Value chain integration of export-oriented and domestic market manufacturing firms

An analysis based on a heterogeneous input-output table for Belgium

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Abstract - For a finer analysis of competitiveness and value chain integration, this working paper presents a micro-data based breakdown of manufacturing industries in the 2010 Belgian supply-and-use and input-output tables into export-oriented and domestic market firms. The former are defined as those firms that export at least 25% of their turnover. Analyses based on the resulting export-heterogeneous IOT reveal differences between the two in terms of input structures and import behaviour: export-oriented manufacturers have lower value-added in output shares, and they import proportionally more of the intermediates they use. Moreover, exports of export-oriented manufacturers generate a substantial amount of value added in other Belgian firms, in particular providers of services. The policy implication of these results is that Belgium's external competitiveness depends not only on exporters but also on firms that mainly serve the domestic market. To maximise the impact of export promotion in terms of domestically generated value added, the entire value chain for the production of exports must be taken into account.

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Executive summary

The reorganisation of production processes in increasingly fragmented and international value chains poses new challenges for the analysis of value creation and competitiveness based on input-output tables and models. In those tables, firms are grouped into industries according to the type of goods and services they produce. However, firm characteristics such as size, ownership and exporter status may actually be the source of technological differences between firms within industries defined in terms of product similarity. Accounting for such firm heterogeneity through a breakdown of industries into different types of firms is required to increase the relevance of value chain analysis.

In this working paper, the focus is on firm heterogeneity in terms of exporter status: we break down manufacturing industries in the 2010 Belgian supply-and-use tables (SUT) and input-output tables (IOT) into export-oriented firms and firms serving mainly the domestic market. For this purpose, we use the full set of individual firm-level data sources that have served for the construction of Belgium's official SUT and IOT for 2010 and define export-oriented manufacturing firms as those that export at least 25% of their turnover. The novelty of our approach lies in the data-based (rather than just proportional) estimation of output, input and import structures for export-oriented and domestic market firms.

The analyses based on the resulting export-heterogeneous IOT reveal differences between export-oriented and domestic market firms in manufacturing industries in terms of input structures and import behaviour. Export-oriented manufacturers have lower value-added in output shares, and they import proportionally more of the intermediates they use, i.e. their production processes are more fragmented, in particular internationally. These results, obtained in a setting that is consistent with the national accounts, confirm findings in prior analyses on firm heterogeneity in international trade. Furthermore, input-output multiplier analyses show that export-oriented manufacturing firms are less integrated upstream into the Belgian economy than domestic market firms: a shock to final demand for their output generates less additional output and value added in the Belgian economy than an equivalent shock to domestic market manufacturers. Finally, the export-heterogeneous IOT also allows to illustrate that the exports of export-oriented manufacturers generate a substantial amount of value added in other Belgian firms, in particular providers of services.

The policy implication of these results is that Belgium's external competitiveness depends not only on exporters but also on firms that mainly serve the domestic market. Export-oriented firms need to be competitive on foreign markets and domestic suppliers have to be competitive in the production of the inputs delivered to those export-oriented firms (internal competitiveness). Hence, to maximise the impact of export promotion in terms of domestically generated value added, it is not sufficient to focus only on export-oriented firms. Domestic upstream suppliers must also be taken into account when defining policies. Overall, for Belgium to reap the full benefits from exports, the entire value chain for the production of exports must be considered.

Synthèse

La réorganisation des processus de production en chaînes de valeur de plus en plus fragmentées et internationales pose de nouveaux défis pour l'analyse de la création de valeur et de la compétitivité sur base des tableaux et modèles entrées-sorties. Dans ces tableaux, les entreprises sont traditionnellement regroupées en branches d'activité selon le type de biens et de services qu'elles produisent. Or, certaines caractéristiques des entreprises, telles que leur taille, leur appartenance à une multinationale et leur statut d'exportateur, peuvent être à l'origine de différences technologiques entre des entreprises d'une même branche définie de façon classique. Afin d'augmenter la pertinence de l'analyse des chaînes de valeur, il convient dès lors de tenir compte de telles hétérogénéités en distinguant différents types d'entreprises au sein des branches.

Dans ce working paper, le critère d'hétérogénéité des entreprises qui est retenu est leur statut d'exportateur : les branches de l'industrie manufacturière des tableaux emplois-ressources (TER) et des tableaux entrées-sorties (TES) de la Belgique pour l'année 2010 sont scindées en entreprises tournées vers l'exportation et entreprises principalement tournées vers le marché domestique. Ce travail est réalisé sur base de l'ensemble des sources de données individuelles d'entreprises qui ont servi pour la construction des TER et TES officiels de la Belgique et une entreprise est considérée comme tournée vers l'exportation dès lors qu'au moins 25 % de son chiffre d'affaires est réalisé à l'exportation. Le caractère novateur de notre approche réside dans le fait que les structures d'output, d'input et d'importation pour ces deux catégories d'entreprises sont estimées à partir de micro-données plutôt que de façon proportionnelle.

Les analyses réalisées au moyen de ce TES hétérogène en termes d'exportations mettent en lumière des différences de structures d'input et d'importation entre les entreprises manufacturières tournées vers l'exportation et celles tournées vers le marché belge. Le contenu en valeur ajoutée de la production des exportateurs est moins élevé et ils importent proportionnellement plus de produits intermédiaires, soit autant de signes que leurs processus de production sont plus fragmentés, en particulier au niveau international. Ces résultats, obtenus dans un cadre cohérent avec les comptes nationaux, confirment des résultats d'analyses antérieures sur les différences entre entreprises exportatrices et non-exportatrices. En outre, l'analyse des multiplicateurs entrées-sorties met en évidence que les entreprises tournées vers l'exportation sont moins intégrées en amont dans l'économie belge : un choc sur la demande finale adressée à leur production génère moins de production et valeur ajoutée additionnelles dans l'économie belge qu'un choc équivalent adressé aux entreprises tournées vers le marché belge. Enfin, ce TES hétérogène permet également de montrer que les exportations des entreprises manufacturières exportatrices génèrent une valeur ajoutée substantielle dans d'autres entreprises belges, en particulier des fournisseurs de services.

Du point de vue des politiques à mener, ces résultats montrent que la compétitivité extérieure de la Belgique ne dépend pas uniquement des entreprises exportatrices, mais aussi des entreprises tournées vers le marché belge. Les entreprises exportatrices doivent être compétitives sur les marchés étrangers et les fournisseurs domestiques doivent être compétitifs dans la production des inputs livrés à ces entreprises exportatrices (compétitivité interne). En conséquence, si l'on veut maximiser les effets de la

promotion des exportations sur la création de valeur ajoutée en Belgique, mener des actions ciblées sur les seules entreprises exportatrices ne suffira pas. Les politiques développées doivent également tenir compte des fournisseurs domestiques en amont. En définitive, si la Belgique veut tirer pleinement parti des exportations, il y a lieu de s'intéresser à l'ensemble de la chaîne de valeur de la production des exportations.

Synthese

De reorganisatie van productieprocessen in steeds meer versnipperde en internationaal gespreide waardeketens zorgt voor nieuwe uitdagingen op het vlak van de analyse van de waardecreatie en het concurrentievermogen gebaseerd op input-outputtabellen en modellen. In die tabellen worden ondernemingen traditioneel gegroepeerd in bedrijfstakken volgens het soort goederen of diensten dat ze produceren. Ondernemingskenmerken zoals grootte, eigenaarschap en exportstatus kunnen evenwel de oorzaak zijn van technologische verschillen tussen ondernemingen binnen klassiek gedefinieerde bedrijfstakken. Een verdere opsplitsing van die bedrijfstakken om rekening te houden met deze heterogeniteit tussen verschillende soorten ondernemingen is dus nodig om de relevantie van de analyse van waardeketens te verhogen.

In deze Working Paper ligt de focus op heterogeniteit in termen van exportgedrag: de takken van de verwerkende nijverheid worden in de Belgische aanbod- en gebruikstabellen (AGT) en input-outputtabellen (IOT) van 2010 opgesplitst in uitvoergerichte ondernemingen en ondernemingen die voornamelijk de binnenlandse markt bedienen. Daarvoor wordt de volledige set van individuele gegevensbronnen op ondernemingsniveau gebruikt die zijn aangewend om de officiële AGT en IOT van 2010 voor België op te stellen en worden de uitvoergerichte industriële ondernemingen gedefinieerd als ondernemingen die minstens 25 % van hun omzet exporteren. Het nieuwe van die benadering ligt in de op gegevens gebaseerde (in plaats van louter evenredige) raming van de output, de input en de invoerstructuur van de twee groepen ondernemingen.

Uit de analyses op basis van de resulterende uitvoerheterogene IOT komen verschillen in termen van inputstructuur en invoergedrag naar voren tussen de uitvoergerichte ondernemingen en ondernemingen gericht op de binnenlandse markt in de verschillende bedrijfstakken van de verwerkende nijverheid. Uitvoergerichte bedrijven vertonen een lagere verhouding tussen toegevoegde waarde en output, en ze voeren verhoudingsgewijs meer in van de intermediaire producten die ze gebruiken, d.w.z. dat hun productieprocessen vooral internationaal meer versnipperd zijn. Deze resultaten, verkregen in een kader dat overeenstemt met de nationale rekeningen, bevestigen de bevindingen van eerdere analyses over ondernemingsheterogeniteit in internationale handel. Uit analyses van de input-outputmultiplicatoren blijkt verder dat uitvoergerichte verwerkende bedrijven stroomopwaarts minder geïntegreerd zijn in de Belgische economie dan binnenlands georiënteerde industriële ondernemingen: een schok op de finale vraag naar hun output leidt tot minder bijkomende output en toegevoegde waarde in de Belgische economie dan een equivalente schok op fabrikanten die gericht zijn op de binnenlandse markt. Tot slot tonen de uitvoerheterogene IOT ook dat de export van uitvoergerichte bedrijven heel wat toegevoegde waarde in andere Belgische ondernemingen genereert, in het bijzonder in ondernemingen uit de dienstensector.

De beleidsimplicatie uit dit alles is dat het externe concurrentievermogen van België niet alleen afhankelijk is van uitvoergerichte ondernemingen, maar ook van ondernemingen die hoofzakelijk de binnenlandse markt bedienen. Exporteurs moeten concurrentieel zijn op buitenlandse markten en binnenlandse leveranciers moeten concurrentieel zijn in de productie van de inputs die ze aan de uitvoergerichte ondernemingen leveren (intern concurrentievermogen). Om het effect van exportpromotie te

maximaliseren in termen van binnenlandse toegevoegde waarde, is het bijgevolg niet voldoende om louter op de uitvoergerichte ondernemingen te focussen. Bij het opzetten van beleid moet dus ook rekening worden gehouden met binnenlandse toeleveranciers. Meer algemeen moet de volledige waardeketen van de uitvoerproductie in rekening worden gebracht als België maximaal profijt wil halen uit zijn uitvoer.

