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# Offshoring and Labor Market Power: Comparing Belgian and Dutch Firms

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## ABSTRACT

We study the relationship between offshoring and labor market imperfections at the firm level in Belgium and the Netherlands. In both countries, wage-markup pricing stemming from workers' monopoly power is more prevalent than wage-markdown pricing originating from firms' monopsony power. Offshoring is associated with a higher prevalence and intensity of wage markdowns, driven by an increase in productivity that is only imperfectly passed through into an increase in wages. The lower firm-level productivity-wage pass-through in Belgium, attributed to its more centralized bargaining structure, makes wage markdowns more responsive to offshoring.

**JEL Classification:** F14, F16, J42, J50

## 1 | Introduction

With the fragmentation of production and the increasing importance of outsourcing, trade in goods through offshoring has gained importance in the global economy over the past few decades. 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 products 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 (see Mion and Zhu 2013 for references). The literature lacks evidence, though, on how offshoring shapes labor market imperfections arising from either firms' monopsony power or workers' monopoly power, a gap that this paper aims to address. Providing such evidence is particularly important as 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). By examining the labor-market-power channel through which wage outcomes may be affected, we complement existing empirical international trade studies that primarily analyze reduced-form effects of offshoring on wage outcomes (see Hummels et al. 2018). Moreover, identifying the sources of labor market power is essential for designing effective labor market policies, connecting our paper

to the growing empirical literature on the determinants of employer monopsony and worker monopoly in rent splitting (see Stansbury and Summers 2020; Grossman and Oberfield 2022).

To empirically measure labor market imperfections at the firm level, we use the production function approach introduced by Dobbelaere and Mairesse (2013) and modified by Caselli et al. (2021) and Yeh et al. (2022). The former demonstrate that labor market imperfections drive a wedge between the output elasticities of labor and intermediate inputs and their revenue shares, while the latter show that this wedge directly quantifies the extent to which the average wage paid by the firm deviates from the marginal revenue product of labor. Such firm-specific labor market imperfections may either stem from firms' monopsony/labor market power enabling them to set a wage markdown (i.e., a wage below the marginal revenue product of labor) or from workers' monopoly/labor market power forcing employers to pay a wage markup (i.e., a wage above the marginal revenue product of labor). The ratio of wages to the marginal revenue product of labor directly translates into the firm's elasticity of the labor supply with respect to the wage in the case of wage markdowns or the firm's elasticity of the wage with respect to the quasi-rent per worker in the case of wage markups. These structural parameters inform us of the intensity of wage-markdown or wage-markup pricing, capturing the intensity of firms or workers' actual labor market power, respectively. Furthermore, the production function approach enables us to jointly estimate labor and product market imperfections at the firm level, with the latter measured by the ability of firms to set prices above marginal costs (price–cost markups). This, combined with the insight that the ratio of wages to the marginal revenue product of labor can be decomposed into three firm-specific components (wages, the value of the marginal product of labor, and the price–cost markup), allows us to investigate not only the relationship between offshoring and labor market imperfections but also between offshoring and the respective components of these imperfections.

Our analysis starts with documenting the prevalence and intensity of wage-markdown and wage-markup pricing for Belgian and Dutch employers in manufacturing. We leverage highly comparable firm panel data drawn from business registers and VAT declarations covering the period 2009–2017 in both countries to estimate production functions using the control function approach and applying Ackerberg et al. (2015)'s estimation procedure. These economies exhibit notable disparities in terms of labor market institutions and internationalization, making them well-suited for an insightful international comparative study. Using additional data from transaction trade databases, we then estimate how firm-level offshoring relates to firms' labor market imperfections in two small European Union economies. We are also in a position to examine different margins by distinguishing offshoring of finished goods from offshoring of intermediate goods. Finally, to understand the mechanism through which the effect of offshoring on labor market imperfections operates, we analyze its impact on each component of the ratio of wages to the marginal revenue product of labor.

Several novel findings emerge. *First*, we document that in both countries, labor market imperfections arising from workers' monopoly power are more prevalent than labor market imperfections originating from firms' monopsony power. Specifically, 59% of employers pay wage markups (favoring employees), while 41% impose wage markdowns (favoring employers).

*Second*, the median wage-markup firm in Belgium pays a wage markup of 1.34, meaning that workers receive 1.34 euros on the marginal euro generated. This implies that 0.26% of a 1% increase in firm surplus is passed on into higher wages for workers (i.e., the firm-level rent-sharing elasticity is estimated to be 0.26). Workers' exercise of labor market power is even larger in the Netherlands. The median wage-markup firm pays a wage markup of 1.47, and the implied rent-sharing elasticity that rationalizes the observed wages equals 0.32. The median wage-markdown firm in the Belgium sets a wage markdown of 0.78, meaning that its workers are paid 78 cents for every marginal euro they generate. The implied labor supply elasticity that rationalizes these observed wages equals 3.62. In the Netherlands, employers exercise even more labor market power: workers at the median firm receive only 73% of their marginal revenue product of labor. This implies that workers' labor supply is less responsive to wages, with an estimated firm-level labor supply elasticity of 2.74.

*Third*, firm-level offshoring plays an important role in shaping firms' labor market imperfections. In both countries, we find that offshoring of both finished and intermediate goods is associated with a higher likelihood of wage-markdown pricing. The positive association between offshoring and the prevalence of wage markdowns is stronger in the Netherlands. This can be attributed to a more pronounced extra-EU internationalization pattern, increasing the potential for delocalization.

*Fourth*, the findings at the extensive margin also hold at the intensive margin. In both countries, offshoring widens wage markdowns; that is, offshoring negatively correlates with firms' labor supply elasticity and, hence, positively with their monopsony power. This relationship is observed for offshoring of both finished and intermediate goods in Belgium and for offshoring of intermediate goods in the Netherlands. The widening effect of offshoring on wage markdowns arises from an increase in the value of the marginal product of labor that is only imperfectly passed through into an increase in wages. This imperfect productivity-wage pass-through is more pronounced in Belgium, where the centralized wage bargaining system limits the responsiveness of firm-specific wages to firm-specific productivity shocks (such as those caused by offshoring) and reduces wage differentials across firms. Consequently, wage markdowns in Belgium are more responsive to offshoring than in the Netherlands.

Methodologically and econometrically, our analysis is most closely related to Yeh et al. (2022) and Dobbelaere et al. (2024), who extend the industrial organization approach of recovering firm-specific price–cost markups from production function estimates and firm accounting information (De Loecker 2011; De Loecker and Warzynski 2012) by relaxing the assumption that firms minimize costs with respect to materials and labor. Imposing that labor market imperfections stem from firms' monopsony power, Yeh et al. (2022) report that workers at the average US manufacturing plant receive 65% of their marginal revenue, observe substantial variation in wage markdowns,

and document an upward trend in a micro-founded measure of aggregate wage markdowns since the early 2000s. Using German plant data, Dobbelaere et al. (2024) find that wage markdowns are far more prevalent than wage markups, the prevalence of wage-markdown pricing is significantly smaller when organized labor (collective bargaining through unions and workplace codetermination through works councils) is present, and employer wage premia are lower in plants that set wage markdowns. Relative to these studies, our paper contributes to the existing literature at the junction of labor and trade and uncovers the mechanism through which our variable of interest (offshoring) affects labor market imperfections via a decomposition analysis.

To be sure, there exists a recent and expanding set of empirical studies examining the relationship between internationalization and labor market power using the production function approach (see e.g., Dobbelaere and Kiyota 2018; Lu et al. 2019; Mertens 2020; Caselli et al. 2021; Damoah 2021; Pham 2023; Dobbelaere and Wiersma 2025).[1] However, none of these recent studies focus on offshoring as an important margin through which firms internationalize their operations. In addition, none are comparative in nature, which would provide insights into how different institutional settings and international trade environments affect labor market power in response to offshoring.

We proceed as follows. Section 2 reviews the literature, provides background information on institutional characteristics and international trade in Belgium and the Netherlands, and derives testable conjectures. Section 3 presents the Belgian and Dutch firm panel data. Section 4 presents the main ingredients of the theoretical structural productivity model with imperfect labor and product markets. Section 5 discusses the identification and estimation of the model. Section 6 documents the prevalence and intensity of labor market imperfections in both countries. Section 7 investigates the relationship between firm-level offshoring and labor market imperfections. Section 8 concludes.

## 2 | Literature Review, Institutional and Internationalization Background, and Testable Conjectures

### 2.1 | Literature Review

One strand of the literature has examined the effect of offshoring on domestic labor market outcomes. This includes investigating whether offshoring substitutes for domestic employment, shifts labor demand from low-skilled production workers to high-skilled non-production workers, exerts downward pressure on domestic wages due to competition from low-wage countries, or increases wage inequality between high- and low-skilled workers (see Mion and Zhu 2013; Hummels et al. 2018, and references therein).

This paper takes a different perspective by examining the impact of offshoring on the prevalence and intensity of labor market imperfections, rather than focusing on labor market endpoints. Theoretical studies exploring this question within a framework of heterogeneous firms and imperfect labor markets have not reached a consensus on the relationship between offshoring and workers' bargaining power (see Ranjan 2013; Sethupathy 2013),[2] which resonates with available empirical evidence. For example, Kramarz (2008) and Carluccio et al. (2015) show that union wages and bargaining are strengthened by offshoring, while Dumont et al. (2006), Moreno and Rodríguez (2011) and Caselli et al. (2021) provide evidence of a negative effect of offshoring on wage bargaining.

From the scarce theory that models the impact of trade on the monopsony/oligopsony power of firms in the labor market, we learn that the relationship between offshoring and firms' monopsony power is expected to be positive, if any (Egger et al. 2022). The intuition is that offshoring involves relocating certain production tasks to foreign workers, effectively substituting domestic labor with cheaper foreign alternatives. This substitution reduces the domestic demand for labor, enabling firms to exercise monopsony power over the remaining domestic workforce. With reduced competition for labor, firms can set wages further below the marginal revenue product of labor, thereby increasing their monopsony power. As far as we know, empirical papers focusing on the impact of offshoring on firms' wage-setting/monopsony power are non-existent, except for Caselli et al. (2021).[3]

This paper investigates the impact of offshoring on the prevalence and intensity of wage markups and wage markdowns, as well as its effect on wages, the value of the marginal product of labor, and price–cost markups. This paper also conducts a comparison between Belgium and the Netherlands, two small open EU economies with comparable economic and labor market developments but some distinct labor market institutions and internationalization characteristics. These differences may shape firms' operational environment and the prevalence and intensity of labor market imperfections.

### 2.2 | Background on Labor Market Institutions

In terms of labor market institutional characteristics, in all EU member states, employees are represented in trade unions, mostly organized on an industry-wide basis, and works councils, organized at the company or establishment level. In both Belgium and the Netherlands, there is a broadly regulated system of wage bargaining structured around three levels (national, industry, and firm level). Firm-level labor agreements between unions and employers are typically more frequent in larger companies where employee representation is facilitated by works councils. Statutory minimum wages and extension mechanisms guarantee that most workers belonging to the private sector are covered by collective agreements. Indeed, 96% of employees are covered by collective bargaining in Belgium (ILO 2022), compared to 76% in the Netherlands.

