The supplier network of exporters: Connecting the dots

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by Emmanuel Dhyne and Stela Rubínová

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Abstract

The capability of domestic firms to compete on 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 sells on foreign markets 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 high-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 fills the gap by offering the first glimpse of the domestic supplier network that underpins exports production. To this purpose we use a new and unique dataset of yearly transactions between all domestic firms in the Belgian economy and augment it with data on firms' characteristics and their international transactions. We show that the current picture of firms in international trade indeed misses an important share of firms. While we confirm that direct exporters are the best performing firms, we also show that they are supported by suppliers that are very good performers themselves. In fact, we find evidence of a performance premium that is increasing in the proximity to foreign demand.

JEL classification: D22, F24, L25.

Keywords: Exporters, domestic suppliers, productivity.

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1 Introduction

When it comes to international trade we tend to think in terms of countries. Free trade allows countries to specialize in products in which they have comparative advantage and to import goods that are cheaper to produce abroad. Since the mid-1990s, however, the empirical literature has focused our attention on 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. It is an established fact that even in comparative advantage industries, only a handful of firms ship their goods abroad and that these firms are systematically different from 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. To assess the importance of this 'missed exporters' phenomenon we need to open the black box of export production and include in our analysis also firms who produce for foreign markets indirectly.

This paper aims at illuminating such indirect export participation using the structure of domestic trade. It maps the network of customer and supplier connections among firms to offer the first glimpse of the domestic supplier network that underpins exports production. In particular, 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 among all domestic firms in Belgium over the years 2002-2012. This dataset is based on information from value added tax (VAT) statements 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 statistics.

We show that almost a half of all non-exporting firms in Belgium supply exporters and therefore may have part of their production embodied in exports. Furthermore, we categorize firms according to their shortest "distance" from exporting which is defined as the smallest number of supplier transactions that connect a firm to an exporter. Our 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. These characteristics include size, measured by sales, employment or the number of business customers, and productivity, measured by value added per employee or total factor productivity (TFP). For instance, compared to firms that do not participate in the exports supply chain, direct suppliers of exporters are on average 22.5 percent more productive (in terms of TFP), and this premium is around one half of the exporter premium.

2 Related literature

Empirical literature on firm heterogeneity has changed the research in international trade dramatically by shifting its focus from industries and countries to firms and products[4]. One particular result that has emerged is the existence of indirect exporters who use trade intermediaries to supply their products to foreign markets. Crozet et al. (2013), Bernard et al. (2012a) or Bernard et al. (2010) show that in France, Italy, and the U.S. respectively a large part of exporting firms are wholesalers that serve as intermediaries for manufacturing firms to reach foreign markets[5]. Blum et al. (2010) document a similar phenomenon on the import side for Chile. Bernard et al. (2014a) and Di Nino (2015) use Belgian and Italian data respectively to show the existence of carry-along trade whereby manufacturing firms serve as export intermediaries for other manufacturing firms. Overall, these studies point to the fact that customs data give us only a partial picture of firms that produce for foreign markets because many firms export indirectly.

As production chains are often split among several countries, international trade comprises of not only final goods but also a large share of intermediate inputs. From the imports points of view, there are firm-level studies that 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), Kasahara and Rodrigue (2008), and Yu (2014) 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. These results thus highlight the importance of the quality and diversity of suppliers for firm performance. However, while these studies focus on the international sourcing, there is little evidence about the role of, and the impact on, its domestic counterpart. Furthermore, as long as the importing firms supply intermediate inputs to other firms, an import shock to their productivity can be transmitted through those supplier relationships onto the rest of the economy. Similar logic applies on the exporting side – foreign demand shocks can have impact on the domestic economy, beyond the direct effect on exporters, through domestic demand linkages. Analysis of the network structure of production has made its way into empirical research only recently. Product level input-output tables were used in this context by Acemoglu et al. (2012) to show how the microstructure of the U.S. economy influences aggregate outcomes. A firm-level research of 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. (2014b; 2014c) and Mizuno et al. (2015). Nevertheless, these studies cover only a selected part of the economy and only domestic transactions. Finally, recently constructed industry-level international input-output tables have also enabled an analysis of international supply linkages and the extent to which value-added trade flows differ from the gross ones (see for instance Timmer et al., 2014 or Koopman et al., 2014, for an application of the World Input-Output Database). In general, this research also highlights a second omission of the analysis of customs data - we observe only the firms that sell a product abroad but not the firms that participated on its production through the supply of intermediate inputs.

Despite the evidence 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. Our paper partially fills this gap by presenting the first evidence on who the domestic suppliers of exporters

[4] See Bernard et al. (2003), Eaton et al. (2004), Bernard et al. (2007), and Bernard et al. (2011) for an overview.

[5] Theoretical approaches include Ahn et al. (2011), Akerman (2010), and Felbermayer and Jung (2011). Survey-based empirical studies that focus on the firms that use trade intermediaries to export include for example Bai et al. (2015), Davies and Jeppesen (2014), Abel-Koch (2013), and McCann (2013).

are and how they differ both from the exporters themselves, and from firms that are not part of the exports supply chain.

3 Data sources and construction

There are three main components of our dataset. In its core, there are data on domestic trade between business enterprises in Belgium for the period 2002 to 2012. These data are then augmented with firm-level balance sheet information and with information on exports and imports of each firm.

3.1 Domestic trade

All companies liable to pay value added taxes in Belgium have to file an annual Client Listing statement reporting taxable transactions with all taxable entities registered for VAT purposes in Belgium. The statement includes the VAT number of the supplier, the VAT numbers of customers and yearly values of trade between them. The threshold for reporting a customer is a yearly value of trade above 250 euro. The resulting dataset covers all trade between enterprises in the non-financial business economy[6] in the period 2002-2012.

3.2 Firm-level characteristics

The National Bank of Belgium manages several databases which we use to extract firm-level information; in particular, we use the annual accounts registry, VAT declarations and the international trade in goods database.

As described in the background paper on construction of the domestic trade dataset (Dhyne et al., 2015), we make use of VAT declarations and the annual accounts registry to get information on total purchases and total sales (including both domestic and foreign) for each firm. We further use the annual accounts to get information on the number of employees (in full-time equivalent units), value added, intermediate inputs, fixed capital and the main industry (NACE at 5-digit level[7]). To measure firm productivity, we use either the value added per employee or the total factor productivity (TFP) computed using the Levinsohn-Petrin-Wooldridge method. It is important to note that even though we refer to these indicators as productivity, they are based on value added without taking into account firm-level mark-ups and therefore they indicate both firm productivity and profitability.

The international trade in goods database includes imports and exports by firm, origin/destination market, and product category (HS 6-digit). The second largest European harbour, Antwerp, is located in Belgium, making it an entry gate to the EU single market and a transit country. Therefore, re-exports play an important role in the Belgian 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 a net exporter or a net importer of a product. Our firm-level exports and imports variables are then a sum of each firm's trade over all products and markets.

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[6] The raw internal trade data include trade between all entities liable to pay value added tax in Belgium. For analytical purposes the data is cleaned to include only enterprises who file annual accounts. Furthermore, we exclude non-market services as the coverage of the VAT dataset is rather poor in this sector.

[7] In Belgium, the standard NACE 4-digit is further disaggregated to 5-digit level. Still, some firms report at a higher level of aggregation, the highest being 2-digit. In our analysis we thus use the 2-digit aggregation as the main definition of an industry.

Overall, our dataset covers all enterprises in the non-financial business economy that file annual accounts, and sell to or buy from at least one domestic non-financial firm in the given year. Compared to the aggregate statistics reported by the Eurostat's Structural Business Statistics (SBS), enterprises present in our dataset (or its manufacturing sector subsample), account for 56 (62) percent of the number of enterprises, 87 (92) percent of turnover, 97 (100) percent of value added, and 93 (98) percent of total purchases of goods and services. Employment in our data is measured in full-time equivalent units and therefore not directly comparable to the number of employees reported in the SBS which is in head counts. In 2012 firms in our dataset had 1 883 732 (463 673) full-time-equivalent employees while the number of employees in SBS was 2 124 489 (490 808). Average value added per employee is 37 percent higher (2 percent lower) in our data. Finally, firms in our dataset account for 62 percent of total exports and 69 percent of total imports reported in the Eurostat's international trade database. Detailed tables with the aggregate statistics and Eurostat comparison are reported in the Appendix (Table A1a, Table A1b, Table A1c).

