Exporters' Suppliers: Shining Bright in the Superstars' Light

Emmanuel Dhyne‡ and Stela Rubínová✧

Abstract

Even in export-oriented industries, only a handful of firms ship their goods abroad and these firms are systematically different from their purely domestic counterparts. The current picture does not, however, encompass the many firms that export via trade intermediaries or supply exporters with intermediate inputs. This paper uses a new and unique dataset of yearly transactions between all domestic firms in Belgium to unveil the supplier network that underpins export production. It shows that even though there are only seven percent of firms that sell goods on foreign markets, more than a third of all firms is within two-transactions distance from foreign demand. Notably, these firms perform better than the rest of the economy and there is a hierarchy within the exports supply chain whereby firm performance increases with foreign demand exposure.

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‡ National Bank of Belgium and University of Mons

✧ The Graduate Institute, Geneva and the World Trade Organization: *stela.rubinova@iheid.ch*

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1. Introduction

It is now an established fact that even in export-oriented industries, only a handful of firms ship their goods abroad and that these firms are systematically different from others (Bernard et al., 2012a; Wagner, 2012). Moreover, there is a substantial heterogeneity among exporters themselves as export sales are highly concentrated among few firms, which gained them the label of "export superstars" (Freund and Pierola, 2015). On the other hand, recent research also highlights that many firms may export indirectly either by using trade intermediaries or by having their products used in other firms' exports as intermediate inputs. Empirical evidence from a range of countries shows that wholesalers and retailers account for 10 to 20 percent of exports value and that even manufacturing firms act as trade intermediaries (Abel-Koch, 2013; Di Nino, 2015). Furthermore, a recent effort to quantify international trade in terms of value added emphasizes that in the age of production fragmentation and global value chains, gross trade flows do not give us an accurate picture of the origins of the value embodied in traded goods (Koopman et al., 2014). Therefore, they convey very limited information about where the jobs and profits associated with the production of traded goods lie. For instance, services, which are considered rather non-tradable, make up an important share of international trade when we take into account their value added embodied in traded goods. In the same manner, the sole focus on firms that are recorded in customs data disregards the vast firm network that underpins export production, and therefore conceals many of the interconnections between domestic firms and international markets.

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 is part of the supply chain of exporters. Furthermore, our results 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), which is a half of the direct exporter premium.

The paper proceeds with a review of related literature in Chapter 2 and the description of the data sources and data construction in Chapter 3. Chapter 4 provides detailed summary statistics of our data and describes the network. Chapter 5 presents regression results for the export supply chain premia. Chapter 6 discusses the results and concludes.

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[1]. 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. (2015a) 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[2]. Blum et al. (2010) document a similar phenomenon on the import side for Chile. Bernard et al. (2012b) 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.

Since production chains are often split among several countries, international trade comprises of not only final goods but also a large share of intermediate inputs. Recently constructed industry-level international input-output tables have 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 highlights a second omission in the analysis of customs data -

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

[2] 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. (2017), Davies and Jeppesen (2014), Abel-Koch (2013), and McCann (2013).

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.

Firm-level evidence on production networks is relatively scarce. Several 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), 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 negative 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. Still, 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 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. (2014; 2015b) and Mizuno et al. (2015). Nevertheless, these studies cover only a selected part of the economy and only domestic transactions. Based on the same data sources as this paper, a study by Magerman et al. (2016) brings the approach of Acemoglu et al. to the firm level to quantify the impact of productivity shocks in a production network with heterogeneous firms.

In conclusion, 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 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 transaction-level 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 and firm characteristics

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[3] in the period 2002-2012.

[3] 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.

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[4]). 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

[4] 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.

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.

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]. The 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 A.9a, Table A.9b, Table A.9c).

3.2. Network-based variables

We use the domestic trade data to construct a network of supplier and customer links among Belgian firms. Based on these relationships and firms' foreign trade participation we calculate several indicators that capture firms' exposure to foreign demand. First, we categorize firms according to the shortest path to exporting. 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 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, to more precisely capture firms' exposure to foreign demand, we also compute a proxy for their total amount of turnover embodied in exports. 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):

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

This 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.

In matrix notation

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

We then apply the Leontief insight (Leontief, 1936) 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.

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

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 provide 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. Furthermore, the indicator is based on the assumption of proportionality between the use of inputs for exported and domestic products, between the use of inputs for the production of inputs for exporters and non-exporters, etc.

