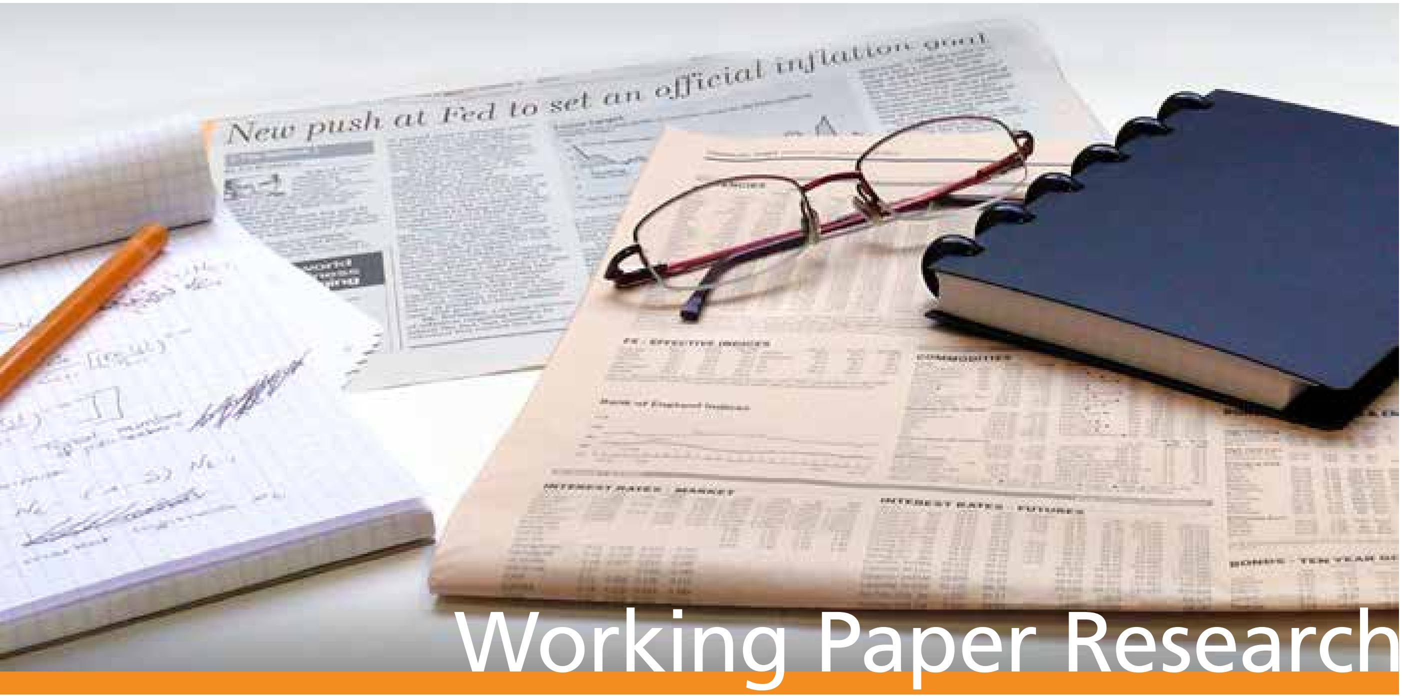
One way to the top: How services boost the demand for goods



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Abstract

In this paper, we take advantage of a uniquely detailed dataset on firm-level exports of both goods and services to show that demand complementarities between services and goods enable firms to boost their manufacturing exports by also providing services. The positive causal effect of services accounts for up to 25% of the manufacturing exports of bi-exporters (i.e. the firms that export both goods and services), and 12% of overall goods exports from Belgium. We find that by associating services with their goods, bi-exporters increase both the quantities and the prices of their goods. To rationalize these findings, we develop a new model of oligopolistic competition featuring one-way complementarity between goods and services, product differentiation, and love for variety. By supplying services with their goods, firms increase their market share, and hence their market power and markup. The model then shows that exporting services acts as a demand shifter for firms, increasing the perceived quality of their products. Going back to the data, we find strong confirmation for this mechanism.

JEL codes: F10, F14, L80.

Keys words: Demand complementarities; Goods & services; Firm-level exports; Quality.

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1 Introduction

Economists and policymakers generally consider goods and services as two distinct sectors subject to their own market adjustments, calling for specific policies. Yet, this is at odds with what we observe for many big firms. Examples include: Apple selling software and assistance with the utilization of its computers and cell phones, Toyota providing both cars and loans to consumers buying these cars, Technip supplying fertilizers as well as technical and financial solutions related to their utilization.

In this paper, we challenge the view that goods and services are two independent items in the consumer portfolio supplied by firms in separate industries. Thanks to a unique dataset recording both goods and services exports at the firm-destination level, we show both empirically and theoretically that the provision of services allows firms to boost their goods sales. The effect is quantitatively important. Based on our regression results, it appears that up to 12% of overall Belgian manufacturing exports and up to 25% of the manufacturing exports of those firms that export both goods and services (called hereafter "bi-exporters") are triggered by the provision of services. The increase in sales is the combination of a price and a quantity effect: when they provide services together with their goods, bi-exporters set a higher price for their goods and still sell higher quantities. Note that this is the price of the good alone: the service is subject to a transaction in its own right in the data; therefore, services act as a demand shifter for the goods. In order to theoretically endogenize this mechanism, we provide a new model that features one-way complementarity between goods and services, love for variety, and oligopolistic competition. These results have important implications. First, they suggest that the frontier between manufacturing and services is blurred. This should affect the way we think of structural change: the expansion of the service sector is not necessarily at the expense of manufacturing. Second, they question the way we should define the relevant markets for competition policy and the design and negotiation of trade agreements. Finally, our mechanism is more general than the goods-service case and can be applied to any firm's output that exhibits the same one-way complementarity. One easy example is represented by the relationship between the iPad and the iPad cover. The identification and analysis of the one-way complementarity between all the possible pairs of products are beyond the scope of this paper, but they represent interesting research avenues that we leave for future work.

The paper is organized into three main blocks. In the first one, we use detailed trade data from the National Bank of Belgium (NBB henceforth) to provide several stylized facts on bi-exporters. We show that firms that export both goods and services represent only 10% of goods exporters, but they account for about 50% of overall goods exports and 35% of services exports. They outperform the other firms in all dimensions: they are larger in terms of sales, employees, product and destination scope; and they are more productive and more often multinationals. Moreover, these firms almost never export services alone, and they export services in only 26% of the destinations where they export goods. When present, services represent only a fraction of the goods export flow. The last two elements reveal an asymmetry in the relationship between goods and services within the same firm, the good being the essential activity. Finally, comparing firm-product-destination export flows that are associated with services to those that are not, we find that services provision is correlated with higher manufacturing sales; this premium holds when we control for both firm-product-year and destination-product-year fixed effects, and for a number of other observable characteristics.

In a second step, we seek an unbiased estimate of the effect of services provision on firm-level goods export performance. Indeed, despite the presence of multiple controls and fixed effects, it could still be the case that unobserved firm-country specific factors could explain both why firms export services in a given destination and also sell large quantities of their goods. We thus rely on an IV strategy proposed by Wooldridge (2002) for the case of endogenous dummy variables. Our excluded variable is constructed as the interaction between a "bundleability" index that measures how much the products in the firm's portfolio can be associated with services, with a proxy for the easiness of trade in services to a given destination. Considering that our excluded variable is a combination of a product-specific technical parameter and a proxy for country-specific conditions for services trade, we can reasonably argue that it is not directly correlated with the unobserved supply and demand shocks that are specific to a firm and a destination. Using this strategy, we confirm the causal positive effect of services provision on firm-level goods export performance in a destination, and we show that this effect is a combination of a price (unit value) and a quantity effect.

These findings show that a service is not just an additional output that broadens a firm's product scope: it raises the price and the quantity of the goods with which it is exported. To rationalize these facts, in the third block we develop a new model of oligopolistic competition in markets where goods and services are one-way essential complements. This means that the service itself does not raise the utility of the consumer unless it is associated with a good. In this way, the product is essential while the service is optional. A firm in our model can be seen as a two-product firm whose core product is the good alone while its peripheral product is a good-service bundle. In an environment featuring a taste for variety (or equivalently a variety of tastes), supplying the bundle naturally raises the demand for the good. This translates into a larger market share, and thus higher markups over the marginal cost of production of the good accounting for the price premium of bi-exporters. We also consider direct extensions of standard models of multi-product firms under monopolistic competition or oligopoly with and without cost linkages and show that they cannot rationalize simply these patterns. In other words, both the assumptions of oligopolistic competition and asymmetric demand complementarities are key to replicate the patterns we observe in the data.

Intuitively, by raising both the demand and the price of the goods, services provision acts as a demand shifter for the goods; or put differently, services increase the perceived quality of the good. Our model puts some structure on this intuition by generating a firm-product-destination demand shifter similar to that in Khandelwal et al. (2013): all else equal, the perceived quality of a good exported should be larger for bi-exporters. This is indeed what we find in the data: a one standard deviation increase in the probability of providing services increases the firm-product-destination index of perceived quality by 20% of a standard deviation.

Our paper contributes to several strands of the literature. First, with the increasing availability of detailed firm-level data, the theoretical and empirical literature on the sources of firm success has thrived over the past twenty years. Limiting the scope to the international trade literature, two main determinants have been emphasized: productivity (e.g. Bernard and Jensen, 1999; Melitz, 2003) and quality (e.g. Johnson, 2012; Crozet et al., 2012). How these differences then translate into heterogeneous markups has also been discussed in some contributions (e.g. Melitz and Ottaviano, 2008; Loecker and Warzynski, 2012). Hottman et al. (2016) develop a model of multi-product firms that encompasses all these aspects, and structurally estimate the relative contributions of these various determinants of firm performance. They find that appeal/quality of products and product scope account for 80% of the observed variation in overall sales of US firms. In their model, the products supplied by a firm are imperfect substitutes. In our model, productivity, product appeal, and markups are related through the combination of one-way complementarity between goods and services, imperfect substitutability between the good alone and the good provided with the service, and consumers' love for variety. By providing services with their goods, more productive firms increase the demand for their good and can, in turn, increase their markup, which leads to improving the perceived quality of their products.

Second, replicating the price/markup up effect we find in the data is difficult to reconcile with monopolistic competition. Considering instead an oligopolistic market structure is motivated by the fact that, in our data, bi-exporters are found among the largest Belgian exporters. In this respect, our paper echoes recent empirical and theoretical works that show that the largest firms in the economy significantly deviate from perfectly or monopolistically competitive firms in many dimensions. Exchange rate pass-through (Berman et al., 2012; Amiti et al., 2014), price interactions between firms (Amiti et al., 2016), and adjustment to trade liberalization (Edmond et al., 2015) are some examples where allowing for strategic behavior of firms is important to account for the patterns observed in the data. Several recent contributions plead to go further in this direction (Bernard et al., 2016; Neary, 2016; Head and Spencer, 2017). We contribute to this literature by showing both empirically and theoretically how the range of activities of a firm impacts its market share and pricing behaviour.

