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Norwegian exports in global value chains

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Norwegian exports in global value chains

Abstract: This study analyses the participation of the Norwegian economy in global value chains in 2000-2014, following the gross exports decomposition framework in Koopman, Wang and Wei (2014) and using the World Input-Output Database (WIOD). The analysis shows that Norway increased its participation in global value chains through both backward and forward linkages, but the latter is more dominant and reflects Norway's endowments in natural resources. Moreover, the study reveals that services exports increased substantially during the period analysed and are even higher than manufacturing exports if measured in value-added terms rather than gross terms. This highlights the key role of services in global value chains as well as the relevance of measuring trade in value-added terms.

1. Introduction

Global value chains (GVCs) is the new standard of how world production and trade are organised, and analysis of GVCs provides useful insights on specialisation patterns and how economies are interlinked.

The emergence of GVCs during the last decades implies that domestic production increasingly relies on foreign and re-imported domestic inputs, which turns conventional trade statistics of gross trade flows insufficient to understand domestic value added and national income. In this context, an analysis based on the value added in trade allows to identify the domestic and foreign sources and uses of output at the industry and country level. The basic objective of such analysis is to break up the production process into the specter of activities involved in bringing a product from its conception to the final consumer. Typical activities in the beginning of a value chain are research and design, while inputs and raw materials are relevant in intermediate stages. Moreover, consumption, marketing, logistics and after-product servicing are present in the final stages. Hence, a complex combination of goods and services intermediates from different locations makes a GVC.

GVC analysis is particularly useful to measure the large and increasing role of services in international trade and production, which has been documented in several studies (WB 2017).¹ The share of services in value-added trade grew from below 30 to above 40 percent during 1980-2009. Most of the growth is explained by an increase in domestic and foreign services intermediates embodied in exports of goods, in which the share of foreign services grew the most (WB 2017). In contrast, the share of services in gross exports remained stable at 20 percent, reflecting that the measurement does not properly take into account the increasing role of services as inputs and linkages in the production of goods. In other words, GVC analysis allows to break down manufacturing value chains to identify the large components of services embodied in them.

This paper assesses Norway's participation in GVCs during 2000-2014 at the aggregate and sector level, emphasizing differences across sectors of services and goods. We decompose Norway's gross exports into domestic and foreign sources of value added as well as double-counted components following the theoretical input-output framework in Koopman, Wang and Wei (2014). Based on this decomposition, we establish indicators of backward and forward participation in GVCs. Finally, we document to what extent different types of services from domestic and foreign sources are embodied in total gross exports and manufacturing gross exports. We first perform the analysis for the aggregate

1. The report is co-published by The World Bank Group, The World Trade Organization (WTO), the Organisation for Economic Co-operation and Development (OECD), the Institute of Development Economics (IDE-JETRO) and the Research Center of Global Value Chains of the University of International Business and Economics (UIBE).

economy, then for the broad sectors services, manufacturing and primary, and finally for services at a disaggregated sector level. The aggregate results include the oil industry (i.e., the Mining and quarrying sector), while it is excluded in the sectoral analysis. Throughout the paper, we emphasize differences between sectors of manufacturing and services.

The aggregate analysis shows that Norway has a high share of domestic value added in gross exports, which is a common feature for countries specialised in exports of commodities. Nevertheless, there has been a small fall in domestic value and slight rise in foreign value added in gross exports. The decomposition of gross exports reflects that Norway's participation in global production and trade primarily occurs through forward industrial linkages. Indeed, the share of domestically produced inputs used by importing countries to produce exports to third countries (i.e., forward participation) grew from 37.2 to 45.3 percent from 2000 to 2014. Participation through backward industrial linkages is also becoming stronger as the share of foreign inputs in gross exports (i.e., backward participation) grew from 13.1 to 16.8 percent in the same period.

The main message arising from the sectoral analysis is the high importance of trade in services in Norway's value-added exports. Indeed, trade in services is relatively larger than that of manufactured goods when measured in value-added terms from 2000 to 2014. Moreover, the share of indirect value-added exports of services has increased while it has remained unchanged for manufactured goods, suggesting that services increasingly participate in global value chains through forward industrial linkages. Finally, the relevance of foreign services inputs embodied in manufacturing exports has increased, reflecting that more manufacturers are outsourcing services to foreign providers.

The paper is organised as follows: Section 2 introduces the nature and measurement of GVCs and value-added trade, the theoretical input-output framework in Koopman et al. (2014) and the data used. Section 3.1 describes the results for the total economy, Section 3.2 for the broad sectors primary, services and manufacturing, and Section 3.3 for services at a disaggregated sector level. Section 4 concludes.

2. The nature of global value chains and value-added trade

2.1. Concepts and definitions

There has been a strong shift into international fragmentation of production, described as the separation of production across countries that specialise in different stages of production of a good or service. Such international fragmentation has led to the emergence of global value chains (GVCs) where domestic and foreign value added are combined to produce exports, which are either embodied in further production or consumed as final goods and services (Amador and Cabral 2017).

In this context, gross trade flows reported by traditional trade statistics do not reflect that the value of exports by an economy consists of a combination of domestic and foreign inputs, which both may have crossed borders several times. In particular, gross exports by the manufacturing sector are to a high extent embodied in foreign inputs and re-exports of domestic inputs that have returned to the domestic production after being processed abroad. Therefore, gross trade flows tend to exceed domestic value-added exports and contain double-counted value, thus, conventional gross measures do not properly reflect the real contribution of a given export to the economy (Francois et al. 2015; Johnson 2014). Furthermore, such statistics may underestimate the role of services in global production and trade as they do not adequately take into account indirect exports of services, which has increased strongly since the early 1990s (Francois et al. 2015; Johnson 2014).² In sum, by tracing value added across countries and sectors, we take into account that a country's exports consist of domestic and foreign inputs of goods and services, and avoid double-counting of re-exported domestic value.