4. Description of the domestic trade network and the exports' supply chain participation

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 at least one incoming transaction in a given year and therefore figure as customers in the network. On the other hand, not all firms have an outgoing transaction; only 76 percent of firms supply another firm in a given year. The remaining 24 percent of firms thus concentrate on selling to final demand, government, firms in non-market services, or foreign customers. For the relevant suppliers sub-network, the total number of firms remains fairly similar but the share of firms who are suppliers decreases to 62 percent[5]. The essential suppliers sub-network retains 78 percent of firms from the total network and the share

[5] The total number of firms decreases because we keep only firms that have at least one relevant supplier or are a relevant supplier for at least one firm. Some firms that are only customers in the network drop out because they do not have a supplier that accounts for more than one percent of their total purchases. However, 94 percent of customers remain in the network.

of firms that are suppliers drops down to 34 percent. Table A.10a in the Appendix provides the summary statistics and their evolution over time.

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 relevant and essential sub-networks retain a majority of firms, they are 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 A.10b in the Appendix provides summary statistics of the transactions' distribution and its evolution over time.

The average number of domestic business customers per firm ranges from 11 in the Primary sector to 76 in Wholesale. The distribution is highly skewed with median values ranging from 2 to 10 customers and maximum values in (tens of) thousands. The number of domestic suppliers varies less both across sectors and across firms. The average ranges from 22 in the Other market services sector to 60 in Manufacturing. The median is between 13 and 32 suppliers. When we restrict the network to relevant suppliers, the median firm has 1 to 2 customers and 6 to 9 suppliers, depending on the sector. Restricting the network to essential suppliers makes it extremely sparse with the majority of firms having only one supplier and no business customer. Table A.11 in the Appendix describes the distribution of the number of links per firm by sector.

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[6]. Yet only seven percent of all firms export goods[7]. 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[8]. The role of wholesalers in export activities is large – they make up 38 percent of exporting firms and 19 percent of the exports value.

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 non-exporting firms that are part of the exports supply chain. OECD's TiVA database already suggests that these firms play an important role as more than 40 percent of the domestic value added in Belgian exports is indirect, i.e. generated by firms in other than the exporting industry. Our data show that even though 93 percent of firms do not ship their goods abroad, 43 percent supply an exporter without exporting themselves (first panel of Table 1). In Manufacturing and Wholesale, the share is 50 percent and 46 percent, respectively. In the Primary sector it is even 56 per cent, reflecting mostly the role of agricultural input into the export-oriented food processing industry.

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

[6] 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.

[7] The share of exporting firms varies by sector. In manufacturing and wholesale, the share is around 20 percent. In the primary sector the share is only 7 percent. There are goods exporting firms also in other sectors but their shares are considerably smaller. The distribution of exporters and exports by sector is reported in Table A.12 in the Appendix.

[8] Even though almost a third of exporters are in Other market services, 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.

exports with a large mass of 2nd link firms and also a relatively high percentage of 3rd and 4th link firms.

Table 1: 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	*80.4*
Manufacturing	21.64	49.90	12.53	1.06	0.11	*85.2*
Utilities and construction	1.69	45.58	30.37	3.30	0.29	*81.2*
Wholesale	19.36	46.40	13.11	1.26	0.11	*80.2*
Other market services	3.50	40.79	22.77	2.52	0.23	*69.8*
Total	*7.05*	*43.33*	*21.57*	*2.31*	*0.21*	*74.5*
	Relevant suppliers (1 percent threshold)					
Primary	7.16	16.03	14.75	7.42	2.85	*48.2*
Manufacturing	22.23	19.84	14.02	7.85	3.40	*67.4*
Utilities and construction	1.75	8.97	19.25	16.93	8.09	*55.0*
Wholesale	20.07	18.02	13.37	7.88	3.49	*62.8*
Other market services	3.67	10.15	14.25	10.18	4.63	*42.9*
Total	*7.34*	*12.02*	*14.87*	*10.63*	*4.86*	*49.7*
	Essential suppliers (10 percent threshold)					
Primary	6.51	2.29	0.63	0.22	0.07	*9.7*
Manufacturing	21.43	3.89	0.78	0.23	0.11	*26.5*
Utilities and construction	1.67	0.99	0.56	0.30	0.15	*3.7*
Wholesale	19.38	3.59	0.83	0.31	0.14	*24.3*
Other market services	3.57	1.50	0.66	0.29	0.13	*6.2*
Total	*6.96*	*1.91*	*0.67*	*0.29*	*0.13*	*10.0*

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 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 the *relevant* sub-network as the benchmark definition in our analysis.