1. Introduction

Trade liberalisation and technological developments have largely contributed to increasing global economic integration between the early 1990s and the late 2000s by reducing trade costs (transport costs, communication costs…). This went hand in hand with profound changes in firm organisation that still shape production processes today. Firms have re-organised their production processes by dividing them into a growing number of separate stages and by outsourcing more and more of those production stages to domestic and foreign suppliers. In other words, as value chains have become increasingly fragmented, firms have become specialised in different segments of this fragmented value chain: supply of intermediate goods and services, delivery to final consumers or exports.

Value chain fragmentation poses new challenges in terms of the analysis of value creation. Input-output tables and models are among the foremost tools for the macro-economic analysis of value chains. In those tables firms are traditionally grouped into industries according to the type of goods and services they produce. This allows to identify the contribution of industries to value creation and their integration into value chains. However, the pattern of specialisation within fragmented value chains is likely to be related to certain firm characteristics such as size, ownership and exporter status. Therefore, an adequate analysis of contributions to value creation in the context of fragmented value chains may require a further breakdown of industries into different types of firms. As suggested in OECD (2015), it is desirable to disaggregate industries in supply-and-use and input-output tables according to firm characteristics such as size, ownership or exporter status because these characteristics may actually be the source of technological differences between firms within industries that are traditionally defined in terms of product similarity. The same point is made by Los (2017) arguing that "such differences can only be captured in value chain trade indicators if each industry is split in two subindustries (p.317)". A finer analysis of contributions to value creation based on data disaggregated along these lines provides a clearer picture of the sources of a country's competitiveness.

Therefore, in order to make informed economic policy choices, it is crucial to shed more light on how different types of a country's firms participate and are positioned in value chains. In this working paper, we break down manufacturing industries in the 2010 Belgian supply-and-use tables (SUT) and input-output tables (IOT) into two groups of firms: those that are export-oriented and those that mainly serve the domestic market. For this purpose, we use the full set of individual firm-level data sources that have served for the construction of Belgium's official SUT and IOT for 2010. The resulting export-heterogeneous tables allow to test for differences in input structures and import behaviour of export-oriented firms and other firms, and to analyse their respective integration into domestic value chains based on input-output multipliers and linkages as defined in Hambÿe (2012). Moreover, we compare our results with those for homogeneous industries derived from the official 2010 Belgian IOT to show that accounting for export heterogeneity in those tables yields important new insights. Finally, as globalisation has become a major challenge in the measurement of national accounts for individual countries, we also see this work as a contribution to determining whether the national accounts – which officially comprise supply-and-use and input-output tables – can accommodate recent findings from the academic literature on international trade. Analyses of the characteristics of exporters based on firm-level data have indeed shown that exporters are different from other firms in terms of production technology. Exporters

are not only more productive (Melitz, 2003), but they also import more of the intermediates they use (Bas, 2009).

There are a few prior contributions on firm heterogeneity in SUT and IOT. The earliest efforts were made for China to isolate processing traders (Koopman et al., 2012). In the wake of this work, Ma et al. (2015) have disaggregated Chinese tables to isolate not only processing traders but also foreign-owned firms. Similar work has been done to separate out firms operating in Mexico under special export regimes (De la Cruz et al., 2012). The disaggregation with respect to processing trade for China and special export regimes for Mexico has also been integrated into the OECD's inter-country input-output tables (Yamano and Webb, 2018). Several other initiatives have been gathered in the context of the OECD's Expert Group on Extended Supply-and-Use Tables: they come, amongst others, from Austria (disaggregation by exporter status and ownership, see Lais and Kolleritsch, 2017), Costa Rica (separation of firms in free trade zones, see Saborio, 2015), the Netherlands (disaggregation by size class, see Chong et al. 2017), and the US (disaggregation by ownership, see Fetzer et al., 2018). The novelty of our approach lies in the data-based (rather than just proportional) estimation of the industry-level output, input and import structures for the export-heterogeneous SUT and IOT.

This article is organised as follows. We first provide details on constructing export-heterogeneous supply-and-use and input-output tables for Belgium in section 2. This includes explanations on how we have disaggregated columns for manufacturing industries in the SUT and then derived a heterogeneous IOT. In section 3, we analyse differences in input structures between export-oriented manufacturing firms and other firms and take a look at their respective integration into value chains. Finally, we draw conclusions in section 4.

2. Export heterogeneity in supply-and-use and input-output tables: sources and data construction

Supply-and-use tables (SUT) are an integral part of national accounts (NA) and provide detailed information about economic flows in monetary terms: they describe production processes and income generated through production. As the central balancing tool for the national accounts, they match the supply and use of goods and services. While SUT are mainly a statistical tool, symmetric input-output tables (IOT) are an analytical tool derived from SUT based on assumptions about the relation between output and inputs.[1]

SUT are product-by-industry tables with domestic production and imports given in the supply table, and intermediate inputs, final uses (final consumption of households and government, gross fixed capital formation, changes in inventories and exports of goods and services) and value added reported in the use table. Thus, the use table reveals the structure of production costs by industry. Moreover, intermediate inputs and final use are split according to where they are purchased from: domestic or foreign producers.

The classification of industries in SUT is such that industries are made up of firms that produce similar goods or services, e.g. all producers of chemicals or financial services are grouped together in one industry. Heterogeneity is traditionally conceived as depending on the detail of the industry classification. The broadly defined chemicals industry will lump together firms that produce different types of chemicals: industrial gases, fertilizers, etc. The standard approach to account for such heterogeneity is further disaggregation of the industry classification along the lines of detailed product categories. However, as emphasized in OECD (2015), there may also be other sources of firm heterogeneity within industries. Firms within the same industry may differ, for example, in terms of size and ownership, and they may be exporters or serve only the domestic market. Their production cost structure may then differ accordingly. This warrants looking at alternative disaggregations of industries within SUT and IOT.

The focus here is on heterogeneity in terms of export behaviour: we disaggregate manufacturing industries into export-oriented firms and firms serving mainly the domestic market.[2] The literature on firm heterogeneity and international trade points to differences between exporters and non-exporters in terms of technology. In particular, exporters are found to have higher productivity levels (and mark-ups) which allows them to cover the fixed cost related to exporting (Melitz, 2003). Moreover, the more productive exporters tend to rely more on imported inputs. They have better access to global input markets, which allows them to purchase cheaper and/or higher quality inputs abroad, thereby further boosting their productivity (Bas, 2009). These technological differences may also shape and be shaped by the deeper integration of exporters into global value chains.

We introduce export heterogeneity into Belgian SUT and IOT for the year 2010 by disaggregating manufacturing industries according to exporter status in the official tables at the most detailed industry-

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[1] For a more detailed description of the construction of SUT and IOT and their role within the system of national accounts, see Beutel (2017).
[2] Extending the analysis to exporters in other industries requires further data work.

level breakdown. The official Belgian SUT (standard SUT) for 2010 – the most recent input-output reference year – have been constructed according to the rules of the European System of Accounts (ESA 2010).[3] The most detailed unpublished version (workformat) of the SUT contains a breakdown into 133 industries and 350 product categories, which are respectively based on the European Union industry and product classifications NACE Rev.2 and CPA2008.[4] Manufacturing covers NACE Rev.2 industries 10 to 33, which amounts to 57 industries in the workformat of the Belgian SUT. For the purpose of disaggregating these industries, we rely on most of the firm-level data that have been used in the construction of the SUT. Note that we make sure that our disaggregation is consistent with the official Belgian SUT, i.e. values for output, intermediate inputs and value added of exporter and non-exporter manufacturing industries sum to the values for the total non-heterogeneous industry in the official table.

The stylized supply table and use tables shown in table 1 and table 2 illustrate the SUT with a disaggregation of manufacturing industries (columns) according to exporter status. Table 3 and table 4 add a split of the use table according to the origin of the used goods and services, i.e. whether they are imported or purchased from Belgian producers (table 3) and, among the latter, whether they are sourced from exporters or non-exporters (table 4).

Table 1   Supply table

		Agri-culture	Mining	Manufacturing				Services			Output	Imports	Total supply
				M1		M2		...	S1	S2	...			
				X	non X	X	non X	...						
Products of agriculture														
Mining products														
Manufactured products	M1													
	M2													
	M3													
	⋮													
Services	S1													
	S2													
	S3													
	⋮													
Total output by industry														

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3   The 2010 Belgian SUT at purchasers' prices and at basic prices with a 64 industry and product breakdown (as well as the IOT) can be downloaded for free from the website of the Belgian Federal Planning Bureau (FPB) at the following address: http://www.plan.be/databases/data-54-en-input+output+tables+2010+esa+2010+december+2015+. Further detail (in French or Dutch) on their construction can be found in FPB (2015).

4   NACE stands for Statistical Classification of Economic Activities in the European Community and CPA for Statistical Classification of Products by Activity in the European Economic Community.

Table 2   Use table (column disaggregation only)

		Agri-culture	Mining	Manufacturing					Services			Final uses	Total use
				M1		M2		...	S1	S2	...		
				X	non X	X	non X	...					
Products of agriculture													
Mining products													
Manufactured products	M1												
	M2												
	M3												
	⋮												
Services	S1												
	S2												
	S3												
	⋮												
Total use by industry													
Net taxes on products													
Value added													
Output													

Table 3   Use table for domestic production and imports

		Agri-culture	Mining	Manufacturing					Services			Final uses	Total use
				M1		M2		...	S1	S2	...		
				X	non X	X	non X	...					
Domestic													
Products of agriculture													
Mining products													
Manufactured products	M1												
	M2												
	⋮												
Services	S1												
	S2												
	⋮												
Imports													
Products of agriculture													
Mining products													
Manufactured products	M1												
	M2												
	⋮												
Services	S1												
	S2												
	⋮												
Total use by industry													
Net taxes on products													
Value added													
Output													

Table 4   Use table (full disaggregation)

		Agri-culture	Mining	Manufacturing					Services			Final uses	Total use
				M1		M2		...	S1	S2	...		
				X	non X	X	non X	...					
Domestic													
Products of agriculture													
Mining products													
Manufactured products	X	M1											
		M2											
		⋮											
	non X	M1											
		M2											
		⋮											
Services		S1											
		S2											
		⋮											
Imports													
Products of agriculture													
Mining products													
Manufactured products		M1											
		M2											
		⋮											
Services		S1											
		S2											
		⋮											
Total use by industry													
Net taxes on products													
Value added													
Output													

In practice, we proceed in several steps to obtain export-heterogeneous Belgian SUT for 2010. First, we identify exporters and disaggregate total output and intermediate inputs for the 57 manufacturing industries in the tables. Then, we split the columns of both the supply and the use table that contain the product distribution of output and intermediate inputs for each industry. We also specifically disaggregate the use table to identify the use of imported intermediate inputs and purchases of intermediate inputs from manufacturing exporters and non-exporters. Finally, we derive symmetric heterogeneous industry-by-industry IOT.