In Belgium, a national-level 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 revolves around joint committees that unite representatives from both

employers and unions. In 2019, this was the relevant bargaining level for approximately 96% of all firms. Furthermore, Belgium's unique state-imposed automatic wage indexation, an exception among OECD countries, guarantees that wage hikes correspond proportionally to increases in the cost of living.[4] Together with industry-level bargaining, this leads to lower wage heterogeneity among firms operating in the same industry in Belgium, and a loose connection between firm-level wages and firm-specific productivity, beyond industry-level productivity developments (Fuss and Wintr 2012).

In the Netherlands, 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 advice for actual negotiations at the industry level. Negotiations between unions and employers commonly take place at the firm level. There are around 700 standard collective agreements, comprising just over 500 company-specific collective agreements and almost 200 industry-wide collective agreements (Jansen 2021). However, these agreements may not necessarily extend automatically to all other firms within the industry. Among employees covered by a collective contract, 75% were under industry-level agreements, while 25% were covered by firm-level agreements in 2019 (ILO 2022).

In terms of employment protection, the OECD indicators for the period 2014–2017 show that employment protection for regular contracts is stricter in Belgium (2.60) and the Netherlands (2.67) than in the OECD (average of 2.28).[5] Given that employment, as recorded in our firm-level datasets, does not include interim agency workers, the relevant EPL measure for the analysis we conduct in this paper is that on regular contracts and is essentially the same in Belgium and the Netherlands.

### 2.3 | Background on Internationalization Characteristics

Regarding internationalization features, both Belgium and the Netherlands are small EU countries with a strong international orientation. This is reflected in inward and outward foreign direct investment (FDI) data as well as foreign trade statistics. Based on UNCTAD data over our sample period, the average outward (inward) FDI-to-GDP ratio is 1.09 (1.07) in Belgium and 1.81 (1.18) in the Netherlands, compared to 0.34 (0.28) in the United States (US) (UNCTAD 2024). Over the period, the average outward FDI stock of the Netherlands (1512 billion US dollars) significantly exceeds that of Belgium (543 billion US dollars). The degree of openness is 1.69 for Belgium and 1.37 for the Netherlands, both significantly higher than that for the US, which stands at 0.21. A closer look reveals that the Netherlands has a much more extra-EU globalization pattern. Eurostat data from 2009 to 2012 reveal that outward (inward) FDI in Belgium is directed toward non-EU countries in 18% (1%) of the cases, compared to 43% (39%) in the Netherlands, with a notable focus on China. During our sample period, 59% of goods imported into the Netherlands come from non-EU countries, compared to 38% for Belgium, while both countries direct one-third of their exported goods to non-EU countries (EUROSTAT 2024). Using our firm-level datasets to differentiate between imports of intermediate goods and final goods, we find that aggregate imports remained stable over the period, totaling 56.5 billion euros in Belgium and 54.2 billion euros in the Netherlands. In Belgium, the share of intermediate goods in total imports remained largely stable, while in the Netherlands, it declined since 2010, decreasing from 0.79 in 2009 to 0.58 in 2017. On average over the period, intermediate goods account for approximately half of aggregate imports in Belgium and about two-thirds in the Netherlands. Imports of final goods is especially higher among larger firms, consistent with offshoring from foreign affiliates being concentrated in larger firms.[6]

On the one hand, offshoring entails the potential for delocalization. This can occur either through imports from a foreign affiliate or by accumulating destination-specific knowledge gained from trade, which can ease setting up production plants abroad (see Conconi et al. 2016 for the relationship between export and FDI activity). Such potential for delocalization is particularly relevant for offshoring of final goods and applies to intermediate inputs only when they were or are (partly) produced inhouse.

On the other hand, offshoring of intermediate products can enhance cost efficiency (particularly when originating from low-wage countries) or improve quality efficiency (when importing high-quality or highly specialized goods from foreign suppliers). As a result, offshoring of intermediate goods can reduce costs, raise markups, or increase productivity. Determining which of the two effects, the potential for delocalization or higher efficiency, dominates is ultimately an empirical question.

### 2.4 | Testable Conjectures

In line with standard terminology in the literature, a firm is said to engage in wage-markdown pricing when it pays the marginal employee a real wage lower than their marginal product and in wage-markup pricing when it pays the marginal employee a real wage higher than their marginal product. As detailed in Section 4, the intensity of wage-markdown pricing or a firm's monopsony power is measured by the wage elasticity of the firm's labor supply. From the theoretical and empirical literature on offshoring and labor market imperfections reviewed above, the following testable conjectures on the relationship between offshoring and the prevalence and intensity of wage markdowns can be formulated[7]:

**Conjecture 1a.** Offshoring firms are more likely to set wages below the marginal revenue product of labor, i.e., offshoring is positively related to the prevalence of wage markdowns.

**Conjecture 1b.** Offshoring widens wage markdowns, showing a positive correlation with firms' monopsony power and, hence, a negative correlation with firms' labor supply elasticity.

Comparing the internationalization pattern of Belgium and the Netherlands suggests that the Netherlands, with a more extra-EU internationalization strategy including connections with China, may benefit from stronger delocalization possibilities to low-wage countries and a higher effective potential for delocalization. This allows us to derive the following testable conjectures:

**Conjecture 2a.** All else being equal, the positive association between offshoring and the prevalence of wage markdowns is stronger in the Netherlands than in Belgium.

**Conjecture 2b.** All else being equal, the positive correlation between offshoring and firms' monopsony power, or put differently, the negative correlation between offshoring and firms' labor supply elasticity, is stronger in the Netherlands than in Belgium.

A higher reliance on imports of final goods can weaken domestic labor demand since these goods replace domestically produced alternatives. This may increase firms' monopsony power because workers face fewer employment opportunities within the country. Imports of intermediate goods can complement domestic production by lowering costs. This may lead to increased domestic production and labor demand in certain industries, potentially reducing firms' monopsony power. However, if intermediate goods imports result in offshoring of labor-intensive processes, monopsony power might still rise. The net effect is a priori unclear. This leads us to postulate the following testable conjectures:

**Conjecture 3a.** Imports of final goods are positively related to the prevalence of wage markdowns.

**Conjecture 3b.** Imports of final goods are positively correlated to firms' monopsony power.

By combining Conjectures 3a and 3b with the Netherlands' stronger extra-EU internationalization pattern, we further derive the following conjectures:

**Conjecture 4a.** All else being equal, the positive relationship between imports of final goods and the prevalence of wage markdowns is more pronounced in the Netherlands than in Belgium.

**Conjecture 4b.** All else being equal, the positive relationship between imports of final goods and firms' monopsony power is more pronounced in the Netherlands than in Belgium.

Comparing the wage bargaining framework in Belgium and the Netherlands suggests that Belgium's more centralized wage bargaining system is likely to result in a greater disconnect between firm-specific wages and firm-specific productivity in response to firm-specific economic conditions, such as offshoring. This reasoning leads to the following testable conjecture:

**Conjecture 5a.** All else being equal, the divergence between the responsiveness of firm-level wages to offshoring and the responsiveness of the marginal product of labor is larger in Belgium than in the Netherlands.

Combining our separate Conjectures 1b and 5a yields the following testable conjecture:

**Conjecture 5b.** All else being equal, wage markdowns show greater responsiveness to offshoring in Belgium than in the Netherlands; put differently, offshoring has a more pronounced widening effect on wage markdowns in Belgium.

## 3 | Data

Our primary objective is to examine how firm-level offshoring shapes labor market imperfections at the firm level. The selection of Belgium and the Netherlands is motivated by differences in labor market characteristics, the distinct international orientation of their economies, and the ability to build two highly comparable microdata sets that span the period 2009–2017.

In both countries, the unbalanced panel datasets are obtained from annual firm accounts and VAT declarations. To ensure consistency in dataset coverage, we excluded firms with fewer than 3 employees.

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 ($K$) measured as the book value of fixed tangible assets are reported in firms' annual accounts collected by the National Bank of Belgium. Intermediate input consumption ($M$) where inputs are supplied by a domestic firm or imported from abroad, and nominal sales ($PQ$) are taken from VAT declarations. The Multinational Enterprise ($MNE$) status of a firm is provided by the Survey of Foreign Direct Investment.

For the Netherlands, firm-level data on value added, nominal sales ($PQ$), the average number of employees in full-time equivalents over the year ($N$), the wage bill ($WN$), the book value of tangible assets ($K$) and MNE status ($MNE$) are sourced from firm reports and income statements retrieved from the Dutch Business Register, compiled by Statistics Netherlands, along with information from Profit and VAT tax records known as Baseline. Intermediate input consumption ($M$) is computed using firm-level data on value added and nominal sales.

To convert nominal into real values, 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 supplied by Statistics Netherlands for the Netherlands.

The variables listed above are used to estimate the prevalence and intensity of firm-year labor market imperfection parameters. We relate these imperfection parameter estimates to a number of covariates. Our primary covariate is offshoring activity at the firm level that we measure based on the ratio of imports ($IMP_{it}$) to sales ($P_{it}Q_{it}$): $IMPsh_{it} = \frac{IMP_{it}}{P_{it}Q_{it}}$, following the literature. Measuring offshoring using detailed import data was first proposed by Feenstra and Hanson (1999) at the industry level and later by Biscourp and Kramarz (2007) and Hummels et al. (2014) at the firm level. These papers define offshoring irrespective of the final versus intermediate nature of the products purchased. Our firm-level offshoring measures borrow from Hummels et al. (2018), Mion and Zhu (2013) and Olney and Pozzoli (2021).

In addition to firm-level total imports, we are able to distinguish between imports of finished and intermediate goods as in Mion and Zhu (2013).[8] As discussed in Section 2, distinguishing by type of good imported may be relevant to assess differentiated effects and mechanisms. We determine whether goods are final or intermediate by comparing the 8-digit CN (Combined Nomenclature) import product code with the

firm's 4-digit industry classification.[9] We classify an imported good as final if it falls within the same 4-digit NACE industry as the firm's main activity, otherwise the good is considered as intermediate. Offshoring of final goods is defined as: $IMPsh_{final,it} = \frac{IMP_{final,it}}{P_{it}Q_{it}}$, with $IMP_{final,it}$ equal to imports of final goods of firm $i$ in year $t$. Offshoring of intermediate goods is defined as: $IMPsh_{int,it} = \frac{IMP_{int,it}}{P_{it}Q_{it}}$, with $IMP_{int,it}$ equal to imports of intermediate goods of firm $i$ in year $t$.

