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Does offshoring shape labor market imperfections? A comparative analysis of Belgian and Dutch firms

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Does offshoring shape labor market imperfections? A comparative analysis of Belgian and Dutch firms*

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Abstract: This paper examines the relationship between offshoring and the prevalence and intensity of labor market imperfections at the firm level. For this purpose, we use Belgian and Dutch manufacturing firm-level data over the period 2009-2017 from Business registers and VAT declarations combined with information in the Transaction Trade database that reports values and volumes of international transactions at the firm, country and product level. In both countries, we find that wage markup-pricing stemming from workers' monopoly power is more prevalent than wage markdown-pricing originating from employers' monopsony power. Offshoring benefits Belgian and Dutch employers in that imports of final as well as intermediate goods are associated with a larger prevalence and intensity of wage markdowns. The opposite holds for the prevalence of wage markups. In Belgium, we also find that offshoring is negatively related to the intensity of wage markups measured by workers' bargaining power. The origin of imports matters for the prevalence of labor market imperfections in Belgian firms. This is far less so in Dutch firms, which could be explained by their more global focus and the more global scale of the vertical chain in which they operate.

JEL-Classification: F14, F16, J42, J50.

Keywords: Wage markdowns, wage markups, firm-level offshoring.

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1 Introduction

With the fragmentation of production and the increasing importance of outsourcing, trade in intermediate goods through offshoring has gained importance in the global economy over the past decade. Media attention to offshoring has predominantly focused on its negative aspects induced by a substitution effect. Indeed, the standard view is that rising imports of cheap low-skilled inputs substitute for domestic low-skilled workers in industrialized countries, leading to a decline in their wages and employment and increasing inequality between high- and low-skilled workers.

By now, there exist many empirical studies using firm panel data that have examined the relationship between offshoring and various firm outcomes such as total employment, the skill or occupational composition of labor demand, average wages, firm survival and innovation. Recent theoretical papers on offshoring explicitly model imperfections in the labor market through some sort of rent-sharing mechanism that generates interfirm wage dispersion (see Hummels et al. (2018) for a recent survey). In spite of the growing importance of labor market imperfections in recent international trade theory, no empirical study has so far investigated how offshoring, differentiated across type and country of origin, shapes labor market imperfections, which is the purpose of this study.

We use the production function approach introduced in Dobbelaere and Mairesse (2013) for estimating jointly labor market and product market imperfections. Labor market imperfections give rise to a wage-employment contract off the firm's labor demand curve. Such imperfections may either stem from firms' monopsony power enabling them to set a wage markdown, or from workers' monopoly power forcing employers to pay a wage markup. Accounting for a possible interdependence between labor and product market imperfections ensures that our estimates of wage markdowns, wage markups and price-cost markups are not contaminated.

We first document the prevalence and intensity of wage-markdown and wage-markup pricing for Belgian and Dutch employers in manufacturing, using firm panel data covering the period 2009-2017 in both countries. We then investigate whether firm-level offshoring matters for labor market imperfections at the firm level. In doing so, we contribute to the empirical international trade literature. Thanks to highly comparable data drawn from Business registers, VAT declarations and Transaction Trade databases, we can estimate how firm-level offshoring and industry-wide import competition relate to firms' labor market power in two small economies with a strong international focus. In addition, we are in a position to examine different margins by distinguishing offshoring of finished goods from offshoring of intermediate goods and by considering imports from different geographical areas (neighboring countries, other OECD countries, non-OECD countries and China). In addition, our study speaks to the growing empirical literature on the determinants of employer monopsony and worker monopoly in rent splitting and the drivers of the falling labor share in income (see Stansbury and Summers (2020), Grossman and Oberfield (2022)).

Several novel findings emerge. First, we find that in both countries labor market imperfections are the norm. These imperfections mainly arise from workers' monopoly power enabling them to push through wages above the marginal revenue product. We observe such labor market setting favoring workers in about 40% (50%) of firm-year observations in Belgium (the Netherlands). For another 30% of firm-year observations in both countries, we find that labor market imperfections give rise to a labor market setting favoring employers who impose wage markdowns on workers.

Second, workers' bargaining power is higher in Belgian firms that pay wage markups, with an average value of 0.53 compared to 0.39 in the Dutch counterparts. In both countries, workers obtain about 66% of their marginal product of labor in firms that set wage markdowns, pointing to considerable monopsony power.

Third, firm-level offshoring plays an important role in shaping employers' labor market power. In both countries, we find that offshoring of both intermediate and finished goods is associated with a higher probability of wage-markdown pricing and a lower probability of wage-markup pricing. Hence, offshoring gives rise to a labor market setting favoring employers, which is most pronounced in the Netherlands.

Fourth, these findings at the extensive margin also hold at the intensive margin. Irrespective of the nature of imports, offshoring is accompanied with higher monopsony power of Belgian and Dutch employers. In Belgium, we also see that offshoring is negatively associated with workers' bargaining power. To solve potential endogeneity problems arising from omitted variables bias and reverse causality, we also apply an Instrumental Variables estimation method using firm-weighted exchange rates as instruments for firm-level (offshoring of finished and intermediate goods) imports. Our TSLS results confirm our findings for the prevalence of wage markdowns and wage markups, and for the intensity of wage markdowns.

Fifth, the origin of imports seems to matter more for a labor market setting favoring Belgian employers. Imports of finished goods from non-OECD countries and imports of intermediate goods from OECD countries are positively associated with the prevalence and intensity of wage markdowns. The more global focus of Dutch companies and the more global scale of the vertical chain in which Dutch firms operate clearly shows up at the extensive margin of labor market imperfections. We find that the positive (negative) association of imports of finished as well as intermediate goods and wage markdowns (wage markups) holds irrespective of the origin of imports.

We proceed as follows. Section briefly reviews the literature related to offshoring. Section 3 provides some background information on institutional characteristics and international trade in Belgium and the Netherlands. Section 4 presents the main ingredients of the theoretical structural productivity model with imperfect product and labor markets. Section 5 discusses our econometric model and the estimation procedure. Section 6 presents the Belgian and Dutch firm panel data. Section 7 documents the prevalence and intensity of labor market imperfections in both countries. Section 8 investigates the relationship between firm-level offshoring and labor market imperfections. Section 9 concludes.

2 Literature on offshoring

A number of theoretical papers model explicitly the impact of offshoring in a context of heterogeneous firms and imperfect labor markets. Again, most papers rely on a bargaining framework and consider rent sharing to be the key mechanism through which offshoring affects wages/wage bargaining. Since offshoring lowers costs and raises profits, theory predicts that part of these higher rents might be transmitted to domestic workers through an offshoring wage premium. This prediction is based on several arguments such as the high productivity of offshoring activities (e.g. Grossman and Rossi-Hansberg (2008)), technology-enhancing effects (e.g. Mion and Zhu (2013) and Goel (2017)) or changes in the labor composition (e.g. Hromcová and Agnese (2019)).

Mitra and Ranjan (2010) construct a two-sector general-equilibrium model in which unemployment is caused by search frictions. Offshoring leads to higher wages and lower unemployment if there is sufficient intersectoral mobility. These effects arise from the dominance of the productivity-enhancing (cost-reducing) effect of offshoring (akin to Grossman and Rossi-Hansberg (2008)) over its negative relative price effect on the offshoring sector. In the absence of search frictions, there is only a wage-increase effect.

Sethupathy (2013) embeds search costs in a model with heterogeneous firms, endogenous price-cost markups, productivity effects à la Grossman and Rossi-Hansberg (2008) and bargaining. This model considers lower marginal costs as a channel through which a rise in offshoring activities affects workers' bargaining power. This offshoring effect is stronger for more productive firms and offshoring reallocates production toward more productivity firms. Employment effects are ambiguous for the more productive firms as the positive productivity effect counteracts the negative employment effect from offshoring. Dumont et al. (2006) postulate that offshoring can also substitute for domestic labor, causing a reduction in wages and hence, a reduction in wage bargaining.

Some theoretical papers consider the relationship between an offshoring threat, rather than actual offshoring, and labor market outcomes. Ranjan (2013) sets up a search and matching model but lets wage bargaining to take place either collectively between workers organized in a union and the firm (as in many European countries) or individually between each worker and the firm (as in the US). Under collective bargaining, the possibility of offshoring (lower offshoring costs) induces lower wages and lower unemployment. However, under individual bargaining, offshoring increases unemployment. Jeon and Kwon (2018) argue that the wage bargaining process might weaken if firms consider a probability to offshore. Using South Korean plant-level data, they validate this theoretical prediction. Kramarz (2008) models imperfect competition in product markets and shows that firms facing strong unions are likely to offshore more intensively than firms facing weaker unions because an increase in offshoring reduces the rents that the union and the firm bargain over. Using French matched employer-employee data, he shows empirical support for this prediction.

International trade models considering the effect of trade on the oligopoly/monopoly power of firms in the labor market are limited. A notable exception concentrating on offshoring is Egger et al. (2022). They show in a model with heterogeneous firms that in the presence of firms with monopsony power, exporting and multinational production have very different effects on labor markets, although they only consider symmetric countries. Through offshoring, firms can reduce domestic employment and thereby the wage rate without having to reduce output. In contrast, if a firm chooses to export it has to increase its domestic employment and therefore the wage that it has to pay. .

On the empirical side, few papers have investigated the relationship between offshoring and labor market imperfections. Using data on French manufacturing firms, Carluccio et al. (2015) find that in firms covered by collective bargaining, the responsiveness of wage to offshoring (and also to exports) is larger than in uncovered firms. These results provide empirical support of offshoring affecting wages through rent sharing. Give that the threat to offshore activities might strengthen the firm's position at the bargaining table, one can question whether the bargaining process is exogenous to offshoring (and other forms of internationalization). Dealing with such potential endogeneity bias, Carluccio et al. (2016) find that offshoring does not affect the probability of signing a collective wage agreement in French firms. Caselli et al. (2021) show a relationship between offshoring (and export intensity) and labor market power. Offshoring and importing intermediates from China increases firms' labor market power while exporting firms pay higher wages explaining the positive relationship between export intensity and workers' bargaining power.

In sum, based on existing theories, the relationship between offshoring and workers' bargaining power is a priori unclear, which is reflected in available empirical evidence. It depends on which of the two forces, the productivity augmenting effect of offshoring increasing rent sharing versus the negative effect of offshoring on workers' bargaining power through replacing domestic employment, dominates. As far as we know, empirical papers that explicitly focus on the impact of offshoring on firms' wage-setting (monopsony power) are non-existent.

3 Background on institutions and international trade

In this Section, we highlight some institutional characteristics in Belgium and the Netherlands and provide some descriptive information on international trade which serves as background information for our comparative study. These characteristics might shape firms' operational environment in general and, within our context, the prevalence and intensity of labor market imperfections.

Institutional characteristics. Industrial relations in Belgium and the Netherlands share some similar wage bargaining institutional characteristics but also differ on important aspects. In both countries, there is a broadly regulated system of wage bargaining characterized by a dominance of industry-level wage bargaining, the existence of statutory minimum wages and extension mechanisms guaranteeing that most workers belonging to the private sector are covered by collective agreements. The wage bargaining system in Belgium is considered to be even more regulated than in the Netherlands because of state-imposed automatic wage indexation and more government interventions. Trade union density rates are also higher (Caju et al. (2008)). In terms of employment protection, the OECD indicators show that employment protection is significantly higher and above the OECD average in Belgium, which is due to much stricter regulation on permanent contracts, while at the OECD average in the Netherlands (Venn (2009); OECD (2013)). Both countries significantly eased the regulation on temporary contracts during the 1990s (Martin and Scarpetta (2012)).

In all EU member states, employees are represented in trade unions which are mostly organized on a industry-wide basis and which embody the traditional form of employee representation, and works councils which are organized at the company or establishment level. According to 2019 figures from the International Labor Office (ILO), trade union representation dominates in Belgium and Belgian trade unions are among the strongest in the OECD with 49.9% of employees in unions which is largely above the OECD average of 23.2

In Belgium, collective bargaining is highly structured. There are three levels with the industry level playing the dominant role. At the centralized level, a national agreement determines a standard for the maximum hourly increase of gross labor compensation according to the expected evolution of labor costs in the neighboring countries during the first year. This so-called ”wage norm” acts as a guideline for complementary negotiations at the industry and firm levels, which are held in the subsequent year (Novella and Sissoko (2013)). Industry-level bargaining is organized around joint committees bringing together employers' and unions' representatives at the detailed industry level. It is the relevant bargaining level for about 96% of all firms in 2019 (ILO database, 2022). Collective labor agreements might also be concluded at the firm level with large firms having a higher probability of firm-level collective bargaining (Economie (2007)). This structure explains the very high proportion of employees covered by collective bargaining.

The dominant form of coordination, which refers to the extent to which wage negotiations are coordinated across the different bargaining levels, is automatic wage indexation, which is an exception in the OECD. This mechanism binds wage increases to cost of living raises in order to guarantee a constant level of purchasing power for employees and those who receive benefits.[4] Another particular characteristic of the wage bargaining system is that blue-collar and white-collar workers are represented by separate unions. Pay scales for blue-collar workers depend primarily on job descriptions while pay scales for white-collar workers are defined according to seniority. Beyond collective bargaining, the wage-setting system shows individualized characteristics with incentive pay and performance reviews determining individual wage increases or promotion.

