers born in and outside Belgium, respectively, and finally on the wages of workers born in developed and developing countries, respectively. Due to the simultaneous use of grouped (firm-level) and individual (worker-level) observations, we have computed cluster-robust standard errors to account for within-firm correlation, as recommended by Greenwald (1983) and Moulton (1990). After controlling for all the covariates described in Equation (1), we find that the regression coefficient associated with upstreamness is always significantly positive.

TABLE 2 OLS, overall and by origin, for different samples and with interaction terms.

Dependent variable: Logarithm of the gross hourly wage	All workers (1)	Workers born in Belgium (2)	Workers born outside Belgium (3)	Workers born in developed countries (4)	Workers born in developing countries (5)	All workers (6)	All workers (7)
Upstreamness[a]	0.021*** (0.002)	0.021*** (0.002)	0.020*** (0.003)	0.021*** (0.002)	0.020*** (0.003)	0.020*** (0.002)	0.020*** (0.002)
Upstreamness[a] × workers born outside Belgium						0.003 (0.003)	
Workers born outside Belgium						−0.019** (0.007)	
Upstreamness[a] × workers born in developing countries							0.004 (0.003)
Workers born in developing countries							−0.043*** (0.009)
Control variables[b]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.56	0.56	0.56	0.561	0.527	0.56	0.56
Model sig. (p-value of F test)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of observations	245,418	220,149	25,269	233,432	11,986	245,418	245,418

Note: By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification. Cluster-robust standard errors are presented between parentheses. ***, ** and * significant at 1%, 5% and 10% levels, respectively.

[a]Steps (weighted distance) before the production of firm meets either domestic or foreign final demand.

[b]Control variables include two dummies for education (i.e., dummies for workers with upper secondary and higher education, respectively; workers with at most lower secondary education being the reference category), three dummies for tenure (i.e., dummies for workers with between 2 and 4, between 5 and 9, and at least 10 years of tenure, respectively; workers with at most 1 year of tenure being the reference category), two dummies for age (i.e., dummies for workers aged at most 29 and those over 49 years, respectively; workers aged between 30 and 49 being the reference category), a dummy for female workers, two dummies for the employment contract (i.e., dummies for workers with a fixed-term contract and under apprenticeship or with an interim contract, respectively; workers with an open-term contract being the reference category), a working-time dummy (full-time workers being the reference category) and seven occupational dummies (i.e., dummies for managers, professionals, technicians and associate professionals, clerical and support workers, craft and related trades workers, plant and machine operators and assemblers, and services and sales workers, respectively; elementary occupations being the reference category), a dummy for the presence of a collective agreement at the firm level, firm size (i.e., the logarithm of the number of full-time equivalent workers at the firm level), two dummies for the region in which the firm is located (i.e., dummies for being located in Brussels and Wallonia, respectively; Flanders being the reference category), a dummy for the type of economic control (i.e., a dummy for firms that are more than 50% privately owned) and 8-year dummies.

It is equal to 0.021 for workers born in Belgium and for those from developed countries, and 0.020 for workers born outside Belgium and for those from developing countries. As these coefficients are not statistically different from each other, they suggest that if a firm's upstreamness increases by one step (i.e., if a firm moves one step further away from the final consumer), wages increase by about 2% on average, regardless of the workers' origin.

Similar results were obtained using a specification with interaction effects. Indeed, in addition to Equation (1) which was estimated on subsamples of workers from different origins, we also ran a single regression on our whole sample including, on top of all the covariates mentioned above: (a) the upstreamness index, (b) a binary variable for the origin of the worker and (c) the interaction between these two variables. We thus estimated by OLS the following equation:

$$log\left(w_{i,j,t}\right) = \beta_0 + \beta_1 up_{j,t} + \beta_2 up_{j,t} * mig_{i,j,t} + \beta_3 mig_{i,j,t} + \beta_4 X_{i,j,t} + \beta_5 Y_{j,t} + \delta_t + \varepsilon_{i,j,t} \quad (2)$$

