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ABSTRACT

Upstreamness, Wages and Gender: Equal Benefits for All?*

This paper provides first evidence on the impact of a direct measure of firm-level upstreamness (i.e. the steps before the production of a firm meets final demand) on workers' wages. It also investigates whether results vary along the earnings distribution and by gender. Findings, based on unique matched employer-employee data relative to the Belgian manufacturing industry for the period 2002-2010, show that workers earn significantly higher wages when employed in more upstream firms. Yet, the gains from upstreamness are found to be very unequally shared among workers. Unconditional quantile estimates suggest that male top-earners are the main beneficiaries, whereas women, irrespective of their earnings, appear to be unfairly rewarded. Quantile decompositions further show that these differences in wage premia account for a substantial part of the gender wage gap, especially at the top of the earnings' distribution.

JEL Classification: F61, F66, J16, J31

Keywords: global value chains, upstreamness, wages, gender

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1. Introduction

The structure of the global economy has evolved dramatically over the past few decades. Recent improvements in transport and communication technologies, along with advances in trade liberalization, have prompted a wide geographical dispersion of production processes. Industries and firms across the globe are today increasingly intertwined within networks of Global Value Chains (GVCs), which embody the full range of activities that firms undertake to bring a product/service from its conception to its end use by final consumers (OECD, 2012). Consequently, products/services undergo multiple stages and cross borders several times, before reaching final consumers. According to UNCTAD (2013), almost 80% of global trade occurs in GVCs through exchanges of intermediate inputs.

The strategy of deepening integration (or upgrading) along GVCs is typically associated to an opportunity for firms and countries to acquire greater access to global markets, increase their competitiveness (Bamber and Staritz, 2016; Gereffi and Fernandez-Stark, 2016), improve employment (Farole, 2016; OECD, 2013), and foster income growth (OECD, 2012). Gereffi (2005: 171) defines (economic) upgrading as: "the process by which economic actors - nations, firms, and workers - move from low-value to relatively high-value activities in global production networks".[1] Growing evidence, echoing the concept of *workplace fissuring* first introduced by Weil (2014), suggests that high-value upstream-end (e.g. R&D/innovation) and downstream-end (e.g. marketing/branding) production stages are progressively retained in more advanced economies. On the contrary, labour costs stemming from less profitable activities (e.g. manufacturing/assembly), typically located in the middle of the value chain, appear to be outsourced to transition/developing economies (Gereffi and Fernandez-Stark, 2016).

A wide array of factors seems to contribute to such *make versus buy* strategy along GVCs. In a recent overview, Bernhardt et al. (2016) emphasize the relevance of demand- and supply-side features, along with institutional and political aspects. In a framework of i) *relative* transaction costs (Coase, 1937), ii) reductions in product market regulations, and iii) deregulation of global capital, labour and financial markets, outsourcing based on cost-minimization and profit-maximization strategies has been increasingly incentivized. In addition, the use of more sophisticated ICTs has lowered coordination, communication and monitoring costs across

[1] Humphrey and Schmitz (2002) categorize four different types of economic upgrading: i) process upgrading, where inputs are transformed into outputs through a more efficient production process; ii) product upgrading, which implies a shift towards more sophisticated product lines; iii) functional upgrading, which implies increasing the overall skill content of activities by acquiring new (or abandoning old) functions; iv) chain or inter-sectoral upgrading, where firms move from one industry to another (often related).

organizational boundaries; therefore reducing both the cost advantage of internal production and the relative advantages of hierarchy. This has spurred firms to retain their *core* high-margin activities in-house, while outsourcing the remaining low-margin ones.

Such task-disaggregation process, which may take the form of a *smile* (Baldwin et al., 2014; Mudambi, 2008; Shih, 1996), is therefore key to understanding how firms and countries secure their competitive advantage and wealth over time (Serpa and Krishnan, 2018). A small number of papers have been able to investigate whether the position of a firm in a GVC matters for the creation of value.[2] Rungi and Del Prete (2018) address this question with data on firms located in the European Union, and a downstreamness measure sourced from Antràs and Chor (2013). Interestingly, the authors uphold the intuition behind the U-shaped value generation curve and reveal a pattern of domestic value retention in the origin (developed) country of the firm. A related study is that of Ju and Yu (2015). Applying the methodology developed by Antràs et al. (2012) to Chinese data, the authors suggest that the position of a firm in a GVC, measured through an industrial upstreamness index, affects its productivity and profitability. Moreover, they show that companies belonging to upstream industries are more capital intensive. Mahy et al. (2018) report a similar finding for the Belgian private sector. The authors find upstreamness to be positively associated with higher productivity and profitability. In line with Ju and Yu (2015), they also find upstream firms to be more capital intensive.

Evidence regarding the impact of firms/industries' upstreamness on workers' wages is particularly thin. Indeed, very little is known on whether and to what extent productivity gains associated to firms/industries' position in GVCs are shared with workers.[3] According to the standard Walrasian (competitive) model of the labour market, wages reflect differences in labour productivity. Shifts towards higher value-added stages of the GVC, accompanied by positive technological spillovers and increased productivity, should thus enhance workers' wages. This prediction is also supported by human capital theory (Becker, 1964). The latter posits that: i) education (as well as formal training and informal work experience) develops skills that make workers more productive, and ii) workers are paid according to their marginal revenue product. Given that higher-value added activities along GVCs are often found to be more knowledge-intensive, and require more non-replaceable skilled workers (Mudambi, 2008), human capital theory suggests that such better skills should be rewarded with higher pay. The study of

[2] The scarcity of evidence on this issue can be explained by the fact that accurate measures of the position of a firm in a GVC, such as upstreamness, have only been designed recently (see Antràs et al., 2012; Fally, 2012), and that data to compute these measures are quite difficult to obtain.

[3] In contrast, a larger number of papers focus on the wage effects of production fragmentation often using a task-based approach (e.g. Baumgarten et al., 2013; Geishecker and Görg, 2008; Hummels et al., 2014).

Szymczak et al. (2019) is one of the first to investigate this issue. Using data for Central and Eastern European countries over the period 2005-2014, the authors examine the effect of industries' upstreamness on workers' wages. Their results show that workers earn higher wages when employed in industries located either at the beginning or at the end of the value chain. Mahy et al. (2018) examine a similar question at the firm level. Their findings for the Belgian economy suggest that productivity gains obtained by firms operating more upstream on the GVC are shared equally between profits and total labour costs. Chen (2017) investigates within-firm wage inequality across heterogeneous industries that hold different positions in the domestic value chain of the Chinese manufacturing industry. Estimates show that wage inequality is more pronounced in upstream industries than in downstream ones, and among firms with greater exposure to international trade. Another study is that of Shen and Silva (2018). The authors show that rising value-added exports from China to the U.S. have affected average wages in the latter country and that the impact depends on the position of the Chinese exporting industry in the global value chain. Yet, clear evidence on the overall and distributional impact of firms' upstreamness on individual workers' wages is still lacking.