We recognize that, to the extent that Belgian or Dutch firms offshore core production and export it then to foreign markets (a practice known as import for re-export),[10] our offshoring variables—which include re-export flows—may underestimate the impact of offshoring on labor market imperfections. Due to their central location in Europe and the size of their major ports (in Antwerp and Rotterdam), approximately one-third of trade in goods in Belgium and the Netherlands involves re-exports. To address this, we perform robustness checks by excluding re-export activities from trade flows in Appendix S3.2, identifying re-export volumes based on yearly flows.

We construct a set of control variables including industry-level import competition, similar to Mion and Zhu (2013) and in contrast to firm-level competition as in Caselli et al. (2021). Offshoring is defined as the import-to-sales ratio at the firm level, while import competition is defined at the industry level. Distinguishing between import competition and offshoring is important as import competition relates to final-goods competition within an industry while offshoring refers to imports of final goods as well as intermediate goods that are part of the firm's production process.[11] In order to measure import competition at the industry level (*IMPcomp* variables), we rely on the OECD STAN Bilateral Trade Database.

Additional controls include the firm's export share (*EXPsh*, defined as the ratio of exports to sales), the firm's capital intensity (*Capint*, defined as the logarithm of the capital-to-labor ratio), firm size (*Size*, defined as the logarithm of the number of workers), the firm's revenue total factor productivity obtained as a residual from production function estimations (*TFP*) and the firm's workforce composition. For Belgium, a worker's skill type is sourced from the Social Balance Sheet which reports, among others, employment for individuals with upper non-university education and university degrees. 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 Labor Force Survey ("Enquête BeroepsBevolking, EBB"). The Education database provides the highest level of education attained by an individual on October 1 of the year and is complete for individuals up to the age of 35.

We first deleted firm-year observations with labor and intermediate consumption shares smaller than or equal to zero and greater than or equal to one. We also disregard firm-year observations with cost shares in the bottom 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 42,907 (66,086) observations for 6,550 (11,224) firms over the years 2009–2017.

Tables S1 and S2 in Appendix S2 report the means of our variables for Belgium and the Netherlands, respectively. Focusing on the trade variables, about 6% of firms are MNEs in both countries. The share of exporters and importers is higher in Belgium (respectively, 44% and 51% 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 (2.8% in Belgium and 2.2% in the Netherlands) while the average share of imports of intermediate goods is higher in Belgium (7.3% as compared to 3.7% in the Netherlands).

## 4 | Theoretical Model With Imperfect Product and Labor Markets

### 4.1 | Intuition Behind the Production Function Approach

To measure product and labor market imperfections at the firm level, we follow the production function approach introduced by Dobbelaere and Mairesse (2013) and modified by Caselli et al. 2021 and Yeh et al. (2022). Essentially, Dobbelaere and Mairesse (2013) nest two polar models of wage formation in imperfect labor markets in the seminal productivity model of Hall (1988) with imperfect product markets: employer wage setting where firms' wage-setting/monopsony power enables them to set a wage markdown and collective wage bargaining where workers' bargaining/monopoly power enables them to impose a wage markup. They infer the size of labor market imperfections—measured by the labor supply elasticity in the case of wage markdowns and the rent-sharing elasticity in the case of wage markups—from the wedge between the output elasticities of intermediate inputs and labor and their respective revenue shares. This wedge equals the ratio of the employer's wage to the marginal revenue product of labor (Caselli et al. 2021; Yeh et al. 2022), serves as a reduced-form employer-specific measure of labor market imperfections and informs us on the direction of these imperfections (wage markdowns versus wage markups). It is directly tied to employers' wage bill and reflects employers' actual exercise of labor market power, rather than merely the potential for it (Dobbelaere et al. 2024). In this section, we summarize the assumptions and outcomes of this approach, whereas we relegate derivations to Appendix S1.

### 4.2 | Production, Input Markets and Firm Decisions

Consider firm $i$ at time $t$ with productivity level ($\exp(\omega_{it})$) that produces output ($Q_{it}$) using labor ($N_{it}$), intermediate inputs ($M_{it}$) and capital ($K_{it}$), subject to a strictly increasing (in all its arguments) and concave production function:

$$Q_{it} = Q(N_{it}, M_{it}, K_{it}) \exp(\omega_{it}) \quad (1)$$

In terms of the firm's input choices, we assume that labor and intermediate (material) inputs are free of adjustments costs, capital is predetermined and the firm takes the price of its intermediate inputs as given.[12] We further assume that all firms in the market maximize short-run profits $\Pi_{it} = R_{it} - W_{it}N_{it} - J_{it}M_{it}$, where $R_{it} = P_{it}Q_{it}$ denotes the firm's revenues, $P_{it}$ the price of the good, and $W_{it}$ and $J_{it}$ the input prices of labor and intermediate inputs, respectively. Then, the firm's optimization problem involves maximizing short-run profits with respect to output $Q_{it}$, intermediate inputs $M_{it}$, and labor $N_{it}$.

### 4.3 | Prevalence and Intensity of Price Markups

Using the first-order conditions for output and intermediate inputs, firm $i$'s price–cost markup $\mu_{it}$ can be expressed as:

$$\mu_{it} = \frac{\left(\varepsilon^{Q}_{M}\right)_{it}}{\alpha^{M}_{it}} \begin{cases} = 1 \text{ under price} - \text{marginal cost pricing} \\ > \text{under price} - \text{markup pricing} \end{cases} \quad (2)$$

with $\left(\varepsilon^{Q}_{M}\right)_{it}$ the output elasticity with respect to intermediate inputs and $\alpha^{M}_{it} = \frac{J_{it}M_{it}}{P_{it}Q_{it}}$ the share of intermediate input expenditure in total revenue (see Equation S4 in Appendix S1). The value of $\mu_{it}$ informs us of the extensive margin of product market power: the firm engages in marginal cost pricing (i.e., $\mu_{it} = 1$) and, hence, has no product market power, or the firm sets its price above marginal cost of production (i.e., $\mu_{it} > 1$) and exercises product market power. The intuition is that the firm will make economic profits when the output elasticity of intermediate inputs exceeds their revenue share and that these profits must stem from product market power because the firm takes the price of intermediate inputs as given.

On top of this extensive margin, the size of the price–cost markup informs us of the degree of product market power at the intensive margin. Therefore, $\mu_{it}$ serves as our model-consistent measure of product market power.

### 4.4 | Prevalence and Intensity of Wage Markdowns and Wage Markups

Using the first-order conditions for output, intermediate inputs, and labor, the existence and size of possible labor market imperfections (i.e., wage markdowns or wage markups) can be inferred from the wedge between the output elasticities of intermediate inputs and labor and their respective revenue shares, which is parameterized by $\psi_{it}$:

$$\psi_{it} = \frac{\left(\varepsilon^{Q}_{M}\right)_{it} / \alpha^{M}_{it}}{\left(\varepsilon^{Q}_{N}\right)_{it} / \alpha^{N}_{it}} = \frac{\mu_{it}}{\frac{(Q_N)_{it}N_{it}}{Q_{it}} \frac{P_{it}Q_{it}}{W_{it}N_{it}}} = \frac{W_{it}\mu_{it}}{P_{it}(Q_N)_{it}} \quad (3)$$

$$= \frac{W_{it}}{(R_N)_{it}} \begin{cases} < 1 \text{ under wage} - \text{markdown pricing} \\ > 1 \text{ under wage} - \text{markup pricing} \end{cases}$$

with $\left(\varepsilon^{Q}_{N}\right)_{it}$ the output elasticity with respect to labor and $\alpha^{N}_{it} = \frac{W_{it}N_{it}}{P_{it}Q_{it}}$ the share of labor input expenditure in total revenue. This wedge equals the ratio of the firm's wage ($W_{it}$) to the marginal revenue product of labor ($(R_N)_{it} = \partial R_{it} / \partial N_{it}$), to which we refer as the reduced-form measure of firm-level labor market imperfections.[13] Thus, the value of $\psi_{it}$ informs us of the extensive margin of labor market power: the firm pays the marginal employee a real wage lower than her marginal product (i.e., it sets a wage markdown if $\psi_{it} < 1$) and, hence, exercises monopsony/wage-setting power, or the workers force the firm to pay the marginal employee a real wage exceeding her marginal product (i.e., the firm pays a wage markup if $\psi_{it} > 1$) and exercise monopoly/bargaining power. The intuition is that under wage-markdown pricing, the economic profits originating from the firm's labor input, which result in a wedge between the output elasticity of labor and its revenue share, dominate those from its intermediate inputs, and thus a below-unity $\psi_{it}$ indicates a wage markdown. Following a similar reasoning, an above-unity $\psi_{it}$ indicates a wage markup.

On top of this extensive margin, the size of $\psi_{it}$ informs us of the degree of labor market power at the intensive margin: the wage elasticity of firm-level labor supply $\left((\varepsilon^{N}_{W})_{it} = (\partial N_{it} / \partial W_{it})(W_{it} / N_{it})\right)$ in the case of wage-markdown pricing or the elasticity of the wage with respect to the quasi-rent per worker $\left(\left(\varepsilon^{W}_{QR/N}\right)_{it} = (\partial W_{it} / \partial (QR/N)_{it})((QR/N)_{it} / W_{it})\right)$[14] in the case of wage-markup pricing. We now turn to these elasticities, which serve as our model-consistent measures of employers' monopsony power under wage-markdown pricing and workers' monopoly power under wage-markup pricing, respectively. There are different underlying theoretical structural models rationalizing wage-markdown pricing. Such pricing behavior may be pervasive in labor markets with many competing employers due to search frictions, mobility costs or job differentiation,[15] or may, e.g., arise from concentration or collusion of employers (Manning 2011, 2021). As shown in Equation S6 in Appendix S1, we can convert the wedge $\psi_{it}$ from the production function approach into the implied labor supply elasticity that rationalizes observed wage outcomes in a monopsony framework:

$$(\varepsilon^{N}_{W})_{it} = \frac{\psi_{it}}{1 - \psi_{it}} \quad (4)$$

Under $\psi_{it} < 1$ (or wage-markdown pricing), workers respond imperfectly to wages, which provides the firm with monopsony/wage-setting power that is inversely related to the elasticity of labor supply $(\varepsilon^{N}_{W})_{it}$, which, in turn, is positively related to $\psi_{it}$. The labor supply elasticity serves as our model-consistent measure of labor market power under wage-markdown pricing, providing insight into the intensity of wage-markdown pricing.

Likewise, there exist different underlying theoretical structural models rationalizing wage-markup pricing. Such pricing behavior may arise from collective or individual bargaining (McDonald and Solow 1981; Stole and Zwiebel 1996), risk-sharing arrangements (Bigsten et al. 2003) or fair wage considerations (Kamal et al. 2019). As shown in Equation S13 in Appendix S1, we can convert the wedge $\psi_{it}$ from the production function approach into

the implied rent-sharing elasticity that rationalizes observed wage outcomes in an efficient bargaining framework:

$$\left(\varepsilon^{W}_{QR/N}\right)_{it} = \frac{\psi_{it} - 1}{\psi_{it}} \tag{5}$$

Under $\psi_{it} > 1$ (or wage-markup pricing), a positive $\left(\varepsilon^{W}_{QR/N}\right)_{it}$ informs us of what fraction of a 1% increase in firm surplus shows up in workers' wages and thus of workers' monopoly/bargaining power, which, in turn, is positively related to $\psi_{it}$. The rent-sharing elasticity serves as our model-consistent measure of labor market power under wage-markup pricing, providing insight into the intensity of wage-markup pricing.