where $w_{i,j,t}$ is the gross hourly wage of worker i in firm j at time t, $up_{j,t}$ is the level of upstreamness in firm j at time t, $X_{i,j,t}$ and $Y_{j,t}$ are vectors of control variables for worker and firm characteristics (defined in the same way as in Equation (1)), $mig_{i,j,t}$ is a binary variable for the origin of worker i (i.e., either a dummy taking the value 1 if the worker was born outside Belgium and 0 otherwise, or a dummy taking the value 1 if the worker was born in a developing country and 0 otherwise). δ_t is a set of 8-year dummies, and $\varepsilon_{i,j,t}$ is the error term.

OLS estimates of Equation (2), presented in columns (6) and (7) of Table 2, show that the regression coefficient associated with the upstreamness variable is always significant and equal to 0.020.[4] In contrast, the coefficient associated with the interaction term is never statistically significant, regardless of whether the dummy variable takes the value 1 for people born outside Belgium (see column (6)) or for those from developing countries (see column (7)). This result again suggests that the magnitude of the elasticity between wages and upstreamness does not depend on the origin of workers.

So far, we have not controlled for the length of GVCs. However, upstreamness could have different effects on wages, depending on whether the length of the value chain in which firms participate is short or long. Table 1, presenting our descriptive statistics, shows that workers born in Belgium and in developed countries work in firms belonging to slightly longer value chains (5.5 steps) than workers born outside Belgium and in developing countries (5.3 steps). As a robustness check, we therefore introduced a new control variable into Equations (1) and (2), namely, the length of the GVC. We obtained this variable by adding the number of steps associated with a firm' upstreamness (i.e., the average distance of that firm from final demand) and downstreamness (i.e., the average distance of that firm from the value chain's primary factors of production). Corresponding estimates are presented in Table S2. They show that controlling for the length of the value chain does not affect the significance of the regression coefficient associated with upstreamness. However, the size of the latter is now somewhat larger and equal to 0.033. As regards the interaction effects (see columns (2) and (3)), they again suggest that the wage-upstreamness elasticity does not depend on workers' origin. Overall, this robustness test, therefore, reinforces our previous results.[5,6]

3.2 | Variability in upstreamness: Within or between firms?

Estimates reported so far are based on pooled cross-sectional data. To get a better understanding of whether our results are driven by variability in upstreamness within and/or between

firms, we ran an additional robustness test with firm-level panel data. In other words, we first aggregated our initial sample, covering the period 2002–2010, to the firm level, to obtain a panel of 10,058 firm-year observations.[7] This aggregation is reliable because it is computed on a reasonable number of data points per firm-year, the average being 46, with a minimum and maximum value of 10 and 549, respectively. Next, we used these firm-level panel data to estimate the elasticity between upstreamness and mean workers' wages and to test whether this elasticity varies according to the share of workers born in developing countries employed inside those firms. In other words, we estimated the following equations:

$$log\left(w_{j,t}\right) = \beta_0 + \beta_1 up_{j,t} + \beta_2 X_{j,t} + \beta_3 Y_{j,t} + \delta_t + \varepsilon_{j,t} \quad (3)$$

$$log\left(w_{j,t}\right) = \beta_0 + \beta_1 up_{j,t} + \beta_2 up_{j,t} * mig_{j,t} + \beta_3 mig_{j,t} + \beta_4 X_{j,t} + \beta_5 Y_{j,t} + \delta_t + \varepsilon_{j,t} \quad (4)$$

where $w_{j,t}$ is the average gross hourly wage in firm j at time t, $up_{j,t}$ is the level of upstreamness of firm j at time t, $mig_{j,t}$ is a dummy variable set equal to 1 when the share of full-time equivalent workers born in developing countries employed in firm j at time t is above the sample mean value, $X_{j,t}$ and $Y_{j,t}$ contain the same sets of covariates as in Equation (1) but these are aggregated at the firm level at time t. In other words, these last two variables include the shares of the workforce in firm j at time t by level of education, years of tenure, age, gender, working time, employment contract and occupation, as well as firm size, type of economic control, level of collective bargaining and regional location. δ_t is a set of 8 year dummies, and $\varepsilon_{j,t}$ is the error term.