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

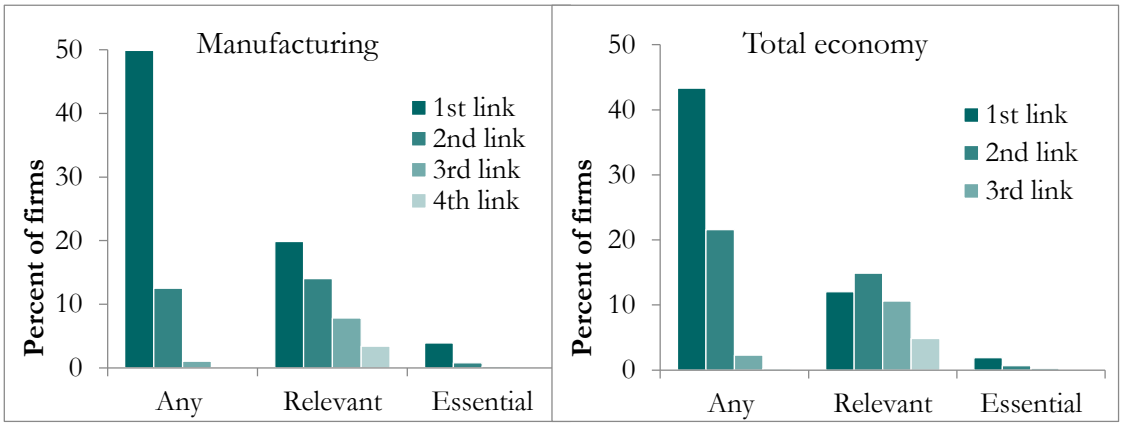
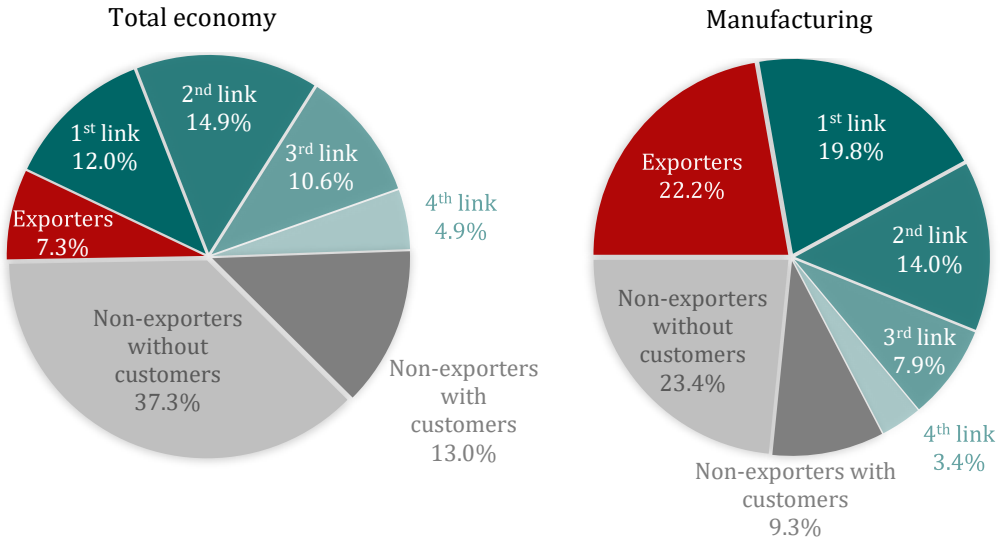


Figure 2 focuses on the relevant sub-network and visualizes the distribution for the total economy and manufacturing. Out of all firms, 12 percent are 1st link, 15 percent are 2nd link, and altogether 50 percent are at most four transactions far from foreign markets. Notably, most of the remaining firms do not supply any businesses and so there are only 13 percent of firms that have a business customer but are further than four transactions from exporting. In manufacturing, the share of exporters is much higher and so is the amount of firms that are within the four-transactions distance from foreign markets, making up more than two thirds of manufacturing firms.

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 2 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 while 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.

Table 2: 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.

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 that is dominated by few large firms that serve a large network of customers.