Another aspect worth considering in the analysis of GVCs is gender. GVCs can indeed be considered as gendered structures due to differences in the allocation of women and men across sectors, jobs and stages of supply chains. These differences are rooted in the roles women and men assume in households and communities, typically determined by social norms rather than by one's potential (Staritz and Reis, 2013). Despite some heterogeneity, this holds true in both developed and developing economies. Case studies on developing countries (Bamber and Staritz, 2016; Barrientos et al. 2011; Carr et al., 2000; Rossi, 2013; Salido and Bellhouse, 2016; Tejani and Milberg, 2016) show that GVC integration can, but does not necessarily lead to higher remuneration for female workers. GVCs seem to exacerbate the gender wage gap and to take advantage of existing stereotypical gender norms to employ women in unskilled stages of the production chain, thus employing artificially low wages as a source of export competitiveness (Barrientos, 2014). In the case of developed countries, the issue of the gender wage gap has received a great deal of attention in the context of trade liberalization (Ben Yahmed, 2013; Black and Brainerd, 2004; Bøler et al., 2015, 2018; Busse and Spielmann, 2006; Juhn et al., 2014; Kongar, 2006; Oostendorp, 2009). However, we find no study examining the gender wage gap (and its related determinants) through the lens of GVCs and, in particular, of industries/firms' relative upstreamness.

The present paper aims to fill this gap by providing first evidence on the impact of a *direct* measure of firm-level upstreamness (i.e. the steps – weighted distance – before the production of a firm meets either domestic or foreign final demand) on workers' wages. We also add to the existing literature by investigating whether results vary for men and women and, more generally, how upstreamness contributes to explaining the gender wage gap at different points of the earnings' distribution. To do so, we rely on matched employer-employee data, covering more than 250,000 workers, that are representative of the Belgian manufacturing sector and that have been merged with a unique Firm-Upstreamness data set derived from the National Bank of Belgium business-to-business (NBB B2B) transactions data set, developed by Dhyne et al. (2015). The latter provides a direct and accurate measure of firm-level upstreamness for all years from 2002 to 2010.[4,5]

Our empirical strategy boils down to regressing individual workers' wages on upstreamness, while controlling for group effects in the residuals (Greenwald, 1983; Moulton, 1990), time fixed effects, and a large set of covariates reflecting worker, job and firm characteristics. We also address the endogeneity of upstreamness using instrumental variables and appropriate diagnoses tests. The consequences of being employed in more upstream firms are then investigated for women and men at the mean value of the earnings' distribution, and at different quantiles. Using both conditional (CQR) (Machado and Mata, 2005; Melly, 2005) and unconditional quantile regressions (UQR - Firpo et al., 2009), we thus investigate: i) whether the gains associated to upstreamness are shared equally between high- and low-wage workers, and ii) whether the wage-upstreamness elasticity evolves in similar way for women and men along the earnings' distribution. To estimate the contribution of the upstreamness variable to the gender wage gap at each quantile, we apply an extension of the Oaxaca-Blinder (1973) decomposition based on UQR techniques, namely the methodology developed by Fortin et al. (2011). Thus doing, we compute the share of the gender wage gap that can be attributed to: i) differences in mean values of firm-level upstreamness for women and men, and ii) gender differences in wage-upstreamness elasticities. This is done at different points of the earnings' distribution. Finally, we provide some robustness tests aiming to: i) examine whether our findings are driven by between- and/or within-firm variability in upstreamness, 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).

[4] 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 import, export or sell to final demand) are not included in Dhyne et al.'s (2015) dataset. Also note that the upstreamness measure only considers production steps that involve a transaction between two firms. Initial production steps such as R&D or design may typically not imply a transaction between the firm that makes those steps and the contractor that produces the good.

[5] We had access to a fully anonymized version of the merged data which prevents us from directly identifying an individual firm.

Belgium represents a particularly interesting case study to examine the interaction between wages and a firm's relative position along the GVC. Indeed, it is a very open and integrated economy, with increasingly diversified trading partners. This is notably illustrated by the GVC participation index, showing that Belgium sources more inputs from abroad and produces more inputs used in GVCs than most other OECD countries (OECD, 2012). Estimates of Dhyne et al. (2015) further indicate that 82% (99%) of commercial firms in Belgium, between 2002 and 2012, have been producing (consuming) goods and services that were either directly or indirectly exported (imported). The manufacturing industry is one of the most fragmented sectors, with a particularly high GVC participation rate: 91.6% (99.5%) of firms operating in this industry are found to be directly or indirectly involved in exports (imports). This industry is thus an ideal candidate to investigate the consequences of upstreamness on workers' wages.

The Belgian labour market is also suitable to analyse wage differences between women and men. The gross monthly gender wage differential (excluding annual and irregular bonuses) is estimated at around 22% in the private sector, and at a similar level in the manufacturing industry (Institut pour l'égalité des Femmes et des Hommes, 2014). While most of this gap can be accounted for by differences in worker, job and firm attributes, there still seems to persist a sizeable gap that cannot be accounted for by standard observables (e.g. higher share of women in part-time employment and/or segregation of women in less profitable firms, as shown by Garnero et al., 2014; Rycx and Tojerow, 2002, 2004). This persistent inequality harms women's labour market situation and career development as well as their social and personal promotion. As a result, women are still far from reaching a work status which equals that of men in qualitative terms (Del Boca and Repetto-Alaia, 2003; Redmond and McGuinness, 2017). Although substantial research has been devoted to the estimation and explanation of the gender wage gap, still little is known on the role of GVCs and, in particular, of firms' relative upstreamness as a cause of such wage differences. Consequently, the latter is a further point of interest in this paper.

The remainder of this paper is organised as follows. Section 2 presents our data set and corresponding descriptive statistics. Section 3 describes our benchmark estimation strategy and main econometric results. Section 4 provides a set of sensitivity analyses. Section 5 concludes.

2. Data and descriptive statistics

2.1 Data

The present study relies on two large-scale data sets. The first is the Structure of Earnings Survey (SES). This matched employer-employee survey provides detailed 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.[6] Specifically, it contains a wealth of information, provided by the human resource departments of firms, both on the characteristics of the latter (e.g. type of economic and financial control, number of workers, level of collective wage bargaining) and on the individuals working there (e.g. age, education, tenure, gross earnings, working hours, gender, occupation).

Data on workers' wages (and the different components thereof) and working hours are known to be particularly precise and reliable in the SES. Yet, this data set contains no information on firms' relative position along GVCs. Therefore, it has been merged by Statistics Belgium, in collaboration with the National Bank of Belgium (NBB), with a unique Firm-Upstreamness dataset derived from the NBB B2B transaction dataset, developed by Dhyne et al. (2015). The latter, following the methodology presented in Antràs et al. (2012), enables us to have a direct measure of the upstreamness of (almost) each manufacturing firm surveyed in the SES in 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 an enterprise-level input-output table for each year, on the basis of the values of transactions between enterprises. They have then applied Antràs *et al.* (2012)'s methodology, which models the upstreamness of the production of a given firm as the number of transactions and/or transformations (made by firms in Belgium but also abroad before being imported or after being exported) which are on average needed for all the production of that firm to finally meet the final demand. The upstreamness of a firm is computed as a sum of terms, i) the first of these representing the output share of that firm directly sold to final demand, ii) the second its output share that reaches final demand only after an additional transformation by other firms, multiplied by the factor 2 (as two transactions are needed to meet final demand), iii) the

[6] The SES is a cross-sectional data set, i.e. it does not enable to follow workers over time. It is representative of all firms in the manufacturing industry employing at least 10 workers. For an extended discussion see Demunter (2000).

third its output share that reaches final demand only after two transformations by other firms, multiplied by the factor 3, and so on (see Dhyne *et al.* (2015) for more details).

Information on upstreamness is not available prior to 2002. Hence, our merged SES/Firm-Upstreamness sample covers all years from 2002 to 2010. Our final sample consists of a pooled cross-sectional data set of 250,108 observations. It is representative of all workers employed in manufacturing firms (employing at least 10 workers) over the period 2002-2010.

