The supplier network of exporters: Connecting the dots

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Abstract

The capability of domestic firms to reach foreign markets is an important indicator of a country's economic strength and a target of many economic policies. We know that only a small share of producers is engaged in international trade and that these firms perform in many aspects differently from their purely domestic counterparts. Recent research, however, highlighted that many exporters are just trade intermediaries that do not produce the exported good and, importantly, the capability to export is supported by availability of cheap and quality inputs. This suggests that in order to understand an economy's involvement in international trade and the characteristics of firms that produce for foreign markets we need to look beyond the firms that own a good when it crosses the border and acknowledge that many firms are engaged in international trade indirectly. This paper offers the first glimpse of the domestic supplier network that underpins exports production. It shows the extent to which all firms in an economy are connected to foreign markets through supplier relationships with exporting firms and how these connections are associated with firms' performance. To this purpose we use a unique panel dataset of yearly transactions between all firms in Belgian economy that is linked to data on firms' characteristics and international transactions.

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1 Introduction

When it comes to international trade we tend to think in terms of countries. We know that free trade allows countries to specialize in products in which they have comparative advantage and to import goods that are cheaper to produce abroad. Beneficial effects of international trade come from better specialization at the global level, and better access to different varieties of goods. Since the mid-1990s, however, the empirical literature has taught us that it is firms that trade, not countries and that thinking in terms of firms brings important insights into the impact of international trade and trade policies. We learned that even in the comparative advantage industries, only a handful of firms ship their goods abroad and that these firms are systematically different from the others. In this framework, first formalized by Melitz (2003), trade openness enhances aggregate productivity because it reallocates factors of production to more productive firms. Therefore winners and losers from trade openness are not defined only by their industry but also by their performance.

The exclusive concentration on direct exports, however, has been questioned by recent studies that have shown that many firms export indirectly via intermediaries, other manufacturing firms (carry-along trade, CAT), and by supplying parts and components that are then embedded in exports. The key conjecture here is that looking only at exporters recorded in customs data, the Melitz approach concealed many of the interconnections between domestic firms and international markets. This 'missed exporters' phenomenon suggests that we need to open the black box of the export production function and acknowledge that many firms are engaged in international trade indirectly.

This paper aims at illuminating such indirect export participation and the structure of the domestic value chain. The idea is to map the network of exporters and their suppliers with the goal of developing insights into the real interconnections between domestic firms and international markets. It offers the first glimpse of the domestic supplier network that underpins exports production. It shows the extent to which all firms in an economy are connected to foreign markets through supplier relationships with exporting firms and how these connections are associated with firms' performance. To this purpose we use a unique dataset of yearly transactions between all firms in Belgium over the years 2002-2012. This dataset is based on information from value added tax (VAT) reports and augmented with annual accounts information and firms' international trade transactions. So far no other study has had such data at hand. It is for the first time that we are able to track all domestic business-to-business transactions among the whole population of firms in an economy, and furthermore have unique identifiers for the buyer and the seller that are the same as in the annual accounts and the international trade datasets.

The results suggest that a third of all non-exporting firms supply exporters and therefore have part of their production embodied in exports. Among manufacturing firms the share is much higher with almost two thirds of non-exporters being suppliers to an exporter. We further quantify the involvement, direct and indirect, in terms of the share of firms' output that ends up being exported and contribute to the picture of firms involved in international trade by characterizing firms along the whole domestic supply chain.

2 Literature

Empirical literature on firm heterogeneity has changed research in international trade dramatically by shifting its focus from industries and countries to firms and products (see Bernard et al., 2003; Eaton et al., 2004; Bernard et al., 2007; and, Bernard et al., 2011, for an overview). One branch of it focuses on the importance of intermediaries in international trade. Among others, Bernard et al.

(2012b), Bernard et al. (2010) and Blum et al. (2010) show that a large part of exporting firms are wholesalers that serve as intermediaries for manufacturing firms to reach foreign markets. Bernard et al. (2012a) show the existence of carry-along-trade whereby manufacturing firms serve as export intermediaries for other manufacturing firms. Overall these studies point towards the fact that customs data give us only a partial picture of firms that produce for foreign markets because many firms export indirectly.

Another strand of research focuses on the fact that the composition of international trade had become increasingly similar to the domestic trade composition. With the production chains being often split among several countries, international trade comprises not only final goods but also a large share of intermediate inputs. Thus looking at the value of products as they cross borders does not give us an informative picture about where the value added of these products came from. The OECD Trade in Value Added Database and several studies based on the international input-output tables from the WIOD try to remedy this and quantify international trade on the value-added basis. However, this research is still limited to rather aggregated industries. At the firm level, studies focus on the role of imported intermediate inputs and their impact on productivity and export variety. Amiti and Konings (2007), Goldberg et al. (2009, 2010), and Kasahara and Rodrigue (2008) find that trade liberalization enables firms to import new varieties, produce new products, and increase their productivity. Gopinath and Neiman (2014) show that a large import price shock can generate a significant decline in productivity.