3.3 Network-based indicators

We use the domestic trade data to construct a network of supplier and customer links among Belgian firms. We calculate several indicators based on the network structure and foreign trade. First, we categorize firms according to the shortest path to a foreign demand. For each firm we generate a dummy for being an exporter (D_X). Based on the supplier-customer relationships we then define *1st link suppliers* (D_{X1}) as firms that, in a given year, supply at least one exporter and do not export themselves. These firms are thus one transaction away from foreign demand. Similarly, we define *2nd link suppliers* (D_{X2}) as firms that are suppliers of suppliers of exporters but are not 1st link suppliers or exporters themselves. 3rd or 4th link suppliers are defined in a similar fashion.

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 present an alternative definition of suppliers as firms that account for at least one percent of the customer's total purchases. We call them *relevant* suppliers. For comparison, we also present a picture where we raise the threshold to ten percent and thus restrict the network to, what we call, *essential* suppliers only.

Finally, we compute a proxy for the total amount of turnover embodied in exports as an indicator of a firm's exposure to foreign demand. 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)[8]:

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

Which can be expressed as

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

Where a_{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.

[8] We apply this decomposition with the caveat in mind that the observed flows among firms do not include only intermediate inputs but also investment goods. In this sense our data do not include enough information to construct a firm-level input-output table. Therefore, we use the Leontief decomposition as an approximation of the exposure of firms to foreign demand rather than tracing exactly the origins of value added.

In matrix notation

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

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

$$Y_X = (\mathbf{I} - \mathbf{A})^{-1}X.$$

4 Summary statistics

4.1 Domestic trade network

The domestic trade network includes on average 262 069 firms per year, 2 882 769 in total. Most firms (99 percent) have some incoming transactions in a given year and therefore figure as customers in the network. On the other hand, not all firms have an outgoing transaction; only 75.5 percent of firms supply another firm in a given year. The remaining firms thus concentrate on final demand, government, firms in non-market services, or exports. Table 1a also reports the number of nodes with a positive outgoing or incoming transaction for the sub-networks where the definition of suppliers is restricted to the relevant or essential ones. For the relevant suppliers sub-network, the total number of nodes remains fairly similar (only five percent drop out) but the share of firms who are essential suppliers decreases to 63 percent[9]. The essential suppliers sub-network retains 78 percent of firms from the total network and the share of nodes that are suppliers drops down to 34 percent.

Table 1a: Network summary statistics – nodes

Sample	Year	N firms	N suppliers	N customers
Total network	2002	216079	160196	214404
	2007	266308	200887	264425
	2012	292218	224405	290832
	Total	2882769	2177119	2864024
Network of relevant suppliers	2002	204295	123198	201396
	2007	252154	154784	249231
	2012	275878	172715	272480
	Total	2735102	1682135	2702147
Network of essential suppliers	2002	160249	55668	139915
	2007	206635	70779	183814
	2012	230449	79047	206705
	Total	2240088	769915	1993198

[9] Some customers drop out too as not all customers have a supplier that accounts for more than one percent of their total purchases. However, 94 percent of customers remain in the network.

Table 1b: Network summary statistics - links

Sample	Year	N	Mean	Median	St. dev.	Min	Max
Total network	2002	6212271	28153	1590	2002189	250	3.21E+09
	2007	7805748	31443	1701	1760169	250	3.59E+09
	2012	8761555	32690	1719	1847224	250	3.97E+09
	Total	84810297					
Network of relevant suppliers	2002	1437472	88854	5783	4153935	250	3.21E+09
	2007	1878104	94903	5976	3568874	250	3.59E+09
	2012	2273099	91726	5111	3596752	250	3.97E+09
	Total	20881675					
Network of essential suppliers	2002	256055	276572	17481	9644716	250	3.21E+09
	2007	345639	286451	18470	8100366	250	3.59E+09
	2012	481970	239311	10828	7486930	250	3.97E+09
	Total	3946511					

Table 1b reports summary statistics of the links. The network is formed by a total of 84 810 297 yearly transactions, with a mean value of 32 690 euro and a considerably lower median of 1 719 euro. Even though the sub-networks retain a majority of nodes they become much sparser than the total network. The relevant suppliers sub-network includes 25 percent and the essential suppliers sub-network only 5 percent of the total number of links. This suggests that the latter captures only rare relationships and may be overly restrictive.

Table 2 describes the distribution of the number of links per firm. The average number of domestic business customers per firm ranges from eleven in the primary sector to 76 in wholesale. The distribution is highly skewed with median values ranging from two to ten customers and very heavy upper tails. The number of domestic suppliers varies less across sectors. The average ranges from 22 in the other services sector to 60 in manufacturing. The median is between 13 and 32 suppliers.

When we restrict the network to relevant suppliers, it becomes much sparser. A median firm has one to two customers for whom it is a relevant supplier. On the other hand, a median firm has six to nine relevant suppliers. Restricting the network to essential suppliers makes it extremely sparse with median firm in any sector not being an essential supplier of any other firm.

Table 2: Link distribution - the number of domestic business customers and suppliers by sector

The number of	Sector	p25	p50	p75	p90	Mean	St. Dev.	Min.	Max.
Customers	Primary	1	3	8	23	10.8	31.1	0	762
	Manufacturing	2	10	41	113	48.6	207.5	0	14942
	Utilities	1	4	12	31	18.4	458.6	0	94408
	Wholesale	1	6	47	163	76.4	365.6	0	23278
	Other market services	0	2	9	37	22.2	251.8	0	55225
	Total	1	3	13	56	30.0	304.8	0	94408
Suppliers	Primary	8	16	29	48	23.3	29.7	0	638
	Manufacturing	11	30	69	141	59.8	102.7	0	3361
	Utilities	10	22	41	73	36.5	66.6	0	5703
	Wholesale	6	17	43	87	35.4	55.8	0	1970
	Other market services	5	12	26	49	22.2	42.3	0	5666
	Total	6	15	33	65	29.4	56.8	0	5703
	Relevant suppliers (1 percent threshold)								
Customers	Primary	0	1	2	6	2.7	10.4	0	363
	Manufacturing	0	2	8	22	9.9	46.6	0	5984
	Utilities	0	1	4	9	4.5	141.7	0	52781
	Wholesale	0	1	9	36	16.7	93.6	0	12126
	Other market services	0	1	2	8	5.1	73.8	0	28154
	Total	0	1	3	12	7.0	88.0	0	52781
Suppliers	Primary	4	6	10	12	6.8	4.2	0	43
	Manufacturing	5	8	12	15	8.6	5.1	0	94
	Utilities	6	9	13	16	9.2	5.1	0	88
	Wholesale	2	5	8	12	5.9	4.7	0	86
	Other market services	3	6	9	13	6.5	4.6	0	100
	Total	3	6	10	14	7.0	4.9	0	100
	Essential suppliers (10 percent threshold)								
Customers	Primary	0	0	0	1	0.4	2.8	0	150
	Manufacturing	0	0	1	3	1.4	10.6	0	1309
	Utilities	0	0	1	2	0.7	19.4	0	7355
	Wholesale	0	0	1	4	2.8	23.0	0	2312
	Other market services	0	0	0	1	0.8	13.3	0	5002
	Total	0	0	1	2	1.1	15.7	0	7355
Suppliers	Primary	0	1	2	2	1.2	1.0	0	10
	Manufacturing	0	1	2	2	1.1	1.0	0	10
	Utilities	1	1	2	3	1.3	1.0	0	10
	Wholesale	0	1	1	2	0.9	1.0	0	10
	Other market services	0	1	2	2	1.1	1.0	0	10
	Total	0	1	2	2	1.1	1.0	0	10

4.2 Distance from exporting

Belgium is a small and very open economy. In 2011 the ratio of exports of goods and services to GDP was 82 percent, and 33 percent of the value added in Belgium was ultimately consumed abroad[10]. Yet only seven percent of all firms export goods[11]. Two thirds of these firms are either in manufacturing or wholesale sector, and together they account for more than 90 percent of the total value of goods exports[12]. The role of wholesalers in export activities is large – they make up 38 percent of exporting firms and 19 percent of the exports value. Furthermore, the TiVA database suggests that more than 40 percent of the domestic value added in exports is indirect, i.e. generated by domestic firms whose goods and services are embodied in exports.

The picture 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 non-exporting firms that are part of the exports supply chain, i.e. firms that account for the 40 percent of domestic value added in exports indirectly. Even though 93 percent of firms do not ship their goods abroad, 43 percent are 1st link suppliers. In manufacturing and wholesale, the share is 50 percent and 46 percent respectively. In the primary sector it is even 56 percent. Hence in these three sectors around two thirds of firms are *at most* one link from exporting (first panel of Table 3).