2.2 Descriptive statistics

[Insert Table 1 here]

Table 1 presents the means and standard deviations of selected variables for the overall sample and by gender. We notice a clear-cut difference in average working conditions of male and female workers. On average, the total gross hourly wage is lower for women (15.0 EUR) than for men (17.5 EUR).[7] The gender wage gap stands at 16.6%. Women are somewhat younger than men in our sample. They have also less years of tenure than their male counterparts, but more years of education. Women are more likely to have a fixed-term employment contract (4 vs. 3%) and especially to work part-time (27 vs. 13%). Regarding occupations, we observe a larger share of men among managers, professionals, craft and machine operators. In contrast, women are overrepresented in elementary occupations, and in particular among clerks. The use of numeracy skills is found to be somewhat more intense in the jobs that are undertaken by women, while the frequency of physical tasks appears to be bigger in the jobs that are done by men.[8] The share of workers covered by a firm-level collective agreement is higher among men than women (46 vs. 40%). As regards upstreamness, the mean number of steps before the production of a firm meets either domestic or foreign final demand is equal to 2.76 for men and slightly lower for women (2.66).

Table A.1 shows descriptive statistics according to firms' level of upstreamness. The threshold for upstreamness has been fixed at 3. Results show that the average gross hourly wage is bigger for workers employed in more upstream firms (17.8 vs. 16.4) The gender wage gap is also

[7] Our measure of workers' gross hourly wage includes: base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses.

[8] This information is drawn from the Belgian PIAAC survey (i.e. the OECD Programme for the International Assessment of Adult Competencies). This survey provides an index respectively for the frequency of physical tasks ('f_q06b') and the intensity of numeracy skills ('numwork_wle_ca') in each job. The index ranges from 1 (never/very low) to 5 (every day/very high). Information on those variables has been aggregated at the NACE 1 – ISCO 2 digit level (i.e. computed for detailed occupational-sector cells) and merged to our SES/Firm upstreamness sample for all years from 2002 to 2010.

found to be more pronounced among firms that are further away from the final consumer (17.9 vs. 16.6%). More upstream firms employ workers that are: i) relatively more educated (especially among women), ii) somewhat over-represented in more specialized occupations (such as machine operators, technicians and associate professionals), and iii) more likely to receive some extra compensation for over-time, shift/week-end/night work (especially among men) and to be covered by a firm-level collective agreement (49.5 vs. 41.1%). On average, the frequency of physical tasks is found to be lower in more upstream jobs, while the intensity of numeracy skills' use appears to be slightly stronger among those jobs.

3. Estimation strategy and results

In the remainder of the paper, we estimate the consequences of firm-level upstreamness on workers' wages. We also investigate whether women and men, located at different points of the earnings' distribution, benefit equally from the potential gains associated to upstreamness. Put differently, we provide first evidence on how upstreamness contributes to the gender wage gap along the earnings' distribution.

Our benchmark specification to address these key questions corresponds to the following semi-logarithmic wage equation:

$$\ln w_{ijt} = \beta_0 + \beta_1 up_{jt} + \beta_2 X_{it} + \beta_3 Z_{jt} + \delta_t + \omega_{ijt} \quad (1)$$

where w_{ijt} represents the gross hourly wage (including base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses) of worker *i* employed in firm *j* at time *t*. Our main variable of interest, up_{jt}, is firm's *j* level of upstreamness 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 (see Dhyne et al. (2015) for more details). X_{it} is a vector of worker and job characteristics (five dummies for education, three dummies for tenure, eight dummies for age, a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies); Z_{jt} includes firm characteristics (the logarithm of firm size (i.e. the number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining); δ_t is a set of 8 year dummies, β_0 is the intercept; β_1, β_2 and β_3 are the parameters to be estimated, and ω_{ijt} is the error term.

3.1. Benchmark estimates

Equation (1) is our benchmark specification. In this model, we regress the logarithm of individual gross hourly wages on the upstreamnness variable, while controlling for detailed worker, job and firm characteristics. This is done using ordinary least squares (OLS) on the full sample of 250,108 observations covering the period 2002-2010. Due to the simultaneous use of grouped (firm-level) and individual (worker-level) observations, cluster-robust standard errors are computed to account for within-firm correlation, as suggested by Greenwald (1983) and Moulton (1990). In addition, to address possible business cycle effects, year dummies are also included in the regression. As shown in column 2 of Table 2, results highlight the existence of a significant positive relationship between upstreamness and workers' wages (coefficient = 0.028). Economically speaking, this coefficient suggests that if firms' upstreamness increases by one step (i.e. if a firm moves one step further away from the final consumer), workers' wages rise on average by 2.8 percent.[9]

While these estimates seem quite accurate, they might be biased due to the potential endogeneity of upstreamness. Endogeneity might be an issue due to: i) the possible correlation between upstreamness and the export behaviour of firms (i.e. the number of steps before firms' production meets final demand is likely to be bigger among exporting firms), and ii) evidence supporting reverse causality between the export behaviour of firms and workers' wages (i.e. more productive firms pay higher wages and are more likely to export).[10] To address this potential issue three instrumental variables (IVs) have been used, namely i) the average share of firm sales in total clients' purchases, ii) a concentration (i.e. Herfindahl-Hirschman) index of domestic clients of the firm, and iii) a dummy identifying whether the firm-level capital stock is above the sample median. The former IVs are used as proxies of the price elasticity of demand for the firm's product. Indeed, the larger the average share of firm sales in total clients' purchases, the smaller the firm's elasticity of product demand is expected to be. As regards our second IV, predictions are less clear-cut. A more concentrated pool of clients might either increase or decrease firm's elasticity of product demand. It notably depends on the outside options of those clients. The intuition for using this IV strategy is provided by Alfaro et al. (2019). The authors extend Antràs and Chor's (2013) property-rights' model of the organization of production to show, both theoretically and empirically, that a firm's decision to integrate upstream or downstream suppliers

[9] We re-estimated our benchmark regression excluding outliers, i.e. workers employed in firms whose upstreamness is below the 10^{th} percentile or above the 90^{th} percentile. Results, available on request, show that the regression coefficient associated to upstreamness remains positive (0.024) and significant. Hence, it appears that our findings are not driven by outliers in the upstreamness variable.

[10] See for instance Macis and Schivardi (2016).

depends crucially on the elasticity of demand for its good. More specifically, they find that a firm is more likely to integrate relatively upstream stages of the value chain, while engaging in outsourcing to downstream suppliers, when the price elasticity of its product demand is more inelastic. Accordingly, we expect our first IV to have a positive effect on the value of upstreamness in the first-stage regression. The effect for our second IV depends on whether it is positively or negatively related with firms' price elasticity of product demand in our data set. As regards our third IV, evidence suggests that more upstream firms tend to be more capital intensive. This positive correlation is notably illustrated in Antràs et al. (2012) and Ju and Yu (2015). Hence, we expect firms with above-median capital stock to be more upstream on the value chain. [11]

[Insert Table 2 here]

2SLS estimates are reported in column 3 of Table 2. They show that the wage-upstreamness elasticity remains significant and reaches now a magnitude of 0.056. To assess the soundness of the 2SLS approach, we perform an array of diagnoses tests. The latter are reported at the bottom of column 3 in Table 2. First-stage estimates indicate that our IVs have a positive impact on firm-level upstreamness. Moreover, both IVs reflecting the price-elasticity of product demand are found to be highly significant. 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 much bigger than 10.[12] 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 bivariate correlations between our IVs and workers' individual gross hourly wages. Findings, reported in Table A2, show that all correlation coefficients are very small. They fluctuate between 0.00 and 0.05. Accordingly, they support the assumption our IVs are fairly exogenous with respect to workers' individual wages.[13] Concerning the quality of our

[11] Information to compute these IVs has been obtained from the Structure of Business Survey (SBS) and input-output tables (IOTs). Data gathered from the SBS and IOTs have been merged to our initial SES/Firm-Upstreamness sample (over the years 2002-2010) by Statistics Belgium, in collaboration with the NBB, using firms' VAT numbers.

