The impact of service and goods offshoring on employment: firm-level evidence

Carmine Ornaghi[*], Ilke Van Beveren[†] and Stijn Vanormelingen[‡§]

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Abstract

We use a newly constructed database of Belgian firms that combines individual transaction-level data on international trade in goods and services with annual financial accounts to produce fresh evidence on the impact of goods and service offshoring on employment and other firms' outcomes for both the manufacturing industry and services sector. Our results show that: (i) goods offshoring has a positive impact on employment growth of both low and high educated workers in manufacturing but this effect is substantially reduced when controlling for scale effects; (ii) service offshoring has a negative impact on employment growth among high educated workers in the services sector; and (iii) the substitutability between offshoring and domestic non-labor inputs is higher than the one between offshoring and labor.

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[*]University of Southampton

[†]De Nederlandsche Bank and KU Leuven

[‡]KU Leuven, Campus Brussels

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1 Introduction

Advances in communication technology have led to a remarkable increase in the tradability of services over the last two decades, resulting in a substantial increase in offshoring of services. Although goods still represent the lion's share of international trade, the growth in services trade substantially outperforms the growth in goods trade nowadays. This evolution has led governments to start new trade negotiations that can reflect the reality of increasingly service-based international commerce; for instance, several members of the WTO are currently negotiating the Trade in Services Agreement (TiSA) with the aim of facilitating market access and improving rules in areas such as licensing, telecommunications, e-commerce and financial services.

The fact that an increasing number of tasks requiring reasonably high levels of skill have become offshorable suggests that more and more jobs previously insulated from foreign competition can be moved abroad (Blinder, 2006),[1] feeding what Amiti and Wei (2005) defined the "fear of service offshoring". A similar view is supported by Feenstra (2017) who notes that the decrease in the number of skilled workers in US manufacturing in the nineties and later years, nicely documented in his graphs, is "*strongly suggestive of the offshoring of service activities*". The speculative nature of this assessment confirms that more high-quality studies are needed to understand how this surge in service offshoring affects employment of different skill levels. This paper tries to fill this gap by producing fresh evidence on the impact of both goods and service offshoring on total employment and employment by level of education not only in the manufacturing industries but also in the less studied services sector, using an unusually rich dataset of Belgium firms.

The model of Grossman and Rossi-Hansberg (2008) and the related work by Wright (2014) show that the impact of offshoring on employment can go either way. The relocation of tasks of the production process abroad may have a *direct* negative effect on firm employment, the

[1]For instance, tasks whose output can be conveyed electronically, such as back-office accounting services, preparing tax forms, or software development, as noted by Grossman and Rossi-Hansberg (2008).

magnitude of which depends on the number of in-house workers that are attached to the offshored process, but it can also lower production costs and improve product quality, thus boosting firms' output and employment, *overall*. Building upon the work of Hummels et al. (2014), in this paper we disentangle the *direct* effects of offshoring on employment from its *overall* effects inclusive of productivity gains and quality improvements by estimating two versions of our empirical specifications: one with firms' output on the right-hand-side and one without this control variable. The intuition is that by incorporating firms' output, we can identify whether offshoring is substitute for or complement to labor types, holding the scale of activities constant. Moreover, to capture the fact that the *direct* effect due to the complementary/substitutability between offshoring and labor are likely to materialize at different point in time than the scale effects driven by productivity gains and quality improvements (Grossman and Rossi-Hansberg, 2008), we define a novel econometric framework that includes both present and past values of offshoring, measured as firm level imports of goods and services.

In this paper, we deal with endogeneity problems due to simultaneity and measurement errors by constructing a detailed set of firm-level instrumental variables. For this, we first retrieve data on exchange rates and exports of goods and services for a large number of countries that our firms trade with. These statistics are then weighted by individual import shares based on the initial amount of goods and services imported by each firm. The rationale behind this approach is that a firm importing initially a certain quantity of goods and services from a set of countries, benefits from changes in the quality and in the costs of the items produced by these countries (as measured by the exchange rates and export flows of these countries) and can then expand offshoring activities. Results in Section 5 show that these instruments are highly correlated with firms' decision to offshore but are not directly related to firms' employment decisions.

To better understand the changes that offshoring triggers within the firm, our analysis is also extended to other firms' outcomes, namely revenues, labor productivity and domestically

purchased intermediate inputs. Specifically, these variables are used as alternative dependent variables while keeping the same empirical framework with goods and service offshoring as main explanatory variables.

This paper contributes to the existing literature, which we summarize in the following section, in different ways. First, as mentioned above, we investigate the relationship between employment outcomes and the offshoring of goods and services for both manufacturing industries and services sector. The number of studies measuring the effects of service offshoring is still limited, and they use mostly aggregated sector-level data or are based on surveys of a restricted sample of firms. In contrast, we can observe firm-level imports of both goods and services and, equally important, we extend the analysis to the services sector. One may argue that once services are tradable, they are no different from goods. Given that services are the core products of services firms as physical goods are the core products of manufacturers, one could expect the effects of service offshoring in the services sector to be similar to the effect of goods offshoring in manufacturing. However, as explained above, the impact of offshoring on total employment depends on the strength of the substitution effect vis-à-vis the output effect. Accordingly, we may expect to find similar effects only if productivity gains for service offshoring are similar to goods offshoring and, at the same time, the demand elasticity in manufacturing industries is comparable to the one in the services sector. Whether this is the case is an empirical question, which we try to address in this paper. Equally important, our analysis aims at studying whether the impact of offshoring differs between high and low skill workers. In this respect, service offshoring can have a different impact on labor composition because services are more skill intensive. It is precisely this concern that fuelled the "fear of service offshoring", namely that high skill workers, previously insulated from foreign competition, would lose their jobs.

Second, our analysis provides a more comprehensive understanding on how offshoring affects firms' activities by extending the analysis to the impact of offshoring on output growth, productivity as well as domestic intermediate inputs. The latter is particularly important

to discern the effect of offshoring on the employment of the firms that are actively pursuing offshoring vis-a-vis its impact on local suppliers of these firms, given that firms' imports include not only goods and services that were previously produced by the firm itself, but also those purchased from other Belgian suppliers.[2] Finally, from the methodological point of view, a distinctive aspect of our analysis is that we use a more flexible specification that allows for both contemporaneous (short-term) and lagged impact of offshoring on firms' outcomes.

Our findings indicate that goods and services offshoring have different effects on employment growth. Employment growth is positively related to goods offshoring in the manufacturing sector. However, when controlling for scale effects, the impact becomes substantially smaller and even non-statistically different from zero in some specifications. Service offshoring is negatively related to employment growth in the services sector, and interestingly enough, this result is driven by employees with high education. To the best of our knowledge, this is the first paper to find robust large-scale evidence that in the services sector, it is the job security of skilled workers that globalisation threatens. Another key finding of our study is that the substitutability between offshoring and local inputs is, in our data, remarkably higher than the one between offshoring and labor, thus suggesting that a large share of offshored tasks were previously acquired from local suppliers rather than performed in-house. This finding is compatible with and complement the findings by Pierce and Schott (2016) who show that employment in US plants respond negatively to exposure to a change in trade policy in downstream (customer) industry.

The rest of the paper is structured as follows. Section 2 gives a brief overview of the literature and Section 3 describes the dataset used for the analysis. Section 4 explains the empirical methodology and the construction of the instrumental variables used to identify the causal impact of offshoring on employment. Section 5 presents the results, and section 6

[2]It is important to note that the effects of offshoring on firms' workers and on their suppliers are often lumped together in studies on offshoring and labor outcome based on industry-level data, since a firm and its local suppliers are likely to be classified in the same sector.

concludes.

2 Literature Overview

Most of the studies on the impact of offshoring on labor have focused on offshoring of goods, initially using industry-level data (see, for example, Feenstra and Hanson, 1999) and more recently using firm-level data (e.g., Gorg et al., 2008 and Mion and Zhu, 2013). The general consensus in this literature is that the relative demand for unskilled workers falls in response to goods offshoring. However, the findings from studies investigating the effects on absolute employment are mixed, with most of them estimating rather small effects of offshoring on domestic employment, whether positive or negative (Wright, 2014). In a recent article, Monarch et al. (2017) study several offshoring events by matching Trade Adjustment Assistance (TAA) program petition data to U.S. Census Bureau micro data. They find that offshoring firms experience a significant decline in employment in the year when offshoring starts and in the following 4 years after the event. They also show that there is no evidence of employment recovery in the longer run.

Compared to the large empirical and theoretical literature on trade in goods, our understanding of trade in services and its impact is still limited. An early study by Gorg et al. (2008) looks at the effect of material and service offshoring on the productivity of Irish manufacturing plans and finds that service offshoring has a positive impact, albeit only for exporters.

Given that service tasks are, on average, more skill-intensive than production tasks,[3] economic intuition would suggest that service offshoring should exert a downward pressure on skilled labor demand (Crino, 2009), an insight that would explain the reduction of skilled employment in US manufacturing industry in the nineties described by Feenstra (2017). But the few available empirical studies have found no support for this hypothesis. On the

[3]For example, Jensen et al. (2005) find that workers tradable services industries and occupations are higher skilled than workers in non-tradable services and manufacturing.

contrary, service offshoring seems to increase relative demand for skilled workers (Crino, 2010b,a, 2012), mimicking the findings for goods offshoring in earlier studies. This could theoretically be explained by heterogeneity in the skill intensity of service activities, whereby developed countries specialize in high-skill intensive activities based on factor proportions arguments, or by the fact that the activities predominantly tradable are those done by low-skill workers, (Crino, 2009). Similarly, Geishecker and Görg (2013) combine individual-level data on wages with sector-level data on service offshoring and find that service offshoring negatively affects the real wage of low-and medium-skilled individuals in the same industry, while skilled workers benefit from service offshoring through higher real wages. Using a panel of Swedish manufacturing firms, Andersson et al. (2016) also finds that service offshoring increases relative demand for skilled labor while goods offshoring appears to have no impact.

The number of studies that investigate the effective impact of service offshoring on total labor demand, instead of relative demand for different types of workers, is even more limited. Early studies by Amiti and Wei (2005, 2006) based on sector-level data for respectively, UK and US manufacturing, find a small negative or no effect of service offshoring on labor demand in the US, but a small positive effect in the UK. Eliasson and Hansson (2016) use linked employer-employee data for Sweden to investigate whether there are differences in the probability of displacement and in the income losses after displacement for workers in manufacturing and tradable services vis-a-vis non-tradable service. Their focus is on large mass dismissal and establishment closure. They do not investigate the causal effect of offshoring as they do not observe offshoring at firm-level.

The two studies most closely related to this paper are Hijzen et al. (2011) and Eppinger (2019). Using data on imports and exports of service retrieved from a survey of UK firms, Hijzen et al. (2011) find that employment growth in firms that import services, is higher than in firms that do not. However, their approach does not address the endogeneity of offshoring, and so the positive correlation can be explained by cost savings from offshoring that give rise to an increase in the scale of production or by simultaneity. Eppinger (2019) looks at

the impact of service offshoring on a large sample of German firms and finds that service offshoring leads to an increase in firms' employment in both services sector and manufacturing industries. Differently from our work, his analysis does not include goods offshoring and, more importantly, does not consider the impact of service offshoring on the labor composition.