We illustrate these arguments in panel (A) of Figure 1, which reports the shares of services or goods in the respective flows of total gross and value-added exports. As expected, the share of services in total world trade increases if measured in terms of value added rather gross terms, whilst the share of manufacturing falls (from 26.8 to 45.6 %; from 61.7 to 36.1 %). Francois and Hoekman (2010), Francois et al. (2015) and Johnson (2014) document similar results and highlight two main explanations for the finding. Firstly, gross manufacturing exports include value added from the service sector as manufacturing firms buy services as inputs, whereas value added that originates in services is reallocated to the service sector itself rather than exports of the manufacturing industry with the value-added trade measurement. Secondly, double-counted intermediates imply that the same value added generated in the manufacturing sector tends to be exported several times due to vertical

2. Throughout the paper, *indirect exports* refer to inputs of an industry embodied in exports of another industry.

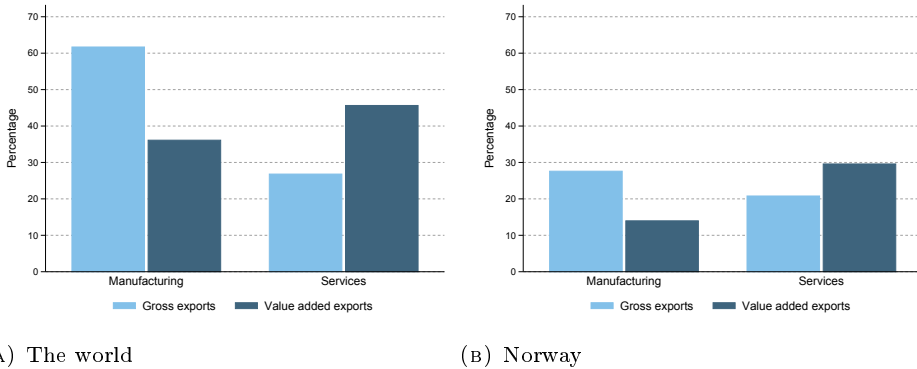


FIGURE 1: Sector shares in total value-added and gross exports, 2014

Notes: The bars give the percentage share by the manufacturing and service sector in total exports, which is measured in gross or value-added terms. We define the manufacturing and service sector according to ISIC Rev. 4 division 5-23 and 27-55, respectively. Total exports include divisions 1-56, which is all sectors in the economy. Table 4 in the Appendix gives an overview of the sectors or divisions.

Source: Author's calculations based on the WIOD 2000-2014.

chains of production (Johnson 2014; Koopman et al. 2014). In contrast to gross exports, such double-counted elements are excluded in the value-added trade measurement. We obtain similar results when performing the same exercise for Norway in panel (B) of Figure 1, the manufacturing share falls from 27.6 to 14.0 percent and the share of services rises from 20.8 to 29.6 percent.

These findings bring us to ask what is the role and function of services in GVCs. On one hand, services are crucial as linkages in value chains as they facilitate transactions across diverse geographical locations (telecommunications, transport and logistics) or through time (financial and legal services). On the other hand, services have functions as outsourced inputs or in-house inputs in the production of goods as they represent activities in the first stages (research and development) and final stages (distribution, marketing, installation, engineering and maintenance) in a product's value chain.

The empirical literature has identified some facts about services in GVCs and how they differ from goods. The main message is the strong and growing role of services as inputs and linkages in GVCs of goods. Francois et al. (2015) show that inputs of services embodied in exports of goods (i.e., indirect exports of services) have increased strongly since the early 1990s, while direct exports of services have remained on a relatively low level. Similarly, Amador and Cabral (2017) document the growing role of indirect value added by representing GVCs as a network of foreign value added in exports. The authors show that foreign services are embodied in both exports of goods and services, whereas foreign inputs of goods are mostly embodied in exports of goods and barely in

services. One explanation for this development is the process of servitisation that has been taking place in the manufacturing sector, meaning a shift towards services in the production and sales by manufacturing firms. Turning to the comparison between GVCs of services and goods, the latter are more internationally developed and integrated as they contain more value-added flows originating from more countries (Amador and Cabral 2017). However, some development of purely services based GVCs has taken place, which is linked to progress in the information and communication technologies, as well as a fall in telecommunication costs (Amador and Cabral 2017; Miroudot and Cadestin 2017).

2.2. Methodology

A global input-output table is necessary to derive value-added trade and indicators of GVC participation by a given country and sector, which we refer to as a *country-sector*. Figure 2 demonstrates the structure of this table of which the three key components are intermediate goods (domestic or foreign, by geographical origin), final demand and value added (or primary inputs).³ Each column gives the intermediates (domestic or foreign, by geographical origin) used in the production of the respective country-sector, in addition to the value added generated, and sums to the total value of output. Each row reflects where the output of each source country-sector (given in the first column) is used along intermediate or final consumption at home or abroad, and sums to the total value of output. Hence, the sum of each row equals the sum of each column.

		Country 1			Country 2			---	Country 1			Country 2			---	Total use of output
		Sector 1	Sector 2	---	Sector 1	Sector 2	---	---	Final consumption	Final consumption	---	Final consumption	Final consumption	---		
Country 1	Sector 1 Sector 2 ---	Use of domestic inputs			Use of foreign inputs					Final use of domestic products	Final use of exports of country 1 (imports country 2)				Sum of lines	
Country 2	Sector 1 Sector 2 ---	Use of foreign inputs			Use of domestic inputs					Final use of exports of country 2 (imports country 1)	Final use of domestic products					
---	---	---	---	---	---	---	---		---	---			---			
	Value added	Use of primary inputs			Use of primary inputs					Final use of primary inputs	Final use of primary inputs					
	Gross output	Sum of columns			Sum of columns											

FIGURE 2: Structure of a global input-output table

Source: The illustration is based on Chart 3 in Amador and Stehrer (2014).

3. Final demand is the sum of final consumption expenditure by households, final consumption expenditure by non-profit organisations serving households, gross fixed capital formation, changes in inventories and valuables, and final consumption expenditure by the government.

Gross exports								
Domestic content						Foreign content		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
DVA in final goods exports	DVA in intermediate exports processed and consumed by direct importer	DVA in intermediates processed and re-exported to third countries by direct importer	DVA in intermediates that returns via final imports	DVA in intermediates that returns via intermediate imports	Double-counted intermediate exports produced at home	FVA in final goods exports	FVA in intermediate goods exports	Double-counted intermediate exports produced abroad
Value-added exports						Backward participation		

FIGURE 3: Decomposition of gross exports

Notes: DVA is domestic value added. FVA is foreign value added. Value-added exports by a country equal (1) + (2) + (3); GDP in gross exports equals (1) + (2) + (3) + (4) + (5); Domestic content in a country's gross exports equals (1) + (2) + (3) + (4) + (5) + (6); Foreign content in a country's gross exports or backward participation equals (7) + (8) + (9); and (3) + (4) + (5) + (6) is part of forward participation; (6) and (9) are pure double-counted intermediates.