### 4.5 | Decomposition of Reduced-Form Measure of Labor Market Imperfections

From Equation (3), it follows directly that the wedge $\psi_{it}$ can be decomposed into four fundamental dimensions: the average wage paid by the firm ($W_{it}$), the marginal product of labor ($(Q_N)_{it}$), the price–cost markup ($\mu_{it}$) and the output price ($P_{it}$).

## 5 | Estimation

Measuring labor and product market imperfections (i.e., the prevalence and intensity of wage markdowns/markups and price–cost markups) at the firm level based on the ratio of wages to the marginal revenue product of labor $\psi_{it}$ and the price–cost markup $\mu_{it}$ requires consistent estimates of the output elasticities of intermediate inputs $\left(\varepsilon^{Q}_{M}\right)_{it}$ and labor $\left(\varepsilon^{Q}_{N}\right)_{it}$ as well as their revenue shares $\left(\alpha^{M}_{it}\right)$ and labor $\left(\alpha^{N}_{it}\right)$.

### 5.1 | Production Function

Guided by data availability in both countries, we cluster producers based on industry, focusing on 19 two-digit manufacturing industries. We consider a production function with Hicks-neutral productivity that is observed by the firm but unobserved by the econometrician (denoted by $\omega_{it}$) and common technology parameters across producers within an industry that need to be identified (denoted by the vector $\beta$). Taking the logarithm of Equation (1), adding an idiosyncratic error term $\zeta_{it}$ that comprises unpredictable output shocks as well as potential measurement error in output and inputs, and approximating the unknown regression function $f(\cdot) = \ln F(\cdot)$ by a second-order Taylor polynomial gives our empirical production function:

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

with lower-case letters denoting logs of variables, e.g., $n_{it} = \ln N_{it}$ and $y_{it} = q_{it} + \zeta_{it}$, assuming that $\zeta_{it}$ is mean independent of current and past input choices. The regression constant $\beta_0$ measures the mean efficiency level across firms.

### 5.2 | Identification and Estimation of Output Elasticities and Revenue Shares

Identifying the production function coefficients ($\beta$) relies crucially on the timing assumptions of the firm's input choices (see Section 4) in combination with a functional form assumption on the productivity transition process ($\omega_{it}$).[16] To control for unobserved productivity shocks $\omega_{it}$, which are potentially correlated with the firm's input choices, we use the control function approach (Ackerberg et al. 2015) using the insight that optimal input choices hold information about unobserved productivity. The estimated production function coefficients $\widehat{\beta}$ are then used together with data on inputs to compute the firm-year elasticity of output with respect to labor as:

$$\left(\widehat{\varepsilon}^{Q}_{N}\right)_{it} = \widehat{\beta}_n + 2\widehat{\beta}_{nn} n_{it} + \widehat{\beta}_{nm} m_{it} + \widehat{\beta}_{nk} k_{it} \tag{7}$$

Similarly, we calculate the firm-year elasticity of output with respect to intermediate inputs as:

$$\left(\widehat{\varepsilon}^{Q}_{M}\right)_{it} = \widehat{\beta}_m + 2\widehat{\beta}_{mm} m_{it} + \widehat{\beta}_{mn} n_{it} + \widehat{\beta}_{mk} k_{it} \tag{8}$$

We correct the observed revenue shares for labor and intermediate inputs for idiosyncratic factors including non-predictable output shocks and potential measurement error in output and inputs ($\zeta_{it}$), following De Loecker and Warzynski (2012). Given that the observed output $Y_{it}$ equals $Q_{it}\exp(\zeta_{it})$, we can recover an estimate of $\zeta_{it}$ from the production function estimation routine and obtain adjusted revenue shares as follows:

$$\widehat{\alpha}^{N}_{it} = \frac{W_{it} N_{it}}{P_{it} \frac{Y_{it}}{\exp(\zeta_{it})}} \tag{9}$$

$$\widehat{\alpha}^{M}_{it} = \frac{J_{it} M_{it}}{P_{it} \frac{Y_{it}}{\exp(\zeta_{it})}} \tag{10}$$

### 5.3 | Estimation of Prevalence and Intensity of Price Markups and Wage Markups/Markdowns

Using Equations (7–10), we obtain estimates of the key parameters of the production function approach, which are the price–cost markup $\mu_{it}$ and the ratio of wages to the marginal product of labor $\psi_{it}$, allowing us to identify the extensive margin of product and labor market power, respectively:

$$\widehat{\mu}_{it} = \frac{\left(\widehat{\varepsilon}^{Q}_{M}\right)_{it}}{\widehat{\alpha}^{M}_{it}} \tag{11}$$

$$\widehat{\psi}_{it} = \frac{\left(\widehat{\varepsilon}^{Q}_{M}\right)_{it} / \widehat{\alpha}^{M}_{it}}{\left(\widehat{\varepsilon}^{Q}_{N}\right)_{it} / \widehat{\alpha}^{N}_{it}} \tag{12}$$

On top of these extensive margins, the estimated $\mu_{it}$ allows us to recover the intensity of price-markup pricing. In addition, converting the estimated $\psi_{it}$ into the implied labor supply elasticity

or the implied rent-sharing elasticity that rationalizes the observed wage outcomes in a monopsony or efficient bargaining framework, respectively, allows us to recover the intensity of wage-markdown or wage-markup pricing:

$$\left(\hat{\varepsilon}^{N}_{W}\right)_{it} = \frac{\hat{\psi}_{it}}{1-\hat{\psi}_{it}} \tag{13}$$

$$\left(\hat{\varepsilon}^{W}_{QR/N}\right)_{it} = \frac{\hat{\psi}_{it}-1}{\hat{\psi}_{it}} \tag{14}$$

### 5.4 | Empirical Decomposition of Reduced-Form Measure of Labor Market Imperfections

To empirically decompose $\psi_{it}$ into its building blocks, we follow Caselli et al. (2021) and deflate total revenue by the two-digit industry deflator for output ($P_{jt}$) to proxy for physical output. Since our data does not contain firm-level prices, we cannot include the output price ($P_{it}$) and productivity $\left((Q_N)_{it}\right)$ as separate components. Defining the value of the marginal product of labor $\left(VMP^{N}_{it}\right)$ as $\left(\varepsilon^{Q}_{N}\right)_{it}\frac{Q_{it}}{N_{it}}\frac{P_{it}}{P_{jt}} = \frac{(Q_N)_{it}P_{it}}{P_{jt}}$ and substituting this expression in the penultimate term of Equation (3) leads to a decomposition of $\psi_{it}$ into measurable components:

$$\psi_{it} = \frac{W_{it}\mu_{it}}{VMP^{N}_{it}P_{jt}} \tag{15}$$

Taking the logarithm of Equation (15) decomposes the log of $\psi_{it}$ into four additive terms: the log of $W_{it}$, $VMP^{N}_{it}$, $\mu_{it}$ and $P_{jt}$.

### 5.5 | Advantages of the Production Function Approach

To conclude, let us discuss several advantages of the production function approach to measuring labor market imperfections over other approaches that have been used in the literature.

First, it allows us to directly quantify at the individual employer level by how much wages deviate from the marginal revenue product of labor. This provides us with a reduced-form, employer-level measure of labor market imperfections ($\psi_{it}$) that captures the employers' actual exercise of labor market power rather than just their potential for it. This measure can then be converted into either the implied labor supply elasticity or rent-sharing elasticity, which rationalizes the observed wage outcomes within a monopsony or efficient bargaining framework, respectively. This stands in contrast to the standard practice of measuring employers' monopsony power based on the turnover-based approach (surveyed in Manning 2011; Manning 2021; Sokolova and Sorensen 2021), which infers the elasticity of labor supply by looking at how sensitive firm recruitment is to wages.[17] Since recruitment is equal to the negative of separations for a firm with constant employment, most studies indirectly measure such elasticity by the separation elasticity with respect to wages. As pointed out by Manning (2021), the estimated labor supply elasticity derived from this approach is only a measure of potential monopsony power, and its pass-through to wages may be limited by factors, such as labor market institutions. This contrasts with the wedge from the production function approach that is rooted in employers' actual exercise of rather than their potential for labor market power.

Second, the production function approach avoids taking a stance on the relevant labor market of employers (e.g., in terms of occupations, skills, and local labor markets). This contrasts with the recently advocated employer concentration measure as an employer-specific measure of labor market power (e.g., Azar et al. 2022; Benmelech et al. 2022; Rinz 2022) which necessitates defining the labor market in order to measure concentration correctly. This concentration approach also requires assumptions about the market structure to lend a causal interpretation to the reduced-form relationship between market shares and wages, following the structure-conduct-performance paradigm in the IO literature. The production function approach, on the other hand, allows the researcher to stay agnostic about market structure.

Third, the production function approach allows researchers to determine whether a firm's wage determination process aligns more closely with either wage-markdown or wage-markup pricing and, consequently, whether labor market imperfections arise from either firms' wage-setting/monopsony power or workers' bargaining/monopoly power, a distinction that neither the turnover-based approach nor the concentration approach can provide (see Van Reenen 2024 for the importance of such distinction).[18]

Fourth, econometrically, measuring labor and product market imperfections using the production function approach boils down to estimating production functions based on standard production data. This contrasts with the turnover-based approach, which typically estimates monopsony power at a more aggregate level than the individual employer due to high data requirements, such as administrative linked employer-employee data. It also differs from the demand-side approach in IO used to infer price–cost markups, which relies on very detailed market-level data, including information on prices, quantities sold, product characteristics, and, more recently, consumer-level attributes (Berry et al. 1995; Nevo 2000, 2001).

Finally, the production function approach permits controlling for price–cost markups and thus accounting for a possible interdependency between labor and product market imperfections that would otherwise contaminate estimates of labor market imperfections (see De Loecker et al. 2016 for a discussion in the case of price–cost markups).

## 6 | Prevalence and Intensity of Labor Market Imperfections

### 6.1 | Extensive Margin of Labor and Product Market Imperfections

Using the datasets described in Section 3 and implementing the econometric framework described in Section 5, we estimate industry-level production function coefficients and compute

output elasticities at the firm-year level (see Tables S3 and S4 in Appendix S2). We use these output elasticities and revenue shares for labor and intermediate inputs to infer the ratio of firm-level average wages to the marginal revenue product of labor $\psi_{it}$. We focus our discussion on the prevalence and intensity of labor market imperfections (wage markdowns/wage markups) but also report product market imperfections (price–cost markups).