To sum up, while there is a growing literature on the effects of service offshoring on employment outcome, to the best of our knowledge, our paper is the first to study the impact of goods and service offshoring on total employment and on labor composition by skill levels in the services sector. This is an important contribution given that service offshoring is more prominent in the services sector. Investigating the effects by skill levels is equally relevant given that the percentage of high-skill workers is substantially higher in services than in manufacturing. Differently from existing studies, this paper tries also to explore how offshoring affects other firms' outcomes, such as revenues, productivity and expenditure on "local" intermediate inputs, with the aim of producing a more complete and exhaustive analysis of the changes triggered by offshoring activities.

3 Data

For our empirical analysis, we rely on Belgian firms' annual accounts which are merged with data on their trading activities for the period 1996-2005.[4] The annual accounts contain the standard variables, such as employment, value added, turnover and book value of tangible assets.[5] A firm is classified as part of a manufacturing industry (NACE Rev 1.1 codes 15 to 36) or a services sector (Nace Rev 1.1 codes 60 to 74, so excluding distributive trade sectors)

[4]We restrict the analysis to the period 1996-2005 for two reasons. First, the definition of employment in the annual accounts has changed in 1996. Since many firms still reported employment according to the old reporting standard, the data for 1995 are not always reliable, hence we drop this year from the sample. Second, trade in services is available for the full population only until 2005. Until 2005, the data were constructed using transaction data on cross-border payments to foreign enterprises reported by financial institutions, implying that data were available for the full population of firms. Starting in 2006, data are collected directly from a sample of (large) firms, resulting in a structural break in the series. Therefore, we include only data until 2005 in our sample.

[5]For a limited number of firms, the reporting year does not run from January to December. To correct for these, we follow a procedure suggested by the National Bank of Belgium to annualize these accounts.

depending on their main activity code.

While all limited-liability firms are required to report their annual accounts to the National Bank of Belgium, reporting requirements are limited for small firms.[6] Since some of the variables used in the empirical analysis, such as turnover and job flows by education levels, are available only for firms that report complete annual accounts, we limit our attention to these (larger) firms. Our sample is highly representative for the population of firms with over 50 employees. For example, for the manufacturing sector, we observe 1563 firms in 2005 in this size category, accounting for 392,730 employees. Eurostat (Structural Business Statistics) report 1692 firms of over 50 employees, accounting for 404,874 employees (unfortunately, data for 2005 was not available per size category at Eurostat). Our data, however, is less representative for the smaller firms, but note that we capture the bulk of total employment, making our results highly relevant for the total economy. For example, our data covers 71% of total employment in 2005 in the manufacturing sector (again compared to total employment reported in the SBS database of Eurostat).

We obtained data on trade in goods from the National Bank of Belgium (NBB). We observe for each firm in a given year its imports and exports at the product-country level, where products are defined according to the Combined Nomenclature (CN8) classification. Data on intra-EU imports and exports of goods are subject to reporting cut-offs that have changed over time. Specifically, from 1995 to 1997, firms had to report intra-EU exports (imports) if their value in the previous year exceeded €104,115. Between 1998 to 2005, this threshold increased to €250,000 per year. Moreover, the change in EU membership in 2004 implicitly increased the number of countries included in intra-EU declarations. For extra-EU trade flows, data are collected from customs data. All transactions for which the value is higher than €1,000 or whose weight is over 1,000Kg have to be recorded.

The international trade in services data for Belgium are collected on the basis of the balance of payment returns sent to the NBB either by commercial banks or by direct re-

[6]Firms are considered small if they do not exceed more than one of three criteria: 1)employment higher than 50; 2) balance sheet total exceeding €3.65 million; and 3)turnover higher than €7.3 million.

porters.[7, 8] Between 1995 and 2005, banks had to report payments made or received by their clients when the payer or the payee was a non-resident. Data are available at the firm-service-country-year level. Starting with the NACE rev1.1 classification used by the NBB, we divide services into seven different groups: Transport, Financial and Insurance, Communication, Information Technologies, (other) Business, Construction and Cultural Services.[9] In our empirical analysis, we exclude construction and cultural services.

In constructing our dataset, we limit attention to transactions involving Belgian firms, thus excluding for example spending by Belgian tourists abroad. We also exclude the following transactions: 1) transactions in goods that did not involve a change in ownership; 2) payments of royalties and license fees and financial flows between related companies since these could reflect profit shifting for tax reasons; 3) all merchanting transactions related to trade in goods and 4) payments made by governments or international institutions.

The growth in trade of services is higher than that for goods over the time window considered, see Figure B.1 in Appendix B. This increase is even more pronounced for services such as Business Services, (+254% increase in nominal value of imports), IT Services (+271%) and Communication Services (+340%), compared to an average of +110% for trade in goods. However, in level terms, imports of services were still much less important than those of goods.

To convert the data into real values, we use deflators from the EUKLEMS database. The international trade data – both services and goods – are deflated with the output deflator

[7]This data has also been used by for example Ariu (2016a) and Ariu (2016b).

[8]Trade in services is usually classified in four different modes (Francois and Hoekman, 2010). *Mode 1* is cross-border supply and applies when service suppliers located in one country provide services in another country without either the buyer or the supplier moving to the physical location of the other. A typical example is a call center located in India that provides services to a Belgian firm. *Mode 2* is consumption abroad and applies when the service is consumed by a resident of one country in the territory of another country–e.g., hotel services to tourists. *Mode 3* refers to commercial presence–i.e. firms moving to the location of the consumers to provide their services locally through the establishment of a foreign affiliate or branch. *Mode 4* is the movement of natural persons and refers to services provided by the firm of one country through the presence of natural persons in another country–for example, a Polish transport company that offers transport services in Belgium through the presence of its trucker in Belgium. Since the data for Belgium are constructed using financial transaction data involving foreign businesses and Belgian residents, mode 3 is not included, as there is no cross-border payment involved in this mode of service trade.

[9]The NACE rev1.1 classification translates one-to-one into the international classification of services EBOPS. Table A.1 in Appendix A shows the EBOPS classification and the corresponding NACE codes.

Table 1: Imports of Different Service Types (values in million euros)

	1996			2005		
Type of Service	Value	Share	% Firms	Value	Share	%Firms
Transport Services	2,054	61.5%	13.6%	3,771	45.9%	14.8%
Business Services	788	23.6%	13.8%	2,411	29.4%	21.5%
IT Services	189	5.7%	5.6%	965	11.8%	8.2%
Communication Services	228	6.8%	2.0%	910	11.1%	2.8%
Financial Services	80	2.4%	11.2%	151	1.8%	12.2%
Total Trade in Services	3,339	100%	28.2%	8,208	100%	38.8%
Total Trade in Goods	29,766		57.2%	56,219		51.6%

corresponding to the NACE code of the trade flow. Firms' turnover, material inputs and value added reported in the annual account dataset are deflated with the deflators for output, material and value added, respectively. To convert tangible and intangible fixed assets into real values, we apply the capital deflator reported by Eurostat for Belgium in the appropriate year. Finally, we use the Harmonized Consumer Price Index (HCPI) to deflate wages.

After some cleaning of the data,[10] the final sample that we use in our empirical analysis consists of an unbalanced panel of 3751 manufacturing firms and 3679 service firms for the period 1996 to 2005. Table 1 displays total imports of the different types of services for this final sample.[11] Services imports have increased by more than imports of goods, mostly due to the boom in business, IT and communication services. Although the sample consists of large firms, only a minority imports services, but the share of firms importing services has increased from 28.2% to 38.8% over the sample period. The share of firms that imports goods is substantially higher, at more than 50% (and over 80% if we consider only firms in the manufacturing sector). These large numbers reflect the Belgium's substantial trade openness as well as the fact that we focus on large firms.

We define offshoring of goods and services as the firm-level imports of goods and services

[10]We drop observations where (i) the share of offshoring–i.e., the ratio between offshoring of goods and services and turnover, is above one; and (ii) the absolute change in the share of offshoring over two consecutive years is above 0.5. Furthermore, we winsorize the growth of employment and share of offshoring at the 1st and 99th percentile.

[11]The relative importance of each service category is comparable to the full dataset. Only the Financial and Insurance Services imports are of relatively lower importance in comparison to the figures in Table B.1, which show the importance of the different types of services in the trade database. This is because banks are not included in the firm-level dataset.

respectively, excluding imports of capital goods.[12] While we check the robustness of our results when using a "narrow" measure of goods offshoring (defined as the purchases of intermediate inputs classified in the same NACE2 manufacturing industry of the firm) and, similarly, a "core" measure of service offshoring (defined as acquired services that belong to the same group classification discussed previously), we advocate that the broad firm-level offshoring variables are the appropriate measures to quantify the overall impact of offshoring on total employment and on different labor types. For instance, consider the case of a firm that decides to outsource two similar tasks, one previously done in-house (task A) and one previously acquired from a local supplier (task B). Assume that the efficiency gains associated with the change in supplier are the same for the two tasks, restricting the attention only to task A may overestimate the negative impact of offshoring on firms employment due to the fact that local workers assigned to task A may be made redundant while similar substitution effects would not be observed for task B.

In Figure B.2 in the Appendix, we plot the average ratio between firm-level offshoring and total expenditures on material and service inputs for each NACE 2-digit sector. Several sectors in the manufacturing compartment are found to import more than 20% of their intermediate inputs. Not surprisingly, offshoring of intermediate inputs is mostly prevalent in the manufacturing industries, while offshoring of service inputs is more common in services sector. Total offshoring is higher in manufacturing industries, reflecting higher tradability of goods in comparison with services.

Table 2 reports summary statistics of the main variables used in the empirical analysis. In our final sample, the average firm in the manufacturing sector employs 153 people and generates 45 million euro in revenues. The share of offshoring of goods, defined as the ratio between offshoring and turnover, is almost 20%, while the corresponding share for services is around 0.5%. Average employment growth is very low and equal to 0.45%. The average firm

[12]Note that these could be used as inputs in firms producing capital goods, leading to an underestimation of their offshoring level. However, we believe this bias to be smaller as compared to including capital goods as imported intermediates.

active in the services sector in our final sample employs around 156 people, with a turnover of almost 22 million euro. In general, total imports as a percentage of turnover is relatively low compared to the manufacturing sector, but imports of services are much more important and equal to 3.3%. Average employment growth is equal to 3.6%, reflecting the aggregate pattern of increasing importance of the services sector.

Table 2: Summary Statistics

Variable	Mean	p50	sd	Obs
Manufacturing				
Turnover (×1000€)	44,932	11,377	181,515	24,489
Employment	153	56	424	24,489
Offshoring of Goods (×1000€)	13,309	1,654	88,390	24,489
Offshoring of Services (×1000€)	552	0	7,163	24,489
Share Offshoring Goods	0.194	0.145	0.189	24,489
Share Offshoring Services	0.005	0	0.021	24,489
Employment Growth	0.45%	0.0%	16.4%	24,489
Services				
Turnover (×1000€)	21,744	5,184	117,440	20,161
Employment	156	27.1	1,389	20,161
Offshoring of Goods (×1000€)	450	0	6,385	20,161
Offshoring of Services (×1000€)	1,702	0	14,977	20,161
Share Offshoring Goods	0.013	0	0.067	20,161
Share Offshoring Services	0.033	0	0.077	20,161
Employment Growth	3.6%	1.7%	23.1%	20,161

Growth of Education Our data set also reports the inflow and outflow of employees by education level, but not their total stock. We make a distinction between low educated workers, those who hold secondary education or lower, and high educated workers, who have either a university degree or other post secondary school qualifications. On average, employees with high education account for 40% of total gross flows in the services sector, compared to a much lower 20% in the manufacturing sector. We use the information on the flows to decompose the observed total labor growth into employment growth of high and low educated workers. Appendix A gives more details on the construction of employment

changes by education level.

