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Wage Differences According to Workers' Origin: The Role of Working More Upstream in GVCs

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Wage Differences According to Workers' Origin:

The Role of Working More Upstream in GVCs

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Abstract

This paper is the first to investigate the role of firm-level upstreamness (i.e. the number of steps before the production of a firm meets final demand) in explaining wage differences according to workers' origin. Using unique linked employer-employee data relative to the Belgian manufacturing industry for the period 2002-2010, our estimates show that firms that are further up in the value chain pay significantly higher wages. However, the wage premium associated with upstreamness is also found to vary substantially depending on the origin of the workers. 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. In contrast, 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 wage gap between workers born in developed and developing countries, especially at the top of the earnings distribution. These results are shown to be robust to a number of sensitivity tests, including broader or narrower definitions of workers' wages and different firm environments in terms of technological and knowledge intensity.

Keywords: Wage Gaps, Workers' Origin, Global Value Chains, Upstreamness, Unconditional Quantile Estimates and Decompositions.
JEL classification: J15, J31, F16

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Introduction

Wage differences according to workers' origin are well documented in the literature (Chiswick, 1978; 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. Chiswick, 1991; Chiswick & Miller, 1995; Borjas, 1999; Carnevale et al., 2001; Dustmann & van Soest, 2002), literacy skills (Ferrer et al., 2004; Himmler & Jäckle, 2018), schooling quality (Sweetman, 2004), job tenure attainment (McDonald & Worswick, 1998), and different school-to-work transitions (Friedberg, 2000; Neels, 2000; Aydemir & Skuterud, 2005; Euwals et al., 2010; Baert & Cockx, 2013). 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 (Aydemir & Skuterud, 2008; Elliott & Lindley, 2008; Peri & Sparber, 2009). Wage differences according to workers' origin may also result from discriminatory behaviours (e.g. Aydemir & Skuterud, 2008; Chiswick et al., 2008; Aeberhardt & Pouget, 2010; Barrett et al., 2012). According to Heckman (1998), wage discrimination occurs when two equally productive workers are paid differently on the basis of different non-productive characteristics, such as their origin.

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 (Shepherd, 2013; Lopez Gonzalez et al., 2015; Chen, 2017). Over the last thirty years, production processes have indeed become increasingly fragmented and divided into ever smaller parts, considered as separate activities (OECD, 2013). In order to minimize costs, the production decision process now involves the sourcing of inputs from multiple suppliers, often located in foreign countries (Antràs et al., 2012; Manello et al., 2016). This has resulted in the emergence of GVCs, that is, a situation where it becomes easier and sometimes inevitable for firms to unbundle factories in order to achieve economies of scale and obtain comparative advantages (Baldwin, 2011). 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 and immigrants (Feenstra & Hanson, 1996; Rossi, 2013). 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 according to their origin and have found differences in the returns of these aspects, often to the detriment of immigrant workers (Abd Rahman et al., 2019; Farole, 2016).

One particular 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 number of steps before their production meets either domestic or foreign final demand). Indeed, as highlighted by Farole (2016: 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*". A couple of recent papers have been able to investigate whether firm-level upstreamness matters for the creation of value.[2] 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 tend 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, whereas intermediate activities (e.g. manufacturing) tend to bring less value. 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. The studies of Dhyne et al. (2015) and Mahy et al. (2018) provide a similar conclusion, using Belgian panel data, and confirm De Backer and Miroudot's (2013) assertion that companies need to "move up the value chain", i.e. to specialize in the early stages of production, in order to create more value. 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.

Evidence on the impact of upstreamness on workers' wages is also scarce. Put differently, little is known on whether and to what extent the productivity gains associated with a firm's position in GVCs are shared with its workers. Moreover, the question whether all workers benefit equally from these productivity gains is still largely unexplored. The study by Szymczak et al. (2019) is one of the first to investigate this issue. Using industry-level data on Central and Eastern European countries, the authors 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. (2018) examine a similar question at the firm level. Their findings for the Belgian private sector suggest that the productivity gains obtained by firms operating more upstream are shared equally between profits and total labour costs. Yet, the study by Gagliardi et al. (2021), also focusing on

[2] The scarcity of evidence on this issue can be explained by the relative newness of accurate measurements of the position of a firm in a global value chain (GVC), such as upstreamness (see Antràs et al., 2012; Fally, 2012), and especially by the difficulty to obtain the data necessary to compute these measurements.

Belgium, indicates that women benefit much less than men from being employed in more upstream firms. Chen (2017) investigates within-firm wage inequality across heterogeneous industries that hold different positions in the domestic value chain of the Chinese manufacturing industry. The author's estimates show 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. Moreover, the authors' estimates suggest a positive impact of upstreamness on workers' wages, tending to be more pronounced among the highly educated.