Contrary to Belgium, employee representation at the workplace only occurs through works councils in the Netherlands. In 2019, trade union membership is low (19.9%) and below the OECD average of 23.3% (ILO database, 2022). Despite low union density, a broad majority agrees with the unions' policies. Every year, collective bargaining starts at the centralized level, where employer associations, trade unions and the government reach an agreement on the desirable development of wages which serves as an advice for actual negotiations on contracts and wages at the industry level. Modest wage increases have been central in these negotiations (Hartog and Salverda (2018)).[5] At both the central and industry level, the government plays the role of moderator, ensuring that agreements are based on consensus. As such, the collective bargaining system is conducive to social stability. Collective labor agreements are concluded at the company level in very large companies. The existence and widespread use of extension procedures for industry-level wage agreements, making these agreements binding for all employers and employees within the industry even if some employers or trade unions did not directly sign the agreement, explains the high rate of collective bargaining coverage despite low trade union density. Of all Dutch employees, 75.6% are covered by a collective contract in 2019 (ILO database, 2022): 75% by industry-level contracts and 25% by company contracts. This wage-setting process is complemented

[4] In particular, wages are automatically indexed according to the health price index, which is the national consumer price index excluding tobacco, motor fuels and alcoholic beverages.

[5] Since 1982, wage claims by Dutch trade unions have been mostly below the EU average (Kleinknecht et al. (2006)).

by the prevalent use of some type of incentive pay defining the position of an employee on the pay scale. Of all Dutch employees, 83% are covered by a collective contract: 69% by industry-level contracts and 14% by company contracts (Borghans and Kriechel (2009)). This wage-setting process is complemented by the prevalent use of some type of incentive pay defining the position of an employee on the pay scale.

International focus. Both Belgium and the Netherlands have a strong international focus, with Dutch companies having a more global status than Belgian firms. Inward and outward foreign direct investment (FDI) data for our sample of firms during the period 2006-2017 show that in Belgium there is more inward than outward FDI, most FDI is within EU-28 and China plays a minor role.[6] This is in contrast to the Netherlands where the more global scope comes from more outward FDI, more direct investments outside EU-28 and an important role played by China.

Such differences in global firm activities are confirmed by Van Cauwenberge et al. (2020) who report that Belgian listed firms mostly trade with European countries while Dutch listed firms trade more and mainly with non-European countries. More specifically, during the period 2006-2015, 70% of imports from Dutch listed firms came from outside the eurozone. In contrast, Belgian listed firms import a larger fraction from the eurozone. Dutch listed companies also export mostly to countries outside the eurozone while Belgian companies export to the euro area. Since listed firms only represent a small fraction of all internationally active firms, we use firm-level trade data on import and export destinations from Transaction Trade databases for our sample of firms during the period 2010-2017 to confirm that Dutch firms trade more with more distant countries.

4 Theoretical framework

To model a firm's product and labor market power, we follow Dobbelaere and Mairesse (2013) and nest two polar models of wage formation in imperfect labor markets in the seminal productivity model of Hall (1988) with imperfect product markets.

Each firm at any point in time produces output (Q_{it}) using labor (N_{it}), intermediate input (M_{it}) and capital (K_{it}). We assume that all producers that are active in the market are maximizing short-run profits and take the price of intermediate input as given.[7] Each

[6] Inward investments refer to investments in the home country (Belgium or the Netherlands) by firms located abroad while outward investments refer to direct investments abroad by companies located either in Belgium or the Netherlands.

[7] This assumption might be perceived as being restrictive, given recent evidence on the importance of imperfect competition in intermediate goods markets. Morlacco (2019) extends our model to account for imperfect competition in all variable input markets and uses company accounts and exhaustive records of export and import flows of French firms. Kikkawa et al. (2022) rely on a model

firm must choose the optimal quantity of output and the optimal demand for intermediate input and labor. We assume that capital is predetermined and thus no choice variable in the short run.

The first-order condition for output yields the firm's price-cost markup $\mu_{it} = \frac{P_{it}}{(C_Q)_{it}}$ with P_{it} the output price and $(C_Q)_{it}$ the marginal cost of production. The first-order condition for intermediate input is given by setting the marginal revenue product of intermediate input equal to the price of intermediate input: $(Q_M)_{it} = \mu_{it}\frac{J_{it}}{P_{it}}$, with $(Q_M)_{it}$ the marginal product of intermediate input and J_{it} the price of intermediate input. Using this first-order condition and the first-order condition for output, we obtain an expression for firm i's price-cost markup μ_{it}:

$$\mu_{it} = \frac{(\varepsilon_M^Q)_{it}}{\alpha_{it}^M} \begin{cases} = 1 & \text{if } PMS_{it} = PMC \\ > 1 & \text{if } PMS_{it} = PMU \end{cases}, \tag{1}$$

with $(\varepsilon_M^Q)_{it}$ the output elasticity with respect to intermediate input and $\alpha_{it}^M = \frac{J_{it}M_{it}}{P_{it}Q_{it}}$ the share of intermediate input expenditure in total revenue. The value of μ_{it} determines the firm's type of competition prevailing in the product market or its product market setting (denoted *PMS*). The product market setting is defined to be perfectly competitive if the firm engages in marginal cost pricing (*PMC*) and, hence, has no product market power. The product market setting is defined to be imperfectly competitive if the firm sets a price-cost markup (*PMU*), which is our model consistent measure of product market power.

Firm i's wage formation process, and, hence, its optimal demand for labor depends on the prevalence and the source of labor market imperfections. The firm's type of competition prevailing in the labor market or its labor market setting (denoted *LMS*) is defined to be perfectly competitive if the firm engages in marginal product pricing (*WMP*), that is, pays the marginal employee a real wage equal to her marginal product.[8] Its labor market setting is defined to be imperfectly competitive if the firm either pays a wage markup (*WMU*), that is, pays the marginal employee a real wage exceeding her marginal product; or sets a wage markdown (*WMD*), that is, pays the marginal employee a real wage lower than her marginal product. Its labor market setting is defined to be imperfectly competitive if the firm either pays a wage markup (*WMU*), that is, pays the marginal employee a real

of oligopolistic competition in firm-to-firm trade and use business-to-business transactions of the universe of Belgian firms. We defend our restrictive assumption on two grounds. The first is a data reason. In line with Morlacco (2019), we could easily model imperfections in intermediate input markets as additional unit costs that create wedges between marginal costs and marginal products. However, data constraints preclude us from considering this choice. The second reason is that we prefer to focus our empirical analysis on relationship between firm-level offshoring and employers' labor market power, abstaining from non-competitive buyer behavior in the market of intermediate inputs.

8 Defining perfect competition in the labor market in such a way is in line with Addison et al. (2014).

wage exceeding her marginal product; or sets a wage markdown (*WMD*), that is, pays the marginal employee a real wage lower than her marginal product.

Intuitively, the perfectly competitive labor market setting ($LMS = WMP$) arises when the wage-employment contract lies on the firm's labor demand curve, which characterizes profit-maximizing employment levels.[9] Analogous to the case of intermediate input, the first-order condition for labor under $LMS = WMP$ is given by setting the marginal revenue product of labor equal to the price of labor: $(Q_N)_{it} = \mu_{it}\frac{W_{it}}{P_{it}}$ with $(Q_N)_{it}$ the marginal product of labor and W_{it} the price of labor. Hence, absent labor market imperfections, there exists no wedge between the output elasticities of intermediate input and labor and their respective revenue shares. Since this wedge is derived using the first-order conditions for output, intermediate input and labor, we call this wedge the firm's joint market imperfections parameter ψ_{it}:

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{\alpha_{it}^M} - \frac{(\varepsilon_N^Q)_{it}}{\alpha_{it}^N} = 0 \quad \text{if } LMS_{it} = WMP \tag{2}$$

with $(\varepsilon_N^Q)_{it}$ the output elasticity with respect to labor and $\alpha_{it}^N = \frac{W_{it}N_{it}}{P_{it}Q_{it}}$ the share of labor input expenditure in total revenue.

In contrast to marginal product pricing, labor market imperfections give rise to wage-employment contracts off the firm's labor demand curve. We consider two polar sources of such imperfections. Labor market imperfections may arise from firms' monoposony power that enables them to set a wage markdown ($LMS = WMD$). There exist different underlying theoretical structural models leading to wage-employment contracts below the firm's labor demand curve. Wage-markdown pricing may, e.g., arise when workers have heterogeneous preferences over work environments of different potential employers, employers collude, or employers are active in highly concentrated labor markets (Manning (2011), Manning (2021)). Considering the first –widely-used– theoretical structural model, Dobbelaere and Mairesse (2013) show that the first-order condition for labor is given by: $(\varepsilon_N^Q)_{it} = \mu_{it}\alpha_{it}^N\left(1 + \frac{1}{(\varepsilon_W^N)_{it}}\right)$, with $(\varepsilon_W^N)_{it} \in \mathbb{R}_+$ the wage elasticity of the labor supply of firm i, measuring the degree of wage-setting power that firm i possesses. $(\varepsilon_W^N)_{it}$ is our model consistent measure of labor market power under $LMS = WMD$. Hence, the firm's joint market imperfections parameter ψ_{it} under $LMS = WMD$ is equal to:

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{\alpha_{it}^M} - \frac{(\varepsilon_N^Q)_{it}}{\alpha_{it}^N} = -\frac{\mu_{it}}{(\varepsilon_W^N)_{it}} < 0 \quad \text{if } LMS_{it} = WMD \tag{3}$$

[9] Such solutions arise under either perfect competition in the labor market, in which case the firm unilaterally chooses the profit-maximizing number of workers at the exogenously-given wage or under right-to-manage bargaining Nickell and Andrews (1983), in which case the firm unilaterally chooses the profit-maximizing employment level at the bargained wage.

Labor market imperfections may also stem from workers' monopoly/bargaining power that forces employers to pay a wage markup ($LMS = WMU$). There exist different underlying theoretical structural models leading to wage-employment contracts above the firm's labor demand curve. Wage-markup pricing may, e.g., arise when a firm and its workforce negotiate simultaneously over wages and employment (McDonald and Solow (1981)), a firm bargains over wages with a workforce of declining size caused by employees gradually losing their job after bargaining breaks down (Dobbelaere and Luttens (2016)), or an employee bargains individually over wages with a firm that does not incur hiring costs (Stole and Zwiebel (1996)). Considering the first –widely-used– theoretical structural model, DobbelaereMairesse2013 show that the first-order condition for labor is given by: $(\varepsilon_N^Q)_{it} = \mu_{it}\alpha_{it}^N - \mu_{it}\gamma_{it}(1-\alpha_{it}^N-\alpha_{it}^M)$, with $\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}} \geqslant 0$ the relative extent of rent sharing and $\phi_{it} \in [0,1]$ the part of economic rents going to the workers or the degree of workers' bargaining power during worker-firm negotiations. ϕ_{it} is our model consistent measure of labor market power under $LMS = WMU$. Hence, the firm's joint market imperfections parameter ψ_{it} under $LMS = WMU$ is equal to:

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{\alpha_{it}^M} - \frac{(\varepsilon_N^Q)_{it}}{\alpha_{it}^N} = \mu_{it}\frac{\phi_{it}}{1-\phi_{it}}\left[\frac{1-\alpha_{it}^N-\alpha_{it}^M}{\alpha_{it}^N}\right] > 0 \quad \text{if } LMS_{it} = WMU \qquad (4)$$

5 Econometric framework

The outlined theoretical framework allows us to determine the firm's labor market and product market setting from its production technology providing us with the output elasticities of intermediate inputs $(\varepsilon_M^Q)_{it}$ and labor $(\varepsilon_N^Q)_{it}$ and its input choices providing us with the revenue shares of intermediate inputs α_{it}^M and labor α_{it}^N. In order to obtain consistent estimates of the output elasticities, we consider production functions with a scalar Hicks-neutral productivity term which is observed by the firm but unobserved by the econometrician (denoted by ω_{it}) and common technology parameters, governing the transformation of inputs to units of output, across a set of producers (denoted by the vector β). These two assumptions imply the following expression for the production function:

$$Q_{it} = F(N_{it}, M_{it}, K_{it}; \beta)\exp(\omega_{it}) \qquad (5)$$

Guided by data availability in both countries, we cluster producers based on industry and consider 19 two-digit manufacturing industries. We approximate the unknown regression function $F(\cdot)$ by means of a second-order Taylor polynomial and estimate the coefficients (β) of a translog production function at the industry level. To control for unobserved productivity shocks ω_{it} , which are potentially correlated with the firm's input choices, we apply the estimation procedure proposed by Ackerberg et al. (2015) using the insight that optimal input choices hold information about unobserved productivity. We also refer to in Appendix A for details of the estimation routine.