Looking further along the supply chain, 22 percent of all firms are two transactions away from exporting (2nd link), and only around four percent of firms are three or four transactions away from foreign demand. Utilities and other 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, 75 percent of firms in the Belgian economy are at most four transactions away from exporting. In the manufacturing sector it is a whole 85 percent. Notably, the remaining 25 percent of all firms and 15 percent of manufacturing firms mostly do not supply any businesses[13]. Thus, if we take into account only firms that do have business customers, 98 percent are at most four transactions far from foreign demand.

Figure 1 visualizes the distributions in each sub-network for the manufacturing sector and the total economy. In the sub-network of relevant suppliers, firms are more evenly distributed across the categories, notably the distribution is much less skewed towards 1st links. The essential sub-network is very sparse to start with and it is therefore not surprising that very few firms qualify as suppliers of exporters under such definition. Based on these statistics we decide to use relevant suppliers as the benchmark definition in our analysis.

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[10] 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.

[11] The share of exporting firms, as presented in Table 3, varies by sector. In manufacturing and wholesale, the share is around 20 percent. In the primary sector the share is only seven percent. There are goods exporting firms also in other sectors but their shares are considerably smaller.

[12] Even though almost a third of exporters are in other market services than wholesale, they account for only five percent of total goods export value. Since our classification is based on the main industry of a firm, these are likely to be multiproduct firms that export products other than is their main industry. Possibly, these could be also carry-along traders. The distribution of exporters and exports by sector is reported in Table A2 in the Appendix.

[13] 23.91 percent in the whole economy and 13.79 percent in manufacturing are firms that do not export and do not supply any other firm.

Table 3: Distribution of firms according to the distance from exporting, by sector and sub-network

Sector	Exporter	1st link	2nd link	3rd link	4th link	*Within 4 links*
	%	%	%	%	%	%
Primary	6.92	56.35	16.02	1.06	0.09	*80.43*
Manufacturing	21.64	49.90	12.53	1.06	0.11	*85.23*
Utilities and construction	1.69	45.58	30.37	3.30	0.29	*81.24*
Wholesale	19.36	46.40	13.11	1.26	0.11	*80.24*
Other market services	3.50	40.79	22.77	2.52	0.23	*69.81*
Total	7.05	43.33	21.57	2.31	0.21	*74.46*
		Relevant suppliers (1 percent threshold)				
Primary	7.16	16.03	14.75	7.42	2.85	*48.21*
Manufacturing	22.23	19.84	14.02	7.85	3.40	*67.35*
Utilities and construction	1.75	8.97	19.25	16.93	8.09	*54.99*
Wholesale	20.07	18.02	13.37	7.88	3.49	*62.82*
Other market services	3.67	10.15	14.25	10.18	4.63	*42.89*
Total	7.34	12.02	14.87	10.63	4.86	*49.72*
		Essential suppliers (10 percent threshold)				
Primary	6.51	2.29	0.63	0.22	0.07	*9.73*
Manufacturing	21.43	3.89	0.78	0.23	0.11	*26.45*
Utilities and construction	1.67	0.99	0.56	0.30	0.15	*3.67*
Wholesale	19.38	3.59	0.83	0.31	0.14	*24.25*
Market services	3.57	1.50	0.66	0.29	0.13	*6.15*
Total	6.96	1.91	0.67	0.29	0.13	*9.97*

Note: The share of exporters changes between the sub-networks because the total number of firms included in each sub-network changes. The statistics are based on the pooled sample from 2002 to 2012.

Figure 1: Distribution of firms according to the distance from exporting

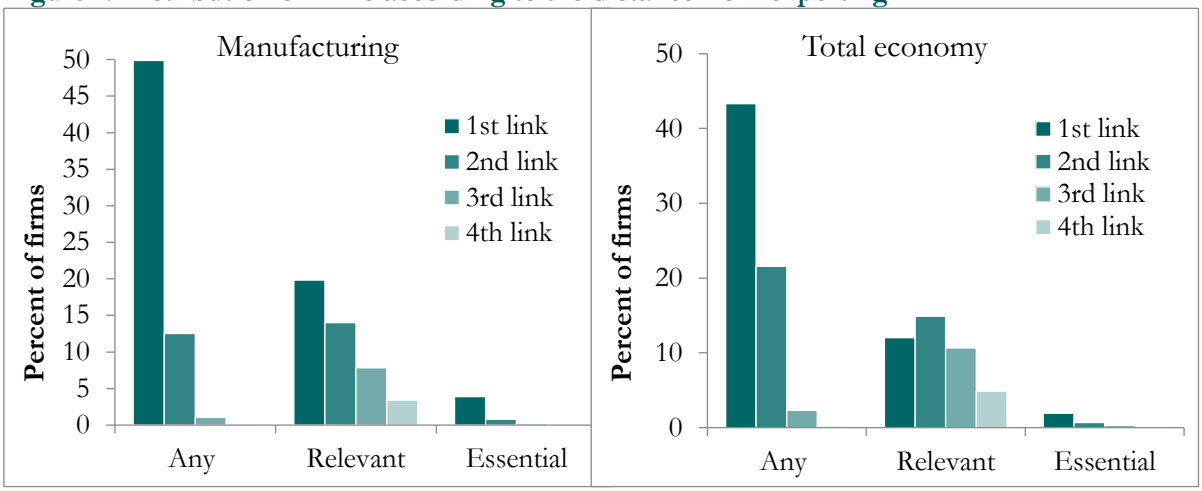
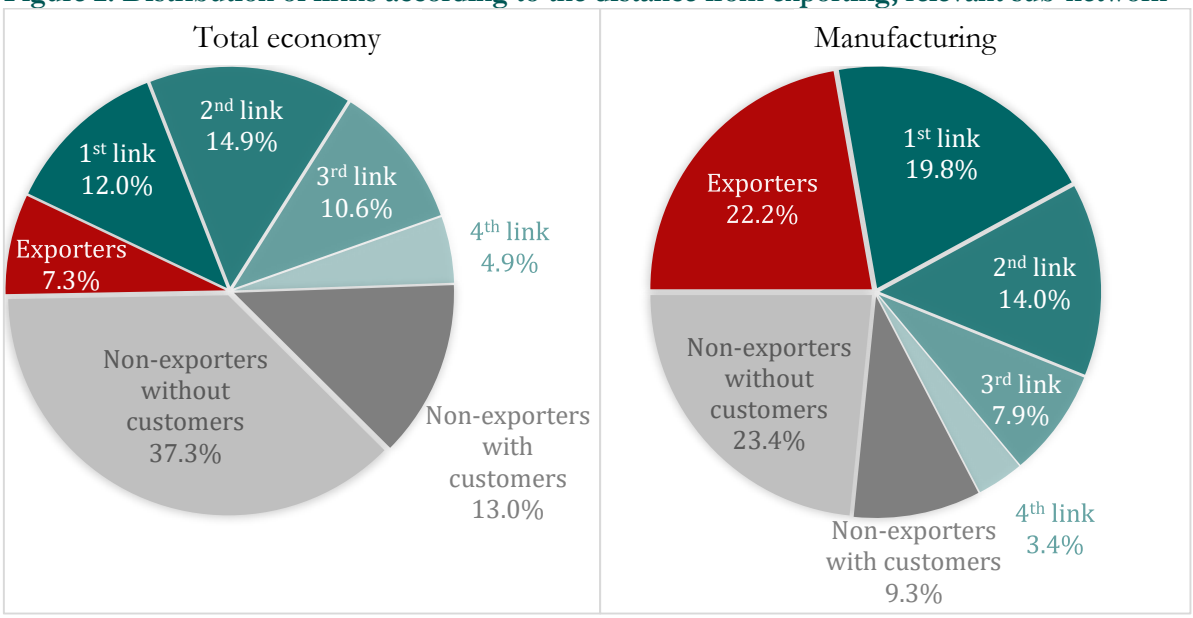


Figure 2 visualizes the distribution based on relevant suppliers in the total economy and manufacturing. Out of all firms, 12 percent are 1st link, 15 percent are 2nd link, and altogether 50 percent are at most four transactions far from foreign markets. Furthermore, there are only 13 percent of firms that have business customers but are further than four transactions from exporting.

Figure 2: Distribution of firms according to the distance from exporting, relevant sub-network



4.3 Number of exporting customers

Instead of looking at *whether* a firm supplies an exporter, in this part we look at *how many* exporters it supplies and what is the share of exporters among its customers. Table 4 presents the distribution of the number and the share of exporting customers, focusing only on firms that supply at least one exporter. The average 1st link firm supplies two exporters and they account for 37 percent of its customers. Among exporters, that supply at least one other exporter, the average number of exporting customers is six. This comparably higher number reflects the fact that exporters are on average large firms and thus their number of customers is larger in general. The average share of exporting customers is similar for exporters and 1st links, both in the total economy and in manufacturing, and ranges between 35 and 40 percent.