Despite the emphasis on the role of trade intermediaries and the importance of intermediate inputs as a source of productivity growth and export competitiveness, studies focusing on the network of suppliers that underpins export production have been limited by data unavailability.[2]

Our paper fills this gap and brings the input-output approach to international trade to the firm level. This approach allows us to identify firms that have their value added embodied in exports, and to what extent. By matching our data with firm characteristics we can in turn better understand who the firms producing for exports are and how they differ from their more domestic counterparts.

3 Data

There are three main components of our dataset. In its core there are data on yearly transactions among all enterprises in Belgium between 2002 and 2012. These data are then augmented with firm-level information from the annual accounts and with information on exports and imports of each firm.

3.1 Transactions network

In order to construct the network of supplier linkages that covers the whole economy, we use as a baseline dataset the VAT listing reports of Belgian enterprises that are filed with the Belgian tax authorities. Each enterprise with a VAT number and liable to pay VAT has to file a list of her Belgian customers with VAT numbers. The list contains the VAT number of the reporter and the customer, the yearly transaction value and the amount of VAT paid. The threshold for reporting a transaction is 250 EUR. As described in the background paper on construction of this dataset (Dhyne, Magerman and Rubínová, forthcoming), we also make use of VAT declarations data and

[2] The network structure of production has made its way into empirical research only recently. A firm-level research of the domestic production linkages includes an early paper mapping the supplier network of the U.S. economy by Atalay et al. (2011) and recent studies of the Japanese network by Bernard et al. (2014a; 2014b) and Mizuno et al. (2015). Nevertheless, all the studies cover only a selected part of the economy and only domestic transactions.

annual accounts to get information on total purchases and total sales (including both domestic and foreign) for each firm. The resulting dataset is an unbalanced panel that covers years 2002-2012 and includes business-to-business domestic transactions between all firms, total purchases and total sales of both the seller and the buyer.

3.2 Firm-level characteristics

Firms in the annual accounts and in the international trade in goods database are identified by their VAT number which makes it straightforward to match them with our transaction-level dataset. From the annual accounts we use information on yearly employment, value added, tangible capital, tangible fixed capital and the main industry (NACE at 5-digit level[3]). The information on export and import status of a firm comes from the dataset on international trade in goods. Since Belgium is a big port and transit country, re-exports may play an important role in the foreign trade statistics. To avoid inclusion of these transactions we subtract for each firm its total imports (from all origins) from its total exports (to all destinations) within the same product category. If the result is positive, it is the total exports of a firm in the product category and if it is negative, it is the total imports of the firm. In other words, each firm is either an exporter or an importer of a specific product. Our exports and imports variables are then a sum of each firm's trade over all products.

3.3 Network-based variables

We calculate several indicators based on the network structure. First, for each pair of firms we calculate the share of the buyer's total domestic sourcing that the supplier accounts for as

$$w_{ij} = \frac{Z_{ji}}{\sum_j Z_{ji}},$$

where Z_{ji} is the amount of intermediate inputs supplied by firm *j* to firm *i*.

We then use it as a weight (w) for each supplier's labour productivity (a) in calculating the *average labour productivity of suppliers* of each firm (a^1):

$$a_i^1 = \sum_j w_{ij} a_j \,,$$

$$\text{where } \sum_j w_{ij} = 1 \,.$$

Similarly, we calculate the *average TFP of suppliers* of each firm. Since we do not observe foreign suppliers' productivity we can calculate only the average productivity of *domestic* suppliers. It is thus important to bear in mind that for firms that source a lot from abroad, the representativeness of this variable is limited.

For each firm we generate a dummy for being an exporter (X). Based on the supplier-customer relationships we also define suppliers of exporters as firms that supply at least one exporter and do not export themselves. We will call them 1st link suppliers (X^1) as they are one transaction away from exporting. Similarly, we define 2nd link suppliers (X^2) as firms that are suppliers of suppliers of exporters but are not 1st link suppliers or exporters themselves.

[3] In Belgium, the standard NACE 4-digit is further disaggregated to 5-digit level.

Finally, the use of each firm's output (Y) can be decomposed into final demand (F), exports (X) and intermediate inputs supplied to other domestic firms (Z):

$$Y_i = F_i + X_i + \sum_j Z_{ij} .$$

Which can be expressed as

$$Y_i = F_i + X_i + \sum_j d_{ij} Y_j ,$$

Where d_{ij} is the share of firm j's output that comes from firm i's output, i.e. the euro amount of firm i's output needed to produce one euro worth of firm j's output.