We estimated Equation (3) with both pooled OLS and a fixed effects (FE) estimators (i.e., a mean-differentiated model accounting for firm unobserved time-invariant heterogeneity). Results, reported in columns (1) and (2) of Table 3, show that the wage-upstreamness elasticity is significant and positive with both types of estimators. Moreover, we find that the regression coefficient associated with upstreamness decreases only slightly (from 0.016 to 0.015, these estimates being significantly different) when moving from OLS to FE estimators. This outcome suggests that our benchmark wage-upstreamness elasticity is largely driven by variability in upstreamness and wages within firms.

Next, we applied the FE estimator to Equation (4), which notably includes a dummy variable set equal to 1 when the firm-level share of workers born in developing countries is above the sample mean and an interaction term between this dummy and the upstreamness variable. The results, presented in column (3) of Table 3, indicate that average gross hourly wages are significantly and positively correlated with the level of upstreamness (0.013) and significantly lower in firms in which the proportion of workers born in developing countries is higher than the sample average (−0.024). We also find that the interaction term between upstreamness and the dummy variable indicating whether the share of workers born in developing countries in the firm is higher than the sample average is not statistically significant. This result again suggests that the correlation between upstreamness and wages does not depend on the origin of workers.

Overall, our firm-level panel data estimates are largely consistent with the results of our benchmark specification based on multiple cross-sections of worker-level data. Moreover, they reinforce the latter by showing that the positive correlation between upstreamness and wages, which does not significantly vary according to workers' origin, is at least partly driven by the variability in upstreamness and wages within firms.

TABLE 3 Firm-level OLS and FE estimates.

Dependent variable: Logarithm of firm-level average gross hourly wage	OLS (1)	FE (2)	FE (3)
Firm-level upstreamness[a]	0.016*** (0.002)	0.015*** (0.002)	0.013*** (0.002)
Firm-level upstreamness × dummy = 1 if the firm-level share of full-time equivalent workers born in developing countries is above the sample average			0.007 (0.004)
Dummy = 1 if the firm-level share of full-time equivalent workers born in developing countries is above the sample average			−0.024** (0.012)
Control variables[b]	Yes	Yes	Yes
Adjusted R^2/within R^2	0.65	0.66	0.66
Number of observations	10,058	10,058	10,058

Note: By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification. Cluster-robust standard errors are presented between parentheses. ***, ** and * significant at 1%, 5% and 10% levels, respectively.

[a]Steps (weighted distance) before the production of firm meets either domestic or foreign final demand.

[b]Control variables include the share of workers by (a) level of education [i.e., the share of workers with (i) a general upper secondary, technical/artistic/professional upper secondary degree and (ii) higher non-university, university and post-graduate degree, respectively; the share of workers with no degree, primary/lower secondary degree being the reference category], (b) years of tenure (i.e., the share of workers with: (i) between 2 and 4 years of tenure, (ii) between 5 and 9 years of tenure and (iii) at least 10 years of tenure, respectively; the share of workers with up to 1 year of tenure being the reference category), (c) age (i.e., the share of workers: (i) aged up to 29 and (ii) over 49, respectively; the share of workers between 30 and 49 being the reference category), (d) gender (i.e., the share of female workers), (e) employment contract (i.e., the share of workers with (i) a fixed-term and (ii) an apprenticeship or interim contract, respectively; the share of workers with an open-term contract being the reference category), (f) working time (i.e., the share of part-time workers), (g) occupation (i.e., the share of (i) managers, (ii) professionals, (iii) technicians and associate professionals, (iv) clerical and support workers, (v) craft and related trades workers, (vi) machine operators and (vii) service workers, respectively; the share of elementary occupations being the reference category), level of wage bargaining (one dummy for the presence of a collective agreement at the firm level), logarithm of the number of full-time equivalent workers, location (two dummies for Brussels and Wallonia, Flanders being the reference category), type of economic control (dummy if the firm is more than 50% privately owned) and time dummies.