The literature on multi-product exporters analyzes the choice of firms to provide multiple products (e.g. Eckel and Neary, 2010; Bernard et al., 2011; Dhingra, 2013; Nocke and Yeaple, 2014; Mayer et al., 2014; Hottman et al., 2016). In multi-product firm models under monopolistic competition, it is assumed that the behavior of a firm is isomorphic to the behavior of a set of single-product firms with different productivities; therefore, the firms decision to add/drop one product in a given market has no impact on its other products. By contrast, models of oligopoly emphasize demand linkages within the firm; however, when products are imperfect substitutes, adding a product tends to *decrease* the output of other products. Our model features large firms competing strategically when the demand features one-way complementarity between goods and services. This mechanism is also in line with Bernard et al. (2017a) who show that the size of firm-level product scope allows firms to raise their price conditional on the quantity sold. Our theory can be seen as one of the ways to micro-found demand-scope complementarities behind the "carry along" trade phenomenon they emphasize, i.e. the observation that firms supply and export goods that they do not directly produce.[1]

Finally, our paper relates to the literature analyzing the structural transformation of the economy and the increasing participation of manufacturing firms in services ac-

[1]Eckel and Riezman (2016) study further implications of "carry along" trade.

tivities. This phenomenon is often viewed as a substitution process: firms progressively give up producing goods to increasingly specialize in services. This is the consequence of trade in goods liberalization (Breinlich et al., 2014; Pierce and Schott, 2016), firm specialization (Bernard and Fort, 2015; Bernard et al., 2017b) or offshoring (Berlingieri, 2014). Our paper provides a different perspective by showing that the production and exports of goods and services can be complementary. Consistent with our results, Crozet and Milet (2017) show that French firms in the manufacturing sector that start selling services increase their profitability and total sales of goods. Using Belgian data on overall sales, Blanchard et al. (2017) show that the probability to provide both goods and services is a non-linear function of firm-level productivity. Focusing on imports, Ariu et al. (2017) estimate a general equilibrium model in which goods and services are imported intermediate inputs that may generate synergies within the firm. These papers remain silent on the various mechanisms underlying the complementarity between goods and services and their consequences for producers' behavior. We empirically document this complementarity using export data, quantify the boosting effect of services on international goods sales, disentangle the different channels and rationalize them in an original micro-founded model able to replicate our empirical findings.

The rest of the paper is organized as follows. We describe the data and outline several stylized facts on bi-exporters in section 2. Based on this evidence, we seek a causal relationship between the service provision and the export performance in section 3. To provide a theoretical basis for our empirical results, we develop in section 4 an imperfect competition model featuring both consumers' love for variety and one-way complementarity between goods and services. Section 5 discusses alternative explanations for our results, and, finally, section 6 concludes.

2 Data description and stylized facts

2.1 Data

The data used in this paper comes from three different datasets provided by the National Bank of Belgium. They contain information on trade in goods (NBB Trade in Goods dataset), trade in services (NBB Trade in Services dataset) and firms' balance-sheets (NBB Business Registers) from 1997 to 2005.

Information on trade in goods is organized at the firm-product-destination-year level, and we have information on the exported values and quantities. Firms are identified by their VAT number and products are classified following the 6-digit Harmonized System Nomenclature (HS6). We restrict our analysis to transactions involving a change in ownership and we discard those referring to movements of stocks, replacement or repair of goods, processing of goods, returns, and transactions without compensation. Declaration thresholds are applied to collect this data. In particular, firms have to declare to the NBB any transaction directed to extra-EU countries exceeding 1,000 Euros, and this threshold has remained stable over time. For flows directed to EU countries instead, firms have to declare their transactions if their total exports in the European Union are above 250,000 Euros in the previous year (this threshold was equal to 104,115 Euros in 1997).

Data on services exports are collected by the NBB to compile the balance of payments. For the period we consider, the biggest firms had to declare directly to the NBB any service transaction with a foreign firm exceeding 12,500 Euros (9,000 Euros from 1997 to 2001); Belgian firms had to declare the export destination, the type of service, and the value of the transaction. For all other firms, the bank involved in the transaction was legally bounded to record the same information and send it to the NBB. As compared to data from other countries, which are generally survey-based, the peculiarity of the Belgian collection system is that it provides a quasi-exhaustive picture of firms, services, and destinations involved in services trade up to 2005.[2] The dataset is organized at the firm-service-destination-year level, firms are identified by their VAT number, and services are classified following the usual Balance of Payments codes. We drop from the original data all the transactions referring to *"Merchanting"* and *"Services between Related Enterprises"* because the first also includes the values of the goods involved and the second does not indicate which service is traded within the firm and is possibly contaminated by transfer pricing issues.[3]

Quite uniquely, we are able to put together information on goods and services exports thanks to the common VAT and destination identifiers. We thus construct a dataset at the firm-product-destination-year level, which gathers information on exported values and quantities for goods (and thus on unit values, which we also refer to as prices in the paper), and on the presence of services exports in the destination. The exhaustiveness of the trade in services dataset is a great advantage here since it allows us to correctly identify the "bi-exporters", i.e. the goods exporters that also export services in a given destination. As the purpose of the paper is to compare firms that export only goods to firms that export both goods and services, we do not keep firms that export only services in our final sample, but we use them for some of our descriptive statistics. Note also that our data is not transaction-level data so that we cannot ascertain that both goods and services are sold to the same buyer in a given market. Moreover, whenever a firm exports more than one product in a market, the information on the services exports is attached to every product. Finally, it is not possible to account for the fact that services and goods might not be delivered at the same time; therefore, there might be some noise in the measurement of bi-exporting. If anything, this should induce an attenuation bias in the estimation of the effect of services provision on firm-level goods export performance.

We complete the resulting dataset with firms' balance-sheet information. We get from the Business Registers (which cover the population of firms required to file their unconsolidated accounts to the NBB) the firm-level turnover, value-added, number of employees, as well as the industry code of the firm (at the NACE 2-digit level).[4] We also use information on the presence of foreign affiliates abroad and on foreign

[2]After 2005 the collection system has become survey-based; therefore, it is not possible to extend our analysis to more recent years. Refer to Ariu (2016) for more information about the change in the collection system.

[3]The data comprises modes one, two and four of trade in services defined in the General Agreement on Trade in Services (GATS). However, since firms do not declare the transaction mode, there is no direct way to infer it.

[4]This information is not available for the smallest firms; since they account for a very small share of aggregate exports, we can safely say that this is a minor issue.

ownership status of the firm from the NBB FDI Survey.[5] In all of our estimations, we control by means of adequate dummies for the multinational nature of exporters and for the presence of affiliates or headquarter in the destination of exports. Moreover, in robustness checks, we show that our results hold when we discard flows directed to destinations where firms have foreign affiliates and/or parent firms. In this way, we ensure that all potential intra-firm trade flows are excluded from the analysis.

We drop wholesalers' exports (NACE codes 51 and 52), because they act as intermediaries while we want to focus on firms that produce most of the products they export. We finally perform a basic cleaning of the dataset. We drop observations with missing information on unit value or turnover per worker and exclude flows for which the unit value is below 0.01, or above 100 times, the median observed among Belgian exporters for each HS6 product-year. We end up with a dataset counting more than 2 million flows and nearly 10,000 firms per year. Table A-1 in the Appendix provides some basic descriptive statistics.

2.2 Stylized facts

In this subsection, we present some stylized facts on the bi-exporting phenomenon. We analyze its frequency and magnitude, the asymmetric relationship between goods and services for bi-exporting firms, and the performance of bi-exporters compared to standard goods exporters.

2.2.1 *Stylized fact 1:* bi-exporting is a rare activity, but it accounts for an important share of overall goods and services exports.

In our sample, we observe that during the 1997 to 2005 period, only 6.9% of firm-product-destination goods export flows are associated with firm-level services exports. In terms of the number of firms, bi-exporters represent only 10.3% of goods exporters. To provide a benchmark, we compare the number of bi-exporting firms with the number of firms that export more than one product (i.e. multi-product exporters). In our data, we observe that 68.1% of goods exporters provide more than one product in foreign markets; therefore, bi-exporting is a very rare activity across firms as compared to multi-product exporting.

Despite being a quite infrequent activity, bi-exporting represents a substantial share of the value of goods exports. Over the period, flows of goods associated with services represent 22.1% of overall goods exports and bi-exporters account for 47.6% of the value of overall goods exports. Almost half of the overall manufacturing exports in our

[5]To be included in this survey firms have to comply with at least one of the following requirements: i) have more than 5 million Euros of financial assets; ii) have more than 10 million Euros equity; iii) have more than 25 million Euros turnover; iv) report foreign participations in their annual accounts; v) publish information related to new investments abroad in the Belgian Official Journal. For outward FDI, the survey has information on all of the foreign affiliates in which the firm has more than 10% of the common shares with details about the country, sector (NACE 2-digit), and total turnover of the affiliate. For inward FDI, we have information on all of the foreign owners with more than 10% of the common shares with indication of the origin and sector of the investors and the percentage of equity in their hands.

Table 1: Composition of services exports (%)

	"Pure" service export flows		Bi-exporting flows	
	Overall value	# flows	Overall value	# flows
Transport	38.23%	28.49%	26.16%	16.92%
Travel	16.61%	7.24%	2.54%	4.95%
Communication	3.78%	2.78%	14.09%	6.54%
Construction	3.90%	5.02%	8.67%	9.34%
Insurance	2.09%	5.27%	0.13%	1.82%
Finance	7.49%	5.14%	2.39%	10.10%
Computer	5.15%	7.37%	13.32%	8.38%
Royalties	1.09%	1.37%	8.36%	3.47%
Business	20.23%	34.21%	23.77%	36.76%
Personal and Cultural	1.18%	2.86%	0.47%	1.52%
Government	0.24%	0.23%	0.10%	0.20%

sample is in the hands of 10.3% of firms exporting both goods and services in at least one destination. Note that the bi-exporters in our sample are also not negligible for aggregate services exports: bi-exporting flows represent 19% of overall services exports and bi-exporters account for 34% of overall services exports. Moreover, the composition of bi-exporters' services exports differs from the composition of "pure" services export flows, i.e. from firms that only export services. Table 1 shows that when firms sell goods together with their services, communication, construction, finance, computer, royalties, and business services account for a higher share of exported flows and/or exported values as compared to firm-level flows originating from firms selling services only. On the other hand, transport, travel, and insurance services are less represented. This shows that the services provided by bi-exporters do not just mirror the activities of "pure" service exporters: there is something specific in providing services together with goods.

Finally, if we look at the share of bi-exporting flows at the industry-level, aircraft and spacecraft (HS88), railway et al. (HS86), ores, slag and ash (HS26), fertilizers (HS31), and inorganic chemicals (HS28) are the industries in which we observe the highest share of trade flows associating services with goods. At the product-level, many goods from the transportation, chemical, and machinery/electrical industries exhibit above-average shares of bi-exporting flows.

2.2.2 *Stylized fact 2:* bi-exporters export services mostly along with goods.

We focus now on the relationship between services and goods within the firm. In terms of frequency, on average bi-exporters offer services alone in only 14.9% of the destinations they serve (median equal to 0), while they export goods alone in 59.5% of the destinations where they are present (median equal to 75.0%). This tells us that whenever bi-exporters offer services, they do so in destinations in which they also export goods. Goods, on the other hand, are frequently exported by bi-exporters in destinations where they do not provide services, which means that the relationship between goods and services is asymmetric within bi-exporters.

Focusing on bi-exporters that export goods to several destinations, we observe that bi-exporting occurs in only 26.3% of the destinations where they are present. Multi-product exporters, instead, sell more than one product in 46.3% of the destinations they serve;[6] hence, bi-exporting is much less frequent than multi-product exporting, not only across firms, but also within firms. Moreover, this highlights that there is some variation in the occurrence of bi-exporting within firms across destinations that can be exploited for identification.

In terms of export shares, when firms export both goods and services in a destination, services represent, on average, 38.1% of bi-exporters' overall exports in that destination. If we consider total exports of bi-exporters (across all destinations), services represent an average of 33.2% of overall firm-level foreign sales;[7] hence, goods remain, on average, the primary activity of bi-exporters.

2.2.3 *Stylized fact 3:* bi-exporting is associated with better goods export performance both across and within firms.