2.1. Disaggregating total industry-level output and intermediate inputs

Identifying exporters among manufacturing firms allows us to disaggregate total industry-level output and intermediate consumption for the 57 manufacturing industries in the SUT based on the exporters' share of turnover and purchases. The results correspond to the dark grey cells in the bottom row of table 1 and table 2, and the 4th row from the bottom in table 2. Disaggregated value added including net taxes on products is obtained as the difference between total output and intermediate inputs of the heterogeneous manufacturing industries (dark grey cells in the 2nd and 3rd rows from the bottom in table 2).

The general business register underlying the 2010 national accounts (NA) and SUT contains 40 194 manufacturing firms[5] for which data on turnover and total purchases is available based on the following sources: balance sheet data, structural business survey data and periodical value added tax (VAT) declarations.[6] These are the main data sources used to estimate industry-level NA aggregates for total output and intermediate inputs by industry. The 40 194 manufacturing firms with turnover and total purchases data constitute our *full sample*. Their total turnover sums to 229.7 billion euros. Merging in merchandise export data, we calculate export to turnover ratios for these firms and consider those with a ratio above 25% as export-oriented. This yields a sample split for manufacturing firms into 2 430 export-oriented firms and 37 764 firms that mainly serve the domestic market, which we also refer to as domestic market firms. The share of export-oriented firms in turnover amounts to about 75% (171.2 billion euros). Hence, export-oriented firms are bigger firms: their average turnover is 70.4 million euros compared to 5.7 million euros for the entire sample. Due to the 25% cut-off ratio for defining export-oriented firms, not all exports are made by this category of firms. Merchandise exports of export-oriented firms amount to 98,2 billion euros out of a total of 101.3 billion euros of exports by manufacturing firms (97%). Finally, the average export to turnover ratio of export-oriented manufacturing firms stands at 57% against 5% for domestic market manufacturing firms. All these sample characteristics are summarised in the upper part of table 5.

2.2. Disaggregating manufacturing industries in the supply-and-use tables

As illustrated by the light grey cells in table 1 and table 2, the SUT show the distribution of industry-level output and use of intermediate inputs over product categories. For the (column-wise) disaggregation of manufacturing industries in the 2010 Belgian SUT into export-oriented and domestic market firms, we use a *restricted sample* of firms for which we have information on turnover and purchases by product category.

In the Belgian SUT, the product distribution of output and intermediate inputs is derived from several sources. The main source are two supplementary questionnaires annexed to the structural business survey (SBS): one on the product detail of turnover and the other on the product detail of total purchases. These two questionnaires are sent out jointly every five years to a *restricted sample* of big firms (all firms with at least 50 employees plus smaller firms if necessary to reach a coverage of minimum 50% of

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[5] Belgian national accounts (NA) are based on legal units, which we refer to as firms.

[6] The order of this list of sources reflects the hierarchy in their use. Balance sheet data is the primary source. If balance sheet data is unavailable for a firm, then structural business survey data is used, and if that is not available either, then data from periodical VAT declarations is used.

turnover at the 4-digit industry-level). For the product detail on output in manufacturing industries, the data from the supplementary SBS questionnaire on turnover is complemented by data from the survey on industrial production (Prodcom). Moreover, the data is compared to firm-level exports by product category to correct inconsistencies. By the same token, the data from the supplementary SBS questionnaire on the product detail of total purchases are cross-checked and corrected for inconsistencies through a comparison with firm-level imports by product category and data on domestic purchases from the VAT transaction dataset.[7] The latter comprises all transactions between domestic firms on which VAT is levied. In the construction of the SUT, the resulting cross-checked datasets are used to distribute total industry-level output and intermediate inputs over product categories.

Table 5   Sample characteristics for manufacturing industries, 2010

	Number of firms	Turnover (billion euros)	Average size (million euros)	Exports (billion euros)	Exports to turnover ratio
Full sample[1]					
All firms	40,194	229.7	5.7	101.3	44.1%
Export-oriented firms[3]	2,430 (6.0%)	171.2 (74.5%)	70.4	98.2 (96.9%)	57.4%
Domestic market firms	37,764 (94.0%)	58.5 (25.5%)	1.5	3.1 (3.1%)	5.3%
Restricted sample[2]					
All firms	1,710	181.2	105.9	85.9	47.4%
Export-oriented firms[3]	980 (57.3%)	149.9 (82.8%)	153.0	83.9 (97.6%)	56.0%
Domestic market firms	730 (42.7%)	31.2 (17.2%)	42.8	2.0 (2.4%)	6.4%

1 The *full sample* comprises all firms with data on turnover and total purchases
2 The *restricted sample* comprises firms with supplementary SBS questionnaires
3 Export-oriented firms are those with an export to turnover ratio above 25%

In 2010, 1 710 manufacturing firms completed the supplementary SBS questionnaires. They form the *restricted sample* for establishing the product distributions. Their turnover amounts to 181.2 billion euros, which is 79% of the total turnover of the 40 194 manufacturing firms in our *full sample*. Among these 1 710 firms, 980 are export-oriented (export to turnover ratio above 25%). The turnover of these export-oriented firms sums to 149.9 billion euros (88% of the turnover of all 2 430 export-oriented firms in the *full sample*). Within the *restricted sample*, the average size of export-oriented firms and firms serving mainly the domestic market is 153.0 and 42.8 million euros respectively). Finally, export-oriented firms' export amount to 83.9 billion euros in the *restricted sample* compared to total exports of 85.9 billion euros by all firms in the *restricted sample* (98%) and their export to turnover ratio is 56%. Again, table 5 provides an overview of these sample characteristics.

At this point, we are able to provide some discussion on why we have defined exporters based on a minimum threshold (in this case an exports-to-turnover ratio of 25%) instead of simply taking all firms with non-zero exports. Our aim is to investigate differences in the production cost structure. Therefore, when determining the product distributions of output and intermediate inputs of heterogeneous industries (columns of the SUT), we have been striving to produce results based on firm-level data rather than just assume proportionality to the non-heterogeneous industries in the official tables. If we had defined the sample split in terms of non-zero exports rather than on the basis of the 25% export to turnover ratio, a data-based approach would have become impossible for too many of the 57 manufacturing

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7   In the construction of the SUT, the aim of these corrections is to avoid that the underlying inconsistencies in the firm-level data resurface in the balancing process of the tables.

industries because sample sizes for non-exporters would have been insufficient for a significant number of industries in the *restricted sample* that we use for determining the product distributions. All in all, we are facing a trade-off between including exporters with a low export to turnover ratio in the exporter sample and avoiding proportionality in the estimation of the product distributions of the heterogeneous industries.

Thus, we split the *restricted sample* into export-oriented firms and firms serving mainly the domestic market and use the cross-checked data from the supplementary SBS questionnaires on turnover and total purchases to estimate separate product distributions of output and intermediate inputs for export-oriented firms and domestic market firms in each manufacturing industry.[8] We then apply a RAS-procedure to ensure consistency with respect to the product distribution of output and intermediate inputs of the non-heterogeneous industries in the official SUT (we henceforth refer to this as standard SUT). As a result, we obtain a heterogeneous supply table as shown in table 1 and a heterogeneous use table as shown in table 2.

At this stage, the heterogeneous use table is still at purchasers' prices. For transformation to basic prices, the valuation matrices for trade and transport margins and for taxes less subsidies on products must be subtracted. As we do not have any firm-level information that would allow us to disaggregate valuation tables according to exporter status, we do so proportionally to values of intermediate inputs at purchasers' prices.

2.3. Disaggregating the use table according to the origin of the products

The disaggregation of the use table at basic prices according to the origin of the products is done in two steps: first a split into imports and goods and services of domestic origin and then a split of the latter into goods produced by export-oriented manufacturers and by domestic market manufacturers (upper part of table 4).

The official Belgian use table at basic prices contains a split according to the origin of the goods and services, i.e. a use table for domestic output and a use table for imports. This is necessary for deriving an IOT. Hence, we need to split the heterogeneous use table into heterogeneous use tables for domestic output and imports. This requires specific data work for the columns of manufacturing industries (see table 3).[9] To estimate the use of imported intermediate inputs by export-oriented and domestic market manufacturers, we use product-level import data for these firms that are corrected for re-exports and exclude imports of capital goods. Again, a RAS-procedure is applied so that the disaggregation respects the values of imported intermediate inputs in the official use table. The use of domestically-produced intermediate inputs by export-oriented and domestic market manufacturers is calculated as the difference between total and imported intermediate inputs.

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[8]   We were able to do so for 47 out of the 57 manufacturing industries. The sample size was insufficient for domestic market firms in eight industries and for export-oriented firms in two industries. In those cases, we had to make a proportionality assumption.

[9]   For all other industries and all final demand categories, the split into goods and services of domestic origin and imports is the same as in the official use table.

Table 6   Heterogeneous supply table, 2010
Millions of euros

	Export-oriented manufacturers	Domestic market manufacturers	Other industries	Imports	Total supply
Manufactured goods	135,960	47,683	10,767	161,793	356,203
Other goods and services	13,344	4,783	538,571	100,952	657,651
Total output/imports	149,304	52,467	549,338	262,745	1,013,854

Table 7   Heterogeneous use table, 2010
Millions of euros

	Export-oriented manufacturers	Domestic market manufacturers	Other industries	Domestic final demand	Commodity exports	Service exports	Total output /imports
Domestic							
Manufactured goods, export-oriented firms	14,816	3,711	9,328	10,058	96,429	1,617	135,960
Manufactured goods, domestic market firms	8,153	6,650	16,815	13,163	10,891	2,778	58,450
Other goods and services	27,545	12,580	170,954	260,813	21,400	63,404	556,698
Imports							
Manufactured goods	39,416	9,839	15,879	35,285	61,374	0	161,793
Other goods and services	26,526	3,558	49,175	7,382	14,312	0	100,952
Total use	116,456	36,338	262,151	326,702	204,407	67,799	1,013,853
Value added	32,848	16,128	287,187				
Total output	149,304	52,467	549,338				

As shown in the upper part of table 4, the rows for domestically-produced manufactured goods in the use table can be further disaggregated according to whether these goods are produced by domestic market manufacturers or by export-oriented manufacturers. To do this, we proceed in two steps. First, we disaggregate exports (which are part of final uses). As illustrated above, export-oriented firms do not account for all exports due to the 25% export to turnover cut-off ratio for identifying these firms. Based on the sample split (for the *full sample*) and firm-level export data by product category, we determine exports by export-oriented firms and by firms mainly serving the domestic market for all categories of manufactured goods. Second, for all other final and intermediate use categories, we disaggregate the rows proportionally for each category of manufactured goods based on shares of export-oriented and domestic market firms in output of these goods that is not exported. These shares are calculated from the data in the heterogeneous supply table.