To 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. The present article aims to fill this gap in the literature by providing first evidence of the impact of a direct measurement of firm-level upstreamness on wages according to workers' origin (i.e. for workers born in developed and developing countries, respectively) and on whether it varies depending on the workers' level of remuneration. We also add to the existing literature by assessing the role of firm-level upstreamness in the explanation of the origin-based wage gap. To this end, we first examine whether workers born in developed and developing countries are employed in firms with different average upstreamness indices and to what extent this composition effect contributes to the wage gap between these two groups of workers. The underlying assumption is that workers born in developed countries earn higher wages than those born in developing countries because the former tend to be employed in firms with a higher position in the value chain, thus creating more value added and paying better wages. Second, we investigate whether the productivity gains associated with firm-level upstreamness are shared equally between workers born in developed and developing countries. Put differently, we test whether the elasticity between workers' wages and firm-level upstreamness varies according to workers' origin, and we evaluate to what extent this wage structure effect contributes to the origin-based wage gap. This exercise is performed not only at the mean value of the earnings' distribution, but also at different quantiles.

To achieve these objectives, 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) transaction 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.[3,4] 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, job, and firm characteristics. We also provide estimates addressing the potential endogeneity of upstreamness and 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). 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 (Oaxaca, 1973; Blinder, 1973) based on UQR techniques, namely the methodology developed by Fortin et al. (2011). Finally, we provide some robustness tests aiming to: i) examine whether our results are driven by the possible over-representation of workers born in developed countries in high-tech/knowledge intensive firms, as the effect of upstreamness on both value added and wages is expected to be higher in these firms; and ii) test the sensitivity of our estimates to different components of workers' wages (e.g. base pay, overtime compensation, premia for shift/night/weekend work, bonuses) to uncover potential transmission channels.

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, which shows that Belgium sources more inputs from abroad and produces more inputs used in GVCs than most other OECD countries (OECD, 2013). According to De Backer and Miroudot (2013), the GVC participation index for firms in Belgium stands at around 60%. The estimates by Dhyne et al.

[3] A few i) micro-enterprises, which are almost sole traders and who do not have to fill VAT declarations, and ii) firms that have no enterprise-to-enterprise transactions inside Belgium (i.e. they only report import, export or sell to final demand) are not included in the dataset provided by Dhyne et al. (2015).
[4] We have access to the fully anonymized version of the merged data, preventing us from directly identifying any individual firm.

(2015) further indicate that 82% (99%) of enterprises in Belgium produced (consumed) goods and services that were directly or indirectly exported (imported) between 2002 and 2012. Last but not least, the manufacturing industry, which is the core 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). This industry is thus an ideal candidate for our investigation on the consequences 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. In 2017, the employment rate for foreign-born individuals was approximately 57%, compared to about 65% for natives (OECD, 2020). For immigrants born outside Europe, this rate drops even further, to about 50% (Eurostat, 2020). As regards the gross hourly wage gap between natives and immigrants in Belgium, the ILO (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% after controlling for a wide range of covariates (including average firm-level productivity), 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 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 according to workers' origin 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. The next section presents the dataset and descriptive statistics. Section 3 describes our methodology, main econometric results, and robustness tests. The last section 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[5]. 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 transactions and/or transformations (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

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

additional transformation by other firms, multiplied by the factor 2 (as two transactions are needed to meet final demand), (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).

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 analysis, we divided workers into two groups: those born in developed countries and those born in developing countries. To make this subdivision, we relied on the nomenclature provided by UNCTAD (2020), which is built on basic economic conditions such as geographical location and similarities in economic structure.[6]

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.

[Insert Table 1 here]

Table 1 presents the means and standard deviations of selected variables for the overall sample in column (1), for workers born in developed countries in column (2), and for workers born in developing countries in column (3). We find a clear difference in the average gross hourly wages between workers born in developed countries and those born in developing countries. This difference amounts to 13% in favour of the former (16.6 vs. 14.7 euros). The descriptive statistics also show that workers born in developed countries are employed in firms that are, on average, higher up in the value chain (2.71 steps away from the final consumer) than those born in developing countries (2.57 steps). Among workers born in 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 to workers born in developed countries, we find a higher share of male, low-educated, prime-age, part-time and less tenured workers among those born in developing countries. In contrast, the proportion of workers with open-term contracts, in high- or medium-

[6] By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification.

high-skilled occupations (according to the ILO (2012) classification), covered by a firm-level collective agreement, and employed in bigger firms is higher among those born in developed countries.

Appendix Table A1 shows descriptive statistics according to firms' level of upstreamness and by workers' region of birth. The threshold for 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 euros). 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 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 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 developed and developing countries, respectively) is the following:

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

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 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 and job characteristics: 2 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), 3 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), 2 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, 2 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 dummy for part-time workers, and 7 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), 2 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 $\varepsilon_{j,t}$ is the error term.

[Insert Table 2 here]

OLS estimates of equation (1), reported in columns (1) to (3) of Table 2, show the impact of upstreamness on the wages of all workers, regardless of their origin, and depending on whether they were born in developed or 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 coefficients associated with upstreamness are significantly positive, amounting to 0.021 and 0.020 for workers born in developed and developing countries, respectively. 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.[7]

3.2 A potential endogeneity bias?

Although we use a large number of covariates, our OLS estimates may suffer from an endogeneity bias, as wages and upstreamness may be related to unobserved characteristics. Indeed, it is possible that a firm's upstreamness and its export behaviour are correlated in the sense that the number of steps before the firm's output meets final demand is likely to be larger among exporting firms (Amador & Cabral, 2016). It is also possible that wages are positively correlated with firms' export behaviour, as exporting firms are likely to be more productive (Baldwin & Yan, 2017). To address this potential problem, we rely on a two-stage least squares (2SLS) approach.