The fact that bi-exporters are few but account for a substantial share of exports suggests that bi-exporters are larger than the other goods exporters. To analyze this feature more in depth, we compare bi-exporters to multi-product and single-product exporters. We regress various firm-level performance indicators on dummies identifying bi-exporters and multi-product exporters, controlling for industry (NACE 2-digit)-year fixed effects. The reference category in this setting is represented by single-product exporters. Considering that 86.9% of bi-exporters are also multi-product exporters, the coefficient on the bi-exporter dummy should be interpreted as a premium on the top of the one accruing to multi-product firms. Table 2 shows that multi-product exporters outperform single-product exporters in all dimensions: they export more, have a wider portfolio in terms of products and destinations, they are larger in terms of employees and sales, more productive, and more likely to have affiliates abroad and to be foreign-owned firms. Newer to the literature, in all of these dimensions bi-exporters have an even larger premium as compared to multi-product firms. This additional premium is often substantial (see total exports, turnover, or turnover per employee); therefore, bi-exporters are superstars among the already exclusive club of multi-product exporting firms.

To go further in the assessment of the bi-exporters' success, we compare goods export flows associated with services to flows without services within the same product-destination-year by means of the following regression:

$$\text{Log Exp}_{fkdt} = \alpha_0 + \alpha_1 \text{Serv}_{fdt} + \alpha_2 \text{X}_{f(kd)t} + \lambda_{kdt} + \epsilon_{fkdt} \quad (1)$$

where Log Exp_{fkdt} indicates the (log) exported value of firm f for product k in

[6] When we compute the frequency of bi-exporting and multi-product exporting at the firm-product level, these shares rise to 39.4% and 91.1% respectively. This rise reflects the fact that not all the products in the export portfolio of a firm are sold together with services or with other goods. Taking this into account, bi-exporting still remains much rarer than multi-product exporting.

[7] The medians equal 27.5% and 10.7%, respectively.

Table 2: Bi-Exporters' Characteristics

	Ln Goods Exports	# of Destinations	# of Products	# of Employees	Ln Turnover	Ln Turnover per Employee	𝟙 Affiliates Abroad	𝟙 Foreign Owned
Bi-Exporter	1.900^a	0.637^a	0.513^a	1.316^a	1.519^a	0.203^a	0.046^a	0.031^a
	(0.024)	(0.011)	(0.010)	(0.018)	(0.018)	(0.011)	(0.002)	(0.002)
Multi-Product	3.166^a	1.185^a	1.676^a	0.740^a	1.011^a	0.270^a	0.012^a	0.008^a
	(0.017)	(0.005)	(0.004)	(0.011)	(0.011)	(0.007)	(0.001)	(0.001)
Observations	98,454	98,454	98,454	98,454	98,454	98,454	98,454	98,454
R-squared	0.497	0.448	0.575	0.264	0.260	0.198	0.032	0.030

Note: Robust standard errors in parentheses. All regressions include industry (NACE 2-digit)-year fixed effects. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

country d and year t. Among the explanatory variables, Serv_{fdt} is our main variable of interest: it is a dummy that is equal to 1 when firm f bi-exports, i.e. when it also exports services in destination d at time t. λ_{kdt} is a product-destination-year fixed effect, and the vector $\text{X}_{f(kd)t}$ contains firm-year, firm-destination-year, and firm-product-destination-year covariates. In particular, we control for the log number of products exported by firm f in destination d, the experience of firm f with product k in country d[8] and the log turnover per worker of firm f as a measure of the average productivity of the firm at time t. We also identify multinational firms thanks to a dummy, MNE_{ft}, as well as the destinations where they have foreign affiliates (AFF_{fdt}) and/or parent firms (PAR_{fdt}). Finally, we control for a dummy that equals 1 if the firm belongs to the service sector.

Results are presented in column (1) of Table 3. The dummy identifying bi-exporting flows (Serv_{fdt}) is positive and significant: all else equal, for a given product in a given destination market, bi-exporters sell on average 58% more than normal goods exporters (i.e. firms that only provide goods). Bi-exporters are, therefore, not just larger firms overall, but they also outperform normal goods exporters in terms of goods sales in the destinations where they provide services. Control variables have the expected sign: more productive, more experienced, and multinational firms sell more. On the contrary, firms that declare a service sector as their main activity sell less. This is consistent with the idea that their competitive advantage does not lie in manufacturing activities. Also, in this specification, the higher the number of products sold by a firm in a market, the lower its sales for a given good.

In column (2) of Table 3, we further control for firm-product-year fixed effects. In this way, we can wash away any firm-product-year determinant of export performance that is correlated with the provision of services, such as unobserved firm-product productivity. The estimation now amounts to a difference-in-difference where, for a given product and a given year, we compare in two different destinations firms that never export services with their product to firms that export services in one destination but not in the other. In this more demanding specification, bi-exporting is still associated with a premium in terms of goods export values. It is, however, considerably reduced and equal to nearly 27%. The lower premium in column (2) as compared to column (1) suggests that bi-exporters have unobserved characteristics that make them able to sell more of their product whatever the destination; but, even when controlling for these characteristics, they still outperform the "normal" goods exporters in the destinations

[8]We proxy experience with the log number of consecutive years of presence of firm f and product k in country d at time t. Since they are available, we also use trade data for years 1995 and 1996 to compute this proxy.

Table 3: Bi-exporting sales premium

Dep. Var.	**Log Exp**$_{fkdt}$	
	(1)	(2)
$\mathbb{1}$ Serv$_{fdt}$	0.582^a	0.268^a
	(0.025)	(0.020)
Log # Products$_{fdt}$	-0.475^a	0.706^a
	(0.005)	(0.006)
Log Turnover/L$_{ft}$	0.296^a	
	(0.006)	
Market Experience$_{fkdt}$	1.491^a	0.962^a
	(0.005)	(0.005)
$\mathbb{1}$ MNE$_{ft}$	0.464^a	
	(0.012)	
$\mathbb{1}$ AFF$_{fdt}$	0.392^a	0.294^a
	(0.026)	(0.023)
$\mathbb{1}$ PAR$_{fdt}$	0.150^a	0.202^a
	(0.034)	(0.032)
$\mathbb{1}$ Service Industry$_{ft}$	-0.398^a	
	(0.014)	
Product-Destination-Year FE	Yes	Yes
Firm-Product-Year FE	No	Yes
Observations	2,106,302	1,652,189
R-squared	0.482	0.801

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

where they bi-export. This positive correlation between firm-level sales of goods and services provision is suggestive of complementarities between the two types of activities. Regarding the other controls, the main change is observed for the number of products exported by a firm in a destination, for which the sign of the coefficient is now reversed. Once we control for firm-product-year fixed effects, it appears that a wider product scope in a given destination is associated with higher sales, on average, for each product. The reason why the across-firm specification offers a different picture is that a firm-level product portfolio is generally composed of one or a few "main" products and several "fringe" products; multi-product firms might not perform as well for these fringe products as compared to firms for which these products are the main activity. The within-firm specification controls for the product-specific ability of the firm and thus neutralizes this unobserved ability effect.

2.2.4 Further empirical regularities

We present here some additional exercises to qualify more extensively the firm-product-destination regularities just highlighted. First, we use a different specification with firm-product-destination and product-destination-year fixed effects. This strategy only relies on the time variations in the data, comparing the firms that switch status in terms of bi-exporting to firms that keep the same status over the entire period. In this more demanding specification, the sales premium remains positive and significant

(Table A-2 in the Appendix); however, identification here crucially depends on the exact moment in which firms sell the good and the service. For several services like technical assistance, maintenance or repair, the export timing of the two activities is not obviously coincident; still, we might observe both activities in the same year because they are provided to different consumers. We prefer not enter the question of the timing here and thus stick to the cross-sectional approach in the rest of the paper.

Second, we divide the service dummy into ten different types of services following the Balance of Payments nomenclature. We observe in Table A-3 in the Appendix that the relationship between the provision of services and firm-level sales of goods is positive and highly significant for Transport, Financial, Computer, and Business services.[9] These services comprise, in particular, firm-level loans for the purchase of their goods, the IT services related to the installation, and the exploitation of the communication systems, maintenance, repair, consultancy and assistance with the use of manufacturing goods. This heterogeneity is thus in line with the idea that the services that are correlated with higher sales for goods are indeed complementary to them.

Third, Table A-4 in the Appendix shows that the sales premium associated with the provision of services is much stronger for the core product than for the fringe products of the firm; hence, there is substantial heterogeneity in the positive correlation between goods sales and services provision across the products in the bi-exporters' product portfolio. That the correlation between goods sales and services provision is much stronger for the main product, suggests that the fringe products may be themselves complements of the core product (Bernard et al., 2017a; Eckel and Riezman, 2016).

3 Causal assessment and mechanism

So far, our results show that the provision of services is robustly associated with greater firm-level sales of goods in a destination. However, even if we control for different supply- and demand-side determinants of firm-level goods export performance in a destination, we cannot claim, yet, that this positive correlation reflects a causal and unbiased effect of services provision on goods sales. As already acknowledged, measurement error in the bi-exporting phenomenon might bias downward the coefficient we estimate on the dummy Serv_{fdt}. Moreover, firm-product-destination unobserved factors could jointly determine firm-level goods export performance and the decision to provide services in a destination. More specifically, we can think of two possible sources of endogeneity. First, as shown by di Comite et al. (2014), firms might face country-specific tastes for their products. This means that for a given product, the relative sales of firms might vary across markets even though their relative prices remain the same. If these demand idiosyncrasies apply to all of the items proposed by a firm in a market, the positive correlation we measure between services provision and firm-level goods exports in a destination might just reflect the fact that bi-exporters export services in markets where they specifically face a high demand for their products. Second, Mayer et al. (2016) show that when multi-product exporters face a positive demand shock, they skew their sales towards their best performing product and extend the range of

[9] The coefficient is also positive and significant for Personal and Cultural services, but this concerns a very small number of flows.

the products they export to products for which they have a relatively lower productivity. This complex dynamics of the product mix can thus affect our estimation of the bi-exporter premium.

We propose in the following an IV strategy to break the firm-product-destination endogeneity just highlighted, and thus provide evidence of a causal relationship between the provision of services and the firm-level goods' export performance. We also shed light on the channels underlying this effect.

3.1 Estimation strategy

We take the specification in column (2) of Table 3 as our benchmark, and we look for an unbiased estimation of the coefficient α_1 in the following regression:

$$\text{Log Exp}_{fkdt} = \alpha_0 + \alpha_1 \text{Serv}_{fdt} + \alpha_2 \text{X}_{fkdt} + \lambda_{kdt} + \kappa_{fkt} + \epsilon_{fkdt} \tag{2}$$

where Log Exp_{fkdt} represents the log value of sales of firm f for product k in destination d at time t, X_{fkdt} stands for firm-product-destination-year covariates, λ_{kdt} is a product-destination-year fixed effect, and κ_{fkt} a firm-product-year fixed effect. We assume that the dummy Serv_{fdt} is determined by a latent variable and defined as follows:

$$\text{Serv}_{fdt} = \begin{cases} 1 & \text{if } \theta X_{fdt} + \mu_{dt} + \xi_{fdt} \geq 0 \\ 0 & \text{if } \theta X_{fdt} + \mu_{dt} + \xi_{fdt} < 0 \end{cases}$$

where X_{fdt} is a vector of firm-year and firm-destination-year covariates, μ_{dt} is a destination-year fixed effect, and ξ_{fdt} is the error term. The endogeneity of Serv_{fdt} we just discussed comes from the possible correlation between ϵ_{fkdt} and κ_{fkt}. To solve for this issue, and given the dichotomous nature of Serv_{fdt}, we follow Wooldridge (2002) and implement a two-step procedure.[10] We first estimate the determinants of the probability that firm f exports services to destination d at time t thanks to a probit model. We then use the fitted probabilities from the probit (that are thus purged from the presence of the firm-product-destination unobserved factors contained in ξ_{fdt}) as an instrument for Serv_{fdt} in a standard 2SLS. This method breaks the correlation between ξ_{fdt} and ϵ_{fkdt} which causes the endogeneity issue and provides an unbiased estimate of the effect of services provision on firm-level goods exports. Wooldridge (2002) argues that this procedure has several advantages. First, the 2SLS standard errors and test statistics are asymptotically valid: we do not need to adjust the standard errors to account for the fact that our instrument is an estimated variable. Second, this estimator has nice robustness properties; in particular, as long as the fitted probabilities are significantly correlated with the endogenous variable, the probit used to build the instrument does not need to be correctly specified.[11]

Note that, in principle, since the vector of fitted probabilities $\hat{\text{Serv}}_{fdt}$ is a non linear function of its determinants, this model can work without an excluded variable; how-

[10] See Chapter 18, section 18.4.1.