3.3 | Are the gains from upstreamness shared equally along the wage distribution?

So far, the consequences of firm-level upstreamness have been estimated at the mean value of the earnings distribution. However, the gains associated with upstreamness could be significantly different between high- and low-wage workers. In addition, the outcomes along the wage distribution could differ between workers born in developed and developing countries. To examine this issue, we rely on unconditional quantile regressions (UQR) with block-bootstrapped standard errors (Daouli et al., 2013; Firpo et al., 2009). As a robustness test, we also apply the more conventional conditional quantile regressions (CQR) approach (Koenker & Bassett, 1978; Machado & Mata, 2005; Melly, 2005), adapted to clustered data as suggested by Parente and Santos (2016).

TABLE 4 OLS, conditional (CQR) and unconditional (UQR) quantile regressions, overall and by origin.

Dependent variable: logarithm of the gross hourly wage	OLS (Mean)	Quantile estimates (0.25)	(0.5)	(0.75)
All workers				
Upstreamness[a] (CQR)	0.021*** (0.002)	0.017*** (0.002)	0.019*** (0.002)	0.025*** (0.002)
Upstreamness[a] (UQR)	0.021*** (0.002)	0.016*** (0.001)	0.019*** (0.002)	0.030*** (0.003)
Workers born in developed countries				
Upstreamness[a] (CQR)	0.021*** (0.002)	0.017*** (0.002)	0.019*** (0.002)	0.025*** (0.002)
Upstreamness[a] (UQR)	0.021*** (0.002)	0.016*** (0.002)	0.019*** (0.002)	0.031*** (0.004)
Workers born in developing countries				
Upstreamness[a] (CQR)	0.020*** (0.003)	0.013*** (0.003)	0.014*** (0.003)	0.017*** (0.004)
Upstreamness[a] (UQR)	0.020*** (0.003)	0.014*** (0.004)	0.013*** (0.003)	0.018*** (0.005)
Number of observations for:				
All workers	245,418	245,418	245,418	245,418
Workers born in developed countries	233,432	233,432	233,432	233,432
Workers born in developing countries	11,986	11,986	11,986	11,986

Note: By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification. Clustered and block-bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported between parentheses for OLS and UQR, respectively. ***, ** and * significant at 1%, 5% and 10% levels, respectively.

[a]Steps (weighted distance) before the production of firm meets either domestic or foreign final demand. All specifications include control variables, covering worker characteristics, firm characteristics and year dummies. For more details, see Table 2.

Results, presented in Table 4, first show that the UQR and CQR estimates are similar for the two populations considered, namely for workers born in developed and developing countries. Next, whereas the OLS results indicate that the impact of upstreamness is not significantly different between the two populations at the mean value of wages, the UQR and CQR estimates reveal substantially larger differences according to workers' origin when considering the whole wage distribution. Indeed, for workers born in developed countries, the UQR (CQR) coefficients associated with upstreamness are found to increase by almost 100% (50%) along the wage distribution, from 0.016 (0.017) at the 25th percentile of the wage distribution to 0.031 (0.025) at the 75th percentile, these estimates being statistically different from each other. For workers born in developing countries, the pattern is much flatter: the UQR (CQR) estimates remain almost unchanged between the 25th percentile and the median, standing at around 0.014 (0.013), and then rise to 0.018 (0.017) at the 75th percentile of the wage distribution.[8] The gap in the wage-upstreamness elasticity by origin thus increases along the wage distribution: it is small at the 25th percentile (around 22%), moderate at the median (around 41%), and much more pronounced at the 75th percentile (around 60%). In sum, our results show that the gains from upstreamness are unequally shared among workers: most of the gains are captured by workers born in developed countries, and in particular by those at the top of the wage distribution. Workers born in developing countries, regardless of their earnings, benefit much less from being employed in firms positioned higher up in the value chain.[9]

TABLE 5 Mean and quantile decompositions of the wage gap by origin.