In matrix notation

$$Y = F + X + \mathbf{D}Y.$$

We can then apply the Leontief insight to compute the amount of turnover embodied in exports (Y_x) both directly through X *and* indirectly through intermediate inputs embodied in exports of others.

$$Y_x = (\mathbf{I} - \mathbf{D})^{-1} X.$$

4 Stylized facts

4.1 Distance from exporting

Belgium is a small and very open economy. In 2012 the ratio of exports of goods and services to GDP was 82% and 33% of the value added in Belgium was ultimately consumed abroad[4]. Yet only 5.5% of all active firms export goods. Two thirds of these firms are either in manufacturing or wholesale sector, and together account for more than 90% of goods export value (Table 1). Even though almost a third of exporters is in other services than wholesale, they account only for 7% of export value. The overall picture is that the bulk of exports is done by manufacturing and wholesale firms but other services firms constitute an important share of the population of exporters.

Table 1 : Distribution of exports and exporters by sector in 2012

Sector	Share of the total exports	Share of the total number of exporters
	%	%
Primary	0.57	1.40
Manufacturing	73.06	26.12
Utilities and construction	1.07	3.54
Wholesale	18.55	36.34
Other services	6.75	31.01

Table 2 presents the distribution of firms according to their distance from exporting. The share of exporting firms varies by sector. In manufacturing and wholesale the share is 20% and 18%,

[4] Source: OECD.Stat, Country profiles: Share of international trade in GDP, and TiVA: Share of domestic valued added embodied in foreign final demand, in 2011.

respectively. In extractive industries and in utilities it is 17% and 13.5%, respectively. In agriculture and in market services it is only 5%, and 3%, respectively.

The picture that we depicted so far is similar to the findings of other firm-level studies from a number of countries. The novel and interesting part appears when we look at the distribution of firms that are connected to exporters as suppliers. Even though 94.5% of firms do not ship their goods abroad, 45% supply at least one exporting firm (1st link suppliers). In manufacturing and wholesale the share is even 54% and 53% respectively. In the primary sector, two thirds of firms are only 1 link from exporting. Hence the percentage of firms that are *at most* one link from exporting is similar in the manufacturing, wholesale and primary sector, around 70%.

Looking further along the supply chain, 30% of all firms are two transactions away from exporting, i.e. they do not export, do not supply an exporter but they supply a supplier of a supplier of exporter. Only around 4% of firms are 3 or 4 links away from exporting. Utilities and market services are relatively "upstream" vis-à-vis exports with a large mass of 2nd link firms and also a relatively high percentage of 3rd and 4th link firms. Overall, **85% of firms in the Belgian economy are at most 4 links from exporting**. In the manufacturing sector it is a whole 93%. The remaining 15% and 7% respectively are mostly firms that do not have any B2B transactions[5]. If we take into account only firms that do have some B2B transaction then 99% of firms (99.3% in manufacturing) are at most 4 links form foreign customers.

In our definition of suppliers we may want to exclude firms that supply products not directly associated with production – e.g. stationery, catering, etc. Therefore we also use an alternative definition of suppliers as those that account for at least 1% of the customer's purchases. We call them *relevant* suppliers. In that case, 11% of firms are 1st link and 54% are at most 4 links from foreign markets. In manufacturing these shares are 19% and 71%, respectively. Finally, we also present the picture when we raise the threshold to 10% and thus restrict the network to, what we call, *important* suppliers only. We can see in the last part of Table 2 that these important links are rare. Under this definition only 3% of manufacturing firms supply exporters and only additional 1% are between 2 and 4 links from exporting.

Table 2: Distribution of firms according to their distance from exporting (Percentage of all firms in 2012)

Sector	Exporter	1st link	2nd link	3rd link	4th link	*Up to 4 links*
	%	%	%	%	%	%
Primary	5.25	62.53	21.97	1.52	0.06	*91.33*
Manufacturing	19.97	53.77	17.33	1.60	0.14	*92.81*
Utilities and construction	1.30	45.89	38.78	4.52	0.39	*90.89*
Wholesale	18.25	52.46	18.28	1.89	0.19	*91.07*
Market services	2.83	42.89	31.76	4.18	0.38	*82.04*
Non-market services	1.66	35.99	24.67	3.90	0.51	*66.71*
All	5.52	45.18	29.80	3.73	0.34	*84.57*
			Relevant suppliers (1% threshold)			
Primary	5.25	16.27	18.00	10.53	4.40	*54.44*

[5] 14% in the whole economy and 6.7% in manufacturing are firms that do not export and do not have any B2B transaction.