Alfaro et al. (2019) show that a firm's decision to engage with upstream or downstream suppliers or consumers depends on the price elasticity of the demand for its goods. Specifically, the authors find that a firm is more likely to integrate into relatively upstream stages in the value chain when the price elasticity of the demand for its product is low. Therefore, we selected instrumental variables (IVs) that reflect the price elasticity of demand at the firm level. More precisely, we selected the following six IVs: (i) the median share of the firm's sales in total clients' purchases, (ii) a concentration index (i.e. Herfindahl-Hirschmann) of domestic customers, (iii) a concentration index (i.e. Herfindahl-Hirschmann) of domestic suppliers, and (iv, v, vi) the cubic values of these three variables to account for possible non-linearities. Firm-level information on these IVs comes from the Structure of Business Survey (SBS) and enterprise-level input-output tables (IOTs), and in particular from calculations made by Dhyne and Duprez (2015) for each year between 2002 and 2010 based on the values of transactions between firms. The data gathered from the SBS and IOTs were merged with our initial SES/NBB-B2B/NR sample by Statistics Belgium, in collaboration with the National Bank of Belgium, using the firms' VAT numbers. Our first IV is a proxy for the firm-level price

[7] Similar results were found using interaction effects. In other words, instead of splitting the sample into two subsamples according to workers' origin, we used OLS to estimate a single regression including, in addition to the covariates mentioned above, the upstreamness index, a dummy variable for workers born in developing countries, and the interaction between these two variables. The estimates show that while the regression coefficient associated with upstreamness is statistically significant and equal to 0.020, that of the interaction term is not significant, again suggesting that there is no difference in the effect of upstreamness on wages by origin.

elasticity of demand. Indeed, the larger the median share of a firm's sales in total clients' purchases, the smaller the firm's price elasticity of product demand is expected to be. As regards our second and third IVs, predictions are less clear-cut. A more concentrated pool of clients or suppliers might either increase or decrease the firm's elasticity of product demand. It notably depends on the outside options available to those clients or suppliers. Accordingly, we expect our first IV to have a positive effect on the value of upstreamness in the first-stage regression, whereas the effects of our second and third IVs should depend on whether they are positively or negatively related with the price elasticity of product demand for the firms in our dataset.

2SLS estimates, using the same covariates as in equation (1), are presented in columns (4) to (6) of Table 2. They again show that upstreamness has a positive and significant impact on workers' wages. However, we now also find that the elasticity between wages and upstreamness is significantly higher for workers born in developed countries than for those born in developing countries (0.036 versus 0.029). To assess the soundness of the 2SLS approach, we performed an array of statistical tests, the results of which are reported at the bottom of columns (4), (5), and (6). First-stage estimates indicate that our first two IVs (i.e. the median share of the firm's sales in total clients' purchases and the concentration index of domestic customers) have an overall positive and significant impact on firm-level upstreamness, whereas our third IV (i.e. the concentration index of domestic suppliers) has a negative and significant impact on firm-level upstreamness. The cubed values of these variables are also generally found to have a significant impact on upstreamness. These first-stage estimates thus suggest that our IVs are not weak, which is also corroborated by the Kleibergen-Paap rk Wald *F* statistic for weak identification. The latter is indeed well above 10, i.e. the standard 'rule of thumb' critical value (van Ours & Stoeldraijer, 2011), in all specifications. Moreover, we can reject the null hypothesis that our first-stage equation is under-identified, as the Kleibergen-Paap rk LM statistic is found to be highly significant. Next, to examine whether our instruments fulfil the exogeneity condition, we computed correlations between our IVs and workers' individual gross hourly wages. Findings, presented in Table A2, show that all correlation coefficients are relatively small (between 0.004 and 0.076). Accordingly, they support the assumption that our IVs are fairly exogenous with respect to workers' individual wages.[8] Finally, regarding the

[8] This outcome is not unexpected. Indeed, our first IV is a proxy for the price elasticity of the demand for the firm's product. Put differently, it is an imprecise measurement of a firm's market power, and in particular of its capacity to generate rents, which may, in turn, benefit workers' wages through rent-sharing (Matano & Naticchioni, 2017; Dobbelaere & Mairesse, 2018). The capacity for a firm to create rents is contingent on many factors beyond our

Durbin-Wu-Hausman endogeneity test, the *p*-values associated with the χ^2 statistic are all greater than 0.10. Overall, this implies that the null hypothesis of no endogeneity should not be rejected, i.e. that our main explanatory variable can actually be treated as exogeneous and that OLS estimates (reported in columns (1) to (3) of Table 2) should be preferred to those obtained by 2SLS.