As is clear from Table 1, labor market imperfections give rise to a power imbalance favoring workers in most firms in both countries. In Belgium, we observe a wage markdown, favoring employers, in 42% of firm-year observations and a wage markup, favoring employees, in 58% of firm-year observations. In the Netherlands, 41% of firm-year observations involve wage-markdown pricing and 59% wage-markup pricing. We note that wage-markup pricing and price-markup pricing often show up together (52% of firm-year observations in Belgium and 59% in the Netherlands). This is in line with expectations as wage-markup pricing assumes substantial rents to be split between employers and workers, a situation that is only sustainable when product market imperfections shield employers from competition.

Table 1 further distinguishes firms according to offshoring activities in Belgium (Panel A) and the Netherlands (Panel B), respectively. Strikingly, when firms engage in offshoring activities, wage-markdown pricing is more prevalent than wage-markup pricing, with this pattern being most pronounced in the Netherlands. In particular, in Belgium, 47% of offshorers pay wages below the marginal revenue product of labor compared to 36% of non-offshorers. In the Netherlands, 53% of offshoring firms and 33% of non-offshoring firms set wage markdowns. Conversely, in Belgium (the Netherlands), 53% (47%) of offshorers pay wages above the marginal revenue product of labor, whereas this is true for 64% (67%) of Belgian (Dutch) non-offshorers.

## 6.2 | Intensive Margin of Labor and Product Market Imperfections

As explained in Section 4, we measure the magnitude of labor market imperfections either by the wage elasticity of a firm's labor supply curve $\left(\varepsilon^N_W\right)_{it}$, which informs us of the size of the wage markdown, or the elasticity of the wage with respect to the quasi-rent per worker $\left(\varepsilon^W_{QR/N}\right)_{it}$, which informs us of the size of the wage markup. A higher $\left(\varepsilon^N_W\right)_{it}$, that is, less employer monopsony power, implies a narrower wage markdown. A higher $\left(\varepsilon^W_{QR/N}\right)_{it}$, that is, more worker monopoly power, implies a wider wage markup.

In Table 2, we report the median values of the intensity of wage markdowns/wage markups and price–cost markups for all firms, as well as for the subsets of offshoring firms and non-offshoring firms, under the relevant price setting in Belgium (left part) and the Netherlands (right part), respectively.

Focusing on firms setting wage markdowns shows that these markdowns are sizeable, implying that actual employer monopsony power is large. Considering the 42% of firm-level observations under wage-markdown pricing in Belgium, the median firm sets a wage markdown of 0.78 throughout the period. This means that workers at the median firm receive 78 cents for every marginal euro they generate.[19] Converting this estimated wage-to-marginal-revenue-product-of-labor ratio ($\psi_{it}$) into the implied labor supply elasticity ($\left(\varepsilon^N_W\right)_{it}$), that rationalizes observed wage outcomes in a monopsony framework, yields a median firm-level elasticity of 3.62. In the Netherlands, employers exercise even more labor market power: for the 41% of observations under wage-markdown pricing, workers at the median firm receive only 73% of the marginal revenue product of labor.[20] This implies that workers' labor supply is less responsive to wages, with an estimated firm-level labor supply elasticity of 2.74. For both countries, we further observe considerable variation in wage markdowns across firms with an interquartile range of 0.26.

**TABLE 1** | The prevalence of labor and product market imperfections in percentages.

| | Price marginal cost | | | Price markup | | | $\sum$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Offshorer | | | Offshorer | | | Offshorer | |
| **Pricing** | **All** | **Yes** | **No** | **All** | **Yes** | **No** | **All** | **Yes** | **No** |
| Panel A: Belgium | | | | | | | | | |
| Wage markdown | 8.37 | 8.57 | 8.17 | 33.24 | 38.62 | 27.70 | 41.61 | 47.18 | 35.88 |
| Wage markup | 6.49 | 3.41 | 9.67 | 51.89 | 49.40 | 54.46 | 58.39 | 52.82 | 64.12 |
| $\sum$ | 14.86 | 11.98 | 17.84 | 85.14 | 88.02 | 82.16 | | | |
| Panel B: The Netherlands | | | | | | | | | |
| Wage markdown | 2.76 | 4.65 | 1.69 | 37.91 | 48.82 | 31.72 | 40.67 | 53.47 | 33.41 |
| Wage markup | 0.74 | 0.74 | 0.75 | 58.58 | 45.80 | 65.84 | 59.33 | 46.53 | 66.59 |
| $\sum$ | 3.51 | 5.38 | 2.44 | 96.49 | 94.62 | 97.56 | | | |

*Note:* 6,550 (11,224) firms in Belgium (the Netherlands) covering the period 2010–2017. Percentages of 42,907 (66,086) firm-year observations in Belgium (the Netherlands). Offshorers are defined as firms reporting a positive ratio of imported goods to sales. Based on the estimates of the ratio of wages to the marginal revenue product of labor $\widehat{\psi}_{it}$ and the estimates of the price–cost markup $\widehat{\mu}_{it}$ (Equations 3 and 2 in the main text, respectively), we identify the prevalence (or extensive margin) of labor market imperfections (wage-markdown/wage-markup pricing) and product market imperfections (price mark-up pricing, respectively).

**TABLE 2** | The intensity of labor and product market imperfections.

| | Belgium | | | The Netherlands | | |
|---|---|---|---|---|---|---|
| | | Offshorer | | | Offshorer | |
| **Market imperfection intensity** | **All** | **Yes** | **No** | **All** | **Yes** | **No** |
| Given wage markdown ($\widehat{\psi}_{it}<1$)... | | | | | | |
| Ratio of firm-level wage to the marginal revenue product of labor ($\widehat{\psi}_{it}$) | 0.784 | 0.767 | 0.804 | 0.733 | 0.713 | 0.751 |
| Firm-level labor supply elasticity $\left(\left(\widehat{\varepsilon}^{N}_{W}\right)_{it}\right)$ | 3.621 | 3.299 | 4.109 | 2.740 | 2.480 | 3.011 |
| Given wage markup ($\widehat{\psi}_{it}>1$)... | | | | | | |
| Ratio of firm-level wage to the marginal revenue product of labor ($\widehat{\psi}_{it}$) | 1.344 | 1.350 | 1.339 | 1.474 | 1.356 | 1.533 |
| Firm-level rent-sharing elasticity $\left(\left(\widehat{\varepsilon}^{W}_{QR/N}\right)_{it}\right)$ | 0.256 | 0.259 | 0.253 | 0.322 | 0.263 | 0.348 |
| Price–cost markup $\left(\widehat{\mu}_{it}\right)$ | 1.096 | 1.102 | 1.090 | 1.296 | 1.216 | 1.349 |
| ...when prices-cost markup pricing $\left(\widehat{\mu}_{it}>1\right)$ | 1.115 | 1.118 | 1.112 | 1.306 | 1.227 | 1.356 |

*Note:* Median values based on the estimates of the ratio of wages to the marginal revenue product of labor and the price–cost markup (Equations (12) and (11) in the main text). Structural measures of employer wage-setting/monopsony and worker bargaining/monopoly power are recovered using Equations (13) and (14) in the main text.

Turning to the 58% of firm-year observations under wage-markup pricing in Belgium reveals that workers at the median firm receive 1.34 euros on the marginal euro generated. Converting this estimated $\psi_{it}$ into the implied rent-sharing elasticity $\left(\left(\varepsilon^{W}_{QR/N}\right)_{it}\right)$, that rationalizes observed wage outcomes in an efficient bargaining framework, indicates a median firm-level elasticity of 0.26. Workers' exercise of labor market power is even larger in the Netherlands: for the 59% of observations under wage-markup pricing, workers at the median firm receive 147% of their marginal revenue product of labor. This implies that 0.32% of a 1% increase in firm surplus translates into higher wages for workers (i.e., the firm-level rent-sharing elasticity is estimated to be 0.32). Focusing on firms setting price–cost markups shows that the intensity of price-markup pricing is larger in the Netherlands: Belgian (Dutch) firms charge prices that are, at the median, 12% (31%) above marginal costs. These estimates lie within the range of estimates for European countries as reported in Soares (2019). Similar to wage markdowns, there is considerable variation in wage markups across firms, with an interquartile range of 0.52 observed in both countries.

Consistent with our descriptive findings at the extensive margin, offshoring activities are associated with larger firm monopsony power. More specifically, firms engaging in offshoring activities set lower wage markdowns, providing them with more monopsony/wage-setting power (lower labor supply elasticities) than non-offshorers in both countries. In the Netherlands, offshoring employers pay lower wage markups than their non-offshoring counterparts, implying lower workers' bargaining/monopoly power in these firms. In contrast, in Belgium, workers' bargaining power does not appear to differ based on whether their employers engage in offshoring.

We now examine these relationships through regression analysis, controlling for confounding variables that may vary across firms based on their offshoring status and the type of offshoring activity.

## 7 | Does Offshoring Shape Labor Market Imperfections?

From Section 2, we learned that offshoring is expected to have a positive effect on firms' monopsony power (if any), while its impact on workers' monopoly power remains theoretically ambiguous and necessitates empirical investigation. The purpose of this section is to examine through regression analysis whether firm-level offshoring matters for firm-level labor market imperfections arising from either firms' monopsony power or workers' monopoly power. In addition, we study the channels through which the offshoring effect operates. To accomplish this, we empirically break down the ratio of the average wage paid by the firm to the marginal revenue product of labor into three fundamental firm-level components (wages, the marginal product of labor and the price–cost markup) and investigate the impact of offshoring on each.

### 7.1 | Does Offshoring Matter for the Prevalence of Labor Market Imperfections?

To assess whether firm-level offshoring shapes the extensive margin of labor market imperfections, we examine partial correlations between firm-level offshoring and the probability of a wage markdown or an estimated wedge $\psi_{it}$ below unity (as opposed to a wage markup or an estimated $\psi_{it}$ above unity). Table 3 reports average marginal effects for the probability of a wage markdown from probit regressions, where our firm-level variables of interest are offshoring measures (possibly split by type). In all regressions, we include firm observables, such as the export-to-sales ratio, firm size (number of employees), capital intensity, the share of employees with upper education, and total factor productivity, as well as industry-level import competition as control variables. Since contemporaneous values of the observables are likely to be endogenous, we use one-year lagged values for all variables (e.g., *LIMPsh*

**TABLE 3** | Average marginal effects on the probability of a wage markdown.

| | Belgium | | The Netherlands | |
|---|---|---|---|---|
| | (1a) | (1b) | (2a) | (2b) |
| *LIMPsh* | 0.303*** | | 0.451*** | |
| | (0.040) | | (0.067) | |
| $LIMPsh_{final}$ | | 0.279*** | | 0.325*** |
| | | (0.091) | | (0.123) |
| $LIMPsh_{int}$ | | 0.287*** | | 0.536*** |
| | | (0.042) | | (0.073) |
| Log likelihood | −20,720.86 | −20,753.47 | −34,008.85 | −33,973.67 |
| # Obs. | 35,766 | 35,766 | 53,756 | 53,756 |

*Note:* Reported numbers are average marginal effects on the probability of a wage markdown from probit regressions. The dependent variable is a binary variable taking a value of 1 in the case of wage-markdown pricing, i.e., $\hat{\varphi}_{it} < 1$. Standard errors are clustered at the firm level and are reported in parentheses. ***/**/*Statistical significance at the 1%/5%/10% level. Control variables included in all specifications are firm observables, such as the export-to-sales ratio, firm size (number of employees), capital intensity, the share of employees with upper education and total factor productivity, as well as industry-level import competition, and industry and year fixed effects. For all firm-year and industry-year varying control variables, we use 1-year lagged values.

stands for the 1-year lagged value of the share of total imports at the firm level). Additionally, we include a full set of industry and year fixed effects.