[12] As suggested by van Ours and Stoeldraijer (2011), we rely on the standard 'rule of thumb' that weak identification is problematic for *F* statistics smaller than 10.

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

instruments, we further find that the p-value associated to the Sargan-Hansen's J overidentification test is equal to 0.319 (see column 3 of Table 2). This outcome suggests that our instruments are valid.[14] Finally, as regards the Durbin-Wu-Hausman endogeneity test, the p-value associated to the Chi-squared statistic is equal to 0.143.[15] This outcome suggests that the null hypothesis of no endogeneity should not be rejected. Estimates thus indicate that our main explanatory variable, i.e. firm-level upstreamness, is actually not endogenous and that OLS estimates (reported in column 2 of Table 2) should be preferred to those obtained by 2SLS. [16]

3.2 Estimates along the wage distribution and by gender

So far, the consequences of firm-level upstreamnness have been investigated at the mean value of the earnings' distribution. However, the gains associated to upstreamness might be significantly different for high- and low-wage workers. To examine this issue, we rely on Unconditional

market. The relationship between our first IV and firms' capacity to create rents is thus not univocal. Moreover, empirical evidence suggests that the magnitude of rent-sharing in the Belgian economy, i.e. 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 percent (Rusinek Rycx, 2013; Rycx and Tojerow, 2004). This outcome is consistent with 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 (du Caju et al., 2011; Rycx, 2002). Similar arguments enable to explain why the correlation between our second IV (i.e. the concentration of domestic clients of the firm) and workers' wages is also found to be very small. In addition, it should be noted that our second IV refers to domestic clients only, while manufacturing firms in Belgium are massively exporting, i.e. have many of their clients abroad. This feature also concurs to the (fairly) exogenous character of our second IV. Finally, as regards the very low correlation between our third IV and workers' individual wages, a potential explanation might be our use of a binary variable (instead of a continuous one) for the firm-level capital stock. However, it most probably also derives from our focus on firms belonging to the manufacturing industry, i.e. to a sector where the average capital stock is higher and less dispersed than in the rest of the economy.

[14] Yet, caution is required as it is always difficult to find good instruments. In particular, our data provide no information on the export behavior of firms. Accordingly, we were not able to test whether this variable is uncorrelated to our instruments.

[15] The Durbin-Wu-Hausman test is based on the difference of two Sargan-Hansen statistics: one for the equation in which the upstreamness variable 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 actually not necessary.

[16] As a robustness test, we also adopted an alternative IV strategy. The latter relies on the following IVs: i) the total amount of goods and services purchased by a firm, and ii) the firm-level capital stock. Theoretically, the former IV is likely to be a significant determinant of the position of a firm in the value chain. Indeed, we might expect firms that are more downstream (i.e. closer to the final consumer) to purchase a bigger amount of goods and services. The intuition for the second IV is as before: more capital-intensive firms are expected to be located more upstream on the value chain. To overcome multicollinearity issues, our IVs have been defined as dummies, namely i) a dummy taking the value 1 if the firm-level value of purchased goods and services is above the 20th percentile of the sample distribution (and zero otherwise), and ii) a dummy taking the value 1 if the firm-level capital stock is above the median sample value. First-stage estimates (available on request) are in line with theoretical expectations. Indeed, regression coefficients associated to our IVs are highly significant and respectively negative and positive. Moreover, second-stage results still show a significantly positive relationship between upstreamness and wages. As regards diagnosis tests, they suggest that our estimates do not suffer from under-identification, nor from weak instruments. The over-identification test suggests that our instruments are valid and the endogeneity test that the upstreamness variable can actually be treated as exogenous, i.e. that OLS estimates (reported in column 2 of Table 2) should be preferred to those obtained by 2SLS.

Quantile Regressions (UQR) with block-bootstrapped standard errors (Cameron et al., 2008; Daouli et al., 2013; Firpo et al., 2009; Fitzenberg and Kurz, 2003). As a robustness test, we also apply the more conventional Conditional Quantile Regressions' (CQR) approach (Koenker and Basset, 1978; Machado and Mata, 2005; Melly, 2005), adapted to clustered data as suggested by Parente and Silva (2016). Results, reported in Table 3, show that UQR and CQR estimates are close to each other. They both indicate that the wage-upstreamness elasticity increases monotonically along the earnings distribution. Indeed, UQR (CQR) estimates vary from 1.8 (1.7) for people located at the 25th percentile of the earnings distribution to 3.1 (2.7) for those at the 75th percentile. High-wage workers are thus found to benefit significantly more from being employed in more upstream firms than their lower-wages counterparts.

[Insert Table 3 here]

Another important issue is whether the gains associated to upstreamness are shared equally between women and men. Results, reported in column 2 of Table 3, indicate that upstreamness is beneficial for both groups of workers. However, they also show that the gains are much smaller for women than for men. When firms' upstreamness increases by one step, men's wages are found to rise on average by 2.9 percent. The corresponding wage increase for women is only equal to 0.9 percent.[17] Turning to quantile estimates by gender, we observe again a striking difference in the magnitude of regression coefficients for women and men. Findings, presented in columns 3 to 5 of Table 3, show that the wage-upstreamness elasticity for men follows a similar pattern than for the overall sample: it increases significantly along the wage distribution (from 0.017 to 0.035 when moving from the 25th to the 75th percentile). The situation for women is quite different the elasticity is very small (0.005 at the 25th percentile) and remains almost unchanged at higher quantiles. Overall, results suggest that the gains associated to upstreamness are very unequally shared among workers. Most of the gains are for high-wage men. Low-wage men, and especially women (irrespective of their level of earnings) benefit much less from being employed in more upstream firms.

[17] We tested for the endogeneity of the upstreamness variable in regressions estimated separately for women and men (following the same approach as in section 3.1). Post-estimation tests, available on request, again indicate that our variable of interest is not endogenous. Moreover, tests for weak-, over, and under-identification imply that the instrumentation is satisfactory. Therefore, as in our benchmark specification, the OLS estimator is to be preferred.

3.3. Upstreamness and the gender wage gap

To complete our distributional analysis, we apply an extension of the Oaxaca-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 gender wage gap can be attributed to: i) differences in mean values of upstreamness for women and men (i.e. the compositional effect or explained part); and ii) gender differences in wage-upstreamness elasticities (i.e. the wage structure effect or unexplained part). Mean and quantile decompositions are presented in Table 4.

[Insert Table 4 here]

The first row of Table 4 reports the overall gender wage gap, measured as the difference between mean log wages of male and female workers. The mean log wage differential is equal to 0.148. It does not vary substantially across quantiles. Table 4 also reports the contribution of upstreamness (both the compositional and wage structure effects) to the gender wage gap in percentage points ('*Magnitude*') and as a percentage of the overall gender wage gap ('*%*"). At the mean, only 1.35 percent of the gender wage gap is due to male-female differences in the level of upstreamness. In contrast, almost 35 percent of the gap can be attributed to differences in the wage-upstreamness elasticity for women and men. This wage structure effect (or unexplained part) is often taken to reflect discrimination (i.e. factors not related to differences in endowments/productivity).[18]

Moving to the quantile decomposition, we find that results are in line with mean-based findings, although more heterogeneous. The explanatory power of the compositional effect is very limited. Even at the 75th percentile of the earnings distribution, it accounts for less than 4% of the overall gender wage gap. As regards the wage structure effect, its explanatory power is quite substantial and increases along the wage distribution. Gender differences in wage premia associated to upstreamness are thus found to explain a substantial part of the earnings' gap between women and men at the bottom and, even more, at the top of the distribution.