The estimated production function coefficients $\widehat{\beta}$ are then used together with data on inputs to compute the output elasticities at the firm-year level. In particular, we calculate the firm-year elasticity of output with respect to labor as:

$$(\widehat{\varepsilon}_N^Q)_{it} = \widehat{\beta}_n + 2\widehat{\beta}_{nn} n_{it} + \widehat{\beta}_{nm} m_{it} + \widehat{\beta}_{nk} k_{it} \tag{6}$$

with n_{it} , m_{it} and k_{it} denoting the logs of Q_{it} , N_{it} , M_{it} and K_{it}, respectively. Similarly, we calculate the firm-year elasticity of output with respect to material as:[10]

$$(\widehat{\varepsilon}_M^Q)_{it} = \widehat{\beta}_m + 2\widehat{\beta}_{mm} m_{it} + \widehat{\beta}_{mn} n_{it} + \widehat{\beta}_{mk} k_{it} \tag{7}$$

Using the shares of labor and intermediate input expenditure in total revenue, α_{it}^N and α_{it}^M , respectively, and our estimates of the output elasticities, $(\widehat{\varepsilon}_N^Q)_{it}$ and $(\widehat{\varepsilon}_M^Q)_{it}$, we are able to compute $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$. Since the observed output $Y_{it} = Q_{it} \exp(\epsilon_{it})$ includes idiosyncratic factors including non-predictable output shocks and potential measurement error in output and inputs, we need to correct the observed revenue shares for N_{it} and M_{it} for these factors. We can recover an estimate of ϵ_{it} from the production function estimation routine and obtain adjusted the revenue shares as follows:

$$\widehat{\alpha}_{it}^N = \frac{W_{it} N_{it}}{P_{it} \frac{Y_{it}}{\exp(\epsilon_{it})}} \tag{8}$$

$$\widehat{\alpha}_{it}^M = \frac{J_{it} M_{it}}{P_{it} \frac{Y_{it}}{\exp(\epsilon_{it})}} \tag{9}$$

Using Eqs. (A.10), (A.11), (8), and (9), we obtain estimates of the key parameters of our static productivity model, which are the price-cost markup μ_{it} and the joint market imperfections parameter ψ_{it}, as follows:

$$\widehat{\mu}_{it} = \frac{(\widehat{\varepsilon}_M^Q)_{it}}{\widehat{\alpha}_{it}^M} \tag{10}$$

$$\widehat{\psi}_{it} = \frac{(\widehat{\varepsilon}_M^Q)_{it}}{\widehat{\alpha}_{it}^M} - \frac{(\widehat{\varepsilon}_N^Q)_{it}}{\widehat{\alpha}_{it}^N} \tag{11}$$

Equation (10) permits us to determine the product market setting as either involving marginal-cost pricing (PMC, $\widehat{\mu}_{it} = 1$) or price-cost markup pricing (PMU, $\widehat{\mu}_{it} > 1$). The sign of Equation (11) allows us to determine the labor market setting as either one

[10] Under a Cobb-Douglas production function $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$ would be equal to $\widehat{\beta}_n$ and $\widehat{\beta}_m$, respectively.

without imperfections involving marginal-product wages (WMP, $\widehat{\psi}_{it} = 0$), or as one with imperfections that result either in a wage markdown (WMD, $\widehat{\psi}_{it} < 0$) or in a wage markup (WMU, $\widehat{\psi}_{it} > 0$). We account for estimation uncertainty in $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$ by using a classification procedure that relies on the the 95% two-sided confidence intervals (CI) for μ_{it} and $gap_{Nit} = \frac{(\varepsilon_N^Q)_{it}}{\widehat{s}_{Nit}}$:

$$[A_{\widehat{\mu}_{it}}, B_{\widehat{\mu}_{it}}] = [\widehat{\mu}_{it} - 1.96 \times \widehat{\sigma}_{\widehat{\mu}_{it}}, \widehat{\mu}_{it} + 1.96 \times \widehat{\sigma}_{\widehat{\mu}_{it}}] \tag{12}$$

$$[A_{\widehat{gap}_{Nit}}, B_{\widehat{gap}_{Nit}}] = [\widehat{gap}_{Nit} - 1.96 \times \widehat{\sigma}_{\widehat{gap}_{Nit}}, \widehat{gap}_{Nit} + 1.96 \times \widehat{\sigma}_{\widehat{gap}_{Nit}}] \tag{13}$$

with $\widehat{\sigma}_{\widehat{\mu}_{it}}$ and $\widehat{\sigma}_{\widehat{gap}_{Nit}}$ denoting the respective standard errors (estimators of the standard deviation of the sampling distribution of $\widehat{\mu}_{it}$ and $\widehat{gap}_{Nit}$, respectively) computed using the Delta method Wooldridge (2010).

To determine firm i's product market setting at time t, we use the 95% CI for μ_{it}. We classify the firm's product market setting as marginal-cost pricing ($PMS_{it} = PMC$) if the lower bound of the 95% CI ($A_{\widehat{\mu}_{it}}$) is lower than or equal to unity and as price-cost markup pricing ($PMS_{it} = PMU$) if $A_{\widehat{\mu}_{it}}$ exceeds unity.

To determine the firm's labor market setting at time t, we compare the 95% CIs for gap_{Nit} and μ_{it} and check for an overlap of the CIs for gap_{Nit} and μ_{it} which informs us whether the difference between these two (ψ_{it}) is statistically significant. If the CIs overlap, $\widehat{\mu}_{it}$ is not significantly different from $\widehat{gap}_{Nit}$, hence $\widehat{\psi}_{it} = 0$ at the 5% significance level. As such, we classify the firm's labor market setting as wage marginal product pricing ($LMS_{it} = WMP$). We classify the firm's labor market setting as wage markdown pricing if $A_{\widehat{gap}_{Nit}} > B_{\widehat{\mu}_{it}}$ implying that $\widehat{\psi}_{it} < 0$ at the 5% significance level and as wage markup pricing if $A_{\widehat{\mu}_{it}} > B_{\widehat{gap}_{Nit}}$ implying that $\widehat{\psi}_{it} > 0$ at the 5% significance level.

On top of these extensive margins, the size of the estimated μ_{it} allows us to directly infer the magnitude of product market imperfections at the intensive margin. The estimated μ_{it} and ψ_{it} permit us to recover the magnitude of labor market imperfections at the intensive margin, that is the structural parameters of the labor market for a given labor market setting. For $LMS_{it} = WMD$ or $\psi_{it} < 0$ we can recover the firm-level labor supply elasticity $(\varepsilon_W^N)_{it}$ and the wage markdown β_{it} using equation (3) together with the estimates (6)–(11) as:

$$(\widehat{\varepsilon}_W^N)_{it} = -\frac{\widehat{\mu}_{it}}{\widehat{\psi}_{it}} \tag{14}$$

$$\widehat{\beta}_{it} = \frac{(\widehat{\varepsilon}_W^N)_{it}}{(\widehat{\varepsilon}_W^N)_{it} + 1} \tag{15}$$

For $LMS_{it} = WMU$ or $\psi_{it} > 0$, we can recover workers' absolute (relative) bargaining power ϕ_{it} (γ_{it}) using equation (4) together with the estimates (6)–(11) as:

$$\widehat{\gamma}_{it} = \frac{\widehat{\psi}_{it}}{\widehat{\mu}_{it}} \left[\frac{\widehat{\alpha}_{Nit}}{1 - \widehat{\alpha}_{Nit} - \widehat{\alpha}_{Mit}} \right] \tag{16}$$

$$\widehat{\phi}_{it} = \frac{\widehat{\gamma}_{it}}{1 + \widehat{\gamma}_{it}} \tag{17}$$

which informs us on the size of the wage markup.

6 Data

Combining firm and country-level perspectives for two countries, our analysis primarily serves the purpose of examining how firm-level offshoring shapes labor market imperfections at the firm level. The selection of Belgium and the Netherlands is motivated by differences in institutional characteristics, the fact that the two economies have a strong international focus and the ability to build two highly comparable microdata sets that span the period 2009-2017. The latter ensures that our results reflect underlying economic differences which enables us to perform a reliable international comparative study.

In both countries, the unbalanced panel datasets to estimate firm-year measures of product and labor market power are sourced from firm annual accounts and VAT declarations. The observational unit is the firm, which can be thought of as the economic actor in the production process.[11]

For Belgium, employment (N) defined as the average number of employees in full-time equivalents over the year, the wage bill (WN) and the capital stock (to proxy K) measured as the stock of fixed tangible assets reported in firms' annual accounts collected by the National Bank of Belgium. Intermediate input consumption (to proxy M) and nominal sales (to proxy Q) are taken from VAT declarations. Ultimate control of ownership to define the MNE status of a firm is provided by the Survey of Foreign Direct Investment.

For the Netherlands, firm data on value-added (to proxy M), nominal sales, the average number of employees in full-time equivalents over the year (FTE, N), the wage bill (WN) the book value of tangible assets (to proxy K) and the ultimate control of ownership (to define MNE status) are drawn from compulsory reporting of firms and income statements available in the Dutch Business Register collected by Statistics Netherlands and data from Profit and VAT tax information referred to as Baseline.

[11] The Eurostat definition is as follows: an enterprise is an organizational unit producing goods or services which has a certain degree of autonomy in decision-making. An enterprise can carry out more than one economic activity and it can be situated at more than one location. An enterprise may consist out of one or more legal units, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Enterprise.

To convert nominal values into real, inflation-adjusted data, we use two-digit industry price deflators for output, intermediate inputs and capital from the OECD STAN database for Belgium and from the National Accounts Statistics for the Netherlands supplied by Statistics Netherlands.

We relate the prevalence and intensity of firm-year labor market imperfection parameters to a number of covariates. By having access to imports at the firm-level, we can distinguish between firm-specific offshoring ($IMPsh$ variables) and industry-wide import competition ($IMPcomp$ variables), which are our covariates of interest. Following Biscourp and Kramarz (2007) and Mion and Zhu (2013), we measure offshoring activities based on the ratio of imports to sales and use rich information in the Transaction Trade database that reports values and volumes of international transactions, export and import, at the firm, country and product level. Values for exports are reported as FOB-type value and values for imports as CIF-type values.[12] Products are classified using the 8-digit CN (Combined Nomenclature) classification.

In addition to firm-level total imports, we are able to distinguish between two different types of firm-level offshoring: offshoring of intermediate and finished goods. The purpose of this distinction is to account for the different nature of imports of goods that will be further processed as inputs within the firm versus imports of goods that are ready to be sold.[13] The identification of final versus intermediate goods is based on the comparison between the imported product and the firm 4-digit industry of economic activity. We convert the CN classification used for trade flows into 4-digit NACE codes, focusing on products for which a one-to-one correspondence exists, a condition that holds for the vast majority of products. We classify an imported good as final if it falls within the same 4-digit NACE sector as the firm main activity, otherwise the good is considered as intermediates.

In addition to this final-intermediate goods classification, we consider offshoring from various income-level countries (high-income versus middle- and low-income countries, following the World Bank classification) and country regions (e.g. (non-)OECD, neighboring countries and China) which could also have varying effects on employers' labor market power. As such, offshoring of final goods is defined as: $IMPsh^c_{final,it} = \frac{IMP^c_{final,it}}{P_{it}Q_{it}}$, with $IMP^c_{final,it}$ equal to imports of final goods of firm i coming from country (group)

[12] FOB-type values include the transaction value of the goods and the value of services performed to deliver goods to the border of the exporting country. CIF-type values include the transaction value of the goods, the value of services performed to deliver goods to the border of the exporting country and the value of the services performed to deliver the goods from the border of the exporting country to the border of the importing country.

[13] This allows for a finer classification than the industry-level distinction between final and intermediate goods. For instance, when an industrial bakery imports sugar, these imports will be classified as intermediate inputs. When a sugar producer imports sugar, this will be classified as final goods imports.

c in year t. Offshoring of intermediate goods is defined as: $IMPsh^{c}_{int,it} = \frac{IMP^{c}_{int,it}}{P_{it}Q_{it}}$, with $IMP^{c}_{int,it}$ equal to imports of intermediate goods of firm i coming from country (group) c in year t.

As a robustness test, we clean the firm-product level trade data for re-export activities. Because of their central locations in Europe and thanks to the size of its main port, about one third of trade in goods in Belgium and the Netherlands can be considered as re-exports. More specifically, the volume of exported products for which an identical volume has been imported within the same year is identified as re-export and cleaned from the data.[14]

We match trade data to Belgian and Dutch manufacturing industries in order to measure import competition at the industry level. Data on international trade are sourced from the OECD STAN Bilateral Trade Database. This database consists of estimates of imports and exports of goods, broken down by reporting (or declaring) and partner countries[15] including all OECD member countries and a wide range of non-OECD economies. The trade flows are divided into nine categories of goods, including the three main end-use categories (capital goods, intermediate inputs and consumption) and broken down by economic activities based on the Revisions 4 of the ISIC classification (Zhu et al. (2011)). Similar to offshoring, we consider import competition from various income-level countries (high-income versus middle- and low-income countries) and country regions (e.g. (non-)OECD and China). Following Bernard et al. (2006), Mion and Zhu (2013), and Dorn et al. (2020), we define import competition as the import share of country group c of the goods produced by industry j in year t: $IMPcomp^{c}_{jt} = \frac{IMP^{c}_{jt}}{Q_{jt}+IMP_{jt}-EXP_{jt}}$, where IMP^{c}_{jt} and IMP^{c}_{jt} represent the value of imports from country group c and all countries, respectively, EXP_{jt} stands for the value of exports and Q_{jt} for the value of domestic production.

Additional controls include the firm's export share (defined as the exports-to-sales ratio $EXPsh$), the firm's capital intensity (defined as the logarithm of the capital-to-labor ratio $\ln(\frac{K}{N})$), firm size (defined as the logarithm of the number of workers), the firm's revenue total factor productivity (Tfp) and the firm's workforce composition. Firm-year varying TFP estimates are obtained by estimating translog production functions separately for each of our 19 industries in both countries. For Belgium, the workers' skill type is sourced from the Social Balance Statistics which reports employment (number of employee or in

14 Re-export activities are identified as import of product p by firm i in year t that firm i exports within the same year. More specifically, re-export volumes are defined as $reEXP_{ipt} = min(EXP_{ipt}, IMP_{ipt})$, where EXP stands for exports and IMP for imports. Net import values are adjusted by subtracting re-export from total import, applying the import (export) unit value aggregated across destination countries: net imports is equal to $P^{IMP}_{ipt}IMP_{ipt} - P^{IMP}_{ipt}.reEXP_{ipt}$ (net exports is equal to $P^{EXP}_{ipt}EXP_{ipt} - P^{EXP}_{ipt}reEXP_{ipt}$. Note that this correction cannot be applied to trade flows by origin or destination country because it would imply (heroic) assumptions on where the re-exported flows come from and go to.