4 Empirical Framework and Instruments

4.1 Framework

The specification we take to the data consists in regressing the growth rate of employment Δe_{it} (either total employment or by education level) on time-varying firm-level offshoring intensity of goods, SO^g_{it}, and services, SO^s_{it}. This specification is similar to those used by, for instance, Bernard et al. (2006) and Mion and Zhu (2013). Expressing the dependent variable as growth rates is also convenient as we observe changes in employment, but not employment levels, for different education levels. The offshoring variables are measured as the ratio of firm level imports of respectively goods and services, over total turnover. We scale offshoring by firm size to eliminate the possibility of finding a positive (or negative) correlation between imports and employment due to exogenous positive (respectively, negative) shocks in demand that cause a proportional increase (respectively, decrease) in both output and variable inputs: for instance, the award of a public procurement contract that leads to a simultaneous increase in output and imported inputs but that leaves the share of offshoring unchanged.[13] Furthermore, to capture the fact that offshoring may imply the *immediate* replacement of a task previously done by domestic workers or suppliers but it may also *later* lead to an expansion of output and employment because of productivity gains and quality improvements, we include both present and past values of offshoring.

Accordingly, we have:

$$\Delta e_{it} = \rho e_{it-1} + \beta_1 SO^g_{it} + \beta_2 SO^g_{it-1} + \beta_3 SO^s_{it} + \beta_4 SO^s_{it-1} + \mathbf{K}_{it}\boldsymbol{\alpha} + \eta_i + \delta_{jt} + \varepsilon_{it}, \quad (1)$$

[13] We have also re-estimated our main specification using the ratio of firm level imports over total intermediate inputs as our offshoring measure. Results are qualitatively the same.

where the residual ε_{it} captures shocks to employment, possibly correlated with the offshoring activities, and measurement error. The specification includes lagged level of employment to control for that fact that firms of different size tend to growth at different speed and firm fixed effects η_i to absorb any time-invariant components that may affect firms' employment growth such as geographic location or ownership structure. In addition, we include a complete set of time-industry fixed effects, δ_{jt}, to control for shocks to demand, labor market, or technology that are common to all firms in an industry, including import competition i.e. overall imports of products that compete with those produced by the firms in our dataset.

In the equation above, $\mathbf{K}_{it}$ refers to capital intensity of the firm, measured as the log of the ratio of tangible and intangible assets over the number of employees. In the regression with total employment as dependent variable, $\mathbf{K}_{it}$ should control for the effect of technical change and capital deepening on the labor demand, both of which may be correlated with offshoring. Similarly, in the regression by labor types, it controls for changes in labor composition due to skill-biased technological changes and capital-skills complementarities.

In order to make apparent the short and longer run impacts of offshoring, we subtract and add $\beta_1 SO^g_{it-1}$ and $\beta_3 SO^s_{it-1}$ on the RHS, thus obtaining our main specification:

$$\begin{aligned} \Delta e_{it} = \rho e_{it-1} + \beta_1 \Delta SO^g_{it} + (\beta_1 + \beta_2) SO^g_{it-1} + \beta_3 \Delta SO^s_{it} + (\beta_3 + \beta_4) SO^s_{it-1} \\ + \mathbf{K}_{it}\boldsymbol{\alpha} + \delta_{jt} + \eta_i + \varepsilon_{it}, \end{aligned} \tag{2}$$

where ΔSO^g_{it} (ΔSO^s_{it}) indicates the difference in the share of goods (respectively, service) offshoring over two consecutive years. In this equation, the coefficients on ΔSO_{it} measure the short-run effect of goods or service offshoring, while the coefficients on SO_{it-1} capture the compound effect over a two-year period.[14] Note that this specification is flexible enough to encompass the most common empirical models used in the literature. For instance, Mion and Zhu (2013) use a specification with the share of offshoring in $t-1$ on the RHS while

[14]This is reminiscent of the "error correction model", where the change in one variable is related to the change in another variable, as well as the gap between the variables in the previous period.

Eppinger (2019) uses a specification with growth of offshoring. To be consistent with the modelling of the offshoring variables, capital intensity enter the equation as lagged levels and yearly changes.[15]

Offshoring firms can concentrate their production on those activities that they do more efficiently and offshore the production of intermediate goods that are produced at a lower cost abroad. While an increase of offshoring may displace domestic employment (*substitution effect*), the access to international inputs that are less expensive or of higher quality can entail a boost in productivity and demand which may offset the initial job losses (*output effect*). Eq.(2) models the *overall* impact of offshoring, including the output effect. In order to estimate the *direct* substitution effect of offshoring, net of the expansion in firms' output and labor inputs generated by quality improvements and efficiency gains, we follow Hummels et al. (2014) and include firms' output as a control variable, thus obtaining our second main specification:

$$\Delta e_{it} = \rho e_{it-1} + \mathbf{SO}_{it}\boldsymbol{\beta} + \mathbf{K}_{it}\boldsymbol{\alpha} + \mathbf{Y}_{it}\boldsymbol{\gamma} + \delta_{jt} + \eta_i + \varepsilon_{it}, \tag{3}$$

where $\mathbf{SO}_{it} \equiv \{SO^g_{it-1}, \Delta SO^g_{it}, SO^s_{it-1}, \Delta SO^s_{it}\}$ while $\mathbf{Y}_{it}$ is the growth and lagged level of output, measured by deflated revenues.

Equation (3) can be considered as a conditional labor demand function, derived from a standard cost minimization problem (see Amiti and Wei (2005) and Eppinger (2019) for similar frameworks). A standard labor demand equation would include the prices of all different input but we assume the cost of intermediates inputs and capital goods to be industry-year specific, a common assumption given data constraints. Accordingly, these prices can be controlled by a complete set of sector-time dummies. Similarly, following Andersson et al. (2016) and Eppinger (2019), among others, we assume that wages are exogenous to firms and changes in labor costs are also absorbed by industry-year fixed effects. This assumption is consistent with the institutional setting in Belgium where wages are set at the industry level as the outcome of bargaining between unions and employer organizations.

[15]This is why we indicate $\mathbf{K}_{it}$ as a vector.

As we don't observe the price of offshoring, our offshoring variables are assumed to pick up changes in prices as these will induce a change in the quantity of imported products. Likewise, Equation (2) corresponds to an unconditional labor demand function, where the output prices are absorbed by the industry-year dummies.

To shed light onto the changes that service offshoring triggers within the firm, we use output, labor productivity and firms' expenditure on domestic materials and services (all in real values and logs) as alternative dependent variables in the equations above.[16] By using output and labor productivity as dependent variables, we can investigate the extent to which offshoring intensity can indeed lead to productivity improvements and market expansion effects. At the same time, the specification with domestic intermediate inputs allows us to assess the effects of offshoring on domestic suppliers of the firms that acquire goods and service abroad. In this way, we can compare the strength of complementarity and substitutability between offshoring and domestic inputs, on one side, to that of offshoring and labor, on the other side. Whereas several authors have tried to disentangle the effects of offshoring of intermediate and finished goods on firms' employment,[17] the novelty of our approach consists in assessing the impact of (total) offshoring on in-house workers producing final goods or services sold by a firm vis-a-vis the effect on local suppliers producing the intermediate inputs bought by the firm.

4.2 Instruments

The key identification challenge we face in our empirical exercise is that productivity shocks and changes in the demand for the firms' products are likely to simultaneously affect employment and offshoring. For instance, there is undisputed evidence that highly productive firms are larger, export more products and import more inputs. Our specification tries to

[16]Domestically purchased inputs are obtained by subtracting firm level imports, excluding imports of capital goods according to the BEC classification, from total reported spending on intermediate goods and services.

[17]Finished goods are generally defined as imported products that correspond to the main activity of the firms while all other imports enter the residual group of intermediate goods.

minimize these sources of endogeneity by including industry-time fixed effects to capture the impact on employment of industry-wide changes in labor costs and import competition, and by including firms' capital intensity to control for the effect of technological changes and capital deepening. Nevertheless, estimating equation (2) with Ordinary Least Squares or FE may still result in biased parameter estimates if there are unobserved productivity changes and demand shocks that affect firms' offshoring intensity as well as their labor demand.

A second source of endogeneity can be traced back to measurement errors in the offshoring variables due to the fact that: (i) international transaction below certain thresholds are not reported and (ii) the price of goods and service is not observed and, accordingly, real values are computed using industry-level deflator. While measurement error leads estimated coefficients biased towards zero, it is difficult to say how the first source of endogeneity affects the estimates.[18]

To tackle these problems, we construct firm-time varying instruments that are correlated with imports at the firm level but uncorrelated with labor demand by combining the firm-level trade structure in a base year with factors at the product-country level affecting the propensity to import (see, also, Hummels et al. (2014) for a similar approach). More precisely, our firm-time varying instrument Z_{it} for firm i in period t is constructed as $Z_{it} = \sum_{c,k} s_{ick} I_{ckt}$, where s_{ick} represents the share of imports of product/service k from country c by firm i in the base year–i.e., the pre-sample year or the first year that the firm enters the sample. The other component of the instrument I_{ckt} consists of factors affecting or reflecting changes in comparative advantage of country c in the production of product/service k. These include exchange rates and world export supply in goods and services, which are discussed in turn below.

Exchange Rates If country c's currency depreciates (appreciates) compared to the Belgian currency, the products/services produced by this country become less (more) expensive,

[18]For instance, labor saving shocks that facilitate offshoring, such as IT investments, can introduce a downward bias in the estimated coefficients, while productivity shocks boosting both offshoring and employment could introduce an upward bias.

altering the optimal amount of imports. At the same time, international exchange rates can be considered exogenous to the employment decisions of individual Belgian firms, especially after controlling for sector-year fixed effects. We retrieve the exchange rates for more than 200 countries from the Word Bank Dataset.[19] Exchange rates have country-time variation and are constructed so that an increase of this variable implies a depreciation with respect to the Belgian franc (until 2001) or the Euro (starting from 2002).

Trade in Goods We follow Hummels et al. (2014) and construct a World Export Supply (WES) measure, which is equal to total exports of product k by country c net of exports of product k by country c to Belgium. The idea is that WES captures changes in comparative advantage for the exporting country, arising from changes in the production price, product quality or variety. Subtracting the exports to Belgium from the total exports ensures that Belgian demand factors are filtered out of the instrument. For bilateral trade flows, we rely on the BACI dataset (Gaulier and Zignago, 2010), which is based on the COMTRADE dataset.[20] From this database we can construct WES at the HS6 digit-year-country level.[21] Other studies use variation in tariffs to construct a similar instrument. We experimented with tariffs from the UNCTAD Trains database, but the tariff instruments had little explanatory power in the first-stage regressions, probably due to the little variation in tariffs over the sample period.