This completes the (column-wise and row-wise) disaggregation of Belgium's 2010 SUT into export-oriented and domestic market firms in manufacturing industries as illustrated in table 1 and table 4. Table 6 and table 7 present the resulting heterogeneous SUT in a very aggregated form.

2.4. Deriving export-heterogeneous industry-by-industry IOT

For the transformation of SUT at basic prices into symmetric industry-by-industry IOT, we choose the fixed product sales structure assumption (Model D in Eurostat, 2008), which is the most commonly used. According to this assumption, "each product has its own specific sales structure irrespective of the industry where it is produced" (Beutel, 2017, p.119). This comes down to assuming that an industry's

output of a certain product is delivered to users in the same proportion as total economy-wide output of that product.[10]

The heterogeneous industry-by-industry IOT that we derive from the heterogeneous SUT is given in very aggregated form in table 8. The rows of this industry-by-industry IOT show the values of deliveries of an industry's output to the different users. The columns for industries indicate where they purchase their inputs from, and their value added, i.e. they describe the industries' cost structures.

Table 8   Heterogeneous input-output table, 2010
Millions of euros

|	Export-oriented manufacturers	Domestic market manufacturers	Other industries	Domestic final demand	Commodity exports	Service exports	Total output
Export-oriented manufacturers	15,335	3,866	11,482	12,446	101,566	4,609	149,304
Domestic market manufacturers	6,900	5,697	14,730	13,278	8,975	2,888	52,467
Other industries	28,279	13,379	170,886	258,311	18,180	60,303	549,337
Imports	65,941	13,397	65,053	42,667	75,686	0	
Value added	32,848	16,128	287,186				
Total output	149,304	52,467	549,337				

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[10]   See Eurostat (2008) for the mathematical expressions of the derivation of industry-by-industry IOT from SUT under the fixed product sales structure assumption.

3. Export heterogeneity in supply-and-use and input-output tables: analysis

Input-output tables enable us to analyse production structures and value chains. With heterogeneous tables, this analysis can be specifically focused on certain types of firms. In our case, we compare the direct cost structures of export-oriented and domestic market firms within manufacturing industries. Input-output-based analysis of value chains goes one step further: the full set of upstream links of industries (indirect cost structures) is taken into account to calculate multipliers that show how much extra output or value added a final demand shock generates in the economy. Furthermore, linkages to downstream industries through deliveries of intermediate inputs can also be determined. This allows us to investigate the value chain integration of export-oriented and domestic market manufacturers. Finally, in view of the growing interest in export figures expressed in value added terms rather than in gross terms, we use the export-heterogeneous IOT to measure to what extent domestic market firms benefit from exports in terms of value creation.

3.1. Differences in direct production cost structures

The IOT with exporter heterogeneity in table 8 allows to determine that export-oriented firms account for almost three-quarters of total output of manufacturing industries but only for two-thirds of total manufacturing value added. In other words, export-oriented manufacturers have a lower value added to gross output ratio than manufacturing firms that mainly serve the domestic market. This is illustrated in graph 1.

Graph 1 **Direct production cost structures in manufacturing, heterogenous and standard IOT, 2010**
Percentages
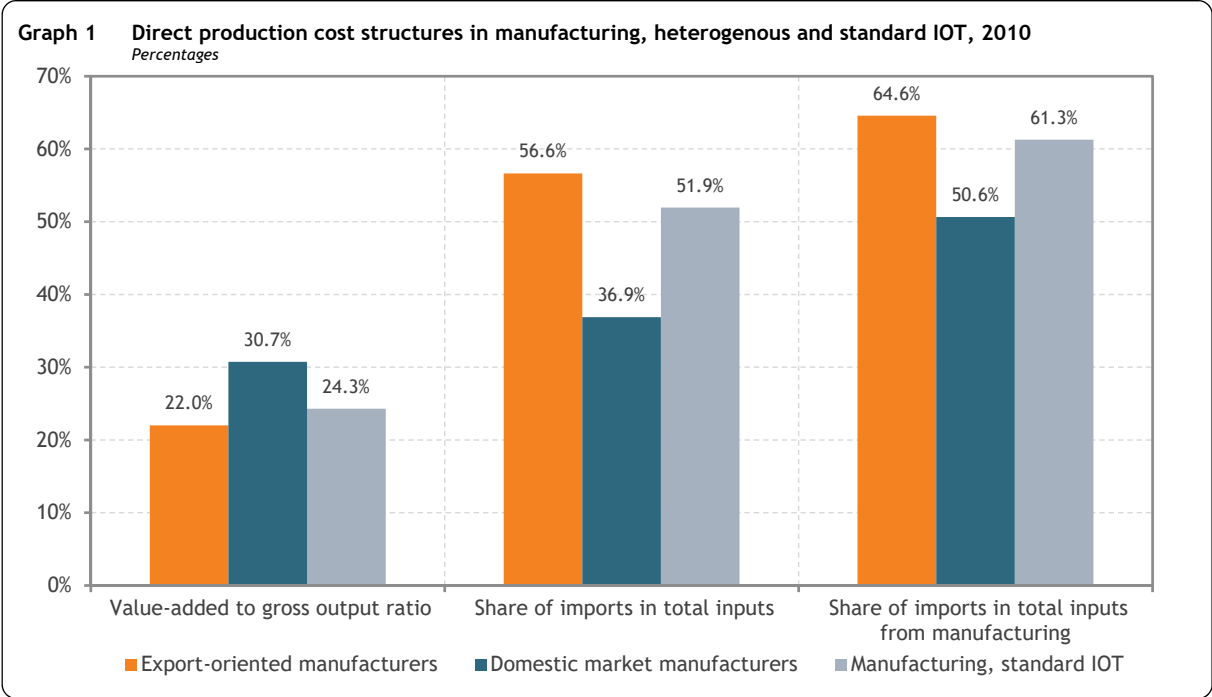
Furthermore, export-oriented manufacturing firms do not only purchase more intermediate inputs compared to their gross output, they also purchase proportionally more of their intermediate inputs from abroad. Indeed, as illustrated in graph 1, imports make for almost 57% of total intermediate inputs of export-oriented firms, while this share is just below 37% for domestic market firms. Hence, in line with prior findings in the literature on firm heterogeneity and international trade, export-oriented manufacturing firms in Belgium tend to rely more on imported intermediate inputs. Narrowing things down to inputs from manufacturing, this share becomes 65% for export-oriented firms and 51% for firms that mainly serve the domestic market (graph 1). This corresponds to offshoring of manufactured goods as originally defined in Feenstra and Hanson (1996). Export-oriented manufacturing firms engage more into offshoring, which reflects the greater cross-border fragmentation of their production processes.

Graph 1 also reports values for these three indicators (value added to gross output ratio, share of imports in total inputs and share of imports in total inputs from manufacturing) for the whole manufacturing based on the standard IOT for 2010. They turn out to be closer to the values for export-oriented manufacturing firms due to the higher shares of this group of firms in the industry totals.
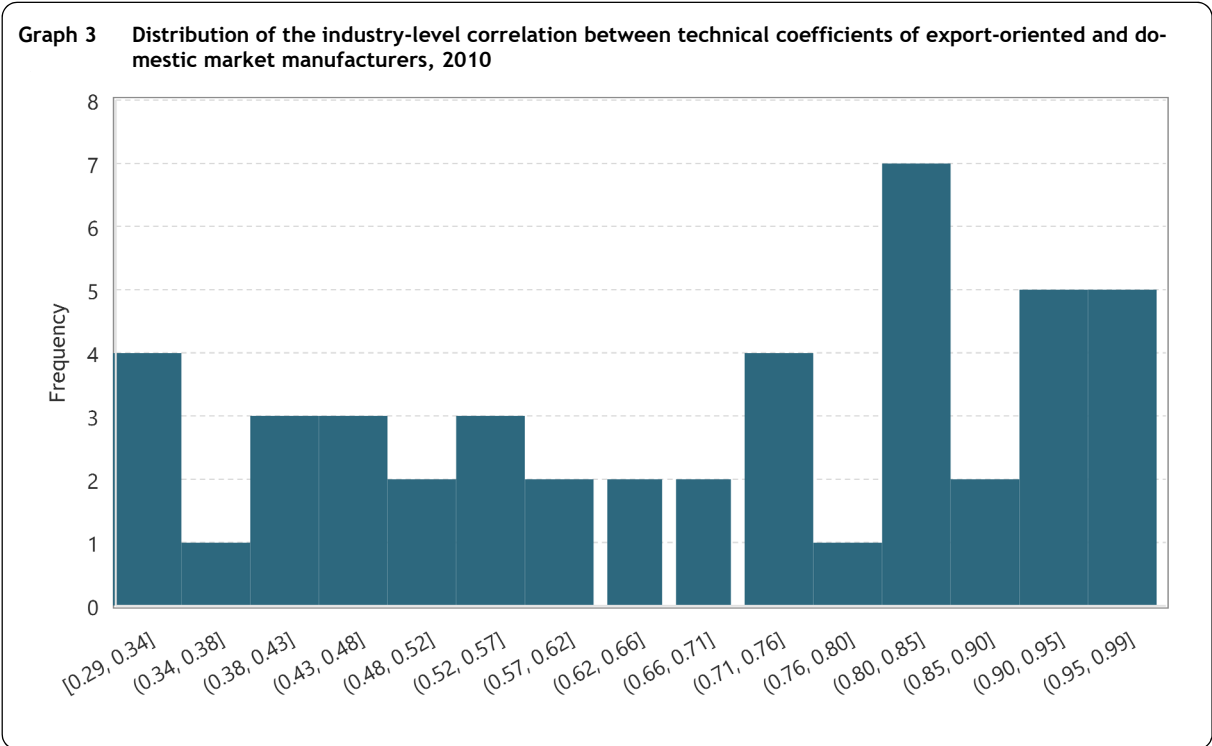
Based on the heterogeneous IOT and looking at intermediate input structures, graph 2 illustrates further differences between export-oriented and domestic market manufacturers.[11] As said before, both groups of firms source most intermediate inputs from abroad. Regarding their purchases from domestic suppliers, more than half comes from other (service) industries for both groups. But domestic market manufacturers purchase relatively more of their intermediate inputs from other domestic market manufacturers, while export-oriented manufacturers purchase relatively more of their intermediate inputs from other export-oriented manufacturers.