15 The origin of imports and the destination of exports.

FTE) by education type, distinguishing between primary education (*Shprim*), secondary education (*Shsec*), upper non-university education and university degree. We aggregate the last two categories to construct the share of workers with upper education (*Shupuniv*). To define the skill type of each employee in Dutch firms, we use their education type reported in the Education database which comes from the Polis Administration and the Labour Force Survey ("Enquête BeroepsBevolking, EBB"). The Education databases provides the highest level of education attained by an individual on October 1 of the year and is complete for persons up to the age of 35 years old. For the remaining individuals, the education type comes from the EBB using population weights. The education type is based on a 2-digit SOI-code (Dutch education classification, "Standaard Onderwijsindeling") and is converted to the ISCED classification (International Standard Classification of Education).

We first deleted firm-year observations with labor and intermediate consumption shares greater than or equal to one and smaller than or equal to zero. In order to remove outliers, we also disregarded firm-year observations with cost shares in the bottom 1% and top 1% of the respective industry-year distributions. We selected firms that survive at least three consecutive years because lagged inputs are needed to construct moment conditions in our estimation framework. For Belgium (the Netherlands), we obtain an unbalanced estimation sample consisting of 52,544 (81,705) observations for 6,695 (11,379) firms over the years 2009-2017.

Tables 1 and 2 report the means of our variables for Belgium and the Netherlands, respectively. In Belgium, real firm output, labor, materials and the Solow residual (*SR*) or conventional TFP measure have been stable over the considered period while capital has decreased at an average annual growth rate of 2.1%. In the Netherlands, labor, real firm output, materials and the Solow Residual have increased at an average annual growth rate ranging between 1.1% and 1.6% whereas capital has decreased at an average annual growth rate of 8.9%. In both countries, about 6% of firms are MNEs. The share of exporters and importers is higher in Belgium (respectively, 45% and 52% as compared to 31% and 36% in the Netherlands). In both countries, the average share of imports of final goods to sales is about the same (2.9% in Belgium and 2.7% in the Netherlands) while the average share of imports of intermediate goods is higher in Belgium (7.5% as compared to 4.9% in the Netherlands). In both countries, about 52-55% of final goods and and 63-67% of intermediate goods are imported from neighboring countries.

<Insert Tables 1 and 2 about here>

7 Prevalence and intensity of labor and product market power

7.1 Extensive margin of labor and product market power

Using our panels of 6,695 Belgian firms and 11,379 Dutch firms covering the period 2009-2017, we now apply the econometric framework described in Section 5. First, we estimate translog production functions for each of the 19 two-digit industries in both countries relying on a control function approach that allows us to control for unobserved productivity shocks. We use the estimated production function coefficients together with data on firms' inputs to compute output elasticities at the firm-year level. Tables A.1 and A.2 in Appendix A present means (overall and by two-digit industries) of the estimated output elasticities of labor, intermediate inputs, and capital as well as the resulting returns to scale, i.e. the sum of the three output elasticities, for Belgium and the Netherlands respectively. For the whole sample, average output elasticities are very similar across the two countries: about 0.25 for labor, 0.75 for intermediate inputs, and 0.03 for capital, with close to constant returns to scale. We also notice some differences in production technologies across manufacturing industries.

We now use firms' estimated output elasticities and revenue shares for labor and intermediate inputs to infer their joint market imperfections parameter and price-cost markup that allow us to pin down firms' time-varying labor and product market settings and, hence, to inform us about the extensive margin of firms' labor and product market power. Recall that by considering jointly market power in both markets, we account for a possible interdependency between the prevalence (and the intensity) of labor and product market imperfections and by doing so, we rule out that our estimates of wage markdowns, wage markups and price-cost markups are contaminated.

In both countries, labor market imperfections are the norm rather than the exception and give rise to a power imbalance favoring workers who are able to force employers to pay a wage markup. In Belgium, 33% of observations are classified as free from labor market imperfections involving marginal-product wages, whereas for 29% of observations we find a wage markdown at the detriment of workers and for 38% a wage markup at the detriment of firms. Market imperfections are also the norm in the product market where 77% of observations show markup pricing while only 23% involve marginal-cost pricing. The overwhelming prevalence of imperfections in labor and product markets is even more so in the Netherlands. Only 17% of firm-year observations involve wage-employment outcomes on the labor demand curve (absence of labor market imperfections) whereas 33% involve wage-markdown pricing and even 50% wage-markup pricing. In the product market, up to 95% of observations involve price-cost markup pricing.

Tables 3 and 4 summarize the outcome of the classification procedure for Belgium and the Netherlands where we distinguish firms according to offshoring activities. In particular, we compare the prevalence of labor/product market power of offshorers (that is, firms that report a positive ratio of imported goods to sales) and firms with no offshoring activities. We reveal clear differences in the prevalence of labor market power across firms with and without offshoring activities. A labor market setting favoring employers (that is, wage-markdown pricing) is more frequent and a labor market setting favoring employees (that is, wage-markup pricing) is less frequent when firms engage in offshoring activities. Such differences are most pronounced in the Netherlands. In particular, 32% (41%) of offshorers in Belgium (the Netherlands) pay wages below the marginal revenue product of labor while this is only the case for about 26% of non-offshorers. In Belgium (the Netherlands), 30% (35%) of offshorers pay wages above the marginal revenue product of labor whereas this is true for 47% (59%) of Belgian (Dutch) firms without offshoring activities. These correlations suggest that engagement in offshoring activities benefits employers. In both countries, absence of labor market power (that is, wage-marginal product pricing) is about 10pp more frequent among offshorers. The prevalence of product market power (that is, price-cost markup pricing) is 3.8pp higher in firms with offshoring activities in Belgium but 6.1pp less frequent for offshorers in the Netherlands.

<Insert Tables 3 and 4 about here>

Exploiting the time-varying nature of our estimates of firms' joint market imperfections parameter and price-cost markup, we also examined persistence in firms' labor and product market setting by investigating one-year transition probability rates across respective states over the period, where the states are defined as $\{WMD,\ WMP,\ WMU\}$ in the case of firms' labor market setting and $\{PMC,\ PMU\}$ in the case of firms' product market setting.

Pooling all firms and focusing on the three labor market settings, wage markups are the most persistent: 85% (91%) of Belgian (Dutch) companies characterized by wage-markdown pricing also impose a wage markdown in the subsequent year. In terms of persistence, wage markups come next: for 83% (86%) of Belgian (Dutch) firms with a wage markup at time t, we also observe a wage markup at $t+1$. In both countries, switches from wage-markdown towards wage-markup pricing (or the other way around) are rarely observed. Paying workers real wages according to their marginal product is the least persistent labor market setting: 71% (57%) of Belgian (Dutch) firms with marginal-product wages stay in this setting in the subsequent year. In both countries, firms with no labor market power are equally likely to switch either to a labor market setting favoring employers (i.e. imposing a wage markdown) or to a labor market setting favoring employees (that is, paying a wage markup) in the next year.

Pooling all firms and focusing on the two product market settings, price-cost markups are the most persistent: 92% (99%) of Belgian (Dutch) firms characterized by price-cost markup pricing also charge prices above marginal costs in the subsequent year. Finally, 68% (58%) of Belgian (Dutch) firms characterized by price marginal cost pricing at time t continue to have no market power in the product market at $t + 1$.

Tables B.1-B.4 in Appendix B reports transition matrices across firms that differ in terms of offshoring activities. For both subsets of firms within both countries, we find the same ranking of persistence in labor/product market settings as for the full set of firms. Persistence in terms of having no labor market power (wage-marginal product pricing) appears to be 14.5pp (8.5pp) higher among offshorers as compared to non-offshorers in Belgium (the Netherlands) while persistence in terms of wage-markup pricing is 7.9pp lower among ffshorers in the Netherlands. Persistence in terms of price-marginal cost pricing is 5.8pp (10.4pp) higher among offshorers in Belgium (the Netherlands). In both countries, offshorers with no labor market power tend to switch more towards wage-markdown pricing in the next year while non-offshorers with no labor market appear to change more towards wage-markup pricing.

7.2 Intensive margin of labor and product market power

So far, we have documented the prevalence of labor and product market power, that is, we have focused on the extensive margin. To recover the magnitude of labor and product market power at the intensive margin, we focus on widely-used models of imperfect competition. Consistent with two widely-used models of imperfect competition in the labor market, we measure the magnitude of labor market power either by the wage elasticity of a firm's labor supply curve $(\varepsilon_W^N)_{it}$ which informs us about the size of the wage markdown or the workers' bargaining power ϕ_{it} which informs us about the size of the wage markup (see Section 4). More specifically, a larger labor supply elasticity (that is, less employer monopsony power) indicates a narrower wage markdown. A larger workers' bargaining power (that is, more worker monopoly power) indicates a wider wage markup. Both structural parameters $(\varepsilon_W^N)_{it}$ and ϕ_{it} are transformations of a firm's wage markdown and a firm's wage markup, respectively.[16] Consistent with standard models of imperfect competition in the product market, we measure the magnitude of product market power by a firm's price-cost markup μ_{it}.

We document average values of the intensity of wage markdowns, wage markups and price-cost markups for all firms, the subset of offshorers and the subset of firms without offshoring activities in the relevant labor/product market setting (see Tables 5 and 6

16 $(\varepsilon_W^N)_{it}$ is a direct transformation of a firm's wage markdown as there exists a 1-1 relationship: a higher $(\varepsilon_W^N)_{it}$ implies a narrower wage markdown. ϕ_{it} is an indirect transformation: a higher ϕ_{it} implies a higher wage markup.

for Belgium and the Netherlands, respectively). Conditional on a labor market setting favoring employers, we observe that firms' monopsony power is roughly at par in Belgium and the Netherlands. More specifically, for the 29% (33%) of Belgian (Dutch) firm-year observations involving wage-markdown pricing, we find that the average labor supply elasticity in Belgian (Dutch) firms amounts to 3.06 (3.13), which is close to mean values of advanced countries reported in other studies (see Sokolova and Sorensen (2021)). Assuming that firms can use all of their monopsony power, this implies that workers are paid about 66% of their marginal product in both countries (that is, the average wage markdown is about 0.66).

Conditional on a labor market setting favoring employees, we find that workers' monopoly power is higher in Belgium. More specifically, for the 38% (50%) of Belgian (Dutch) firm-year observations involving wage-markup pricing, the average value of workers' absolute bargaining power amounts to 0.53 in Belgium and 0.39 in the Netherlands.

Conditional on exercising product market power, the magnitude of price-cost markups is larger in the Netherlands: Dutch (Belgian) firms charge prices that are on average 37% (17%) above marginal costs. These estimates lie within the range of recent estimates for European countries as reported in Soares (2019).

At the extensive margin, we documented that engagement in offshoring activities is associated with a higher prevalence of wage-markdown and a lower prevalence of wage-markup pricing in both countries, and a higher (lower) prevalence of price-cost markup pricing in Belgium (the Netherlands). When it comes to wage-markdown pricing and price-cost markup pricing, our descriptive results at the extensive margin also hold at the intensive margin. More specifically, firms engaging in offshoring activities appear to have larger monopsony power than non-offshorers in both countries (see columns 2 and 3 in Tables 5 and 6) and offshorers seem to set higher (much lower) price-cost markups in Belgium (the Netherlands). However, the picture is less clear for wage-markup pricing: on average, Belgian firms with offshoring activities tend to share more rents with their workers whereas workers' bargaining power does not seem to differ across firms' offshoring status. Such rather mixed picture could, however, be driven by confounding factors that differ across firms with and without offshoring activities and by not having distinguished between firm-level offshoring of final versus intermediate goods. In the next section, we therefore infer partial correlations from estimating regressions.

<Insert Tables 5 and 6 about here>

8 Does offshoring shape labor market imperfections?

This section aims to examine whether firm-level offshoring matters for firm-level labor market imperfections based on regression analysis. To examine how firm-level offshoring shape the extensive margin of labor market power, we run multinomial logit regressions for the labor market setting being either one favoring employers who set wage markdowns or one favoring workers who receive wage markups. The baseline is a labor market setting in which workers obtain the marginal product of wages. As such, we specify the following model:

$$\begin{aligned} LMS_m^* &= \mathbf{x}_m \beta_m + \epsilon_m, \qquad m = 1,2 \\ LMS_m &= I(LMS_m^* > 0), \quad m = 1,2 \\ \epsilon &= (\epsilon_1, \epsilon_2)\prime \sim N(0, \Sigma) \end{aligned} \tag{18}$$

where LMS_1 = Pr(LMS=WMD|$\mathbf{x}$) and LMS_2 = Pr(LMS=WMU|$\mathbf{x}$). The baseline category is LMS=WMP. The vector x includes firm observables, such as offshoring measures (split by type and source country group), the export-to-sales ratio, firm size (number of employees), capital intensity, the share of employees with upper education and total factor productivity, and industry observables such as import competition measures (split by source country group). Since contemporaneous values of the observables are likely to be endogenous, we use one-year lagged values for all variables (e.g. $LIMPsh$ stands for the 1-year lagged value of the share of total imports at the firm level). We also include a full set of year and industry fixed effects. Firm i's labor market setting at time t might also depend on unobservable factors ϵ_m such as managerial ability and its corporate culture.

We consider three model specifications. In each specification, we consider the offshoring variables as our variables of interest and the remaining observables as control variables. In specification 1, we include the firm-level total import share ($LIMPsh$). In specification 2, we distinguish two different types of firm-level offshoring: offshoring of finished goods ($LIMPsh\_final$) and intermediate goods ($LIMPsh\_int$). In specification 3, we examine even more margins by differentiating between the origin of firm-level imports. More specifically, we categorize countries into four mutually exclusive groups: neighboring countries, OECD countries excluding neighoring countries, non-OECD countries excluding China and China ($LIMPsh\_X\_neig$, $LIMPsh\_X\_OECDexclneig$, $LIMPsh\_X\_nonOECDexclChina$ and $LIMPsh\_X\_China$, where $X \in \{final, int\}$). As control variables, we also refine industry-level imports by country of origin. More specifically, we classify countries into three groups to define import competition: OECD countries, non-OECD countries exclusive China and China ($LIMPcomp\_OECD$, $LIMPcomp\_nonOECDexclChina$ and $LIMPcomp\_China$).