Trade in Services We also construct a measure of World Export Supply for trade in services. Bilateral trade flows of services are not as detailed as those for trade in goods. From the World Input-Output Tables (Timmer et al., 2015), we can derive exports of 8

[19] https://datacatalog.worldbank.org/official-exchange-rate-lcu-usd-period-average.

[20] The BACI dataset makes corrections to COMTRADE based on the observation that the reported imports of country j from country c should be the same as the reported exports of country c to country j, after taking into account that import values are reported CIF (cost, insurance and freight) and export values are reported FOB (free on board).

[21] To control for HS6 codes changing over time, we follow the concordance procedure explained in Van Beveren et al. (2012).

different types of services for 40 different countries.[22] Note that these countries account for the vast majority of Belgian service imports. We also experimented with the WTO trade in services database which has the advantage of reporting services exports of all countries, but only for two types of services. Results remained the same when using this database to construct WES of services.

The different variables described above have country-time or country-industry-time variation. As mentioned above, we obtain firm-year level instruments by taking a weighted sum of these factors with the share of the import value of product/service k from country c by firm i in the base year as weight. Most firms that source a particular input k from country c are likely to keep on buying this input from the same country c over a long period of time because, for example, the product is a particularly good fit for the firm or because there are fixed costs associated with switching countries to buy the inputs (Hummels et al., 2014). The stability of the importing structure allows us to hold firms' import shares fixed at the base year, thus avoiding a potential endogeneity issue due to adjustments in these shares over time. Econometric tests reported in the following section suggest that our instruments are highly correlated with the offshoring variables while being orthogonal to the changes in firm level employment.

5 Results

In this section we first present the results on the impact of offshoring on total employment, on employment by educational level, and on other outcome variables, namely output, productivity and domestic inputs. We then check the robustness of the results when *(a)* we use the Arellano and Bover (1995) estimator to deal with the endogeneity of the lagged dependent variable; *(b)* we use "narrow" measures of goods and service offshoring in our analysis, and *(c)* we control for exports. Finally, we expand the analysis to understand whether the impact

[22]The 8 services types are Other Transport, Sea Transport, Air Transport, Financial Services and Insurance, Post and Telecommunications, Construction, Other Business Services and Personal and Cultural Services.

of offshoring differs between OECD and non-OECD countries.

5.1 Main Results

Total Employment

Table 3 shows the estimated coefficients of our empirical specifications for the manufacturing sector on the left panel and for the services sector on the right panel. All specifications include lagged level of employment, capital intensity (growth and lagged levels) and a complete set of time-industry dummies. Following the discussion in Section 4, we report estimates for specifications that do not control for firms' turnover (see eq.2) as well as results for specifications that do (see eq.3). The table shows the results obtained using the fixed-effect estimator (FE) and then those obtained when we instrument for the four offshoring variables (FE-IV).[23]

[23]We have also experimented with an alternative specification where we use only lagged offshoring instead of our richer dynamic framework and obtained similar results.

Table 3: Employment growth and offshoring

	Manufacturing				Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FE	FE	IV-FE	IV-FE	FE	FE	IV-FE	IV-FE
SO^g_{it-1}	0.108***	-0.018	0.777***	0.314**	0.154**	0.008	1.550***	0.497*
	(0.03)	(0.02)	(0.16)	(0.14)	(0.08)	(0.07)	(0.31)	(0.26)
ΔSO^g_{it}	0.113***	0.005	1.560***	0.647***	0.238***	0.064	2.128***	0.461
	(0.03)	(0.03)	(0.20)	(0.19)	(0.07)	(0.07)	(0.39)	(0.41)
SO^s_{it-1}	0.051	0.072	0.495	0.078	-0.095*	-0.098***	0.049	-0.328**
	(0.11)	(0.09)	(0.40)	(0.28)	(0.05)	(0.04)	(0.15)	(0.14)
ΔSO^s_{it}	0.055	0.072	0.547	-0.164	-0.090**	-0.098**	0.425**	-0.178
	(0.09)	(0.08)	(0.36)	(0.21)	(0.04)	(0.04)	(0.17)	(0.12)
$ln(K/L)_{it-1}$	0.010**	-0.003	0.004	-0.005	0.006	-0.014***	0.003	-0.014***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$\Delta ln(K/L)_{it}$	-0.064***	-0.058***	-0.071***	-0.061***	-0.051***	-0.056***	-0.055***	-0.056***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
l_{it-1}	-0.182***	-0.245***	-0.200***	-0.250***	-0.249***	-0.308***	-0.249***	-0.302***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
q_{it-1}		0.171***		0.153***		0.202***		0.197***
		(0.02)		(0.01)		(0.01)		(0.01)
Δq_{it}		0.276***		0.259***		0.330***		0.327***
		(0.01)		(0.01)		(0.01)		(0.01)
Obs	24489	24489	24489	24489	20161	20161	20161	20161
Test $SO^g_{it-1} = \Delta SO^g_{it}$	.815	.242	.000	.144	.251	.306	.835	.927
Test $SO^s_{it-1} = \Delta SO^s_{it}$	.970	.996	.890	.914	.917	.019	.479	.531
Hansen $p-$val (d.f.)			.674 (4)	.845 (4)			.398 (4)	.274 (4)

[a] Standard errors clustered at firm and year level in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Capital intensity is included as control variable in the same way as the offshoring variables. All specifications include as well lagged employment.

[c] All specifications include firm and industry×year fixed effects.

In the manufacturing sector, when we do not control for changes in output nor we instrument for the offshoring variables, both the change in goods offshoring and the lagged level of goods offshoring are positively related to employment growth but we do not find any significant effect of service offshoring on employment growth (cfr. column 1). The coefficients on SO^g_{it-1} and on ΔSO^g_{it} are not statistically different. Given that the coefficient on lagged offshoring shows the overall impact over two years , this suggests that the impact of offshoring on employment materializes in a short period of time, with no further adjustments in the second year. As mentioned before, the estimated effects of offshoring are a combination of a scale effect and a technology effect. The scale effect could stem from imports of intermediate products increasing firm-level productivity because of learning, variety or quality effects, thus boosting competitiveness and increasing sales and, in turn, employment growth.[24] The fact that the coefficient for ΔSO^g_{it} is positive in column (1) but not statistically different from zero in the second column (2) shows that the positive correlation between offshoring and employment is driven by an expansion in output.

The FE results controls for industry-wide changes in wages and import competition using a complete set of time-industry dummies and for technological changes at firm level using capital intensity. However, there could still be an endogeneity problem in the form of firms' specific demand or productivity shocks that increase simultaneously labor demand and the share of imported intermediate inputs. For this, we use the IV strategy explained in Section 4.2. The results of the first-stage regression pertinent to columns (3) and (7) are reported in Appendix C where we shows that the Angrist and Pischke (2009) F-test of weak and underidentification strongly rejects underidentification of each endogenous variable, with p-values of the F-statistic below 0.001 in all the specifications we present. Moreover, the $p-$values of the Hansen test of overidentifying restrictions support the idea that instruments are exogenous.[25]

[24]Note that the increase in imports must be higher than the increase in sales to have an increase in the share of offshoring.

[25]We obtain very similar results for the first-stage regressions of the other specifications reported in this Section. Results are available upon request.

The results in column (3) show that our IV strategy leads to a dramatic increase in the point estimates of the coefficients pertinent to goods offshoring. The short-run coefficient on ΔSO^g_{it} is significantly larger than the coefficient on SO^g_{it-1}, a common feature across most of the specifications presented in the rest of this Section. This interesting finding confirms the importance of using an empirical framework that allows us to assess the effect of offshoring at different points in time. The coefficient on SO^g_{it-1} suggests that a firm going from zero offshoring of goods to the average offshoring intensity (0.194) would witness an increase in employment of around 15% (= 0.777×0.194). Interestingly enough, the "long-term" coefficient on SO^g_{it-1} is still positive but significantly smaller in column (4) where we control for output growth. This is consistent with the idea that offshoring leads to productivity gains that, in turn, lead to an increase in production.

The estimates for the services sector in the right panel show a more complex picture. Similar to the manufacturing sector, an increase in the offshoring of goods is related to an increase in employment - cfr. column (7) - and this effect is substantially reduced when we include our controls for output growth - column (8). This, again, can be explained by service firms replacing domestic intermediate goods with foreign goods that have a better price/quality ratio, an issue that we explore in more detail at the end of this section by using, as said, a specification with intermediate inputs as dependent variable.

Offshoring of services is, instead, negatively related to employment growth in the fixed effects specifications of column (5). When instrumenting for the offshoring variables, we estimate a positive effect of ΔSO^s on employment growth.[26] However this is a short-lived effect that disappears after one period, given that the coefficient on lag offshoring is insignificant. Finally, results in column (8) show that once we control for output, service offshoring makes firms in the services sector less labor intensive. However, it is important to note that the size of the effect remains relatively small. For example, a firm that would increase its share of service offshoring from 0 to the average 0.033, would see a reduction in employment of around

[26]The positive coefficient on ΔSO^s is consistent with the finding in Eppinger (2019).

1%, holding output fixed. This limited effect of offshoring is mainly driven by the relatively low level of service offshoring during our sample period (1996-2005). Miroudot et al. (2013) show this is as well due to regulatory barriers. If, thanks to policy reforms and technological progress, trade in services comes closer to the level of trade in goods, the impact of service offshoring on employment will be substantially higher.

We note that the coefficients pertinent to change in capital intensity are all negative and statistically significant, suggesting that there is some substitutability between capital and labor for both the manufacturing industry and the services sector.[27]

Education level

Previous work has found that the effects of offshoring may vary across employees with different education/skill level. In this section, we produce fresh evidence on this issue by replacing total employment with low- and high-educated employees as dependent variables. Tables 4 and 5 show the IV estimates for respectively, manufacturing and services. For ease of comparison, the first two columns report the IV results already shown in Table 3.[28]

Columns (3) and (5) in Table 4 show that the positive effects of goods offshoring on employment growth in the manufacturing sector are shared by low- and high-skilled workers. Given our definition of the dependent variable as the change in employment of a particular skill type divided by total employment, the coefficient on the offshoring variable also varies with the importance of the labor type in total employment.[29] So, given that the fraction of low-skilled workers in manufacturing industries is approximately four times as large as the fraction of high-skilled workers, the coefficient on offshoring for the low-skilled should also

[27]Excluding (lag level and growth) of capital intensity does not have any bearing on the estimated coefficients on the offshoring variables.

[28]All the specifications still include lag employment and capital intensity. For the sake of brevity, we do not report the coefficients of these control variables. Results are available upon request.

[29]We divide the change in the skill level by total employment for two reasons. First, we do not observe the levels of employment by skill level. Second, this approach allows us to neatly decompose the impact on total employment growth between the two skill groups. In fact, when estimated by OLS, the two coefficients on a explanatory variable in the regressions with low-skill growth and high-skill growth as dependent variables sum up to the coefficient on this variable when using total employment growth as dependent variable. In the IV regression, this is only approximately true.

be four times as large as that for the high-skilled in order to keep the relative shares of the different types at the same level. However, the coefficients for the high-skilled in column (5) are larger than $1/4^{th}$ of the coefficients for the high-skilled workers in column (3), indicating that the firms are becoming more skill-intensive. When we control for output changes, we find a significant reduction of the effect of goods offshoring on employment for both low-skilled (column 4) and high-skilled workers (column 6). As for service offshoring, results in columns (5) and (6) of Table 4 suggest that there is a significant positive effect on workers with high-level of education but this is not statistically significant over two-years period.