Graph 2   **Origin of domestically-sourced intermediate inputs of export-oriented and domestic market manufacturers, 2010**
Percentages

Export-oriented manufacturers

Export-oriented manufacturers; 30%
Other industries; 56%
Domestic market manufacturers; 14%

Domestic market manufacturers

Export-oriented manufacturers; 17%
Other industries; 58%
Domestic market manufacturers; 25%

Finally, we also test for similarity of intermediate input structures at a more detailed level by calculating the correlation between technical coefficients of export-oriented and domestic market firms in each manufacturing industry. Technical coefficients are the result of a normalisation of an industry's input structure by its output, i.e. they indicate the amount of the different types of intermediate inputs required per unit of output. The average correlation between the intermediate input structures of export-

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[11]   The difference in the shares of imports was already shown in graph 1 and will not be repeated here.

oriented and domestic market firms in the same industry is 0.707. This excludes industries for which we had to rely on proportionality when determining the respective product distributions of intermediate inputs for export-oriented and domestic market firms. The histogram in graph 3 provides a picture of the distribution of the correlation coefficients. Among industries for which the input structure is not split proportionally, 'Printing', 'Manufacture of motor vehicles' and 'Manufacture of general-purpose machinery' have the highest correlation coefficients (close to 1), followed by 'Manufacture of grain mill and starch products', 'Manufacture of tobacco products' and 'Manufacture of paper and paper products' (0.95) while 'Manufacture of paints and similar coatings, printing ink and mastics', 'Manufacture of rubber products', 'Repair and installation of machinery and equipment', 'Manufacture of air and spacecraft and parts thereof' and 'Manufacture of leather and related products' the lowest (below 0.38), i.e. export-oriented and domestic market firms have very similar intermediate input structures in the former and relatively different ones in the latter.

Graph 3   **Distribution of the industry-level correlation between technical coefficients of export-oriented and domestic market manufacturers, 2010**

3.2. Multipliers and linkages

Input-output analysis is all about taking into account not only direct intermediate inputs in the production process as analysed above but also indirect intermediate inputs requirements of suppliers. The underlying idea can be described as follows: take a final demand shock (domestic final demand or exports) and determine its effect on economy-wide output or value added. The final demand shock prompts a firm to expand the scale of its production process. When expanding its production, the firm purchases more inputs from its suppliers, and, as a consequence, the firm's suppliers also produce more output, for which they purchase additional inputs from their suppliers. In turn, the suppliers' suppliers produce more output and purchase extra inputs, and so on. This gives rise to an upstream effect on output, which comes through the increase in purchases of domestically-produced intermediate inputs. Standard input-output analysis models the effect of such a demand shock on the entire domestic production chain

in terms of output or value added that is generated in the chain. Here, we focus on output and value added of export-oriented and domestic market manufacturers. And we will show that an export demand shock may not only increase the output of export-oriented manufacturers but also lead to substantial extra output and value added of all other firms due to local intermediate input purchases by export-oriented manufacturers.
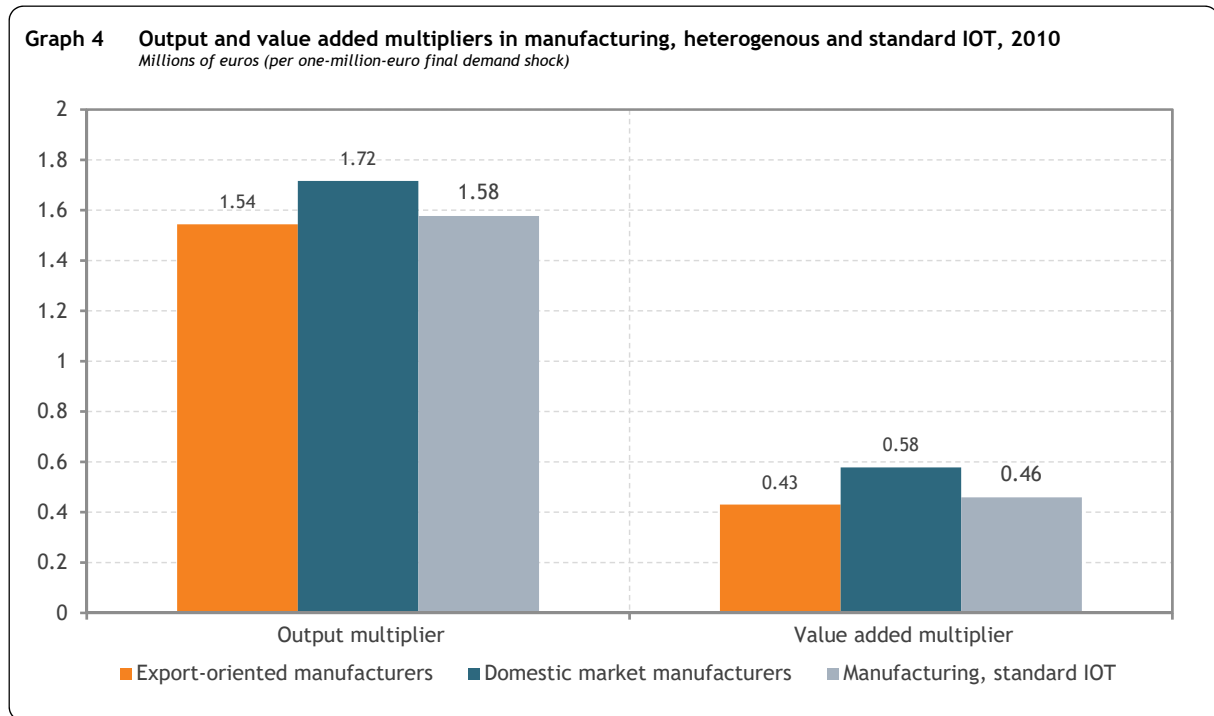
In the input-output model, the total effect on output is measured by multiplying the shocks by the Leontief inverse matrix. This accounts for the magnitude of the shock and all extra output generated in domestic supplying (upstream) industries. In a national IOT framework, the Leontief inverse matrix L, which is also called total requirements matrix, is calculated as follows:

$$L = (I - A^d)^{-1}$$

(1)

where A^d is an industry-by-industry matrix of domestic technical coefficients and I is an identity matrix of the same dimensions as A^d. For any industry, domestic technical coefficients represent the shares of inputs purchased from domestic supplying industries in its total output. The matrix A^d is calculated as $Z^d * \hat{y}^{-1}$ where Z^d is the matrix of domestically-produced intermediate inputs and $\hat{y}$ a diagonalised vector of output by industry. Any element l_{ij} of the L-matrix represents domestic output by industry i generated (directly or indirectly) by a one-euro final demand shock for output of industry j. The sum over all i (producing industries) is called the *output multiplier* for industry j ($\sum_i l_{ij}$). It indicates how many extra euros of domestic output are generated (in all industries) through domestic intermediate input purchases by a one-euro increase in final demand for output of industry j. The output multiplier is an indicator of an industry's backward integration into a country's economy. Note that, in this national framework, imported intermediate inputs are not taken into account: they do not generate domestic output. Thus, industries that use relatively more domestically-produced intermediate inputs tend to have higher output multipliers.

Effects can also be calculated in terms of value added. Multiplying l_{ij} by industry i's value added in output share v_i yields the amount of value added of industry i generated by this shock to industry j's final demand. The *value added multiplier* corresponds to the sum over the producing industries ($\sum_i v_i l_{ij}$). It indicates how many extra euros of domestic value added are generated (in all industries) through intermediate input purchases by a one-euro increase in final demand for output of industry j.

Based on the 2010 heterogeneous national IOT for Belgium, we calculate output and value added multipliers for export-oriented and domestic market firms in manufacturing industries. Overall results are reported in graph 4, including those for total manufacturing based on the standard IOT. The average output multiplier is substantially higher for domestic market firms than for export-oriented firms. Thus, as expected, export-oriented manufacturers are less (backward) integrated into the Belgian economy. This finding reflects the international fragmentation of their production process. They use more intermediate inputs than domestic market manufacturers, but most of these inputs are imported, which implies that their output multiplier is lower.

Graph 4   Output and value added multipliers in manufacturing, heterogenous and standard IOT, 2010
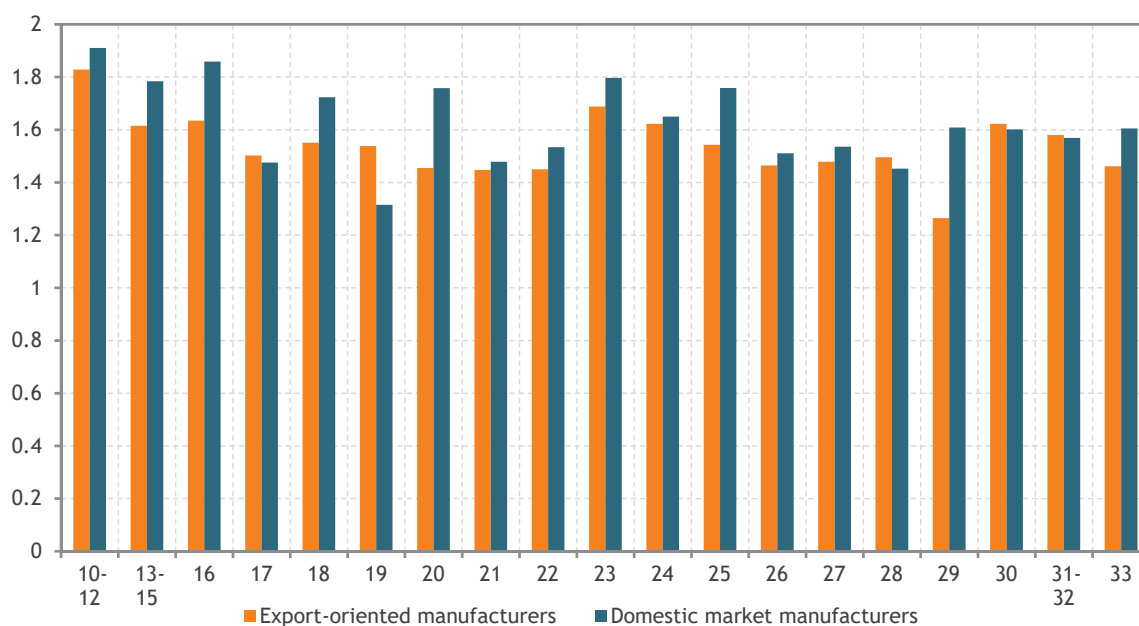*Millions of euros (per one-million-euro final demand shock)*

As shown in graph 4, the value added multiplier for domestic market manufacturers is also higher. It stands at 0.58 against 0.43 for export-oriented manufacturers. Two underlying differences between export-oriented and domestic market manufacturers drive this result. First, a one-euro final demand shock to the output of export-oriented manufacturers generates less direct value added than an equivalent shock to the output of domestic market manufacturers since the value added in output share is lower for export-oriented manufacturers. Second, it also generates proportionally less output in domestic upstream industries and hence also less value added.