[18] Yet, the unexplained part might also reflect differences in unobserved productivity-related characteristics.

4. Sensitivity tests

In this section, we provide some complementary tests aiming to: i) examine whether our findings are driven by between- and/or within-firm variability in upstreamness and ii) investigate the sensitivity of our estimates to different components of workers' wages.

4.1. Within versus between firms' changes in upstreamness

Estimates reported so far are based on repeated cross-sectional data. To get a better understanding of whether the latter are driven by within- and/or between-firms' variability in upstreamness, two robustness tests have been run.

First, we re-estimated our benchmark equation (1) solely for workers employed in *fast-moving* firms, i.e. firms at the top 25% in terms of recorded changes in their upstreamness over the sample period. OLS estimates, reported in Table A3, show that the wage-upstreamness elasticity remains positive and significant among those workers and is even somewhat enhanced in this setup. This outcome emphasizes the role played by within-firm changes in upstreamness to explain workers' wages.

As a second robustness test, we aggregated our initial sample at firm level, so as to estimate the elasticity between upstreamness and mean workers' wages with a panel of firms. [19] More precisely, we estimated the following equation:

$$\ln w_{jt} = \lambda_0 + \lambda_1\, up_{jt} + \lambda_2 X_{jt} + \lambda_3 Z_{jt} + \gamma_t + \nu_{jt} \qquad (2)$$

The dependent variable in equation (2) is the average gross hourly wage in firm *j* at time *t* and up_{jt} is firm j's level of upstreamness. X_{jt} contains the same set of control variables for worker and job characteristics as in equation (1) but aggregated at firm level. Put differently, it includes the share of the workforce in firm *j* by: level of education, years of tenure, age, working time, employment contract and occupation. Z_{jt} includes identical firm characteristics as in equation (1), γ_t includes 8 year dummies, λ_0 to λ_3 are the parameters to be estimated, and ν_{jt} is the error term. Equation (2)

[19] While our data do not permit to track workers over time, they contain firm identifiers enabling us to construct an unbalanced panel of firms over the period 2002-2010. Given that sampling percentages of firms in the SES/Firm-Upstreamness data increase with the size of the latter (see Demunter, 2000), medium-sized and large firms are over-represented in the panel. Descriptive statistics relative to our unbalanced panel show that mean upstreamness is equal to 2.68 with an overall/between/within standard deviation equal to respectively 0.87/0.67/0.64. The full set of descriptive statistics is available on request.

has been estimated with both pooled OLS and a fixed effect (FE) estimator over the period 2002-2010.[20] Results, reported in Table A4, show that the wage-upstreamness elasticity is significant and positive with both types of estimators. Moreover, we find that the regression coefficient associated to upstreamness decreases only slightly (from 0.019 to 0.016) when using the FE estimator instead of OLS. This outcome reinforces our first robustness test suggesting that our benchmark wage-upstreamness elasticity is also driven by within-firm variability in upstreamness and wages.

4.2 The role of compensating differentials

Goldin (2014) points at the role of compensating differentials as a *final chapter* for gender pay gap convergence. The argument is that many high-paying jobs require individuals to spend long hours in office. These jobs, however, are incompatible with a good work-family balance; a feature particularly relevant for female workers, who are often expected to be the primary care-givers in households (Blau and Kahn, 2017; Meulders and O'Dorchai, 2004; McRae, 2003). Accordingly, many women still opt for jobs with more flexible schedules and lower salaries.

Starting from these premises, our final sensitivity test aims to identify the role of compensating differentials associated to longer and more atypical hours (i.e. over-time and shift/night/weekend work) to explain gender differences in wage-upstreamness elasticities.[21] To do so, we re-estimated equation (1) by gender and quantile using as dependent variable the log of individual gross hourly wages, *excluding* overtime compensation and premia for shift/night/weekend work.

OLS estimates for the overall sample are in line with our benchmark scenario (see upper part of Table A5). We find a positive and significant relationship between upstreamness and workers' wages. However, the magnitude of the wage-upstreamness elasticity is somewhat smaller when excluding compensation for overtime, shift/night/weekend work. It is now equal to 0.022 (as opposed to 0.028 in our benchmark specification). Results by gender show a drop in the elasticity for men (from 0.029 in the benchmark to 0.022), while that for women remains almost unchanged (0.010 vs. 0.009). Yet, differences in elasticities between men and women are still substantial. In addition, estimates by quantile are smaller than in the benchmark, especially for men. However,

[20] By using a FE model, i.e. a model where the mean of each variable has been subtracted from the initial values, we are able to estimate how *within*-firm changes in upstreamness affect workers' wages.

[21] Descriptive statistics, reported in Tables 1 and A1, show that men – especially when employed in more upstream firms – are much more likely to receive overtime compensation and premia for shift/night/weekend work than women (whatever their position in the value chain).

they deliver a similar message. The wage-upstreamness elasticity increases along the wage distribution for men (from 0.013 at the 25th percentile to 0.022 at the 75th percentile) and is much smaller for women (around 0.006), irrespective of their earnings. As regards the wage decomposition, results are overall in line with our benchmark analysis (see Table A6). Gender differences in wage-upstreamness elasticities still explain around 27% of the overall gender wage gap and the contribution of this unexplained part increases along the earnings distribution.

We have also tested the robustness of our findings with alternative definitions of wages. As an illustration, Table A7 shows quantile regression estimates by gender using workers' base pay (i.e. gross hourly wages *excluding* overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses). Results are line with our benchmark specification. Indeed, they show that the wage-upstreamness elasticity is significantly bigger for (high-wage) men than for women. Interestingly, this is also the case when focusing on alternative components of workers' wages (e.g. annual and irregular bonuses).[22] In addition, Table A8 shows that 22% of the gender wage gap in base pay is due to differences in wage-upstreamness elasticities for women and men, and that the contribution of this unexplained component increases at upper quantiles.

Overall, sensitivity tests indicate that the larger wage premium obtained by (male high-wage) workers employed in more upstream firms is not solely driven by differences in overtime hours and shift/night/weekend work, but also by differences in other pay components, including basic pay and bonuses.

5. Conclusion

This paper provides an original contribution to the literature regarding the impact on wages of firms' relative position in Global Value Chains (GVCs). More precisely it is the first to estimate the impact of a *direct* measure of firm-level upstreamness (i.e. the steps – weighted distance – before the production of a firm meets either domestic or foreign final demand) on workers' wages. It also adds to the existing literature by investigating whether results vary for women and men and, more generally, how upstreamness contributes to the explanation of the gender wage gap along the earnings' distribution. To do so, we rely on detailed matched employer-employee data relative to the Belgian manufacturing sector that have been merged with a unique Firm-Upstreamness data set derived from the NBB B2B transactions data set, developed by Dhyne et

[22] The full set of results for the different components of workers' wages is available upon request.

al. (2015). The latter provides a direct and accurate measure of firm-level upstreamness for all years from 2002 to 2010.