Manufacturing	19.97	19.29	16.21	10.72	4.82	*71.02*
Utilities and construction	1.30	7.90	21.56	21.66	10.64	*63.06*
Wholesale	18.25	18.65	15.99	10.37	4.90	*68.16*
Market services	2.83	9.87	16.55	13.46	6.64	*49.35*
Non-market services	1.66	4.96	9.29	9.99	5.93	*31.83*
All	5.52	11.10	16.90	13.94	6.85	*54.31*
			Important suppliers (10% threshold)			
Primary	5.25	1.75	0.68	0.26	0.04	*7.98*
Manufacturing	19.97	3.01	0.72	0.19	0.09	*23.98*
Utilities and construction	1.30	0.68	0.52	0.30	0.19	*3.00*
Wholesale	18.25	2.63	0.64	0.34	0.19	*22.05*
Market services	2.83	1.12	0.56	0.31	0.14	*4.96*
Non-market services	1.66	0.53	0.16	0.17	0.08	*2.60*
All	5.52	1.34	0.56	0.30	0.15	*7.86*

4.2 Number of customers that are exporters

Instead of looking at *whether* a firm supplies an exporter, in this part we look at *how many* exporters it supplies (N_X) and what is the share of exporters among its customers (N_X_share). The average 1st link firm supplies 9 exporters and exporters account for 35% of its customers. In manufacturing the average is very similar, 10 exporters and 34% of customers. Among exporters themselves the average number of customers that are also exporters is 37 and in manufacturing it is 34. These comparably higher numbers may reflect the fact that exporters are on average large firms and thus their number of customers is large in general. Interestingly though, the average share of exporters in the total number of customers is also higher, especially in manufacturing. *This suggests that in manufacturing there is a sort of "exporter's club" – exporters are relatively more connected to other exporters than to the rest of the economy. Section 4.4 shows that exporters are more productive than non-exporters and also have more productive supplier networks. These facts combined are suggestive of a more general phenomenon – a clustering of firms based on their productivity whereby more productive firms have more productive suppliers, and in turn more productive firms have more productive customers.*

Table 3: Average number of exporting customers and their share in the total number of customers

	Exporters		1st link			
			All suppliers		Relevant suppliers	
	All	Manufacturing	All	Manufacturing	All	Manufacturing
N_X	37	34	9	10	2	2
N_X_share	0.37	0.43	0.35	0.34	0.40	0.38

Table 4 presents the distribution of the number of exporting customers, focusing only on firms that supply at least one. The first column reports the distribution for 1st link firms being any supplier of exporter and the second columns for the definition restricted to relevant suppliers. Most 1st link firms supply only one exporter (39.6%) and the distribution is close to Pareto. In the second column only relevant suppliers are considered as 1st link firms. In that case the distribution becomes much more skewed with more than 70% of firms supplying only 1 customer and more than 90% supplying less than 4.

Table 4: The distribution of the number of exporting customers among 1st link suppliers in 2012

N_X	Share of 1st link firms (%)	
	All suppliers	Relevant suppliers
1	39.6	71.2
2	16.0	14.7
3	8.7	5.4
4	5.6	2.8
5	4.2	1.6
6	3.1	1.1
7	2.5	0.7
8	2.0	0.6
9	1.6	0.3
10	1.4	0.3
11-20	7.6	0.9
>20	7.8	0.4
Total	100	100

4.3 Exported output

To quantify the *extent* to which firms engage in production for exports, we use the input-output approach and compute the share of firm's turnover that ends up being embodied in exports. We denote exports X, turnover Y, the amount of turnover supplied to exporters Y_{x1}, and the total amount of turnover embodied directly and indirectly in exports Y_x. Therefore $Y_x = X + \sum_{i=1}^{\infty} Y_{xi}$. The first column of Table 5 reports the share of turnover exported directly, the second column reports the share of output exported via supplying exporters. Finally the third column reports the total share of turnover embodied in exports, taking into account the whole supply chain. In the whole economy, the average firm exports directly 1.5% of its turnover but additional 5.5% is embodied in exports through supplier connections, out of which 2.9% is through the 1st connections. In manufacturing the direct export share is 8.5% and yet another 10.6% is embodied in exports indirectly[6].

Table 5: Exported share of output for the average firm in an sector in 2012, in percent

Sector	X/Y	Y_{x1}/Y	Y_x/Y
Primary	2.7	10.3	24.3
Manufacturing	8.5	7.1	19.1
Utilities and construction	0.3	1.6	3.5
Wholesale	5.2	4.6	12.6
Market services	0.5	2.4	5.4
Non-market services	0.2	1.2	2.5
All	1.5	2.9	7.0

4.4 Firm characteristics

In order to gauge the differences among firms at different distance from foreign markets we run a set of dummy regressions. We look at nine firm characteristics. Five of them are associated with

[6] A breakdown for manufacturing industries is presented in the Appendix.

firm's quality and technology - **labour productivity** (defined as the value added per employee), **total factor productivity** (TFP) [7], **the average labour productivity of suppliers**, **the average TFP of suppliers**, and **capital intensity** (fixed capital per employee). Two characteristics relate to the firm size – **sales** and **imports**, and finally two are associated with both firm size and its position in the network – **the number of suppliers** and **the number of customers**.

As a preliminary, we regress each outcome variable (V) on a dummy for exporter (D_X), the logarithm of employment (L), industry (NACE 2-digit) dummies ($\boldsymbol{\iota}$) and year dummies ($\boldsymbol{\tau}$)[8]:

$$V = \alpha + \beta D_X + \gamma \ln(L) + \boldsymbol{\delta}'\boldsymbol{\iota} + \boldsymbol{\eta}'\boldsymbol{\tau} + \varepsilon.$$

We run this estimation first for the whole sample and then for a subsample of manufacturing firms only.