We ran two model specifications. In one specification, we include the firm-level total import share (*LIMPsh*).[21] In the other specification, we distinguish two different types of firm-level offshoring: offshoring of finished goods ($LIMPsh_{final}$) and intermediate goods ($LIMPsh_{int}$). In both specifications, we consider the offshoring variables as our variables of interest and the remaining observables as control variables.

Table 3 presents the marginal effects of the regressors of interest for the probability of a wage markdown in Belgium (left part) and the Netherlands (right part), respectively.[22] Conjecture 1a, postulating that offshoring firms are more likely to set wages below the marginal revenue product of labor (see Section 2), is confirmed. Such a positive association between offshoring and the likelihood of wage-markdown pricing holds in both countries. The positive association between offshoring and the probability of a wage markdown is stronger in the Netherlands. This can be attributed to a greater focus on extra-EU internationalization strategies in the Netherlands, which heightens (the potential for) delocalization opportunities, thus supporting Conjecture 2a. More precisely, a 0.1 increase in the 1-year lagged total import share is accompanied by an average rise in the probability of a wage markdown of 4.5 percentage points (pp) in the Netherlands (see column (2a)) compared to 3.0 pp in Belgium (see column (1a)).

A robustness check, reported in Table S5 in Appendix S3.1, addresses potential endogeneity concerns regarding our offshoring variable. We implement an Instrumental Variables (IV) estimation using the Two-Stage Least Squares (TSLS) estimator. The instruments leverage firm-level variation in origin country exposure and origin country year-specific real exchange rate risk to isolate exogenous variation in the contemporaneous firm-level offshoring variable. Following Mion and Zhu (2013), separate instruments are constructed for final and intermediate goods. More specifically:

$$IV_{final,it} = \sum_{c} weight^{c}_{final,it} \text{ x } \ln\left(RER^{c}_{t}\right) \tag{16}$$

$$IV_{int,it} = \sum_{c} weight^{c}_{int,it} \text{ x } \ln\left(RER^{c}_{t}\right) \tag{17}$$

where $RER^{c}_{t}$ represents country $c$'s real exchange rate vis-à-vis the domestic country (Belgium or the Netherlands). The terms $weight^{c}_{final,it}$ and $weight^{c}_{int,it}$ denote the current averages of import shares of final and intermediate goods from country $c$ across all firms except firm $i$, respectively. These weights are defined as follows: $weight^{c}_{final,it} = \sum_{j \neq i} \frac{IMP^{c}_{final,jt}}{P_{jt}Q_{jt}}$ and $weight^{c}_{int,it} = \sum_{j \neq i} \frac{IMP^{c}_{int,jt}}{P_{jt}Q_{jt}}$ where $IMP^{c}_{final,jt}$ and $IMP^{c}_{int,jt}$ represent the imports of final and intermediate goods from country $c$ by firm $j$ in year $t$, respectively.

We use the average imports-to-sales ratio of all other firms, explicitly excluding the imports-to-sales ratio of the firm itself from the weighting to ensure that our instrumental variable is not subject to endogeneity. The real exchange rate is defined as the nominal exchange rate, expressed as the domestic currency per euro, multiplied by the relative deflator of consumption. For imports from Eurozone countries, the nominal exchange rate is fixed at one, and variation in deflators can be used to construct the instruments even within the Euro Area. The economic rationale for the correlation between these instruments and firm-level offshoring (i.e., their relevance) is that variations in offshoring among other firms within an industry may result from exchange rate risks. These risks can serve as a proxy for changes in the international market and may influence firm $i$. Such risks can vary across firms based on their international structure, including their offshoring activities, as highlighted in the literature (see Hummels et al. 2018 for a review).[23] The instruments as defined in Equations (16) and (17) prove to be valid, satisfying the relevance as well as the exogeneity condition for both countries. Instrument relevance

is assessed using the first-stage *F*-statistic, while instrument exogeneity is evaluated using the *p*-value of the Hansen test for overidentifying restrictions. Consistent with our probit estimates reported in Table 3, the IV results confirm that (i) firms with a higher total import share are more likely to set wage markdowns, supporting Conjecture 1a, and (ii) the positive association between offshoring and the prevalence of wage markdowns is stronger in the Netherlands, supporting Conjecture 2a.

Let us now examine the different facets of offshoring. Confirming Conjecture 3a, we find that imports of final goods are positively related to the prevalence of wage markdowns in both countries (see columns (1b) and (2b) in Table 3). This finding can be explained by the fact that increased reliance on imports of final goods can diminish domestic labor demand, as these imports replace domestically produced alternatives. This, in turn, can reduce workers' employment opportunities in the domestic market and increase the likelihood of wage-markdown pricing. Given the stronger extra-EU internationalization pattern in the Netherlands, the positive relationship between imports of final goods and the prevalence of wage markdowns is more pronounced in the Netherlands, thereby confirming Conjecture 4a. More precisely, a 0.1 increase in the 1-year lagged import share of final goods is accompanied by an average rise in the probability of a wage markdown of 3.3 pp. in the Netherlands (see column (2b)) compared to 2.8 pp. in Belgium (see column (1b)). In addition, imports of intermediate goods are found to be positively associated with wage-markdown pricing, with this relationship being stronger in the Netherlands. Evidence from a Eurostat survey encompassing several EU countries, including Belgium and the Netherlands, shows that firms primarily engage in offshoring to reduce costs.[24] Our findings suggest that the labor-displacement effect of importing intermediate goods outweighs their cost-reducing effect, with the Netherlands' more pronounced extra-EU internationalization pattern accounting for the stronger positive association between imports of intermediate goods and wage-markdown pricing observed in that country.

### 7.2 | Does Offshoring Matter for the Intensity of Labor Market Imperfections?

To assess whether firm-level offshoring shapes the intensive margin of labor market imperfections, we examine partial correlations between the 1-year lagged values of firm-level offshoring and the logarithm of (i) the implied firm-level labor supply elasticity $\left(\epsilon_W^N\right)_{it}$ in the case of wage-markdown pricing or $\psi_{it} < 1$ and (ii) the implied firm-level rent-sharing elasticity $\left(\epsilon_{QR/N}^W\right)_{it}$ in the case of wage-markup pricing or $\psi_{it} > 1$. Table 4 reports estimates from Ordinary Least Squares (OLS) regressions for Belgium (left part) and the Netherlands (right part), using the same variables of interest and control variables and running the same model specifications as in the extensive-margin analysis. Since the dependent variables are in logarithm, the coefficient on the offshoring variables can be interpreted as the percentage change in the labor market imperfection parameter given a one-unit increase in the independent variable.

Starting with firms that set wage markdowns (14,988 firm-level observations in Belgium and 21,815 observations in the Netherlands), we find that offshoring widens wage markdowns. This follows from the negative correlation between offshoring and firms' labor supply elasticity in both countries (see columns (1a) and (3a)), indicating a positive correlation with firms' monopsony power, thereby confirming Conjecture 1b. This positive correlation is more pronounced among Belgian employers who pay workers less than their marginal revenue product. The regression coefficient on offshoring shows that a 0.1-unit increase in the 1-year lagged total import share is associated with a 7.8% lower labor supply elasticity in Belgium, compared to a 6.0% lower elasticity in the Netherlands, thereby invalidating Conjecture 2b. As will become clear in our decomposition exercise (see infra), which examines the channels through which offshoring affects labor market imperfections, this invalidation arises from the centralized bargaining system in Belgium. This system makes firm-level wages less responsive to economic conditions (such as offshoring) than firm-level productivity, resulting in a larger responsiveness of wage markdowns to offshoring in Belgium than in the Netherlands. Since the implied labor supply elasticity is a direct transformation of the wage markdown, this explains the stronger negative relationship between offshoring and firms' labor supply elasticity in Belgium. In short, the "ceteris paribus" assumption of Conjecture 2b does not hold.

The nature of offshoring matters for firms' wage-setting power. Supporting Conjecture 3b, Belgian firms importing final goods display lower labor supply elasticities, indicating higher wage-setting power (see column (1b)). However, we do not find evidence of a positive relationship between imports of final goods and monopsony power among Dutch firms (see column (3b)). These last two findings, taken together, do not support the validation of Conjecture 4b. As before, this invalidation may stem from differences in labor market institutions, particularly the centralized bargaining system in Belgium, which challenges the "ceteris paribus" assumption of Conjecture 4b. Instead, the positive association between offshoring and monopsony power in the Netherlands is exclusively driven by the offshoring of intermediate goods, as demonstrated by its strong negative correlation with firms' labor supply elasticity. Specifically, a 0.1-unit increase in the 1-year lagged import share of intermediate goods is associated with an 11.3% reduction in the labor supply elasticity. This relationship is significantly weaker in Belgium, where the regression coefficient for offshoring of intermediate goods equals −0.53. Consistent with the extensive margin analysis, the labor-displacement effect of importing intermediate goods dominates the cost-reducing effect. The greater dominance of this effect in the Netherlands can be attributed to its more pronounced extra-EU internationalization pattern.

Turning to firms paying wage markups (20,778 firm-level observations in Belgium and 31,941 observations in the Netherlands), we do not find an association between (either type of) firm-level offshoring and firms' rent-sharing elasticity or workers' monopoly/bargaining power (see columns (2a)–(2b) for Belgium and columns (4a)–(4b) for the Netherlands).