3.3 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 they are driven by variability in upstreamness within and/or between firms, we ran a robustness test with firm-level panel data. In other words, we aggregated our initial sample, covering the period 2002-2010, at the firm level in order to estimate the elasticity between upstreamness and the mean value of workers' wages and to test whether this elasticity varies according to the share of workers employed in those firms that were born in developing countries. More precisely, we estimated the following equations:

$$log(w_{j,t}) = \beta_0 + \beta_1 up_{j,t} + \beta_2 X_{j,t} + \beta_3 Y_{j,t} + \delta_t + \varepsilon_{j,t} \quad (2)$$

$$log(w_{j,t}) = \beta_0 + \beta_1 up_{j,t} + \beta_2 mig_{j,t} + \beta_3 up_{j,t} * mig_{j,t} + \beta_4 X_{j,t} + +\beta_5 Y_{j,t} + \delta_t + \varepsilon_{j,t} \quad (3)$$

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 (FTE) 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

first IV. These factors notably include the firm's number of clients, the ease with which clients can switch to alternative suppliers, the degree of concentration among the firm's suppliers, and the overall competition on the firm's main product market. The relationship between our first IV and a firm's capacity to create rents is thus not univocal. Moreover, empirical evidence suggests that the magnitude of rent-sharing in the Belgian economy, that is, the elasticity between wages and firms' rents, is quite small. On average, a doubling of firm-level profits-per-worker is found to increase workers' wages by around 3% (Rycx & Tojerow, 2004; Rusinek & Rycx, 2013). This outcome is consistent with the studies showing that the dispersion of inter-industry wage differentials in Belgium is quite limited compared to other advanced economies, a finding that is notably attributed to the strong centralization of the Belgian collective bargaining system (Rycx, 2002; Du Caju et al., 2011). Similar arguments help to explain why the correlation between our second and third IVs (i.e. the concentration of a firm's domestic customers and the concentration of its domestic suppliers) and workers' wages is also found to be very small. In addition, it should be noted that our second and third IVs refer to domestic clients and suppliers only, while manufacturing firms in Belgium are massively exporting and importing, that is, have many of their clients and suppliers abroad.

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.

[Insert Table 3 here]

We estimated equation (2) with both pooled OLS and a fixed effects (FE) estimator (i.e. a mean-differentiated model accounting for unobserved time-invariant heterogeneity in firms). 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 estimations. 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 (3), 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 affected by the level of upstreamness (0.013) and negatively affected when the firm-level proportion of workers born in developing countries is above the sample average (-0.024). We also find that the interaction term between upstreamness and the share of workers born in developing countries is not statistically significant. This result suggests that the influence of upstreamness on wages does not depend on the origin of the 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 influence of upstreamness on wages, which does not significantly vary according to workers' origin, is at least partly due to the variability in upstreamness and wages within firms.

3.4 Are the gains 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 (Fitzenberger & Kurz, 2003; Cameron et al., 2008; Firpo et al., 2009; Daouli et al., 2013). 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 Silva (2016).

[Insert Table 4 here]

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. 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. In contrast, workers born in developing countries, regardless of their earnings, benefit much less from being employed in firms positioned higher up in the value chain.

3.5 To what extent does upstreamness contribute to the wage gap by workers' 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.

[Insert Table 5 here]

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 in percentage points ('Magnitude') and as a percentage of 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, the contribution 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)[9], 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.

3.6 Robustness tests

a) Firms' technological and knowledge intensity

One may question whether the results we have obtained so far may be dependent on the level of technological and knowledge intensity characterizing firms. On the one hand, the literature indeed suggests that participation in GVCs is more productivity-enhancing for high-tech and knowledge-intensive firms (HT-KIS) (OECD, 2013; Benkovskis et al., 2020). It is also argued that firms that are positioned higher up in the value chain and provide HT-KIS inputs, such as key technological components (e.g. electric batteries) or R&D services (e.g. vaccine development), often create more value added and hence pay higher wages than those providing more generic goods or services (e.g. the sale of unprocessed agricultural products, such as milk). On the other hand, HT-KIS firms are likely to employ a more skilled workforce. Therefore, given that workers from developed countries are generally more educated, it could be argued that these workers will be over-represented in HT-KIS firms, i.e. in firms where the benefits of being more upstream are higher, and that our results may be driven by this over-representation. Therefore, our first robustness test aims to analyse whether: i) workers born in developed countries are over-represented in HT-KIS firms, ii) the elasticity between wages and upstreamness is higher in these firms, and iii) our results are still valid when controlling for these two potential effects.

To this end, we first divide our sample of workers into two groups according to whether or not they are employed in HT-KIS firms. For this division, we rely on the HT-KIS nomenclature developed by Eurostat (2016), which allows the classification of firms as high-tech/knowledge (HT-KIS) or low-tech/knowledge (LT-LKIS) based on their NACE codes at 2 digits. Second, we also split our sample according to whether the workers were born in developed or developing countries, respectively.

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

[Insert Table 6 here]

The first column of Table 6 shows that 37% of workers born in developed countries are employed in HT-KIS firms, compared to only 33% of workers born in developing countries. The results also show that workers born in developed countries represent almost 96% of those employed in HT-KIS firms and slightly less than 95% of those employed in LT-LKIS firms. It can therefore be concluded that, overall, the over-representation of workers born in developed countries is slightly higher in high-tech/knowledge than in low-tech/knowledge firms.

Regarding the size of the elasticity between wages and upstreamness, results in column (2) of Table 6 support the hypothesis that being further up in the value chain is more rewarding for workers employed in HT-KIS firms, regardless of their origin. At the mean value of wages, the elasticity is indeed estimated at 0.027 among HT-KIS firms for both categories of workers, and at 0.018 and 0.016 among LT-LKIS firms for workers born in developed and developing countries, respectively. Unconditional quantile estimates, reported in columns (3) to (5) of Table 6, further show that: i) the gap in wage-upstreamness elasticities between HT-KIS and LT-LKIS firms increases along the earnings distribution; ii) regardless of firms' technological and knowledge intensity, the wage premium for workers employed in more upstream firms is higher for workers born in developed countries than for those from developing countries; and iii) high-wage workers born in developed countries and employed in HT-KIS firms are the main beneficiaries of more upstream positions.