[11] As shown by Imbens and Wooldridge (2007), the robustness of the second step to the specification of the probit function is also a nice feature of this estimator, as compared to a control function approach where a probit model would be estimated in the first stage and the inverse Mills ratio introduced as a regressor in the second stage regression.

ever, the identification would only come from the non-linearity of the function used to build the instrument, thus limiting its explanatory power and the precision of the IV estimates. This is why we decide to introduce into the probit a firm-destination specific variable that explains why firms export services in a given market without directly affecting firm-level manufacturing sales in that market. We build this variable as the interaction between a technological parameter related to the types of goods exported by the firm (regardless of the destination) and a proxy for country-level barriers to services trade.

The firm-level technological parameter relies on the idea that not all the products are equally likely to be associated with services. Depending on both technology and preferences, some products are certainly more "bundleable" with services than others. For example, parts of aircraft or data-processing machines are exported frequently with many services such as installation, maintenance, and repair. Instead, some vegetable and textile products are never associated with services. In our data, we can compute for each product k its "bundleability" index. We define it as the average share of transactions that are bundled with services, computed across all of the Belgian exporters of product k over the period under study. As mentioned in section 2.2, many goods from the transportation, chemical, and machinery/electrical industries appear as highly "bundelable", and financial, computer and business services are often associated with goods. The average number of Belgian exporters active in a given HS6 over the period is equal to 82 and the median, 36; we are thus confident that one single firm cannot directly affect the "bundleability" index at the product-level. This index is then averaged across all of the products in the portfolio of firm f in year t. The resulting variable BI_{ft} should be positively correlated with the probability of bi-exporting, and it varies across firms due to differences in the product portfolio of each firm.

To obtain the second level of variation needed to build an instrument that is firm-destination specific, and thus varies within firms across markets, we interact the BI_{ft} with the log of overall imports of services by country d at time t SI_{dt} (excluding Belgium from the trade partners). This interaction takes into account the demand for services in country d, which is itself a function of the barriers to trade in services and the comparative advantage of d in the production of services.[12] This provides the variation needed to explain why the same firm does not necessarily bi-export in all of the destinations where it provides goods in a given year.

Since both BI_{ft} and SI_{dt} are built using product and/or country-specific information, we can reasonably assume that they are not directly correlated with the unobserved firm-product-destination specific determinants of manufacturing success.[13]

Finally, we also tackle the possible endogeneity of the measure of product scope of firm f in destination d at time t. As emphasized in the introduction, the same complementarity might, indeed, not solely apply to services, but also between the goods

[12]This information comes from the Francois and Pindyuk (2013) trade in services database. Note that, since our specification includes destination-year fixed effects, we do not need to include this variable alone in the probit.

[13]Note that, in case of correlated demand shocks between goods and services, country-level services imports might also proxy for the demand for the goods associated with these services. However, as long as these correlated demand shocks are common to all potential suppliers of the goods in the destination country, our destination-product-year fixed effects in the second step capture their direct effect on firm-level sales of goods.

exported by multi-product exporters, such as the iPad and its cover. Product scope is thus subject in our regressions to the same endogeneity concerns as the provision of services.[14] We thus need to find an excluded variable that can explain the number of products exported by a firm in a given destination and be exogenous to the manufacturing sales of that firm in that destination. We propose an instrument whose rationale is close to the one of the "bundleability" index defined for services exports. For each HS6 product k, we calculate the average size (across all years and destinations) of the product scope of the firms that export k. We then average this statistic across all of the products exported by firm f in country d at time t. This provides us with a predicted measure of the product scope of firm f in destination d at time t. Again, since it is based on a technological parameter attached to each of the products in the firm-destination level portfolio, it should not be correlated with the unobserved firm-product-destination factors and allow for a proper identification.

3.2 Results

The results of our IV strategy are presented in column (1) of Table 4.[15] They confirm that bi-exporting has a positive and significant causal effect on the goods export values. Relative to normal goods exporters, bi-exporters export, on average, 75% more of their goods in destinations where they provide services than in destinations where they do not. The magnitude of this effect is boosted as compared to the fixed effect estimation, implying that the biases highlighted in the previous subsections were leading to a downward bias overall. The effect of the product scope on firm-product-destination sales remains positive and significant after the implementation of our IV strategy, but contrary to services provision, it is slightly reduced compared to the fixed-effect estimation in column (2) of Table 3. The coefficients on the other variables do not change much.

To get a sense of how much services matter for aggregate manufacturing exports, we run the following exercise: we assume that the possibility of exporting services is shut down for all of the bi-exporting flows in our dataset, and using the coefficient estimated in column (1) of Table 4, we re-compute the value of these manufacturing flows absent the service. With this procedure, we find that the overall manufacturing exports of bi-exporters would decrease by nearly 25% on average, implying a 12% decrease in overall Belgian manufacturing exports. Of course, this exercise ignores general equilibrium effects and assumes that services are exported along with all the products sold by a firm in a destination. For this reason, we should certainly see it as an upper bound of the contribution of services to manufacturings sales; but it definitely suggests that the boosting effect of services on manufacturing performance is not negligible and is worthy of investigation.

Since our data on trade in goods contains the value and the quantity exported, we can compute the unit value of each firm-product-destination export flow. We can then use these unit values as a proxy for prices and decompose the sales premium into a

[14] Please note that the identification of the goods that exhibit the same type of asymmetric relationship as the one documented for goods and services is beyond the scope of this paper.

[15] The results of the first-stage probit are presented in Table B-1 of Appendix B.

Table 4: The causal effects of bi-exporting

	(1)	(2)	(3)
Dep. Var.	**Log Exp**$_{fkdt}$	**Log Q**$_{fkdt}$	**Log P**$_{fkdt}$
$\mathbb{1}\text{Serv}_{fdt}$	0.749^a	0.276^c	0.474^a
	(0.161)	(0.146)	(0.058)
Log # Products$_{fdt}$	0.645^a	0.681^a	-0.035^a
	(0.012)	(0.012)	(0.005)
Market Experience$_{fkdt}$	0.990^a	1.001^a	-0.011^a
	(0.005)	(0.006)	(0.002)
$\mathbb{1}\text{AFF}_{fdt}$	0.286^a	0.341^a	-0.055^a
	(0.024)	(0.020)	(0.010)
$\mathbb{1}\text{PAR}_{fdt}$	0.177^a	0.220^a	-0.043^a
	(0.032)	(0.031)	(0.011)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,587,271	1,587,271	1,587,271
R-squared	0.802	0.865	0.920
Kleinbergen-Paap F-Stat		111.881	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

quantity and a price effect. This can help us understand the channels behind the boost in manufacturing sales caused by the provision of services. The results are displayed in Columns (2) and (3) of Table 4 and show that the positive effect on sales is a combination of both a quantity and a price increase. Relative to normal goods exporters, bi-exporters charge a price for their good that is 47% higher in destinations where they provide the service than in destinations where they do not. Importantly, despite this higher price, bi-exporters manage to sell 28% more in volume. Note that the magnitude of the impact we measure for unit values is sensible. In our estimation sample, the coefficient of variation of firm-product unit values across destinations is equal to 0.41,[16] i.e. the same order of magnitude as the price premium associated with bi-exporting. Consumers are willing to buy more of the product even if it is more expensive. It thus seems that the association of services acts as a positive demand shifter, making the product more appealing to consumers. In this sense, services influence the perceived quality of the product and are an active determinant of the goods export performance of firms.

We provide, in Appendix B, four types of robustness checks. First, in the first-stage probit, we use two alternative excluded variables by interacting the "bundleability index BI_{ft} with: i) the share of services in the overall imports of the destination d at time t, IMPSH_{dt}, taken from the Comtrade dataset; ii) the Service Restrictiveness Index, SRI_d, computed by the World Bank. In this way, we can check how sensitive the results are to alternative proxies for country-level openness to services trade (Tables B-2 and B-3 in Appendix). Second, we exclude from the estimation sample potential outliers by

[16]For this exercise, we focus on firm-product-year triplets for which we have at least 4 observations in our sample (i.e. 4 destinations). Quite interestingly, the standard-deviation of unit values within exporters across markets reported by Manova and Zhang (2012) for Chinese firms is equal to 0.46, very close to ours. Martin (2012) also reports the within firm-product variation of unit values across destinations to be large for French firms.

dropping those firms for which the share of services in overall exports is above 50% (their core business being on services rather than manufacturing, Table B-4 in the Appendix). Third, we exclude destinations in which a multinational has either an affiliate or a parent firm to dissolve any remaining concern about the behavior of multinationals in countries that are part of their business structure (see table B-5 in Appendix).[17] Fourth, we code the Serv_{fdt} dummy equal to one only if the firm exports the services that are significantly associated with higher sales, as discussed in section 2.2.4 (see Table B-6). In all of these robustness checks, our results are confirmed.

4 One-way complementarity and perceived quality: theory and further evidence

Our analysis shows that services provision allows bi-exporters to sell more of their goods, all else equal, than standard goods exporters. Bi-exporters increase their sales by charging a higher price for their good and still selling it in higher quantities than firms that export the good only. Services, then, look like a determinant of the perceived quality and vertical differentiation of products.

At first sight, these results could seem consistent with multi-product firm models under monopolistic competition with variable markups (e.g. Mayer et al., 2014, 2016) and/or quality differences across varieties (e.g. Manova and Yu, 2017). Despite the ample theoretical development in both directions, we argue here that these models alone cannot replicate our empirical results. First, absent diseconomies of scope,[18] a standard model of monopolistic competition where each firm can supply a good with or without a service - a two-product firm - cannot generate the positive effect of services provision on manufacturing goods' unit values we find. This is because cross-price elasticities under monopolistic competition are null by assumption. In other words, the price of the good and the export of a service are the result of independent decisions. Importantly enough, this is true whatever the demand system considered is - derived from a CES utility or not (see also section 5 for a derivation with non-CES preferences). Second, the price premium we measure is not simply reflecting the cost of providing a service, as would be the case with any investment in product quality (e.g. Eckel et al., 2015). This is because, in our data, the provision of a service is accounted for in a separate transaction. In other words, the price charged by the firm for the service is not embodied in the unit-value of the good on which our empirical analysis is based. Nevertheless, that bi-exporting raises both the price and the quantity of the good suggests that bi-exporting may act as a *demand shifter* for the good. The model we build in this section will help us reinterpret the provision of the service as a determinant of the *perceived* quality of the good.

