The interconnections between services and goods trade at the firm-level

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Abstract

In this paper we study how international trade in goods and services interact at the firm level. Using a rich dataset on Belgian firms during the period 1995-2005, we show that: i) firms are much more likely to source services and goods inputs from the same origin country rather than from different ones; ii) increases in barriers to imports of goods reduce firm-level imports of services from the same market, and conversely. We build upon a discrete-choice model of goods and services input sourcing that can reproduce these facts to design our econometric strategy. The results suggest that a liberalization of service trade has direct and sizable effects on goods trade and vice-versa. Moreover, sourcing goods and services from the same origin brings substantial complementarities to both.

JEL classification: F10, F13, F14, L60, L80

Keywords: Trade in Services; Trade in Goods; Complementarity; Firm-level Analysis; Discrete Choice Models.

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TABLE OF CONTENTS

1 Introduction

Services feature prominently on the trade liberalization agenda. After the recent Canada-EU Trade Agreement (CETA), the European Commission stated that "around half of the overall GDP gains for the EU will come from liberalising trade in services".[1] The recent Trade in Services Agreement (TiSA) initiative between the US, the EU and 21 trade partners aims to breathe new life into the Doha Round liberalization talks. While the future of the proposed Transatlantic Trade and Investment Partnership (TTIP) between the US and EU is highly uncertain in the current political scenario, the proposal had services at the heart of its "Market Access" chapter. At the same time a key element for the UK, the second largest services exporter in the world, in the ongoing Brexit negotiations is precisely the future of trade in services with both the EU and the rest of the world.

To date, the economic evaluation of services trade barriers has relied on sector-specific studies (Francois and Hoekman, 2010), general equilibrium work with separate goods and services sectors (Francois et al., 2003; Egger et al., 2012) or services-only gravity models (Anderson et al., 2014). Yet, both anecdotal evidence and recent research show increasingly blurred boundaries between the manufacturing and services sectors. Production and trade statistics reveal significant services sales, exports and imports by manufacturing firms.[2] This may partly reflect a "servitization" process, i.e., a shift from products to solutions and integrated "product-service systems" (Neely, 2008), as well as a greater reliance of manufacturing firms on intermediate services, both domestic and imported (Nordås, 2010; Timmer et al., 2013). These observations raise the possibility that goods trade may directly and substantially benefit from services trade liberalization, and vice-versa.

In this paper, we study if and how both types of trade interact at the level of individual firms. In particular, we study how firms' imports of goods respond to the liberalization of trade in services, and how firms' imports of services react to goods trade liberalization. We believe this question is important for at least two reasons. First, simultaneous imports of goods and services is a first-order feature in our data representing more than 80% of total imports value. Thus, existing firm-level research focused on, for example, goods trade only completely overlooks an important services trade component, and vice-versa. Secondly, estimating the interactions between the two forms of trade is directly relevant for the design of trade policy and for the important ongoing trade negotiations (TTIP, Brexit, etc.). Indeed, if there are complementarities

[1] See http://ec.europa.eu/trade/policy/in-focus/ceta/

[2] See Crozet and Milet (2017b), Breinlich and Criscuolo (2011), Ariu and Mion (2016), Walter and Dell'mour (2010), Kelle and Kleinert (2010) among others.

in sourcing goods and services from the same origin, lowering/increasing services barriers might lead to higher/lower services *and* goods imports. This also suggests that recent efforts to liberalize trade in services - where trade barriers are still significant - might be highly effective at increasing goods trade in a context where tariff barriers have already fallen to historically low levels.

To explore the interactions between goods and services trade and trade liberalization at the firm level, we start by analyzing highly disaggregated data on Belgian firms' imports between 1995 and 2005. Our descriptive exercise shows that firms are disproportionately likely to import goods and services from the same rather than separate origins. At the same time, reduced-form regressions suggest that, while controlling for firm-year and country unobservables, a reduction in goods trade barriers from one country has a positive effect on services imports from that same country.

To go beyond these reduced-form results, we build a model of good and service input sourcing to guide our empirical analysis. The model features a final sector and two (goods and services) intermediate sectors. Final producers may source intermediate goods and services domestically or from abroad. To capture the observed sparsity of imports across origin countries, intermediate sourcing is represented as a discrete choice between pairs of country-specific goods and services varieties. The model fully specifies the probability of sourcing inputs from countries, which increases in input quality and decreases with trade costs, all else equal. Conditional on that choice, goods and services import values are also specified as functions of a narrow set of parameters. The model also allows for technological complementarities between inputs coming from the same origin country.

We then use the model to design our estimation strategy. We use a two-stage econometric approach where the first stage describes the choice of origin countries and the second stage describes the value of imports of goods and services from chosen country pairs. The theoretical model provides us with guidance on how to combine and interpret parameters as well as on how to deal with selection bias in a consistent and parsimonious way. More specifically, we end up using the selection model developed in Lee (1983) and described by Bourguignon et al. (2007). The first-stage selection equation features a conditional multinomial logit for the probability to source inputs from a given country. In the second stage, we estimate two export value outcome regressions, one for goods and one for services, that are augmented with selection-bias controls coming from the first stage. We also allow for both firm-specific time-varying and country-specific time invariant unobservables that may be correlated with the regressors in both the first and second stage.

The results of this estimation strategy reveal a strong direct complementarity between goods and services. Reducing trade barriers in services have positive and significant effects on the goods export values. Moreover, the magnitude of the coefficient reveals that this effect could potentially be stronger than further liberalizing goods. At the same time, a tariff reduction would positively affect trade in services. An important result is that the complementarity between goods and services is particularly strong when both come from the same origin. This can be the result of different mechanisms: i) if the same firm provides both goods and services and this has an effect on the quality of one of the two (or both);[3] ii) if the parent firm provides both goods and "specific" services to the affiliates; iii) if transactions costs and/or economies of scope are high.

In addition to the literature on the quantification of services' trade barriers mentioned above, our work contributes to a small number of papers studying the connections between services and goods trade and production at the level of individual firms. This literature has been mostly descriptive in nature, highlighting the importance of firms trading in, or producing, both goods and services (e.g., Crozet and Milet (2017b); Ariu (2016b)). Three recent exceptions are Breinlich et al. (2016), Crozet and Milet (2017a) and Ariu et al. (2016). Breinlich et al. (2016) analyze the impact of goods trade liberalization on the shift of UK manufacturing firms into services, but do not look at trade responses nor at the interaction between goods and services imports. Crozet and Milet (2017a) studies the interaction between goods and services in the domestic market finding that service sales have a positive impact on the performance of manufacturing firms. This paper complements ours with a a domestic perspective on the good-service relation but it does not investigate the related policy issues. Ariu et al. (2016) studies why manufacturing exporters associate services to their goods exports and it provides a micro-foundation of the different mechanisms that can explain the complementarity between goods and services. While complementing our work on the exports as opposed to the imports side, they do not look at the related trade policy issues.[4] Finally, our work is related to recent quantitative models of firm-level imports, such as Kasahara and Lapham (2013), Armenter and Koren (2013) and Antras et al. (2017). While these papers also look at import sourcing choices at the firm level, they do not incorporate services trade and its relation with goods trade.

This paper is organized in four additional sections. Section 2 presents the data and two stylized facts paving the way to the theoretical model. Section 3 offers a model

[3]For example, proprietary knowledge can make original component manufacturers the best providers of services of those goods.

[4]There is also a more substantial business literature on the shift of manufacturing firms into services provision; see for example Roy et al. (2009) and Neely et al. (2011). These papers are descriptive in nature and do not look at services trade.

generating predictions on goods and services intermediates imports at both the firm and the aggregate levels. Section 4 is devoted to estimations. Finally, section 5 concludes.

2 Data and Stylized Facts

In this section we outline the data used in the analysis and we provide some descriptive evidence that will guide the construction of the theoretical framework.

2.1 Data

The empirical analysis of this paper needs four types of data: data on trade in services, data on trade in goods as well as service and goods trade barriers.

Trade Data. Information on goods imports comes from the National Bank of Belgium (NBB). The data is organized at the firm-year-origin-product level and spans the 1995-2005 period. Firms are identified by their VAT number and goods are classified using the CN 8-digit nomenclature. We consider only transactions giving rise to a change in ownership and we get rid of transactions referring to movements of stocks, replacement or repair of goods, processing of goods as well as returns and transactions without compensation. In this way, we eliminate trade performed by non-resident firms, accounting for the majority of re-exports. The requirement for observing a firm-level flow is rather low: firms trading with EU countries had to declare their transactions in a given year if their cumulative imports in the European Union were above 104,115 Euros the year before. This threshold increased to 250,000 Euros between 1998 and 2005. Instead, firms trading with extra-EU countries had to declare to the NBB any transaction exceeding 1,000 Euros and this limit remained stable over the 1995-2005 period.[5] Similar thresholds apply to the French data used in Eaton et al. (2011), Mayer and Ottaviano (2007) and Mayer et al. (2014).

Data on service imports were collected by the NBB during the period 1995-2005 to compile the Balance of Payments. In particular, a list of firms had to directly declare to the NBB any service transaction with a foreign firm above 12,500 Euros (9,000 Euros from 1995 to 2001). For the other firms, the bank involved in the service transaction was obliged (under the same threshold requirements) to record the information and send it to the NBB.[6] The data is organized at the firm-year-origin-product level. Firms

[5] For more details on this dataset see Amiti et al. (2014), Ariu (2016b), Bernard et al. (2010) and Muûls and Pisu (2009).