The distribution of the number of exporting customers is fat tailed with a large mass of 1st link firms that have only one or two such customers. In manufacturing, the 90th percentile 1st link firm has still just four exporting customers while the largest one has 37. The distribution is very specific in the utilities sector which is dominated by few large firms that serve a large network of customers.

Table 4: Distribution of the number and the share of exporting customers, by sector and exporting status, firms with at least one exporting customer

	Sector	p25	p50	p75	p90	Mean	St. Dev.	Min.	Max.
				The number of exporting customers					
1st links	Primary	1	1	2	3	1.43	0.95	1	12
	Manufacturing	1	1	2	4	2.00	2.05	1	37
	Utilities	1	1	1	2	1.84	21.31	1	2289
	Wholesale	1	1	2	5	2.38	3.48	1	154
	Other market services	1	1	2	3	2.13	8.25	1	672
	Total	1	1	2	4	2.11	9.45	1	2289
Exporters	Primary	1	2	3	6	3.04	4.36	1	48
	Manufacturing	1	3	6	12	5.42	9.05	1	403
	Utilities	1	2	4	8	4.63	14.03	1	532
	Wholesale	1	3	6	14	6.58	17.02	1	731
	Other market services	1	2	5	11	6.35	22.69	1	611
	Total	1	3	6	12	6.03	16.50	1	731
				The share of exporting customers					
1st links	Primary	0.29	0.50	1	1	0.59	0.35	0.004	1
	Manufacturing	0.12	0.27	0.50	1	0.39	0.33	0.003	1
	Utilities	0.09	0.18	0.33	1	0.29	0.28	0.003	1
	Wholesale	0.06	0.19	0.50	1	0.33	0.35	0.001	1
	Other market services	0.09	0.25	0.50	1	0.40	0.36	0.001	1
	Total	0.09	0.25	0.50	1	0.37	0.35	0.001	1
Exporters	Primary	0.14	0.33	0.50	1	0.39	0.31	0.006	1
	Manufacturing	0.14	0.33	0.59	1	0.40	0.30	0.002	1
	Utilities	0.09	0.20	0.50	0.90	0.33	0.31	0.004	1
	Wholesale	0.08	0.21	0.50	1	0.34	0.33	0.001	1
	Other market services	0.08	0.18	0.44	1	0.30	0.30	0.002	1
	Total	0.10	0.25	0.50	1	0.35	0.31	0.001	1

Note: The statistics are based on the relevant suppliers sub-network.

4.4 Foreign demand exposure

To quantify the *extent* to which firms engage in the production for exports, we use the input-output approach and compute a proxy for the share of firm's sales that ends up being embodied in exports. We denote exports X, sales Y, the amount of sales exported via supplying exporters Y_{X1}, and the total amount of sales 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 sales exported directly, the second column reports the share of sales exported via supplying exporters. Finally, the third column reports the total share of sales embodied in exports, taking into account the whole supply chain. In the whole economy, the average firm exports directly two percent of its sales but additional six percent is embodied in exports through supplier connections, out of which three percent is through the 1st link connections. In manufacturing the average direct export share is ten percent and yet another eleven percent is embodied in exports indirectly. In the second set of columns of Table 5 we take into

account firm size and weigh the average by the share of firm sales in the total sales of the sector[14]. Using this metric, the average exposure to foreign demand is much more important, 27 percent for the whole economy. The indirect exports share is especially high in the primary sector, reflecting mostly the role of agricultural input into the export-oriented food processing industry. Contrary to the simple average, most of the weighted-average exposure comes from direct exports, which is due to that large firms engage disproportionately more in direct exporting. Notably, in manufacturing the weighted-average indirect exports share is lower than the simple average which suggests that smaller firms engage more in supplying exporters than large firms do.

Table 5: The average share of sales embodied in exports, by sector

Sector	Simple average			Weighted average		
	X/Y	Y_{X1}/Y	Y_X/Y	X/Y	Y_{X1}/Y	Y_X/Y
Primary	0.04	0.11	0.25	0.23	0.12	0.44
Manufacturing	0.10	0.08	0.21	0.50	0.05	0.56
Utilities and construction	0.00	0.02	0.04	0.03	0.03	0.08
Wholesale	0.06	0.05	0.14	0.14	0.04	0.19
Other market services	0.01	0.03	0.06	0.04	0.03	0.08
Total	0.02	0.03	0.08	0.21	0.04	0.27

5 Regression results

In order to gauge the differences among firms at different distance from foreign markets we run a set of dummy regressions using the categories defined above. We look at two sets of outcome variables. First, we look at the size of firms as measured by sales, employment and the number of domestic business customers. Second, we focus on performance measures such as labour productivity (defined as the value added per employee), total factor productivity (TFP) [15], and capital intensity (measured as fixed capital per employee). Since our categories are defined rather crudely based on the shortest distance and irrespective of the intensity of the exposure to foreign demand we then complement the analysis with two more steps. First, we focus on direct suppliers of exporters and replace the binary 1st link variable by the actual number of exporting customers. Second, we use the proxy for output embodied in exports as a continuous measure of the distance from foreign markets.

5.1 Exporter premia revisited

To quantify the average differences in performance between different categories of firms we regress each outcome variable (V) on a set of dummies ($\boldsymbol{D_X}$) that includes a dummy for exporter, 1st link firm (D_{X1}) and 2nd link firm (D_{X2}), 3rd link (D_{X3}), and 4th (D_{X4}). We include industry-year (NACE 2-digit) dummies ($\boldsymbol{\iota\tau}$) so that we compare firms within an industry in a given year[16]:

$$V = \alpha + \boldsymbol{\beta}'\boldsymbol{D_X} + \boldsymbol{\delta}'\boldsymbol{\iota\tau} + \varepsilon,$$

where $\boldsymbol{D_X} = (D_X, D_{X1}, D_{X2}, D_{X3}, D_{X4})$ and $\boldsymbol{\beta} = (\beta, \beta^1, \beta^2, \beta^3, \beta^4)$.

[14] This measure therefore corresponds to the sector-level share of output embodied in exports.
[15] Sales and value added are in nominal terms while TFP is computed in real terms using industry-specific deflators. In our regressions we always control for industry-year fixed effects and therefore this is not a concern.
[16] All variables are firm-year specific. For the sake of readability, the firm-year indexes are omitted in this and all the following equations.

In the second set of regressions that focus on productivity, we also include the log of employment and the log of the number of domestic business customers[17] to compare performance of firms of similar size.

The results from the two sets of regressions are presented in Table 6 and Table 7. The first row of each table confirms findings from previous studies[18] that exporters are markedly different from other firms in the same industry. They are the largest firms in terms of employment and sales, and even within the same size category they are more productive and capital intensive than other firms. The first new finding is that exporters have more domestic business customers than other firms (Table 6, columns 3 and 6).

The main finding is that firms that participate on exports production in general perform better than other firms. For instance, exporters are 45.5 percent more productive than firms further than four transactions away from foreign demand, but the premium exists also for 1st and 2nd link firms. It is 22.5 percent for 1st links, 8.4 percent for 2nd links (column 2 of Table 7), and the premia are statistically significantly different from each other[19]. Notably, firms in the exports supply chain perform better not only in terms of monetary measures such as sales or productivity[20] but also in physical terms such as the number of domestic business customers they serve.

Table 6: Exports supply chain premia - size

	All firms			*Manufacturing firms*		
V:	**Sales**	**Employment**	**Number of customers**	**Sales**	**Employment**	**Number of customers**
D_X	1.786[a]	2.275[a]	3.029[a]	2.335[a]	2.830[a]	2.529[a]
	(0.131)	(0.183)	(0.208)	(0.100)	(0.163)	(0.102)
D_{X1}	1.125[a]	1.624[a]	2.721[a]	1.062[a]	1.527[a]	2.145[a]
	(0.075)	(0.116)	(0.158)	(0.088)	(0.143)	(0.092)
D_{X2}	0.562[a]	0.898[a]	2.055[a]	0.511[a]	0.912[a]	1.812[a]
	(0.0573)	(0.0910)	(0.168)	(0.0944)	(0.133)	(0.117)
D_{X3}	0.223[a]	0.494[a]	1.508[a]	0.130	0.482[b]	1.426[a]
	(0.0397)	(0.0690)	(0.156)	(0.133)	(0.142)	(0.140)
D_{X4}	0.111[c]	0.326[a]	1.163[a]	0.0195	0.261	1.136[a]
	(0.0445)	(0.0537)	(0.132)	(0.174)	(0.130)	(0.125)
N	1214949	1214949	1214949	153721	153721	153721
Adj. R^2	0.231	0.305	0.078	0.349	0.373	0.044

Industry-clustered standard errors in parentheses.