Because of the above-mentioned reasons, in this section, we depart from existing models in two ways. First, we consider a model of oligopolistic competition. Under this

[17]Remember that in the main specification, intra-firm services trade is already removed from the estimation sample and we control in the regressions for the fact that a firm has affiliates and/or parent firms in the destinations where it exports goods.

[18]See section 5 for a discussion of a supply-side driven price effect.

assumption, goods and services supplied by a single firm have a direct impact on the market aggregate - the price index - so that pricing decisions across the service and the good are naturally inter-related. Second, we consider goods and services as one-way complements. In the words of Chen and Nalebuff (2006), one-way complementarity implies that the good is essential to the use of the service but not vice-versa.[19] This second assumption ensures that bi-exporters find it optimal to set a higher price for their good while setting a strictly positive price for the service.

4.1 Preferences

The economy of destination d features a continuum of consumers who share the same preferences. Each consumer derives her utility from a Cobb-Douglas function over different goods $k \in \mathcal{K}$:

$$\mathcal{U} := \int_{\mathcal{K}_d} \alpha_k \ln \left(\mathcal{C}_{kd}\right) dk$$

where the income shares sum up to one:

$$\int_{\mathcal{K}_d} \alpha_k dk = 1$$

$\mathcal{C}_{kd}$ is the ideal consumption index of good k in destination d and is defined as the aggregation of the $\mathcal{C}_{fkd}$ consumption indices which are specific to the variety of product k supplied by firm f in destination d:

$$\mathcal{C}_{kd} := \left(\int_{f \in \Omega_{kd}} \mathcal{C}_{fkd}^{\frac{\sigma_k - 1}{\sigma_k}} df\right)^{\frac{\sigma_k}{\sigma_k - 1}}$$

The set of varieties of product k available in d is defined by Ω_{kd}, and the elasticity of substitution across varieties is equal to σ_k. These varieties may be consumed with or without a service. We denote by g_{fkd} the total consumption of variety fk in destination d. The amount consumed *with* a service is denoted by $g^S_{fkd} \leq g_{fkd}$, and consumption of the complementary service is denoted by s_{fkd}.

One-way complementarity The consumption index of variety fk in country d is defined by:

$$\mathcal{C}_{fkd} = \left(\left(g_{fkd} - g^s_{fkd}\right)^{\frac{\sigma_k - 1}{\sigma_k}} + \min\left(g^s_{fkd}, s_{fkd}\right)^{\frac{\sigma_k - 1}{\sigma_k}}\right)^{\frac{\sigma_k}{\sigma_k - 1}}$$

where $\min\left(g^s_{fkd}, s_{fkd}\right)$ is a Leontief aggregator.[20]

[19] One-way complementarity can be seen as a special case of mixed bundling (Adams and Yellen, 1976) where there is no demand for the service alone. The analogy, however, is of little use here as our data does not allow us to consider mixed-bundling pricing: there is only one price (unit value) observed for each good in a given destination, whether it is bundled or not.

[20] The model can also accommodate imperfect complementarity through a CES aggregator without

This specification implies that the consumption s_{fkd} of the service itself does not raise the utility of the consumer unless she consumes at least $g^s_{fkd} \geq s_{fkd}$ units of the good with it. This means that the good is essential while the service is optional. The CES aggregation of the consumption of the good alone and the bundle implies that the consumer perceives a good and its service-augmented version as two different varieties.[21]

A mass of L_d consumers own an equal share of the firms in their economy on top of their labor income. Total income amounts to I_d and the budget constraint reads as:

$$\int_{\mathcal{K}_d} \mathcal{P}_{kd} \mathcal{C}_{kd} dk \leq I_d$$

where $\mathcal{P}_{kd}$ is the ideal price index of product k in destination d:

$$\mathcal{P}_{kd} := \left(\int_{\Omega_{kd}} \mathcal{P}_{fkd}^{1-\sigma_k} df \right)^{\frac{1}{1-\sigma_k}}$$

The firm-product-destination specific price index aggregates the price of the good alone and the price of the bundled good. The latter is the sum of the price of the good and the price of the service $p_{fk} + p^s_{fk}$:

$$\mathcal{P}_{fkd} := \left(p_{fkd}^{1-\sigma_k} + \left(p_{fkd} + p^s_{fkd} \right)^{1-\sigma_k} \right)^{\frac{1}{1-\sigma_k}}$$

Demand Utility maximization implies $g^S_{fk} = s_{fk}$ and yields the direct demand functions of the good and the service:

$$d \quad \left[p_{fkd}, p^s_{fkd}; \mathcal{P}_{kd} \right] = g_{fkd} = \quad \alpha_k \cdot I_d \cdot \mathcal{P}_{kd}^{\sigma_k - 1} \cdot \left(p_{fkd}^{-\sigma_k} + \left(p_{fkd} + p^s_{fkd} \right)^{-\sigma_k} \right) \quad (3)$$

$$d^s \quad \left[p_{fkd} + p^s_{fkd}; \mathcal{P}_{kd} \right] = g^S_{fkd} = \quad \alpha_k \cdot I_d \cdot \mathcal{P}_{kd}^{\sigma_k - 1} \cdot \left(p_{fkd} + p^s_{fkd} \right)^{-\sigma_k} \quad (4)$$

so that total expenditures on good fk and its complementary service are given by:

$$E_{fkd} := \alpha_k \cdot I_d \cdot \left(\frac{\mathcal{P}_{fkd}}{\mathcal{P}_{kd}} \right)^{1-\sigma_k}$$

---

qualitatively changing its predictions. This will become clear in section 4.4 when we turn to the intuitions behind the theoretical channels at play.

[21] This implies that consumers have a positive demand for both. While it might appear more realistic to assume heterogeneous consumers, CES preferences can also be seen as a reduced form for a richer model featuring consumer heterogeneity (see section 5). These preferences can also easily accommodate vertical differentiation between the two varieties through the introduction of a demand shifter β_k such that $\mathcal{C}_{fkd} = \left(\left(g_{fkd} - g^s_{fkd} \right)^{\frac{\sigma_k - 1}{\sigma_k}} + \left(\beta_k \min \left(g^s_{fkd}, s_{fkd} \right)^{\frac{\sigma_k - 1}{\sigma_k}} \right) \right)^{\frac{\sigma_k}{\sigma_k - 1}}$. Since it does not affect any of the predictions, we omit it without any loss of generality.

4.2 Firm technology

In the following, we carry out the analysis at the firm level. We take the perspective of a domestic firm which decides whether or not to export to destination d and, if so, whether to export a service or not with its good. All workers in the home country supply one efficiency unit of labor and their wages are normalized to one. Let c_{fk} and c^s_{fk} be firm f's marginal costs of production of good k and its complementary service, respectively. Corresponding trade costs are denoted by τ_{kd} and τ^s_{kd}. These costs are product-country specific: for instance, the cost of supplying communication services includes trade costs related to the linguistic distance and the good category with which it is bundled. For the sake of simplicity, we assume further that all firms supplying good k face the same proportional cost increment when deciding to supply a service together with their good.[22] Firms that are good at producing the good are also good at providing the service, which is in line with our descriptive statistics. Last, trade costs to destination d for the goods and services are assumed to differ up to a product-specific multiplicative term. Taken together these assumptions allow us to work with a product-specific cost-increment which is inclusive of trade costs:

$\omega_k := 1 + \frac{\tau^s_{kd} c^s_{fk}}{\tau_{kd} c_{fk}}$.

In the absence of fixed costs, since consumers' reservation price for any variety is infinite, all firms would find it profitable to provide services with their goods at any cost. We, therefore, assume that firms incur a fixed cost F^b in order to export a service with their good. The subset of firms that export a service with their variety of good k in destination d is denoted by Ω^b_{kd}.

Exporters' profits in destination d are given by:

$$\begin{aligned} \pi_{fkd} := & \left(p_{fkd} - \tau_{kd} c_{fk}\right) L_d \cdot d\left[p_{fkd}, p^s_{fkd}; \mathcal{P}_{kd}\right] + \\ & \left(p^s_{fkd} - \tau^s_{kd} c^s_{fk}\right) L_d \cdot d^s\left[p_{fkd} + p^s_{fkd}; \mathcal{P}_{kd}\right] \cdot \mathbf{1}_{\Omega^b_{kd}}[F^b] \quad \forall f \in \Omega^b_{kd} \end{aligned} \tag{5}$$

For a bi-exporter, i.e. $\mathbf{1}_{\Omega^b_{kd}}[F^b] = 1$, the maximization problem boils down to one of a two-product firm whose core competence is the good to be consumed alone while its side product is made of the good to be consumed with the service. Producing and shipping the former requires a constant marginal cost $\tau_{kd} c_{fk}$ while the bundle requires $\tau_{kd} c_{fk} + \tau^s_{kd} c^s_{fk}$.

4.3 Firm behavior

We do not model how firms initially decide to export. We focus only on their decision and on the impact of exporting a service along with their good, in line with our empirical exercise on manufacturing goods exporters.

Before solving the model, we should note that $\mathcal{P}_{kd}$ summarizes the demand linkages between goods: under monopolistic competition, the impact of the price of any individual variety on this aggregate would be negligible; therefore the optimal pricing rule of

[22]This is close in spirit to the multi-product firm model by Mayer et al. (2014) where firms born with a different productivity for their core product face the same increase in marginal cost as they expand their product portfolio.

a firm would be independent on whether this firm is supplying a service or not. Importantly enough, this is not an artefact of CES preferences; it is due to the fact that under monopolistic competition, cross-price elasticities of demand are null across the varieties sold by a firm. Here instead, when oligopolistic firms compete à la Bertrand (similar results hold under Cournot), they take into account their impact on the price-index $\mathcal{P}_{kd}$ (See Anderson et al., 1992; Yang and Heijdra, 1993), and cross-price elasticities across their product scope are no longer negligible.

4.4 Prices, quantities and sales

The first-order conditions with respect to p_{fk} and p^s_{fk} lead to the pricing rule:

$$\mathcal{M}_{fkd} := p_{fkd}/c_{fkd} = p^s_{fkd}/c^s_{fkd} \tag{6}$$

where the mark-up $\mathcal{M}_{fkd}$ is given by:

$$\mathcal{M}_{fkd} = \mathcal{M}_k[\mathcal{S}_{fkd}] := 1 + \frac{1}{(\sigma_k - 1)(1 - \mathcal{S}_{fkd})}$$

Oligopolistic firms charge a markup that is a convex function of their market share. Using (3) and (4) leads to the implicit definition of an oligopolistic firm's market share[23] $\mathcal{S}_{fkd}$:

$$\mathcal{P}_{kd}^{\sigma_k-1} \cdot (\tau_{kd} \cdot c_{fk})^{1-\sigma_k} \cdot \left(1 + \omega_k^{1-\sigma_k} \cdot \mathbf{1}_{\Omega^b_{kd}}\right) = \mathcal{S}_{fkd} \cdot \mathcal{M}_k[\mathcal{S}_{fkd}]^{\sigma_k-1} \tag{7}$$

Equation (7) shows that, all else equal, bi-exporters have a larger market share and thus charge a higher markup. Plugging the optimal prices into the demand functions leads to the good and service output chosen by a bi-exporting firm:

$$g_{fkd} = \alpha_k \cdot I_d \cdot \mathcal{P}_{kd}^{\sigma_k-1} \cdot \mathcal{M}_{fkd}^{-\sigma_k} \cdot (\tau_{kd} c_{fk})^{-\sigma_k} \cdot \left(1 + \omega_k^{-\sigma_k} \cdot \mathbf{1}_{\Omega^b_{kd}}[F^b]\right) \tag{8}$$

$$s_{fkd} = \alpha_k \cdot I_d \cdot \mathcal{P}_{kd}^{\sigma_k-1} \cdot \mathcal{M}_{fkd}^{-\sigma_k} \cdot (\tau_{kd} c_{fk})^{-\sigma_k} \cdot \omega_k^{-\sigma_k} \cdot \mathbf{1}_{\Omega^b_{kd}}[F^b] \tag{9}$$

Inspecting (8) shows that supplying a service, i.e. $\mathbf{1}_{\Omega^b_{kd}}[F^b] = 1$ has two opposite effects on the quantities of good k sold by firm f in destination d, captured respectively by $\left(1 + \omega_k^{-\sigma_k}\right)$ and $\mathcal{M}_{fkd}^{-\sigma_k}$.