	Workers born in developed vs. developing countries			
		Quantile estimates		
	OLS (Mean)	(0.25)	(0.5)	(0.75)
Gross hourly wage gap between workers born in developed and developing countries (in logs)	0.104	0.075	0.100	0.149
Magnitude				
Compositional effect of upstreamness	0.003	0.002	0.002	0.005
Wage structure effect of upstreamness	0.012	0.011	0.027	0.076
Magnitude (in %)				
Composition effect of upstreamness	2.9	2.7	2.0	3.4
Wage structure effect of upstreamness	11.5	14.7	27.0	51.0

Note: By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification. Decompositions are based on unconditional quantile regression (UQR) estimates, namely, the methodology developed by Fortin et al. (2011).

3.4 | How much does upstreamness contribute to the wage gap by origin?

To deepen our understanding of the role of upstreamness in explaining wage differences by workers' origin along the wage distribution, we applied an extension of the Oaxaca (1973) and Blinder (1973) decomposition, based on the methodology developed by Fortin et al. (2011). Our purpose is to estimate, for each quantile of the wage distribution, which proportion of the overall origin-based wage gap can be attributed to (i) differences in mean values of upstreamness by origin (i.e., the compositional effect or explained part) and (ii) differences in wage-upstreamness elasticities by origin (i.e., the wage structure effect or unexplained part). The mean and quantile decompositions are presented in Table 5.

The first row of Table 5 shows that the overall wage gap by origin, measured as the difference between the average log gross hourly wages of workers born in developed and developing countries, is equal to 0.104. This wage gap almost doubles along the wage distribution. More precisely, it stands at 0.075 at the 25th percentile and rises up to 0.149 at the 75th percentile. Table 5 also presents the contribution of upstreamness (both the compositional and wage structure effects) to the wage gap by origin (Magnitude), and its relative contribution to the overall wage gap by origin (Magnitude (in %)). The results of the decomposition first show that the contribution of compositional effects to the overall wage gap according to workers' origin is very small along the wage distribution. The differences in average upstreamness values according to origin only represent between 2% and 3.4% of the overall wage gap (i.e., a maximum of 0.5 log point). As far as the effects of the wage structure are concerned, the results are quite different. At the 25th percentile, differences in wage-upstreamness elasticities by origin explain about 15% of the overall wage gap (1.1 log points). At higher quantiles, upstreamness relative contribution to the wage gap by origin is even larger: it amounts to 27% at the median value of the wage distribution (2.7 log points) and 51% at the 75th percentile (7.6 log points). Overall, we find that origin-based differences in wage premia associated with upstreamness explain a

significant part of the wage gap between workers born in developed and developing countries at the bottom and, even more so, at the top of the earnings distribution. As wage structure effects are often considered to reflect discrimination (i.e., factors unrelated to differences in endowments/productivity),[10] our results suggest that the gains from upstreamness are shared unfairly, to the detriment of workers born in developing countries, especially those that are higher up in the wage distribution.

4 | CONCLUSION

Although substantial research has been devoted to the analysis of wage differences according to workers' origin in OECD countries, surprisingly little is known about the role of global value chains (GVCs) in these wage differences (Chen, 2017; Lopez Gonzalez et al., 2015; Shepherd, 2013). In this article, we focus on a particular aspect of GVCs that has been receiving increasing attention, namely the relative position of firms in GVCs, measured by their level of upstreamness (i.e., the average number of steps/transactions before the production of a firm meets final demand). More precisely, using detailed linked employer–employee data for the Belgian manufacturing industry, we provide first evidence on the impact of a direct measurement of firm-level upstreamness on wages according to workers' origin (i.e., for workers born in developed countries and in developing countries, respectively). We also add to the existing literature by assessing the role of firm-level upstreamness in explaining the origin-based wage gap. We perform this analysis at the mean value of the earnings distribution but also at different quantiles.