[a] $p<0.001$, [b] $p<0.01$, [c] $p<0.05$.

Sales and employment are in logarithms. The number of customers is estimated using the negative binomial estimator, thus R^2 in the third and sixth column is the pseudo R^2. Each regression includes industry-year dummies (NACE 2 dgt.).

[17] In fact, we use the inverse hyperbolic sine (IHS) transformation, instead of logs, of the number of business customers in all the following empirical specifications. The IHS allows to keep also firms without business customers in the baseline estimation and its interpretation is equivalent to the logarithm. The results are not sensitive to this choice.

[18] See for example Bernard et al. (2012b) or Wagner (2012) for a review of the literature on exporter premia.

[19] The coefficients reported in Table 6, 7 and 8 represent log-differences. The percentage difference presented in the text are thus calculated as $\exp(\beta)$-1.

[20] Even though TFP is measured in real terms, the price deflators are computed at the industry level and therefore the TFP measure still includes any firm-specific price variation.

Controlling for the number of domestic business customers in the productivity regressions (Table 7) yields two additional insights. First, the productivity premium is indeed associated with exports supply chain participation and not simply with the fact that firms with more customers (that are likely to be larger and more productive) are more likely to have an exporter in their customer network. Second, the premia are not due to a difference between firms that have business customers and firms that serve only final demand. Notably, the fact that we control for the number of domestic customers in the productivity regressions is the reason why 3rd and 4th links do not have statistically significant productivity premium despite having a size premium[21].

To sum up, not only exporters but also firms in their supply chain perform better than other firms in the same industry and size category, and the performance premium increases with the proximity to foreign demand.

Table 7: Exports supply chain premia - productivity

	All firms			*Manufacturing firms*		
V:	**Labour productivity**	**TFP**	**Capital per employee**	**Labour productivity**	**TFP**	**Capital per employee**
D_X	0.481[a]	0.375[a]	0.688[a]	0.468[a]	0.365[a]	0.750[a]
	(0.0389)	(0.0314)	(0.108)	(0.0632)	(0.0600)	(0.0826)
D_{X1}	0.267[a]	0.203[a]	0.392[a]	0.242[a]	0.186[a]	0.334[a]
	(0.0273)	(0.0242)	(0.0771)	(0.0453)	(0.0448)	(0.0506)
D_{X2}	0.111[a]	0.0805[a]	0.215[b]	0.149[b]	0.123[b]	0.185[a]
	(0.0171)	(0.0112)	(0.0631)	(0.0405)	(0.0397)	(0.0400)
D_{X3}	0.0199	0.0103	0.109[c]	0.069	0.0565	0.119[c]
	(0.0128)	(0.0087)	(0.0450)	(0.0392)	(0.0364)	(0.0515)
D_{X4}	-0.0295[c]	-0.0274[c]	0.0348	0.004	0.004	0.012
	(0.0124)	(0.0116)	(0.0374)	(0.0350)	(0.0295)	(0.0620)
NC	0.047[a]	0.037[a]	0.062[c]	0.018	0.014	0.016
	(0.0129)	(0.0098)	(0.0293)	(0.0090)	(0.0074)	(0.0229)
N	1214949	1214949	1214949	153721	153721	153721
R^2	0.181	0.945	0.137	0.130	0.959	0.087

Industry-clustered standard errors in parentheses.

[a] $p<0.001$, [b] $p<0.01$, [c] $p<0.05$.

Labour productivity, TFP and Capital per worker are in logarithms. NC stands for the number of business customers and is in a logarithm. Each regression includes the log of employment and industry-year dummies (NACE 2 dgt.).

In the following paragraphs we discuss several extensions and robustness checks of the baseline results. In Table 8 we report only the results for TFP in manufacturing but the other performance measures follow the same pattern.

The finding that exporters are better performing than 1st link suppliers who in turn are better performing than other firms can be compared to the findings of survey-based studies that show a similar hierarchy among direct exporters and firms that export indirectly through trade intermediaries[22]. Our data does not allow us to distinguish firms that use exporters as trade

[21] When we include only the log of employment in the productivity regressions, the 3rd and 4th link firms do have statistically significant, even though economically small, productivity premia (not reported).

[22] See for instance Bai et al. (2015), Davies and Jeppesen (2014), Abel-Koch (2013), and McCann (2013)

intermediaries from firms that supply inputs into exporters' production. However, we can proxy the "true" indirect exporters by 1st link manufacturing firms who supply wholesale firms to see if indirect exporting could drive our results. To that purpose we run a regression on the manufacturing subsample of firms where we add indicators for 1st links that supply manufacturing exporters (D_{X1_M}) and 1st links that supply wholesale exporters (D_{X1_W})[23]. The first column of Table 8 shows the results. We find that the premia for the two types of firms are very similar and, if anything, the baseline result is driven rather by firms that supply manufacturing exporters. This suggests that rather than reflecting firm decisions about how to serve foreign markets, our results capture a hierarchy in the production network structure.

There is a range of potential reasons for the performance hierarchy that we observe along the exports supply chain and it goes beyond the scope of this study to disentangle causal mechanisms. Nevertheless, we take one incremental step towards determining the range by using the panel structure of our data. Do our results reflect simply a (self-)selection of suppliers or do firms start performing better when they become part of the exports supply chain? To gauge an answer to this question we present in the second column results from a fixed effects specification where we compare the average changes within firms in the same industry. The coefficients associated with 1st link and 2nd link firms remain positive and significant which means that the observed premia are, at least partially, a result of changes within firms. This is not to imply that becoming part of exports production networks leads to better firm performance as there is a multiplicity of potentially confounding factors, discussed widely in the learning-by-exporting literature. The results nevertheless show that the dynamics of firm productivity/profitability and exports supply chain participation are interconnected.

One policy-relevant aspect of looking at the entire exports supply chain is the participation of small and medium enterprises. We show that suppliers of exporters are on average smaller (in terms of both employment and sales) but still larger than other firms. We also know that the distribution of exports and sales is very concentrated and so the question is whether the observed premia are also identified among smaller firms. The third column is therefore run on the subsample of manufacturing small and medium enterprises (SMEs) that are defined as having more than 1 and less than 250 employees. Compared to the baseline results in column five of Table 7, the indirect export premia are similar but the difference between exporters and firms that participate in the exports production indirectly is less pronounced.

In the remaining columns we report some robustness checks on sub-samples of our data. First, foreign-owned companies are more likely to be part of the exports production network and, as shown by a large body of literature, they tend to be more productive than other firms. To make sure that the observed performance hierarchy is not driven by foreign ownership we exclude foreign owned companies from our sample[24]. Second, we run our estimation on a subsample of firms with more than one business customer which helps to avoid capturing some very specific

[23] The baseline category D_{X1} refers to 1st link firms that supply exporters in other services. The coefficients on dummies D_{X1_M} and D_{X1_W} indicate how suppliers of manufacturing exporters and wholesale exporters, respectively, differ from the baseline category.

[24] Foreign owned companies are defined in accordance with the Eurostat's definition of a foreign controlled enterprise; an enterprise is deemed to be controlled by a foreign enterprise when the latter controls, whether directly or indirectly, more than half of the shareholders' voting power or more than half of the shares.

relationships, and possibly ownership linkages. Third, we restrict the sample to firms that file full-length annual accounts and therefore have better data quality, these are essentially larger firms[25]. The baseline results are not significantly altered by any of these changes.

Table 8: Extensions and robustness of the exports supply chain premium

V:	TFP	TFP	TFP	TFP	TFP	TFP
	Exporter type	*Firm FE*	*SMEs*	*Domestic owned*	*More than 1 customer*	*Full data*
D_X	0.367[a]	0.119[a]	0.288[a]	0.375[a]	0.371[a]	0.379[a]
	(0.0601)	(0.0089)	(0.0573)	(0.0558)	(0.0497)	(0.0825)
D_{X1}	0.148[b]	0.076[a]	0.182[b]	0.202[a]	0.195[a]	0.217[b]
	(0.0419)	(0.0086)	(0.0494)	(0.0449)	(0.0394)	(0.0608)
D_{X1_M}	0.045[a]					
	(0.0104)					
D_{X1_W}	0.033[c]					
	(0.0151)					
D_{X2}	0.124[b]	0.044[a]	0.136[b]	0.124[b]	0.139[a]	0.156[b]
	(0.0395)	(0.0066)	(0.0457)	(0.0409)	(0.0350)	(0.0552)
D_{X3}	0.0566	0.019[c]	0.0559	0.0490	0.0735[c]	0.0584
	(0.0363)	(0.0077)	(0.0413)	(0.0384)	(0.0315)	(0.0491)
D_{X4}	0.0041	0.012	0.00731	-0.0022	0.0202	0.0152
	(0.0296)	(0.0067)	(0.0367)	(0.0323)	(0.0241)	(0.0434)
N	153721	147612	128085	147355	136770	58886
Adj. R^2	0.959	0.026	0.968	0.959	0.961	0.965

Industry-clustered standard errors in parentheses.