Source: The illustration is based on Figure 1 in Koopman et al. (2014).

Based on yearly global input-tables we can decompose gross exports into its contributions of value added from foreign and domestic sources. Domestic value added represents contributions from exports based on domestic inputs, while foreign value added reflects exports based on foreign inputs. Following the methodology in Koopman et al. (2014), we split these terms into nine categories based on the final use of a given export. In short, the authors provide a mathematical framework that decomposes gross exports with the purpose of tracing domestic and foreign value added, quantifying double-counted elements, and providing mathematical definitions of forward and backward vertical specialisation.⁴ Figure 3 maps the nine components and illustrates how they are used to establish measures of participation in GVCs. Below we focus on the components and measures most relevant for our analysis.

Value-added exports correspond to exports of domestic value added from the source country that is finally absorbed abroad, as defined in Johnson and Noguera (2012). Hence, the concept excludes value added that is initially exported by the home country and ultimately returned home for consumption after being processed abroad. Koopman et al. (2014) further decompose value-added exports into three groups according to where and how it is absorbed: (1) value added in exports of final goods that are consumed by the direct importer; (2) value added in intermediate exports used by the direct importer to produce

4. Koopman et al. (2014) integrate the former literature on vertical specialisation and the literature on value added. See Koopman et al. (2014) for a detailed step-by-step overview of their framework.

final goods that are consumed there; and (3) value added in intermediate exports used by the direct importer to produce final goods that are shipped to third countries. In general, gross exports exceed value-added exports because it contain returned domestic value added in imports and double-counted elements.

Koopman et al. (2014) provide indicators for the participation by an economy in GVCs based on their decomposition framework. *Forward participation* measures the share of domestic value added of a source country used by the direct importer to produce final exports to third countries. *Backward participation* is the share of foreign value added embodied in exports of the source country or the country-sector.⁵ These indicators are percentage shares in gross exports. A common approach to measure the *total participation* of an economy in GVCs is to sum the forward and backward participation.

2.3. Data

We base our analysis on the second edition of the World Input-Output Database (WIOD), which links national supply and use tables with bilateral trade data in goods and services to produce a unique global input-output table. The data builds on national official statistics, including 43 countries that cover 85 percent of world GDP (at current exchange rates) and a model for the rest of the world.⁶ A novelty of the second edition is that Norway has been included, and that services sectors have a more disaggregated breakdown level. The database covers the years 2000 to 2014, and it comprises 56 sectors of which 4 are primary, 19 are manufacturing, 27 are services and 3 are utilities. The sectors correspond to a sectoral breakdown of 2-digit ISIC revision 4 (Timmer et al. 2015; Timmer et al. 2016). Table 4 and 5 in the Appendix present the countries and sectors in the database.

The aggregate analysis in Section 3.1 is based on all 56 sectors in the economy, while the more disaggregated analysis in Section 3.2 excludes oil, mining, quarrying, utilities and activities of extraterritorial organisations (i.e., ISIC Rev. 4 Division 4, 24-26 and 56). In this section, we break down the economy into three broad sectors which are primary, manufacturing and services. These are defined according to ISIC Rev. 4 Division 1-3, 5-23 and 27-55, respectively. We continue by studying different types of services in Section 3.3. These are defined according to ISIC Rev. 4 with the grouped divisions in

5. Hummels et al. (2001) provide the first definition of backward participation or vertical specialisation grounded in an input-output framework. Koopman et al. (2014) develop their definition by adjusting for the back-and-forth trade of intermediates across multiple borders.

6. The WIOD includes 28 European Union (EU) countries and 15 other major economies: Australia, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Norway, Russia, South Korea, Switzerland, Taiwan, Turkey and the United States. In addition, a model for the remaining non-covered part of the world economy is estimated, called the “rest of the world” region, which constituted 9.1 of world trade in 2014 (Timmer et al., 2016).

paranthesis: Wholesale and retail (28-30), Transport and storage (31, 33-35), Water transport (32), Telecommunications (39), Computer and information (40), Finance and insurance (41-43) and Professional services (45-49).

The database includes trade in services that occurs through cross-border and consumption abroad.⁷ It is important to note that the input-output tables do not capture all services that are relevant to fragmented production processes (Heuser and Mattoo 2017). Mostly because the data does not include trade in services through commercial presence or investments, which WTO (2015) estimates to account for more than half of total world trade in services.⁸ Moreover, it is not possible to capture the contribution by services to global value chains when services inputs are provided in-house (Heuser and Mattoo 2017; Miroudot and Cadestin 2017). For Norway, it should be kept in mind that mining support service activities are explicitly included in the Mining and quarrying sector. Thus, activities that should ideally be classified as services output are instead reflected in this sector. As a result, estimates of value-added trade in services by Norway are likely to be underestimated.

7. International trade in services is classified into four modes of supply by the General Agreement on Trade on Services (GATS): Cross-border supply; Consumption abroad; Commercial presence; and Presence of natural persons.

8. The WTO (2015) estimates that GATS mode 1,2,3 and 4 account for respectively 30, 10, 55 and 5 percent of world trade in service, in 2014.

3. Results: Norwegian exports in global value chains

3.1. The total economy

We start by analysing Norway’s aggregate exports, which include exports from all sectors of the economy. Following the decomposition framework in Koopman et al. (2014), Table 1 demonstrates the percentage shares of domestic and foreign value added as well as double-counted components in Norway’s gross exports. The share of domestic value added in total gross exports fell from 86.6 percent in 2000 to 83.0 percent in 2014, primarily due to a decrease in domestic value added in products directly consumed as final goods by the importer (from 17.1 to 12.0 %). The three first components of domestic value added in Table 1 sum to value-added exports, which decreased from 86.2 to 82.5 percent of gross exports from 2000 to 2014. The foreign value added in Norway’s gross exports grew only slightly, from 9.1 to 10.9 percent, and is mostly explained by an increase in foreign intermediate inputs. Double-counted components rose from 4.3 to 6.2 percent due to an increase in double-counted foreign intermediates. In sum, the decomposition of gross exports shows that Norway has a substantially higher share of domestic rather than foreign value added in production and exports. Although, there has been a decrease in domestic value and a rise in foreign value embodied in gross exports.