**TABLE 4** | OLS estimates for the intensity of wage-markdown pricing measured by firms' labor supply elasticity and wage-markup pricing measured by firms' rent-sharing elasticity.

| | Belgium: Log of | | | | The Netherlands: Log of | | | |
|---|---|---|---|---|---|---|---|---|
| | Firm-level labor supply elasticity $\left(\hat{\varepsilon}^{N}_{W}\right)_{it}$ | Firm-level labor supply elasticity $\left(\hat{\varepsilon}^{N}_{W}\right)_{it}$ | Firm-level rent-sharing elasticity $\left(\hat{\varepsilon}^{W}_{QR/N}\right)_{it}$ | Firm-level rent-sharing elasticity $\left(\hat{\varepsilon}^{W}_{QR/N}\right)_{it}$ | Firm-level labor supply elasticity $\left(\hat{\varepsilon}^{N}_{W}\right)_{it}$ | Firm-level labor supply elasticity $\left(\hat{\varepsilon}^{N}_{W}\right)_{it}$ | Firm-level rent-sharing elasticity $\left(\hat{\varepsilon}^{W}_{QR/N}\right)_{it}$ | Firm-level rent-sharing elasticity $\left(\hat{\varepsilon}^{W}_{QR/N}\right)_{it}$ |
| | (1a) | (1b) | (2a) | (2b) | (3a) | (3b) | (4a) | (4b) |
| *LIMPsh* | −0.775*** | | −0.139 | | −0.604*** | | −0.188* | |
| | (0.107) | | (0.098) | | (0.124) | | (0.099) | |
| $LIMPsh_{final}$ | | −0.915*** | | −0.156 | | −0.050 | | −0.207 |
| | | (0.196) | | (0.151) | | (0.136) | | (0.165) |
| $LIMPsh_{int}$ | | −0.530*** | | −0.179 | | −1.131*** | | −0.178 |
| | | (0.123) | | (0.127) | | (0.123) | | (0.126) |
| $R^2$ | 0.211 | 0.208 | 0.103 | 0.103 | 0.069 | 0.075 | 0.120 | 0.120 |
| # Obs. | 14,988 | 14,988 | 20,778 | 20,778 | 21,815 | 21,815 | 31,941 | 31,941 |

*Note:* Reported numbers are OLS regression coefficients with standard errors clustered at the firm level in parentheses. ***/**/*Statistical significance at the 1%/5%/10% level. Control variables included in all specifications are firm observables, such as the export-to-sales ratio, firm size (number of employees), capital intensity, the share of employees with upper education, and total factor productivity, as well as industry-level import competition and industry and year fixed effects. For all firm-year and industry-year varying control variables, we use 1-year lagged values.

Similar to the robustness check for the extensive-margin analysis, Table S6 in Appendix S3.1 presents TSLS estimates exploiting the same instruments as previously employed. The instruments are again shown to be valid, satisfying the relevance as well as the exogeneity condition in the TSLS regressions using either the firm-level labor supply elasticity or the firm-level rent-sharing elasticity as the dependent variable in both countries (see columns (1) and (3), and columns (2) and (4), respectively). The TSLS estimates are consistent with the OLS findings reported in Table 4 for the intensity of wage-markdown pricing (offshoring increases firms' monopsony power in both countries, supporting Conjecture 1b) and the intensity of wage-markup pricing (offshoring does not affect workers' bargaining power). Consistent with the OLS estimates, the negative impact of offshoring on firms' wage-setting power is more pronounced in Belgium.

We also checked and confirmed the robustness of all our main results, both at the extensive and intensive margin, using firm-product-level trade data adjusted for re-export activities when defining our firm-level offshoring variables of interest and our firm-level export variable, which is included as a control variable.[25] This robustness check is reported in Tables S7 (extensive-margin analysis) and S8 (intensive-margin analysis) in Appendix S3.2.

### 7.3 | How Does Offshoring Affect the Intensity of Labor Market Imperfections?

We are now in a position to examine the channels through which the effect of firm-level total imports on labor market imperfections operates. Consistent with the intensive-margin analysis, we examine partial correlations between the one-year lagged values of firm-level offshoring and the reduced-form firm-level labor market imperfection parameter $\psi_{it}$, along with its three firm-level components (the average wage paid by the firm $W_{it}$, the value of the marginal product of labor $VMP^{N}_{it}$ and the firm-level price–cost markup $\mu_{it}$). All four dependent variables are expressed in logarithms. We include the same set of control variables as in the intensive-margin analysis. Table 5 reports the OLS estimates for four separate regressions, each corresponding to one of the dependent variables, across two subsets of firms: wage-markdown firms (left part) and wage-markup firms (right part). Panel A (top part) shows the results for Belgium, and Panel B (bottom part) for the Netherlands.

The results in Table 5 show for both countries a statistically significant negative correlation between the 1-year lagged total import share and the reduced-form labor market imperfection parameter ($\psi_{it}$) for wage-markdown firms. In other words, increased offshoring widens the wedge between the average wage paid by the firm and the marginal revenue product of labor (widens wage markdowns). This offshoring effect operates via an increase in the value of the marginal product of labor that is imperfectly passed through into increased wages in both countries (see columns (3) and (2) in Panels A and B, respectively). Such imperfect productivity-wage pass-through is most pronounced in Belgium, confirming Conjecture 5a: in Belgian wage-markdown firms, a 0.1 increase in the 1-year lagged total import share is associated with a 4.4% increase in productivity and a 2.3% increase in wages, while in Dutch wage-markdown firms, the same 0.1 increase in offshoring is associated with a 2.8% increase in productivity and a 2.2% increase in wages.[26]

The lower pass-through of firm-level productivity to firm-level wages in Belgium can be attributed to the more centralized bargaining structure, which is conducive to wage rigidity. Supporting evidence is given by, e.g., Dhyne and Druant (2010) and Fuss and Wintr (2012). Both studies document that in Belgium, firm-level wage bill variation is primarily driven by fluctuations in firm-level labor rather than wages. Furthermore, Fuss and Wintr (2012) find that firm-level wages are significantly less responsive to firm-specific shocks (e.g., changes in firms' economic conditions such as offshoring) than to industry-level shocks. The positive association between offshoring and both productivity and wages can be reconciled with empirical evidence on offshoring enabling firms to import either high-quality intermediates in order to increase efficiency or cheap intermediate inputs in order to concentrate on core, high-productivity, high-skilled tasks (see e.g., Bernard et al. 2020). In addition, these productivity and wage-augmenting effects are consistent with labor restructuring (see e.g., Mion and Zhu 2013 for evidence on offshoring inducing skill upgrading and productivity increases in Belgian firms). The larger divergence between the responsiveness of firm-level wages to offshoring and the responsiveness of firm-level marginal productivity to offshoring in Belgium implies that wage markdowns are more responsive to offshoring in Belgium, ceteris paribus. We indeed confirm this conjecture (Conjecture 5b): A 0.1 increase in the 1-year lagged total import share widens the wedge between the average wage paid by the firm and the marginal revenue product of labor by 2.1% in Belgium and 1.5% in the Netherlands (see column (1) in Panels A and B, respectively).[27] We also checked and confirmed the robustness of this decomposition exercise using firm-product-level trade data adjusted for re-export activities when defining our firm-level offshoring variable of interest and our firm-level export variable, which is included as a control variable (see Table S9 in Appendix S3.2).

The insignificant offshoring effect on the reduced-form labor market imperfection parameter ($\psi_{it}$) for wage-markup firms in both countries is consistent with the lack of a relationship between offshoring and firms' rent-sharing elasticity, as shown in columns (2a) and (4a) of Table 4. This is because our structural measure of workers' monopoly power (the firm's rent-sharing elasticity $\left(\varepsilon^{W}_{QR/N}\right)_{it}$) is a direct transformation of the firm's wage markup $\psi_{it}$. The positive association between offshoring and the value of the marginal product of labor is much smaller in wage-markup firms than in wage-markdown firms, and only significantly so in Dutch firms, where a 0.1 increase in the 1-year lagged total import share is associated with a 1.3% higher productivity (see column (7) in Panel B). Offshoring increases wages by 2.4% in Belgium and 1.4% in the Netherlands (see column (6) in Panels A and B, respectively). Consequently, offshoring leads workers in Dutch wage-markup firms to obtain wage increases that are proportional to increases in the value of the marginal product of labor, whereas offshoring results in wage increases that exceed the corresponding productivity gains in Belgian wage-markup firms.

**TABLE 5** | OLS estimates for the reduced-form labor market imperfection parameter and its three firm-year varying components (the average wage paid by the firm, the value of the marginal product of labor and the firm-level price-cost markup).

| | Wage-markdown firms | | | | Wage-markup firms | | | |
|---|---|---|---|---|---|---|---|---|
| | Log of... | | | | Log of... | | | |
| | Reduced-form labor market imperfection parameter $\widehat{\psi}_{it}$ | Average wage paid by the firm $W_{it}$ | Value of marginal product of labor $VMP^{N}_{it}$ | Firm-level price–cost markup $\mu_{it}$ | Reduced-form labor market imperfection parameter $\widehat{\psi}_{it}$ | Average wage paid by the firm $W_{it}$ | Value of marginal product of labor $VMP^{N}_{it}$ | Firm-level price–cost markup $\mu_{it}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Panel A: Belgium | | | | | | | | |
| *LIMPsh* | −0.207*** | 0.232*** | 0.440*** | 0.001 | 0.088* | 0.242*** | 0.088 | −0.068*** |
| | (0.032) | (0.023) | (0.037) | (0.009) | (0.053) | (0.038) | (0.055) | (0.013) |
| $R^2$ | 0.338 | 0.430 | 0.589 | 0.305 | 0.147 | 0.410 | 0.339 | 0.315 |
| # Obs. | 14,988 | | | | 20,778 | | | |
| Panel B: the Netherlands | | | | | | | | |
| *LIMPsh* | −0.145*** | 0.216*** | 0.282*** | −0.082*** | −0.041 | 0.136*** | 0.134** | −0.039* |
| | (0.032) | (0.045) | (0.051) | (0.015) | (0.040) | (0.051) | (0.066) | (0.021) |
| $R^2$ | 0.110 | 0.497 | 0.567 | 0.251 | 0.228 | 0.547 | 0.613 | 0.498 |
| # Obs. | 21,815 | | | | 31,941 | | | |

*Note:* The dependent variable is the logarithm of the reduced-form labor market imperfection parameter (log of the ratio of the average wage paid by the firm to the marginal revenue product of labor), the average wage paid by the firm, the value of the marginal product of labor, and the firm-level price–cost markup. Reported numbers are OLS regression coefficients with standard errors clustered at the firm level in parentheses. ***/**/*Statistical significance at the 1%/5%/10% level. Control variables included in all specifications are firm observables, such as the export-to-sales ratio, firm size (number of employees), capital intensity, the share of employees with upper education, and total factor productivity, as well as industry-level import competition and industry and year fixed effects. For all firm-year and industry-year varying control variables, we use 1-year lagged values.

## 8 | Conclusion

The acceleration of technological progress, the reduction in transport and communication costs, and the fragmentation of production have 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. In response to 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. As such, our analysis complements reduced-form evidence of offshoring on endpoints (wages and employment).