To sum up, our estimates support the hypothesis that being higher up in the value chain is more rewarding for workers employed in HT-KIS firms. However, they also indicate that the over-representation of workers from developed countries among HT-KIS firms is only slightly higher than among LT-LKIS firms. Furthermore, they show that our main finding, i.e. that (high-wage) workers from developed countries are the main beneficiaries of firms' more upstream positions, holds true in both high- and low-tech/knowledge environments. Accordingly, our first robustness test validates and even reinforces the results we have obtained so far.

b) Different components of workers' wages

Our second robustness test aims to identify the role of compensating differentials associated with longer and more atypical hours (i.e. over-time and shift/night/weekend work) in explaining differences in wage-upstreamness elasticities between workers born in developed and developing countries. To this end, we re-estimate equation (1) by origin and quantiles using as dependent variable the gross hourly wage, this time *excluding* overtime compensation and premia for shift/night/weekend work.

[Insert Table 7 here]

OLS results, presented in Table 7, again show a positive and significant effect of upstreamness on workers' wages, although this effect is slightly weaker than in our benchmark specification. The elasticity decreases from 0.021 to 0.016 and from 0.020 to 0.018 for workers born in developed and developing countries, respectively. As for the quantile estimates, although they are also somewhat smaller, they are relatively in line with our benchmark results. Indeed, we find that the wage-upstreamness elasticity increases by more than 60% along the wage distribution for workers born in developed countries (from 0.013 to 0.021 between the 25^{th} and the 75^{th} percentile (t = 2.2)). In contrast, the pattern is flat for workers born in developing countries: the elasticity decreases from 0.016 to 0.011, but the difference is not statistically significant (t = 0.8)). Accordingly, we conclude that upstreamness still benefits (high-wage) workers from developed countries the most.

We also tested the robustness of our findings with an even more restrictive definition of workers' wages. More precisely, we used workers' base pay, that is, the gross hourly wage from which we excluded not only overtime compensation and premia for shift/night/weekend work but also performance-related pay and commissions, as well as annual and irregular bonuses. The regression coefficients, presented in Table 7, are weaker than when accounting for compensating differentials but are broadly in line with our benchmark estimates. Indeed, the wage-upstreamness elasticity is again found to be slightly greater for (high-wage) workers born in developed countries than for workers born in developing countries.

Overall, our second robustness test confirms our previous results by showing 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.

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 (Shepherd, 2013; Lopez Gonzalez et al., 2015; OECD, 2016; Chen, 2017). In this paper, 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 number of steps before the production of a firm meets final demand). More precisely, 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 and 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. To do so, we rely on detailed linked employer-employee data for the Belgian manufacturing industry, which have been merged with information on the origin of workers, extracted from the Belgian National Register, and a unique indicator of firm upstreamness derived from the NBB-B2B transactions dataset (Dhyne et al., 2015). The latter provides a direct and accurate measurement of firm-level upstreamness for all years from 2002 to 2010.

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, job and firm characteristics, time fixed effects as well as the endogeneity of upstreamness. Our most robust estimate suggests 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. 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 wage gap between workers born in developed countries and those born in developing countries, 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. 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.

Overall, our results suggest that the rents generated by more upstream firms 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. This could be related to the power and authority associated with certain higher-level occupations, which are more likely to be held by high-wage workers born in developed countries (Cattaneo et al., 2015). A complementary interpretation is that, for a given occupation, workers born in developing countries are less likely to engage in wage negotiations with their employers (Tomaskovic-Devey et al., 2015) or to leave firms with unfavourable wage practices due to their poorer knowledge of the labour market (Hirsch & Jahn, 2015). Ethnic segregation and/or discrimination in performance-related pay might also be part of the explanation (Fang & Heywood, 2010). Interestingly, these arguments echo the estimates of Fays et al. (2021), showing that workers born in developing countries generate rents in the Belgian private sector and that these rents derive from the fact that these workers earn less than those born in developed countries at any given level of productivity.

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Tables

Table 1: Means and standard deviations of selected variables, overall and by origin