Tables 7 and 8 present the marginal effects of the regressors for the probability of a wage markdown from the multinomial logit regressions for Belgium and the Netherlands, respectively. From specification 1 (column (1a)), we learn that offshoring as an aggregate activity is associated with an increase in the conditional probability of a wage markdown in both countries, with the positive association being higher for the Netherlands. Offshoring might substitute for domestic labor. As such, offshoring activities are likely to increase intra-firm labor replacement and to decrease firm's labor demand, giving employers monopsony power. Recent evidence for Belgium by Merlevede and Michel (2020) shows indeed a negative impact of downstream offshoring on employment in upstream manufacturing firms. Capturing the different facets of offshoring in specification (2) shows that offshoring of intermediate and finished goods seem to be of equal importance in terms of increasing the likelihood of wage-markdown pricing in Belgium while imports of intermediate goods plays a larger role in Dutch firms. Differentiating between the origin of imports (see specification (3)) reveals clear similarities and differences in partial correlations. First, offshoring of finished goods from non-OECD countries matters most for wage-markdown pricing in both countries. Second, the large positive association between offshoring of intermediate goods and the probability of a labor setting favoring employers in the Netherlands holds for all country source groups while importing intermediate goods from neighboring and other OECD countries seems to drive the positive association between offshoring of intermediate goods and firms' labor market power in Belgian companies. Such differences could be explained by Dutch firms having a more global focus with the different stages of production process being located across different countries.

<Insert Tables 7-8 about here>

In Tables 9 and 10, we report the marginal effects of the regressors for the probability of a wage markup for Belgium and the Netherlands, respectively. Overall, our results provide evidence of offshoring being associated with a lower probability of paying wage markups. Evidence from an Eurostat survey on a set of EU countries including Belgium and the Netherlands shows that firms primarily engage in offshoring to reduce costs, which is in line with theoretical predictions as e.g. in Antras and Helpman (2004).[17] In the absence of a complete pass-through of these cost reductions to domestic wage increases, increased offshoring might dampen wage bargaining, which is consistent with our findings. From specification (2), we learn that the negative relationship between offshoring activities and the likelihood of wage-markup pricing does not hinge on the nature of firm-level imports. Again, the negative correlation, both in the case of offshoring of finished and intermediate goods, is much stronger in absolute value in the Netherlands. Distinguishing across source country groups shows that offshoring of final goods originating from neighboring countries

[17] See outsourcing survey data results at https://ec.europa.eu/eurostat/web/economic-globalisation/globalisation-in-business-statistics/global-value-chains.

as well as non-OECD countries (excluding China) are driving the negative correlations in both countries. Offshoring intermediate inputs from neighboring and other OECD countries seems to prevent workers in Belgian firms from exercising their bargaining power while the origin of imported intermediate goods does not matter for workers in Dutch firms. In the latter, offshoring from non-OECD countries and China appears to decrease the likelihood of a wage markups even more than offshoring from OECD countries. Again, these findings may reflect the global scale in which Dutch firms as compared to Belgian firms operate. Concerning the impact of import competition on wage bargaining, we find some ambiguous results.

Our results presented so far could potentially suffer from endogeneity problems arising from omitted variable bias. For example, changes in the global value chain as a result of quality-adjusted innovation, changes in the mix of products within an industry and trade liberalization are all factors which might jointly determine domestic labor market settings and offshoring. Reverse causality could be another concern since offshoring activities could also be affected by the domestic labor market setting. In both cases, the offshoring variables might be endogenous.

To solve such potential threats to internal validity of our analysis, we rely on Instrumental Variables estimation. To construct country group-firm-year-specific instruments for our aggregate offshoring variable, we follow Mion and Zhu (2013) and Goel (2017) and use firm-level import shares as weights to construct a weighted geometric mean of exchange rates for each country group-firm-year triple. We consider countries belonging to three country groups: OECD countries (excluding neighboring countries), China and rest of the world. The data on exchange rates are obtained from the IMF International Financial Statistics. One important caveat here is that it only applies to transactions that are outside the euro zone. For example, both Belgian and Dutch firms typically have as main trading partners EU countries. As such, in most of the cases there will be no exchange rate (Euro area trade only) or the British pound only. At the firm-level, it will be equal to zero for firms that have no export outside the Euro area. This may concern a large fraction of exporters. In the first stage of our TSLS estimation, we use as control variables sector dummies and the one-year lagged values of exports, employment, import competition, productivity, capital intensity and education. Based on standard tests, we conclude that our instruments are relevant and exogenous.

Our TSLS estimates are reported in column (1b) of Tables 7-10. Estimating these linear probability models leads to similar conclusions as estimating the logit models discussed above.

<Insert Tables 9-10 about here>

Let us now turn to the intensive margin and examine how firm-level offshoring shape the intensity of labor market power. We correct for censoring by fitting type II Tobit models, in which the first-stage probit participation equation for $\psi_{it} < 0$ (in the case of a wage markdown) and $\psi_{it} > 0$ (in the case of a wage markup), respectively, and the second-stage outcome equation for the respective labor imperfection parameters (firm-level labor supply elasticity $(\varepsilon_W^N)_{it}$ under wage markdown-pricing and workers' relative bargaining power γ_{it} under wage-markup pricing) include the same regressors, but these are allowed to have different coefficients in the two equations. We use the same set of regressors and the same four model specifications as in the extensive margin analysis.

We report the results for the second-stage output equation for the intensity of wage-markdown pricing measured by the firm's labor supply elasticity in Tables 11-12 in both countries, respectively. For Belgium, it follows from Table 11 that the patterns for the firm-level offshoring that showed up at the extensive margin also hold at the intensive margin. More specifically, given a wage markdown, firms importing finished as well as intermediate goods display lower labor supply elasticities, that is, such firms have higher monopsony/wage-setting power. Again, the nature of imports does not play a role (though the effect of final goods offshoring is larger than that of offshoring intermediate goods in Belgium), but the country of origin does play a role. More specifically, the negative correlation between offshoring of intermediate goods and firms' monopsony power is primarily due to imports from neighboring and OECD countries.

Unlike the extensive margin results, only imports of final goods from neighboring countries seem to fortify the wage-setting power of Dutch firms, as shown by the negative association between such imports and firms' labor supply elasticities in Table 12.. Also, contrary to our findings at the extensive margin, only offshoring of intermediate goods from neighboring and OECD countries positively correlates with firms' monopsony power.

<Insert Tables 11-12 about here>

Table 13 presents the results for the second-stage output equation for the intensity of wage-markup pricing measured by the magnitude of workers' bargaining power for Belgium and shows that these intensive margin results are very much in line with the extensive margin results. In firms where workers are paid above their marginal revenue product, firm-level offshoring of both finished and intermediate inputs is negatively associated with workers' bargaining power. In the case of offshoring of finished goods, such negative correlation is driven by imports from non-OECD countries, which could be rationalized by labor cost reductions. In the case of offshoring of intermediate goods, imports from neighboring countries and China seem responsible for dampening workers' bargaining power during negotiations.

Unlike the results for Belgium, firm-level offshoring does not play a large role in affecting the intensity of workers' bargaining power in Dutch firms that pay wage markups (see Table 14). Only offshoring of intermediate goods correlates negatively with workers' bargaining power and this is true irrespective of the country of origin, except for imports from neigboring countries.

<Insert Tables 13-14 about here>

Our TSLS results, using firm-weighted exchange rates vis-a-vis the euro as instruments for aggregate firm-level offshoring, confirms the estimates of the type II Tobit regressions for the intensity of wage markdown-pricing. In particular, we find that offshoring increases firms' monopsony power in both countries.

9 Conclusion

The acceleration of technological progress, the reduction in transport and communication costs and the fragmentation of production has profoundly affected international trade patterns in recent decades. Empirical studies using firm panel data have investigated the impact of increased offshoring on various firm outcomes such as total employment, the composition of labor demand in terms of skill- or occupation types, average wages, firm survival and innovation. Against the concern that firms' monopsony power has been on the rise in recent years, this paper examines how different facets of firm-level offshoring relate to the prevalence and intensity of firms' labor market power.

Our empirical analysis is based on firm-level data sourced from firm annual accounts and VAT declarations complemented with information on international transactions at the country, firm and product level sourced from the Transaction Trade database. Having access to such rich data for Belgian as well as Dutch firms over the period 2009-2017 allows us to compare the interplay between firm-level offshoring and firms' labor market power in two small open economies that differ in terms of global focus. We use the production function approach introduced by Dobbelaere and Mairesse (2013) to measure the prevalence and intensity of firms' labor market power. At the extensive margin, firms either impose a wage markdown on workers or pay a wage markup to workers. The magnitude of firms' labor supply elasticity informs us about the intensity of wage markdowns and the magnitude of workers' bargaining power informs us about the intensity of wage markups.

Our core result is that offshoring shapes employers' labor market power, irrespective of the nature of imports. Firm-level offshoring of finished as well as intermediate goods favors employers as firms with offshoring activities are more likely to impose wage markdowns and less likely to pay wage markups. These findings at the extensive margin also show up at the intensive margin. Offshoring is associated with higher monopsony power of Belgian and Dutch firms while accompanied with lower workers' bargaining power in Belgian firms. In the Netherlands, the results at the extensive margin are stronger than at the intensive margin and larger than in Belgium. In Belgian firms, offshoring plays an important role at the extensive as well as the intensive margin of firms' labor market power. Contrary to the nature of imports (finished versus intermediate goods), the origin of imports matters for Belgian firms' labor market power. This is far less so for Dutch companies which could be explained by their more global focus and the more global scale of the vertical chain in which they operate.

Tables

Table 1: Descriptive statistics for Belgium, 2009-2017

	Mean	Sd	p25	p50	p75	
Real firm output growth rate (Δq_{it})	-0.006	0.219	-0.089	0.001	0.090	52,543
Labor growth rate (Δn_{it})	0.002	0.146	-0.053	0.000	0.056	52,544
Intermediate inputs growth rate (Δm_{it})	-0.007	0.257	-0.109	0.001	0.108	52,544
Capital growth rate (Δk_{it})	-0.021	0.427	-0.175	-0.075	0.068	45,800
Revenue share of labor (α_{Lit})	0.253	0.130	0.158	0.237	0.329	52,544
Revenue share of intermediate inputs (α_{Mit})	0.670	0.161	0.558	0.681	0.792	52,544
1-(α_{Nit})-(α_{Mit})	0.078	0.132	0.007	0.075	0.153	52,544
ln(wagebill$_{it}$	13.656	1.387	12.622	13.413	14.413	52,544
ln(output$_{it}$)	10.546	1.551	9.408	10.281	11.388	52,544
ln(employment$_{it}$)	2.956	1.210	2.041	2.728	3.622	52,544
ln(intermediate inputs$_{it}$)	10.098	1.691	8.877	9.868	11.075	52,544
ln(capital$_{it}$)	8.570	1.859	7.439	8.585	9.681	52,544
ln(real output per worker) ($\ln(\frac{Q}{N})_{it}$)	7.590	0.720	7.102	7.508	7.984	52,544
ln(real value added per worker) ($\ln(\frac{Q-M}{N})_{it}$)	6.469	0.519	6.174	6.445	6.747	52,443
Capital intensity ($\ln(\frac{K}{N})_{it}$)	5.614	1.330	4.895	5.775	6.506	52,544
Solow Residual (SR_{it})	0.001	0.150	-0.059	0.003	0.064	45,799
Share of workers with primary education	0.131	0.256	0.000	0.000	0.120	52,544
Share of workers with secondary education	0.395	0.361	0.000	0.370	0.723	52,544
Share of workers with upper education	0.065	0.136	0.000	0.000	0.078	52,544
IMP	0.518	0.500	0.000	1.000	1.000	52,544
IMPsh	0.113	0.190	0.000	0.000	0.189	52,544
IMPsh_cor	0.029	0.085	0.000	0.000	0.000	52,544
IMPsh_final	0.029	0.096	0.000	0.000	0.001	52,544
IMPsh_final_cor	0.009	0.046	0.000	0.000	0.000	52,544
IMPsh_final_neig	0.015	0.061	0.000	0.000	0.000	52,544
IMPsh_final_OECDexclneig	0.010	0.062	0.000	0.000	0.000	52,544
IMPsh_final_nonOECDexclChina	0.002	0.019	0.000	0.000	0.000	52,544
IMPsh_final_China	0.002	0.022	0.000	0.000	0.000	52,544
IMPsh_int	0.075	0.143	0.000	0.000	0.092	52,544
IMPsh_int_cor	0.018	0.061	0.000	0.000	0.000	52,544
IMPsh_int_neig	0.050	0.108	0.000	0.000	0.048	52,544
IMPsh_int_OECDexclneig	0.024	0.072	0.000	0.000	0.007	52,544
IMPsh_int_nonOECDexclChina	0.002	0.021	0.000	0.000	0.000	52,544
IMPsh_int_China	0.004	0.024	0.000	0.000	0.000	52,544
EXPxIMP	0.385	0.487	0.000	0.000	1.000	52,544
EXP	0.448	0.497	0.000	0.000	1.000	52,544
EXPsh	0.183	0.327	0.000	0.000	0.286	52,544
EXPsh_cor	0.084	0.211	0.000	0.000	0.001	52,544
MNE	0.063	0.243	0.000	0.000	0.000	52,544
IVEXCHSH_OECDexclneig	0.430	0.868	0.000	0.073	0.412	24,894
IVEXCHSH_ROW	0.808	1.639	0.000	0.000	0.691	24,894
IVEXCHSH_China	0.616	0.952	0.000	0.000	1.992	24,894
IMPcomp	1.540	1.980	0.522	0.633	2.061	52,553
IMPcomp_OECD	0.964	1.045	0.347	0.379	1.495	52,553
IMPcomp_nonOECDexclChina	0.436	0.735	0.121	0.250	0.394	52,553
IMPcomp_China	0.140	0.343	0.007	0.055	0.136	52,553
Firms	6,695					

Note: $SR_{it} = \Delta q_{it} - \alpha_{Nit}\Delta n_{it} - \alpha_{Mit}\Delta m_{it} - (1 - \alpha_{Nit} - \alpha_{Mit})\Delta k_{it}$.