Table 6: Characteristics of exporters

V	All sectors	Manufacturing
Labour productivity	**0.502**	**0.383**
	(0.0560)	(0.0400)
TFP	**0.326**	**0.294**
	(0.0246)	(0.0349)
Suppliers' labour productivity	**0.092**	**0.083**
	(0.0162)	(0.0153)
Suppliers' TFP	**0.423**	**0.585**
	(0.0878)	(0.138)
Capital per employee	**0.449**	**0.541**
	(0.0746)	(0.0779)
Sales	**0.943**	**0.811**
	(0.0657)	(0.0950)
Imports	**1.228**	**1.371**
	(0.282)	(0.292)
Number of suppliers	**-0.664**	**-0.697**
	(0.0664)	(0.0559)
Number of customers	0.025	-0.009
	(0.0808)	(0.121)

Industry-clustered standard errors in parentheses.
All coefficients in bold are statistically significant at 99% confidence level.
Each coefficient is obtained from a separate regression.
Labour productivity, TFP, Supplier's productivity, Supplier's TFP, Capital per labour and Sales are in logarithms.
Imports equations are estimated by PPML, the Number of suppliers and customers by negative binomial estimator.
Each regression includes the log of employment, industry (NACE 2 dgt.) dummies and time dummies.
The set of regressions for all sectors is based on 2 491 312 observations and the set of regression for manufacturing sector is based on 212 933 observations. Non-linear regressions are based on data for 2012 only, therefore 250 080 and 18 564 observations respectively.

Each cell in Table 6 presents the estimated coefficient β from one specification. Comparably to previous studies, we find that exporters are markedly different from other firms in the same industry and size category (measured by employment). Their labour productivity and TFP are 65%

[7] TFP is computed using the Wooldridge method.
[8] All variables are at the firm-year level. For the sake of readability the firm-year indexes are omitted in this and all the following equations.

and 38.5% higher respectively. The average labour productivity of their suppliers is 9.6% higher and the average TFP of suppliers 53% higher. Exporters are 57% more capital intensive, have 157% higher sales and 241% more imports. They also have 48.5% less suppliers while the number of customers is not significantly different from non-exporters. The results are very similar in the manufacturing subsample.

In the next set of regressions we include indicators also for firms that are suppliers of exporters (D_{X1}) and suppliers of suppliers of exporters (D_{X2}):

$$V = \alpha + \boldsymbol{\beta}' \boldsymbol{D_X} + \gamma \ln(L) + \delta' \iota + \eta' \tau + \varepsilon,$$

where $\boldsymbol{D_X} = (D_X, D_{X1}, D_{X2})$ and $\boldsymbol{\beta} = (\beta, \beta^1, \beta^2)$.

We run this estimation for each outcome variable three times, based on the definition of a supplier as presented in section 4.1.