Firms now face a positive demand for the bundled good which increases the demand addressed to variety fk by a factor $\left(1 + \omega_k^{-\sigma_k}\right)$. This demand for the bundle, however, cannibalizes the sales of the good alone. All else equal, firms increase their markup and restrict their supply of the good alone by a factor $\mathcal{M}_{fkd}^{-\sigma_k}$. In a model of monopolistic competition, there would be no impact on the price, and the output would always

[23] Our specification of consumer preferences implies that the relevant market on which firms compete, consists of horizontally differentiated goods *and* their service-augmented versions. Therefore, the market share is the share of a firm's overall sales - including both goods and services sales - relative to its competitors.

increase. Under oligopoly, the price effect goes against this increase in output and could even potentially offset it (in that case, it would have to be that an increase in the sales of the services does more than offset the decrease in the sales of the good). Our empirical analysis finds evidence for a price effect which is never strong enough to reverse the positive impact on output. Furthermore, we show below that, theoretically, the *perceived* quality of the good necessarily increases with the provision of the service.

4.5 Perceived quality

Equation (8) shows that, conditional on price, the provision of services acts as a demand shifter for the good. Given this expression, the demand shifter is equivalent to a factor $\eta_{fkd} := \left(1 + \omega_k^{-\sigma_k} \cdot \mathbf{1}_{\Omega_{kd}^b}[F^b]\right)^{\frac{1}{\sigma_k - 1}}$ before the consumed quantity of variety fk in the utility function of consumers from country d, so that the demand function in equation (3) could be written as follows:

$$d\left[p_{fkd}, p_{fkd}^s; \mathcal{P}_{kd}\right] = g_{fkd} = \alpha_k \cdot I_d \cdot \mathcal{P}_{kd}^{\sigma_k - 1} \cdot p_{fkd}^{-\sigma_k} \cdot \eta_{fkd}^{\sigma_k - 1} \tag{10}$$

According to our model, supplying a service along with a good translates unambiguously into a larger *perceived* quality of the good. Using (10), we can thus derive a measure of perceived quality as in Khandelwal et al. (2013). Taking the logarithm of this expression, we obtain:

$$\ln g_{fkd} + \sigma_k \ln p_{fkd} = \ln \alpha_k \cdot I_d + (\sigma_k - 1) \cdot \ln \mathcal{P}_{kd} + (\sigma_k - 1) \cdot \ln \eta_{fkd} \tag{11}$$

From an empirical viewpoint, equation (11) can be estimated with our data as:

$$\ln \mathrm{q}_{fkdt} + \sigma_k \ln \mathrm{uv}_{fkdt} = \lambda_{kdt} + \epsilon_{fkdt} \tag{12}$$

where q_{fkdt} and uv_{fkdt} are the quantity and price charged by firm f for product k sold to country d at time t, and λ_{kdt} is a product-destination-year fixed effect. We can then recover the residual, and in light of our model, interpret it as a function of the estimated firm-product-destination level demand shifter such that $\ln \hat{\eta}_{fkdt} = \frac{\hat{\epsilon}_{fkdt}}{\sigma_k - 1}$.[24] Intuitively, a higher η_{fkdt} means that, conditional on price, firm f faces a higher demand for its good than its competitors.

To assess the impact of services provision on the perceived quality of goods, we apply the same empirical strategy as the one used for values, quantities, and prices using our measure of perceived quality, $\ln \hat{\eta}_{fkdt}$, as the dependent variable. Table 5 shows the results: the provision of services has a positive effect on the perceived quality of the good. To get a sense of the economic magnitude of these effects, we transform them into standardized coefficients.[25] When considering all the firms in our sample, we find that a one standard deviation increase in the probability of exporting services

[24] We use the product-destination specific elasticity of substitution estimated by Broda et al. (2006).

[25] Put differently, we calculate the effect of one standard deviation of each explanatory variable x as a share of one standard deviation of the dependent variable y: $\frac{\beta_x \times \mathrm{sd}_x}{\mathrm{sd}_y}$. Standard deviations are computed based on the variables demeaned in the product-destination-year and firm-product-year dimensions, since our regression controls for fixed effects in these dimensions.

together with goods is associated with a 0.11 increase in the demand shifter. To provide a benchmark, we compute the same for the product scope variable: a one standard deviation increases in the size of the product scope is associated with a 0.11 increase in the demand shifter. When we compute these contributions for bi-exporters only, these figures are respectively equal to 0.19 and 0.10. While both effects are sizeable, services provision explains a greater share of the variations in the perceived quality of bi-exporters' products across destinations as compared to product scope. We can thus conclude that services are an important determinant of the perceived quality of bi-exporters' products.

Table 5: Perceived quality - IV results

	(1)
Dep. Var.	$\ln \hat{\eta}_{fkdt}$
Serv_{fdt}	0.737^a
	(0.125)
Log # Products_{fdt}	0.250^a
	(0.011)
Market Experience_{fkdt}	0.473^a
	(0.005)
AFF_{fdt}	0.064^a
	(0.021)
PAR_{fdt}	0.080^a
	(0.025)
Product-Destination-Year FE	Yes
Firm-Product-Year FE	Yes
Observations	1,252,510
R-squared	0.603
Kleinbergen-Paap F-Stat	100.838

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

5 Alternative interpretations for our results

Our model relies on the assumption of one-way complementarity between goods and services to explain the patterns we find in the data. We now review alternative interpretations and explanations for both our theoretical and empirical results.

Non-CES preferences under monopolistic competition.

As mentioned at the beginning of section 4, we show briefly below that under monopolistic competition - even when departing from CES preferences, bundling a service along with a good does not have any impact on its price. This is why we have considered an oligopolistic market structure instead.

For the sake of brevity, we normalize population size to one. Each consumer has now additively separable preferences across varieties within a sector:

$$\mathcal{C}_{kd} := \int_{\mathcal{K}_d} \left(u(g_{fkd} - g^s_{fkd}) + u\left(\min\left(g^s_{fkd}, s_{fkd}\right)\right)\right) di$$

They perceive the good alone and the bundle as two horizontally differentiated varieties. We assume that $u(.)$ is thrice continuously differentiable, strictly increasing, and strictly concave. Utility maximization[26] implies $g^s_{fkd} = s_{fkd}$ and yields the inverse demand functions for the good and the service as:

$$\begin{aligned} p_{fkd} &= \frac{u'(g_{fkd} - g^s_{fkd})}{\lambda} \\ p_{fkd} + p^s_{fkd} &= \frac{u'(s_{fkd})}{\lambda} \end{aligned}$$

where λ is a Lagrange multiplier associated with the consumer's budget constraint.

The problem of a bi-exporter now becomes:

$$\max \pi_{fkd} := \left(p_{fkd} - \tau_{kd}c_{fk}\right)\left(g_{fkd} - g^s_{fkd}\right) + \left(p_{fkd} + p^s_{fkd} - \omega_k \tau_{kd} c_{fk}\right) s_{fkd} \mathbf{1}_{\Omega^b_{kd}}[F^b] \quad \forall f \in \Omega^b_{kd}$$

It is therefore separable in $\left(g_{fkd} - g^s_{fkd}\right)$ and s_{fkd}. In other words, the price set by a firm for its good does not depend on whether it is supplying a service or not. This is because monopolistically competitive firms are λ-takers by assumption, whether their markups are constant or not.

Supply-side driven price effect.

Under monopolistic competition, without any demand-side explanation, reconciling larger sales of the good with a higher price is simply not possible as it contradicts the law of demand. However, sticking to monopolistic competition, we could assume that preferences feature one-way complementarity while the price effect, instead of arising from oligopoly, would be driven by the supply side. For the price of the good to be higher when a service is jointly exported, it would have to be that the marginal cost of production of that good goes up when bundled with a service, i.e. decreasing returns to scope. Now, for the overall sales of the good to go up as observed, it would have to be that the sales of the bundle do more than offset the decline induced by decreasing returns to scope. Under certain parameter restrictions this is perfectly reasonable and would replicate comparisons within countries across firms; however, it sounds much less convincing when coming to within-firm across-country comparisons. Replicating our results would require that decreasing scope economies are destination specific, i.e. producing a good would be costlier - net of the service production cost itself - in a destination when bundled with a service to be shipped to that same destination.

Services as a fringe item in the firm's scope of activities.

[26] $\mathcal{C}_{kd}$ is not a consumer index and two-stage budgeting does not apply anymore, but this is not a concern for the argument that follows.

We could see bi-exporters as multi-product firms for which the good is the firm's core competence and the service a peripheral product.

In Eckel and Neary (2010), a firm's decisions for each product are interconnected, again, through a cannibalization effect. This is a model that could capture, for instance, a firm selling a printer and also renting it. Everything else being equal, however, selling two substitutable goods implies lower sales for each good compared to the case where only one is sold.

These types of models are thus unable to replicate the positive association between goods and services we find with our difference-in-difference setting in the data.

Two-way complementarity between goods and services.

The model considers that each bi-exporter faces demand for both the good and the good augmented with the service. We consider, here, the special case where goods and services are two-way complements, i.e. that services are also necessary to the consumption of the good. In the present model, where complementarity is captured through a Leontiev aggregator, the price of the good and the service are no longer determined. The impact on quantities, however, can be derived. When the service provider is also a monopolist, the problem for each variety boils down to a Cournot (1838) complementary monopoly problem. In that case, internalizing the positive price externality for the good provider leads her to decrease the price of the bundle and increase the quantity supplied. To get some prediction on prices, it is enough to introduce some degree of imperfect complementarity. In that case, producing both the good and the service in-house tends to increase the sales of both and the quantities of both, but also reduces their prices (Belleflamme and Peitz, 2010). This is consistent with the model of Eckel and Riezman (2016), but not with the positive price effect we have identified.

Add-on pricing

In our model of one-way complementarity, the service is very much like an option or an add-on. The literature on the pricing of add-ons (See for instance Gabaix and Laibson, 2006; Ellison, 2005) is based on the assumption that consumers do not know the prices of these options when deciding to buy the essential good. While this theory is appealing, it mainly offers predictions on the prices of add-ons - which we don't observe in our data - but no clear predictions on the price of the essential good. Moreover, while our model is very stylized, we are able to replicate our empirical results without assuming myopic consumers.

Heterogeneous consumers and market segmentation.

In our model, aggregate demand, is obtained by assuming that all consumers are identical and have CES preferences. The same demand system can be obtained assuming that a unit mass of heterogeneous consumers decide first to allocate $\alpha_k I_d$ to each good k and then decide which variety to buy according to their idiosyncratic taste. Their second-stage indirect utility for variety fkd is then:

$$\mathcal{V}_{fkd} = \ln \alpha_k + \ln I_d - \ln p_{fkd} + \varepsilon_{fkd}$$

when consumed alone or:

$$\mathcal{V}^b_{fkd} = \ln \alpha_k + \ln I_d - \ln \left[p_{fkd} + p^s_{fkd}\right] + \varepsilon^b_{fkd}$$

when bundled with a service. Under the assumption that $\left(\varepsilon_{fkd}, \varepsilon^b_{fkd}\right)$ are drawn identically and independently from a Gumbel distribution with standard deviation $\frac{\pi}{\sqrt{6}(\sigma_k - 1)}$, aggregating consumers' demand for their preferred variety leads back to the CES preferences considered in the baseline model (see also Thisse and Ushchev (2016) for further discussions.)