The results for the services sector are reported in Table 5. The positive effect of goods offshoring on employment growth when we do not include controls for output is shared by both low-educated and high-educated workers. For service offshoring, columns (4) and (6), where we control for output growth, show that the negative effect on total employment in column (2) is entirely due to high-skilled employment. This suggests that for the case of Belgium, the offshored services are executed mainly by highly-educated employees. Moreover, the fact that the coefficient on SO^s_{it-1} in column (5) is negative but lower in absolute value than in column (6) suggests that the direct replacement effect is softened by an increase in output, possibly due to productivity gains/quality improvements linked to service offshoring. This is one of our key findings, as it offers the first large-scale evidence using firm-level data that service offshoring is more likely to replace high-educated workers than employees with low-education level.

Table 4: Employment growth and offshoring in manufacturing sectors; Low versus high educated

	Total		Low Skilled		High Skilled	
	(1)	(2)	(3)	(4)	(5)	(6)
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	0.777***	0.314**	0.535***	0.176*	0.205***	0.102*
	(0.16)	(0.14)	(0.11)	(0.10)	(0.06)	(0.05)
ΔSO^g_{it}	1.560***	0.647***	1.064***	0.383**	0.341***	0.147*
	(0.20)	(0.19)	(0.14)	(0.15)	(0.08)	(0.08)
SO^s_{it-1}	0.495	0.078	0.125	-0.229	0.200	0.130
	(0.40)	(0.28)	(0.23)	(0.18)	(0.15)	(0.13)
ΔSO^s_{it}	0.547	-0.164	0.001	-0.525***	0.432***	0.270**
	(0.36)	(0.21)	(0.24)	(0.16)	(0.12)	(0.11)
Control Output		X		X		X
Obs	24489	24489	24489	24489	24489	24489
Test $ShOf^g_{it-1} = \Delta ShOf^g_{it}$	.815	.242	.000	.054	.148	.593
Test $ShOf^s_{it-1} = \Delta ShOf^s_{it}$	970	.996	.580	.018	.044	.115
Hansen $p-$val (d.f.)	.375 (4)	.674 (4)	.947 (4)	.995 (4)	.724 (4)	.836 (4)

[a] Standard errors clustered at firm and year level in parentheses.
$*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

Table 5: Employment growth and offshoring in services sector; Low versus high educated

	Total		Low Skilled		High Skilled	
	(1)	(2)	(3)	(4)	(5)	(6)
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	1.550***	0.497*	0.698***	0.130	0.662***	0.305
	(0.31)	(0.26)	(0.14)	(0.13)	(0.21)	(0.20)
ΔSO^g_{it}	2.128***	0.461	0.867***	0.085	0.973***	0.534*
	(0.39)	(0.41)	(0.20)	(0.19)	(0.29)	(0.28)
SO^s_{it-1}	0.049	-0.328**	0.186	-0.015	-0.170**	-0.321***
	(0.15)	(0.14)	(0.12)	(0.12)	(0.08)	(0.07)
ΔSO^s_{it}	0.425**	-0.178	0.241***	-0.089	0.046	-0.188*
	(0.17)	(0.12)	(0.08)	(0.07)	(0.11)	(0.10)
Control Output		X		X		X
Obs	20161	20161	20161	20161	20161	20161
Test $ShOf^g_{it-1} = \Delta ShOf^g_{it}$	.049	.914	.471	.823	.097	.235
Test $ShOf^s_{it-1} = \Delta ShOf^s_{it}$	.002	.161	.538	.405	.052	.197
Hansen $p-$val (d.f.)	.398 (4)	.274 (4)	.674 (4)	.673 (4)	.785 (4)	.723 (4)

[a] Standard errors clustered at firm and year level in parentheses.
$*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

Other Outcomes

The findings above focus on the effects of offshoring on the employment outcome of firms that acquire goods and services from other countries. In order to have a broader view of the impact of service offshoring, in this section we estimate an empirical model similar to equations (2) and (3) but with growth of output, growth of labor productivity (measured as output per hours of work) and growth of domestic intermediate inputs as dependent variables. Domestic intermediate inputs are used to explore the impact of offshoring on domestic suppliers, which could experience employment losses and possibly exit the market.

Results for the manufacturing sector reported in column (1) show that offshoring of both goods and services leads to a substantial increase in output. The effect on productivity is also positive but not precisely estimated - cfr column (2). Similar results are obtained for the services sector, where we also find a significant growth in output and productivity - cfr columns (5) and (6). These findings are in line with those reported in Tables 4 and 5 where we find that the impact of offshoring on employment is substantially reduced once we control for scale effects.

Results in column (4) and (8) show another key finding of our study: the existence of a strong substitutability between offshoring and domestic intermediates.[30] These results support the idea that in our data, offshoring is by and large a mean by which firms can expand the range and improve the quality of their inputs more than a strategic choice to outsource production of final goods and service. Our results are compatible with findings in Pierce and Scott (2016) that show that plants whose customers are more exposed to a trade policy change, contract employment and are more likely to die. For service offshoring, the fact that negative coefficients are also estimated for the specifications that do not control for output - see column (7) - suggests that whereas firms' employees seems to benefit from output expansion driven by productivity gains and quality improvements due to offshoring,

[30]These results are confirmed in early work when we estimate a nested CES production function and find a high elasticity of substitution between domestic intermediate inputs and offshoring, while the elasticity of substitution between intermediates and labor and capital is substantially lower.

this (indirect) benefit do not seem to soften the (direct) substitution effect in the case of local suppliers.

We conclude this section by noticing that a study based on industry-level would compound the results for employment presented in Tables 4 and 5 with those on intermediate inputs presented here to the extent that firms and suppliers are often classified in the same sector. In this respect, the fact that the substitution between offshoring and labor is lower than the substitution between offshoring and products of the local suppliers, may explain why other studies have found that industry-level imports have a stronger negative impact on employment than firm-level imports (see, for instance, Mion and Zhu, 2013)

Table 6: Output; Productivity; and Intermediates

	Manufacturing				Services			
	Output	Productivity	Materials		Output	Productivity	Materials	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	1.399***	0.023	3.191***	-2.341***	2.831***	0.458	5.349***	-3.096**
	(0.35)	(0.20)	(0.59)	(0.69)	(0.39)	(0.32)	(1.57)	(1.52)
ΔSO^g_{it}	3.402***	0.327	2.102**	-3.423***	4.044***	0.897*	6.764*	0.144
	(0.37)	(0.26)	(0.95)	(0.88)	(0.65)	(0.54)	(3.72)	(2.98)
SO^s_{it-1}	1.394**	0.684	-1.848	-7.119**	0.923***	0.604**	-3.537***	-8.083***
	(0.68)	(0.45)	(3.60)	(2.83)	(0.25)	(0.25)	(0.88)	(0.90)
ΔSO^s_{it}	2.562***	1.776***	-0.728	-5.511*	1.847***	0.915***	-5.770***	-8.971***
	(0.84)	(0.49)	(3.64)	(2.89)	(0.27)	(0.22)	(1.23)	(1.26)
Control Output				X				X
Obs	24489	24489	24489	24489	20161	20161	20161	20161
Test $SO^g_{it-1} = \Delta SO^g_{it}$	0.000	0.174	0.271	0.224	0.043	0.345	0.627	0.213
Test $SO^s_{it-1} = \Delta SO^s_{it}$	0.148	0.001	0.475	0.117	0.000	0.038	0.001	0.294

[a] Standard errors clustered at the firm and year level in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$

[b] All specifications include firm and industry×year fixed effects.

5.2 Robustness Checks and Extensions

In this part, we check the robustness of the results when: (a) using the Arellano-Bover estimator; (b) constructing "narrow" measures of offshoring; and when (c) adding the proportion of exports as control variable. Finally, we also explore whether the results above are driven by imports from OECD or non-OECD countries.

Arrellano-Bover Estimator

In FE models, where the transformed error terms include past, present and future of the residuals, the coefficient on the lagged dependent variable suffers from the so-called "Nickell bias", a bias that can be transmitted to the other coefficients. Given that we have employment growth as dependent variable and lag employment level as regressor, the estimated coefficient on lag employment may be biased and this bias could spill over to our coefficients of interest. Although we do not expect our results to be largely affected by this problem because (1) the bias on the lagged dependent variable decreases with the time span of the dataset, which in our case is 10 years, and (2) our IV strategy should soften the transmission of the bias from the lagged labor coefficient to the offshoring coefficients, here we check the robustness of our results when using the FOD estimator proposed by Arellano and Bover (1995).[31] Results presented in Table 7 are qualitatively similar to those reported above. Interestingly enough, the negative coefficient on SO^s in column (6) is even higher (in absolute value) than the corresponding value reported in column (5) of Table 5, thus giving further support to one of the key findings of this study.

[31] An important advantage of FOD is that, unlike the First-Difference estimator which introduces a moving average structure in the error term, the lack of correlation in the transformed errors is preserved if the original ones are not autocorrelated. The instruments we use are the lagged values of employment in t-2.

Table 7: Employment growth and offshoring in manufacturing sectors; Arrellano-Bond Estimator

	Manufacturing			Services		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Low Skilled	High Skilled	Total	Low Skilled	High Skilled
SO^g_{it-1}	1.255***	0.903***	0.294***	-0.060	-0.174	-0.002
	(0.23)	(0.16)	(0.09)	(0.40)	(0.26)	(0.23)
ΔSO^g_{it}	1.366***	1.030***	0.330***	1.471***	0.676**	0.632**
	(0.27)	(0.22)	(0.11)	(0.50)	(0.33)	(0.31)
SO^s_{it-1}	0.623	0.213	0.369*	-0.798***	-0.242	-0.477***
	(0.59)	(0.43)	(0.21)	(0.24)	(0.15)	(0.14)
ΔSO^s_{it}	0.490	-0.052	0.421*	0.115	0.071	-0.053
	(0.54)	(0.40)	(0.22)	(0.22)	(0.14)	(0.13)
Obs.	16710	16710	16710	16197	16197	16197

[a] Standard errors clustered at firm and year level in parentheses.
$*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

Narrow Definition of Goods Offshoring and Core Services

The closer the imported inputs are to the outputs produced by the firm, the more likely it is that within-firm labor could have produced those inputs. This intuition has led some scholars to construct a so-called "narrow" measure of offshoring which includes only imported goods that are classified in the same industry of the firm. Similarly, the measure of offshoring we have used so far includes transport services. However, especially for the manufacturing sector, these are likely to be strongly correlated to trade in goods.[32] Accordingly, we check whether there are substantial changes in our estimates when using a "narrow" definition of goods offshoring and when excluding transport in service offshoring. Results in Table 8 are very similar to those presented in the previous section; in particular, offshoring of goods is confirmed to have a large positive impact on employment of all types of workers but this effect either disappears or it is substantially reduced when we control for output. One important

[32]Note that if we were to apply the definition of "narrow" offshoring to services, the value of service offshoring would be equal to zero for manufacturing firms as services will not correspond to their main activity.

implication of this set of results is that the discussion about what definition of offshoring is more appropriate to capture its effects on offshoring, is not relevant for our conclusions.