Variables	All workers	Workers born in developed countries	Workers born in developing countries
	(1)	(2)	(3)
Gross hourly wage (€, at constant 2004 prices)	16.52	16.61	14.74
	(7.62)	(7.61)	(7.53)
Upstreamness	2.71	2.71	2.57
	(0.89)	(0.89)	(0.89)
Workers born in developed countries (%)	95.1	100	
Workers born in developing countries (%)	4.9		100
North Africa	1.8		36.7
Sub-Saharan Africa	0.9		17.3
Near and Middle East	1.1		22.8
Asia	0.5		10.1
Eastern European	0.5		9.6
Latin American	0.1		3.5
Age (%)			
Younger than 30	18.4	18.5	16
Between 30 and 49	62.4	62	69.9
Older than 49	19.2	19.5	14
Education (%)			
No degree, primary/lower secondary	32.3	31.4	49.7
General upper secondary, technical/artistic/professional upper secondary	45.4	45.8	36.7
Higher non university, university and postgraduate	22.3	22.8	13.6
Tenure (%)			
Up to 1 year	16.4	15.9	25.7
2 to 4 years	18.5	18.2	24.9
5 to 9 years	19.9	19.8	21.4
10 years and more	45.2	46.1	28
Female workers (%)	22.7	23.1	14.2
Type of employment contract (%)			
Open-term contracts	96.4	96.5	93.6
Fixed-term contracts	2.9	2.8	5.8
Apprenticeship and interim contracts	0.7	0.7	0.6
Part-time work (%)	15.8	15.7	19
Occupations (%)			
Managers	3.8	3.8	2.1
Professionals	7.8	7.9	5
Technicians and associate professionals	8.8	9	4.7
Clerical support workers	13.4	13.8	5.1
Craft and related trades workers	27.3	26.9	36.2
Plant and machine operators and assemblers	30	29.9	32.6
Services and sales workers	1.8	1.9	1.2
Elementary occupations	7.1	6.8	13.1
Compensations for overtime work (Yes, % workers)	5.8	5.8	5.4
Premia for shift/weekend/night work (Yes, % workers)	22	21.8	26
Firm size (in full-time equivalent)	403.3	405.7	355.8
Firm-level collective agreement (%)	37.3	37.5	32.6

Region (%)			
Brussels	7.9	7.3	18.8
Flanders	66.2	66.7	56.3
Wallonia	25.9	26	24.9
More than 50% privately-owned firms (%)	98	98	98.2
Number of observations	245,418	233,432	11,986

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. Standard deviations are reported between parentheses.

Table 2: OLS and 2SLS regressions, overall and by origin

Estimation technique	OLS			2SLS		
Dependent variable: logarithm of the gross hourly wage	All workers (1)	Workers born in developed countries (2)	Workers born in developing countries (3)	All workers (4)	Workers born in developed countries (5)	Workers born in developing countries (6)
Upstreamness[A]	0.021***	0.021***	0.020***	0.036***	0.036***	0.029*
	(0.002)	(0.002)	(0.527)	(0.006)	(0.006)	(0.016)
Control variables[B]	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.56	0.561	0.527	0.56	0.558	0.525
Model sig. (p-value of *F* test)	0.0	0.0	0.0	0.0	0.0	0.0
Number of observations	245,418	233,432	11,986	245,418	233,432	11,986
Diagnoses tests for 2SLS:						
Underidentification test[C]						
p-value Kleibergen-Paap rk LM statistic				0.00	0.00	0.00
Weak identification test[D]						
Kleibergen-Paap rk Wald F statistic				144.1	140.2	56.4
Endogeneity test[E]						
p-value Durbin-Wu-Hausman χ^2 statistic				0.14	0.17	0.35
First-stage estimates of 2SLS (dependent variable: upstreamness):						
Median share of the firm's sales in total clients' purchases				0.515**	0.569**	-0.382
				(0.251)	(0.251)	(0.484)
Concentration index of domestic customers at time *t*				0.916***	0.916***	0.884***
				(0.092)	(0.093)	(0.147)
Concentration index of domestic suppliers at time *t*				-0.377***	-0.371***	-0.459***
				(0.114)	(0.115)	(0.175)
Cube of the median share of the firm's sales in total clients' purchases				-0.290	-0.327	0.099
				(0.321)	(0.318)	(0.782)
Cube of the concentration index of domestic customers at time *t*				-0.709***	-0.707***	-0.680***
				(0.102)	(0.103)	(0.180)
Cube of the concentration index of domestic suppliers at time *t*				-0.876***	-0.888***	-0.728***
				(0.130)	(0.133)	(0.190)
Model sig. of the 1st stage (p-value of *F* test)				0.00	0.00	0.00

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. [A] Steps (weighted distance) before the production of firm meets either domestic or foreign final demand. [B] Control variables include 2 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), 3 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), 2 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, 2 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 dummy for part-time workers, and 7 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), 2 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. [C] The Kleibergen-Paap rk LM statistic for under-identification tests whether the equation is identified, that is, whether the excluded instruments are all relevant. The null hypothesis in this test is that the equation is under-identified. [D] The Kleibergen-Paap

rk Wald F statistic tests whether the excluded instruments are sufficiently correlated with the endogenous regressor. The null hypothesis is that the instruments are weak. According to the standard 'rule of thumb', weak identification is problematic for *F* statistics smaller than 10 (as suggested by van Ours and Stoeldraijer (2011)). [E] The Durbin-Wu-Hausman χ^2 statistic endogeneity test is based on the difference of two Sargan-Hansen statistics: one for the equation in which firm-level upstreamness is treated as endogenous, and one in which it is treated as exogenous. If the null hypothesis of this test cannot be rejected, then instrumentation is not necessary, that is, upstreamness can be considered as exogenous. Cluster-robust standard errors are presented between parentheses. ***, **, * significant at 1, 5 and 10% levels, respectively.

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***	0.015***	0.013***
	(0.002)	(0.002)	(0.002)
Firm-level upstreamness x 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
Number of observations	10,058	10,058	10,058

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. [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 (1 dummy for the presence of a collective agreement at the firm level), logarithm of the number of full-time equivalent workers, location (2 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. Cluster-robust standard errors are presented between parentheses. ***, **, * significant at 1, 5 and 10% levels, respectively.