[6] After 2005 the information on trade in services was collected using different surveys targeting different types of services and firms. This major change undermines any possibility to extend the

are identified using their VAT number and the service product classification follows the usual Balance of Payments codes counting about 39 types of service products.[7] We do not consider transactions classified as *"Merchanting"* and *"Services between Related Enterprises"*. We exclude the first category because it combines the value of merchanting services and the value of the goods involved. We exclude the second because it doesn't provide information on the specific service product traded. The data comprises transactions under modes one, two and four of trade in services as defined by the General Agreement on Trade in Services (GATS), but there is no information on the specific mode used in each transaction.[8]

We match the datasets on trade in goods and services by means of the unique VAT firm identifier. As will become clear in the following, our estimation procedure is computationally intensive, forcing us to reduce the dimensionality of our data in three ways. First, we focus on the top 50 origin countries in terms of total Belgian imports (goods and services) over the 1995-2005 period. Such countries represent 97.2% of total Belgian imports over the period of analysis and are listed in Table A-2 in the Appendix.

We further restrict the analysis to those firms who have imported both goods *and* services at least once during the period 1995-2005, though not necessarily from the same country or in the same year. Apart from computational considerations, this last restriction is applied because our objective is to study interconnections between goods and services imports at the firm level. In order to construct firm-specific measures of trade barriers (see below), we also need at least one import flow for both goods and services. This second restriction means that we cannot make predictions of the counterfactual behavior of firms outside our sample, such as non-importers turning into importers. However, we can account for counterfactual scenarios in which, for example, firms re-start importing services, or start importing from other origin countries. Overall, firms in our sample accounted for 83.4% (84.4%) of Belgian imports of goods (services) from the selected 50 countries in 2005.

In order to gain insights about what goods and services are imported jointly Tables 1 and 2 break down goods and services imports by product category among all importers (A), the sample used in the estimation (ES) and the sub-sample of firms with joint imports of goods and services from the same origin country and year (Strict Joint imports: SJ). Sample SJ represents 43.42% (49.43%) of the value of goods (services) imports in the ES sample. Column 2 of Table 1 reveals that the most common imported products

analysis to more recent years. For more details about the change in the collection system refer to Ariu (2016a).

[7]See Table 1 in Ariu (2016b) for a complete list.

[8]The logic of our model can be extended to mode 3 exports with appropriately defined variable trade costs. However we choose to exclude these transactions from the analysis due to coverage and quality issues with affiliate sales (FATS) data.

are Machinery, Vehicles, Mineral Products, and Chemicals. Columns 3 and 4 show similar product breakdowns in sample ES and (to a lesser extent) SJ, suggesting that joint goods-services imports affect most product categories. Columns 5 and 6 indicate that joint sourcing is more likely in some categories though, namely Mineral Products, Chemicals and Vehicles. Similarly, Table 2 reveals that Transportation, Travel and Other business services represent the main services imported, but only the latter are likely to be imported jointly with goods, as are IT, Communication and Construction services. Overall, the same products tend to be imported jointly in samples ES and SJ and the joint sourcing phenomenon is not driven by transportation or travel services.

Table 1: Breakdown of Belgian goods imports by products.

Section	Share of imports (A)	Share of imports (ES)	Share of imports (SJ)	Ratio 1 (ES/A)	Ratio 2 (SJ/A)
LIVE ANIMALS; ANIMAL PRODUCTS	2.81%	2.50%	2.02%	0.8927	0.7185
VEGETABLE PRODUCTS	3.06%	2.82%	1.81%	0.9225	0.5909
ANIMAL OR VEGETABLE FATS AND OILS AND	0.57%	0.62%	0.50%	1.0828	0.8728
PREPARED FOODSTUFFS; BEVERAGES	4.53%	4.29%	3.46%	0.9459	0.7633
MINERAL PRODUCTS	10.83%	12.33%	20.82%	1.1384	1.9214
PRODUCTS OF THE CHEMICAL OR ALLIED	10.98%	11.64%	14.65%	1.0599	1.3342
PLASTICS AND ARTICLES THEREOF; RUBBER	6.05%	5.61%	5.42%	0.9280	0.8958
RAW HIDES AND SKINS	0.43%	0.33%	0.17%	0.7637	0.3857
WOOD AND ARTICLES OF WOOD; WOOD	1.08%	0.74%	0.54%	0.6847	0.4989
PULP OF WOOD OR OF OTHER FIBROUS	3.01%	2.82%	2.41%	0.9375	0.7998
TEXTILES AND TEXTILE ARTICLES	4.85%	3.81%	2.65%	0.7853	0.5449
FOOTWEAR	0.62%	0.42%	0.13%	0.6756	0.2062
ARTICLES OF STONE	1.40%	1.18%	0.98%	0.8473	0.7056
NATURAL OR CULTURED PEARLS	7.16%	8.00%	2.53%	1.1176	0.3542
BASE METALS AND ARTICLES OF BASE METAL	7.46%	7.26%	7.60%	0.9737	1.0184
MACHINERY AND MECHANICAL APPLIANCES;	18.16%	18.26%	17.09%	1.0056	0.9410
VEHICLES	11.78%	12.83%	14.00%	1.0893	1.1892
OPTICAL INSTRUMENTS	1.98%	1.90%	1.46%	0.9571	0.7349
ARMS AND AMMUNITION; PARTS AND	0.05%	0.05%	0.05%	0.9683	1.0414
MISCELLANEOUS MANUFACTURED ARTICLES	2.45%	1.77%	0.83%	0.7226	0.3399
WORKS OF ART	0.74%	0.81%	0.90%	1.0931	1.2065

Note: product shares are computed for the 1995-2005 imports of all Belgian firms (A), firms in our estimation sample (ES) and firms importing goods and services from the same country in the same year (Strictly Joint imports or SJ).

Finally, we drop the product dimension and work with aggregate goods and services imports at the firm-destination level to make our empirical analysis computationally feasible. Thus, for each firm-origin country-year combination, we observe *total* goods and *total* services imports. We will, however, use the product dimension in the construction of our trade barrier measures below. This choice relieves us from solving the issue that the level of aggregation for goods and services are very different (e.g. 39 service types against about 10,000 products). Moreover, it is not a relevant issue since, if we look at I-O tables for Belgium, we observe that every sector imports both goods and services from all sectors. More specifically, out of the 34*34 input-output relations (looking only at imports), only 1.6% have zero values.

Table 2: Breakdown of Belgian services imports by product.

Section	Share of imports (A)	Share of imports (ES)	Share of imports (SJ)	Ratio 1 (ES/A)	Ratio 2 (SJ/A)
Transportation	31.81%	29.69%	22.59%	0.9333	0.7101
Travel	20.56%	21.26%	15.05%	1.0338	0.7317
Communications services	4.03%	4.46%	6.28%	1.1076	1.5592
Construction services	3.08%	3.10%	4.51%	1.0081	1.4669
Insurance services	1.98%	1.41%	0.34%	0.7092	0.1696
Financial services	4.65%	4.65%	4.55%	1.0006	0.9798
Computer and information services	5.29%	5.71%	7.63%	1.0793	1.4407
Royalties and license fees	4.26%	4.64%	7.54%	1.0896	1.7705
Other business services	21.43%	22.09%	28.28%	1.0313	1.3201
Personal, cultural, and recreational services	1.48%	1.43%	1.40%	0.9618	0.9454
Government services, n.i.e.	1.43%	1.56%	1.84%	1.0894	1.2798

Note: product shares are computed for the 1995-2005 imports of all Belgian firms (A), firms in our estimation sample (ES) and firms importing goods and services from the same country in the same year (Strictly Joint imports or SJ).

Trade Barriers Data Turning to trade barriers data, we use data on ad valorem applied goods import tariffs coming from the online customs tariff database (TARIC) provided by the European Commission. This dataset combines most-favored nation and preferential tariff-like restrictions applying to goods entering the EU market by country of origin and CN8 product code for several years. This level of detail is a unique feature of these data compared to, for example, the widely used UNCTAD's TRAINS database in which only information at the HS6 digit is available.[9] The data is organized at the country of origin-product level and is available for the entire 1995-2005 period. We denote by t^G_{pgt} the % tariff on good product p imported from country g at time t.[10]

Our measure of services trade restrictions are based on the OECD Product Market Regulation (PMR) index. More precisely, we use PMR data on the Accounting, Legal, Architectural, Engineering, Telecom, Post, and Air, Rail and Road Transport sectors, which we map into our Balance of Payments categories using the correspondence provided in Table A-1 in the Appendix.[11] The main advantage of using PMR data is that they cover service sector restrictions *over time and for multiple sectors.* Alternative

[9] See Mion and Zhu (2013) for further details.

[10] In a relative small amount of cases the information on tariffs is missing. In such cases we record tariffs as zero and assign value one to a dummy, that we use alongside the tariffs data, to construct an additional control. More specifically we construct, building on the formula of firm-specific weighted import barriers for goods described below, a measure of the share of imports of goods value of firm k from country g at time t for which we have no information on the goods trade cost t^G_{pgt}. Such additional control is used throughout our estimations.

[11] Since the data for the Accounting, Legal, Architectural, Engineering sectors are available only for 1998, 2003 and 2008, we impose a linear interpolation for the missing years in order to cover the entire period of our analysis. For the few Balance of Payments categories for which there is no data on PMR we recoded them as zero and assign value one to a dummy, that we use alongside the PMR index, to construct an additional control. More specifically we construct, building on the formula of firm-specific weighted import barriers for services described below, a measure of the share of imports of services value of firm k from country s at time t for which we have no information on the service trade cost t^S_{pst}. Such additional control is used throughout our estimations.

datasets such as the World Bank SRI or the OECD STRI include more countries and finer service categories coverage, but they are available only for one year, making them unsuitable for our analysis. While the OECD PMR mainly targets domestic regulation which is *de jure* non-discriminatory (i.e. the restrictions are applied by Belgium to all firms regardless of the origin country), it represents *de facto* a serious obstacle to cross-border trade (Crozet et al., 2016). This is because domestic regulation is usually designed with domestic suppliers in mind. This makes it harder for foreign service suppliers to serve the market as they have, of course, also to comply with the same regulations (which is possibly different from the one of the origin country). In addition, the PMR index has a "barriers to trade and investment" component which captures discriminatory regulations. Other papers (e.g. Crozet et al. (2016)) have used the OECD PMR index as a measure of service trade barriers for the same reasons. Now, while the PMR index varies across sectors and over time, it does not vary across the origin countries from which Belgium imports. To allow for variation along this dimension, we interact the PMR index with data from the WTO Regional Trade Agreement dataset, which indicates whether a country has a trade agreement covering trade in services with another country.[12] Therefore our measure of services trade barriers combines the PMR index and the WTO data in the following way:

$$t^S_{pst} = PMR_{pt} \times RTA_{st}$$

where PMR_{pt} denotes the PMR index for the service product p at time t corresponding to Belgium and RTA_{st} takes value one in the *absence* of a RTA between Belgium and country s covering trade in services at time t, and zero otherwise.