The decomposition of gross exports reflects that Norway’s participation in global value chains (GVCs) primarily occurs through forward industrial linkages, which is common for a country rich in natural resources. For the Norwegian economy, this characteristic particularly reflects the large presence by the oil industry but also resource-based industries such as fishing, metals and forestry. We observe the forward and backward participation in GVCs in Figure 4. Panel (A) illustrates how the share of domestically produced inputs used by importing countries to produce exports to third countries (i.e., forward

	2000	2005	2007	2009	2012	2014
(1) DVA in final goods exports	17.1	14.4	14.5	14.7	12.5	12.0
(2) DVA in intermediate exports processed and consumed by direct importer	57.3	58.5	55.7	56.6	57.1	58.1
(3) DVA in intermediates processed and re-exported to third countries by direct importer	11.8	12.6	12.9	12.4	14.0	12.3
Value-added exports (1) to (3)	86.2	85.4	83.1	83.7	83.6	82.5
(4) DVA in intermediates that returns via final imports	0.2	0.2	0.2	0.2	0.2	0.2
(5) DVA in intermediates that returns via intermediate imports	0.2	0.3	0.3	0.3	0.3	0.3
(6) Double-counted intermediate exports produced at home	0.2	0.2	0.3	0.2	0.3	0.2
Domestic content (1) to (6)	86.9	86.1	83.9	84.4	84.5	83.2
DVA in gross exports (1) to (5)	86.6	85.8	83.6	84.2	84.2	83.0
(7) FVA in final goods exports	3.9	3.6	3.8	4.0	3.5	3.6
(8) FVA in intermediate goods exports	5.2	5.6	6.4	6.4	6.3	7.3
(9) Double-counted intermediate exports produced abroad	4.0	4.7	5.8	5.2	5.6	5.9
FVA in gross exports (7) and (8)	9.1	9.2	10.2	10.4	9.9	10.9
Backward participation (7) to (9)	13.1	13.9	16.1	15.6	15.5	16.8
Pure double-counted terms (6) and (9)	4.3	5.0	6.1	5.4	5.9	6.2
Sum (1) to (9)	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 1. Decomposition of total gross exports, 2000-2014

Notes: DVA is domestic value added. FVA is foreign value added. Table 6 in the Appendix presents the same information for 2000-2014.

Source: Author’s calculations based on the WIOD 2000-2014.

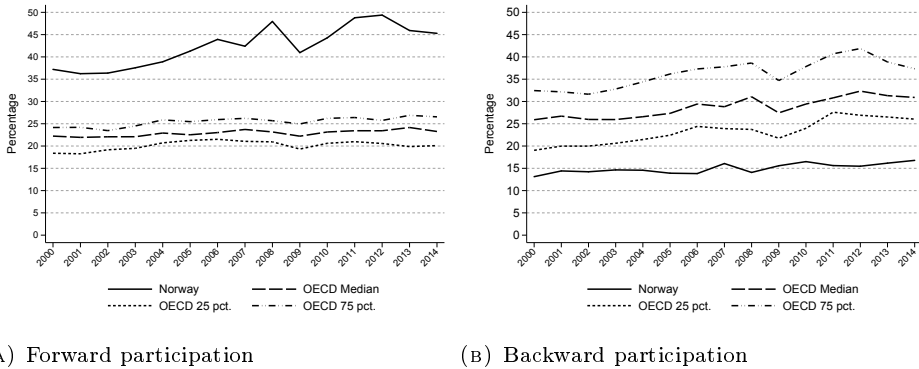


FIGURE 4: Participation in global value chains, 2000-2014

Notes: Forward and backward participation are expressed as percentage shares in total gross exports.

Source: Author's calculations based on the WIOD 2000-2014.

participation) grew from 37.2 to 45.3 percent from 2000 to 2014. The dynamics of the forward participation is likely to have been affected by the oil price changes during the period analysed. The price grew strongly until its collapse in the end of 2008, and it has remained relatively high since 2011. Panel (B) documents that participation through backward industrial linkages (i.e., backward participation) became stronger as the share of foreign inputs in gross exports grew from 13.1 to 16.8 percent in the same period. In comparison to OECD countries for which the median, upper and lower quartiles are indicated in both panels, Norway has a much higher forward participation but lower backward participation. Figure 4 also reflects the collapse in world trade in 2008-2009. This is particularly evident for the backward participation by OECD countries, while it remained quite stable for the Norwegian economy.

Figure 5 shows forward, backward and total participation by all countries in the database. We observe that most countries have a higher backward than forward participation in GVCs, while the opposite pattern applies to countries specialised in commodities such as Norway, Russia and Australia. In sum, the total participation index suggests that Norway's integration into GVCs grew from 50.3 to 62.1 percent from 2000 to 2014. However, backward participation by the Norwegian economy is one of the lowest among all countries.

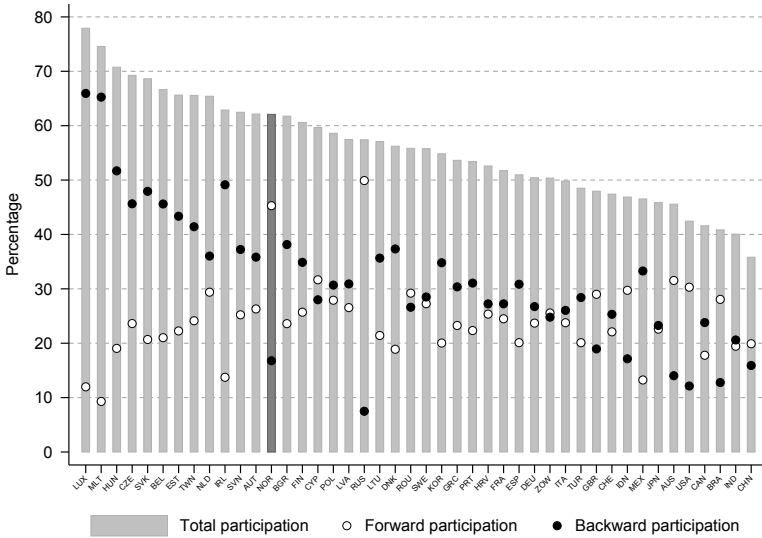


FIGURE 5: Participation in global value chains, 2014

Notes: Total, forward and backward participation are expressed as percentage shares in total gross exports.
Source: Author's calculations based on the WIOD 2000-2014.