Table 7: Characteristics of firms up to 2 links from exporting

	Labour productivity		TFP		Suppliers' labour productivity		Suppliers' TFP		Capital per worker	
	All	Manuf.	All	Manuf.	All	Manuf.	All	Manuf.	All	Manuf.
D_X	**1.039**[a]	**0.904**[a]	**0.633**[a]	**0.589**[a]	**0.233**[a]	**0.188**[a]	**0.875**[a]	**1.131**[a]	**0.930**[a]	**0.974**[a]
	(0.0673)	(0.0366)	(0.0336)	(0.0453)	(0.0199)	(0.0403)	(0.101)	(0.150)	(0.0881)	(0.141)
D_{X1}	**0.631**[a]	**0.586**[a]	**0.351**[a]	**0.325**[a]	**0.164**[a]	**0.122**[a]	**0.543**[a]	**0.617**[a]	**0.547**[a]	**0.475**[a]
	(0.0343)	(0.0533)	(0.0215)	(0.0253)	(0.0231)	(0.0320)	(0.0389)	(0.0806)	(0.0518)	(0.0831)
D_{X2}	**0.237**[a]	**0.163**[a]	**0.173**[a]	**0.147**[a]	**0.070**[a]	-0.016	**0.123**[a]	0.147	**0.335**[a]	**0.249**[a]
	(0.0214)	(0.0281)	(0.0141)	(0.0196)	(0.0237)	(0.0291)	(0.0379)	(0.0860)	(0.0276)	(0.0629)
N	2491312	212933	2079948	200243	2476091	212418	2471820	212251	2491312	212933
R^2	0.078	0.102	0.897	0.928	0.158	0.228	0.166	0.308	0.100	0.057
	Relevant suppliers (1% threshold)									
D_X	**0.843**[a]	**0.787**[a]	**0.527**[a]	**0.510**[a]	**0.174**[a]	**0.177**[a]	**0.567**[a]	**0.751**[a]	**0.773**[a]	**0.882**[a]
	(0.0760)	(0.0343)	(0.0363)	(0.0404)	(0.0187)	(0.0340)	(0.1000)	(0.1710)	(0.0920)	(0.0879)
D_{X1}	**0.705**[a]	**0.630**[a]	**0.401**[a]	**0.330**[a]	**0.166**[a]	**0.163**[a]	**0.283**[a]	0.249[b]	**0.681**[a]	**0.546**[a]
	(0.0337)	(0.0380)	(0.0253)	(0.0315)	(0.0190)	(0.0300)	(0.0300)	(0.0906)	(0.0493)	(0.0475)
D_{X2}	**0.451**[a]	**0.447**[a]	**0.253**[a]	**0.244**[a]	**0.113**[a]	**0.061**[a]	**0.211**[a]	0.208[b]	**0.418**[a]	**0.342**[a]
	(0.0188)	(0.0325)	(0.0141)	(0.0231)	(0.0102)	(0.0148)	(0.0279)	(0.0793)	(0.0221)	(0.0347)
N	2491312	212933	2079948	200243	2476091	212418	2471820	212251	2491312	212933
R^2	0.083	0.121	0.898	0.929	0.158	0.229	0.160	0.305	0.105	0.065
	Essential suppliers (10% threshold)									
D_X	**0.549**[a]	**0.441**[a]	**0.356**[a]	**0.327**[a]	**0.099**[a]	**0.098**[a]	**0.436**[a]	**0.585**[a]	**0.502**[a]	**0.607**[a]
	(0.0590)	(0.0414)	(0.0264)	(0.0364)	(0.0169)	(0.0211)	(0.0894)	(0.152)	(0.0775)	(0.0796)
D_{X1}	**0.650**[a]	**0.439**[a]	**0.402**[a]	**0.247**[a]	**0.090**[a]	0.108[c]	**0.175**[a]	0.0127	**0.751**[a]	**0.509**[a]
	(0.0422)	(0.0462)	(0.0305)	(0.0316)	(0.0238)	(0.0571)	(0.0532)	(0.131)	(0.0673)	(0.0748)
D_{X2}	**0.606**[a]	**0.465**[a]	**0.385**[a]	**0.276**[a]	**0.104**[a]	**0.155**[a]	0.182[b]	-0.0614	**0.690**[a]	**0.526**[a]
	(0.0371)	(0.0480)	(0.0260)	(0.0419)	(0.0329)	(0.0506)	(0.0784)	(0.0773)	(0.0636)	(0.0795)

N	2491312	212933	2079948	200243	2476091	212418	2471820	212251	2491312	212933
R^2	0.049	0.080	0.896	0.928	0.156	0.228	0.159	0.303	0.095	0.055

Industry-clustered standard errors in parentheses.
[a] p<0.01, [b] p<0.05, [c] p<0.1.
Labour productivity, TFP, Supplier's productivity, Supplier's TFP, Capital per labour are in logarithms.
Each regression includes the log of employment, industry (NACE 2 dgt.) dummies and time dummies.

Table 7 shows estimates of the three sets of βs and three definitions of suppliers. When compared to non-exporters that are more than 2 links from exporting, all the differences of exporters are magnified. Firms that supply exporters are also different in all the aspects but to a lesser extent. For example, exporters' TFP is 88% higher, while TFP of 1st link suppliers is 42% higher (Column 3). The 2nd link suppliers also differ from the rest of the economy but less than 1st link suppliers. These results overall suggest that the outstanding characteristics of exporters are present also along their supply chain and that they fade with the distance from exporting.

When we restrict the definition of suppliers to those that account for at least 1% of a firm's domestic purchases, the comparison group changes as more firms are neither relevant 1st link nor 2nd link. The exporter premium decreases compared to the first specification, coming closer to the estimates from Table 7 where the comparison group was all non-exporters. Interestingly, the 1st link and 2nd link premia increase (except the suppliers' TFP). The difference between exporter and 1st link premium even becomes statistically insignificant in some cases, such as the labour productivity and TFP in the whole economy[9].

Table 8 presents additional characteristics. In terms of size of firms as represented by sales the hierarchy is the same as for productivity. Imports on the other hand have less straightforward results. Even though the magnitude of the coefficients suggests the same hierarchy, the statistical significance varies with the definition of a supplier. In what follows we discuss the results for relevant suppliers. Exporters import twice much more than 1st link firms and 1st link firms still import significantly more than the rest of the economy. In manufacturing even the 2nd link firms import more than the rest. The number of domestic customers is higher for 1st and 2nd link firms than it is for exporters, *which suggests that foreign customers are substitutes to domestic customers.* The number of domestic suppliers is significantly lower for exporters and 1st link firms (in manufacturing even for the 2nd link firms). *This result combined with the result on imports suggests that foreign suppliers are substitutes for domestic suppliers – the more a firm imports the less domestic suppliers it has.*

Table 8: Characteristics of firms up to 2 links from exporting cntd.