The interaction between PMR_{pt} and RTA_{st} broadly captures the differential obstacles faced by a firm exporting service p to Belgium depending on whether the country of the firm has in place a service trade agreement with Belgium or not. A firm coming from a country that has no services trade agreement with Belgium is deemed to face higher de facto or de jure discriminatory restrictions to services trade.

Equipped with measures of goods and services trade barriers t^G_{pgt} and t^S_{pst}, we are in a position to construct firm-specific weighted import barriers as follows:[13]

[12] Available at http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx These data are based on the compulsory notification of the establishment of a Regional Trade Agreement (RTA) to the WTO by the parties concerned with indication of the content and scope of the agreement. Therefore, we are able to track the countries involved in the agreement, the date of the agreement and whether it includes services, goods or both.

[13] Our firm-level weights give more importance to those products that have a higher share in the total imports of the firm. In order to check to what extent our results rely upon this choice, we have experimented with assigning equal weights and ultimately found very similar results.

$$t^G_{gkt} = \sum_p \varphi_{kp} t^G_{pgt} \qquad \text{where} \quad \varphi_{kp} = \frac{\sum_t \sum_g Imp^{goods}_{pgkt}}{\sum_p \sum_t \sum_g Imp^{goods}_{pgkt}}$$

$$t^S_{skt} = \sum_p \phi_{kp} t^S_{pst} \qquad \text{where} \quad \phi_{kp} = \frac{\sum_t \sum_s Imp^{services}_{pskt}}{\sum_p \sum_t \sum_s Imp^{services}_{pskt}}$$

where p indicates the good or service product, k the firm, g (s) the origin country of goods (services), t the year and Imp^{goods}_{pgkt} ($Imp^{services}_{pskt}$) corresponds to imports of goods (services). Constructing firm-specific trade barriers in this way allows us to exploit the product dimension of our data to some extent, even though we cannot use it for the main analysis due to computational constraints. Notice also that the weights are time- and origin-invariant and measure the importance of a given imported good or service for the firm. The idea behind this approach is to capture the set of trade barriers that are relevant to firm k, rather than using cruder proxies such as industry affiliation. For example, if firm k has ever imported good g, this means that g is likely to be of value to firm k (possibly because it is a production input). So, firm k will be affected by higher trade barriers on good g, irrespective of whether it is currently importing it or not.[14] Using time-origin-invariant weights also avoids spurious correlations between import flows and our trade barrier measures. Last but not least, in unreported results we have also experimented using firm-product weights based on 1995-2000 import patterns while estimating the model only for the time frame 2001-2005. Results are qualitatively, and to a large extent also quantitatively, identical but we lose in precision.

The basic combined dataset of imports values and imports barriers for goods (services) at the firm-origin-year level comprises 1,239,294 (1,041,486) observations. Mean, median and standard deviation of imports values (million euros) and import barriers are provided in Table 3.

Table 3: Some Sample Descriptives

	Obs	Mean	Median	St. Dev.
Goods Imports Imp^{goods}_{gkt}	1,239,294	5.012	0.098	70.214
Services Imports $Imp^{services}_{skt}$	1,041,486	1.376	0.080	15.962
Goods Tariffs t^G_{gkt}	1,239,294	0.626	0.000	1.966
Services Trade Barriers t^S_{skt}	1,041,486	0.512	0.000	1.038

[14] An alternative approach would be to use domestic input usage to construct our weights. Unfortunately, such information is not available to us and explains why we need to focus on firms that have imported goods and services at least once.

2.2 Key Features of the Data

In this section, we outline two features of the data that will guide the construction of our theoretical model.

As documented in numerous studies, firm-level imports are sparsely distributed across countries and years. In our sample positive goods imports are observed in 11.7% of the all the possible firm-country-year triples and services imports only 5.6% of the time. Therefore, there is a high number of zeros in the data. While import flows of either type are sparse, a key feature of the combined data is that imports of goods and services from the same country are extremely frequent. To give an idea, consider the count of firm-year pairs with positive imports of goods from g and services from s. The frequency of joint imports ($g = s$) is five times higher than the product of the marginal frequencies for all countries.

Fact 1: *The probability of observing a joint service-good flow is low but higher than the product of the probabilities of observing them separately.*

This raw statistic suggests the existence of a strong complementarity between goods and services imports from the same country. Note that such complementarity cannot be explained by simple comparative advantage and/or trade cost patterns arguments. For example, if the US has a comparative advantage in computers (goods) and computer services (services), both the probability of joint imports from the US and the product of the marginal probabilities will be high and should be roughly comparable. In Section 3 we will model this complementarity as coming from a productivity channel where final good output is higher whenever intermediates are sourced from the same country. For example, the productivity of US computers might be enhanced by the use of US computer services; something that would arise if the US firm selling the computer tailors the services to the good or even use the services to make the goods more relationship-specific, as in the case of maintenance, leasing or 'business solutions'. Section 3 discusses this mechanism in more detail including an analysis based on input-output tables and also looks at related mechanisms that could generate Fact 1.

When moving to estimation in Section 4 we then allow for the presence of a rather different channel that can indeed generate Fact 1, namely fixed costs. As long as there are fixed costs involved in importing something from one country, and fixed costs for importing goods and services from the same country are less than the sum of the fixed costs of importing only goods or only services, there would be scope for fixed costs savings from joint imports of goods and services from the same country that can generate Fact 1. Yet those fixed costs should affect the likelihood of joint imports but not import values conditional on importing. In our estimations we find that both the likelihood of importing and import values are higher when goods and services are sourced from the same country which is consistent with our story.

Our second fact highlights another form of interdependency between goods and services sourcing decisions, namely that goods trade barriers reduce the likelihood of importing services from the same country, and the other way around. To show this, we separately model the choice of importing goods and the choice of importing services from a given origin country by firm k at time t. For each firm-year pair in the data for which we observe imports from at least one origin, we construct the dummy I^G_{gkt} taking value one if firm k imports goods from country g at time t and zero otherwise (i.e., if the firm imports from two out of fifty possible origins, $I^G_{gkt} = 1$ for two firm-destination-year observation and zero for the remaining 48). $I^S_{gkt} = 1$ is defined accordingly. We model the sourcing decision as depending on both goods and services trade barriers as well as firm-time fixed effects and country dummies:

$$I^G_{gkt} = d_g + d_{kt} + \beta^S_1 t^S_{gkt} + \beta^G_1 t^G_{gkt} + \eta^G_{gkt} \quad (1)$$

$$I^S_{skt} = d_s + d_{kt} + \beta^S_2 t^S_{skt} + \beta^G_2 t^G_{skt} + \eta^S_{skt} \quad (2)$$

where, for example, t^S_{gkt} is the service import barrier of firm k at time t corresponding to country g, i.e., the same country for which we consider the goods import barrier (s=g). Country dummies d_g and d_s control for gravity determinants of trade flows while firm-year fixed effects d_{kt} control for unobserved idiosyncratic shocks that may affect the import decision. We estimate a conditional logit model and cluster standard errors at the firm-year level.[15] Results are reported in Table 4 while in Table A-3 in the Appendix we report results obtained excluding Vehicles from goods and Transportation from services (two clear candidates for global value chains trade) from the regression.

Both types of trade barriers have a negative effect on both types of trade. The probability to import services from a given origin country is negatively and significantly correlated with both goods and service trade barriers. At the same time, the probability to import goods is negatively and significantly correlated with goods trade barriers. In the same regression the coefficient of service trade barriers is negative but fails (not by much) to be significant. Furthermore, the correlation between t^G_{gkt} and t^S_{skt} is equal to 0.339 which is positive as expected but not large enough to generate multi-

[15]It would have been perhaps desirable to cluster standard errors at the country level. However, this is technically not possible when having fixed effects d_{kt} in the regression. Indeed, in order to operate clustering of standard errors in fixed effects models individuals (a firm-time pair in our setting) should be nested within clusters while in our regression the same firm-year could span into several clusters (countries).

Table 4: Reduced-form estimates of the impact of services trade barriers on goods sourcing choices, and vice versa

	Goods	**Services**
	(1)	(2)
Dep. Var.:	$I^G_{gkt}=1$	$I^S_{skt}=1$
Goods trade barriers	-0.0480[a]	-0.0183[a]
	(0.0026)	(0.0029)
Services trade barriers	-0.0061	-0.0618[a]
	(0.0044)	(0.0069)
Firm-Year fixed effects	Yes	Yes
Country Dummies	Yes	Yes
Observations	5,209,100	3,123,400
Pseudo R-squared	0.3999	0.3981
Number of firm-years	104,182	62,468

Note: Firm-time clustered standard errors in parentheses. [a] p<0.01, [b] p<0.05, [c] p<0.1

collinearity and prevent identification. Interpreting coefficients in Table 4 is difficult because the conditional logit model does not allow recovering meaningful marginal effects. Yet, if we run the same two estimations with a linear probability model, where actually all coefficients are negative and highly significant, we get the following insights. Considering the first regression, the expectation of I^G_{gkt} in the data, i.e., the probability that $I^G_{gkt}=1$, is 0.1166. The coefficients of goods and services trade barriers are such that a 1 standard deviation increase of such barriers would reduce the probability of importing goods from a given country by 0.0060 (goods barriers) and 0.0069 (services barriers) probability units, i.e., roughly 5% and 6% of the unconditional probability. Moving to the second regression, a 1 standard deviation increase in barriers would reduce the probability of importing services from a given country by 0.0007 (goods barriers) and 0.0041 (services barriers) probability units, i.e., roughly 1% and 7% of the unconditional probability.