3.2. Comparing the primary, manufacturing and services sectors

Important results appear when aggregating the economy into the three broad sectors primary, services and manufacturing. The primary sector includes agriculture, forestry and fishing, the service sector covers both construction, distribution, transport, telecommunications, financial and professional services, and the manufacturing sector includes traded goods from industrial production.⁹ Oil related activity is excluded in the following figures (i.e., the Mineral and quarrying sector) in order to focus on the other economic activities in the Norwegian economy.

Figure 6 demonstrates the development in gross and value-added exports in the three broad sectors from 2000 to 2014, and two notable results appear. Firstly, value-added exports of services are above gross exports of services during the whole period, whilst the opposite result applies to the manufacturing sector. Secondly, trade in services exceeds manufacturing trade when measured in value-added terms. The fall in manufacturing exports when using value-added rather than gross term measurement, reflects that the first method reallocates value added originating from services into the service sector itself

9. See detailed definition of the broad sectors in Section 2.3.

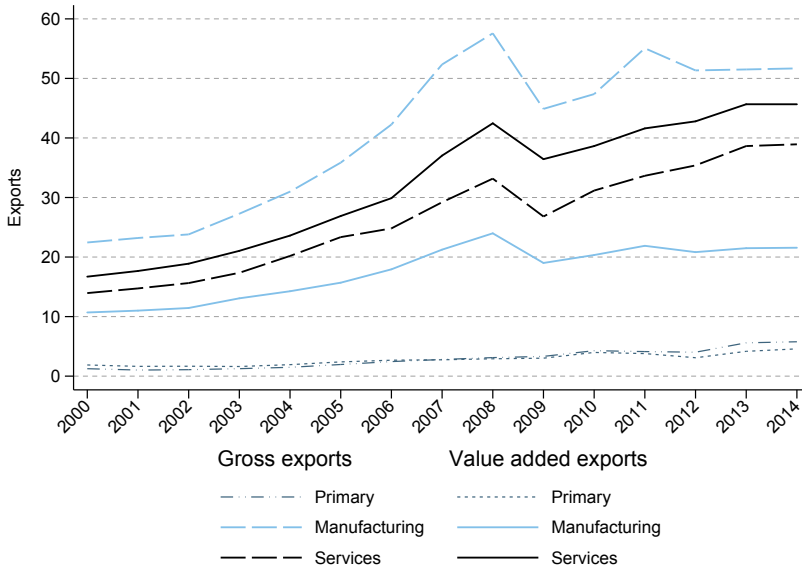


FIGURE 6: Value-added and gross exports, 2000-2014

Notes: Exports are in billion current US dollars.

Source: Author's calculations based on the WIOD 2000-2014.

rather than as output in the manufacturing sector. The large difference between gross and value-added exports does not apply to the primary sector, in contrast, gross exports by this sector have exceeded value-added exports since 2008. This can be explained by the significant and increasing use of vegetable feed such as corn, wheat and soya in the aquaculture industry, for instance, two thirds of the raw inputs in the feed used in the salmon and trout production were from vegetable sources in 2015 (Melchior 2015). This causes the gross production to exceed the value-added production in the aquaculture industry.

A fall in Norway's trade of both manufacturing and services took place in the crisis years 2008-2009, but picked up again already in 2009-2011. However, exports have stagnated for manufacturing since 2011 while services exports have continued to expand. These trends apply to both gross and value-added exports. These patterns are in line with developments in total world trade, where trade in goods collapsed dramatically in 2008-2009, but services such as business, telecommunications and finance continued its upward trend and only transport services declined (IMF 2016; Borchert and Mattoo 2009). In this context, Timmer et al. (2016) show that a high demand for trade intensive products such as manufactured goods and continuous international production fragmentation drove the growth in world trade until 2008, but that the global demand shifted towards products with low import intensity such as services

after the crisis. In accordance, Ariu (2016) finds that services exports are less sensitive to income shocks in destination countries than goods.

We further assess the share of foreign inputs in gross exports by the primary, manufacturing and services sectors in Table 2. Overall, the backward participation in GVCs grew for these sectors from 2000 to 2014, with some exceptions for services and manufacturing in the past crisis years. Manufacturing has the largest content of foreign value added, amounting to 28.2 percent in 2014. This share was 22.9 percent for services. Both sectors had a 2-3 percentage points increase from 2000 to 2014. The primary sector stands out as its share of foreign inputs increased strongly from 12.8 to 17.0 percent during this period, which is mostly explained by the significant and growing use of imported vegetable feed in the aquaculture industry during the 2000s (Melchior 2015).

	Primary	Manufacturing	Services
2000	12.8	25.9	20.0
2005	13.4	28.3	23.0
2007	16.4	31.0	22.6
2009	17.2	27.7	20.1
2012	19.8	28.0	25.1
2014	17.0	28.2	22.9

TABLE 2. Foreign value added in gross exports, 2000-2014

Notes: The numbers give the percentage share of foreign inputs in the respective sectors' total gross exports.
Source: Author's calculations based on the WIOD 2000-2014.

Dynamics in the sectors' forward integration into GVCs are evaluated by how the composition of value-added exports has changed over time. Figure 7 decomposes value-added exports into three components of domestic value added according to how and where it is finally absorbed.¹⁰ The size of each component reflects its percentage share in total value-added exports by the primary, manufacturing or service sector. We observe that domestic value added in intermediate exports processed and consumed in the direct importer is the largest component for both manufactured goods and services, amounting to 50.3 and 64.7 percent in 2014. However, the share increased by about 10 percentage points from 2000 to 2014 for services while it remained almost unchanged for manufactured goods. The higher importance of such intermediate services is in line with the findings in Francois et al. (2015), which point towards an increased role of services as inputs in global production and trade. Furthermore, the primary sector experienced a strong increase in the share of intermediate exports absorbed directly by the importer from 2000 to 2014, but domestic value added in final goods remained the biggest component.