Table 4: OLS, conditional (CQR) and unconditional (UCR) quantile regressions, overall and by origin

Dependent variable: logarithm of the gross hourly wage	All workers			
	OLS	Quantile estimates		
	(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (CQR)	0.021***	0.017***	0.019***	0.025***
	(0.002)	(0.002)	(0.002)	(0.002)
Upstreamness[A] (UQR)	0.021***	0.016***	0.019***	0.030***
	(0.002)	(0.001)	(0.002)	(0.003)
	Workers born in developed countries			
	OLS	Quantile estimates		
	(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (CQR)	0.021***	0.017***	0.019***	0.025***
	(0.002)	(0.002)	(0.002)	(0.002)
Upstreamness[A] (UQR)	0.021***	0.016***	0.019***	0.031***
	(0.002)	(0.002)	(0.002)	(0.004)
	Workers born in developing countries			
	OLS	Quantile estimates		
	(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (CQR)	0.020***	0.013***	0.014***	0.017***
	(0.527)	(0.003)	(0.003)	(0.004)
Upstreamness[A] (UQR)	0.020***	0.014***	0.013***	0.018***
	(0.527)	(0.004)	(0.003)	(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

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. [A] Steps (weighted distance) before the production of firm meets either domestic or foreign final demand. All specification include control variables, namely 2 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), 3 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), 2 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, 2 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 dummy for part-time workers, and 7 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), 2 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. Clustered and block-bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported between parentheses for OLS and UQR, respectively. ***, **, * significant at 1, 5 and 10% levels, respectively.

Table 5: Mean and quantile decompositions of the wage gap by origin

	Workers born in developed vs. developing countries			
	OLS	Quantile estimates		
	(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

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

Table 6: OLS and unconditional quantile regressions (UQR), by origin and firms' technological and knowledge intensity

Dependent variable: logarithm of the gross hourly wage	Number of observations (as % of total workers by origin – in HT-KIS firms)	HT-KIS firms[B]			
		OLS	Unconditional quantile estimates		
		(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (sample of workers born in developed countries)	86,552 (37% – 96%)	0.027*** (0.004)	0.018*** (0.003)	0.029*** (0.004)	0.047*** (0.006)
Upstreamness[A] (sample of workers born in developing countries)	3,911 (33% – 4%))	0.027*** (0.006)	0.017*** (0.006)	0.018*** (0.006)	0.028** (0.011)
	Number of observations (as % of total workers by origin – in LT-LKIS firms)	LT-LKIS firms[B]			
		OLS	Unconditional quantile estimates		
		(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (sample of workers born in developed countries)	146,880 (63% – 95%)	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.002)	0.022*** (0.004)
Upstreamness[A] (sample of workers born in developing countries)	8,075 (67% – 5%)	0.016*** (0.004)	0.014*** (0.004)	0.014*** (0.005)	0.010* (0.005)

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. [A] Steps (weighted distance) before the production of firm meets either domestic or foreign final demand. [B] HT-KIS and LT-LKIS refer to high-tech/knowledge and low-tech/knowledge firms, respectively. This subdivision is based on the Eurostat (2016) nomenclature providing the 2 or 3 digit NACE code, according to which some firms can be classified as high-tech/knowledge and others as low-tech/knowledge. All specification include control variables, namely 2 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), 3 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), 2 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, 2 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 dummy for part-time workers, and 7 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), 2 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. Clustered and block-bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported between parentheses for OLS and UQR, respectively. ***, **, * significant at 1, 5 and 10% levels, respectively.

Table 7: OLS and unconditional quantile regressions (UQR), by origin using different components of workers' wages as dependent variable

	Workers born in developed countries			
	OLS	Unconditional quantile estimates		
	(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (using gross hourly wages, *benchmark specification*)	0.021***	0.016***	0.019***	0.031***
	(0.002)	(0.002)	(0.002)	(0.004)
Upstreamness[A] (using gross hourly wages *excluding:* - overtime compensation and premia for shift/night/weekend work)	0.016***	0.013***	0.017***	0.021***
	(0.002)	(0.002)	(0.003)	(0.003)
Upstreamness[A] (using gross hourly wages *excluding:* - overtime compensation, premia for shift/night/weekend work, - performance-related pay and commissions, and annual and irregular bonuses)	0.011***	0.009***	0.014***	0.019***
	(0.002)	(0.002)	(0.002)	(0.003)
	Workers born in developing countries			
	OLS	Unconditional quantile estimates		
	(Mean)	(0.25)	(0.5)	(0.75)
Upstreamness[A] (using gross hourly wages, *benchmark specifications*)	0.020***	0.014***	0.013***	0.018***
	(0.527)	(0.004)	(0.003)	(0.005)
Upstreamness[A] (using gross hourly wages *excluding:* - overtime compensation and premia for shift/night/weekend work)	0.018***	0.016***	0.013**	0.011**
	(0.004)	(0.005)	(0.005)	(0.004)
Upstreamness[A] (using gross hourly wages *excluding:* - overtime compensation, premia for shift/night/weekend work, - performance-related pay and commissions, and annual and irregular bonuses)	0.015***	0.011**	0.013***	0.015**
	(0.004)	(0.004)	(0.005)	(0.005)
Number of observations for workers born in:				
Developed countries	233,432	233,432	233,432	233,432
Developing countries	11,986	11,986	11,986	11,986