Our findings show that workers earn significantly higher wages when being employed in relatively more upstream firms (i.e. in firms that are further away from the final consumer), even after controlling for group effects in the residuals, a large set of individual, job and firm characteristics, time fixed effects, as well as for the endogeneity of upstreamness. Our most robust estimate suggests that if firm-level upstreamness increases by one step (i.e. by approximately one standard deviation), workers' gross hourly wages rise on average by 2.8 percent. Yet, the gains from upstreamness are found to be very unequally distributed among workers. The wage-upstreamness elasticity is more than three times bigger for men than for women (0.029 vs. 0.009). Moreover, quantile regressions indicate that high-wage men benefit substantially more from upstreamness than their low-wage counterparts. For women, the benefits of working in more upstream firms appear to be very limited, irrespectively of how much they earn. Quantile decompositions of the gender wage gap further show that differences in mean values of upstreamness for women and men only modestly contribute to the overall gender wage gap. On the contrary, gender differences in wage premia associated to upstreamness are found to explain a substantial part of the earnings gap, especially at the top of the earnings' distribution.

Sensitivity tests, focusing on workers employed in fast-moving firms (i.e. top 25% firms in terms of recorded changes in their upstreamness over the sample period) and based on firm-level fixed effects estimates, emphasize the role played by within-firm changes in upstreamness to explain workers' wages. As for gender, several robustness tests have been run considering varying components of workers' wages. The latter indicate that the higher wage-upstreamness elasticity for (high-wage) men is partly driven by differences in overtime and shift/night/weekend work. However, this is not the whole story. The wage premium associated to upstreamness is still found to be substantially larger for (high-wage) men than for women when considering other pay components, such as base pay or irregular/annual bonuses. This suggests that rents generated by more upstream firms are unfairly distributed between (high-wage) men and women. Put differently, it appears that the unexplained part of the gender wage gap, associated to upstreamness, is at least partly reflective of non-productive factors. The latter might be related to power and authority associated to certain higher-level occupations, more likely to be held by high-wage men (Bebchuk and Fried, 2003; Osterman et al., 2009). A complementary interpretation, provided by Card et al. (2015: 634), is that women, in a given occupation, "are less likely to initiate wage bargaining with their employer and are (often) less effective negotiators than men. Gender segregation and/or discrimination in performance-related pay might also be part of the explanation (for a discussion see McGee et al. (2015) and Xiu and Gunderson (2013)). Interestingly, these arguments echo the estimates of Garnero et al. (2014) showing that women generate employer rents in the Belgian private sector and that these rents derive from the fact that women earn less than men at any given level of productivity.

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Table 1: Means (standard deviations) of selected variables, 2002-2010

Variables	Overall	Men	Women
Gross hourly wage (in EUR)[a]	17.0	17.5	15.0
	(7.7)	(8.0)	(6.0)
Upstreamness (in steps)[b]	2.74	2.76	2.66
	(89.5)	(89.7)	(88.0)
Age structure of workforce (% workers)			
20-24 years	5.9	6.1	5.5
25-29 years	11.4	11.1	12.6
30-34 years	13.8	13.2	16.1
35-39 years	16.4	15.9	18.2
40-44 years	17.1	17.2	17.0
45-49 years	15.3	15.5	14.4
50-54 years	12.3	12.9	10.2
55-59 years	5.7	6.1	4.3
60 years and more	1.0	1.1	0.7
Education (% workers)			
Lower secondary	24.8	25.5	22.3
General upper secondary	18.8	17.3	24.1
Technical/Professional upper secondary	26.2	29.0	16.0
Higher non-university, short-type	12.5	10.6	19.6
University and non-university higher education, long-type	9.0	9.0	9.1
Post-graduate	0.5	0.5	0.5
Seniority in the company (% workers)			
0-1 year	15.3	14.6	18.0
2-4 years	17.4	17.0	19.2
5-9 years	19.3	18.9	20.9
10 years or more	47.7	49.3	41.7
Type of employment contract (% workers)			
Permanent contract	96.1	96.4	95.4
Fixed-term contract	3.1	2.9	3.8
Other contract	0.6	0.6	0.6
Part-time (% workers)[c]	16.3	13.4	26.8
Overtime compensation (Yes, % workers)	6.4	7.4	2.5
Premia for shift/weekend/night work (Yes, % workers)	25.6	28.9	13.3
Occupations (% workers)			
Managers	2.3	2.6	1.4
Professionals	7.3	7.5	6.8
Technicians and Associate Professionals	8.2	8.2	8.2
Clerks	7.2	5.1	14.7
Craft	16.5	19.5	5.5
Machine operators	18.0	19.2	13.6
Service	0.9	0.8	1.6
Elementary occupations	5.7	5.3	7.4
Type of skills used /tasks performed at work[d]:			
Frequency of physical tasks	3.31	3.39	3.01
Intensity of numeracy skills' use	2.87	2.84	2.98
Firm-level collective agreement (Yes, % workers)	44.5	45.7	40.2
More than 50% privately-owned firm (Yes, % workers)	97.7	97.5	98.2
Number of observations	251,364	194,540	56,824

Notes: The descriptive statistics refer to the weighted sample. [a] At 2004 constant prices. It includes base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. [b] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [c] Less than 30 hours per week. [d] This information is drawn from the Belgian PIAAC survey (i.e. the OECD Programme for the International Assessment of Adult Competencies). This survey provides an index respectively for the frequency of physical tasks ('f_q06b') and the intensity of numeracy skills ('numwork_wle_ca') in each job. The index ranges from 1 (never/very low) to 5 (every day/very high). Information on those variables has been aggregated at the NACE 1 – ISCO 2 digit level (i.e. computed for detailed occupational-sector cells) and merged to our SES/Firm upstreamness sample for all years from 2002 to 2010.

Table 2: Log wage equation, OLS and 2SLS estimates, overall sample

	Overall sample	
Variables	OLS	2SLS
Upstreamness[a]	0.028***	0.056**
	(0.002)	(0.020)
Individual and job characteristics[b]	Yes	Yes
Firm characteristics[c]	Yes	Yes
Year dummies	Yes	Yes
Group effects[d]	Yes	Yes
Adjusted R^2	0.516	0.511
Model significance:		
p-value of F test	0.000	0.000
Underidentification test[e]:		
p-value Kleibergen-Paap rk LM statistic		0.000
Weak identification test[f]:		
Kleibergen-Paap rk Wald F statistic		20.74
Overidentification test[g]:		
p-value of Sargan-Hansen J statistic		0.319
Endogeneity test[h]:		
p-value associated to Chi-squared statistic		0.143
First-stage estimates of 2SLS *(Dependent variable: upstreamness$_{ij}$ at time t)*		
Average share of firm sales in total clients' purchases at time t		0.507**
		(0.191)
Concentration index of domestic clients of the firm at time t		0.288***
		(0.055)
Firm-level capital stock > sample median at time t		0.055
		(0.038)
Individual and job characteristics[b]		YES
Firm characteristics[c]		YES
Year dummies		YES
Model significance, first stage:		
p-value of *F* test		0.000
Number of observations	250,108	250,108
Number of firms	4,645	4,645

Notes: The dependent variable is the logarithm of the individual gross hourly wage, which includes base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. Robust standard errors are reported between brackets. [a] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [b] Individual and job characteristics include: six dummies for education, three dummies for tenure, eight dummies for age, a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies. [c] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. [d] Group effects estimations use the correction for common variance components within groups, as suggested by Greenwald (1983) and Moulton (1990). [e] The Kleibergen-Paap rk LM statistic for under-identification tests whether the equation is identified, i.e. whether the excluded instruments are all relevant. The null hypothesis in this test is that the equation is under-identified. [f] Kleibergen-Paap rk statistic for weak identification is a Wald F statistic testing 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)). [g] The Sargan-Hansen J statistic tests the null hypothesis that the instruments are valid, i.e. uncorrelated with the error term. [h] The Durbin–Wu–Hausman 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 actually not necessary, i.e. upstreamness can actually be considered as exogenous. ***/**/*: significance at the 1, 5 and 10 per cent, respectively.