10. See Section 2.2 for the definition.

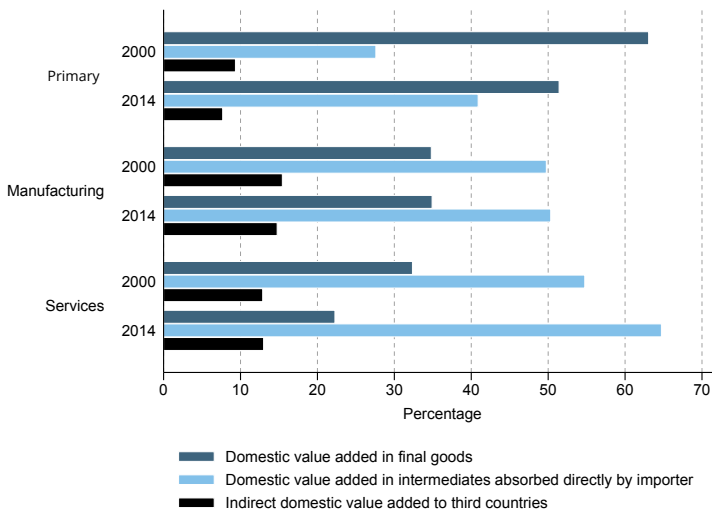


FIGURE 7: Decomposition of value-added exports

Notes: The bars give the percentage share of each component of value-added exports in the respective sectors' total value-added exports. Thus, the three bars for each sector-year combination sum to 100.

Source: Author's calculations based on the WIOD 2000-2014.

The third component, indirect domestic value added to third countries, works as a measure of the likely length of a GVC (Aslam et al. 2017). Intuitively, if a country exports intermediate inputs that are re-exported to third countries it participates in longer value chains. For Norway, the share of this component in each broad sector has remained stable during the 2000-2014 period.

We have observed that the role of services as linkages and inputs is stronger when assessing value added in trade rather than conventional gross trade measures. We develop the analysis in Section 3.3 by assessing what types of services are relevant and how they participate in GVCs.

3.3. Services in global value chains

This section assesses what types of services are relevant for Norway's participation in GVCs. We start by presenting value-added exports by the different services sectors and their use of foreign inputs. Then we evaluate how domestic and foreign inputs of services are embodied in total gross exports and manufacturing gross exports, thereby highlighting Norway's indirect exports of services. We use a more disaggregated services classification in order to identify whether there are differences across types of services. These are Wholesale and

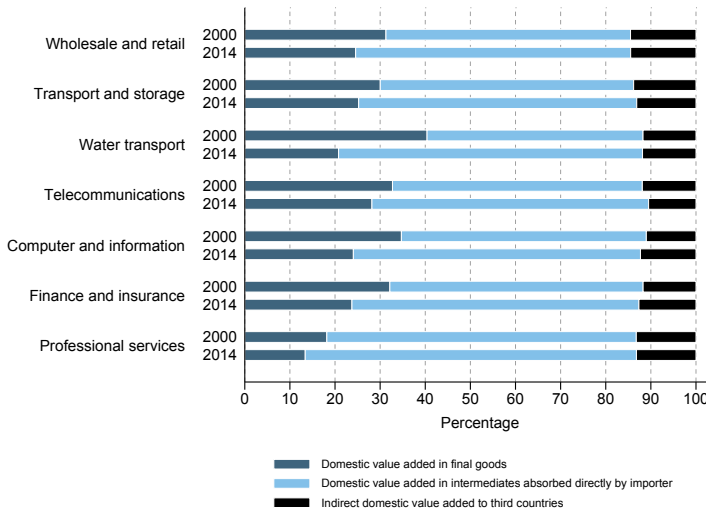


FIGURE 8: Decomposition of services value-added exports, 2000 and 2014

Notes: The bars give the percentage share of each component of value-added exports in the respective sectors' total value-added exports.

Source: Author's calculations based on the WIOD 2000-2014.

retail, Transport and storage, Water transport, Telecommunications, Computer and information, Finance and insurance, and Professional services.¹¹

In Figure 8 we start by decomposing value-added exports into three components according to how and where it is finally absorbed.¹² The main result is that domestic value added in intermediates absorbed directly by the importer is the largest component across all services types, and its relevance grew from 2000 to 2014. This component particularly grew for water transport, amounting to an increase by 19.5 percentage points. Computer and information follows with 9.4 percentage points, and finance and insurance with 7.5 percentage points. Professional services had the largest share of this component in both 2000 and 2014, amounting to around 70 percent. Hence, as highlighted in the previous section, there is a growing importance of intermediate services exports relative to exports of final services. In other words, the different services types increasingly participate in GVCs through forward industrial linkages.

We further assess the share of foreign value added, both goods and services inputs, across services types in Table 3. The share rose in all sectors from 2000

11. See detailed definition of the types of services in Section 2.3.

12. See Section 2.2 for the definition.

	2000	2005	2007	2009	2012	2014
Wholesale and retail	11.3	11.5	11.2	11.9	13.0	14.1
Transport and storage	16.2	16.8	17.3	19.3	24.3	25.5
Water transport	24.5	32.2	32.1	27.3	35.1	31.7
Telecommunications	15.4	12.2	13.5	15.2	13.2	13.8
Computer and information	10.6	8.9	9.3	9.7	11.5	11.9
Finance and insurance	5.9	6.0	6.2	5.8	8.6	8.4
Professional services	15.8	13.2	13.9	14.4	15.8	16.4

TABLE 3. Foreign value added in service sectors, 2000-2014

Notes: The numbers give the percentage share of foreign inputs in the respective sectors' total gross exports.
Source: Author's calculations based on the WIOD 2000-2014.

to 2014, particularly in transport both by land and water. It also grew quite strongly in wholesale and retail. The only exception is telecommunications of which the share fell from 2000 to 2014, but with ups and downs during the period. Overall, this suggests that most services sectors have increased their backward participation in GVCs, which potentially signals some development in GVCs of services themselves.