4.4. Exported share of output

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 3 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, half of which is through directly supplying exporters. 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 3 we take into account firm size and weigh the average by the share of firm sales in the

total sales of the sector[9]. 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 again 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 3: 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. Analysis of the exports supply chain premium

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)[10], and

[9] This measure therefore corresponds to the sector-level share of output embodied in exports.

[10] 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.

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 with 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 Exports supply chain premium

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}), 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[11]:

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

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

In the second set of regressions that focus on productivity, we also include the log of employment (L) and the log of the number of domestic business customers (NC)[12] to compare the performance of firms of similar size.

[11] All variables are firm-year specific. For the sake of readability, the firm-year indexes are omitted in this and all the following equations.

[12] 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.

Table 4: Exports supply chain premia - size

	(1)	(2)	(3)	(4)	(5)	(6)
	All firms			Manufacturing firms		
V:	Sales	Employment	Number of customers	Sales	Employment	Number of customers
D_X	1.786***	2.275***	3.029***	2.335***	2.830***	2.529***
	(0.131)	(0.183)	(0.208)	(0.100)	(0.163)	(0.102)
D_{X1}	1.125***	1.624***	2.721***	1.062***	1.527***	2.145***
	(0.075)	(0.116)	(0.158)	(0.088)	(0.143)	(0.092)
D_{X2}	0.562***	0.898***	2.055***	0.511***	0.912***	1.812***
	(0.0573)	(0.0910)	(0.168)	(0.0944)	(0.133)	(0.117)
D_{X3}	0.223***	0.494***	1.508***	0.130	0.482**	1.426***
	(0.0397)	(0.0690)	(0.156)	(0.133)	(0.142)	(0.140)
D_{X4}	0.111*	0.326***	1.163***	0.0195	0.261	1.136***
	(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.

*** p<0.001, ** p<0.01, * 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.).

Results from the two sets of regressions are presented in Table 4 and Table 5. The first row of each table confirms findings from previous studies that exporters are markedly different from other firms in the same industry[13]. 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. Notably, exporters also have more domestic business customers than other firms (Table 4, 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 46 percent more productive than firms further than four transactions away from foreign demand, but the premium exists also for 1st and 2nd link

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

firms[14]. It is 23 percent for 1st links, 8 percent for 2nd links (column 2 of Table 5), and the premia are statistically significantly different from each other. Notably, firms in the exports supply chain perform better not only in terms of monetary measures such as sales or productivity[15] but also in physical terms such as the number of domestic business customers they serve.

Table 5: Exports supply chain premia - productivity

	(1)	(2)	(3)	(4)	(5)	(6)
	All firms			Manufacturing firms		
V:	Labour productivity	TFP	Capital per employee	Labour productivity	TFP	Capital per employee
D_X	0.481***	0.375***	0.688***	0.468***	0.365***	0.750***
	(0.0389)	(0.0314)	(0.108)	(0.0632)	(0.0600)	(0.0826)
D_{X1}	0.267***	0.203***	0.392***	0.242***	0.186***	0.334***
	(0.0273)	(0.0242)	(0.0771)	(0.0453)	(0.0448)	(0.0506)
D_{X2}	0.111***	0.0805***	0.215**	0.149**	0.123**	0.185***
	(0.0171)	(0.0112)	(0.0631)	(0.0405)	(0.0397)	(0.0400)
D_{X3}	0.0199	0.0103	0.109*	0.069	0.0565	0.119*
	(0.0128)	(0.0087)	(0.0450)	(0.0392)	(0.0364)	(0.0515)
D_{X4}	-0.0295*	-0.0274*	0.0348	0.004	0.004	0.012
	(0.0124)	(0.0116)	(0.0374)	(0.0350)	(0.0295)	(0.0620)
NC	0.047***	0.037***	0.062*	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
Adj. R^2	0.181	0.945	0.137	0.130	0.959	0.087

Industry-clustered standard errors in parentheses.

*** p<0.001, ** p<0.01, * 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 also includes the log of employment and industry-year dummies (NACE 2 dgt.).

[14] 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.

[15] 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 5) 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[16]. Second, the premia are not due to a difference between firms that have business customers and firms that focus on serving only final demand.