Our estimates show that firms that are further up in the value chain pay significantly higher wages, even after controlling for group effects in the residuals, a large set of worker and firm characteristics, and time-fixed effects. More precisely, they suggest that if a firm's upstreamness increases by one step (i.e., if a firm moves one step further away from the final consumer), wages increase on average by about 2%. However, the wage premium associated with upstreamness is also found to vary substantially according to workers' origin along the wage distribution. Unconditional quantile estimates suggest that those who benefit the most from being employed in more upstream firms are (high-wage) workers born in developed countries, whereas workers born in developing countries, irrespective of their earnings, appear to be unfairly rewarded. Quantile decompositions further show that, while differences in average values of upstreamness according to workers' origin play a limited role, differences in wage premia associated with upstreamness account for a substantial part of the origin-based wage gap, especially at the top of the earnings distribution.

Sensitivity tests, based on firm-level fixed effects estimates, emphasize the role played by within-firm changes in upstreamness to explain workers' wages. Instrumental variable regressions, addressing the potential endogeneity of firm-level upstreamness, also support our conclusions. As for origin, several robustness tests have been run considering various components of workers' wages as well as different firm environments in terms of technological and knowledge intensity. These robustness tests indicate that the larger wage premium obtained by (high-wage) workers from developed countries is not driven solely by differences in overtime hours and shift/night/weekend work, but also by differences in other pay components, including base pay. They also confirm our conclusion by showing that benchmark estimates remain valid in both high-tech/knowledge and low-tech/knowledge environments.

In sum, our results suggest that the rents generated by more upstream firms in the Belgian manufacturing industry are unfairly distributed between workers born in developed and

developing countries, especially at the top of the earnings distribution. In other words, it seems that the unexplained part of the origin-based wage gap associated with upstreamness reflects, at least partly, non-productive factors.

Results from our benchmark specification showing the existence of a significant, positive relationship between wages and upstreamness back up the idea that firms higher up the value chain are likely to be more productive (e.g., due to increased market power, strong control over high value-added downstream activities, better ability to learn about new technologies and products, and knowledge transfers from highly productive customers to suppliers) and that these additional productivity gains will be shared with workers through higher wages. Our results are also consistent with the existing literature, which suggests that workers born in developing countries may benefit less from the productivity gains achieved by firms located further upstream, particularly because of (i) origin-based differences in information, power and authority, (ii) a less effective representation by trade unions and (iii) a more inelastic labour supply. Moreover, our estimates showing that the wage-upstreamness elasticity increases along the wage distribution corroborate theoretical arguments notably based on the greater oligopolistic power of tertiary educated workers (who tend to be at the higher end of the wage distribution). Finally, our finding suggesting that most of the gains are captured by high-wage workers from developed countries may be explained by origin-based differences in (i) human capital (if, e.g., degrees obtained in developing countries are of a lower quality or less valuable in the host country), and (ii) the oligopolistic power of highly educated workers (if, e.g., immigrants from developing countries are less well informed of the functioning of the host country and its institutions, and have a less broad and effective network). In addition, the setting of wages (and in particular bonuses) on the basis of the relative performance of workers could also help to explain our finding, especially in the case of statistical or taste-based discrimination against immigrants from developing countries (which would lead to the undervaluation of their performance and result in unfair bonus payments).

Results presented in this article are robust to various sensitivity tests. Yet, they should not be interpreted as causal due to possible remaining endogeneity. Finding an instrument for firm-level upstreamness that is both relevant and exogenous remains indeed a very difficult task. With the method of Fortin et al. (2011), we have taken a first step in this direction by estimating a counterfactual wage distribution for workers born in developing countries, i.e., the wage distribution that would characterize workers from developing countries if they received the same returns to their labour market characteristics as workers born in developed countries. That said, the application of propensity score matching would be useful to eliminate any imbalance between workers from developed and developing countries when estimating the wage-upstreamness elasticity by origin. Finally, as our results concern the Belgian manufacturing industry (which only accounts for circa 15% of total employment and GDP in Belgium (National Bank of Belgium, 2022)), it would be probably most appropriate to test their validity in other contexts. It would indeed be particularly interesting to carry out a sensitivity analysis for other sectors or countries with, for example, different product and labour market characteristics and/or with a different positioning in GVCs.