We turn to assess how services value added from domestic and foreign sources are embodied in gross exports in Figure 9, where domestic services value added is separated into direct and indirect value added. Direct services exports correspond to inputs of services embodied in exports by services sectors themselves, while indirect services exports refer to inputs of services embodied in exports by non-services sectors. Note that non-services sectors include the primary, also oil, and the manufacturing sector. The value-added content of services in gross exports grew significantly from 28.1 to 32.9 percent from 2000

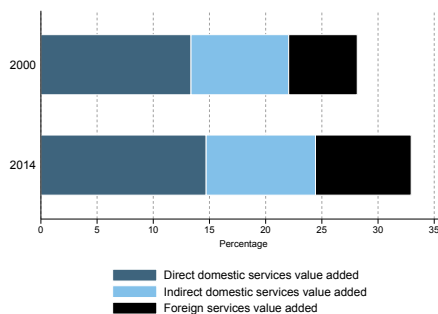


FIGURE 9: Services embodied in total gross exports, 2000 to 2014

Notes: The bars give the percentage share of the types of services value added in total gross exports. Services are defined as divisions 27-56 in the ISIC Rev. 4. Total exports include divisions 1-56, which is all sectors in the economy.

Source: Author's calculations based on the WIOD 2000-2014.

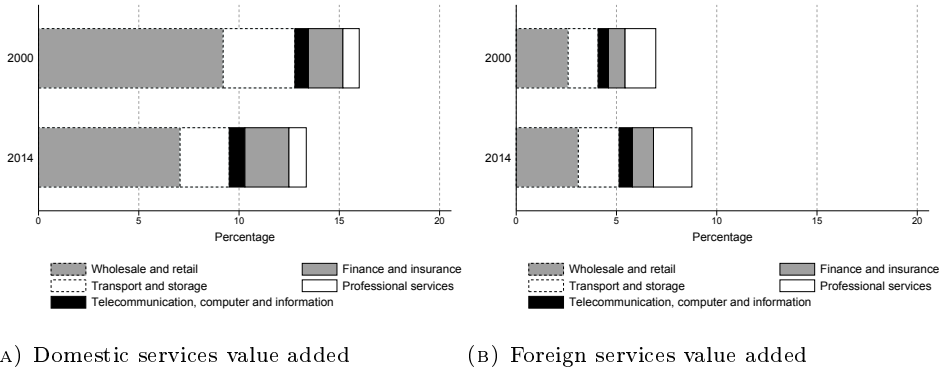


FIGURE 10: Services embodied in manufacturing gross exports, 2000 and 2014

Notes: The bars give the percentage share of domestic and foreign value added from the respective services sectors in total gross exports by the manufacturing sector.

Source: Author's calculations based on the WIOD 2000-2014.

to 2014, mostly driven by an increase in foreign services value added (from 6.1 to 8.5 %). Direct and indirect services value added both grew by around 1 percentage point (from 13.4 to 14.7 %; from 8.7 to 9.7 %).

We take a closer look at what kind of services are embodied in exports by the manufacturing sector in Figure 10, where Panel (A) and (B) report the use of domestic and foreign services inputs. A key result is that the share of domestic services value added decreased from 2000 to 2014, while the share of foreign services value added grew (from 21.1 to 18.9 %; from 9.7 to 12.0 %). This is in line with the general pattern that manufacturers are increasingly outsourcing services to foreign providers (Heuser and Mattoo 2017). Wholesale, retail and transport represent the largest sources of both domestic and foreign services value added, and the relevance of foreign providers of these services grew from 2000 to 2014. Overall, this highlights that services are important in the distribution and logistics of manufacturing production. Moreover, the relevance of financial services has increased on the domestic side, while there has been an increase in the sourcing of professional services from abroad. For these estimates, it should be kept in mind that outsourcing of services can occur between divisions at home and abroad within the same international company. Transactions are then potentially subject to transfer pricing, and this could imply measurement error in the traded values.

4. Conclusion

This analysis presents new insights regarding Norway's trade in value added and participation in global value chains (GVCs) during 2000-2014. We use the decomposition framework in Koopman et al. (2014) to decompose gross exports into value added by origin and to establish measures of participation in GVCs. We emphasize differences between sectors of services and goods, and assess what types of services are relevant and how they participate in GVCs.

We arrive at some key results. Firstly, Norway's total participation in GVCs has been increasing strongly, with forward linkages (i.e. domestically produced inputs used by importing countries to produce exports to third countries) being stronger than backward linkages (i.e. foreign inputs in gross exports). This is a common feature for countries rich in natural resources. Though both forward and backward participation grew during the period analysed. Secondly, trade in services is larger than trade in manufactured goods if measured in value-added terms rather than gross terms. Thirdly, domestic value added in exports of intermediates absorbed directly by the importer has increased for services, which suggests that services have been increasing their participation in GVCs through forward industrial linkages. Fourthly, the share of foreign inputs of both goods and services has increased in most services sectors (i.e. their backward participation), which potentially signals some development in GVCs of services itself. Fifthly, the relevance of foreign services inputs embodied in manufacturing exports has increased, reflecting that more manufacturers are outsourcing services to providers abroad.

The results are relevant for policy-makers and trade policy. On one hand, the emergence of GVCs introduces new challenges to policy-makers as it contributes to increased structural interdependence in the world economy, which has implications of how an individual country is hit by economic shocks or implementation of external trade policy. Therefore, a correct understanding of the integration and positioning of an economy in GVCs is crucial to maximize the benefits from international trade and to correctly shape trade policy. On the other hand, the key role of services in GVCs implies that they are important in determining the competitiveness of a country. This points towards the need of facilitating trade in services through regulatory harmonisation. In fact, services are critical to the overall cost structure and performance of an economy since inputs of services are increasingly embodied in production and exports of services and particularly goods.