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. In the following paragraphs we discuss several extensions and robustness checks of the baseline results. We report only the results for TFP in the manufacturing sector (Table 6) but estimates for the other performance measures as well as for the full sample follow a similar 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[17]. Our data does not allow us to distinguish firms that use exporters as trade 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

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

[17] See for instance Bai et al. (2017), Davies and Jeppesen (2014), Abel-Koch (2013), and McCann (2013)

manufacturing exporters (D_{X1_M}) and 1st links that supply wholesale exporters (D_{X1_W})[18]. The first column of Table 6 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 firms' 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. In the second column we present results from a fixed effects specification where we compare the average changes within firms. 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 1st link firms are on average smaller (in terms of both employment and sales) than exporters 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 identified among smaller firms as well. The third column is therefore run

[18] 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.

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 5 of Table 5, the indirect export premia are similar but the difference between exporters and firms that participate in the exports production indirectly is less pronounced.

Table 6: Extensions and robustness of the exports supply chain premium

	(1)	(2)	(3)	(4)	(5)	(6)
V:	TFP	TFP	TFP	TFP	TFP	TFP
	Exporter type	Firm FE	SMEs	Domestic owned	More than 1 customer	Full data
D_X	0.367***	0.119***	0.288***	0.375***	0.371***	0.379***
	(0.0601)	(0.0089)	(0.0573)	(0.0558)	(0.0497)	(0.0825)
D_{X1}	0.148**	0.076***	0.182**	0.202***	0.195***	0.217**
	(0.0419)	(0.0086)	(0.0494)	(0.0449)	(0.0394)	(0.0608)
D_{X1_M}	0.045***					
	(0.0104)					
D_{X1_W}	0.033*					
	(0.0151)					
D_{X2}	0.124**	0.044***	0.136**	0.124**	0.139***	0.156**
	(0.0395)	(0.0066)	(0.0457)	(0.0409)	(0.0350)	(0.0552)
D_{X3}	0.0566	0.019*	0.0559	0.0490	0.0735*	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.

*** p<0.001, ** p<0.01, * 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.

In the remaining columns we report robustness of the baseline results to 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[19]. Second, we run our estimation on a subsample of firms with more than one business customer which helps to avoid capturing some very specific 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[20]. The baseline results are not significantly altered by any of these changes.

Overall, our analysis provides 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

[19] 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.

[20] 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).

vary with the number of exporters supplied. Since many exporters also supply other exporters, we include 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 ($D_X = 0$). We thus estimate the following equation:

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

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)[21].

The results are presented in Table 7[22]. They show that on top of being an exporter, supplying other exporting firm is also positively correlated with firm's productivity. This relationship holds even stronger for the 1st link firms, though the difference is not statistically significant. It is possible that these results are driven by the fact that better performing firms have more customers (as documented in Table 4) and therefore are also more likely to have more exporting customers. To shut this correlation channel, in the second part of Table 7 we include also the number of non-exporting domestic customers. The coefficient on the number of exporting customers remains significant for both exporters and 1st link firms which suggests that serving more customers that *export* indeed requires on average higher productivity[23].

[21] The variables are transformed using the inverse hyperbolic sine which yields the same coefficients interpretation as with a log-transformation.

[22] We present only the results for TFP but the same relationships hold for labour productivity or capital per worker.

[23] Similar results are obtained when we use the share of exporting customers in the total number of business customers.

Table 7: Firm productivity and the number of exporting customers[24]

V:	(1)	(2)	(3)	(4)
	TFP		TFP	
	All	Manuf.	All	Manuf.
D_X	0.235***	0.210***	0.240***	0.215***
	(0.0198)	(0.0372)	(0.0223)	(0.0393)
$NC_X \cdot (D_X = 0)$	0.179***	0.108***	0.153***	0.100***
	(0.0153)	(0.0240)	(0.0203)	(0.0179)
$NC_X \cdot (D_X = 1)$	0.137***	0.098***	0.113***	0.0885***
	(0.0107)	(0.0128)	(0.0098)	(0.0086)
NC_N			0.034*	0.014
			(0.0161)	(0.0119)
N	1214949	153721	1214949	153721
Adj. R^2	0.945	0.959	0.945	0.959

Industry-clustered standard errors in parentheses.

*** p<0.001, ** p<0.01, * 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.

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. 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.

[24] 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.