In this setting, supplying the good-service bundle allows firms to segment the market for product k between high and low-valuation consumers, and thus to extract more surplus overall. Interestingly enough, the presence of high-valuation consumers decreases the surplus of low-valuation consumers. We leave the distributional implications of services trade liberalization for future research.

Empirics: Tracking services' flows and external service suppliers. On the empirical front, one might worry that services could sometimes be directly charged with the good. We think that this should not be too often the case since generally the provision of services (warranties, maintenance, assistance, consultancy etc.) are the object of a separate transaction or a separate line in the contract so that they must be declared by firms separately. However, should it be the case, this means that we might identify among "normal" goods exporters firms that are in reality bi-exporters, which should drive to zero the price, sales and quantity effects.

Another related issue is that services might sometimes be provided by external suppliers directly in the destination country. From a purely empirical perspective, this means that we might consider as "standard" goods flows some flows that in reality are also bundled with services. Again, if anything, this biases our estimations of the effect of services provision towards zero. The fact that we do find an effect suggests that either the presence of external suppliers is negligible, or that the complementarity is not the same if the service is provided by an external supplier. This is why we do not model "pure" services suppliers in our theory. In such a framework, their presence would provide consumers with the further option of purchasing the service from external suppliers. This would increase the price of the good supplied alone and delete any difference between bi-exporting and normal exporting. While interesting, this case does not seem to hold in our empirical results, and in the absence of information on local services suppliers, the data does not allow us to further analyze this case.

Overall, we are quite confident in the fact that we have identified a new mechanism relating manufacturing and services activities within the firm through demand complementarities between the two.

6 Conclusion

While the servitization of our economies is often seen as going hand in hand with deindustrialization, our work provides a different perspective on these two phenomena.

By documenting that the very best goods exporters also export services in some of the destinations they serve, we show that both activities are not necessarily antagonistic. Moreover, by means of an instrumentation strategy to infer causation, we argue that the provision of services might actually boost the demand for goods, allowing firms to charge higher prices without harming the demand for their goods. This can be rationalized in a model with oligopolistic competition where services are one-way complements to goods and consumers love variety. By attracting a larger share of the market, firms that export services together with their goods can increase their markups. Services act as a demand-shifter for goods, and thus as a vector of perceived vertical differentiation; therefore, services are a determinant of firm-level differences in goods export performance. Finally, our results suggest that the liberalization of trade in services, which is at stake in many bilateral negotiations such as those between the EU and the US for the TTIP or those with the UK for Brexit, might have also important consequences for trade in goods in general and for the biggest firms that are bi-exporters in particular. This is especially true for services that are highly "bundleable" with goods such as business or computer services. Considering goods and services separately in the negotiation of trade agreements is thus likely to miss part of the business and welfare gains and losses related to these treaties.

References

Adams, W. J. and Yellen, J. L. (1976). Commodity Bundling and the Burden of Monopoly. *Quarterly Journal of Economics*, 90(3):475–498.

Amiti, M., Itskhoki, O., and Konings, J. (2014). Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review*, 104(7):1942–78.

Amiti, M., Itskhoki, O., and Konings, J. (2016). International Shocks and Domestic Prices: How Large Are Strategic Complementarities? NBER Working Papers 22119, National Bureau of Economic Research, Inc.

Anderson, S., Palma, A. D., and Thisse, J. (1992). *Discrete Choice Theory of Product Differentiation*. MIT Press.

Ariu, A. (2016). Crisis-Proof Services: Why Trade in Services Did Not Suffer During the 2008-2009 Collapse. *Journal of International Economics*, 98(C):138–149.

Ariu, A., Breinlich, H., Corcos, G., and Mion, G. (2017). The Interconnections Between Services and Goods Trade at the Firm-Level. CEPR Discussion Papers 12169.

Belleflamme, P. and Peitz, M. (2010). Platform Competition and Seller Investment Incentives. *European Economic Review*, 54(8):1059–1076.

Berlingieri, G. (2014). Outsourcing and the Shift From Manufacturing to Services. CentrePiece - The Magazine for Economic Performance 413, Centre for Economic Performance, LSE.

Berman, N., Martin, P., and Mayer, T. (2012). How do Different Exporters React to Exchange Rate Changes? *The Quarterly Journal of Economics*, 127(1):437–492.

Bernard, A. and Jensen, J. (1999). Exceptional Exporter Performance: Cause, Effect, or Both? *Journal of International Economics*, 47(1):1–25.

Bernard, A. B., Blanchard, E., van Beveren, I., and Vandenbussche, H. (2017a). Carry-Along Trade. *Review of Economic Studies*, Forthcoming.

Bernard, A. B. and Fort, T. C. (2015). Factoryless Goods Producing Firms. *American Economic Review*, 105(5):518–23.

Bernard, A. B., Jensen, J. B., Redding, S. J., and Schott, P. K. (2016). Global Firms. NBER Working Papers 22727, National Bureau of Economic Research, Inc.

Bernard, A. B., Redding, S. J., and Schott, P. K. (2011). Multiproduct Firms and Trade Liberalization. *The Quarterly Journal of Economics*, 126(3):1271–1318.

Bernard, A. B., Smeets, V., and Warzynski, F. (2017b). Rethinking deindustrialization. *Economic Policy*, 32(89):5–38.

Blanchard, P., Fuss, C., and Mathieu, C. (2017). Why do manufacturing firms produce services? Evidence for the servitization paradox in Belgium. NBB Discussion Papers 330, National Bank of Belgium.

Breinlich, H., Soderbery, A., and Wright, G. C. (2014). From Selling Goods to Selling Services: Firm Responses to Trade Liberalization. CEP Discussion Papers dp1303, Centre for Economic Performance, LSE.

Broda, C., Greenfield, J., and Weinstein, D. (2006). From Groundnuts to Globalization: A Structural Estimate of Trade and Growth. NBER Working Papers 12512, National Bureau of Economic Research, Inc.

Chen, M. K. and Nalebuff, B. J. (2006). One-Way Essential Complements. Cowles Foundation Discussion Papers 1588, Cowles Foundation for Research in Economics, Yale University.

Cournot, A. (1838). *Researches on the Mathematical Principles of the Theory of Wealth*. Macmillan.

Crozet, M., Head, K., and Mayer, T. (2012). Quality Sorting and Trade: Firm-level Evidence for French Wine. *Review of Economic Studies*, 79(2):609–644.

Crozet, M. and Milet, E. (2017). Should Everybody be in Services? The Effect of Servitization on Manufacturing Firm Performance. *Journal of Economics and Management Strategy*, 26(4):820–841.

Dhingra, S. (2013). Trading Away Wide Brands for Cheap Brands. *American Economic Review*, 103(6):2554–84.

di Comite, F., Thisse, J., and Vandenbussche, H. (2014). Verti-zontal Differentiation in Export Markets. *Journal of International Economics*, 93(1):50–66.

Eckel, C., Iacovone, L., Javorcik, B., and Neary, J. P. (2015). Multi-Product Firms at Home and Away: Cost- versus Quality-Based Competence. *Journal of International Economics*, 95(2):216–232.

Eckel, C. and Neary, J. P. (2010). Multi-Product Firms and Flexible Manufacturing in the Global Economy. *Review of Economic Studies*, 77(1):188–217.

Eckel, C. and Riezman, R. (2016). CATs and DOGs. CEPR Discussion Papers 11695, C.E.P.R. Discussion Papers.

Edmond, C., Midrigan, V., and Xu, D. Y. (2015). Competition, Markups, and the Gains from International Trade. *American Economic Review*, 105(10):3183–3221.

Ellison, G. (2005). A Model of Add-On Pricing. *The Quarterly Journal of Economics*, 120(2):585–637.

Francois, J. and Pindyuk, O. (2013). Consolidated Data on International Trade in Services. IIDE Discussion Papers 20130101, Institute for International and Development Economics.

Gabaix, X. and Laibson, D. (2006). Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets. *The Quarterly Journal of Economics*, 121(2):505–540.

Head, K. and Spencer, B. J. (2017). Oligopoly in International Trade: Rise, Fall and Resurgence. NBER Working Papers 23720, National Bureau of Economic Research, Inc.

Hottman, C. J., Redding, S. J., and Weinstein, D. E. (2016). Quantifying the Sources of Firm Heterogeneity. *The Quarterly Journal of Economics*, 131(3):1291–1364.

Imbens, G. and Wooldridge, J. (2007). Control Function and Related Methods in What's New In Econometrics? *NBER Lecture Note 6*.

Johnson, R. C. (2012). Trade and prices with heterogeneous firms. *Journal of International Economics*, 86(1):43–56.

Khandelwal, A. K., Schott, P. K., and Wei, S.-J. (2013). Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters. *American Economic Review*, 103(6):2169–95.

Loecker, J. D. and Warzynski, F. (2012). Markups and Firm-Level Export Status. *American Economic Review*, 102(6):2437–71.

Manova, K. and Yu, Z. (2017). Multi-Product Firms and Product Quality. *Journal of International Economics*, forthcoming.

Manova, K. and Zhang, Z. (2012). Export Prices Across Firms and Destinations. *The Quarterly Journal of Economics*, 127(1):379–436.

Martin, J. (2012). Markups, Quality, and Transport Costs. *European Economic Review*, 56(4):777–791.

Mayer, T., Melitz, M. J., and Ottaviano, G. I. (2016). Product Mix and Firm Productivity Responses to Trade Competition. Nber working papers, National Bureau of Economic Research, Inc.

Mayer, T., Melitz, M. J., and Ottaviano, G. I. P. (2014). Market Size, Competition, and the Product Mix of Exporters. *American Economic Review*, 104(2):495–536.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6):1695–1725.

Melitz, M. J. and Ottaviano, G. I. P. (2008). Market Size, Trade, and Productivity. *Review of Economic Studies*, 75(1):295–316.

Neary, P. (2016). International Trade in General Oligopolistic Equilibrium. *Review of International Economics*, 24(4):669–698.

Nocke, V. and Yeaple, S. (2014). Globalization and Multiproduct Firms. *International Economic Review*, 55:993–1018.

Pierce, J. R. and Schott, P. K. (2016). The Surprisingly Swift Decline of US Manufacturing Employment. *American Economic Review*, 106(7):1632–62.

Thisse, J.-F. and Ushchev, P. (2016). Monopolistic Competition Without Apology. CEPR Discussion Papers 11449, C.E.P.R. Discussion Papers.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross-Section and Panel Data*. MIT Press.

Yang, X. and Heijdra, B. J. (1993). Monopolistic Competition and Optimum Product Diversity: Comment. *American Economic Review*, 83(1):295–301.

Appendix

A Descriptive Statistics

Table A-1: Descriptive statistics on firms and flows

Variable	Obs	Mean	Std. Dev.	Min	Max
Exports of Goods (firm-product-destination-year, million euros)	2,576,339	0.30	4.53	0.00	3703.40
Weight (firm-product-destination-year, tons)	2,576,339	354,486.30	1.24×10^{7}	1	1.34×10^{10}
Service Dummy (firm-product-destination-year)	2,576,339	0.07	0.25	0	1
# years of presence in the market (firm-product-destination-year)	2,576,339	3.09	2.55	1	11
Turnover/Employment (firm-year, million euros)	98,900	0.81	12.82	0.00	1995.76
Service Industry Dummy (firm-year)	98,900	0.44	0.50	0	1
Multinational Firm Dummy (firm-year)	98,900	0.08	0.26	0	1

Note: This table presents some descriptive statistics of the variables used.