	Sales		**Imports**		**Number of customers**		**Number of suppliers**	
	All	Manuf.	All	Manuf.	All	Manuf.	All	Manuf.
D_X	**1.729**[a]	**1.591**[a]	**1.835**[a]	**2.346**[a]	**1.952**[a]	**2.390**[a]	**-0.734**[a]	**-0.786**[a]
	(0.160)	(0.0905)	(0.436)	(0.714)	(0.120)	(0.137)	(0.0801)	(0.0764)
D_{X1}	**0.925**[a]	**0.877**[a]	0.695[b]	1.072[c]	**2.079**[a]	**2.507**[a]	**-0.104**[a]	-0.113[c]
	(0.109)	(0.130)	(0.347)	(0.600)	(0.0887)	(0.0908)	(0.0247)	(0.0596)
D_{X2}	**0.348**[a]	0.265[b]	**-0.777**[a]	-0.982	**1.644**[a]	**1.970**[a]	0.0219[c]	0.0156
	(0.0833)	(0.114)	(0.166)	(0.610)	(0.103)	(0.0778)	(0.0130)	(0.0505)

[9] In the Appendix we also present results where we include dummies for firms up to 4 links far from exporting. The hierarchical structure largely remains.

N	2491312	212933	250080	18564	250080	18564	250080	18564
R^2	0.554	0.750	0.221	0.286				
				Relevant suppliers (1% threshold)				
D_X	**1.421**[a]	**1.298**[a]	**2.119**[a]	**2.333**[a]	**0.312**[a]	0.366[b]	**-0.749**[a]	**-0.858**[a]
	(0.125)	(0.0884)	(0.295)	(0.430)	(0.0915)	(0.185)	(0.0805)	(0.0703)
D_{X1}	**1.003**[a]	**0.755**[a]	**1.391**[a]	**1.313**[a]	**0.539**[a]	**0.568**[a]	**-0.262**[a]	**-0.322**[a]
	(0.0840)	(0.0474)	(0.332)	(0.377)	(0.0648)	(0.143)	(0.0445)	(0.0733)
D_{X2}	**0.615**[a]	**0.554**[a]	0.172	0.781[b]	**0.518**[a]	**0.475**[a]	**-0.0988**[a]	**-0.171**[a]
	(0.0532)	(0.0298)	(0.231)	(0.356)	(0.0498)	(0.120)	(0.0164)	(0.0414)
N	2491312	212933	250080	18564	250080	18564	250080	18564
R^2	0.557	0.752	0.218	0.286				
				Essential suppliers (10% threshold)				
D_X	**1.018**[a]	**0.884**[a]	**1.442**[a]	**1.499**[a]	0.0344	0.0104	**-0.676**[a]	**-0.714**[a]
	(0.0743)	(0.100)	(0.245)	(0.357)	(0.0828)	(0.130)	(0.0688)	(0.0590)
D_{X1}	**1.063**[a]	**0.559**[a]	**1.005**[a]	0.626	0.141[b]	0.180[c]	**-0.292**[a]	**-0.210**[a]
	(0.0932)	(0.0774)	(0.200)	(0.416)	(0.0685)	(0.0930)	(0.0653)	(0.0724)
D_{X2}	**0.915**[a]	**0.611**[a]	**0.701**[a]	0.610	**0.205**[a]	0.126	-0.155[b]	-0.0129
	(0.0858)	(0.0915)	(0.224)	(0.761)	(0.0644)	(0.248)	(0.0786)	(0.200)
N	2491312	212933	250080	18564	250080	18564	250080	18564
R^2	0.526	0.737	0.220	0.286				

Industry-clustered standard errors in parentheses.

[a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$.

Sales are in a logarithm. Imports equations are estimated by PPML, the Number of suppliers and customers by negative binomial estimator. The non-linear regressions are based on observations for 2012.

Each regression includes the log of employment, industry (NACE 2 dgt.) dummies and time dummies.

5 Conclusions

TBD

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Appendix

Distribution of non-exporters according to their distance from exporting (1% threshold), by year

All non-exporting firms

	1st link		2nd link		3rd link		4th link	
Year	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters
2002	29840	16.0	32331	17.3	20220	10.8	8630	4.6
2007	33173	14.0	43546	18.4	31529	13.3	14304	6.0
2012	31052	11.7	47279	17.9	39001	14.8	19149	7.2

Non-exporting manufacturing firms

	1st link		2nd link		3rd link		4th link	
Year	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters
2002	4620	31.5	2769	18.9	1337	9.1	496	3.4
2007	4799	28.5	3431	20.4	1927	11.5	825	4.9
2012	3897	24.1	3275	20.3	2165	13.4	974	6.0

1st link suppliers according to the sector of the exporting customer (1% threshold)