The relationship we estimate is:

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

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 8: Firm productivity and foreign demand exposure

	(1)	(2)	(3)	(4)
V:	TFP		TFP	
	All	Manuf.	All	Manuf.
$\frac{\text{X}}{\text{Y}}$	0.462***	0.372***	0.383***	0.296***
	(0.0274)	(0.0580)	(0.0600)	(0.0269)
$\frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 0)$	0.259***	0.196***	0.360***	0.221***
	(0.0306)	(0.0516)	(0.0558)	(0.0254)
$\frac{\text{Y}_{\text{X1}}}{\text{Y}} \cdot (\text{D}_\text{X} = 1)$	0.577***	0.303**	0.123	0.0866
	(0.104)	(0.0907)	(0.0923)	(0.0564)
Sales			0.356***	0.333***
			(0.0231)	(0.0133)
N	1075393	138649	1075393	138649
Adj. R^2	0.946	0.960	0.959	0.971

Industry-clustered standard errors in parentheses.

*** p<0.001, ** p<0.01, * 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 8 we present two sets of results. The first two columns confirm that both direct and indirect export exposure is positively related to productivity. In the second two columns we control for the size of the firm by including total sales. Both the direct export share for exporters and the indirect export share for non-exporters remain strongly positively correlated with productivity while the indirect export share for exporters loses its significance. This suggests that for non-exporters the interaction with exporters and/or the indirect exposure to foreign demand is positively correlated with productivity. On the other hand, for exporters this relationship does not go beyond the sheer size effect, i.e. that larger firms are more productive

and more likely to have part of their output embodied in exports. Finally, though the coefficients suggest that productivity is more strongly associated with direct export exposure than with the indirect one, the difference is not statistically significant. The results are almost identical when we use the total indirect exports share that takes into account the entire supply chain (not reported).

6 Discussion and conclusion

This article provides the first complete picture of firms that participate in 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. Firms involved in exports production make up a large part of the economy. Even though there are only seven percent of firms who directly sell goods on foreign markets, another twelve percent of firms are their suppliers, 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 domestic business customers. Furthermore, there is a hierarchy within the exports supply chain as the performance measures decline with the distance from foreign demand. We therefore confirm that direct exporters are the best performing firms in the economy while showing that they source from suppliers who perform very well themselves.

We complement the main findings in two ways. First, we show that firm productivity is positively correlated with the number of exporting customers. That is, when we compare two firms in the same industry and with the same number of customers, the one with more exporting customers is more productive. Second, the extent of foreign demand exposure, measured by a proxy for the share of output embodied in exports, is also positively correlated with firm

performance. Comparing two exporters in the same industry producing the same amount of output, the one with a higher direct exports share is more productive. The same relationship holds between productivity and indirect exports share for non-exporters. In conclusion, firms who manage to supply relatively more exporters and have a large share of their output embodied in exports perform better.

We further show that our results hold also for changes within firms. When a firm gets closer to foreign demand its productivity improves. This suggests that a selection mechanism, i.e. exporters picking already successful firms as suppliers, does not fully explain our baseline results. It is for future research to establish which underlying mechanisms are behind the observed patterns; whether it is learning from customers or simultaneous determination by other firm-level choices.

Finally, our research highlights that a better understanding of the production structure that underpins observed international trade flows is important for assessing trade-related policies. In complex economies that are characterised by a large degree of production fragmentation, customs data alone provide limited information for answering questions such as which firms are impacted by trade policies, or how foreign demand shocks impact the domestic economy. This is because exporters are just a tip of the production iceberg, embedded in the domestic network of firms who contribute their value to exports indirectly. The group of stakeholders in trade liberalization is therefore much wider than the "happy few" who export directly and distributional effects of globalisation go beyond the exporters versus non-exporters dichotomy.

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Appendix A.

Table A.9a: Aggregate statistics in our sample 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	N.A.
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 A.9b: 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 A.9c: 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 A.10a: Summary statistics for firms

Sample	Year	N firms	Suppliers (% of N firms)	Customers (% of N firms)
Total network	2002	216079	74.1	99.2
	2007	266308	75.4	99.3
	2012	292218	76.8	99.5
	Total	*2882769*	*75.5*	*99.3*
Network of relevant suppliers	2002	204295	60.3	98.6
	2007	252154	61.4	98.8
	2012	275878	62.6	98.8
	Total	*2735102*	*61.5*	*98.8*
Network of essential suppliers	2002	160249	34.7	87.3
	2007	206635	34.3	89.0
	2012	230449	34.3	89.7
	Total	*2240088*	*34.4*	*89.0*

Table A.10b: Summary statistics for transactions

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 A.11: The distribution of supplier-customer links per firm, 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*

Table A.12: 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 A.13: 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 A.14: 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 a subsample used for the regression analysis. Sales are in millions euro; labour productivity, TFP and capital per employee are in thousands.