[a] $p<0.001$, [b] $p<0.01$, [c] $p<0.05$.

The results reported are for the sub-sample of manufacturing firms. TFP is in logarithm. Each regression includes the log of employment, the IHS of the number of customers and industry-year dummies (NACE 2 dgt.) The subsample in column 3 is all manufacturing firms with more than 1 and less than 250 employees. D_{X1_M} is a dummy for a manufacturing firm that supplies at least one exporting manufacturing firm and D_{X1_W} is a dummy for a manufacturing firm that supplies at least one exporting wholesale firm.

Overall, there is a robust evidence that the outstanding characteristics of exporters are present also along their supply chain and that they fade with the distance from exporting. These characteristics include labour productivity, total factor productivity, capital per worker, sales, employment and the number of customers.

5.2 Firm performance and the number of exporting customers

In this section we take a closer look at the relationship between firm performance and supplying exporters. We focus only on direct suppliers of exporters and instead of using a dummy for 1st link firms we include the number of exporters a firm supplies. We run a specification where we allow, as before, exporters to be on average different, and the characteristics of 1st link firms to vary with the number of exporters supplied. Since many exporters also supply other exporters, we include

[25] Abridged format of the annual accounts may be used by companies that do not exceed more than one of the following thresholds in the last two financial years for which the accounts are closed: 50 employees (FTE), 7.3 mil. EURO turnover, 3.65 mil EURO balance sheet total. Turnover, employment and inputs need not be reported in the abridged format and we use VAT declarations data to fill them in as described in Dhyne et al. (2015).

interaction terms so that the relationship between the number of exporting customers and the outcome variable can differ between exporters $(D_X = 1)$ and 1st link firms $(D_X = 0)$:

$$\ln(TFP) = \alpha + \beta_1 D_X + \beta_2 \ln(NC_X) \cdot (D_X = 1) + \beta_3 \ln(NC_X) \cdot (D_X = 0) + \beta_4 \ln(NC_N) + \gamma \ln(L) + \boldsymbol{\delta}' \boldsymbol{\iota\tau} + \varepsilon,$$

where NC_X stands for the number of exporting customers and NC_N for the remaining number of domestic business customers (i.e. non-exporters)[26].

Table 9: Firm productivity and the number of exporting customers[27]

V:	TFP		TFP	
	All	*Manuf.*	*All*	*Manuf.*
D_X	0.235[a]	0.210[a]	0.240[a]	0.215[a]
	(0.0198)	(0.0372)	(0.0223)	(0.0393)
$NC_X \cdot (D_X = 0)$	0.179[a]	0.108[a]	0.153[a]	0.100[a]
	(0.0153)	(0.0240)	(0.0203)	(0.0179)
$NC_X \cdot (D_X = 1)$	0.137[a]	0.098[a]	0.113[a]	0.0885[a]
	(0.0107)	(0.0128)	(0.0098)	(0.0086)
NC_N			0.034[c]	0.014
			(0.0161)	(0.0119)
N	1214949	153721	1214949	153721
R^2	0.945	0.959	0.945	0.959

Industry-clustered standard errors in parentheses.
[a] p<0.001, [b] p<0.01, [c] p<0.05.
TFP is in logarithm. Each regression includes the log of employment, and industry-year (NACE 2 dgt.) dummies.
The NC_N and NC_X variables are transformed with the inverse hyperbolic sine transformation and therefore the coefficients can be interpreted as elasticities.

The results are presented in Table 9[28]. They show that on top of being an exporter, supplying other exporting firm is also positively correlated with firm's productivity. Importantly, this relationship holds also for the 1st link firms. It is possible that these results are driven by the fact that better performing firms have more customers (as documented in Table 6) and therefore are also more likely to have more exporting customers. To shut this possible correlation channel, in the second part of Table 9 we include also the number of non-exporting domestic customers. The coefficient on the number of exporting customers remains significant which suggests that serving more customers that *export* indeed requires on average higher productivity[29].

[26] The variables are transformed using the inverse hyperbolic sine which yields the same coefficients interpretation as with a log-transformation.
[27] All supplier-related variables in this specification are defined on the basis of relevant suppliers. The total number of customers and the number of exporting customers thus include only those customers for which the firm is a relevant supplier.
[28] We present only the results for TFP but the same relationships hold for labour productivity or capital per worker.
[29] Similar results are obtained when we use the share of exporting customers in the total number of business customers.

5.3 Firm performance and the exported share of output

So far we focused only on the existence of an interaction between a firm and an exporter, disregarding its intensity. This meant that a firm that supplies only a tiny share of its output to an exporter that exports only a tiny share of its production was in the same category as a firm that supplies exclusively an exporter that exports a large share of its output. In this section we use our proxy for the indirect exposure to foreign demand to take these differences into account. Instead of using dummy variables, we regress firm productivity on the share of sales exported directly and the share of sales exported indirectly through supplies of inputs into the exports production chain.

The relationship we estimate is:

$$\ln(\text{TFP}) = \alpha + \beta_1 \frac{\text{X}}{\text{Y}} + \beta_2 \frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 1) + \beta_3 \frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 0) + \gamma \ln(\text{L}) + \boldsymbol{\delta}' \boldsymbol{\iota}\boldsymbol{\tau} + \varepsilon.$$

As before, Y is total sales, X stands for direct exports, and Y_{X1} is the sales embodied in exports indirectly through input supplies to exporters. The relationship between indirect exports and productivity is allowed to vary between exporters $(\text{D}_\text{X} = 1)$ and non-exporters $(\text{D}_\text{X} = 0)$.

Table 10: Firm productivity and foreign demand exposure

V:	TFP		TFP	
	All	*Manuf.*	*All*	*Manuf.*
$\frac{\text{X}}{\text{Y}}$	0.462[a]	0.372[a]	0.383[a]	0.296[a]
	(0.0274)	(0.0580)	(0.0600)	(0.0269)
$\frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 0)$	0.259[a]	0.196[a]	0.360[a]	0.221[a]
	(0.0306)	(0.0516)	(0.0558)	(0.0254)
$\frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 1)$	0.577[a]	0.303[b]	0.123	0.0866
	(0.104)	(0.0907)	(0.0923)	(0.0564)
Sales			0.356[a]	0.333[a]
			(0.0231)	(0.0133)
N	1075393	138649	1075393	138649
R^2	0.946	0.960	0.959	0.971

Industry-clustered standard errors in parentheses.
[a] p<0.001, [b] p<0.01, [c] p<0.05.
TFP and Sales are in logarithms. Each regression includes the log of employment, the IHS of the number of customers and industry-year dummies (NACE 2 dgt.).

In Table 10 we present two sets of results. The first two columns confirm that both direct and indirect export orientation is positively related to productivity. Furthermore, the relationship is stronger for direct exports. In the second two columns we control for the size of the firm by including total sales. Both the direct export share, and the indirect export share for non-exporters remain strongly positively related with productivity while the indirect export share for exporters loses its significance. This suggests that while for non-exporters the interaction with exporters and/or the indirect exposure to foreign demand is correlated with productivity, for exporters it does not go beyond the sheer size effect (that larger firms are more productive/profitable). The results are almost identical when we use the total indirect exports share that takes into account the entire supply chain (not reported).

5.4 Sourcing pattern along the exports supply chain

So far we have established that firm's performance is positively related with producing intermediate inputs and services for exports. To complement this picture, in this last part we look at the exports supply chain from a different angle and present results that summarize the *sourcing patterns* of firms that produce for exports. We focus on manufacturing firms and run the same regression specifications as in Table 6 using different dependent variables: total domestic purchases, the number of domestic suppliers, the probability of importing, the share of imports in total purchases, and the average TFP of suppliers.