Table A-2: Bi-exporting sales premium - Identification on switchers

	(1)
Dep. Var.	**Log Exp**$_{fkdt}$
$\mathbb{1}$ Serv$_{fdt}$	0.067^{a}
	(0.014)
Log # Products$_{fdt}$	0.466^{a}
	(0.007)
Market Experience$_{fkdt}$	0.322^{a}
	(0.006)
$\mathbb{1}$ AFF$_{fdt}$	0.113^{a}
	(0.021)
$\mathbb{1}$ PAR$_{fdt}$	0.023
	(0.035)
Product-Destination-Year FE	Yes
Firm-Product-Destination FE	Yes
Observations	1,634,212
R-squared	0.896

Note: Standard errors clustered at the firm-destination-year level in parentheses.
^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Table A-3: Bi-exporting sales premia by service type

	(1)
Dep. Var.	**ln Exp**$_{fkdt}$
$\mathbb{1}$ Transport	0.106^{a}
	(0.040)
$\mathbb{1}$ Travel	0.094
	(0.064)
$\mathbb{1}$ Communication	-0.101
	(0.062)
$\mathbb{1}$ Construction	-0.031
	(0.058)
$\mathbb{1}$ Insurance	0.010
	(0.080)
$\mathbb{1}$ Financial	0.306^{a}
	(0.041)
$\mathbb{1}$ Computer	0.118^{b}
	(0.052)
$\mathbb{1}$ Royaties	-0.032
	(0.045)
$\mathbb{1}$ Business	0.219^{a}
	(0.028)
$\mathbb{1}$ Personal and Cultural	0.393^{a}
	(0.107)
$\mathbb{1}$ Government	0.235
	(0.249)
Log # Products$_{fdt}$	0.707^{a}
	(0.006)
Market Experience$_{fkdt}$	0.963^{a}
	(0.005)
$\mathbb{1}$ AFF$_{ft}$	0.301^{a}
	(0.023)
$\mathbb{1}$ PAR$_{ft}$	0.190^{a}
	(0.032)
Product-Destination-Year FE	Yes
Firm-Product-Year FE	Yes
Observations	1,652,189
R-squared	0.801

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

B Further Tables IV

We present in Table B-1 the results of the first step of our identification strategy. More productive, multinational and service industry firms are more likely to export services in the destinations where they already export goods.[27] Services provision is also more likely in destinations where multinational firms have foreign affiliates or parent firms. Finally, our results show that the higher the number of exported products and the more experienced a firm in a given market, the more likely it is to be a bi-exporter in that destination.[28] Regarding our excluded variables, as expected, we observe that BI_{ft} is positively correlated with the likelihood of bi-exporting. This means that firms with a product portfolio composed of goods that are more likely to be associated with

[27]Note that in the second stage these variables will be absorbed by the fixed effect κ_{fkt}. For computational reasons, we cannot include firm-year fixed effects in the probit; due to the incidental parameter problem, the predicted probability of bi-exporting would then be hard to compute.

[28]For market experience, we use here the maximum of years of presence observed across all products exported by firm f in destination d at time t.

Table A-4: Bi-exporting sales premium - Core product

Dep. Var.	(1) **ln Exp**$_{fkdt}$
$\mathbb{1}$ Serv$_{fdt}$	0.145^a
	(0.023)
$\mathbb{1}$ Serv$_{fdt}$* $\mathbb{1}$ Core product$_{ft}$	0.878^a
	(0.030)
Log # Products$_{fdt}$	0.705^a
	(0.006)
Market Experience$_{fkdt}$	0.961^a
	(0.005)
$\mathbb{1}$ AFF$_{ft}$	0.297^a
	(0.023)
$\mathbb{1}$ PAR$_{ft}$	0.205^a
	(0.032)
Product-Destination-Year FE	Yes
Firm-Product-Year FE	Yes
Observations	1,652,189
R-squared	0.801

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

services have a higher probability of being bi-exporters. The sign of the coefficient on the interaction term cannot be interpreted due to the non-linearity of the probit model. We checked however that in a linear probability specification, the coefficient is positive and significant, suggesting that on average, the effect of the BI$_{ft}$ index is magnified in markets where the demand for services is high.

Table B-1: Determinants of the probability of bi-exporting

	(1)	(2)	(3)
Dep. Var.		$\mathbb{1}$ Serv$_{fdt}$	
BI$_{ft}$	19.190^{a}	10.340^{a}	12.960^{a}
	(1.976)	(0.820)	(0.527)
BI$_{ft}\times$ SI$_{dt}$	-0.643^{a}		
	(0.175)		
BI$_{ft}\times$ IMPSH$_{dt}$		-5.447^{a}	
		(1.852)	
BI$_{ft}\times$ SRI$_{d}$			0.058^{a}
			(0.030)
Log # Products$_{fdt}$	0.145^{a}	0.149^{a}	0.144^{a}
	(0.007)	(0.008)	(0.008)
Log Turnover/L$_{ft}$	0.071^{a}	0.071^{a}	0.070^{a}
	(0.004)	(0.005)	(0.004)
Market Experience$_{fkdt}$	0.0417^{a}	0.0428^{a}	0.0413^{a}
	(0.007)	(0.007)	(0.007)
$\mathbb{1}$ MNE$_{ft}$	0.428^{a}	0.425^{a}	0.428^{a}
	(0.012)	(0.013)	(0.012)
$\mathbb{1}$ AFF$_{fdt}$	0.245^{a}	0.220^{a}	0.242^{a}
	(0.019)	(0.019)	(0.019)
$\mathbb{1}$ PAR$_{fdt}$	0.258^{a}	0.256^{a}	0.258^{a}
	(0.031)	(0.032)	(0.031)
$\mathbb{1}$ Service industry dummy$_{ft}$	0.612^{a}	0.574^{a}	0.609^{a}
	(0.018)	(0.018)	(0.018)
Destination-Year FE	Yes	Yes	Yes
Observations	503,728	417,751	479,086

Note: Probit model. BI$_{ft}$ is the "bundleability" index of the firm-level product portfolio with services, SI$_{dt}$ stands for destination-level imports of services (excluding Belgium from the source countries), IMPSH$_{dt}$ for the share of services in overall imports of the destination country and SRI$_{d}$ is an OECD measure of barriers to services trade imposed by the destination country. Standard errors clustered at the destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1.

Table B-2: IV results - $IMPSH_{dt}$ as instrument

	(1)	(2)	(3)
Dep. Var.	**Log Exp**$_{fkdt}$	**Log Q**$_{fkdt}$	**Log P**$_{fkdt}$
$Serv_{fdt}$	0.763^{a}	0.289^{b}	0.474^{a}
	(0.157)	(0.142)	(0.057)
Log # $Products_{fdt}$	0.643^{a}	0.678^{a}	-0.035^{a}
	(0.012)	(0.012)	(0.005)
Market $Experience_{fkdt}$	0.992^{a}	1.002^{a}	-0.010^{a}
	(0.005)	(0.006)	(0.002)
AFF_{ft}	0.283^{a}	0.337^{a}	-0.054^{a}
	(0.024)	(0.021)	(0.010)
PAR_{ft}	0.177^{a}	0.220^{a}	-0.043^{a}
	(0.032)	(0.030)	(0.011)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,570,818	1,570,818	1,570,818
R-squared	0.803	0.866	0.920
Kleinbergen-Paap F-Stat		118.929	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1.

Table B-3: IV results - SRI_{d} as instrument

	(1)	(2)	(3)
Dep. Var.	**Log Exp**$_{fkdt}$	**Log Q**$_{fkdt}$	**Log P**$_{fkdt}$
$Serv_{fdt}$	0.758^{a}	0.246^{c}	0.512^{a}
	(0.159)	(0.143)	(0.058)
Log # $Products_{fdt}$	0.654^{a}	0.693^{a}	-0.040^{a}
	(0.013)	(0.014)	(0.005)
Market $Experience_{fkdt}$	1.010^{a}	1.020^{a}	-0.009^{a}
	(0.006)	(0.006)	(0.002)
AFF_{ft}	0.253^{a}	0.302^{a}	-0.050^{a}
	(0.026)	(0.022)	(0.011)
PAR_{ft}	0.216^{a}	0.254^{a}	-0.038^{a}
	(0.034)	(0.032)	(0.011)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,338,656	1,338,656	1,338,656
R-squared	0.810	0.870	0.921
Kleinbergen-Paap F-Stat		118.895	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1.

Table B-4: Second-stage results - Services share in firm-level exports <50%

Dep. Var.	(1) **Log Exp**$_{fkdt}$	(2) **Log Q**$_{fkdt}$	(3) **Log P**$_{fkdt}$
Serv$_{fdt}$	0.840^{a}	0.368^{b}	0.472^{a}
	(0.170)	(0.152)	(0.061)
Log # Products$_{fdt}$	0.648^{a}	0.681^{a}	-0.033^{a}
	(0.012)	(0.012)	(0.005)
Market Experience$_{fkdt}$	0.992^{a}	1.003^{a}	-0.011^{a}
	(0.006)	(0.006)	(0.002)
AFF$_{ft}$	0.286^{a}	0.341^{a}	-0.054^{a}
	(0.025)	(0.021)	(0.010)
PAR$_{ft}$	0.180^{a}	0.222^{a}	-0.043^{a}
	(0.032)	(0.031)	(0.011)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,568,510	1,568,510	1,568,510
R-squared	0.803	0.865	0.920
Kleinbergen-Paap F-Stat		102.057	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1. In columns 1-3 we instrument only Serv$_{fdt}$, in columns 4-6 we also instrument Log # Products$_{fdt}$.

Table B-5: IV results - Excluding destinations with parents or affiliates

Dep. Var.	(1) **Log Exp**$_{fkdt}$	(2) **Log Q**$_{fkdt}$	(3) **Log P**$_{fkdt}$
Serv$_{fdt}$	0.864^{a}	0.303	0.561^{a}
	(0.217)	(0.202)	(0.083)
Log # Products$_{fdt}$	0.649^{a}	0.683^{a}	-0.034^{a}
	(0.012)	(0.013)	(0.005)
Market Experience$_{fkdt}$	0.989^{a}	0.999^{a}	-0.010^{a}
	(0.005)	(0.006)	(0.002)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,387,010	1,387,010	1,387,010
R-squared	0.802	0.865	0.922
Kleinbergen-Paap F-Stat		99.715	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1.

Table B-6: IV results - Serv_{fdt} coded one only for complementary services

	(1)	(2)	(3)
Dep. Var.	**Log Exp**$_{fkdt}$	**Log Q**$_{fkdt}$	**Log P**$_{fkdt}$
Serv_{fdt}	0.874^a	0.321^c	0.552^a
	(0.190)	(0.170)	(0.072)
Log # Products_{fdt}	0.645^a	0.680^a	-0.035^a
	(0.012)	(0.012)	(0.005)
Market Experience_{fkdt}	0.991^a	1.001^a	-0.010^a
	(0.005)	(0.006)	(0.002)
AFF_{ft}	0.300^a	0.346^a	-0.046^a
	(0.033)	(0.031)	(0.012)
PAR_{ft}	0.159^a	0.213^a	-0.054^a
	(0.033)	(0.031)	(0.012)
Product-Destination-Year FE	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes
Observations	1,587,271	1,587,271	1,587,271
R-squared	0.802	0.865	0.920
Kleinbergen-Paap F-Stat		161.605	

Note: Standard errors clustered at the firm-destination-year level in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1.

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