Table 8: Employment growth and offshoring in manufacturing sectors; Narrow goods offshoring and service offshoring without transport services

	Total		Low Skilled		High Skilled	
	(1)	(2)	(3)	(4)	(5)	(6)
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	0.920***	0.340**	0.630***	0.170	0.241***	0.115*
	(0.19)	(0.16)	(0.12)	(0.12)	(0.06)	(0.06)
ΔSO^g_{it}	1.907***	0.756***	1.280***	0.404**	0.418***	0.184**
	(0.23)	(0.22)	(0.19)	(0.19)	(0.10)	(0.08)
SO^s_{it-1}	0.786	0.091	0.082	-0.365	0.380*	0.257
	(0.56)	(0.41)	(0.38)	(0.29)	(0.22)	(0.22)
ΔSO^s_{it}	1.069**	-0.175	0.002	-0.789***	0.752***	0.471**
	(0.52)	(0.32)	(0.34)	(0.26)	(0.20)	(0.19)
Control Output		X		X		X
Obs	24495	24495	24495	24495	24495	24495

[a] Standard errors clustered at firm and year level in parentheses.
$*p < 0.10, **p < 0.05, ***p < 0.01$
[b] LLag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.
[c] All specifications include firm and industry×year fixed effects.

We apply similar ideas to the services sector and we repeat the same analysis, but we now include only the core services–that is, the offshoring of services that correspond to the main activity of the firm. Results reported in Table 9 confirm the findings in Table 5, most notably the fact that it is only for workers with a high level of education that we find a negative overall effect of offshoring - see the coefficient on ΔSO_{it} and SO^s_{it-1} in column (6).

Table 9: Employment growth and offshoring in services sector; offshoring of core services

	Total		Low Skilled		High Skilled	
	(1)	(2)	(3)	(4)	(5)	(6)
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	1.474***	0.508*	0.662***	0.143	0.655***	0.334*
	(0.31)	(0.26)	(0.14)	(0.13)	(0.22)	(0.20)
ΔSO^g_{it}	1.979***	0.457	0.731***	0.018	0.993***	0.598**
	(0.40)	(0.42)	(0.21)	(0.18)	(0.28)	(0.27)
SO^s_{it-1}	0.113	-0.651**	0.369	-0.058	-0.348**	-0.652***
	(0.31)	(0.28)	(0.24)	(0.24)	(0.16)	(0.15)
ΔSO^s_{it}	1.249***	-0.317	0.626***	-0.253	0.171	-0.415
	(0.40)	(0.31)	(0.17)	(0.16)	(0.29)	(0.27)
Control Output		X		X		X
Obs	20275	20275	20275	20275	20275	20275

[a] Standard errors clustered at firm and year level in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

Share of Exports

The fact that we use a rich set of control variables and several high-quality IVs should minimize concerns with omitted variables that can simultaneously affect offshoring and the optimal level of employment set by the firms. However, it can be the case that our offshoring variables may pick up some change in the total number and composition of the workforce due to the fact that exporting may be correlated with importing. For this reason, we check whether there is any relevant change in the estimates when adding the percentage of output that is exported on the right-hand side of specification. Table 10 shows that there are no substantial changes in the estimated coefficient of offshoring. In particular, column (12) confirms the negative impact of service offshoring on skilled employees working in the services sector when we control for output.

Table 10: Employment growth and offshoring; Controlling for Exports

	Manufacturing						Services					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Total		Low Skilled		High Skilled		Total		Low Skilled		High Skilled	
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1}	0.781***	0.291**	0.547***	0.139	0.228***	0.113**	1.536***	0.332	0.658***	0.119	0.627***	0.223
	(0.18)	(0.14)	(0.12)	(0.10)	(0.06)	(0.05)	(0.36)	(0.30)	(0.15)	(0.14)	(0.22)	(0.19)
ΔSO^g_{it}	1.546***	0.529***	1.058***	0.238*	0.352***	0.102	1.942***	0.153	0.807***	-0.019	0.628**	0.166
	(0.20)	(0.16)	(0.14)	(0.14)	(0.10)	(0.08)	(0.51)	(0.39)	(0.24)	(0.24)	(0.26)	(0.26)
SO^s_{it-1}	0.562	0.078	0.096	-0.213	0.265*	0.157	0.241	-0.312***	0.248*	-0.028	-0.116	-0.287***
	(0.35)	(0.26)	(0.22)	(0.20)	(0.15)	(0.13)	(0.16)	(0.12)	(0.14)	(0.14)	(0.09)	(0.09)
ΔSO^s_{it}	0.825**	-0.149	0.137	-0.485**	0.389***	0.186*	0.662***	-0.243*	0.323***	-0.157*	0.099	-0.165
	(0.37)	(0.26)	(0.23)	(0.19)	(0.12)	(0.11)	(0.22)	(0.14)	(0.08)	(0.09)	(0.15)	(0.12)
Control Output		X		X		X		X		X		X
Obs	23550	23550	23550	23550	23550	23550	19373	19373	19373	19373	19373	19373

[a] Standard errors clustered at firm and year level in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

Origin of Imports

Several empirical works have found that the negative impact of goods offshoring on manufacturing sector employment is driven by imports from developing countries–China in particular. For instance, Pierce and Schott (2016) find: "*Industries where the threat of tariff hikes declines the most experience more severe employment losses along with larger increases in the value of imports from China and the number of firms engaged in China-U.S. trade.*" In the present context, it is interesting to assess whether our two main results (i.e., the positive effect of goods offshoring on employment for all types of workers and the negative impact of services offshoring on highly-educated workers in the services sector) change according to the origin of the imported inputs. For this, we divide our measure of offshoring intensity between offshoring from OECD countries and from non-OECD countries.

A few interesting facts emerge from the results reported in Table 11. First, imported goods from both OECD and non-OECD countries have a positive impact on total employment growth when not controlling for output -cfr columns (1) and (7). Second, when looking at skill composition, we find that the positive coefficients on goods offshoring are confirmed for low skilled workers - cfr column (3) and (9). However, we find that the positive impact of goods offshoring on employees with high education is driven by imports from OECD countries in the manufacturing industry- cfr columns (5). This result is probably due to the fact that the imports from Western economies are more complementary to the skills of this group of workers. Third, as above, the coefficients on SO^s are lower than those pertinent to ΔSO^s, thus confirming that the positive effect decrease over time. Coefficients are also substantially lower when including controls for output. Finally, columns (11) and (12) show that the negative effect of services offshoring on higher-educated workers in the services sector is driven by trading with OECD countries. This is not surprising given that the vast majority of trade in services is with developed countries. This result complements the findings of previous studies, in which trading from low-wage countries–China in particular, was found to be the main culprit for the loss of blue-collar jobs in the manufacturing industries.

Table 11: Employment growth and offshoring; goods and services separately; OECD versus non-OECD

	Manufacturing						Services					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Total		Low Skilled		High Skilled		Total		Low Skilled		High Skilled	
	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
SO^g_{it-1} OECD	0.910***	0.363***	0.550***	0.218**	0.206***	0.101**	1.551***	0.489**	0.661***	0.039	0.463**	0.236
	(0.11)	(0.13)	(0.10)	(0.09)	(0.06)	(0.05)	(0.36)	(0.25)	(0.22)	(0.20)	(0.20)	(0.17)
ΔSO^g_{it} OECD	1.797***	0.798***	1.154***	0.449***	0.383***	0.187*	1.905***	0.339	0.644***	-0.110	0.873***	0.373**
	(0.17)	(0.18)	(0.14)	(0.15)	(0.10)	(0.10)	(0.41)	(0.32)	(0.19)	(0.23)	(0.22)	(0.17)
SO^g_{it-1} non-OECD	0.654***	-0.276	0.691***	-0.125	0.176	-0.038	3.930***	2.340***	2.449***	1.264**	1.414***	0.848*
	(0.24)	(0.22)	(0.18)	(0.21)	(0.13)	(0.15)	(0.91)	(0.72)	(0.65)	(0.51)	(0.51)	(0.51)
ΔSO^g_{it} non-OECD	1.442***	0.595***	1.292***	0.661***	0.135	-0.078	7.038***	3.546***	4.938***	2.392***	1.151*	0.550
	(0.40)	(0.22)	(0.30)	(0.22)	(0.10)	(0.10)	(1.63)	(1.14)	(0.88)	(0.88)	(0.66)	(0.79)
SO^s_{it-1} OECD	0.251	-0.068	0.084	-0.294	0.358**	0.274*	-0.004	-0.227	0.106	0.031	-0.148*	-0.264***
	(0.38)	(0.32)	(0.23)	(0.34)	(0.17)	(0.16)	(0.20)	(0.15)	(0.12)	(0.12)	(0.09)	(0.07)
ΔSO^s_{it} OECD	0.420	-0.157	-0.178	-0.649***	0.522***	0.388**	0.220	-0.335***	0.088	-0.173***	0.055	-0.122
	(0.38)	(0.24)	(0.26)	(0.24)	(0.17)	(0.19)	(0.15)	(0.12)	(0.09)	(0.07)	(0.09)	(0.08)
SO^s_{it-1} non-OECD	-1.913	0.392	0.875	5.875	-3.697**	-2.877*	4.633***	0.158	3.549***	0.965	1.378*	-0.430
	(4.18)	(3.37)	(2.32)	(8.97)	(1.84)	(1.58)	(1.56)	(1.31)	(1.09)	(0.95)	(0.77)	(0.67)
ΔSO^s_{it} non-OECD	0.239	3.023	3.414	11.579	-2.715*	-1.966	8.331***	1.877	4.825***	1.487	2.874**	0.061
	(3.35)	(3.76)	(2.50)	(17.80)	(1.64)	(1.43)	(1.63)	(0.87)	(1.22)	(1.13)	(1.07)	(1.45)
Control Output		X		X		X		X		X		X
Obs	24498	24498	24498	24498	24498	24498	20177	20177	20177	20177	20177	20177

[a] Standard errors clustered at firm and year level in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$

[b] Lag employment is included in all specifications. Capital intensity is included as control variable in the same way as the offshoring variables.

[c] All specifications include firm and industry×year fixed effects.

6 Conclusion

The impact of trade and globalisation on domestic labor markets has been the subject of a large debate within the academic arena and among the general public. While the focus has historically been on goods, services have recently attracted more and more interest as advances in information and communication technology have led to a remarkable increase in their tradability.

In this paper we use an original dataset with firm-level information on imports of both goods and services to produce fresh evidence on the impact of offshoring on the employment in manufacturing industries and services sector. We deal with the standard endogeneity problem of offshoring by constructing firm-level instrumental variables based on high-quality information on exchange rates and international trade flows in services and goods. Diagnostic tests presented in the empirical section suggest that our IVs are both highly correlated with offshoring and exogenous with respect to the possible demand and productivity shocks buried in the residual.

We find that employment growth of both workers with low and high education is positively related to goods offshoring in the manufacturing sector. Our empirical specification allows us to uncover a substantial reduction in this positive impact over time, with a coefficient on lagged offshoring often halved compared to the (short-run) effect in period t. Moreover, we find that this positive relationship is also substantially reduced when controlling for scale effects. Our estimates when using output and output per worker as dependent variables confirm that that part of the positive impact of offshoring on employment is due to output expansion driven by an increase in firms' efficiency.