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5. Appendix

Nr.	Industry	Description
1	A01	Crop and animal production, hunting and related service activities
2	A02	Forestry and logging
3	A03	Fishing and aquaculture
4	B	Mining and quarrying
5	C10-C12	Manufacture of food products, beverages and tobacco products
6	C13-C15	Manufacture of textiles, wearing apparel and leather products
7	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
8	C17	Manufacture of paper and paper products
9	C18	Printing and reproduction of recorded media
10	C19	Manufacture of coke and refined petroleum products
11	C20	Manufacture of chemicals and chemical products
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
13	C22	Manufacture of rubber and plastic products
14	C23	Manufacture of other non-metallic mineral products
15	C24	Manufacture of basic metals
16	C25	Manufacture of fabricated metal products, except machinery and equipment
17	C26	Manufacture of computer, electronic and optical products
18	C27	Manufacture of electrical equipment
19	C28	Manufacture of machinery and equipment n.e.c.
20	C29	Manufacture of motor vehicles, trailers and semi-trailers
21	C30	Manufacture of other transport equipment
22	C31_C32	Manufacture of furniture; other manufacturing
23	C33	Repair and installation of machinery and equipment
24	D35	Electricity, gas, steam and air conditioning supply
25	E36	Water collection, treatment and supply
26	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
27	F	Construction
28	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
29	G46	Wholesale trade, except of motor vehicles and motorcycles
30	G47	Retail trade, except of motor vehicles and motorcycles
31	H49	Land transport and transport via pipelines
32	H50	Water transport
33	H51	Air transport
34	H52	Warehousing and support activities for transportation
35	H53	Postal and courier activities
36	I	Accommodation and food service activities
37	J58	Publishing activities
38	J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
39	J61	Telecommunications
40	J62_J63	Computer programming, consultancy and related activities; information service activities
41	K04	Financial service activities, except insurance and pension funding
42	K05	Insurance, reinsurance and pension funding, except compulsory social security
43	K06	Activities auxiliary to financial services and insurance activities
44	L68	Real estate activities
45	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
46	M71	Architectural and engineering activities; technical testing and analysis
47	M72	Scientific research and development
48	M73	Advertising and market research
49	M74_M75	Other professional, scientific and technical activities; veterinary activities
50	N	Administrative and support service activities
51	O84	Public administration and defence; compulsory social security
52	P85	Education
53	Q	Human health and social work activities
54	R_S	Other service activities
55	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
56	U	Activities of extraterritorial organizations and bodies

TABLE 4. Divisions or sectors in the WIOD 2000-2014, according to ISIC Rev. 4

Notes: The aggregated sectors primary, manufacturing and services are defined according to ISIC Rev. 4 Divisions 1-3, 5-23, 27-55, respectively. The disaggregated services types are defined as Wholesale and retail (28-30), Transport and storage (31,33-35), Water transport (32), Telecommunications (39), Computer and information (40), Finance and insurance (41-43), and Professional services (45-49).

Nr.	Country	Description	Nr.	Country	Description
1	AUS	Australia	23	IRL	Ireland
2	AUT	Austria	24	ITA	Italy
3	BEL	Belgium	25	JPN	Japan
4	BGR	Bulgaria	26	KOR	Korea
5	BRA	Brazil	27	LTU	Lithuania
6	CAN	Canada	28	LUX	Luxembourg
7	CHE	Switzerland	29	LVA	Latvia
8	CHN	China	30	MEX	Mexico
9	CYP	Cyprus	31	MLT	Malta
10	CZE	Czech Republic	32	NLD	Netherland
11	DEU	Germany	33	NOR	Norway
12	DNK	Denmark	34	POL	Poland
13	ESP	Spain	35	PRT	Portugal
14	EST	Estonia	36	ROU	Romania
15	FIN	Finland	37	RUS	Russia
16	FRA	France	38	SVK	Slovak Republic
17	GBR	United Kingdom	39	SVN	Slovenia
18	GRC	Greece	40	SWE	Sweden
19	HRV	Croatia	41	TUR	Turkey
20	HUN	Hungary	42	TWN	Taiwan
21	IDN	Indonesia	43	USA	United States
22	IND	India	44	ROW	Rest of World

TABLE 5. Countries in the WIOD 2000-2014

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(1) Domestic VA in direct final goods	17.1	19.0	18.1	16.6	15.6	14.4	13.7	14.5	13.1	14.7	13.9	11.7	12.5	11.0	12.0
(2) Domestic VA in intermediates to direct importer	57.3	54.0	55.1	56.2	57.0	58.5	58.3	55.7	58.1	56.6	55.8	57.9	57.1	59.5	58.1
(3) Indirect VA exports to third countries	11.8	11.8	11.8	11.9	12.1	12.6	13.4	12.9	13.9	12.4	12.9	13.9	14.0	12.4	12.3
Value-added exports (1) to (3)	86.2	84.9	85.1	84.7	84.7	85.4	85.4	83.1	85.0	83.7	82.6	83.5	83.6	82.9	82.5
(4) Returned domestic VA in final goods	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.4	0.3	0.2	0.3	0.2
(5) Returned domestic VA in intermediate goods	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
(6) Pure double-counted returned intermediates	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.2
Domestic content (1) to (6)	86.9	85.6	85.8	85.3	85.4	86.1	86.2	83.9	85.9	84.4	83.5	84.4	84.5	83.8	83.2
Domestic VA in gross exports (1) to (5)	86.6	85.3	85.6	85.1	85.2	85.8	85.9	83.6	85.6	84.2	83.2	84.2	84.2	83.5	83.0
(7) Foreign VA in final goods	3.9	4.6	4.3	4.0	3.7	3.6	3.6	3.8	3.6	4.0	3.8	3.4	3.5	3.4	3.6
(8) Foreign VA in intermediate goods	5.2	5.5	5.5	5.9	5.9	5.6	5.4	6.4	5.4	6.4	6.9	6.4	6.3	7.1	7.3
(9) Pure double-counted foreign intermediates	4.0	4.3	4.4	4.7	4.9	4.7	4.8	5.8	5.1	5.2	5.7	5.8	5.6	5.6	5.9
Foreign VA in gross exports (7) and (8)	9.1	10.1	9.9	9.9	9.6	9.2	9.0	10.2	9.0	10.4	10.8	9.8	9.9	10.5	10.9
Backward participation (7) to (9)	13.1	14.4	14.2	14.6	14.6	13.9	13.8	16.1	14.1	15.6	16.5	15.6	15.5	16.2	16.8
Pure double-counted terms (6) and (9)	4.3	4.6	4.6	4.9	5.2	5.0	5.1	6.1	5.3	5.4	6.0	6.0	5.9	6.0	6.2
Sum (1) to (9)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 6. Decomposition of gross exports, 2000-2014

Source: Author's calculations based on the WIOD 2000-2014.



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