Table 2: Descriptive statistics for Belgium, 2009-2017

	Mean	Sd	p25	p50	p75	
Real firm output growth rate (Δq_{it})	0.013	0.315	-0.088	0.009	0.107	79,875
Labor growth rate (Δn_{it})	0.011	0.156	-0.052	0.000	0.070	79,875
Intermediate inputs growth rate (Δm_{it})	0.014	0.427	-0.104	0.006	0.122	79,857
Capital growth rate (Δk_{it})	-0.089	2.539	-0.158	-0.044	0.082	79,301
Revenue share of labor (α_{Lit})	0.235	0.106	0.155	0.228	0.304	81,705
Revenue share of intermediate inputs (α_{Mit})	0.582	0.147	0.474	0.578	0.686	81,705
1-(α_{Nit})-(α_{Mit})	0.183	0.115	0.110	0.174	0.248	81,705
ln(wagebill$_{it}$	6.058	1.341	5.204	6.009	6.880	81,601
ln(output$_{it}$)	7.598	1.410	6.552	7.437	8.464	81,705
ln(employment$_{it}$)	2.748	1.001	1.990	2.615	3.331	81,705
ln(intermediate inputs$_{it}$)	7.017	1.544	5.867	6.851	7.979	81,705
ln(capital$_{it}$)	5.459	2.355	4.461	5.809	6.926	81,705
ln(real output per worker) (ln($\frac{Q}{N}$)$_{it}$)	4.850	0.765	4.390	4.839	5.288	81,705
ln(real value added per worker) (ln($\frac{Q-M}{N}$)$_{it}$)	3.931	0.637	3.592	3.982	4.310	81,635
Capital intensity (ln($\frac{K}{N}$)$_{it}$)	2.711	2.229	2.063	3.200	4.056	81,705
Solow Residual (SR_{it})	0.016	0.504	-0.063	0.007	0.074	79,295
Share of workers with primary education	0.156	0.150	0.042	0.125	0.222	81,495
Share of workers with secondary education	0.265	0.179	0.146	0.250	0.361	81,495
Share of workers with upper education	0.145	0.215	0.000	0.063	0.222	81,495
IMP	0.363	0.481	0.000	0.000	1.000	81,705
IMPsh	0.076	2.617	0.000	0.000	0.007	81,705
IMPsh_cor	0.064	2.174	0.000	0.000	0.005	81,705
IMPsh_final	0.027	1.617	0.000	0.000	0.000	81,705
IMPsh_final_cor	0.023	1.352	0.000	0.000	0.000	81,705
IMPsh_final_neig	0.015	0.266	0.000	0.000	0.000	81,705
IMPsh_final_OECDexclneig	0.003	0.055	0.000	0.000	0.000	81,705
IMPsh_final_nonOECDexclChina	0.001	0.019	0.000	0.000	0.000	81,705
IMPsh_final_China	0.009	1.378	0.000	0.000	0.000	81,705
IMPsh_int	0.049	1.715	0.000	0.000	0.003	81,705
IMPsh_int_cor	0.040	1.429	0.000	0.000	0.001	81,705
IMPsh_int_neig	0.031	0.339	0.000	0.000	0.000	81,705
IMPsh_int_OECDexclneig	0.008	0.319	0.000	0.000	0.000	81,705
IMPsh_int_nonOECDexclChina	0.002	0.020	0.000	0.000	0.000	81,705
IMPsh_int_China	0.011	1.164	0.000	0.000	0.000	81,705
EXPxIMP	0.256	0.436	0.000	0.000	1.000	81,705
EXP	0.315	0.464	0.000	0.000	1.000	81,705
EXPsh	0.151	6.022	0.000	0.000	0.007	81,705
EXPsh_cor	0.139	5.403	0.000	0.000	0.005	81,705
MNE	0.060	0.238	0.000	0.000	0.000	81,705
IVEXCHSH_OECDexclneig	0.358	0.982	0.000	0.000	0.216	29,599
IVEXCHSH_ROW	0.314	1.216	0.000	0.000	0.000	29,599
IVEXCHSH_China	0.148	0.534	0.000	0.000	0.000	29,599
IMPcomp	1.104	2.457	0.414	0.577	1.067	81,705
IMPcomp_OECD	0.773	1.326	0.327	0.463	0.849	81,705
IMPcomp_nonOECDexclChina	0.171	0.601	0.033	0.088	0.147	81,705
IMPcomp_China	0.160	0.575	0.011	0.055	0.102	81,705
Firms			11,379			

Note: $SR_{it} = \Delta q_{it} - \alpha_{Nit}\Delta n_{it} - \alpha_{Mit}\Delta m_{it} - (1 - \alpha_{Nit} - \alpha_{Mit})\Delta k_{it}$.

Table 3: The prevalence of labor and product market imperfections of offshorers (non-offshorers) in Belgium (percentages)

Labor market setting	Product market setting		$\sum$
	Price marginal cost	Price-cost markup	
Wage markdown	10.4 (9.0)	21.5 (16.8)	31.9 (25.8)
Wage marginal product	7.5 (6.4)	30.6 (20.9)	38.1 (27.3)
Wage markup	3.3 (9.6)	26.7 (37.3)	30.0 (46.9)
$\sum$	21.2 (25.0)	78.8 (75.0)	

Table 4: The prevalence of labor and product market imperfections of offshorers (non-offshorers) in the Netherlands (percentages)

Labor market setting	Product market setting		$\sum$
	Price marginal cost	Price-cost markup	
Wage markdown	5.9 (1.9)	35.6 (25.6)	41.5 (27.4)
Wage marginal product	2.1 (0.8)	21.3 (12.9)	23.4 (13.7)
Wage markup	0.4 (0.6)	34.7 (58.2)	35.0 (58.8)
$\sum$	8.4 (3.3)	91.6 (96.7)	

Table 5: The intensity of labor and product market imperfections in Belgium (means)

Market imperfection intensity	All	Offshorer	
		Yes	No
Joint market imperfections parameter (ψ_{it})	–0.018	–0.091	0.056
… when wage markdown ($\psi_{it} < 0$)	–0.669	–0.810	–0.491
… when wage markup ($\psi_{it} > 0$)	0.473	0.599	0.391
Given wage markdown ($\psi_{it} < 0$) …			
Plant-level labor supply elasticity ($(\varepsilon_w^N)_{it}$)	3.063	2.742	3.466
Wage markdown (β_{it})	0.673	0.646	0.706
Given wage markup ($\psi_{it} > 0$) …			
Workers' absolute bargaining power (ϕ_{it})	0.529	0.576	0.498
Workers' relative bargaining power (γ_{it})	4.556	6.163	3.513
Price-cost markup (μ_{it})	1.115	1.129	1.102
… when markup pricing ($\mu_{it} > 1$)	1.162	1.171	1.153

Notes: Based on the estimates of the price-cost mark-up ($\widehat{\mu}$) and the joint market imperfections parameter ($\widehat{\psi}$), we classify firm-year observations to labor market and product market settings. Conditional on a labor/product market setting, structural parameters are recovered.

Table 6: The intensity of labor and product market imperfections in the Netherlands (means)

Market imperfection intensity	All	Offshorer	
		Yes	No
Joint market imperfections parameter (ψ_{it})	0.022	–0.185	0.140
... when wage markdown ($\psi_{it} < 0$)	–0.804	–0.850	-0.765
... when wage markup ($\psi_{it} > 0$)	0.570	0.497	0.595
Given wage markdown ($\psi_{it} < 0$) ...			
Plant-level labor supply elasticity ($(\varepsilon_w^N)_{it}$)	3.127	2.699	3.497
Wage markdown (β_{it})	0.657	0.636	0.675
Given wage markup ($\psi_{it} > 0$) ...			
Workers' absolute bargaining power (ϕ_{it})	0.394	0.390	0.396
Workers' relative bargaining power (γ_{it})	3.156	2.315	3.441
Price-cost markup (μ_{it})	1.346	1.250	1.400
... when markup pricing ($\mu_{it} > 1$)	1.366	1.275	1.415

Notes: Based on the estimates of the price-cost mark-up ($\widehat{\mu}$) and the joint market imperfections parameter ($\widehat{\psi}$), we classify firm-year observations to labor market and product market settings. Conditional on a labor/product market setting, structural parameters are recovered.

Table 7: Average marginal effects from multinomial logit regressions and average effects from an IV regression for the probability of a wage markdown for Belgium

	(1a)	(1b)	(2)	(3)
LIMPsh	0.207***	0.748***		
	(0.033)	(0.277)		
LIMPsh_final			0.235***	
			(0.056)	
LIMPsh_final_neig				0.139
				(0.088)
LIMPsh_final_OECDexclneig				0.152*
				(0.080)
LIMPsh_final_nonOECDexclChina				0.713***
				(0.264)
LIMPsh_final_China				0.773***
				(0.288)
LIMPsh_int			0.205***	
			(0.040)	
LIMPsh_int_neig				0.162***
				(0.050)
LIMPsh_int_OECDexclneig				0.247***
				(0.079)
LIMPsh_int_nonOECDexclChina				0.143
				(0.200)
LIMPsh_int_China				0.272
				(0.177)
LIMPcomp	0.006*	0.014**	0.006*	
	(0.003)	(0.006)	(0.003)	
LIMPcomp_OECD				0.002
				(0.019)
LIMPcomp_nonOECDexclChina				-0.002
				(0.041)
LIMPcomp_China				0.029
				(0.075)
LEXPsh	0.016	-0.076	0.020	0.012
	(0.019)	(0.046)	(0.019)	(0.019)
LSize	0.016***	0.010	0.016***	0.017***
	(0.005)	(0.013)	(0.005)	(0.005)
LCapint	0.013***	0.016*	0.013***	0.013***
	(0.004)	(0.009)	(0.004)	(0.004)
LShupuniv	-0.119***	-0.311***	-0.118***	-0.118***
	(0.034)	(0.061)	(0.034)	(0.034)
LTfp	0.001	-0.145**	0.003	0.006
	(0.034)	(0.059)	(0.034)	(0.035)
Log likelihood	–30,012.1		–30,025.6	–29,950.6
R^2		0.178		
Number of observations	32,188	10,067	32,188	32,188

Notes: 2010–2017. The dependent variable is a categorical variable for the classification of the labour market setting as involving either marginal-product wages or a wage mark-down or a wage mark-up. Reported numbers in columns 1, 3 and 4 are average marginal effects on the probability of a wage mark-down with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 8: Average marginal effects from multinomial logit regressions and average effects from an IV regression for the probability of a wage markdown for the Netherlands

	(1a)	(1b)	(2)	(3)
LIMPsh	0.641***	1.489***		
	(0.063)	(0.332)		
LIMPsh_final			0.414***	
			(0.096)	
LIMPsh_final_neig				0.476***
				(0.085)
LIMPsh_final_OECDexclneig				0.046
				(0.250)
LIMPsh_final_nonOECDexclChina				0.904***
				(0.312)
LIMPsh_final_China				0.531***
				(0.204)
LIMPsh_int			0.816***	
			(0.085)	
LIMPsh_int_neig				0.784***
				(0.106)
LIMPsh_int_OECDexclneig				0.567***
				(0.161)
LIMPsh_int_nonOECDexclChina				0.874***
				(0.287)
LIMPsh_int_China				0.874***
				(0.215)
LIMPcomp	-0.013***	-0.009	-0.014***	
	(0.005)	(0.006)	(0.005)	
LIMPcomp_OECD				-0.124***
				(0.022)
LIMPcomp_nonOECDexclChina				0.292***
				(0.050)
LIMPcomp_China				-0.129***
				(0.045)
LEXPsh	0.026	-0.698***	0.037	0.050*
	(0.025)	(0.156)	(0.025)	(0.027)
LSize	-0.011**	0.066***	-0.014***	-0.016***
	(0.005)	(0.011)	(0.005)	(0.005)
LCapint	0.002	0.008***	0.001	0.001
	(0.002)	(0.003)	(0.002)	(0.002)
LShupuniv	0.021	0.022	0.018	0.013
	(0.020)	(0.036)	(0.020)	(0.020)
LTfp	-0.314***	-0.315***	-0.308***	-0.307***
	(0.046)	(0.080)	(0.046)	(0.046)
Log likelihood	–4,8512.9		–48,452.6	–48,348.8
R^2		0.068		
Number of observations	52,433	19,360	52,433	52,433

Notes: 2010–2017. The dependent variable is a categorical variable for the classification of the labour market setting as involving either marginal-product wages or a wage mark-down or a wage mark-up. Reported numbers in columns 1, 3 and 4 are average marginal effects on the probability of a wage mark-down with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 9: Average marginal effects from multinomial logit regressions and average effects from an IV regression for the probability of a wage markup for Belgium