Table 11: Sourcing pattern along the exports supply chain

V:	**Domestic purchases**	**Number of domestic suppliers**	**Importer**	**Import share**	**Suppliers' TFP**
D_X	0.841[a]	-0.178[a]	2.216[a]	0.843[a]	0.432[c]
	(0.173)	(0.0360)	(0.198)	(0.127)	(0.176)
D_{X1}	0.322[c]	-0.0307	0.437[c]	0.217	0.0364
	(0.141)	(0.0374)	(0.216)	(0.137)	(0.117)
D_{X2}	0.264[c]	0.0095	0.0329	0.115	0.0480
	(0.117)	(0.0306)	(0.220)	(0.124)	(0.112)
D_{X3}	0.182[c]	0.0268	-0.0990	-0.116	0.154
	(0.0859)	(0.0308)	(0.188)	(0.0943)	(0.122)
D_{X4}	0.0615	0.0231	-0.0030	-0.260	0.170[c]
	(0.0474)	(0.0292)	(0.0988)	(0.168)	(0.0750)
Domestic purchases		-0.034[b]	0.292[a]	-0.427[a]	0.187[a]
		(0.0113)	(0.0525)	(0.0326)	(0.0218)
N	148552	148552	148552	51119	148469
Adj. R^2	0.684	0.027	0.446	0.196	0.307

Industry-clustered standard errors in parentheses.

[a] $p<0.001$, [b] $p<0.01$, [c] $p<0.05$.

Domestic purchases, import share and suppliers' TFP are in logarithm. Each regression includes the log of employment, the IHS of the number of customers and industry-year dummies (NACE 2 dgt.). The number of domestic suppliers is estimated using the negative binomial estimator, the probability of importing is estimated by logit.

Several additional stylized facts emerge from the results reported in Table 11. Firms in the exports supply chain, and especially exporters, buy more from domestic suppliers than the rest of the economy. However, given the amount of domestic sourcing, exporters have much smaller number of domestic suppliers. Exporters, and to some extent also 1st link firms, are more likely to source from abroad. Also, among firms that do import, exporters have much larger share of imports in total sourcing. Finally, exporters are not only more productive than non-exporters but they also have on average more productive domestic suppliers[30].

[30] There is no premium along the rest of the exports supply chain. Intuitively, the average productivity of suppliers reflects the same picture as the own TFP premium for firms along the exports supply chain but from a slightly different angle. If the 1st link firms are relatively more productive than the rest of the economy (positive 1st link productivity premium) then the average supplier's TFP of exporters should also be relatively high (positive exporter premium on

Overall, exporters, and to some extent 1st link firms, have less domestic suppliers and import much more than other firms. Combining the results that exporters have larger share of imports in their sourcing and higher average productivity of domestic suppliers suggests that offshoring may substitute for less productive domestic suppliers. Indeed, when we include the import share in the suppliers' TFP regression, it is strongly positively correlated with the average domestic suppliers' TFP and all the other controls lose their statistical (and most of the economic) significance. Similarly, the import share is negatively correlated with the amount of domestic purchases and the number of domestic suppliers. These results are in detail reported in the Appendix (Table A5).

6 Discussion and conclusion

In this study we provide the first complete picture of firms that participate in the exports production. We combine international and domestic trade data to show that encompassing all firms that contribute their value added to exports alters substantially the view of firms that produce for foreign markets. We confirm that direct exporters are the best performing firms in the economy. However, we also show that these firms are supported by suppliers who are very good performers themselves. Furthermore, we find evidence for a performance premium along the exports supply chain in general and show that this premium declines with the distance from foreign demand.

The main results are that firms who are involved in exports production permeate the economy to a large extent. Even though there are only seven percent of firms who sell goods on foreign markets, another twelve percent of firms are suppliers of these firms, and more than a third of Belgian firms are within two-transactions distance from foreign demand. These firms perform better than the rest of the economy according to various measures such as value added per worker, total factor productivity, sales or the number of business customers. Furthermore, there is also a hierarchy within the exports supply chain as the performance measures decline with the distance from foreign demand.

We complement the main findings with several extensions. First, we focus only on suppliers of exporters and show that their performance is increasing in the number of exporting customers that they supply, and that this relationship goes beyond the fact that more productive firms have more customers in general. Second, we show that accounting for the extent of foreign demand exposure, measured by a proxy for the share of output embodied in exports, also suggests that firms that are more exposed to foreign demand perform better, and that the association is stronger for direct exposure than the indirect one. Finally, we focus on sourcing patterns and show that exporters source much more from abroad and have less domestic suppliers, while the weighted average productivity of these suppliers is much higher than the average supplier productivity of other firms. To some extent we observe these characteristics also at firms one transaction away from foreign demand but the difference is less marked.

suppliers' TFP). However, the supplier's TFP includes TFP of all firm's suppliers, thus also those that are at the same distance as, or closer to, the export markets as the sourcing firm is. For example, for a 1st link firm it may include not only the 2nd links but also other 1st link firms and exporters. Furthermore, the productivities are weighted by the supplier's share in the total domestic purchases of the firm. Therefore, as long as the most productive firms (who are also the closest to foreign markets) account for large shares of purchases of *all* firms, the TFP differences further up the exports supply chain do not have much impact on the average suppliers' TFP. This is indeed corroborated by the results in Table 6 that show that exporters serve the largest number of domestic firms.

The patterns emerging from this research are the first step towards our better understanding of the production structure that underpins the observed international trade flows. It emphasizes the importance of production fragmentation and the fact that firm's performance and its position within the production network are related. It is for future research to establish which underlying mechanisms are behind these patterns; whether it is how firms search for suppliers, self-selection into different positions according to their profitability and fixed costs, learning from customers or simultaneous determination by other firm-level choices.

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Appendix

Table A1a: Aggregate statistics in our sample and the coverage as compared to the Eurostat's Structural Business Statistics

	Number of enterprises		Turnover		Value added		Employment		Total purchases		VA per employee	
						Total business economy						
2008	271136	0.60	780000	0.88	163000	0.98	1865692	0.89	691000	0.95	102	1.27
2009	284356	0.59	699000	0.87	162000	0.96	1841793	0.90	604000	0.94	99	
2010	287046	0.53	758000	0.85	170000	0.96	2031364	0.96	658000	0.90	103	1.24
2011	296500	0.54	837000	0.85	183000	0.99	2084554	0.97	731000	0.91	109	1.27
2012	292218	0.52	865000	0.88	178000	0.94	1883732	0.89	749000	0.93	149	1.68
Average		0.56		0.87		0.97		0.92		0.93		1.37
						Manufacturing						
2008	22774	0.61	239000	0.90	47700	0.97	505981	0.93	209000	0.96	84	0.93
2009	23080	0.61	190000	0.90	43700	0.98	488877	0.93	161000	0.97	79	0.93
2010	22760	0.61	218000	0.92	48100	1.00	469313	0.93	189000	0.98	91	0.96
2011	22779	0.61	249000	0.92	47500	1.02	468980	0.93	221000	0.97	89	0.96
2012	22316	0.66	253000	0.94	47900	1.02	463673	0.94	238000	1.05	107	1.11
Average		0.62		0.92		1.00		0.93		0.98		0.98

Source: Our data and Eurostat, http://ec.europa.eu/eurostat/web/structural-business-statistics/data/database. For each indicator the first column contains the total in our sample, the second column contains the ratio of the total and a corresponding SBS indicator. We report only years for which the SBS indicators are available.

NOTES: Definitions of each indicator in the Structural Business Statistics and our dataset

Indicator	SBS	Our data	Unit
Number of enterprises	Number of enterprises	Number of enterprises	
Turnover	Turnover or gross premiums written	Turnover	millions of EURO
Value added	Value added at factor cost	Value added	millions of EURO
Employment	Number of employees	Employment	Full time equivalent in our data
Total purchases	Total purchases of goods and services	Intermediate inputs	millions of EURO
Value added per employee	Gross value added per employee	Value added per employee	thousands of EURO

Table A1b: Our sample coverage by size class

Year	Size class	*Total business economy*			*Manufacturing*		
		Number of enterprises	Turnover	Value added	Number of enterprises	Turnover	Value added
2010	From 0 to 9	0.52	0.73	0.81	0.56	0.88	0.93
	From 10 to 19	0.69	0.77	0.94	0.76	0.75	0.84
	From 20 to 49	0.80	0.79	0.93	0.91	0.84	1.03
	From 50 to 249	0.87	0.90	0.96	0.92	0.94	1.01
	250 or more	0.93	0.93	1.07	0.98	0.94	1.02
	Total	0.53	0.85	0.96	0.61	0.92	1.00
2011	From 0 to 9	0.52	0.76	0.99	0.56	0.91	1.05
	From 10 to 19	0.69	0.74	0.88	0.73	0.79	0.95
	From 20 to 49	0.78	0.80	0.93	0.88	0.81	0.98
	From 50 to 249	0.87	0.88	0.99	0.91	0.95	0.98
	250 or more	0.92	0.94	1.05	0.97	0.94	1.04
	Total	0.54	0.85	1.00	0.61	0.92	1.01
2012	From 0 to 9	0.50	0.85	0.77	0.61	0.92	1.04
	From 10 to 19	0.69	0.72	0.86	0.77	0.87	1.03
	From 20 to 49	0.82	0.79	0.89	0.91	0.85	0.96
	From 50 to 249	0.88	0.85	0.97	0.93	0.94	0.96
	250 or more	0.96	0.97	1.07	1.00	0.95	1.05
	Total	0.52	0.88	0.94	0.66	0.94	1.02

Source: Our data and Eurostat, http://ec.europa.eu/eurostat/web/structural-business-statistics/data/database. We report the comparison for years and indicators that are available in the SBS database. Size class represents the number employed persons.