For the services sector, our key finding is that there is a negative effect of service offshoring on the employment outcome of workers with higher education. To the best of our knowledge, this is the first large-scale study with detailed information on services offshoring that shows that globalisation may threaten the job security of higher-educated workers. The fact that service offshoring represents a small percentage of firms' turnover implies that its impact on

the employment of higher-educated workers is not large in the period we study. However, the nature of our findings is very important if we take into consideration that service offshoring has grown at a faster pace than goods offshoring in the last decade, a trend that may even increase given that ongoing trade negotiations are increasingly focused on facilitating market access in areas such as licensing, telecommunications, e-commerce and financial services.

Finally, our study presents fresh evidence on the existence of a large substitutability between offshoring and domestic inputs, substantially higher than the one between offshoring and labor An interesting venue for further research is to further explore the effects of firms' offshoring on competitors and on companies that are vertically related (suppliers and clients) to these firms.

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Appendices

A Data

Classification of Services

Table A.1 lists the types of services and the corresponding NACE code. The table further aggregates services into seven categories: Transport, Financial and Insurance, Construction, IT Business and Cultural Services.

Table A.1: International trade of services: Classification of services

Rub	EBOPS	Description of service in services trade database	NACE 1.1	EU KLEMS	Category
100	207	Transportation - Sea transport - Passenger	61	60t63	Transport
101	208	Transportation - Sea transport - Freight			
102	209	Transportation - Sea transport - Other			
110	211	Transportation - Air transport - Passenger	62	60t63	
111	212	Transportation - Air transport - Freight			
112	213	Transportation - Air transport - Other			
120	215	Transportation - Other transport - Passenger	60 + 63	60t63	
121	216	Transportation - Other transport - Freight			
122	217	Transportation - Other transport - Other			
130	260	Financial services	65t67	J	Financial/Insurance
131	260	Financial services			
142	246	Communication services - Postal and courier services	64	64	Communication
143	246	Communication services - Postal and courier services			
144	247	Communication services - Telecommunication services			
156	249	Construction Services	45	F	Construction
162	263	Computer and information services - Computer services	72	71t74	IT
163	264	Computer and information services - Information services			
180	271	Insurance services - Other direct insurance	65t67	J	Financial/Insurance
181	256	Insurance services - Life insurance and pension funding			
182	254	Insurance services - Freight insurance			
183	255	Insurance services - Reinsurance			
184	257	Insurance services - Auxiliary services			
190	258	Other business services - Research and development	73	71t74	Business services
191	274	Other business services - Miscellaneous business, professional and technical services - Legal, accounting, management, consulting and public relations	74	71t74	
193	280	Other business services - Miscellaneous business, professional and technical services - Architectural, engineering and other technical services			
194	278	Other business services - Miscellaneous business, professional and technical services - Advertising, market research, and public opinion polling			
195	283	Other business services - Miscellaneous business, professional and technical services - Agricutltural, mining and on-site processing services - Other			
196	282	Other business services - Miscellaneous business, professional and technical services - Agricutltural, mining and on-site processing services -Waste treatment and depollution			
199	284	Other business services - Miscellaneous business, professional and technical services - Other			
231	288	Personal, cultural and recreational services: Audiovisual and related services	92	O	Cultural
239	289	Personal, cultural and recreational services: Other personal, cultural and recreational activities			
247		DROPPED from data, does not exist in classification	-		
270	272	Other business services - Operational leasing services	71	71t74	Business services

[a] Column "Rub" lists the services codes appearing in the Belgian data. The column "EBOPS" lists the corresponding (international) EBOPS code for that service. The column "NACE Rev 1.1" lists the corresponding NACE sector for each service, while the column "EU KLEMS" assigns a NACE sector code that features in the EU KLEMS data (sometimes these sectors are more aggregated than the original NACE codes. The final column "Service category" shows the groupings applied in the data. We consider these services categories separately in the data. All services except "Transport" are "producer services", we have already excluded e.g. travel services from the data prior to assigning service categories.

Education

Our data reports the inflow and outflow of employees (but not their total stock) by education level. The employees are divided into 4 categories: (1) primary education or lower; (2) secondary education; (3) higher education, non-university; and (4) university education. We collapse these four categories into two education levels: low education (categories 1 and 2) and high education (categories 3 and 4). To gain insight into the relative importance of workers with low (L) and high (H) education in the manufacturing and services sector, we compute the share of group j=L, H in the total gross flow of employees as $Share^j = \frac{Inflow^j + Outflow^j}{\sum_{j=L,H}(Inflow^j + Outflow^j)}$, and we find that employees with high education account for 40% of total gross flows in the services sector, compared to a much lower 20% in the manufacturing sector.

To compute the growth rate of employment by education level for each firm i, we use the following procedure. First, we use the observed net flow of employment $\Delta N^j_{it} = Inflow^j_{it} - Outflow^j_{it}$ by education to compute the corresponding net flows in total employment, $\Delta N_{it} = \sum_{j=L,H} \Delta N^j_{it}$. Second, we compute the difference between ΔN_{it} and the change in total average number of employees ΔE_{it},[33] and we add this difference to the net flows of low-education or high-education workers proportionally to their share in the sum of the absolute values of these net flows. For example, suppose that ΔE is equal to 1, ΔN^L equal to -4 and ΔN^H equal to 2, resulting in ΔN being equal to -2. The difference between ΔE and ΔN is, thus, equal to 3. The share of low-(high-) skilled workers in the total flow is $\frac{4}{4+2} = \frac{2}{3}$ (respectively, $\frac{1}{3}$). The adjusted flows are then $\Delta \widehat{N}^L = -4 + \frac{2}{3}3 = -2$ and $\Delta \widehat{N}^H = 2 + \frac{1}{3}3 = 3$. One important advantage of this approach is that the adjusted net flows of employment for each education group $\Delta \widehat{N}^j_{it}$ sum up to the total change in average employment $\Delta E_{it} = \sum_{j=L,H} \Delta \widehat{N}^j_{it}$. Finally, we use the resulting adjusted flows $\Delta \widehat{N}^j_{it}$ in each education group to compute the growth rate of employment by education levels as $\Delta e^j_{it} = \frac{\Delta \widehat{N}^j_{it}}{0.5(E_{it-1}+E_{it})}$.[34]

B Summaries Evolution Trade in Goods and Services

This section presents some summary statistics on trade in goods and services, constructed from our database.

Figure B.1 shows the evolution of trade in goods and trade in services in nominal values.

Figure B.2 displays the average offshoring intensity by sector. Offshoring intensity is computed as the ratio of offshoring over total intermediate inputs (both services and goods). Offshoring of goods and of services are shown in light-grey and dark-grey, respectively.

Table B.1 displays services imports and exports for the years 1995 and 2005. The total

[33] The difference between ΔN and ΔE is due to the fact that ΔN refers to the difference between employment at the end of year t and employment at the end of year $t-1$, while ΔE refers to the change in average employment during the year, which is a more accurate measure of labor.

[34] Following the notation just introduced, in the rest of the paper, we use Δx to indicate the percentage change (i.e. growth rate) of variables X and ΔX to indicate the difference between the levels of X over two consecutive years.

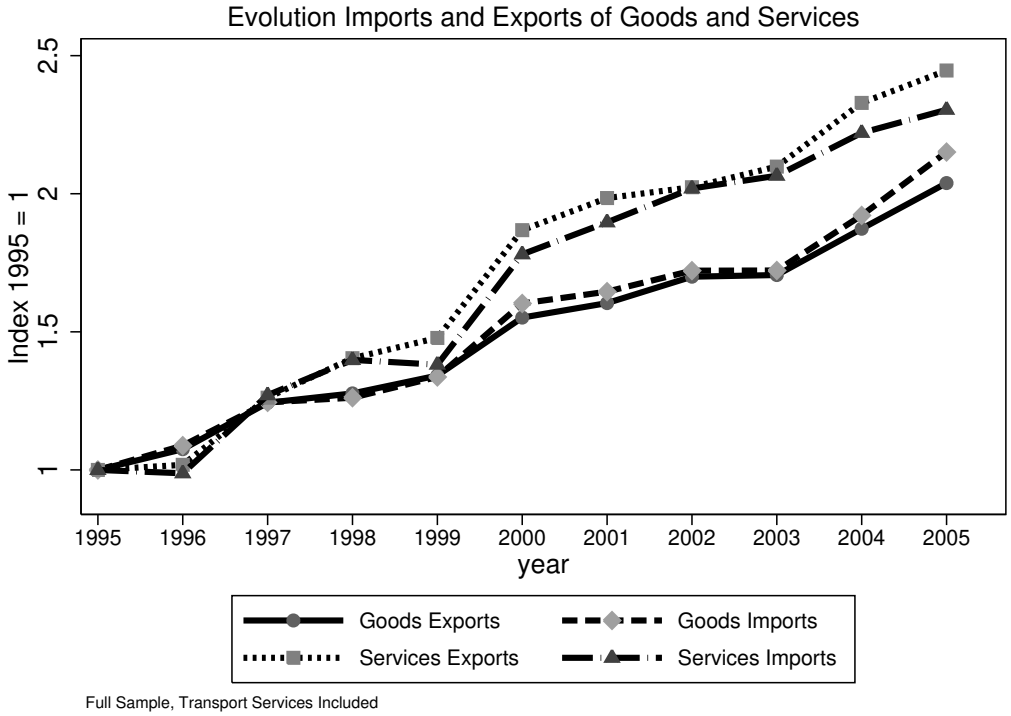

Figure B.1: Evolution Trade in Goods and Services

value of service imports surged from 8.5 billion euros in 1995 to 20 billion euros in 2005, an increase of over 130%. Service exports increased by 145%, from 10 billion euros to 24 billion euros. Transport services are the largest category, followed by Business Services and Financial Services. The rankings of the different service types are similar for imports and exports, consistent with models of intra-industry trade and product differentiation. Growth in Transport Services follows the trend in goods trade more closely and decreases in relative importance over the sample period. International trade in Business, ICT and Communication Services boomed particularly between 1995 and 2005. The last row in Table B.1 displays total imports and exports of goods in 1995 and 2005. While the increase in Service Trade was more pronounced over the period, the value of total trade in services was only 10% of the value of total trade in goods in 2005.

Table B.1: International Trade in Goods and Services, 1995-2005

	Imports					Exports				
	1995		2005		Change	1995		2005		Change
	Value	Share	Value	Share	95-05	Value	Share	Value	Share	95-05
Transport Services	4,628	53.4%	8,802	44.1%	+90.2%	5,639	56.5%	9,922	40.7%	+75.9%
Business Services	1,604	18.5%	5,692	28.5%	+254.8%	1,645	16.5%	6,214	25.5%	+277.8%
Financial/Insurance Services	1,112	12.8%	1,929	9.7%	+73.4%	1,122	11.2%	2,800	11.5%	+149.5%
Construction Services	442	5.1%	636	3.2%	+43.8%	410	4.1%	1,439	5.9%	+251.3%
IT Services	398	4.6%	1,476	7.4%	+271.2%	656	6.6%	1,975	8.1%	+201.0%
Communication Services	238	2.7%	1,048	5.3%	+340.8%	418	4.2%	1,644	6.7%	+293.3%
Cultural Services	237	2.7%	370	1.9%	+55.7%	86	0.9%	411	1.7%	+376.2%
Total Trade in Serices	8,659	100.0%	19,952	100%	+130.4%	9,977	100.0%	24,406	100.0%	+144.6%
Trade in Goods	99,740		214,540		+115.0%	110,352		224,976		+103.9%

Values in Million Euros. Full sample from international trade in services and international trade in goods databases.