Having access to rich data on international transactions at the firm, product, and country level 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 European economies that differ in terms of their labor market institutional framework and global orientation. To measure the prevalence and intensity of firms' labor market power, we use the production function approach introduced by Dobbelaere and Mairesse (2013) and modified by Caselli et al. (2021) and Yeh et al. (2022). At the extensive margin, firms either impose a wage markdown with employers' exercise of monopsony power allowing them to set wages below the marginal revenue product of labor or pay a wage markup with workers' exercise of monopoly power enabling them to obtain wages above the marginal revenue product. Firms' labor supply elasticity informs us of the intensity of wage markdowns and firms' rent-sharing elasticity of the intensity of wage markups.

Our core result is that offshoring shapes employers' labor market power. Firm-level offshoring favors employers as firms with offshoring activities are more likely to impose wage markdowns on their workers. The stronger positive relationship between offshoring and the prevalence of firms' labor market power in the Netherlands can be attributed to a more pronounced extra-EU internationalization pattern, which increases the potential for delocalization. These findings at the extensive margin also show up at the intensive margin. Offshoring is associated with higher monopsony power (wider wage markdowns). In both countries, the widening effect of offshoring on wage markdowns arises from productivity gains that are only imperfectly passed through into higher wages. The large responsiveness of wage markdowns to offshoring in Belgium can be attributed to a highly regulated system of collective wage bargaining, primarily at the industry level, combined with automatic wage indexation. Such a system limits the responsiveness of firm-specific wages to firm-specific productivity shocks (such as those induced by offshoring) and reduces wage heterogeneity among firms operating in the same industry.

These core findings motivate a broader assessment of the potential labor market implications of increasing offshoring trends in Belgium and the Netherlands. To illustrate the magnitude of these effects, we conducted a back-of-the-envelope calculation based on changes in the import-to-GDP ratio over the 2009–2017 period. According to Eurostat, the import-to-GDP ratio increased by 8.6 percentage points in Belgium and 10.0 percentage points in the Netherlands over the 2009–2017 period. Based on our findings, these changes would result in an increase in the probability of wage markdowns by 3.4 percentage points in Belgium and 7.2 percentage points in the Netherlands. Applying these probabilities to the average number of workers per firm suggests that 4,250 workers in Belgium and 12,619 in the Netherlands would move from being subject to wage-markup pricing to wage-markdown pricing. These observed trends reflect a shift toward heightened employer monopsony power and diminished worker monopoly power during this period, underscoring the complex interplay between globalization and labor market dynamics in small open economies.

If the observed increase in the import-to-GDP ratio applies equally to the import shares of both wage-markdown and wage-markup firms, this would translate, according to our findings, into a decrease in the labor supply elasticity by 8.3% for Belgian offshoring firms and 9.2% for Dutch offshoring firms under wage-markdown pricing. For wage-markdown firms that increased offshoring, these changes would lead to an increase in the marginal product of labor of 5.0% in Belgium and 4.6% in the Netherlands. However, this would correspond to only a 2.6% increase in average wages for Belgian offshoring firms and a 3.5% increase for Dutch offshoring firms under wage-markdown pricing.


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### Ethics Statement

The authors have nothing to report.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

### Endnotes

[1] Dobbelaere and Kiyota (2018) focus on export/foreign direct investment status in Japan, Lu et al. (2019) on foreign direct investment liberalization in China, Mertens (2020) on final product trade with China in Germany, Caselli et al. (2021) on import competition from China in France, Damoah (2021) on Ghana's World Trade Organization (WTO) accession in Ghana, and Pham (2023) and Dobbelaere and Wiersma (2025) on China's WTO accession in China.

[2] The relationship depends on which of the two mechanisms dominates: the productivity-augmenting effect of offshoring, which increases rent sharing, or the negative impact of offshoring on workers' bargaining power through substituting domestic employment.

[3] While Caselli et al. (2021) focus on import competition, they also show that offshoring and importing intermediates from China increase firms' monopsony power.

[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] Employment protection legislation (EPL) is described along 21 basic items which can be classified in three main areas: (i) protection of regular workers against individual dismissal, (ii) regulation of temporary forms of employment and (iii) additional, specific requirements for collective dismissals. These items are translated into values which are then converted into a score measured on a 0–6 scale, with higher values representing stricter regulation (OECD 2024).

[6] As shown in the firm-level figures in Tables S1 and S2 in Appendix S2, imports of intermediates account for a larger share of firm imports. This discrepancy arises because (1) imports of final goods are particularly high among larger firms, consistent with offshoring from foreign affiliates being concentrated into larger firms, and (2) in aggregate statistics, larger firms have a higher weight (proportional to their size) than smaller firms, whereas in Tables S1 and S2, all firms are given equal weight.

[7] Recall that the literature has not reached a consensus on the relationship between offshoring and the prevalence and intensity of wage markups, leaving this relationship ultimately as an empirical question.

[8] This allows for a finer classification than the industry-level distinction. For example, when an industrial bakery imports sugar, these imports will be classified as intermediate inputs that will be further processed by the firm. When a sugar producer imports sugar, this will be classified as final goods that are ready to be sold.

[9] We convert the 8-digit CN classification used for trade flows into 4-digit NACE codes using Eurostat conversion tables. We focus on products for which a one-to-one correspondence exists, a condition that holds for the vast majority of products.

[10] Imports of goods that are re-exported often fall under the Carry-Along Trade (CAT) category, referring to goods exported by a company but not produced by it. Re-export activities are also influenced by the status of Antwerp and Rotterdam as major European ports. In Belgium, re-exports account for 30% of trade flows (Duprez 2014), while 30% of the total export value (whether re-exported or not) is classified as CAT, according to Bernard et al. (2019). In the Netherlands, the share of CAT in total exports varies significantly across industries, from nearly 30% in the wood, paper, and printing industry to just over 10% in the metal industry. Re-exports account for a substantial fraction of CAT (van den Berg et al. 2019).

[11] An important finding from the literature on heterogeneous firms and trade is that import competition typically exerts competitive pressure on domestic firms (e.g., Bloom et al. 2016). The theoretical prediction is that larger and more productive firms expand while small and less productive firms shrink or exit. Indirectly, import competition reduces the rents to be shared and thereby erodes workers' bargaining power, especially for workers employed in low-productivity firms.

[12] The availability of an input (i) that is free of adjustment costs and (ii) for which the firm takes its price as given is essential to distinguish between price–cost markups and wage markdowns/markups (see Equations 2 and 3 below) and to decompose the ratio of the employer's wage to the marginal revenue product of labor into four fundamental dimensions (see Equation 3 below). While it is standard in the Industrial Organization (IO) literature to assume that intermediate inputs meet these two conditions (Basu 1995; De Loecker and Warzynski 2012), recent evidence on imperfect competition in intermediate goods markets challenges the second assumption (see Morlacco 2020; Dhyne et al. 2022). Despite this, we maintain the assumption of price-taking behavior in intermediate input markets for two reasons. First, empirical evidence (for the U.S.) supports this assumption. The U.S. Census Bureau categorizes material inputs primarily as goods and services traded at world prices (Yeh et al. 2022). Additionally, Atalay (2014) documents that material input prices from the U.S. Census Bureau do not vary with quantities, suggesting that price variations are likely due to suppliers' marginal costs rather than firms exerting monopsony power. Second, we lack data on alternative inputs, such as energy, for which prices can be assumed to be taken as given by producers. This prevents us from modeling non-competitive buyer behavior in the intermediate input market as additional unit costs that create wedges between marginal costs and marginal products, as in Morlacco (2020).

[13] The second equality makes use of Equation (2) for the price–cost markup $\mu_{it}$ and the last equality relies on the marginal revenue product of labor being given by $(R_N)_{it} = P_{it}(Q_N)_{it} / \mu_{it}$, where $(Q_N)_{it} = \partial Q_{it} / \partial N_{it}$ denotes the marginal product of labor.

[14] The quasi-rent per worker is defined as: $\left(R_{it} - (R_N)_{it} N_{it} - J_{it} M_{it}\right) / N_{it}$.

[15] The simplest way to micro-found a firm-level labor supply curve in modern monopsony models stems from discrete choice modeling in IO, following the framework of Berry (1994) which assumes that job amenities are valued differently by heterogeneous workers (Card et al. 2018). Specifically, workers' heterogeneous preferences over the work environments of different employers are embedded in a random utility model that characterizes firm-specific labor supply functions. A firm's labor supply elasticity then depends on its market share and workers' responsiveness to wage changes. Inframarginal workers who highly value the specific attributes of their job are less likely to quit, even in response to a wage cut.

[16] We assume that productivity ($\omega_{it}$) 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*) to endogenously affect future productivity, which is supported by evidence in international economics applications (see e.g., Blomström and Kokko 1997; Helpman et al. 2004; Girma et al. 2005; Greenaway and Kneller 2007).

[17] This approach builds on the canonical work of Burdett and Mortensen (1998) as a micro-foundation for modern monopsony models. In this partial equilibrium dynamic monopsony model, a firm's labor supply elasticity is defined as a function of the long-run elasticities of recruitment and separations.

[18] Although collective bargaining has fallen in many Western countries (Schnabel 2020), there is still much evidence of bargaining, especially outside the United States.

[19] Alternatively, taking the reciprocal as Yeh et al. (2022) do, a firm's marginal revenue product of labor is at the median 28% higher than the wage it pays to its workers.

[20] This aligns with the median ratio of 73% reported for U.S. manufacturing plants by Yeh et al. (2022).

[21] In unreported results, we considered an alternative definition of offshoring for the Netherlands using data on foreign affiliates coming from the Foreign Affiliated Trade Statistics (FATS) for the period 2010–2017. This data is compiled at the consolidated firm level and since our unit of observation is the firm, we therefore assume that a firm is engaged in offshoring if it belongs to the enterprise group with affiliates in a foreign country (and with actual foreign employment). Because the latest (2019) Eurostat outsourcing survey reveals a dominance of within enterprise group outsourcing, the assumption on the measurement of this alternative offshoring measure seems to be plausible. We obtain similar results at the extensive as well as the intensive (see infra) margin. These results are available upon request.

[22] The estimated marginal effects on our control variables are available upon request.

[23] We refer to Fraser and Pantzalis (2004), Ekholm et al. (2012), Dai and Xu (2017) and Van Cauwenberge et al. (2022) for the motivation and construction of firm-level exchange rate variables.

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

[25] The only exception is the validation of Conjecture 4b, where the positive association between offshoring of final goods (adjusted for re-export activities) and the likelihood of wage-markdown pricing is found to be stronger in Belgium.

[26] In wage-markdown firms in the Netherlands, the widening effect of offshoring on wage markdowns also runs through a decrease in the price–cost markup (see column (4) in Panel B).

[27] As said before, since our structural measure of a firm's monopsony power (the firm's labor supply elasticity $(\varepsilon_W^N)_{it}$) is a direct transformation of the firm's wage markdown $\psi_{it}$, this finding, in turn, explains why Conjecture 2b —stating that the negative relationship between offshoring and firms' labor supply elasticity is expected to be stronger in the Netherlands— is not supported.

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## Supporting Information

Additional supporting information can be found online in the Supporting Information section.