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Table 3: Log wage equation, OLS, UQR and CQR estimates, overall sample

	Overall			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.028***	0.018***	0.019***	0.031***
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.003)
Conditional Quantile Regression (CQR)	0.028***	0.017***	0.020***	0.027***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.002)
	Men			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.029***	0.017***	0.020***	0.035***
Upstreamness[a]	(0.002)	(0.001)	(0.002)	(0.004)
Conditional Quantile Regression (CQR)	0.029***	0.018***	0.021***	0.028***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.002)
	Women			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.009***	0.005**	0.008**	0.009**
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.003)
Conditional Quantile Regression (CQR)	0.009***	0.007**	0.006**	0.009***
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.002)
Individual and job characteristics[b]	Yes	Yes	Yes	Yes
Firm characteristics[c]	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Group effects[d]	Yes	Yes	Yes	Yes
Number of observations for:				
Overall	250,108	250,108	250,108	250,108
Men	193,719	193,719	193,719	193,719
Women	56,389	56,389	56,389	56,389
Number of firms for:				
Overall	4,645	4,645	4,645	4,645
Men	4,634	4,634	4,634	4,634
Women	4,444	4,444	4,444	4,444

Notes: The dependent variable is the logarithm of the individual gross hourly wage, which includes base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. Clustered and block-bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported in parentheses for OLS/CQR and UQR, respectively. [a] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [b] Individual and job characteristics include: six dummies for education, three dummies for tenure, eight dummies for age, a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies. [c] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. [d] Group effects estimations use the correction for common variance components within groups, as suggested by Greenwald (1983) and Moulton (1990). ***/**/* Significance at the 1, 5 and 10 per cent, respectively.

Table 4: Mean and quantile decomposition of the gender wage gap

	Overall sample			
	OLS	Quantile estimates		
	(Mean)	*(.25)*	*(.50)*	*(.75)*
Overall gender wage gap	0.148	0.144	0.139	0.140
Decomposition:				
Magnitude:				
Compositional effect of upstreamness	0.002	0.001	0.002	0.005
Wage structure effect of upstreamness	0.052	0.031	0.044	0.113
% of the overall gender wage gap explained by:				
Composition effect of upstreamness	1.35	0.69	1.43	3.57
Wage structure effect of upstreamness	35.1	21.5	31.6	80.7

Notes: Decompositions are based on the Unconditional Quantile Regression (UQR) estimates. For exposition purposes, the '*magnitude'* and the '*percentage'* (of the overall gender wage gap) have only been reported for the upstreamness variable.

Table A1: Means (standard deviations) of selected variables according to firms' level of upstreamness, 2002-2010

	Upstreamness < = 3			*Upstreamness > 3*		
Variables	Overall	Men	Women	Overall	Men	Women
Gross hourly wage (in EUR)[a]	16.4 (7.4)	16.9 (7.7)	14.5 (5.8)	17.8 (8.1)	18.4 (8.4)	15.6 (6.4)
Age structure of workforce (% workers)						
20-24 years	6.1	6.3	5.4	5.7	5.7	5.6
25-29 years	11.5	11.2	12.7	11.3	11.0	12.6
30-34 years	13.6	13.1	15.5	14.1	13.4	17.0
35-39 years	16.1	15.5	17.9	16.8	16.3	18.8
40-44 years	17.1	17.1	17.1	17.3	17.4	16.9
45-49 years	15.5	15.7	14.8	14.9	15.2	13.7
50-54 years	12.4	12.9	10.5	12.2	12.9	9.8
55-59 years	5.6	5.9	4.3	5.9	6.3	4.3
60 years and more	1.1	1.2	0.7	0.9	1.0	0.7
Education (% workers)						
Lower secondary	26.2	26.7	24.2	22.6	23.4	19.2
General upper secondary	18.4	16.9	23.9	19.2	17.9	24.4
Technical/Professional upper secondary	25.6	28.2	16.2	27.3	30.3	15.6
Higher non-university, short-type	11.7	10.1	17.7	13.7	11.4	22.6
University and non-university higher education, long-type	8.8	8.9	8.5	9.4	9.2	10.1
Post-graduate	0.4	0.4	0.4	0.6	0.6	0.8
Seniority in the company (% workers)						
0-1 year	16.0	15.3	18.4	14.3	13.6	17.2
2-4 years	17.8	17.3	19.5	16.9	16.4	18.7
5-9 years	19.4	19.0	20.9	19.2	18.7	21.0
10 years or more	46.7	48.2	41.0	49.4	51.1	42.9
Type of employment contract (% workers)						
Permanent contract	95.7	95.8	95.3	96.8	97.2	95.6
Fixed-term contract	3.2	3.0	3.7	2.9	2.6	4.0
Other contract	1.1	1.0	0.9	0.1	0.1	0.2
Part-time (% workers)[c]	16.9	13.8	27.9	15.4	12.8	24.8
Overtime compensation (Yes, % workers)	5.5	6.3	2.2	7.8	9.1	2.9
Premia for shift/weekend/night work (Yes, % workers)	23.8	26.5	14.1	28.5	32.8	12.0
Occupations (% workers)						
Managers	2.1	2.4	1.1	2.7	2.9	1.9
Professionals	7.2	7.5	6.2	7.5	7.4	8.0
Technicians and Associate Professionals	7.1	7.3	6.5	10.0	9.8	11.0
Clerks	7.4	5.5	14.5	6.8	4.6	15.0
Craft	17.9	21.4	5.3	14.3	16.6	6.0
Machine operators	16.7	17.8	12.6	20.1	21.4	15.3
Service	1.1	0.8	2.3	0.7	0.7	0.6
Elementary occupations	5.6	5.0	7.8	6.0	5.8	6.7
Type of skills used /tasks performed at work[d]:						
Frequency of physical tasks	3.40	3.48	3.11	3.17	3.25	2.85
Intensity of numeracy skills' use	2.83	2.80	2.93	2.93	2.90	3.05
Firm-level collective agreement (Yes, % workers)	41.1	42.6	36.7	49.5	50.5	45.9
More than 50% privately-owned firm (Yes, % workers)	97.3	97.1	98.2	98.2	98.3	98.0
Number of observations	154,035	118,316	35,719	96,076	75,405	20,671

Notes: The descriptive statistics refer to the weighted sample. [a] At 2004 constant prices. It includes base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. [b] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [c] Less than 30 hours per week. [d] This information is drawn from the Belgian PIAAC survey (i.e. the OECD Programme for the International Assessment of Adult Competencies). This survey provides an index respectively for the frequency of physical tasks ('f_q06b') and the intensity of numeracy skills ('numwork_wle_ca') in each job. The index ranges from 1 (never/very low) to 5 (every day/very high). Information on those variables has been aggregated at the NACE 1 – ISCO 2 digit level (i.e. computed for detailed occupational-sector cells) and merged to our SES/Firm upstreamness sample for all years from 2002 to 2010.