Figure B.2: Offshoring per Sector

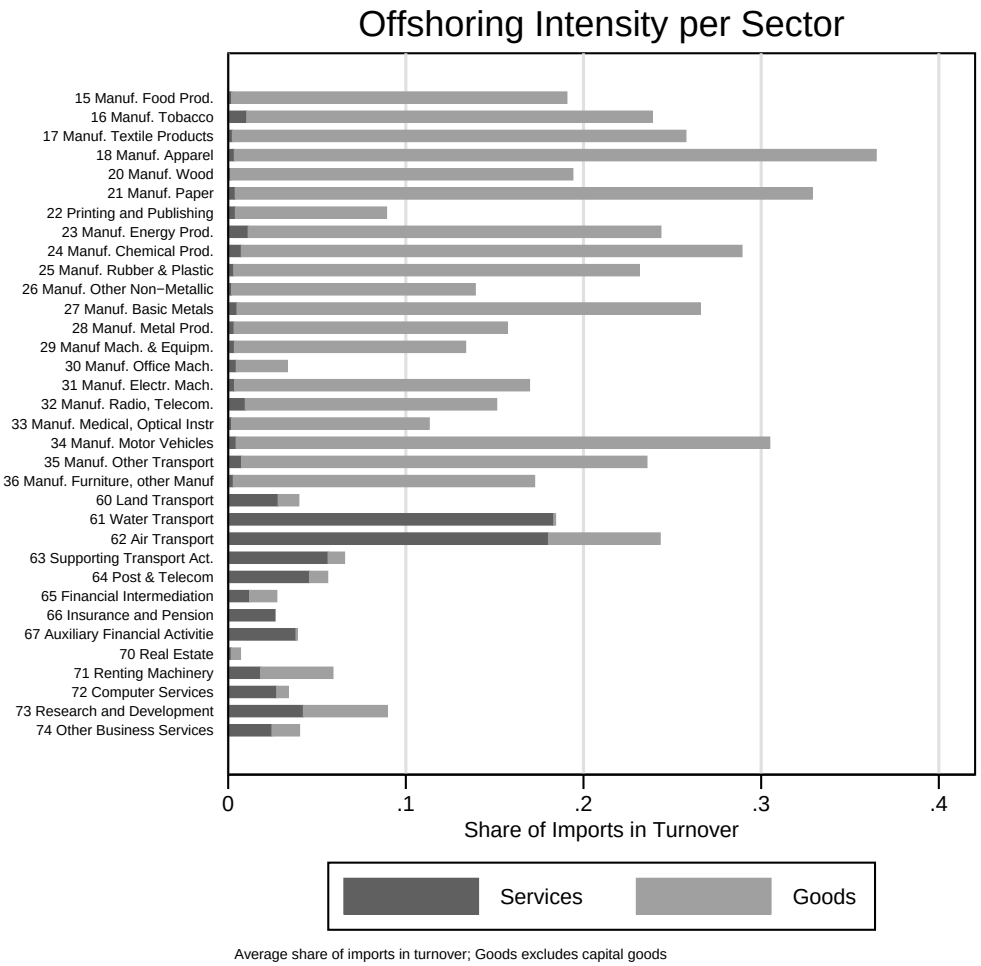

Table B.2 makes a comparison between the top destination countries/countries of origin for exports and imports of goods versus services. Trade in goods is dominated by trade with the three neighbouring countries (The Netherlands, Germany and France), accounting for over 40% of total trade in goods. For trade in services, the United Kingdom tops the ranking of the countries of destination/origin and the US ranks second for exports. This is consistent with the findings of Breinlich and Criscuolo (2011) that the US and the UK are more important trading partners for services than for goods trade.

C First Stage Regressions

Table C.1 displays the results of the first stage regression for the four endogenous variables pertinent to specification (3) and specification (7) of Table 3. As explained in Section 4.2, the instruments consist of the lag level and growth of the World Export Supply of goods (WES^g) and services (WES^s) as well as the exchange rates weighted by imported products ($Exch^g$) and by imported services ($Exch^s$). A number of findings emerge from these tables.

Table B.2: Countries of Origin/Destination and Trade in Services/Goods

Services					
Imports			Exports		
Top Countries	Value	Share	Top Countries	Value	Share
United Kingdom	3,226	16.2%	United Kingdom	4,260	17.5%
France	2,502	12.5%	USA	4,147	17.0%
The Netherlands	2,479	12.4%	The Netherlands	3,600	14.7%
USA	2,311	11.6%	France	2,888	11.8%
Germany	2,212	11.1%	Germany	2,706	11.1%
Italy	870	4.4%	Luxembourg	1,136	4.7%
Switzerland	726	3.6%	Switzerland	730	3.0%
Spain	574	2.9%	Sweden	487	2.0%
Luxembourg	522	2.6%	Italy	455	1.9%
Hong Kong	403	2.0%	Spain	351	1.4%
Goods					
Imports			Exports		
Top Countries	Value	Share	Top Countries	Value	Share
The Netherlands	51,272	20.5%	Germany	42,383	16.1%
Germany	35,918	14.3%	France	40,669	15.5%
France	27,457	11.0%	The Netherlands	32,798	12.5%
USA	14,362	5.7%	United Kingdom	19,186	7.3%
United Kingdom	14,356	5.7%	USA	15,599	5.9%
Ireland	14,254	5.7%	Italy	12,107	4.6%
China	8,035	3.2%	Spain	8,313	3.2%
Italy	6,987	2.8%	India	6,661	2.5%
Japan	5,942	2.4%	Luxembourg	4,973	1.8%
Russia	5,935	2.4%	Poland	4,479	1.7%

Values in Million Euros. Services data are from 2005. Goods data are from 2010

First, the Angrist and Pischke (2009) F-test of weak and underidentification show that these instruments are highly correlated with our endogenous variables. Second, in most of the regressions, the lagged levels (respectively, change) of the instruments are highly correlated with the lagged levels (change) of the offshoring variables. In particular, the coefficients on WES^g_{it-1} and WES^s_{it-1} are positive and statistically significant in the regressions for respectively, lagged shares of good offshoring - cfr. columns (1) and (5) - and lagged shares of service offshoring - columns (3) and (7). Similar findings apply the the variables ΔWES^g_{it-1} in column (2) (but not in column 6) and ΔWES^s_{it-1} in columns (4) and (8). Third, the coefficients on $Exch^s_{it-1}$ and $\Delta Exch^s_{it}$ are positive and statistically significant in the regressions on respectively, lagged service offshoring - cfr. columns (3) and (7) - and change in service offshoring - cfr. columns (4) and (8). This confirms that, at least for services, there is a positive relationship between offshoring and the devaluation of the currency of foreign partners of Belgian firms. Finally, we conclude by noting that we have also used alternative set of instruments, in particular wage and inflation of exporting countries and we find that

diagnostics test for the first-stage regression are easily passed and that the second-stage IV results are extremely robust.

Table C.1: First-Stage Regressions

	Manufacturing				Services			
	(1) SO^g_{it-1}	(2) ΔSO^g_{it}	(3) SO^s_{it-1}	(4) ΔSO^s_{it}	(5) SO^g_{it-1}	(6) ΔSO^g_{it}	(7) SO^s_{it-1}	(8) ΔSO^s_{it}
WES^g_{it-1}	0.00370*	0.000200	0.000102	-0.00000682	0.00188*	-0.000242	-0.000377	0.000418
	(0.00119)	(0.000291)	(0.000157)	(0.0000698)	(0.000592)	(0.000218)	(0.000490)	(0.000411)
ΔWES^g_{it}	0.00117	0.00166*	0.000183	-0.0000512	0.000855*	0.000108	-0.000273	0.000148
	(0.000893)	(0.000570)	(0.000127)	(0.000105)	(0.000257)	(0.000188)	(0.000326)	(0.000323)
$Exch^g_{it-1}$	0.0343*	-0.0155**	-0.000849	0.00102	0.00573	-0.000173	0.00703	-0.00642
	(0.0130)	(0.00380)	(0.00200)	(0.000772)	(0.00502)	(0.00222)	(0.00580)	(0.00495)
$\Delta Exch^g_{it}$	0.0129	-0.000223	-0.00248	0.000893	0.000543	0.00456*	0.00401	-0.00148
	(0.00839)	(0.00588)	(0.00142)	(0.00125)	(0.00204)	(0.00183)	(0.00342)	(0.00384)
WES^s_{it-1}	0.000543	-0.000346	0.000462*	0.000128	0.000769	-0.000201*	0.00197*	-0.0000744
	(0.000607)	(0.000403)	(0.000177)	(0.000128)	(0.000342)	(0.0000675)	(0.000662)	(0.000309)
ΔWES^s_{it}	0.000553	-0.000152	0.0000856	0.000323*	0.000116	0.000197	-0.0000228	0.00139**
	(0.000391)	(0.000365)	(0.000127)	(0.000111)	(0.000244)	(0.000103)	(0.000302)	(0.000297)
$Exch^s_{it-1}$	0.000888	0.00638	0.00846***	-0.000936	-0.00458	0.00161	0.0293***	0.000756
	(0.00537)	(0.00399)	(0.00154)	(0.000819)	(0.00275)	(0.00116)	(0.00579)	(0.00339)
$\Delta Exch^s_{it}$	-0.00239	0.00443	0.000993	0.00496***	0.00164	-0.00245	0.00740*	0.0127***
	(0.00356)	(0.00271)	(0.000807)	(0.000547)	(0.00232)	(0.00143)	(0.00268)	(0.00235)
l_{it-1}	0.0187**	-0.000599	-0.000563	0.000604	0.00103	-0.000419	0.00108	0.000133
	(0.00488)	(0.00222)	(0.000472)	(0.000352)	(0.00138)	(0.000613)	(0.00178)	(0.000921)
$ln\left(K/L\right))_{it-1}$	0.00437	0.00131	0.0000237	-0.0000270	0.00186*	-0.000500	-0.000550	0.000149
	(0.00225)	(0.000834)	(0.000314)	(0.000216)	(0.000721)	(0.000420)	(0.000937)	(0.000422)
$\Delta ln\left(K/L\right))_{it}$	0.000779	0.00340**	0.000306	-0.000121	-0.0000747	0.000841*	0.00000963	0.0000470
	(0.00159)	(0.000993)	(0.000223)	(0.000213)	(0.000591)	(0.000330)	(0.000906)	(0.000517)
Obs.	24489	24489	24489	24489	20161	20161	20161	20161
AP F-Stat (p-val)	23.5 (.000)	23.4 (.000)	48.9 (.000)	34.5 (.000)	15.3 (.001)	49.7 (.000)	63.1 (.000)	41.1 (.000)
Hansen $p-val$	0.674				0.398			

[a] Standard errors clustered at firm and year level in parentheses. $*p < 0.05, **p < 0.01, ***p < 0.001$

[b] AP F-test refers to the Angrist and Pischke (2009) test of weak and underidentification.

[c] All specifications include firm and industry×year fixed effects.