All non-exporting firms

Customer:	Any exporter		Manufacturing exporter		Wholesale exporter	
Year	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters
2002	29840	16.0	11093	5.9	10967	5.9
2007	33173	14.0	11140	4.7	12448	5.2
2012	31052	11.7	10429	3.9	11540	4.4

Non-exporting manufacturing firms

Customer:	Any exporter		Manufacturing exporter		Wholesale exporter	
Year	#	% of non-exporters	#	% of non-exporters	#	% of non-exporters
2002	4620	31.5	2804	19.1	1606	11.0
2007	4799	28.5	2687	16.0	1689	10.0
2012	3897	24.1	2216	13.7	1314	8.1

Exported share of output for the average firm in an industry in 2012, in percent

Industry	NACE	X/Y	Y_{x1}/Y	Y_x/Y
Food products	10	7.6	3.9	13.2
Beverages	11	19.2	5.3	26.0
Tobacco products	12	29.1	5.1	34.4
Textiles	13	18.7	12.6	35.3
Wearing apparel	14	8.8	3.9	14.2
Leather and related products	15	9.0	2.5	12.4
Wood and wood products	16	5.1	5.5	13.6
Paper and paper products	17	20.6	12.2	36.7
Printing and reproduction of recorded media	18	2.0	5.2	10.0
Coke and refined petroleum products	19	23.6	10.6	36.3
Chemicals and chemical products	20	31.1	8.3	42.3
Pharmaceutical products	21	22.1	4.6	28.4
Rubber and plastic products	22	23.9	11.5	39.2
Other non-metallic mineral products	23	6.4	2.9	10.9
Basic metals	24	24.3	12.1	41.2
Fabricated metal products	25	4.7	12.2	23.8
Computer, electronic and optical products	26	14.7	6.5	24.7
Electrical equipment	27	7.2	9.1	20.9
Machinery and equipment n.e.c.	28	14.7	10.4	30.4
Motor vehicles, trailers and semi-trailers	29	15.4	9.2	27.5
Other transport equipment	30	9.5	7.1	20.2
Furniture	31	4.2	2.6	8.2
Other manufacturing	32	4.6	1.8	7.5

Characteristics of firms up to 4 links from exporting

	Labour productivity		TFP		Suppliers' labour productivity		Suppliers' TFP		Capital per worker	
	All	Manuf.	All	Manuf.	All	Manuf.	All	Manuf.	All	Manuf.
D_{X}	**0.940**[a]	**0.901**[a]	**0.583**[a]	**0.575**[a]	**0.201**[a]	**0.191**[a]	**0.637**[a]	**0.886**[a]	**0.872**[a]	**0.967**[a]
	(0.0804)	(0.0503)	(0.0386)	(0.0426)	(0.0190)	(0.0357)	(0.104)	(0.158)	(0.0961)	(0.0972)
D_{X1}	**0.802**[a]	**0.746**[a]	**0.458**[a]	**0.396**[a]	**0.193**[a]	**0.178**[a]	**0.353**[a]	**0.386**[a]	**0.780**[a]	**0.633**[a]
	(0.0371)	(0.0572)	(0.0260)	(0.0338)	(0.0199)	(0.0324)	(0.0371)	(0.0914)	(0.0501)	(0.0599)
D_{X2}	**0.547**[a]	**0.563**[a]	**0.310**[a]	**0.310**[a]	**0.141**[a]	**0.0754**[a]	**0.280**[a]	**0.347**[a]	**0.516**[a]	**0.429**[a]
	(0.0290)	(0.0572)	(0.0151)	(0.0271)	(0.0125)	(0.0209)	(0.0377)	(0.109)	(0.0277)	(0.0502)
D_{X3}	**0.319**[a]	**0.353**[a]	**0.181**[a]	**0.193**[a]	**0.0881**[a]	0.0407[c]	**0.213**[a]	**0.371**[a]	**0.319**[a]	**0.274**[a]
	(0.0262)	(0.0453)	(0.0153)	(0.0219)	(0.0125)	(0.0222)	(0.0334)	(0.104)	(0.0223)	(0.0419)
D_{X4}	**0.161**[a]	**0.183**[a]	**0.0810**[a]	**0.104**[a]	**0.0497**[a]	0.0316[b]	**0.153**[a]	**0.338**[a]	**0.178**[a]	0.111[b]
	(0.0255)	(0.0272)	(0.0222)	(0.0202)	(0.0130)	(0.0138)	(0.0262)	(0.0725)	(0.0266)	(0.0469)
N	2491312	212933	2079948	200243	2476091	212418	2471820	212251	2491312	212933
R^2	0.089	0.128	0.898	0.929	0.158	0.229	0.161	0.306	0.107	0.065

Industry-clustered standard errors in parentheses.

[a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$.

Labour productivity, TFP, Supplier's productivity, Supplier's TFP, Capital per labour are in logarithms.

Each regression includes the log of employment, industry (NACE 2 dgt.) dummies and time dummies.