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.388***	-0.666***		
	(0.041)	(0.240)		
LIMPsh_final			-0.343***	
			(0.082)	
LIMPsh_final_neig				-0.254**
				(0.112)
LIMPsh_final_OECDexclneig				-0.167
				(0.146)
LIMPsh_final_nonOECDexclChina				-1.424***
				(0.436)
LIMPsh_final_China				-0.803*
				(0.449)
LIMPsh_int			-0.395***	
			(0.049)	
LIMPsh_int_neig				-0.436***
				(0.064)
LIMPsh_int_OECDexclneig				-0.341***
				(0.099)
LIMPsh_int_nonOECDexclChina				0.076
				(0.268)
LIMPsh_int_China				-0.814***
				(0.254)
LIMPcomp	-0.011***	-0.025***	-0.010***	
	(0.004)	(0.007)	(0.004)	
LIMPcomp_OECD				0.003
				(0.019)
LIMPcomp_nonOECDexclChina				-0.044
				(0.050)
LIMPcomp_China				0.029
				(0.089)
LEXPsh	-0.044**	0.057	-0.052**	-0.040*
	(0.023)	(0.040)	(0.022)	(0.022)
LSize	-0.031***	0.017	-0.032***	-0.032***
	(0.006)	(0.013)	(0.006)	(0.006)
LCapint	-0.027***	-0.006	-0.027***	-0.027***
	(0.004)	(0.008)	(0.004)	(0.004)
LShupuniv	0.048	0.090*	0.044	0.047
	(0.034)	(0.051)	(0.034)	(0.034)
LTfp	-0.131***	0.104*	-0.132***	-0.135***
	(0.044)	(0.059)	(0.044)	(0.045)
Log likelihood	–30,012.1		–30,025.6	–29,950.6
R^2		0.131		
Number of observations	32,188	10,067	32,188	32,188

Notes: 2010–2017. The dependent variable is a categorical variable for the classification of the labour market setting as involving either marginal-product wages or a wage mark-down or a wage mark-up. Reported numbers in columns (1), (3) and (4) are average marginal effects from multinomial logit regressions and reported numbers in column (2) are IV estimates on the probability of a wage mark-down with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 10: Average marginal effects from multinomial logit regressions and average effects from an IV regression for the probability of a wage markup for the Netherlands

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.879***	-1.870***		
	(0.090)	(0.352)		
LIMPsh_final			-0.614***	
			(0.144)	
LIMPsh_final_neig				-0.619***
				(0.108)
LIMPsh_final_OECDexclneig				-0.011
				(0.363)
LIMPsh_final_nonOECDexclChina				-1.220***
				(0.433)
LIMPsh_final_China				-0.833***
				(0.302)
LIMPsh_int			-1.045***	
			(0.111)	
LIMPsh_int_neig				-0.984***
				(0.136)
LIMPsh_int_OECDexclneig				-0.754***
				(0.210)
LIMPsh_int_nonOECDexclChina				-1.191***
				(0.390)
LIMPsh_int_China				-1.188***
				(0.273)
LIMPcomp	0.014***	0.013**	-0.014***	
	(0.005)	(0.006)	(0.005)	
LIMPcomp_OECD				0.142***
				(0.023)
LIMPcomp_nonOECDexclChina				-0.329***
				(0.058)
LIMPcomp_China				0.136***
				(0.048)
LEXPsh	-0.071*	0.876***	-0.071*	-0.076*
	(0.040)	(0.165)	(0.040)	(0.040)
LSize	0.017***	-0.085***	0.017***	0.017***
	(0.006)	(0.012)	(0.006)	(0.006)
LCapint	-0.003*	-0.012***	-0.003*	-0.002
	(0.002)	(0.003)	(0.002)	(0.002)
LShupuniv	-0.042*	-0.080**	-0.043*	-0.040*
	(0.022)	(0.040)	(0.022)	(0.022)
LTfp	0.452***	0.246***	0.451***	0.456***
	(0.055)	(0.086)	(0.055)	(0.054)
Log likelihood	–4,8512.9		–48,452.6	–48,348.8
R^2		0.081		
Number of observations	52,443	19,360	52,443	52,443

Notes: 2010–2017. The dependent variable is a categorical variable for the classification of the labour market setting as involving either marginal-product wages or a wage mark-down or a wage mark-up. Reported numbers in columns (1), (3) and (4) are average marginal effects from multinomial logit regressions and reported numbers in column (2) are IV estimates on the probability of a wage mark-down with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 11: Estimates of the second-stage output equation of type II Tobit regressions and of an IV regression for the intensity of wage-markdown pricing measured by the magnitude of labor supply elasticities for Belgium

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.584***	-1.415***		
	(0.089)	(0.541)		
LIMPsh_final			-0.688***	
			(0.154)	
LIMPsh_final_neig				-0.461**
				(0.232)
LIMPsh_final_OECDexclneig				-0.775***
				(0.280)
LIMPsh_final_nonOECDexclChina				-1.037*
				(0.618)
LIMPsh_final_China				-1.214***
				(0.417)
LIMPsh_int			-0.370***	
			(0.101)	
LIMPsh_int_neig				-0.570***
				(0.140)
LIMPsh_int_OECDexclneig				-0.500**
				(0.198)
LIMPsh_int_nonOECDexclChina				-1.093*
				(0.577)
LIMPsh_int_China				-0.327
				(0.381)
LIMPcomp	-0.001	-0.032	0.001	
	(0.010)	(0.025)	(0.010)	
LIMPcomp_OECD				0.048
				(0.072)
LIMPcomp_nonOECDexclChina				0.215*
				(0.128)
LIMPcomp_China				-0.555*
				(0.240)
LEXPsh	-0.070	0.126	-0.119**	-0.076
	(0.057)	(0.096)	(0.054)	(0.054)
LSize	-0.117***	0.119***	0.109***	0.119***
	(0.020)	(0.032)	(0.020)	(0.020)
LCapint	-0.067***	-0.127***	-0.068***	-0.067***
	(0.013)	(0.023)	(0.013)	(0.013)
LShupuniv	0.229*	0.409***	0.227*	0.242**
	(0.120)	(0.150)	(0.121)	(0.121)
LTfp	1.048***	1.333***	1.022***	1.039***
	(0.120)	(0.155)	(0.121)	(0.121)
Log likelihood	–17,773.8		–17,804.3	–17,733.3
R^2		0.541		
Number of observations	14,861	3,779	14,861	14,861

Notes: 2010–2017. Reported numbers in columns (1), (3) and (4) are coefficients from the outcome equation of type II Tobit regressions and reported numbers in column (2) are IV estimates with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 12: Estimates of the second-stage output equation of type II Tobit regressions and of an IV regression for the intensity of wage-markdown pricing measured by the magnitude of labor supply elasticities for the Netherlands

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.8114***	-0.913***		
	(0.093)	(0.317)		
LIMPsh_final			-0.657***	
			(0.128)	
LIMPsh_final_neig				-0.708***
				(0.154)
LIMPsh_final_OECDexclneig				-0.448
				(0.302)
LIMPsh_final_nonOECDexclChina				-0.966*
				(0.497)
LIMPsh_final_China				0.213
				(0.302)
LIMPsh_int			-0.918***	
			(0.115)	
LIMPsh_int_neig				-0.802***
				(0.124)
LIMPsh_int_OECDexclneig				-1.149***
				(0.191)
LIMPsh_int_nonOECDexclChina				-0.610
				(0.435)
LIMPsh_int_China				-0.679**
				(0.293)
LIMPcomp	0.029**	0.018**	0.030***	
	(0.011)	(0.009)	(0.011)	
LIMPcomp_OECD				0.260***
				(0.068)
LIMPcomp_nonOECDexclChina				-0.576***
				(0.171)
LIMPcomp_China				0.218*
				(0.128)
LEXPsh	-0.047	-0.012	-0.072*	-0.089**
	(0.037)	(0.056)	(0.038)	(0.040)
LSize	0.123***	0.053***	0.126***	0.128***
	(0.016)	(0.019)	(0.016)	(0.016)
LCapint	-0.002	-0.015**	-0.002	-0.001
	(0.005)	(0.006)	(0.005)	(0.005)
LShupuniv	-0.032	-0.068	-0.028	-0.028
	(0.058)	(0.065)	(0.058)	(0.058)
LTfp	0.913***	1.080***	0.905***	0.915***
	(0.120)	(0.139)	(0.120)	(0.120)
Log likelihood	–30,811.1		–30,800.7	–30,779.8
R^2		0.231		
Number of observations	21,785	8,071	21,785	21,785

Notes: 2010–2017. Reported numbers in columns (1), (3) and (4) are coefficients from the outcome equation of type II Tobit regressions and reported numbers in column (2) are IV estimates with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 13: Estimates of the second-stage output equation of type II Tobit regressions and of an IV regression for the intensity of wage-markup pricing measured by the magnitude of workers' bargaining power for Belgium

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.789***	-0.466		
	(0.180)	(2.088)		
LIMPsh_final			-0.728***	
			(0.369)	
LIMPsh_final_neig				-0.589
				(0.533)
LIMPsh_final_OECDexclneig				-0.697
				(0.553)
LIMPsh_final_nonOECDexclChina				-4.074**
				(2.015)
LIMPsh_final_China				-0.424
				(1.761)
LIMPsh_int			-0.774***	
			(0.210)	
LIMPsh_int_neig				-0.928***
				(0.309)
LIMPsh_int_OECDexclneig				-0.424
				(0.440)
LIMPsh_int_nonOECDexclChina				-0.339
				(1.027)
LIMPsh_int_China				-2.739***
				(0.965)
LIMPcomp	0.004	0.019	0.004	
	(0.015)	(0.054)	(0.015)	
LIMPcomp_OECD				-0.019
				(0.074)
LIMPcomp_nonOECDexclChina				0.344
				(0.218)
LIMPcomp_China				-0.636*
				(0.379)
LEXPsh	-0.046	0.190	-0.060	-0.024
	(0.099)	(0.177)	(0.099)	(0.098)
LSize	0.273***	0.199***	0.271***	0.279***
	(0.025)	(0.070)	(0.025)	(0.024)
LCapint	-0.304***	-0.253***	-0.305***	-0.304***
	(0.017)	(0.072)	(0.017)	(0.017)
LShupuniv	0.494***	1.035***	0.491***	0.504**
	(0.149)	(0.293)	(0.149)	(0.145)
LTfp	-0.732***	0.219	-0.732***	-0.775***
	(0.181)	(0.297)	(0.182)	(0.178)
Log likelihood	–26,283.2.8		–26,283.3	–26,205.4
R^2		0.162		
Number of observations	17,203	2,196	17,203	17,203

Notes: 2010–2017. Reported numbers in columns (1), (3) and (4) are coefficients from the outcome equation of type II Tobit regressions and reported numbers in column (2) are IV estimates with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

Table 14: Estimates of the second-stage output equation of type II Tobit regressions and of an IV regression for the intensity of wage-markup pricing measured by the magnitude of workers' bargaining power for the Netherlands

	(1a)	(1b)	(2)	(3)
LIMPsh	-0.120	3.746***		
	(0.074)	(1.313)		
LIMPsh_final			-0.058	
			(0.096)	
LIMPsh_final_neig				-0.515*
				(0.296)
LIMPsh_final_OECDexclneig				0.138
				(0.116)
LIMPsh_final_nonOECDexclChina				0.423
				(1.654)
LIMPsh_final_China				-1.955*
				(1.175)
LIMPsh_int			-0.151	
			(0.106)	
LIMPsh_int_neig				-0.247
				(0.196)
LIMPsh_int_OECDexclneig				-0.938**
				(0.391)
LIMPsh_int_nonOECDexclChina				-2.682**
				(1.267)
LIMPsh_int_China				-1.684**
				(0.703)
LIMPcomp	0.001	-0.025	0.001	
				(0.097)
LIMPcomp_nonOECDexclChina				-0.481**
				(0.235)
LIMPcomp_China				0.075
				(0.163)
LEXPsh	-0.049**	-0.601	-0.049**	-0.056
	(0.024)	(0.367)	(0.024)	(0.039)
LSize	0.023	-0.050	0.023	0.004
	(0.017)	(0.046)	(0.017)	(0.019)
LCapint	-0.071***	-0.077***	-0.071***	-0.071***
	(0.006)	(0.012)	(0.006)	(0.006)
LShupuniv	-0.079	0.014	-0.079	-0.124*
	(0.064)	(0.130)	(0.064)	(0.074)
LTfp	-0.334**	-0.207	-0.333**	0.063
	(0.156)	(0.352)	(0.156)	(0.175)
Log likelihood	–50,938.2		–50,937.8	–50,429.0
R^2		0.168		
Number of observations	30,658	6,823	30,658	30,658

Notes: 2010–2017. Reported numbers in columns (1), (3) and (4) are coefficients from the outcome equation of type II Tobit regressions and reported numbers in column (2) are IV estimates with standard errors clustered at the plant level in parentheses. ***/**/* denotes statistical significance at the 1%/5%/10% level. Further covariates included in all specifications are industry and year dummies.

A Estimating firms' production function

In order to obtain consistent estimates of the output elasticities $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$, we consider production functions with a scalar Hicks-neutral productivity term (denoted by ω_{it}) and common technology parameters across producers within a manufacturing industry cell (denoted by the vector β). These two assumptions imply the following expression for the production function:

$$Q_{it} = F(N_{it}, M_{it}, K_{it}; \beta) \exp(\omega_{it}) . \tag{A.1}$$

To control for productivity shocks ω_{it} which are observed by the firm when making optimal input choices but unobserved by the econometrician, we follow standard practice in the extant literature. We employ a semi-parametric structural control function approach and use the insight that optimal intermediate input demand holds information about unobserved productivity. We apply the estimation procedure proposed by Ackerberg et al. (2015). We denote the logs of Q_{it}, N_{it}, M_{it} and K_{it} by q_{it}, n_{it}, m_{it} and k_{it}, respectively.