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ENDNOTES

[1] The SES is a cross-sectional dataset that allows to follow firms over time. It is representative of all firms in the manufacturing industry employing at least 10 workers. For an extended discussion, see Demunter (2000).

[2] Only for a few enterprises, such as sole traders and those who are not required to fill VAT declarations, this index has not been computed by Dhyne et al. (2015).

[3] By *developing countries*, we actually refer to both transition and developing countries listed in the United Nations Conference on Trade and Development (UNCTAD) (2020) classification.

[4] As expected, we also find that the regression coefficients associated with the dummy variables for workers born outside Belgium and in developing countries, respectively, are negative and statistically significant (and equal to −0.019 and −0.043, respectively).

[5] Furthermore, despite the fact that Equations (1) and (2) include a large number of covariates, we cannot exclude that our OLS estimates may suffer from an endogeneity bias, as wages and upstreamness may be related to unobserved characteristics. To address this potential issue, we adopted a two-stage least squares (2SLS) estimator, using as instrumental variables (IVs) proxies of the firm-level price elasticity of demand, as Alfaro et al. (2019) have shown that a firm's decision to engage with upstream or downstream suppliers is influenced by the magnitude of this elasticity. Our results, including an array of validity tests, are presented and discussed in the Supporting Information S3 available online. Overall, they indicate that our main explanatory variable (i.e., upstreamness) is exogenous and that OLS estimates should be preferred to those obtained by 2SLS. However, this conclusion should be taken with caution. Indeed, it remains very difficult to find a valid instrument, i.e., a variable that is both relevant (i.e., a good predictor of firm-level upstreamness) and exogenous (i.e., uncorrelated with the dependent variable). Accordingly, while estimates presented so far strongly support the existence of a significant wage premium associated with firm-level upstreamness, they should not be interpreted as causal.

[6] For the sake of brevity, in the remainder of this article we will only analyse the impact of upstreamness on the wages of workers born in developed and developing countries, respectively. Indeed, as our descriptive statistics show, workers born in Belgium are very similar to workers born in developed countries as a whole, whereas the differences between the latter and workers born in developing countries are quite large, and therefore interesting to study further. Other studies for Belgium (e.g., Federal Public Service Employment, Labour and Social Dialogue, & Unia, 2017; Grinza et al., 2020; Pineda-Hernandez et al., 2022) also make this point.

[7] Descriptive statistics relative to this firm-level dataset are presented in column (6) of Table 1.

[8] The OLS regression coefficient (estimated at the mean) for workers born in developing countries is somewhat higher than those obtained by CQR and UQR, even at the 75th percentile. This could be due to the skewness of the wage distribution of workers born in developing countries, which is significantly larger than that of workers from developed countries (10.8 vs. 4.98). In a positively skewed distribution, the mean tends indeed to be larger than the median because the data are more on the lower side.

[9] Note that this conclusion remains valid when (a) considering the level of technology and knowledge intensity of firms employing workers from developed and developing countries, and (b) focusing on the different components of workers' wages. More precisely, our results show that the larger wage premium obtained by (high-wage) workers from developed countries is not driven solely by differences in overtime hours and shift/night/weekend work, but also by differences in other pay components, including base pay. They also confirm our conclusion by showing that benchmark estimates remain valid in both high-tech/knowledge and low-tech/knowledge environments. For an extended discussion of these robustness tests, see Tables S4 and S5.

[10] However, wage structure effects might also reflect differences in unobserved productivity-related characteristics, such as knowledge of languages.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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