The output and value added multipliers for manufacturing overall shown in graph 4 are closer to the multipliers for export-oriented firms. This is again due to the higher weight of export-oriented firms in manufacturing industries.
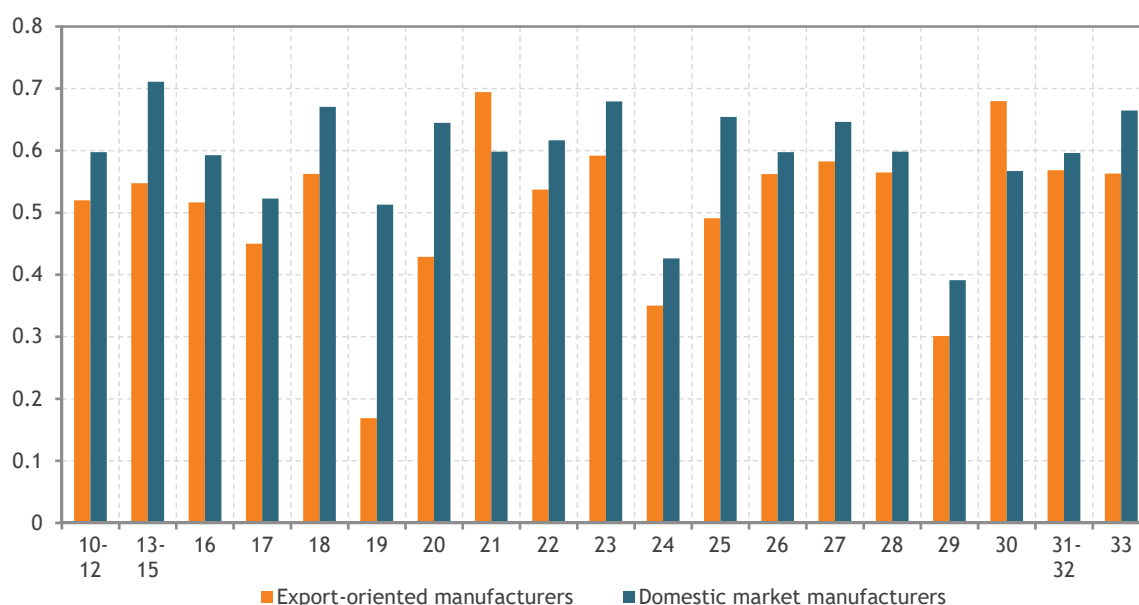
Graph 5 and graph 6 show output and value added multipliers at the NACE Rev.2 A64 industry level for export-oriented and domestic market firms.[12] The output multiplier of export-oriented manufacturers is lower in most industries as illustrated in graph 5 (this actually holds for all but five of the manufacturing industries). Moreover, there is a relatively strong spread in the values of output multipliers: between 1.32 and 1.91 for domestic market firms and between 1.26 and 1.83 for export-oriented firms. Graph 6 shows that the value added multiplier of export-oriented firms is lower than the one of domestic market firms in all manufacturing industries except for the pharmaceutical and the other transport equipment industries (codes 21 and 30). In those two industries, export-oriented firms rely proportionally more on intermediates produced domestically than do firms that mainly serve the domestic market.

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[12]   There are 19 manufacturing industries at this level of disaggregation (see list in the appendix).

Graph 5   Output multipliers of export-oriented and domestic market manufacturers, by industry, 2010
Millions of euros (per one-million-euro final demand shock)

Export-oriented manufacturers ■ Domestic market manufacturers

Graph 6   Value added multipliers of export-oriented and domestic market manufacturers, by industry, 2010
Millions of euros (per one-million-euro final demand shock)

Export-oriented manufacturers ■ Domestic market manufacturers

Furthermore, we have calculated the output and value added multipliers of a shock to exports for export-oriented and domestic market firms. An extra one million euros of exports by export-oriented manufacturers generates a total of 1.54 million euros of output in Belgium and 0.43 million euros of value added, whereas an extra million euros of exports by firms mainly serving the domestic market generates a total of 1.67 million euros of output and 0.55 million euros of value added. The difference is due to a composition effect (different product mix of exports) and a within industry effect (different production structures). Graph 7 also shows where the effects of an export shock on output and value added actually

occur. It turns out that the biggest part of the upstream effects is in the 'other industries', which mainly comprise service industries.

Graph 7   Output and value added multipliers, export shock, 2010
Millions of euros (per one-million-euro export shock)
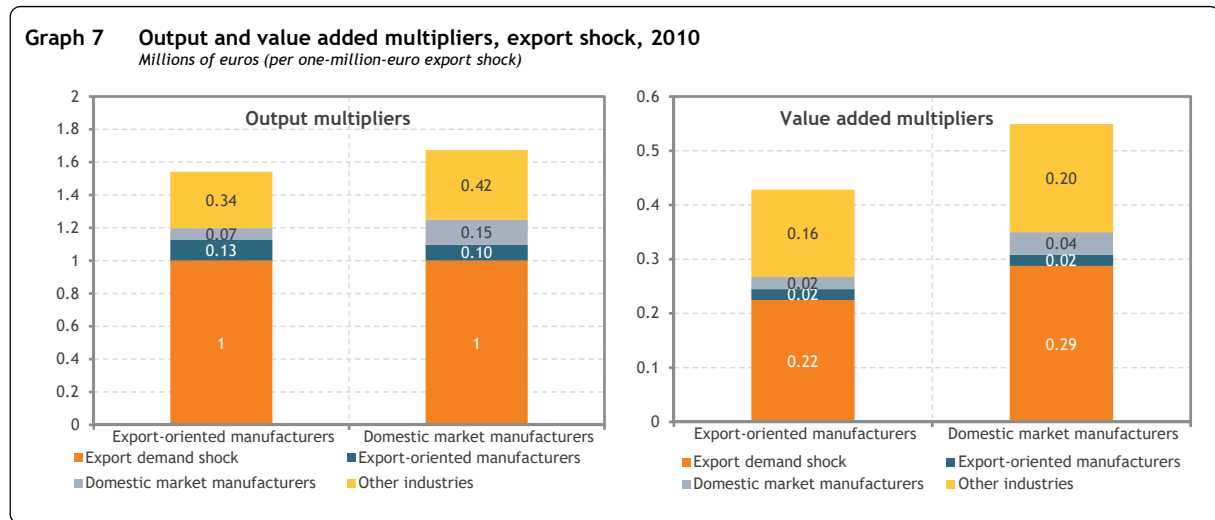
Finally, in input-output analysis, an industry's integration into the domestic economy is considered not only in terms of its purchases of domestically-produced intermediate inputs (upstream) but also in terms of its deliveries of goods and services to other domestic industries that use them as intermediates (downstream). The former is referred to as backward integration or backward linkages of an industry and, as mentioned above, can be measured by the output multiplier. The latter is referred to as forward integration or forward linkages of an industry. It can be measured as the sum of the industry's row in the Ghosh inverse matrix, which is calculated based on the shares of the industry's output used as intermediate inputs by other domestic industries. Our calculations of this forward linkage indicator show that it is generally much lower for export-oriented manufacturers than for manufacturing firms that mainly serve the domestic market. The reason is very simple: export-oriented firms deliver relatively less of their output to other domestic industries than domestic market firms. Thus, forward integration into the domestic economy is higher for domestic market firms. However, exports may be used as intermediate inputs abroad. Hence, export-oriented firms are likely to be integrated forward into global value chains rather than domestic value chains.[13]

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[13]   This cannot be identified based on a national IOT, which does not provide information on how exports are used in destination countries, but requires a global multi-regional input-output table (GMRIO).

Graph 8 **Forward and backward integration into the domestic economy, export-oriented and domestic market manufacturers, 2010**
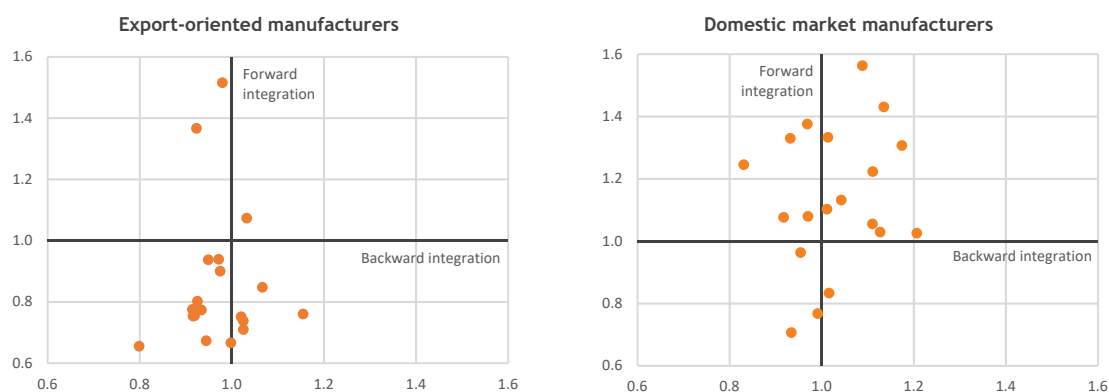
Integration of export-oriented and domestic market manufacturers into Belgian domestic value chains is summarized in the scatterplots of graph 8. Backward integration is shown on the horizontal axis and forward integration on the vertical axis. Both are normalized with respect to the average for all manufacturing industries. The scatterplot for manufacturing firms serving mainly the domestic market is skewed more towards the top and right indicating a stronger integration into domestic value chains.

3.3. Trade in value added indicators

As production processes have become increasingly fragmented at the international level, a growing share of international trade is trade in intermediate goods and services (Miroudot et al., 2009). Moreover, greater fragmentation implies that many goods are shipped back and forth in the course of the production process before being delivered to final consumers. Due to multiple border crossings, gross export flows have increased faster than the underlying value added. These trends in international trade and production have prompted researchers to look at the domestic and foreign value added shares in a country's exports (Hummels et al., 2001; Koopman et al., 2014).

The vertical specialisation in trade (VS) share measure defined by Hummels et al. (2001) represents "the value of imported inputs embodied in goods that are exported" (p.76-77) as a share of gross exports. It reveals to what extent imported intermediates are used in a country to produce exported goods and services. Calculated based on an input-output table and model, this indicator takes into account the use of imported intermediates at all stages of the production process. It is a widely-used indicator of the extent of the international fragmentation of production processes.

Belgium's VS share of exports computed with the standard 2010 IOT amounts to 44%. This is in line with the 46% VS share reported in Los (2017)[14] and an indication of a relatively strong integration into international value chains. According to the international comparison of VS shares in Los (2017), Belgium is among the countries with the highest VS shares (only Luxemburg, Taiwan and the Czech Republic have higher VS shares than Belgium). When restricting the scope to manufacturing industries, we find that Belgium's VS share based on the standard national IOT stands at the much higher level of

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[14] Note that the VS share in Los (2017) is calculated for the year 2011 based on a global multi-regional input-output table rather than a national IOT.