Fact 2: *Controlling for both firm-year and country unobservables, goods trade barriers are negatively correlated with service imports and vice-versa.*

3 Theory

In what follows we present a simple sourcing model that will be used to guide our empirical analysis. The model is simple in many respects and we will subsequently relax some of its assumptions in order to cope with the richness of the actual data. This means our framework does not correspond to a structural approach. Yet, the theoretical model is useful in that it provides guidance on how to combine and interpret parameters as well as on how to deal with selection bias in a consistent and parsimonious way.

There are C countries with identical preferences and market structure. Most of the exposition will focus on a single importing country, for the sake of saving notation and matching our empirical application. In each country there are L consumers endowed with one unit of labor each. We assume that the preferences of the representative consumer are represented by:

$$U(A, M) = A^{1-\beta} M^{\beta} \tag{3}$$

where A denotes consumption of the non-tradable numeraire good A and $M = \left(\int_0^N q_k^{\frac{\sigma-1}{\sigma}} dk \right)^{\frac{\sigma}{\sigma-1}}$ denotes consumption of a CES aggregate final product (see below).

National income equals labor income and profits. It is assumed that each worker has an equal share in a perfectly diversified international portfolio. It follows that national income is given by:

$$Y = L + L \frac{\Pi_w}{L_w} \tag{4}$$

where Π_w denotes world profits, which will be determined endogenously below, and L_w denotes world population.

3.1 Final sector

A sector. Good A is produced out of labor under the following linear technology:

$$A = F(L_A) = L_A \tag{5}$$

where L_A denotes labor use by sector A. We assume that A is costlessly tradable and that all countries produce that good, so that wages equal one everywhere.[16]

[16]Sector A may be thought of as agriculture. Having constant wages simplifies the analysis of import choices considerably. In the empirical part of this paper we will control for cross-country differences in wages with country fixed effects.

M sector: demand. In industry M final goods are also nontradable and sold on a monopolistically competitive domestic market. Demand for variety k of the final good equals:

$$q_k = \beta Y \frac{p_k^{-\sigma}}{P^{1-\sigma}} \tag{6}$$

where $P_d \equiv \left(\int_0^N p_k^{1-\sigma} dk\right)^{\frac{1}{1-\sigma}}$ and N is the mass of varieties consumed in the country.

M sector: supply. Each final good producer k uses two types of inputs: goods (G) and services (S). Goods and services are differentiated by origin country, and each country produces a single variety g and a single variety s (an Armington assumption). We further assume that final producers can only choose one good g and one service s.[17] This reduces input choice to the discrete choice of where to source each of the two inputs from. For each firm the index g will refer to both a good and an origin country, and similarly for s. Goods and services are combined to produce output q_k using a Cobb-Douglas technology:[18]

$$\forall k, q_k(q_{gk}, q_{sk}) = \Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k q_{gk}^{\alpha} q_{sk}^{1-\alpha} \tag{7}$$

where q_{gk} and q_{sk} represent quantities of intermediate good g and service s and $0 < \alpha < 1$. $\lambda_g > 1$ and $\lambda_s > 1$ capture the quality of inputs g and s. Θ_{gs} is a parameter that takes value $\Theta \geq 1$ if both inputs are sourced from the same country, and value 1 otherwise.[19] φ_k is an idiosyncratic TFP parameter while ξ_{gsk} is a random variable whose properties are explained below. Minimization of the costs of producing q_k implies:

$$q_{gk} = \frac{1}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}\left(\frac{\alpha p_s}{(1-\alpha)p_g}\right)^{1-\alpha} q_k \tag{8}$$

$$q_{sk} = \frac{1}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}\left(\frac{(1-\alpha)p_g}{\alpha p_s}\right)^{\alpha} q_k \tag{9}$$

[17] In the data we observe firms importing goods and services from multiple countries. In the model we assume that firms choose only one g and one s, in order to obtain simple expressions that will be useful in handling the size of the dataset used in the estimation. To give an idea of the problem, we are going to use 10 years of data and 50 origin countries implying that for each firm in the data we will have $50 \times 50 \times 10 = 25,000$ corresponding observations. This assumption will be relaxed in the empirical analysis.

[18] The model could easily accommodate the more general case of a CES production function, with an elasticity of substitution either above or below the benchmark value of one. However, when turning to estimation some key parameters would not be identified due to non-linearities. Indeed random utility models, like the one we will spell out below, cannot handle non-linearity in parameters. The production function could also have labor as an additional factor, though the unit wages assumption makes the omission innocuous. We thank an anonymous referee for pointing this out.

[19] This assumption, which is motivated by Fact 1, is discussed at length in Section 3.4.

so that marginal cost does not depend on scale and equals

$$c_k = \frac{\Gamma p_g^{\alpha} p_s^{1-\alpha}}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}$$

where $\Gamma = \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$ is a constant.

Given $(p_g, p_s, \lambda_g, \lambda_s, \Theta_{gs}, \xi_{gsk}, \varphi_k)$ and the price index P, producer k solves

$$\max_{\{p_k\}}\{(p_k - \frac{\Gamma p_g^{\alpha} p_s^{1-\alpha}}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k})\left(\beta Y \frac{p_k^{-\sigma}}{P^{1-\sigma}}\right)\} \tag{10}$$

which implies the following optimal price

$$p_k = \frac{\sigma}{\sigma-1}\frac{\Gamma p_g^{\alpha} p_s^{1-\alpha}}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k} \tag{11}$$

Final production sold in k equals

$$q_k = \beta Y \left(\frac{\sigma-1}{\sigma}\frac{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}{\Gamma p_g^{\alpha} p_s^{1-\alpha}}\right)^{\sigma} P^{\sigma-1} \tag{12}$$

so that firm k's profits equal

$$\pi_k = \frac{1}{\sigma}\beta Y \left(\frac{\sigma-1}{\sigma}\frac{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}{\Gamma p_g^{\alpha} p_s^{1-\alpha}}\right)^{\sigma-1} P^{\sigma-1} \tag{13}$$

and log profits are given by

$$\ln \pi_k = \ln\left(\frac{1}{\sigma}\beta Y(\frac{\sigma-1}{\sigma}P)^{\sigma-1}\right) + (\sigma-1)\ln\Theta_{gs} + (\sigma-1)\ln\left(\frac{\lambda_g\lambda_s}{\Gamma p_g^{\alpha} p_s^{1-\alpha}}\right) + (\sigma-1)\ln\varphi_k + (\sigma-1)\ln\xi_{gsk} \tag{14}$$

We now turn to the choice of g and s by final producers.

3.2 Intermediate goods and services sector

Choice of supplier We assume that suppliers price at marginal cost, inclusive of iceberg trade costs.[20] We also assume goods and service inputs bear iceberg trade costs $\tau_g \geq 1$ and $\tau_s \geq 1$ with $\tau_g = 1$ ($\tau_s = 1$) if the good (service) is sourced domestically.

We assume that one unit of intermediate goods (services) is produced out of c_g (c_s)

[20] This follows from the Armington assumption and ensures tractability. The setup could be extended to exogenous country-specific markups, but more sophisticated pricing strategies would prevent us from finding a closed-form solution for country pairs' markets shares.

units of labor. Marginal cost pricing implies

$$p_g = \tau_g c_g \tag{15}$$

$$p_s = \tau_s c_s. \tag{16}$$

Each pair of good g and service s is characterized by a random productivity component $\ln \xi_{gsk}$ which is known and idiosyncratic to the buyer firm. For each gs pair, we treat $\ln \xi_{gsk}$ as a set of iid random variables following a Gumbel distribution with cumulative distribution function

$$F(x) = \exp\left[-\exp[-(\frac{x}{\mu} + \gamma)]\right]$$

and density

$$f(x) \equiv \frac{dF(x)}{dx} = \frac{1}{\mu}\exp[-(\frac{x}{\mu} + \gamma)]\exp\left[-\exp[-(\frac{x}{\mu} + \gamma)]\right]$$

where $\mu > 0$ and γ is the Euler constant. Our assumptions imply that firm k's draw of $\ln \xi_{gsk}$ for a given gs pair is independent of draws for other gs pairs as well as other firms' draws.

Each purchase of a good-service combination therefore represents an independent choice between the C^2 alternative combinations of goods and services. Given (14), producer k chooses a sourcing country g for goods and s for services to maximize (a monotonic transformation of):

$$\ln \Theta_{gs} + \ln\left(\frac{\lambda_g \lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right) + \ln \varphi_k + \ln \xi_{gsk}.$$

This can be interpreted as a multinomial logit linear random utility model[21] where the individual (firm k) maximizes utility $\tilde{U}_{gsk} = u_{gsk} + \ln \xi_{gsk}$ where

$$u_{gsk} = \ln \Theta_{gs} + \ln \lambda_g + \ln \lambda_s - \alpha \ln(\tau_g c_g) - (1-\alpha)\ln(\tau_s c_s) + \ln \varphi_k$$

Given distributional assumptions on $\ln \xi_{gsk}$, the probability that firm k chooses a particular good-service combination gs is given by:

$$s_{gsk} = \frac{(\varphi_k)^{\frac{1}{\mu}}\left(\frac{\Theta_{gs}\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}}{(\varphi_k)^{\frac{1}{\mu}}\sum_{gs}\left(\left(\frac{\Theta_{gs}\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}\right)} = \frac{\left(\frac{\Theta_{gs}\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}}{\sum_{gs}\left(\left(\frac{\Theta_{gs}\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}\right)} \equiv s_{gs} \tag{17}$$

[21]See Anderson et al. (1992) for a textbook treatment.