Table A2: Correlation coefficients between workers' individual wages and instrumental variables, 2002-2010

	Workers' individual gross hourly wages at time *t*
a) Average share of firm sales in total clients' purchases at time *t*	0.00
b) Concentration index of domestic clients of the firm at time *t*	0.05
c) Firm-level capital stock > sample median at time *t*	0.04

Table A3: Log wage equation, OLS estimates, sample of workers in *fast-moving* firms[a]

Variable:	OLS
Upstreamness[b]	0.030***
	(0.004)
Individual and job characteristics[c]	Yes
Firm characteristics[d]	Yes
Year dummies	Yes
Group effects[e]	Yes
Adjusted R^2	0.528
Model significance:	
p-value of F test	0.000
Number of observations	61,176
Number of firms	1,123

Notes: The dependent variable is the logarithm of the individual gross hourly wage, which includes base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. Robust standard errors are reported between brackets. [a] Sample only includes workers employed in fast-moving firms, i.e. top 25% firms in terms of recorded changes in their upstreamness over the sample period. [b] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [c] Individual and job characteristics include: six dummies for education, three dummies for tenure, eight dummies for age, a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies. [d] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. [e] Group effects estimations use the correction for common variance components within groups, as suggested by Greenwald (1983) and Moulton (1990 ***/**/*: significance at the 1, 5 and 10 per cent, respectively.

Table A4: Log wage equation *at firm level*, OLS and FE estimates, overall sample

Variables	OLS	FE
Upstreamness[a]	0.019***	0.016***
	(0.002)	(0.002)
Individual and job characteristics[b]	Yes	Yes
Firm characteristics[c]	Yes	Yes
Year dummies	Yes	Yes
Adjusted R^2	0.592	0.573
Model significance:		
p-value of F test	0.000	0.000
Number of firm-year observations	10,268	10,268

Notes: The dependent variable is the average workers' gross hourly wage at firm level (in logarithms), including base pay, overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses. Robust standard errors are reported between brackets. [a] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [b] Share of the workforce (at firm level) by education, years of tenure, age, working time, type of employment contract, and occupation. [c] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. ***/**/*: significance at the 1, 5 and 10 per cent, respectively.

Table A5: Log wage equation, OLS, UQR and CQR estimates, overall sample
(Gross hourly wages excluding compensation for overtime and shift/night/weekend work)

			Overall	
	OLS		Quantile estimates	
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.022***	0.015***	0.017***	0.022***
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.003)
Conditional Quantile Regression (CQR)	0.022***	0.013***	0.016***	0.018***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.002)
			Men	
	OLS		Quantile estimates	
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.022***	0.013***	0.017***	0.022***
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.003)
Conditional Quantile Regression (CQR)	0.022***	0.013***	0.015***	0.020***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.002)
			Women	
	OLS		Quantile estimates	
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.010***	0.004	0.006**	0.007**
Upstreamness[a]	(0.002)	(0.003)	(0.003)	(0.003)
Conditional Quantile Regression (CQR)	0.010***	0.006**	0.006**	0.009**
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.002)
Individual and job characteristics[b]	Yes	Yes	Yes	Yes
Firm characteristics[c]	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Group effects[d]	Yes	Yes	Yes	Yes
Number of observations for:				
Overall	250,108	250,108	250,108	250,108
Men	193,719	193,719	193,719	193,719
Women	56,389	56,389	56,389	56,389
Number of firms for:				
Overall	4,645	4,645	4,645	4,645
Men	4,634	4,634	4,634	4,634
Women	4,444	4,444	4,444	4,444

Notes: The dependent variable is the gross hourly wage, excluding compensation for overtime and shift/night/weekend work (ln). Clustered and block bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported in parentheses for OLS/CQR and UQR, respectively. [a] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [b] Individual and job characteristics include: six dummies for education, three dummies for tenure, eight dummies for age, , a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies. [c] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. [d] Group effects estimations use the correction for common variance components within groups, as suggested by Greenwald (1983) and Moulton (1990). ***/**/* Significance at the 1, 5 and 10 per cent, respectively.

Table A6: Mean and quantile decomposition of the gender wage gap
(Gross hourly wages excluding compensation for overtime and shift/night/weekend work)

	OLS	Quantile estimates		
	Mean	*(.25)*	*(.50)*	*(.75)*
Overall gender wage gap	0.119	0.130	0.100	0.097
Decomposition:				
Magnitude:				
Compositional effect of upstreamness	0.002	0.001	0.002	0.003
Wage structure effect of upstreamness	0.032	0.017	0.040	0.057
% of the overall gender wage gap explained by:				
Compositional effect of upstreamness	1.68	0.76	2.00	3.09
Wage structure effect of upstreamness	26.8	13.0	40.0	58.7

Notes: Decompositions are based on the Unconditional Quantile Regression (UQR) estimates. For exposition purposes, the '*magnitude'* and the '*percentage'* (of the overall gender wage gap) have only been reported for the upstreamness variable.

Table A7: Log wage equation, OLS, UQR and CQR estimates, overall sample
(Gross hourly base pay, excluding any additional component)

	Overall			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.017***	0.010***	0.014***	0.019***
Upstreamness[a]	(0.002)	(0.001)	(0.002)	(0.002)
Conditional Quantile Regression (CQR)	0.017***	0.010***	0.013***	0.016***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.001)
	Men			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.016***	0.010***	0.014***	0.020***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.003)
Conditional Quantile Regression (CQR)	0.016***	0.009***	0.012***	0.016***
Upstreamness[a]	(0.002)	(0.001)	(0.001)	(0.002)
	Women			
	OLS	Quantile estimates		
Variables	*(Mean)*	*(.25)*	*(.50)*	*(.75)*
Unconditional Quantile Regression (UQR)	0.007**	0.003	0.005**	0.006*
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.003)
Conditional Quantile Regression (CQR)	0.007**	0.005**	0.004**	0.006**
Upstreamness[a]	(0.002)	(0.002)	(0.002)	(0.002)
Individual and job characteristics[b]	Yes	Yes	Yes	Yes
Firm characteristics[c]	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Group effects[d]	Yes	Yes	Yes	Yes
Number of observations for:				
Overall	250,087	250,087	250,087	250,087
Men	193,698	193,698	193,698	193,698
Women	56,389	56,389	56,389	56,389
Number of firms for:				
Overall	4,645	4,645	4,645	4,645
Men	4,634	4,634	4,634	4,634
Women	4,444	4,444	4,444	4,444

Notes: The dependent variable is the gross hourly base pay, excluding overtime compensation, premia for shift/night/weekend work, performance-related pay and commissions, and annual and irregular bonuses Clustered and block bootstrapped standard errors (100 replications), corrected for heteroscedasticity, are reported in parentheses for OLS/CQR and UQR, respectively. [a] Steps (distance) before the production of a firm meets either domestic or foreign final demand. [b] Individual and job characteristics include: six dummies for education, three dummies for tenure, eight dummies for age, a dummy for part-time, two dummies for the type of employment contract, and seven occupational dummies. [c] Firm characteristics include: the logarithm of firm size (number of workers), a dummy for the type of financial and economic control, and a dummy for the level of collective wage bargaining. [d] Group effects estimations use the correction for common variance components within groups, as suggested by Greenwald (1983) and Moulton (1990). ***/**/* Significance at the 1, 5 and 10 per cent, respectively.

Table A8: Mean and quantile decomposition of the gender wage gap
(Gross hourly base pay, excluding any additional component)

	OLS	Quantile estimates		
	Mean	*(.25)*	*(.50)*	*(.75)*
Overall gender wage gap	0.109	0.121	0.097	0.085
Decomposition:				
Magnitude:				
Compositional effect of upstreamness	0.001	0.001	0.002	0.002
Wage structure effect of upstreamness	0.024	0.013	0.037	0.057
% of the overall gender wage gap explained by:				
Compositional effect of upstreamness	0.91	0.82	2.06	2.35
Wage structure effect of upstreamness	22.0	10.7	38.1	67.0

Notes: Decompositions are based on the Unconditional Quantile Regression (UQR) estimates. For exposition purposes, the '*magnitude'* and the '*percentage'* (of the overall gender wage gap) have only been reported for the upstreamness variable.