55%, i.e. the degree of integration into international value chains is much higher on average for manufacturing than for service industries.

As emphasized in Piacentini et Fortanier (2015), "the use of homogeneous input-output tables (…) assumes that imported inputs are used evenly in production for domestic sales and exports. If domestic production is different from production for exports, i.e. the input-output structure of exporters is different from the one of non-exporters, then the measure based on standard (IOT) is biased. The direction of the bias is clear: as exporters make a more intensive use of intermediate imports than non-exporters, the standard measure under-estimates vertical specialisation (p.16)." The VS share of manufacturing for Belgium based on our export-heterogeneous IOT amounts to 56%. Hence, we find that the downward bias of computing the VS share with the standard table is rather small. Nonetheless, the computation of separate VS shares for export-oriented and domestic market firms reveals a large difference, which is indeed driven by the difference in the intensity in the use of imported intermediates. The VS share is 57% for export-oriented manufacturers and 45% for domestic market manufacturers. This also means that the overall VS share for manufacturing is mostly determined by export-oriented firms.

Graph 9   **Vertical specialisation share and value added to output ratio, export-oriented and domestic market manufacturers, 2010**
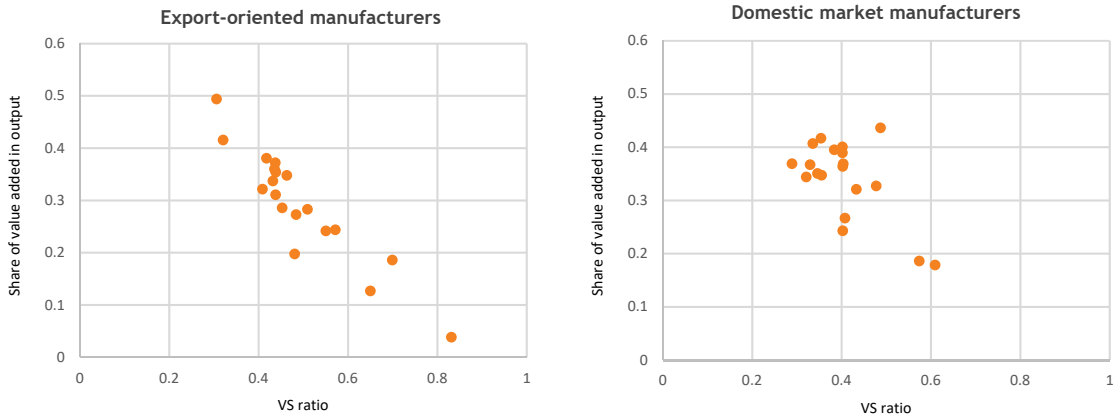
Graph 10   **Vertical specialisation share and share of imports in total inputs, export-oriented and domestic market manufacturers, 2010**
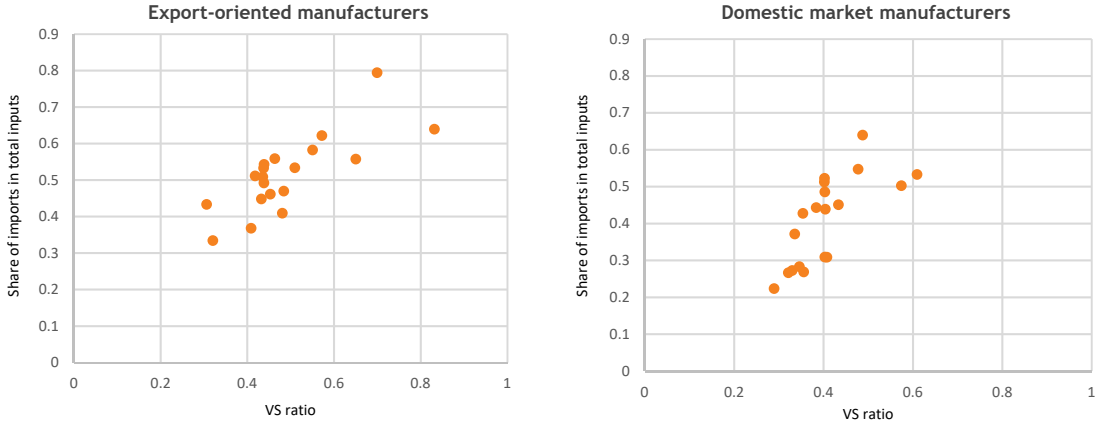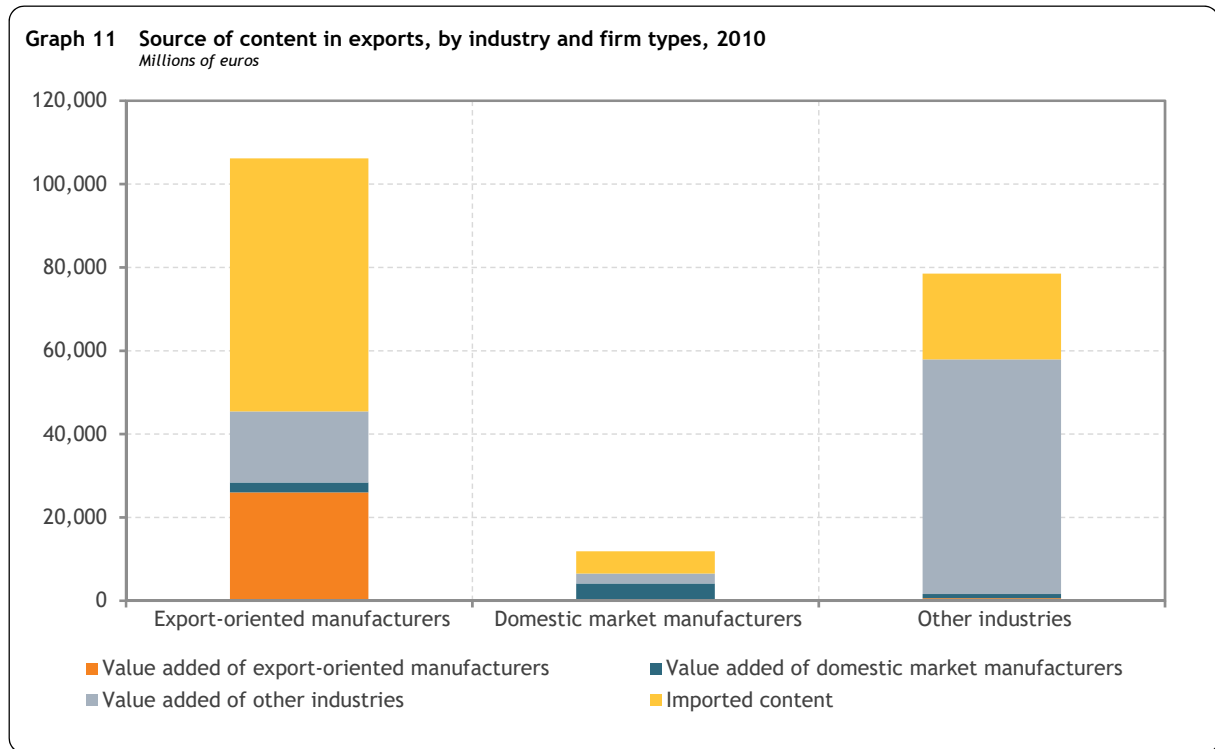
The VS share is influenced by three main factors: a) the share of exports in total output, b) the value added to output ratio, and c) the share of imports in total use of intermediate inputs (Piacentini and Fortanier, 2015). By definition, export-oriented manufacturers have a higher share of exports in total output. But the other two factors also play a role. This is illustrated in graph 9 and graph 10 and in line with results reported earlier. Export-oriented manufacturers have lower value added to output ratios, i.e. use proportionally more intermediates in their production process, and they rely to a larger extent on imports when sourcing these intermediates.

The complement of VS share measure is the domestic value added in exports (DVAX) share as defined by Koopman et al. (2014). Total domestic value added generated by exports in 2010 amounts to 109.9 billion euros, which corresponds to 56% of Belgium's total gross exports (of 196.5 billion euros). We use the heterogenous IO tables to specifically decompose the domestic (Belgian) value added embodied in exports by industry and firm types. Results are illustrated in graph 11 and reported in table 9 with value added by types of firms in the rows and exports by types of firms in the columns.

Table 9   Domestic value added in exports, 2010
Millions of euros

Value added \ exporter	Export-oriented manufacturers	Domestic market manufacturers	Other industries	Total
Export-oriented manufacturers	25,992	248	603	26,843
Domestic market manufacturers	2,364	3,900	981	7,245
Other industries	17,069	2,368	56,340	75,776
Total	45,425	6,515	57,923	109,863
Gross exports	106,175	11,862	78,483	196,520

As an example on how to read this table, take the cell corresponding to the second row in the first column: it reports the value added of domestic market manufacturers generated by exports of export-oriented manufacturers. The table reveals several interesting results. First, the exports of export-oriented manufacturers generate a total domestic value added of 45.4 billion euros, of which more than half is value added of this group of firms. But their exports also generate a substantial amount of value added in the rest of the Belgian economy: 17.1 billion euros in firms outside manufacturing (mainly service industries), and 2.4 billion euros in domestic market firms in manufacturing industries. Hence, Belgian service industries do actually participate in global value chains through their deliveries to export-oriented manufacturers. Second, the exports of domestic market manufacturers and of firms in the other industries generate only very little value added for export-oriented manufacturers. Again, this is related to the lesser integration of export-oriented manufacturers into the domestic economy. Third, the exports of the other industries, mostly service exports, generate comparatively less value added in manufacturing (for both export-oriented and domestic market manufacturers). Two characteristics of service industries contribute to this finding: they have a higher value added to output ratio and services make for a larger share of the intermediates they purchase. The comparison of column and row totals of table 9 shows, for export-oriented manufacturers, that the value added generated in Belgium by their exports (45.4) is much higher than their value added due to total Belgian exports (26.8). The opposite holds for domestic market manufacturers and firms in other industries. Finally, comparing the two bottom rows of the table reveals that gross exports of export-oriented and domestic market manufacturers generate proportionally less domestic value added than gross exports of firms in other (service) industries.

Graph 11   Source of content in exports, by industry and firm types, 2010
Millions of euros

- Value added of export-oriented manufacturers
- Value added of domestic market manufacturers
- Value added of other industries
- Imported content

Graph 12 provides a comparison of shares in gross exports and in domestic value added in exports. There is a striking difference in these shares for some of the groups of firms. Export-oriented manufacturers account for more than half of Belgium's total gross exports (54%) but only for a quarter of the domestic value added generated by these exports (24%). Most of the domestic value added in exports is generated in other industries, i.e. service industries (69%), although the share of these industries in gross exports is only 40%. For domestic market manufacturers, the shares in gross exports and domestic value added in exports are similar and low (close to 6 or 7%).