Table A1c: Aggregate international trade in our sample and its coverage as compared to the Eurostat's International trade data

	Exports		Imports	
2002	156100	0.68	157200	0.75
2003	161800	0.72	165200	0.80
2004	170500	0.69	172700	0.75
2005	164300	0.61	184100	0.72
2006	172900	0.59	213200	0.76
2007	175800	0.56	216900	0.72
2008	189200	0.59	244100	0.77
2009	156700	0.59	197100	0.77
2010	181200	0.59	226000	0.77
2011	212300	0.62	265900	0.79
2012	217300	0.63	250300	0.73
Average		0.62		0.76

Source: Our dataset and Eurostat, http://ec.europa.eu/eurostat/web/international-trade/data/database. For each indicator the first column contains the total in our sample, the second column contains the ratio of the total and a corresponding value in the Eurostat database. Both indicators are in millions of EURO.

Table A2 : Distribution of exports and exporters by the main sector of a firm, in 2012

Sector	Share of total exports	Share of the total number of exporters
	In percent	In percent
Primary	0.60	1.67
Manufacturing	74.62	26.35
Utilities and construction	1.22	3.58
Wholesale	18.57	38.16
Other services	4.99	30.25

Table A3: Summary statistics of firm performance, total economy and manufacturing

Variable	N	Mean	Median	St. Dev.	Min.	Max.
			Total business economy			
Sales	1214949	5.70	0.51	127.00	1.00E-08	33000
Employment	1214949	15.64	2.90	278.05	7.41E-04	127242
Number of customers	1214949	59.87	11	333.63	0	64550
Number of customers (relevant)	1214949	13.95	3	103.91	0	28154
Labour productivity	1214949	100.14	57.36	1385	4.55E-04	771000
TFP	1214949	88.26	4.59E-04	11200	6.45E-16	6050000
Capital per employee	1214949	354.46	36.48	40200	3.29E-05	42400000
Number of suppliers	1214949	53.18	34	78.82	0	5666
Number of suppliers (relevant)	1214949	8.82	8	5.28	0	764
Share of imports in total purchases	1179303	0.05	0	0.156	0	1.00
			Manufacturing			
Sales	153721	14.10	0.77	259.00	6.00E-08	33000
Employment	153721	34.73	6.10	174.82	0.01	8208
Number of customers	153721	69.25	24	216.79	0	16095
Number of customers (relevant)	153721	14.73	5	58.32	0	5984
Labour productivity	153721	81.61	56.41	424	4.55E-04	89600
TFP	153721	545.76	0.001	30600	2.88E-09	6050000
Capital per employee	153721	259.26	40.31	12500	1.33E-04	2890000
Number of suppliers	153721	87.03	53	120.97	0	3361
Number of suppliers (relevant)	153721	9.87	10	4.87	0	294
Share of imports in total purchases	148552	0.11	0	0.22	0	1.00

Summary statistics calculated on the subsample used for regression analysis. Sales are in millions euro; labour productivity, TFP and capital per employee are in thousands.

Table A4: Means and standard deviations of firm performance by distance from foreign demand

Variable	Exporter	1st link	2nd link	3rd link	4th link	Other
	Total business economy					
Sales	**31.10**	**5.41**	**1.57**	**0.93**	**0.82**	**1.00**
	343.00	44.60	11.90	5.37	4.16	41.40
Employment	**58.64**	**22.87**	**8.32**	**5.52**	**4.49**	**4.93**
	477.57	362.42	277.89	169.66	14.77	143.66
Number of customers (relevant)	**42.38**	**29.27**	**12.37**	**6.30**	**3.95**	**0.66**
	266.92	89.07	20.15	9.32	5.34	1.84
Labour productivity	**112.61**	**115.79**	**99.05**	**91.30**	**91.20**	**92.26**
	562.90	2141.20	736.27	220.87	279.46	1616.58
TFP	**409.75**	**91.20**	**32.35**	**20.52**	**23.46**	**29.52**
	22000	14300	3329.52	1390.47	1678.34	8306.45
Capital per employee	**312.09**	**407.35**	**284.02**	**235.47**	**235.77**	**427.59**
	13900	12100	6314.44	3176.17	2256.02	65600
Number of suppliers	**121.11**	**69.61**	**49.17**	**40.04**	**36.44**	**29.11**
	163.39	79.72	46.86	33.81	28.85	25.80
Number of suppliers (relevant)	**7.21**	**8.85**	**9.62**	**9.78**	**9.77**	**8.59**
	6.54	5.43	5.34	4.97	4.72	4.65
Share of imports in total purchases	**0.22**	**0.06**	**0.02**	**0.02**	**0.02**	**0.01**
	0.28	0.18	0.12	0.10	0.09	0.08
	Manufacturing					
Sales	**41.40**	**2.69**	**1.17**	**0.69**	**0.59**	**0.90**
	462.00	10.90	3.00	1.33	1.06	9.58
Employment	**90.59**	**14.48**	**7.44**	**4.93**	**4.91**	**6.05**
	301.97	37.70	14.80	8.00	16.82	23.97
Number of customers (relevant)	**25.72**	**16.98**	**11.91**	**7.01**	**4.59**	**0.87**
	97.65	33.17	17.87	9.56	6.03	2.49
Labour productivity	**92.18**	**78.48**	**76.70**	**77.16**	**71.41**	**75.32**
	684.10	178.54	168.78	172.94	108.96	303.00
TFP	**1284.36**	**244.37**	**27.34**	**46.34**	**81.98**	**367.57**
	39300	32400	1842.89	3549.59	1765.25	31400
Capital per employee	**467.50**	**154.91**	**136.20**	**155.01**	**128.33**	**203.20**
	22300	1065.47	974.72	1200.58	592.38	2603.23
Number of suppliers	**118.83**	**78.61**	**55.36**	**35.37**	**25.70**	**7.86**
	357.35	128.59	77.63	47.89	35.45	23.27
Number of suppliers (relevant)	**25.72**	**16.98**	**11.91**	**7.01**	**4.59**	**0.87**
	97.65	33.17	17.87	9.56	6.03	2.49
Share of imports in total purchases	**0.27**	**0.07**	**0.03**	**0.02**	**0.01**	**0.02**
	0.28	0.18	0.13	0.09	0.09	0.09

Means (in bold) and standard deviations calculated on the subsample used for the regression analysis. Sales are in millions euro; labour productivity, TFP and capital per employee are in thousands.

Table A5: Sourcing pattern of exporters – the effect of imports

V:	**Domestic inputs**	**Number of domestic suppliers**	**Suppliers' TFP**
D_X	0.610[a]	-0.071[c]	0.124
	(0.0981)	(0.0322)	(0.164)
D_{X1}	0.253[c]	0.0245	0.0025
	(0.0906)	(0.0290)	(0.155)
D_{X2}	0.237[b]	0.0499	-0.0646
	(0.0808)	(0.0257)	(0.205)
D_{X3}	0.120	0.0383	0.0132
	(0.0775)	(0.0247)	(0.209)
D_{X4}	0.0543	-0.0140	0.253
	(0.0839)	(0.0268)	(0.136)
Domestic inputs		-0.102[a]	-0.0204
		(0.0155)	(0.0330)
Import share	-0.128[a]	-0.060[a]	0.066[a]
	(0.0120)	(0.0044)	(0.0167)
N	51119	51119	51119
Adj. R^2	0.647	0.159	0.319

Industry-clustered standard errors in parentheses.

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

Domestic inputs, import share and suppliers' TFP are in logarithm. Each regression includes the log of employment, the IHS of the number of customers and industry-year dummies (NACE 2 dgt.). The number of domestic suppliers is estimated using the negative binomial estimator.

Similar results are obtained when we control for sales.

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