Notice that the idiosyncratic TFP parameter φ_k cancels out.

Conditional input demand Given (8), (12), (15) and (16), producer k's demand for intermediate good g *conditional on choosing gs* equals

$$\begin{aligned} q_{gk} &= \frac{1}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}\left(\frac{\alpha p_s}{(1-\alpha)p_g}\right)^{1-\alpha}\beta Y\left(\frac{\sigma-1}{\sigma}\frac{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}{\Gamma p_g^{\alpha}p_s^{1-\alpha}}\right)^{\sigma}P^{\sigma-1} \\ &= \left(\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k\right)^{\sigma-1}\left(\tau_s c_s\right)^{(1-\sigma)(1-\alpha)}\left(\tau_g c_g\right)^{\alpha-1-\alpha\sigma}\underbrace{\left(\frac{\alpha}{(1-\alpha)}\right)^{1-\alpha}\left(\frac{\sigma-1}{\sigma}\frac{1}{\Gamma}\right)^{\sigma}\beta}_{B}YP^{\sigma-1} \end{aligned} \tag{18}$$

The value of purchased intermediate goods is thus:

$$p_g q_{gk} = \left(\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k\right)^{\sigma-1}\left(\tau_s c_s\right)^{(1-\sigma)(1-\alpha)}\left(\tau_g c_g\right)^{\alpha(1-\sigma)}BYP^{\sigma-1} \tag{19}$$

Similarly, producer k's demand for intermediate services s equals:

$$\begin{aligned} q_{sk} &= \frac{1}{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}\left(\frac{(1-\alpha)p_g}{\alpha p_s}\right)^{\alpha}\beta Y\left(\frac{\sigma-1}{\sigma}\frac{\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k}{\Gamma p_g^{\alpha}p_s^{1-\alpha}}\right)^{\sigma}P^{\sigma-1} \\ &= \left(\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k\right)^{\sigma-1}\left(\tau_s c_s\right)^{(1-\sigma)(1-\alpha)-1}\left(\tau_g c_g\right)^{\alpha(1-\sigma)}\underbrace{\left(\frac{\alpha}{(1-\alpha)}\right)^{-\alpha}\left(\frac{\sigma-1}{\sigma}\frac{1}{\Gamma}\right)^{\sigma}\beta}_{B'}YP^{\sigma-1} \end{aligned} \tag{20}$$

and the value of purchased intermediate services equals:

$$p_s q_{sk} = \left(\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k\right)^{\sigma-1}\left(\tau_s c_s\right)^{(1-\sigma)(1-\alpha)}\left(\tau_g c_g\right)^{\alpha(1-\sigma)}B'^{\sigma-1} \tag{21}$$

Notice in (19) and (21) that an increase in goods iceberg trade costs reduces imports of services, and vice-versa. This holds irrespective of whether the sourcing country is the same for goods and services ($g = s$). Also note this result holds in our Cobb-Douglas specification in which goods and services are neither complements not substitutes.

3.3 Closing the model

Aggregate Profits and National Income We now index importing countries by subscript d. Given marginal cost pricing in the intermediate sector only final sector firms earn profits. Aggregate world profits enter national income as seen in (4). We further assume that N^d is exogenous as in Chaney (2008).

World profits are equal to:

$$
\begin{aligned}
\Pi_w = \sum_d \int_0^{N^d} \pi_{dk} dk &= \sum_d \int_0^{N^d} \frac{\beta Y_d}{\sigma} \left(\frac{\sigma}{\sigma - 1} c_{dk} \right)^{1-\sigma} P_d^{\sigma-1} dk \\
&= \sum_d \frac{\beta Y_d}{\sigma} P_d^{\sigma-1} \int_0^{N^d} p_{dk}^{1-\sigma} dk \\
&= \sum_d \frac{\beta Y_d}{\sigma} \\
&= \frac{\beta Y_w}{\sigma}
\end{aligned}
$$

where $Y_w = \sum_d Y_d$.

Since

$$
Y_w = L_w + \Pi_w = L_w + \frac{\beta Y_w}{\sigma} = \frac{\sigma}{\sigma - \beta} L_w
$$

it follows that

$$
\Pi_w = \frac{\beta}{\sigma - \beta} L_w
$$

and

$$
Y_d = \frac{\sigma}{\sigma - \beta} L_d \tag{22}
$$

Price Index Recall that $P \equiv \left(\int_0^N p_k^{1-\sigma} dk \right)^{\frac{1}{1-\sigma}}$, where $p_k = \frac{\sigma}{\sigma - 1} \frac{\Gamma c_g^\alpha \tau_g^\alpha c_s^{1-\alpha} \tau_s^{1-\alpha}}{\Theta_{gs} \xi_{gsk} \lambda_g \lambda_s \varphi_k}$. From equation 2.25 in Anderson et al. (1992) we know that the probability of choosing a particular country pair gs, i.e., the probability that $\tilde{U}_{gsk}$ is maximal across country pairs, can be written as:

$$
s_{gs} = \int_{-\infty}^{\infty} f(x) \prod_{qr \neq gs} F(u_{gsk} - u_{qrk} + x) dx,
$$

where $F(.)$ refers to the Gumbel cumulative distribution function and $f(.)$ its density. The term inside the integral represents the probability density of $\ln \xi_{gsk}$ being equal to x and x being such that gs is chosen. Recalling that all firms draw from the same Gumbel distributions irrespective of their φ_k we can write:

$$
P = \left(\sum_{gs} \left(\frac{\sigma}{\sigma - 1} \frac{\Gamma c_g^\alpha \tau_g^\alpha c_s^{1-\alpha} \tau_s^{1-\alpha}}{\Theta_{gs} \lambda_g \lambda_s} \right)^{1-\sigma} E\left[\varphi_k^{\sigma-1}\right] \int_{-\infty}^{\infty} \mathrm{e}^{x^{\sigma-1}} f(x) \prod_{qr \neq gs} F(u_{gsk} - u_{qrk} + x) dx \right)^{\frac{1}{1-\sigma}} \tag{23}
$$

3.4 The importance of Θ_{gs}

The Θ_{gs} component in the production function (7) takes a higher value when inputs come from the same country. We show below that this parameter implies a greater probability of sourcing goods and services inputs from the same country, a key feature of the data which we labelled Fact 1 in Section 2. At the same time, the presence of Θ_{gs} implies that, everything else equal, also import values conditional on importing should be higher when inputs come from the same country; something that is at odds with an alternative, to our Θ_{gs}, channel potentially driving Fact 1: fixed costs savings from jointly importing goods and services from the same country. In our estimations in Section 4 we allow for both Θ_{gs} and fixed costs to affect importing behavior.

We acknowledge the parameter Θ_{gs} may well capture a number of related economic mechanisms. Firstly, it may capture that there is an advantage if the same exporting firm supplies both g and s.[22] This is the case when: i) the good and/or the service are of higher quality if bought from the same firm. For example, the presence of the service can be perceived as higher quality of the products (Ariu et al., 2016). Similarly, some intangibles owned by the supplier, such as ISO9000 quality certification or a reputation for quality, have non-rival effects on g and s.[23] At the same time, proprietary knowledge can potentially make original component manufacturers the best providers of services of those goods; the same firm can be better in tailoring services to the goods, or uses the services to make the goods more relationship-specific. This is likely in the case of maintenance, leasing or "business solutions" that outsource some of the downstream firm's tasks. ii) joint exports from the same firm are alike to arise when a parent firm provides specific "headquarter" services along with intra-firm goods trade to an affiliate. iii) when transaction or search costs are high and/or there are economies of scope in producing both.

Secondly, Θ_{gs} may capture country-specific complementarity in goods and services, resulting for instance from service providers being more familiar with national goods. In the case of engineering, design, consulting, maintenance or monitoring services, that familiarity is likely to make goods and services of the same origin more complementary than with varieties of other countries. While all these mechanisms are interesting, we do not provide more specific microfoundations as the lack of data on the identity of foreign exporters prevents us from discriminating between these stories.[24] Yet, results obtained from combining our data with Input-Output Tables for Belgium do provide

[22] Ariu et al. (2016) shows that about 10% of exporters offer both goods and services together, accounting for more than 45% of trade.

[23] According to Bernard et al. (2010) this argument may explain the greater propensity of the most productive Belgian firms to perform "carry-along trade".

[24] Ariu et al. (2016) provide evidence on the mechanisms behind goods-services complementarity.

some interesting information. More specifically, goods and services products that are jointly imported from the same country in the same year (SJ sample) are systematically characterized by higher weights in the input-output technology of the importing firms as compared to those goods and services products imported in the whole sample (ES sample).[25]

Turning back to the model the Θ_{gs} assumption implies that the probability of choosing a particular gs combination in our model is generally different from the product of the marginal probabilities (of sourcing goods from g and services from s). Only in the special case of $\Theta_{gs} = 1, \forall g, s$ the joint probability equals the product of the marginal probabilities.

To see this, consider the following. Given the problem each firm k is solving is characterized by a finite number of alternatives we readily have:

$$\max_{gs}\{\tilde{U}_{gsk}\} = \max_{g}\{\max_{s}\{\tilde{U}_{gsk}\}\} \tag{24}$$

Consider one possible origin country for goods imports, g^*, that may or may not be chosen by firm k. Due to the IIA property of the multinomial logit, the probability of sourcing services from country s rather than s^* is the same conditionally on sourcing goods from a particular country g^* or not (see Anderson et al. (1992) p23, Equation 2.10). Therefore we can start solving problem (24) by choosing a country s among C possible countries to source services from, so as to maximize:

$$\begin{aligned} \hat{U}_{sk}^{g^*} &= u_{sk}^{g^*} + \ln \xi_{sk}^{g^*} \\ \text{where } u_{sk}^{g^*} &= \ln \eta^{g^*} + \ln \Theta_s^{g^*} + \ln \lambda_s - (1-\alpha)\ln(\tau_s c_s) + \ln \varphi_k \end{aligned} \tag{25}$$

where $\eta^{g^*} = \frac{\lambda_{g^*}}{(\tau_{g^*} c_{g^*})^\alpha}$ is an irrelevant constant in this problem, $\Theta_s^{g^*}{=}\Theta_{gs}$ for $g{=}g^*$ or equivalently $\Theta_s^{g^*} = \Theta_{g^*s}$, and $\ln \xi_{sk}^{g^*} = \ln \xi_{gsk}$ for $g{=}g^*$ is distributed Gumbel and is iid across firms and alternatives.