Graph 12   Shares in domestic value added in exports and in gross exports, by firm types, 2010
Percentages

- Gross exports
- Value added exports
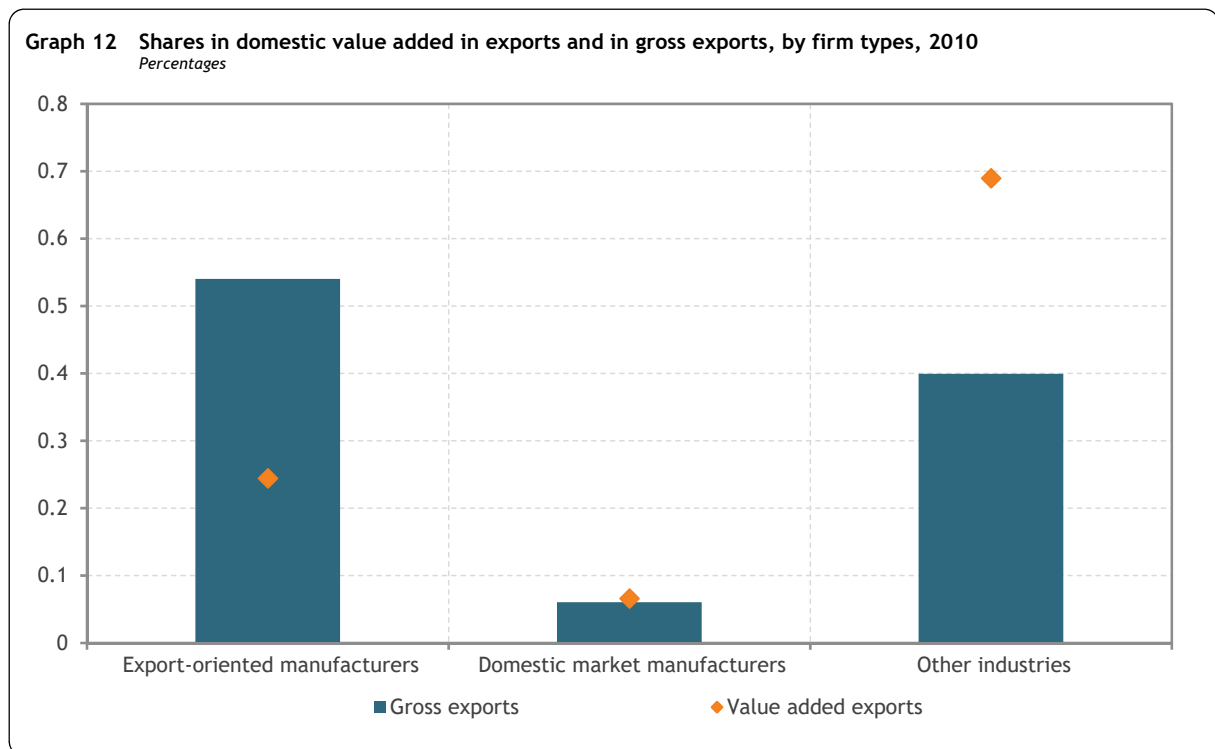
4. Conclusions

In this working paper, we have described the statistical methodology for obtaining export-heterogeneous SUT and IOT for Belgium for the year 2010 and presented results from analyses based on these tables. A disaggregation of industries in SUT and IOT according to exporter status is highly desirable as this may actually be at the origin of technological differences between firms within an industry defined in terms of product similarity (OECD, 2015; Los, 2017).

From a statistical point of view, we propose a data-based split of manufacturing industries' output and input structures into export-oriented and domestic market firms. Such a data-based split represents a clear improvement with respect to the proportionality assumptions that most prior contributions in this field have relied on. It has enabled us to provide a comparison of cost structures of export-oriented and domestic market firms and to look at their integration into the Belgian economy and their contributions to value creation, in particular for the value added generated by exports.

However, our work also illustrates limitations to what can be done in this respect from a statistical point of view. It shows that, especially for a small country like Belgium, a sample size problem may arise in the context of a data-based split of output and input structures in SUT and IOT. At the most detailed industry level, sample sizes may prove insufficient for a data-based split. In our case, we faced a trade-off between including minor exporters into the category of export-oriented firms and avoiding proportionality in the estimation of product distributions for heterogeneous industries in the most detailed breakdown of the SUT. We are aware that this may be less of an issue for larger countries. Nonetheless, this problem related to sample size represents a serious constraint for combined disaggregations, e.g. firm size and ownership.

The comparison of cost structures of export-oriented and domestic market firms in manufacturing industries reveals that they are indeed different in terms of input structures (production technology) and import behaviour. Export-oriented manufacturers have lower value-added in output shares, and they import proportionally more of the intermediates they use. This means that their production processes are more fragmented, in particular internationally. These results confirm prior findings in the literature on firm heterogeneity in international trade (Melitz, 2003; Bas, 2009). We believe that it is an important step to have confirmed these findings in a setting that is consistent with the national accounts.

The input-output analysis based on the heterogeneous tables illustrates that export-oriented manufacturing firms are less integrated into the Belgian economy than domestic market firms. A shock to final demand for their output generates less additional output and value added in the Belgian economy than an equivalent shock to domestic market manufacturers. Furthermore, the export-heterogeneous IOT also allows to highlight the links that exist between export-oriented manufacturers and other Belgian firms. The analysis reveals that the exports of export-oriented manufacturers generate a substantial amount of value added of other Belgian firms, in particular providers of services.

The policy implication of these results is that external competitiveness for a small open economy like Belgium depends not only on exporters but also on firms that mainly serve the domestic market. To get most from exports in terms of value added, export-oriented firms need to be competitive on foreign

markets and domestic suppliers have to be competitive in the production of the inputs delivered to those export-oriented firms (internal competitiveness). Therefore, when setting up policies to foster exports, it is not sufficient to focus only on measures for export-oriented firms. For the country to reap the full benefits from exports in terms of value creation, it is necessary to make sure that domestic upstream suppliers are part of the plan so that they can generate additional domestic value added by delivering intermediate goods and services to export-oriented firms. In short, the entire value chain for the production of exports must be taken into account when it comes to defining economic policies aimed at fostering competitiveness.

References

Bas M. (2009), "Trade, Foreign Inputs and Firms' Decisions: Theory and Evidence", CEPII Working Paper N°2009-35, December 2009.

Beutel, J. (2017), "The supply and use framework of national accounts" (Chapter 3) in T. Ten Raa (ed.), Handbook of Input-Output Analysis, Edward Elgar.

Chong, S., Hoekstra, R., Lemmers, O., Van Beveren, I., Van den Berg, M., Van Der Wal, R. and P. Verbiest (2017), "The role of small and medium enterprises in the Dutch economy: An analysis using an extended supply and use table", unpublished, transmitted by the authors.

De la Cruz, J., Koopman R., Wang Z. and S.-J. Wei (2011), 'Estimating Foreign Value-Added in Mexico's Manufacturing exports, Office of Economics Working Paper N° 2011-04A, U.S. International Trade Commission.

Eurostat (2008), Eurostat Manual of Supply, Use and Input-Output Tables, Luxembourg.

FPB (2015), "Tableaux Entrées-Sorties 2010", "Input-outputtabellen 2010", Federal Planning Bureau, Brussels.

Fetzer, J. J., Highfill, T., Hossiso, K., Howells III, T. F., Strassner, E. H. and J. A. Young (2018), "Accounting for Firm Heterogeneity within U.S. Industries: Extended Supply-Use Tables and Trade in Value Added using Enterprise and Establishment Level Data", Paper presented at the CRIW Conference on the Challenges of Globalization in the Measurement of National Accounts, Washington DC, 9-10 March 2018.

Gereffi, G. (1994), "The organization of buyer-driven global commodity chains: how US retailers shape overseas production networks", in G. Gereffi and M. Korzeniewicz (eds.) Commodity Chains and Global Capitalism, Westport, pp.95-122.

Hambÿe C. (2012), " Analyse entrées-sorties : modèles, multiplicateurs, linkages ", Working Paper 12-12, Bureau fédéral du Plan, Septembre 2012.

Hummels, D., Ishii J. and K.-M. Yi (2001), "The nature and growth of vertical specialization in world trade", Journal of International Economics, 54, pp. 75-96.

Inomata, S. (2017), "Analytical frameworks for global value chains: An overview", in Global Value Chain Development Report 2017: Measuring and analyzing the impact of GVCs on economic development, International Bank for Reconstruction and Development/The World Bank.

Johnson, R.C. and G. Noguera (2012), "Fragmentation and Trade in Value Added Over Four Decades", NBER Working Paper n° 18186.

Koopman, R., Wang Z. and S.-J. Wei (2012), "Estimating domestic content in exports when processing trade is pervasive", Journal of Development Economics, 99, pp. 178-189.

Koopman, R., Wang Z. and S.-J. Wei (2014), "Tracing Value added and Double Counting in Gross Exports", American Economic Review, 104(2), pp. 459-94.

Lais, K. and E. Kolleritsch (2017), "OECD Expert Group on Extended SUTs: Final Report Austria", unpublished, transmitted by the authors.

Los, B. (2017), "Input-output analysis of international trade", (Chapter 8) in T. Ten Raa (ed.), Handbook of Input-Output Analysis, Edward Elgar.

Ma, H., Wang Z. and K. Zhu (2015), "Domestic content in China's exports and its distribution by firm ownership", Journal of Comparative Economics, 43, pp. 3-18.

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

Miroudot, S., Lanz R. and A. Ragoussis (2009), "Trade in Intermediate Goods and Services", OECD Trade Policy Working Paper, no. 93, OECD, Paris.

OECD (2015), Terms of Reference, Expert Group on Extended Supply and Use Tables, Paris.

Piacentini, M. and F. Fortanier (2015), "Firm heterogeneity and trade in value added", STD/CSSP/WPTGS(2015)231, OECD Publishing.

Saborio, G. (2015), "Costa Rica: An Extended Supply-Use Table", Paper prepared for 23rd IIOA Conference, Mexico City.

Yamano, N. and C. Webb (2018), "Future Development of the Inter-Country Input-Output (ICIO) Database for Global Value Chain (GVC) and Environmental Analyses", Journal of Industrial Ecology, vol. 22 (3), pp.487-488.

Appendix

Manufacturing industries (A64)

NACE Rev. 2	Description
10-12	Manufacture of food products, beverages and tobacco products
13-15	Manufacture of textiles, wearing apparel and leather products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Chemical industry
21	Manufacture of pharmaceutical products
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31-32	Manufacture of furniture; Other manufacturing
33	Repair and installation of machinery and equipment