We impose the following timing assumptions. Capital k_{it} is assumed to be decided a period ahead (at $t-1$) because of planning and installation lags. Labor is "less variable" than material. More precisely, n_{it} is chosen by firm i at time $t-b$ $(0 < b < 1)$, after k_{it} being chosen at $t-1$ but prior to m_{it} being chosen at t. This assumption is consistent with e.g. firms needing time to train new workers.

We assume that productivity (ω_{it}) evolves according to an endogenous first-order Markov process. In particular, we allow a firm's decision to engage in foreign direct investment (denoted MNE_{it-1}) to endogenously affect future productivity, which is supported by evidence in international economics applications (see e.g. Blomström and Kokko (1999), Helpman et al. (2004), Girma et al. (2005), Greenaway and Kneller (2007)). As such, we can decompose ω_{it} into its conditional expectation given the information known by the firm in $t-1$ (denoted I_{it-1}) and a random innovation to productivity (denoted ξ_{it}):

$$\omega_{it} = \mathbb{E}[\omega_{it}|I_{it-1}] + \xi_{it} = \mathbb{E}[\omega_{it}|\omega_{it-1}, MNE_{it-1}] + \xi_{it} = g(\omega_{it-1}, MNE_{it-1}) + \xi_{it} \tag{A.2}$$

with $g(\cdot)$ a general function. ξ_{it} is assumed to be mean independent of the firm's information set at $t-1$.

Given these timing assumptions, firm i's intermediate input demand at t depends directly on n_{it} chosen prior to m_{it}, i.e. the input demand function for m_{it} is conditional on n_{it}:

$$m_{it} = m_t(n_{it}, k_{it}, MNE_{it}, \omega_{it}) \tag{A.3}$$

Eq. (A.3) shows that ω_{it} is the only unobservable entering the intermediate input demand function. This scalar unobservable assumption together with the assumption that $m_t(\cdot)$ is strictly increasing in ω_{it} conditional on n_{it}, k_{it} and MNE_{it} (strict monotonicity assumption), allow to invert ω_{it} as a function of observables:

$$\omega_{it} = m_t^{-1}(m_{it}, n_{it}, k_{it}, MNE_{it})\,. \tag{A.4}$$

Considering the logarithmic version of Eq. (A.1) and allowing for an idiosyncratic error term including non-predictable output shocks and potential measurement error in output and inputs (ϵ_{it}) gives:

$$y_{it} = f(n_{it}, m_{it}, k_{it}; \beta) + \omega_{it} + \epsilon_{it} \tag{A.5}$$

where $y_{it} = q_{it} + \epsilon_{it}$ with ϵ_{it} assumed to be mean independent of current and past input choices.[18]

We approximate $f(\cdot)$ by a second-order polynomial where all logged inputs, logged inputs squared and interaction terms between logged inputs are included (translog production function):

$$\begin{aligned} y_{it} = {} & \beta_0 + \beta_n n_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_{nn} n_{it}^2 + \beta_{mm} m_{it}^2 + \beta_{kk} k_{it}^2 \\ & + \beta_{nm} n_{it} m_{it} + \beta_{nk} n_{it} k_{it} + \beta_{mk} m_{it} k_{it} + \omega_{it} + \epsilon_{it} \end{aligned} \tag{A.6}$$

where β_0 has to be interpreted as the mean efficiency level across firms.

Substituting Eq. (A.4) in Eq. (A.6) results in a first-stage equation of the form:

$$y_{it} = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, MNE_{it}) + \epsilon_{it} = \varphi_t(n_{it}, m_{it}, k_{it}, MNE_{it}) + \epsilon_{it} \tag{A.7}$$

which has the purpose of separating ω_{it} from ϵ_{it}, i.e. eliminating the portion of output y_{it} determined by unanticipated shocks at time t, measurement error or any other random noise (ϵ_{it}).

Hence, the first stage involves using Eq. (A.7) and the moment condition $\mathbb{E}[\epsilon_{it}|I_{it}] = 0$ to obtain an estimate $\widehat{\varphi}_{it}$, of the composite term $\varphi_t(n_{it}, m_{it}, k_{it}, MNE_{it}) = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, MNE_{it})$, which represents output net of ϵ_{it} In our application, estimation of Eq. (A.7) is implemented by regressing output on a second-order polynomial series expansion where all logged inputs, logged inputs squared and interaction terms between logged inputs are included. To allow for time variation in φ_t, these polynomial terms are interacted with a time trend.

18 Note that $(\varepsilon_N^Q)_{it} = \frac{\partial f(\cdot)}{\partial n_{it}}$ and $(\varepsilon_M^Q)_{it} = \frac{\partial f(\cdot)}{\partial m_{it}}$. These output elasticities are by definition independent of a firm's productivity shock.

Given a particular set of parameters β, we can compute (up to a scalar constant) an estimate of ω_{it}:

$$\begin{aligned}\widehat{\omega}_{it}(\beta) &= \widehat{m}_t^{-1}(m_{it}, n_{it}, k_{it}, MNE_{it}) \\ &= \widehat{\varphi}_{it} - \beta_0 - \beta_n n_{it} - \beta_m m_{it} - \beta_k k_{it} - \beta_{nn} n_{it}^2 - \beta_{mm} m_{it}^2 - \beta_{kk} k_{it}^2 \\ &\qquad - \beta_{nm} n_{it} m_{it} - \beta_{nk} n_{it} k_{it} - \beta_{mk} m_{it} k_{it}\end{aligned} \tag{A.8}$$

In order to implement the second stage and to identify the production function coefficients, we need to recover the innovation to productivity (ξ_{it}) to form moments on. Using Eq. (A.8), a consistent (non-parametric) approximation to $\mathbb{E}[\omega_{it}|\omega_{it-1}, MNE_{it-1}]$ is given by the predicted values from regressing nonparametrically $\widehat{\omega}_{it}(\beta)$ on $\widehat{\omega}_{it-1}(\beta)$ and MNE_{it-1}. The residual from this regression provides us with an estimate of ξ_{it}.

Given the timing assumptions on input use, the following population moment conditions can be defined: $\mathbb{E}[\xi_{it}(\beta)d] = 0$ where the set of instruments is:

$$d_{it} = \left\{n_{it-1}, m_{it-1}, k_{it}, n_{it-1}^2, m_{it-1}^2, k_{it}^2, n_{it-1}m_{it-1}, n_{it-1}k_{it}, m_{it-1}k_{it}\right\} \tag{A.9}$$

Exploiting these moment conditions, we can now estimate the production function coefficients β using standard GMM and rely on block bootstrapping for the standard errors.The estimated production function coefficients $\widehat{\beta}$ are then used together with data on inputs to compute the output elasticities at the firm-year level. In particular, we calculate the firm-year elasticity of output with respect to labor as:

$$(\widehat{\varepsilon}_N^Q)_{it} = \widehat{\beta}_n + 2\widehat{\beta}_{nn} n_{it} + \widehat{\beta}_{nm} m_{it} + \widehat{\beta}_{nk} k_{it} \tag{A.10}$$

Similarly, we calculate the firm-year elasticity of output with respect to material as:[19]

$$(\widehat{\varepsilon}_M^Q)_{it} = \widehat{\beta}_m + 2\widehat{\beta}_{mm} m_{it} + \widehat{\beta}_{mn} n_{it} + \widehat{\beta}_{mk} k_{it} \tag{A.11}$$

[19] Under a Cobb-Douglas production function $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$ would be equal to $\widehat{\beta}_n$ and $\widehat{\beta}_m$, respectively.

Table A.1: Estimated output elasticities by two-digit industry for Belgium (means)

Industry (NACE2)		Output elasticity of... labor	inter-mediate inputs	capital	Returns to scale	Obs.	Firms
Food products	(10)	0.260	0.729	0.031	1.020	7,829	1,213
Beverages	(11)	0.200	0.749	0.073	1.021	544	78
Textiles	(13)	0.253	0.757	0.019	1.029	1,749	271
Wearing apparel, leather	(14–15)	0.187	0.831	0.014	1.033	824	125
Wood and wood products	(16)	0.258	0.755	0.049	1.062	1,835	285
Paper and paper products	(17)	0.243	0.791	0.045	1.079	907	132
Printing and recorded media	(18)	0.292	0.754	0.046	1.092	2407	379
Chemicals and petroleum products	(19–20)	0.172	0.798	0.042	1.012	1,902	290
Basic pharmaceutical products	(21)	0.298	0.792	-0.063	1.027	406	61
Rubber and plastic products	(22)	0.169	0.787	0.040	0.996	2,130	324
Non-metallic mineral products	(23)	0.184	0.749	0.046	0.979	3,121	466
Basic Metals	(24)	0.356	0.778	0.032	1.166	579	86
Fabricated metal products	(25)	0.262	0.678	0.023	0.963	9,899	1,519
Machinery and equipment	(28)	0.302	0.762	0.040	1.104	3,214	493
Computer and electronic products	(26)	0.385	0.757	0.028	1.170	832	128
Electrical equipment	(27)	0.263	0.725	0.020	1.008	1,044	155
Motor vehicles and trailers	(29)	0.258	0.801	0.050	1.109	595	88
Furniture	(31)	0.209	0.735	0.026	0.971	2,227	337
Other Manufacturing	(32)	0.237	0.698	0.041	0.976	1,737	265
All		0.249	0.736	0.033	1.018	43,781	6,695

Table A.2: Estimated output elasticities by two-digit industry for the Netherlands (means)

Industry (NACE2)		Output elasticity of... labor	intermediate inputs	capital	Returns to scale	Obs.	Firms
Food products	(10)	0.211	0.870	0.054	1.136	12,392	2,131
Beverages	(11)	0.214	0.849	0.000	1.064	192	36
Textiles	(13)	0.314	0.758	0.034	1.106	1,709	279
Wearing apparel, leather	(14–15)	0.226	0.756	0.022	1.004	1,091	199
Wood and wood products	(16)	0.233	0.762	0.028	1.022	2,466	417
Paper and paper products	(17)	0.224	0.755	0.030	1.009	921	159
Printing and recorded media	(18)	0.294	0.703	0.032	1.030	4,768	824
Chemicals and petroleum products	(19–20)	0.220	0.782	0.036	1.038	1,725	309
Basic pharmaceutical products	(21)	0.216	0.740	0.049	1.006	351	68
Rubber and plastic products	(22)	0.231	0.760	0.026	1.017	3,052	521
Non-metallic mineral products	(23)	0.221	0.755	0.032	1.008	2,173	378
Basic Metals	(24)	0.200	0.762	0.037	0.999	740	126
Fabricated metal products	(25)	0.301	0.678	0.039	1.018	14,596	2,392
Machinery and equipment	(28)	0.266	0.724	0.019	1.010	6,654	1,165
Computer and electronic products	(26)	0.235	0.818	0.018	1.071	1,891	343
Electrical equipment	(27)	0.225	0.770	0.028	1.023	1,831	313
Motor vehicles and trailers	(29)	0.246	0.766	0.027	1.039	1,399	252
Furniture	(31)	0.316	0.783	0.024	1.123	3,813	669
Other Manufacturing	(32)	0.308	0.655	0.037	0.999	4,544	798
All		0.262	0.752	0.035	1.049	66,308	11,379

B Labor and product market setting switches

Table B.1: Transition matrix for the labor market setting of offshorers (non-offshorers) for Belgium

Labour market setting in t	Labour market setting in $t+1$		
	Wage mark-down	Marginal-product wages	Wage mark-up
Wage mark-down	85.2 (82.1)	13.6 (15.7)	1.2 (2.1)
Marginal-product wages	13.3 (16.1)	77.8 (63.3)	9.0 (20.6)
Wage mark-up	1.7 (2.2)	14.8 (11.9)	83.4 (86.0)

Notes: 2010-2017, percentages of 39,758 firm-year observations. Based on the estimates of the joint market imperfections parameter ($\widehat{\psi}$), we classify observations to labor market settings.

Table B.2: Transition matrix for the product market setting of offshorers (non-offshorers) for Belgium

Product market setting in t	Product market setting in $t+1$	
	Marginal cost	Price mark-up
Marginal cost	71.2 (65.4)	28.8 (34.6)
Price mark-up	6.9 (9.1)	93.1 (90.9)

Notes: 2010-2017, percentages of 39,758 firm-year observations. Based on the estimates of the price-cost mark-up ($\widehat{\mu}$), we classify observations to product market settings.

Table B.3: Transition matrix for the labor market setting of offshorers (non-offshorers) for the Netherlands

Labour market setting in t	Labour market setting in $t+1$		
	Wage mark-down	Marginal-product wages	Wage mark-up
Wage mark-down	86.1 (85.8)	11.4 (10.5)	2.5 (3.8)
Marginal-product wages	22.1 (21.7)	61.5 (53.0)	16.4 (25.3)
Wage mark-up	3.6 (2.1)	11.9 (5.4)	84.6 (92.5)

Notes: 2010-2017, percentages of 66,308 firm-year observations. Based on the estimates of the joint market imperfections parameter ($\widehat{\psi}$), we classify observations to labor market settings.

Table B.4: Transition matrix for the product market setting of offshorers (non-offshorers) for the Netherlands

Product market setting in t	Product market setting in $t+1$	
	Marginal cost	Price mark-up
Marginal cost	62.5 (52.1)	37.5 (47.9)
Price mark-up	2.3 (0.7)	97.7 (99.3)

Notes: 2010-2017, percentages of 66,308 firm-year observations. Based on the estimates of the price-cost mark-up ($\widehat{\mu}$), we classify observations to product market settings.

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