This implies that a multinomial logit model can be used to describe this problem.

[25] We assign each firm-year to its corresponding two-digit Nace rev 1.1 main industry affiliation and use Input-Output Table weights for Belgium broken down at the two-digit Nace rev 1.1 level for the year 2000. We then compute, separately for the SJ and ES samples, equivalent weights based on imported goods and services products. We finally analyze the difference between imports-based weights and input-output weights and find that in the SJ sample such difference is, as compared to the ES sample, more likely to be positive for goods and services products with high input-output weights.

The probability of importing services from a country s conditional on g=g^* is given by:

$$s_{sk}^{g^*} = s_s^{g^*} = \frac{\left(\frac{\Theta_s^{g^*}\lambda_s}{(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}}{\sum_s \left(\left(\frac{\Theta_s^{g^*}\lambda_s}{(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}\right)}. \tag{26}$$

Note that in general $s_s^{g^*} \neq s_s^{g'}$ because $\Theta_s^{g^*} \neq \Theta_s^{g'}$. Conversely we can find the optimal g given s is equal to a particular s^*. More precisely, for a given source country of services there are equivalent expressions to (25) and (26) leading to:

$$s_{gk}^{s^*} = s_g^{s^*} = \frac{\left(\frac{\Theta_g^{s^*}\lambda_g}{(\tau_g c_g)^{\alpha}}\right)^{\frac{1}{\mu}}}{\sum_g \left(\left(\frac{\Theta_g^{s^*}\lambda_g}{(\tau_g c_g)^{\alpha}}\right)^{\frac{1}{\mu}}\right)}. \tag{27}$$

Finally note the following. Suppose we set $\Theta_{gs} = 1, \forall g, s$. We will then have $s_s^{g^*} = s_s^{g'} = s_s$ and $s_g^{s^*} = s_g^{s'} = s_g$ with:

$$s_g s_s = \frac{\left(\frac{\lambda_g}{(\tau_g c_g)^{\alpha}}\right)^{\frac{1}{\mu}}}{\sum_g \left(\left(\frac{\lambda_g}{(\tau_g c_g)^{\alpha}}\right)^{\frac{1}{\mu}}\right)} \frac{\left(\frac{\lambda_s}{(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}}{\sum_s \left(\left(\frac{\lambda_s}{(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}\right)} = \frac{\left(\frac{\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}}{\sum_{gs} \left(\left(\frac{\lambda_g\lambda_s}{(\tau_g c_g)^{\alpha}(\tau_s c_s)^{1-\alpha}}\right)^{\frac{1}{\mu}}\right)} = s_{gs}, \tag{28}$$

which means that the choice of the sourcing country for goods and services are independent.

4 Estimation

4.1 Econometric Model

The theoretical model delivers three fundamental equations to be estimated.

Firstly, each firm k is solving the following problem:

$$\begin{aligned} &\max_{g,s}\{\tilde{U}_{gsk}\} \qquad\qquad (29)\\ &\quad \text{where } \tilde{U}_{gsk} = u_{gsk} + \ln \xi_{gsk} \\ &\qquad\qquad u_{gsk} = \ln \Theta_{gs} + \ln \lambda_g + \ln \lambda_s - \alpha \ln(\tau_g c_g) - (1-\alpha)\ln(\tau_s c_s) + \ln \varphi_k \end{aligned}$$

and $\ln \xi_{gsk}$ is iid across firms and gs pairs and is distributed Gumbel with shape parameter μ. Solving this problem yields the multinomial logit choice probabilities (17) of choosing each potential gs country pair.

Secondly, the model predicts the value of imports of goods and services from any potential gs country pair. However, we only observe imports from *chosen* country pairs. In the model, conditional on choosing a particular gs, these are given by:

$$p_g q_{gk} = (\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k)^{\sigma-1} (\tau_s c_s)^{(1-\sigma)(1-\alpha)} (\tau_g c_g)^{\alpha(1-\sigma)} BYP^{\sigma-1} \tag{30}$$
$$p_s q_{sk} = (\Theta_{gs}\xi_{gsk}\lambda_g\lambda_s\varphi_k)^{\sigma-1} (\tau_s c_s)^{(1-\sigma)(1-\alpha)} (\tau_g c_g)^{\alpha(1-\sigma)} B'^{\sigma-1}. \tag{31}$$

The model described by (29-31) has two outcome equations of interest, (30) and (31), and a conditional multinomial logit selection equation (29). To estimate such a model, we use a two-stage estimation method drawing from the theory developed in Lee (1983), and described by Bourguignon et al. (2007).

Note that in the model a fall in some country's (say g^*) goods tariff raises service imports from other countries, not just from that country. This is because the (now cheaper) good is complementary with services sourced from any origin, albeit more complementary with services sourced from the same origin. The resulting change in imports can be decomposed into two effects. The first is a change in the probabilities of importing that favors all g^*s origins at the expense of the other gs combinations. The second one comes from import values conditional on importing, that would increase for all g^*s origins and remain constant for the other gs combinations.

In designing an empirical counterpart to (29-31) we extend the theoretical model in four ways. First, we introduce a time dimension, t. Second, we allow for the presence of fixed costs to start importing from a particular gs pair. Denote by y_{gskt} a binary variable that takes value one when a particular gs combination is chosen by firm k in year t. Fixed costs make the choice of origin dependent on past choices, which we capture by introducing the lagged dependent variable $y_{gsk,t-2}$ in the first-stage selection equation. Such fixed costs should not affect second-stage conditional import equations, which we use as an exclusion restriction. Note that we let these fixed costs vary freely across country pairs, so that our assumption is consistent with fixed cost savings from joint imports, as in for instance Antras et al. (2017). While fixed cost savings are consistent with Fact 1, they cannot however explain systematic differences in import values, which we find below.

Third, different firms import different goods and services, and we do observe the specific products imported. In our analysis we do not fully exploit the product dimension, mainly to reduce the dimensionality of the problem. For example by collapsing the product dimension we will still be working with about 300 million observations when estimating the counterpart to (29) while including a large number of dummy variables.

We do however exploit some of the information coming from the product dimension by allowing trade costs to vary by firm, country and year: τ_{gkt} and τ_{skt}. More specifically, we exploit the heterogeneity across firms in the trade costs of the specific inputs they import as an additional source of identification and use the proxies outlined in Section 2.

Fourth, we allow for multiple-origin importers, i.e., firms that import from many origins in the same year. In our sample roughly 40% (60%) of firms import goods (services) from a single origin country in a given year, behaving exactly as in our model. We choose to include multiple-origin importers to account for the remaining imports, but check that results are qualitatively similar in the subsample of single-origin importers. In the first stage equation the conditional multinomial logit model allows for multiple 'ones' - though the discrete choice model interpretation is weakened. In the second stage we address the multiple-origin importers issue in the following way. For example suppose a firm imports goods from 1 country and services from 3 countries in a given year. In that case we create 3 gs pairs and impute goods imports to the 3 pairs based on the share of country s in total services imports. This way imports of goods from the three pairs will add up to total goods imports. This proportional assignment rule is consistent with our assumption of Cobb-Douglas production functions.

We specify the empirical counterpart to (29-31) as:

$$
\begin{aligned}
y_{gskt} &= \mathbf{1}_{[\tilde{U}_{gskt}=\max_{qr}\{\tilde{U}_{qrkt}\}]} \\
\tilde{U}_{gskt} &= a y_{gsk,t-2} + \theta_{gs} + \mathbf{D}_g + \mathbf{D}_s + a_1 t^G_{gkt} + a_2 t^S_{skt} + e_{kt} + e_{gskt} \qquad (32)\\
Imp^{goods}_{gskt} &= \exp\left[b_0 + \theta_{gs} + \mathbf{D}_g + \mathbf{D}_s + b_1 t^G_{gkt} + b_2 t^S_{skt} + u_{kt} + u_{gskt}\right] \qquad (33)\\
Imp^{services}_{gskt} &= \exp\left[c_0 + \theta_{gs} + \mathbf{D}_g + \mathbf{D}_s + c_1 t^G_{gkt} + c_2 t^S_{skt} + v_{kt} + v_{gskt}\right], \qquad (34)\\
gs &= 1...C^2.
\end{aligned}
$$

As described above y_{gskt} is a binary variable that takes value one when a particular gs combination is chosen by firm k in year t, i.e., if $\tilde{U}_{gskt} = \max_{qr}\{\tilde{U}_{qrkt}\}$ and zero otherwise. Imp^{goods}_{gskt} represents imports of goods by firm k at time t from country g assigned to the gs pair, as explained above. $Imp^{services}_{gskt}$ is defined in a similar way. These outcome variables are observed only if the gs combination is chosen ($y_{gskt} = 1$). θ_{gs} is a dummy variable that takes value one if $g = s$ and the corresponding coefficient in the regression is equivalent to $\ln \Theta_{gs}$ in the theoretical model. D_g and D_s are vectors of dummies for source countries of goods and services respectively while e_{kt}, u_{kt} and v_{kt}

are firm-time unobservables potentially correlated with regressors.[26]

The trade barrier proxies, t^G_{gkt} and t^S_{skt}, are as defined in Section 2 and represent the empirical counterparts of (the log of) the firm-destination-time dimension of τ_{gkt} and τ_{skt}. Formally, we impose that $\ln \tau_{gkt}$ is a linear combination of a country-specific component t^G_g, a firm-time specific component t^G_{kt} and the trade-barrier proxy t^G_{gkt}. t^G_g is a proxy for average trade costs in country g and is absorbed by the D_g country dummy. t^G_{kt} controls for the average trade costs for the particular bundle of goods purchased by firm k and goes into firm-time unobservables. t^G_{gkt} corresponds to the import tariff of the firm-specific bundle in country g in year t. We impose a similar linear form for $\ln \tau_{skt}$.

Turning to the cost of producing intermediate goods c_g, our empirical specifications allow this to be firm-origin-time-specific: c_{gkt}. We impose that (the log of) c_{gkt} can be linearly decomposed into a country-specific component that will be absorbed by the D_g country dummy, and a firm-time specific component that we capture by means our firm-time unobservables. We impose a similar linear form for c_{skt}. We also assume that e_{gskt} is distributed Gumbel. We finally allow the value of imports of goods and services to be measured with error, under the assumption that such measurement error is iid. Therefore u_{gskt} and v_{gskt} contain such measurement error and are in general different from e_{gskt}. In terms of inference, we cluster standard errors at the firm-time level in all estimations.[27]

Five things are worth noting. First, the firm-time specific component e_{kt} in (32) can be arbitrarily correlated with the regressors but vanishes when estimating the first stage conditional logit model. Indeed, components that are not choice-specific do not affect estimations of choice-specific coefficients and/or the choice probabilities. Second, firm-time specific components u_{kt} and v_{kt} in (33) and (34) can also be arbitrarily correlated with the regressors and will be accounted for by means of fixed effects. Both types of firm-time components will capture variation over time and unobserved heterogeneity in input prices as well as downstream firms' TFP not accounted for by the model.

Third, although the assumptions in Lee (1983) are in general restrictive, they are

[26]We refrain from using country-time dummies for reasons related to computational power. Indeed, even with a dedicated multi-core powerful server, running the first stage (32) with country-time dummies implies estimating a non-linear model with more than 1000 dummy variables that are not possible to partial out over a sample of about 300 million observations. However, we can run the two second stages (33) and (34) with country-time dummies. The results, provided in Table 6 below, are very similar to those obtained with country dummies.

[27]It would have been perhaps desirable to cluster standard errors at the country level. However, this is technically not possible when having fixed effects in a regression. Indeed, in order to operate clustering of standard errors in fixed effects models individuals (a firm-time pair in our setting) should be nested within clusters while in our estimations the same firm-year could span into several clusters (countries).

coherent with our framework. As discussed in Bourguignon et al. (2007), Lee (1983) imposes a certain structure on the correlation between the error terms in the selection and outcome equations. Considering for example the import of goods outcome, the correlations between e_{qrkt} - e_{gskt} and u_{gskt} should be identical for all q and r. This result naturally follows in our framework from the fact that e_{gskt} and u_{gskt} are iid across alternatives and differ from each other only by some orthogonal iid measurement error.

Fourth, because of the presence of $y_{gsk,t-2}$ and the fact that we allow trade barriers to be firm-time-origin specific, the probability of choosing a particular gs sourcing pair by firm f at time t will vary across firms and time ($s_{gskt} = s_{gs}$ in the model in Section 3). Yet, it is straightforward to show it is still true that s_{gskt} will in general be different from the product of marginal probabilities s_{gkt} and s_{skt} and will be equal to that product only in the special case of $\theta_{gs} = 1, \forall g, s$.[28] Fifth, in the second stage of the model we estimate equations (33) and (34) by means of a Poisson pseudo-maximum-likelihood (PPML) estimator rather than log-linearizing and using OLS. This reflects our interest in import values, rather than log-values.[29]

4.2 Estimation Results

Focusing on column (1) of Table 5, we can observe the first step of our estimation procedure for the complete sample. The exclusion restriction, $y_{gsk,t-2}$, is highly significant, meaning that past import status/fixed costs is a strong predictor of current import status. All the other covariates have the expected sign and significance level. More specifically, goods and services are disproportionately more likely to be sourced from the same country (positive and significant coefficient of θ_{gs}) while trade barriers for both goods and services matter in the choice of a particular gs pair.

In columns (2) and (3) of Table 5, we can appreciate the results of the second step of our estimation. The most important result is that there is again evidence of strong complementarities in importing goods and services together, as shown by the positive and significant coefficient of θ_{gs}. In particular, firms import a higher value of goods

[28] In estimating (32) we employ the Stata command clogit and trim some observations based on the distribution of the number of instances y_{gskt} is equal to one across firm-years. More specifically, we exclude from the estimation those (very few) observations pertaining to firms that in a given year import from more than 100 goods-services origin pairs. We do this because of computational constraints.

[29] The equivalence between a Poisson and a log linear model strictly holds in the case of errors distributed log-normally and homoscedasticity. In such a case Lee (1983) is perfectly consistent with our framework and in particular with estimating second stages in levels rather than log-linearizing. Finally, in estimating (33) and (34) we trim the top and bottom 0.5% of observations based on the distribution of Imp^{goods}_{gskt} and $Imp^{services}_{gskt}$.

and services when sourcing from the same country which is at odds with a simple fixed costs savings mechanism. At the same time, goods (services) trade barriers decrease goods (services) import values. Moreover, service trade barriers have a negative and significant effect on the value of goods imports. Similarly, goods trade restrictions have a negative and significant impact on services imports values. Finally, the additional control for selection dictated by the Lee (1983) model and coming from the first step (we loosely label this 'inverse Mills ratio' - IMR - in what follows) is highly significant in both the goods and services values regressions suggesting that it is indeed warranted to control for selection.

In terms of magnitudes there are several things to notice. First, the easiest coefficient to interpret and compare with previous studies is the one of t^G_{gkt} in column (2). That coefficient measures the elasticity of goods trade values with respect to tariffs. A value of -2.44% means that a 1% ad valorem tariff reduces trade values by 2.44%; a number in line with the existing literature on trade elasticities (Broda and Weinstein, 2006). As far as θ_{gs} is concerned, values from columns (2) and (3) indicate that, everything else equal, importing goods and services from the same country corresponds to about 45-50% higher import values. This is by all means sizeable. Moving to t^S_{skt}, there is no clear scale to consider but variation in the data. In this respect, a one standard deviation increase in t^S_{skt} implies a 13% decrease of import values for goods and a 5% decrease of import values for services. The corresponding numbers for t^G_{gkt} are a 5% reduction for goods and a 6% reduction for services. All in all, this suggests there is scope for larger trade boost effects stemming from a reduction in services as compared to goods trade barriers.

Second, in the model described in Section 3 the parameters corresponding to θ_{gs}, t^G_{gkt} and t^S_{skt} are the same across the selection and outcome equations. The use of a latent model for estimating the selection equation means that the coefficients of our first stage are not comparable to those of the second stage. More specifically, coefficients in column one cannot be translated into meaningful partial effects within the conditional multinomial logit model.[30] Yet, coefficient ratios are comparable. In this respect, looking across coefficients in columns (1) to (3) does suggest that, despite being simple, our model imposes coefficient restrictions that find some counterpart in the data.

To explore the data further and provide additional support to our analysis, in panel (b) we restrict our estimations to the sample of firms belonging to the manufacturing sector only. The idea is to check whether results are possibly stronger for such firms who are more likely to combine imported goods and services into a production process along the lines of what described in equation (7). Results look qualitatively identical to

[30]See Wooldridge (2010) for a in-depth discussion of this aspect.

Table 5: Main Estimation Results

	Panel (a): Complete Sample			Panel (b): Manufacturing			Panel (c): MNE and Foreign Owned		
	1^{st} Stage	2^{nd} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage	2^{nd} Stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	y_{gskt}	$\text{Imp}_{gskt}^{Goods}$	$\text{Imp}_{gskt}^{Services}$	y_{gskt}	$\text{Imp}_{gskt}^{Goods}$	$\text{Imp}_{gskt}^{Services}$	y_{gskt}	$\text{Imp}_{gskt}^{Goods}$	$\text{Imp}_{gskt}^{Services}$
$y_{gsk,t-2}$	3.3361^a			3.0806^a			3.0351^a		
	(0.0123)			(0.0210)			(0.0257)		
θ_{gs}	0.3821^a	0.5119^a	0.4439^a	0.2721^a	0.4440^a	0.4064^a	0.2686^a	0.4875^a	0.4723^a
	(0.0047)	(0.0172)	(0.0249)	(0.0058)	(0.0224)	(0.0276)	(0.0072)	(0.0245)	(0.0367)
t_{gkt}^{G}	-0.0264^a	-0.0244^a	-0.0295^b	-0.0188^a	-0.0682^a	-0.0963^a	-0.0179^a	-0.0395^a	-0.0441^c
	(0.0220)	(0.006)	(0.0173)	(0.0032)	(0.0126)	(0.0235)	(0.0034)	(0.0103)	(0.0260)
t_{skt}^{S}	-0.0274^a	-0.1290^a	-0.0421^b	-0.0580^a	-0.1901^a	-0.2091^a	-0.0418^a	-0.1327^a	-0.0154
	(0.0086)	(0.0296)	(0.0195)	(0.0150)	(0.0354)	(0.0395)	(0.0173)	(0.0372)	(0.0286)
IMR		0.8606^a	0.9708^a		-0.7128^a	-1.0447^a		-0.9457^a	-1.2070^a
		(0.023)	(0.0329)		(0.0390)	(0.0528)		(0.0403)	(0.0629)
D_g	yes	yes	yes	yes	yes	yes	yes	yes	yes
D_s	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm-year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Cond. Logit	PPML	PPML	Cond. Logit	PPML	PPML	Cond. Logit	PPML	PPML
Observations	254,204,600	1,201,131	1,008,274	70,998,200	589,863	509,525	36,480,600	619,103	593,209
# of Firm-Years	97,762	69,888	41,297	27,307	24,401	13,307	14,031	13,200	10,858
(Pseudo) R2	0.45			0.45			0.40		

Note: Firm-year clustered standard errors in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

those of the complete sample both for the first step (column 4) and for the second steps (columns 5 and 6). In terms of magnitudes, however, the coefficients corresponding to trade barriers in the outcomes equations (first step coefficients are not really comparable) are considerably larger when restricting the attention to manufacturing firms which is in line with intuition. On the other hand, the coefficients of θ_{gs} are broadly similar between columns (2) to (3) and (5) to (6) suggesting that the strength of complementarities between goods and service sourced from the same country is roughly comparable for manufacturing and non-manufacturing firms.

In panel (c) we restrict our estimation sample to multinational and foreign owned firms.[31] On the one hand, these firms have a more prominent involvement in international activities than purely domestic firms and might be the ones benefiting the most from a reduction in trade barriers. On the other hand, they also have extended networks across countries allowing them to minimize the impact of differences in trade costs across origins. Despite the sharp reduction in the number of observations, results in columns (7) to (9) look very similar to those of the complete sample and coefficients are all significant but in one case. Magnitudes are also roughly comparable between the complete sample and the multinational and foreign owned sample suggesting that multinational and foreign owned firms are no more or less likely to benefit from a trade liberalization in goods and/or services.

Table 6 reports the results of three other robustness checks. Panel (a) simply displays the same estimates as in panel (a) of Table 5 for the sake of comparison. Panel (b) shows estimates from an alternative first-stage regression run on the subsample of single-origin importers. As explained above those firms behave exactly as in our theoretical model. Reassuringly, results are very similar to the baseline first-stage regression, which lends support for our discrete-choice interpretation of the baseline conditional logit results.[32] In Panel (c) we run another alternative set of second-stage regressions where we control for country-year unobservables (as explained above, using country-year dummies in the first stage would be computationally unfeasible). A simple gravity regression framework would indeed suggest a number of omitted time-varying country characteristics making this robustness check worthwhile. In these regressions use the inverse Mills ratio from the baseline regression to control for selection effects. Results are qualitatively similar to the baseline, with slightly higher trade cost elasticities. Finally in panel (d) we check whether controlling for selection is crucial for our results. In particular, we exclude from the estimation of the two outcome equations the inverse Mills ratio computed in

[31]This is possible using the NBB Survey on FDI.

[32]Note that our baseline second-stage estimation uses firm-year fixed effects, relying on multiple-origin importers for identification. This is why we do not compare the results of second-stage regressions on the single-origin subsample to the baseline.

Table 6: Additional Robustness Checks

	Panel (a): Baseline, complete sample			Panel (b): Single-origin importers	Panel (c): Country-time dummies		Panel (d): No Inv. Mills Ratio	
	1^{st} Stage	2^{nd} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage	2^{nd} Stage	2^{nd} Stage	2^{nd} Stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	y_{gskt}	$\text{Imp}^{Goods}_{gskt}$	$\text{Imp}^{Services}_{gskt}$	y_{gskt}	$\text{Imp}^{Goods}_{gskt}$	$\text{Imp}^{Services}_{gskt}$	$\text{Imp}^{Goods}_{gskt}$	$\text{Imp}^{Services}_{gskt}$
$y_{gsk,t-2}$	3.3361^a			3.5485^a				
	(0.0123)			(0.0312)				
θ_{gs}	0.3821^a	0.5119^a	0.4439^a	2.1766^a	0.5088^a	0.4399^a	0.6626^a	0.6385^a
	(0.0047)	(0.0172)	(0.0249)	(0.0383)	(0.0170)	(0.0247)	(0.0170)	(0.0246)
t^G_{gkt}	-0.0264^a	-0.0244^a	-0.0295^a	-0.0630^a	-0.0273^a	-0.0329^a	-0.0327^a	-0.0438^b
	(0.0220)	(0.006)	(0.0173)	(0.0047)	(0.0061)	(0.0163)	(0.0060)	(0.0185)
t^S_{skt}	-0.0274^a	-0.1290^a	-0.0421^a	-0.0695^a	-0.1380^a	-0.0612^a	-0.1500^a	-0.0576^b
	(0.0086)	(0.0296)	(0.0195)	(0.0163)	(0.0296)	(0.0197)	(0.0290)	(0.0194)
IMR		0.8606^a	0.9708^a		0.8707^a	0.9770^a		
		(0.023)	(0.0329)		(0.0222)	(0.0309)		
D_g	yes	yes	yes	yes	yes	yes	yes	yes
D_s	yes	yes	yes	yes	yes	yes	yes	yes
Firm-year FE	yes	yes	yes	yes	yes	yes	yes	yes
Country-year dummies	no	no	no	no	yes	yes	no	no
	Cond. Logit	PPML	PPML	Cond. Logit	PPML	PPML	PPML	PPML
Observations	254,204,600	1,201,131	1,008,274	60,286,200	1,201,131	1,008,274	1,201,131	1,008,274
# of Firm-Years	97,762	69,888	41,297	23,187	69,888	41,297	69,888	41,297
(Pseudo) R2	0.45			0.5369				

Note: Firm-year clustered standard errors in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

the (baseline) first stage. Results remain qualitatively unchanged. However, coefficient values are somewhat inflated. Overall, this suggests that controlling for selection is warranted but does not affect our core findings much.

5 Conclusions

In this paper we have examined the interactions between goods and services imports within firms and explored their implications for goods and services trade policies. We started from several observations pointing towards some complementarity between imports of both types of products: firstly, importers of both goods and services account for the lion share of Belgian imports. Secondly, sourcing both goods and services from the same country is disproportionately likely, given the marginal frequencies of importing goods or importing services from that country. Thirdly, services imports appear to be negatively correlated with goods trade costs and vice versa, even when controlling for firm-year and country unobservables.

We then develop a theoretical model to guide our empirical analysis that embeds a discrete choice of input origin countries in a simple general equilibrium setup. The model ties the choice of origin countries and the conditional choice of import values to a relatively narrow set of parameters. In particular, we capture technological complementarities in goods and services from the same origin country. Moreover, input-output linkages in our model create a trade policy spillover, not just from intermediate to final products, but also from intermediate goods to intermediate services.

In moving to the empirics, we extend beyond the model to better capture the richness of the data and consider complementary channels. In particular, we use the selection model developed in Lee (1983) and described by Bourguignon et al. (2007). The first-stage selection equation features a conditional multinomial logit for the probability to source inputs from a given country. In the second stage, we estimate two export value outcome regressions, one for goods and one for services, that are augmented with selection-bias controls coming from the first stage. We also allow for both firm-specific time-varying and country-specific time invariant unobservables that may be arbitrarily correlated with the regressors in both the first and second stage.

Our results reveal strong direct complementarities between goods and services which are important not just because bi-traders account for a large share of trade, but also because they can affect the design of trade policy evaluation and of trade policy itself. Finally, By focusing on firms rather than sectors, this paper offers a first attempt at looking at goods-services trade policy spillovers while accounting for the ongoing "servitization" of manufacturing. Several simplifying assumptions were necessary to achieve tractability and we look forward to further work extending this approach.

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Appendices

Table A-1: Correspondence Between BoP and PMR Sectors

BoP Classification	BoP Code	PMR Sector
Air transport	210	Airlines
Air transport, passengers	211	Airlines
Air transport, freights	212	Airlines
Air transport, other	213	Airlines
Other transport	214	Rail
Other transport, passengers	215	Rail
Other transport, freights	216	Rail
Other transport, other	217	Rail
Other transport	214	Road
Other transport, passengers	215	Road
Other transport, freights	216	Road
Other transport, other	217	Road
Communication services	245	Post
Communication services	245	Telecom
Postal and courrier services	246	Post
Telecommunications services	247	Telecom
Legal, Accounting, Management, Consulting and Public Relations	274	Accounting
Legal, Accounting, Management, Consulting and Public Relations	274	Legal
Architectural, Engineering and Other Technical Services	280	Architect
Architectural, Engineering and Other Technical Services	280	Engineer

Table A-2: List of countries included in our analysis

iso 2	country	iso 2	country
AE	United Arab Emirates	IN	India
AO	Angola	IT	Italy
AR	Argentina	JP	Japan
AT	Austria	KR	Korea, Republic of
AU	Australia	LR	Liberia
BG	Bulgaria	LU	Luxembourg
BR	Brazil	MA	Morocco
CA	Canada	MX	Mexico
CD	Congo, The Democratic Republic of the	MY	Malaysia
CH	Switzerland	NL	Netherlands
CN	China	NO	Norway
CZ	Czech Republic	NZ	New Zealand
DE	Germany	PL	Poland
DK	Denmark	PT	Portugal
DZ	Algeria	RO	Romania
ES	Spain	RU	Russian Federation
FI	Finland	SE	Sweden
FR	France	SG	Singapore
GB	United Kingdom	SK	Slovakia
GR	Greece	TH	Thailand
HK	Hong Kong	TN	Tunisia
HU	Hungary	TR	Turkey
ID	Indonesia	TW	Taiwan
IE	Ireland	US	United States
IL	Israel	ZA	South Africa

Table A-3: Reduced-form estimates of the impact of services trade barriers on goods sourcing choices, and vice versa. Robustness: eliminating firm-time observations corresponding to Vehicles and Transportation

	Goods	**Services**
	(1)	(2)
Dep. Var.:	$I^G_{gkt} = 1$	$I^S_{skt} = 1$
Goods trade barriers	-0.0478^a	-0.0188^a
	(0.0027)	(0.0030)
Services trade barriers	-0.0050	-0.0649^a
	(0.0044)	(0.0072)
Firm-Year fixed effects	Yes	Yes
Country Dummies	Yes	Yes
Observations	5,141,700	2,944,600
Pseudo R-squared	0.4001	0.4030
Number of firm-years	102,834	58,892

Note: Firm-time clustered standard errors in parentheses. ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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