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. [A] Steps (weighted distance) before the production of firm meets either domestic or foreign final demand. All specification include control variables, namely 2 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), 3 dummies for tenure (i.e. dummies for workers with between 2 and 4, 5 and 9 and at least 10 years of tenure, respectively; workers with at most 1 year of tenure being the reference category), 2 dummies for age (i.e. dummies for workers aged at most 29 and more than 49 years, respectively; workers aged between 30 and 49 being the reference category), a dummy for female workers, 2 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-ended contract being the reference category), a dummy for part-time workers, 7 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), 2 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. Clustered and block-bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported between parentheses for OLS and UQR, respectively. ***, **, * significant at 1, 5 and 10% levels, respectively.

Appendix

Table A1: Means of selected variables, overall and by level of upstreamness and origin

	Upstreamness ≤ median			Upstreamness > median		
Variables	All workers (1)	Workers born in developed countries (2)	Workers born in developing countries (3)	All workers (4)	Workers born in developed countries (5)	Workers born in developing countries (6)
Gross hourly wage (€, at constant 2004 prices)	16.2	16.3	14.4	16.9	16.9	15.2
Workers born in developed countries (in %)	94.5	100		95.7	100	
Workers born in developing or transition countries (in %)	5.5		100	4.3		100
North Africa	1.9		34.5	1.7		39.4
Sub-Saharan Africa	1		18.7	0.7		15.5
Near and Middle East	1.2		22.5	1		23.3
Asia	0.6		10.5	0.4		9.6
Eastern European	0.6		10.4	0.4		8.5
Latin American	0.2		3.4	0.1		3.7
Age (in %)						
Younger than 30	18.7	18.9	16.1	18	18	15.9
Between 30 and 49	61.9	61.4	70.5	63	62.7	69.1
Older than 49	19.3	19.7	13.4	19	19.3	15
Education (in %)						
No degree, primary/lower secondary	33.1	32	50.3	31.6	30.8	49
General upper secondary, technical/artistic/professional upper secondary	44.8	45.3	35.9	45.9	46.3	37.7
Higher non university, university and post-graduate	22.1	22.7	13.8	22.5	22.9	13.3
Tenure (in %)						
Up to 1 year	17.2	16.6	26.8	15.5	15.1	24.2
2 to 4 years	18.7	18.4	25	18.3	18	24.7
5 to 9 years	19.9	19.8	21.6	19.9	19.8	21.3
More than 10 years	44.2	45.2	26.6	46.3	47.1	29.8
Female workers (in %)	23.6	24.1	15.5	21.8	22.2	12.6
Type of employment contract (in %)						
Open-term contracts	95.8	96	92.8	97	97.1	94.7
Fixed-term contracts	3.1	2.9	6.4	2.8	2.7	5
Apprenticeship and interim contracts	1.1	1.1	0.8	0.2	0.2	0.3
Part-time workers (in %)	15.9	15.7	18.7	15.7	15.6	19.3
Occupations (in %)						
Managers	3.7	3.7	2	3.9	4	2.3
Professionals	8.1	8.3	5.6	7.4	7.5	4.1
Technicians and associate professionals	8.7	8.9	4.8	8.9	9.1	4.5
Clerical support workers	13.7	14.2	5.3	13.1	13.5	4.9

Craft and related trades workers	32.1	31.6	40.9	22.6	22.2	30.2
Plant and machine operators and assemblers	24.6	24.4	27.5	35.4	35.2	39.2
Services and sales workers	2.4	2.5	1.8	1.2	1.3	0.4
Elementary occupations	6.7	6.4	12.1	7.5	7.2	14.4
Firm size (in full-time equivalent)	438.3	440	409.8	368.3	372	287.1
Firm-level collective agreement (in %)	33.8	34	29.8	40.7	40.9	35.6
Region (in %)						
Brussels	11.5	10.7	24.9	4.3	4	11
Flanders	64.7	65.3	53.2	67.7	68	60.4
Wallonia	23.8	24	21.9	28	28	28.6
More than 50% privately-owned firms (in %)	97.6	97.6	97.9	98.5	98.5	98.5
Number of observations	122,612	115,906	6,706	122,806	117,526	5,280

Notes: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification. The median value of upstreamness is equal to 2.86 steps.

Table A2: Correlation coefficients between 2SLS instruments and workers' gross hourly wage

	All workers	Workers born in developed countries	Workers born in developing countries
	(1)	(2)	(3)
	Workers' gross hourly wage	Workers' gross hourly wage	Workers' gross hourly wage
Median share of the firm's sales in total clients' purchases	-0.020	-0.019	-0.020
Concentration index of domestic customers	0.056	0.058	0.043
Concentration index of domestic suppliers at time t	-0.050	-0.047	-0.076
Cube of the median share of the firm's sales in total clients' purchases	-0.010	-0.010	-0.011
Cube of the concentration index of domestic customers	-0.005	-0.004	-0.010
Cube of the concentration index of domestic suppliers at time t	-0.050	-0.047	-0.058

Note: By 'developing countries', we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification.