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GLOBAL VALUE CHAINS

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RESUME

Endelige varer og tjenester er skabt via en kæde af processer, som tilfører produktet værdi. Værdikæder beskriver de processer, som virksomheder og arbejdere udfører for at producere en vare eller en tjeneste frem til, at den bliver til endeligt forbrug. Vi analyserer betydningen af globale værdikæder ved hjælp af World Input-Output Databasen, som indeholder data for køb og salg af produkter for 35 industrier i 40 lande. Særligt analyserer vi betydningen af globale værdikæder for dansk handel og beskæftigelse. Vi undersøger, gennem hvilke industrier dansk værditilvækst bliver eksporteret, og hvor det bliver endeligt forbrugt. Ydermere er vi i stand til at knytte dansk beskæftigelse til endeligt forbrug i udlandet. Vi finder, at andelen af udenlandsk værditilvækst i dansk eksport er steget drevet af en større andel af værditilvækst skabet uden for euroområdet. Fremstillingsindustrierne spiller en nøglerolle i forhold til eksport af dansk værditilvækst, og mere dansk værditilvækst ender som endeligt forbrug i USA, Storbritannien og Kina, end hvad adelen af dansk eksport til disse lande indikerer. Endvidere finder vi, at et betydeligt antal danske job i både eksport-orienterede og hjemmemarkeds-orienterede industrier kan henføres til eksport, og at endeligt forbrug i Kina har fået større betydning for den danske beskæftigelse, mens endelig forbrug i Tyskland har fået mindre.

ABSTRACT

A final product is created through a chain of activities that add value to the product. Value chains describe the range of activities firms and workers perform to produce a product or service from its foundation to final use. Using the World Input-Output Database containing data on sales and purchases for 35 industries in 40 countries, we analyse the importance of global value chains. In particular, we analyse the importance of global value chains for Danish trade and employment. We track through which industries Danish value added is exported and where it is finally consumed. We are furthermore able to link Danish employment to final consumption in partner countries. We find that the share of foreign value added in Danish exports has increased mainly driven by a larger share of value added created outside the euro area. The manufacturing industries play a key role in exporting Danish value added and more Danish value added end up being consumed in the United States, the United Kingdom and China than indicated by the share of Danish gross export to these countries. We furthermore find that a significant number of Danish jobs in both exporting and domestic market-oriented industries can be ascribed to exports, and that final consumption in China has become increasing important to Danish employment, while the importance of German final consumption has declined.

1. INTRODUCTION

Value chains describe the range of activities which firms and workers perform in order to produce a product or service from its foundation to final use. The value chain activities include everything from design, production, marketing, distribution until the product reaches the final consumer. The activities in the value chains can all be done by a single firm or distributed between different firms. As technological progress advances and the cost of transportation and communication falls, the possibilities of international trade with both final and intermediate goods and services have improved. This allows firms to further optimize production by locating various production stages across different locations. Hence, production has now changed from being concentrated in one location or firm, to a global restructuring of operations, e.g. through outsourcing and offshoring of firm activities. Firms compete to enter at different stages of the global value chains. This has made the production process even more complex. Using input-output tables for analysis of global value chains it is possible to track in what countries and industries value is added to a product.

We add to the literature by analysing the importance of global value chains to Danish trade and employment. We investigate how much of the value of the Danish exports that is created in Denmark and abroad respectively. Due to global value chains, value created in one country can be used as intermediate inputs in another country and end up as final consumption in a third country. Many trade analyses focus on gross exports and imports between countries. However, using input-output tables it is possible to shift the focus from gross trade flows to trade in value added. Value added created in one country can be tracked through the global value chains to where it is finally consumed. Thereby it is possible to analyse and quantify the importance of final demand in different partner countries to e.g. Danish production. This approach gives a more adequate representation of how creation of Danish value added is related to final demand in partner countries than traditional trade statistics. Linking employment to production it is furthermore possible to analyse the importance of global value chains to Danish employment. We investigate in what industries jobs dependent on exports are located and the importance of final demand in partner countries to Danish employment. This can be useful for analyses of how trends in final consumption in partner countries are likely to affect Danish employment.

We find that the importance of global value chains has increased and resulted in a larger share of foreign value added in Danish exports. This is mainly driven by a larger share of value added created outside the euro area. The manufacturing industries play a key role in exporting Danish value added and more Danish value added end up being consumed in the United States, the United Kingdom and China than indicated by the share of Danish gross export to these countries. We furthermore find that a significant number of Danish jobs in both exporting and domestic market-oriented industries are linked to exports, and that final consumption in China has become increasing important to Danish employment, while the importance of German final consumption has declined.

The remainder of this paper is structured as follows. The next section provides a description of the database used and section 3 introduces the theory of input output table analysis. In section 4 and 5 we analyse the importance of global value chains for trade and foreign value added in exports. In section 6 we analyse how Danish value added end up as exports and in section 7 we track the exported value added to where it is finally consumed. Section 8 provides an analysis of the importance of global value chains to Danish employment and finally section 9 concludes.

2. THE WORLD INPUT-OUTPUT DATABASE

The World Input-Output Database (WIOD) contains annual data for 40 countries[1] for the period 1995 to 2011. In addition, the rest of the world is modelled as one economy. The database contains a world input-output table and a number of environmental and socioeconomic accounts. One of these accounts is employment. The input-output tables provide data on the value of the flow of production in 35 industries in each country in current prices denoted in USD. The production in each industry can either be exported as intermediate or final goods or enter into domestic demand for intermediate inputs in one of the 35 industries or final domestic consumption. The world input-output table is constructed using national supply-use tables, national accounts statistics and international trade statistics (see Timmer (2012) or Timmer et al. (2015)). An important difference between the world input-output table and national input-output tables is that use of products is broken down according to their origin.

3. THEORY

The production process can be captured by using input-output tables. The input-output tables describe the sale and purchase relationships between producers and consumers in an economy. The input-output table illustrates the flows of sales and production (final and intermediate) between different firms across industries and the flows from firms to final demand.

The industry columns of the input-output table specify the use of intermediate inputs in the production, which can be either imported or produced domestically, cf. Figure 1. The difference between the total value of output and the value of intermediate consumption is defined as value added created in the industry. The value added in each industry consists of the compensation for labour and capital services. The rows in the table specify the use of a product (intermediate or final). A product can either be used as an intermediate in the domestic production (intermediate use), as a final product for domestic use or it can be exported. Final use includes consumption by households and governments, gross fixed capital formation and changes in inventories and valuables. The sum of intermediate and final use is the total output of the economy. An important accounting identity in the input-output table is that the total output of the domestic industries is equal to the total use of domestic output.

[1] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, Canada, United States, Brazil, Mexico, China, India, Japan, South Korea, Australia, Taiwan, Turkey, Indonesia and Russia.

One country input-output table

Figure 1

	Industry	Final use			Total
Industry	Intermediate use of domestic input	Domestic final use	Export	=	Total Output
	Intermediate use of imports	Imported final use			
	+	=			
	Value Added	Total final use			
	=				
	Total Output				

When the production process expands across borders, the input-output table has to capture all flows of intermediate and final demand across industries and countries. Figure 2 shows the input-output table in a three-economy framework where the economies are named country A, country B and rest of the world. The use and supply from country A now enters as both domestic and foreign intermediate and final use (as indicated by the highlighted blue cells in Figure 2).

The difference between the national input-output table and the multi country input-output table is that the use of all products is now broken down by origin of both country and industry. The same as with the national input-output table, the columns of the multi country input-output table show the use of intermediate and final products, which is now broken down by country and industry of origin. The sum of intermediate inputs used in production and value-added equals the total output of each industry. The rows in multi country input-output table show how output from each industry in each country is distributed for intermediate and final use broken down by country and industry. The accounting identity also holds for the multi country input-output table, so that the total output of each country and industry (the columns) is equal to the total use of that country and industry (the rows).

Multi country input-output table

Figure 2

		Country A Intermediate Industries	Country B Intermediate Industries	Rest of World Intermediate Industries	Country A Final use	Country B Final use	Rest of World Final use	
Country A	**Industries**	Intermediate use of domestic output within industries in country A	Intermediate use by industries in country B from industries in country A	Intermediate use by industries in RoW from industries in country A	Final use of domestic output in country A	Final use in country B of exports from country A	Final use in RoW of exports from country A	Output in country A
Country B	**Industries**	Intermediate use by industries in country A from industries in country B	Intermediate use of domestic output within industries in country B	Intermediate use by industries in RoW from industries in country B	Final use in country A of exports from country B	Final use of domestic output in country B	Final use in RoW of exports from country B	Output in country B
Rest of World	**Industries**	Intermediate use by industries in country A from industries in RoW	Intermediate use by industries in country B from industries in RoW	Intermediate use of output within industries in RoW	Final use in country A of exports from RoW	Final use in country B of exports from RoW	Final use of output within RoW	Output in RoW
		Value Added in country A	Value Added in country B	Value Added in RoW				
		Output in country A	Output in country B	Output in RoW				

The World Input-Output Table (WIOT) is the result of adding more countries to the input-output table. The table captures all cross-border input, output, intermediate and final demand, and value added in the different industries. The total gross output must in equilibrium equal the sum of intermediate and final demand:

$$\underbrace{y_t}_{Total\ gross\ output} = \underbrace{A_t y_t}_{Intermediate\ demand} + \underbrace{f_t}_{final\ dmand} \tag{1}$$

$$\text{with} \quad A_t \equiv \begin{pmatrix} A_{11t} & A_{12t} & \cdots & A_{1Nt} \\ A_{21t} & A_{22t} & \cdots & A_{2Nt} \\ \vdots & \vdots & \ddots & \vdots \\ A_{N1t} & A_{N2t} & \cdots & A_{NNt} \end{pmatrix}, \quad y_t \equiv \begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{Nt} \end{pmatrix}, \quad \text{and} \quad f_t \equiv \begin{pmatrix} \sum_j f_{1jt} \\ \sum_j f_{2jt} \\ \vdots \\ \sum_j f_{Njt} \end{pmatrix}$$

The matrix A_t is referred to as the global matrix of intermediate input. It captures all within-country, cross-country, and cross-industry intermediate goods linkages at date t. The vector y_t captures all gross output for each country and industry and the matrix f_t captures all final demand, i.e. household and government consumption and gross capital formation. Rearranging Equation 1, we can write the output vector as:

$$y_t = (I - A_t)^{-1} f_t \tag{2}$$

The matrix $(I - A_t)^{-1} = L$ is known as the Leontief Inverse Matrix of the global input-output matrix. This matrix tells us how much output from each country and industry is required to

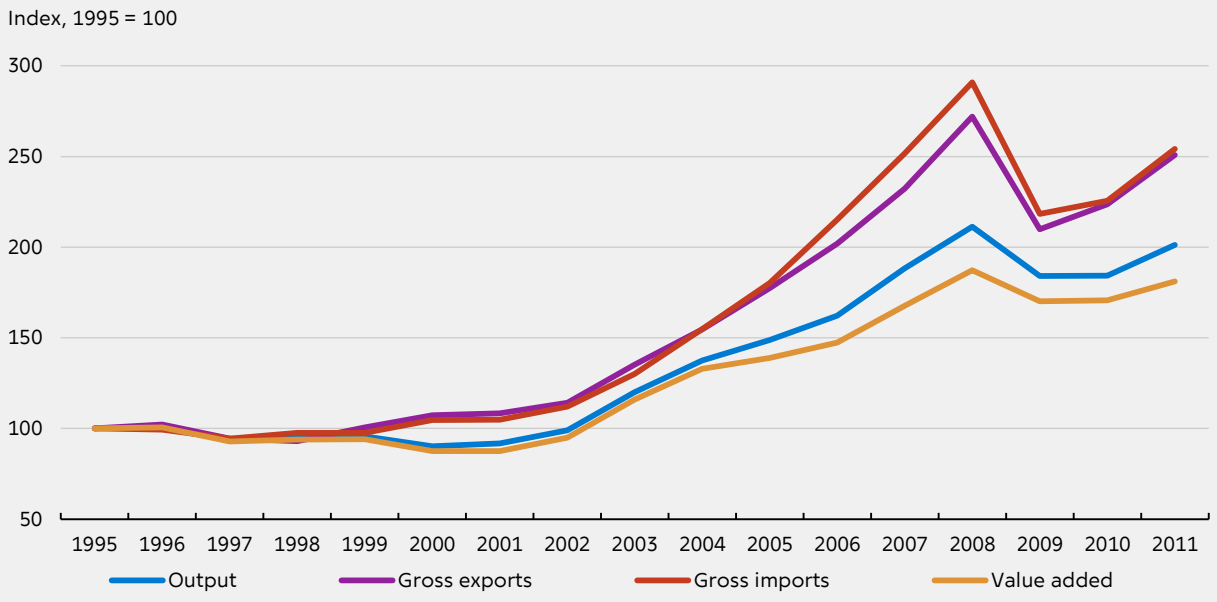
produce a given vector of final goods, where in this example the vector of final goods is the total world absorption of final goods, f_t. The gross output required to produce this amount of final goods includes the final goods themselves, but also all the intermediate goods and services required in the production. The calculations are explained in more details in Miller and Blair (2009).

In the production process, each industry requires intermediate inputs from other countries and industries to produce the final output, which is a sum of all intermediate inputs and value added in the industry. Hence, companies compete in adding value to the production process. Continuing internationalization and fragmentation of production implies that industries require more inputs from upstream intermediate activities in other countries and industries.

4. DEVELOPMENT OF OUTPUT, EXPORTS, IMPORTS AND VALUE ADDED

Since 1995 both Danish gross exports and gross imports have increased more than total output and value added. This can be interpreted as a consequence of increased specialisation in the economy cf. Chart 1.

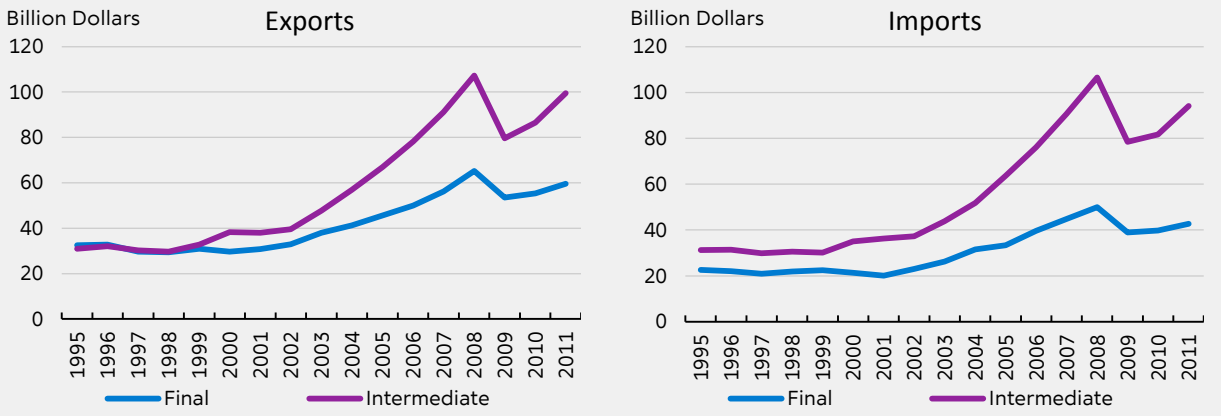
Development of Danish output, gross exports, gross imports and value added Chart 1



Note: The indexes are calculated using data denominated in USD.
Source: WIOD and own calculations.

The increase in imports and exports is due to higher demand for both final and intermediate goods, with the latter as the most important factor, cf. Chart 2 (left and right). This indicates that the expansion of global value chains has been an important driver behind the increase in trade. Over the period 1995-2011 the value of Danish exports and imports of final goods and services has doubled while the value of exports and imports of intermediates has tripled. The value of intermediate goods trade now exceeds by far the value of final good trade.

Value of Danish exports and imports Chart 2



Source: WIOD and own calculations.

5. FOREIGN AND DOMESTIC VALUE ADDED EMBODIED IN EXPORTS

Danish gross exports contain value added created in other countries which enters as intermediate inputs in the production. The WIOD holds information on the direct value added in each country and industry. Using this information, it is possible to calculate how much foreign value added is embodied in a country's exports. To do so we first need to calculate the value added coefficients defined as the share of value added created in an industry compared to total output of that industry. For a given country the value added coefficients, v, for each industry, i, can be calculates as:

$$v_i = \frac{Value\ added_i}{Gross\ output_i}, \quad i = 1, 2, 3, \ldots \tag{3}$$

Together with the Leontief Inverse Matrix, L, and the export vector, the total foreign value added embodied in the exports of country A can be calculated:

$$FVA^A = v^{-A} L x^A \tag{4}$$

where FVA^A is foreign value added embodied in exports of country A, v^{-A} is the row vector of value added coefficients for all industries in all countries other than country A and zeros for industries in country A. The vector x^A is the export column vector of country A of both intermediate and final goods. (For further details on the calculations see e.g. Foster-McGregor and Stehrer (2013)). The foreign value added in exports can be interpreted as a measure of vertical specialisation (see e.g. Stehrer and Stöllinger (2013)).

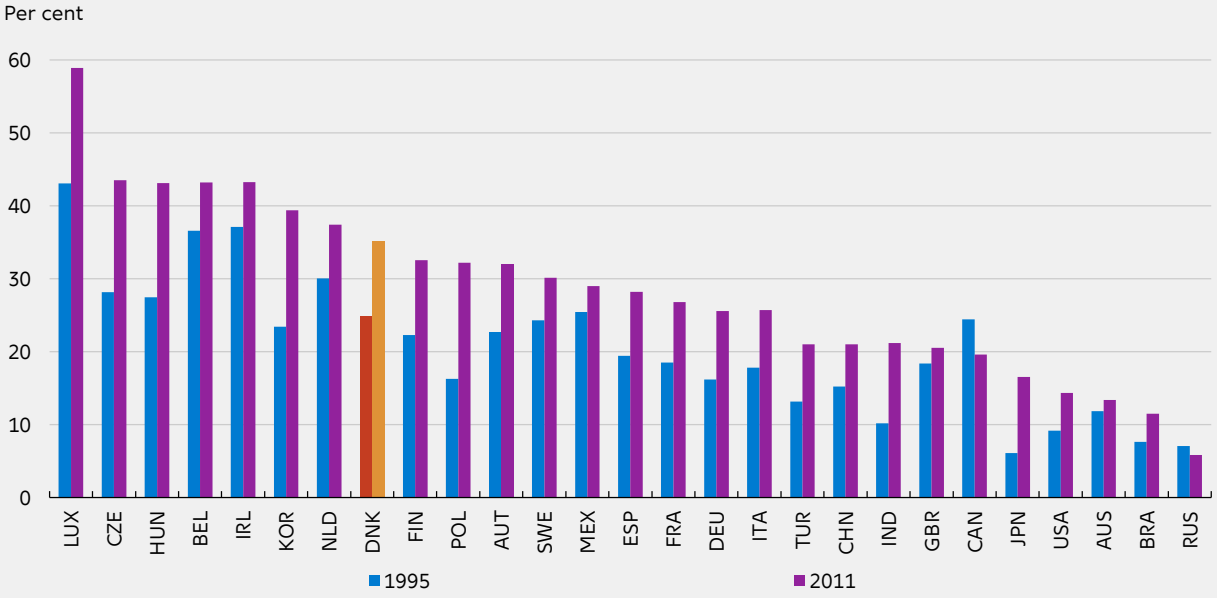
The vector of value added coefficients includes information for all countries and industries, which allows for both country and industry specific analysis. This allows us to calculate the foreign value added embodied in gross exports from a particular foreign country, simply by only using value added coefficients from that particular country:

$$FVA^{A,B} = v^B L x^A \tag{5}$$

where $FVA^{A,B}$ is the foreign value added from country B embodied in the exports of country A and v^B is the row vector of value added coefficients for the industries in country B and zeros otherwise.

As shown in the previous section trade of intermediate goods has become increasingly important, which has increased foreign value added in Danish exports. A similar development can be found for most other countries. However, the share of value added embodied in exports differs among countries, cf. Chart 3. Large economies tend to have a smaller share of foreign value added in their exports, possibly reflecting a larger domestic market for intermediate goods as the economy increases.

Foreign value added embodied in gross exports Chart 3



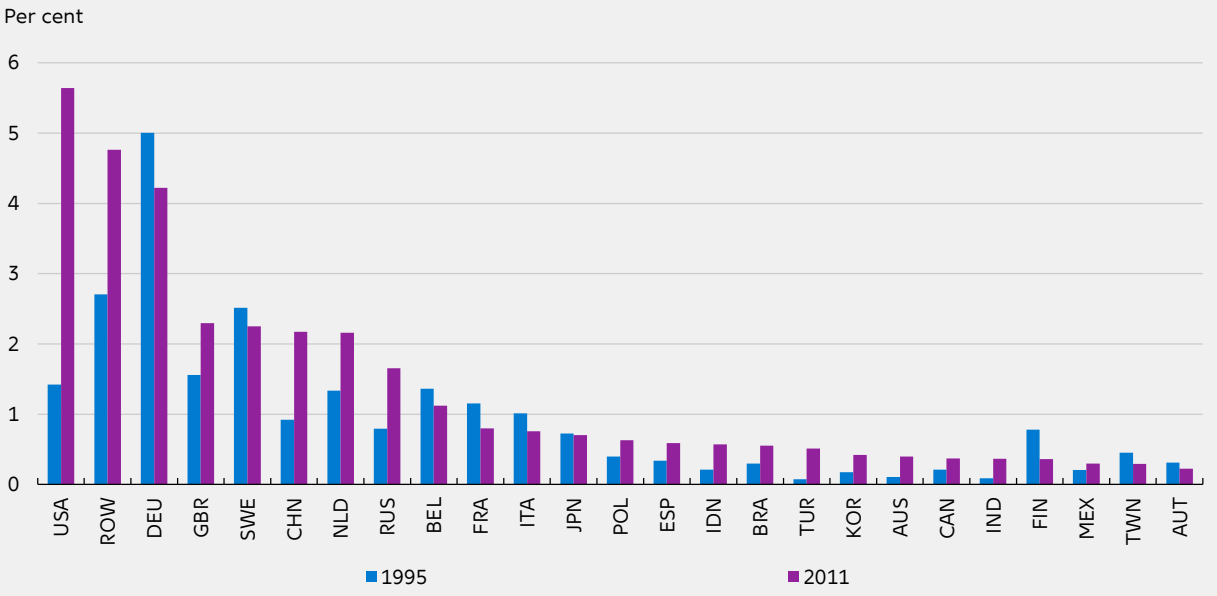
Note: An overview of the country codes can be found in appendix 1.
Source: WIOD and own calculations.

The increase in foreign value added in Danish exports is mainly driven by an increased use of intermediate inputs from outside the euro area, in particular the United States, China and rest of the world, cf. Chart 4. On the contrary, the share of Swedish and German value added in Danish exports has declined since 1995. The increased use of intermediates from markets further away could reflect lower transportation costs and better means of communication. Stehrer and Stöllinger (2013) find a similar development in Austria.

The increase in value added from the United States is particularly pronounced and the country is now the largest contributor to foreign value added in Danish exports. About half of the observed increase comes from the industry "Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies" and enters Danish export mainly through the Danish "Water Transport" industry. This includes services such as cargo handling and storage bought by Danish shipping companies.

Foreign value added embodied in Danish gross exports

Chart 4

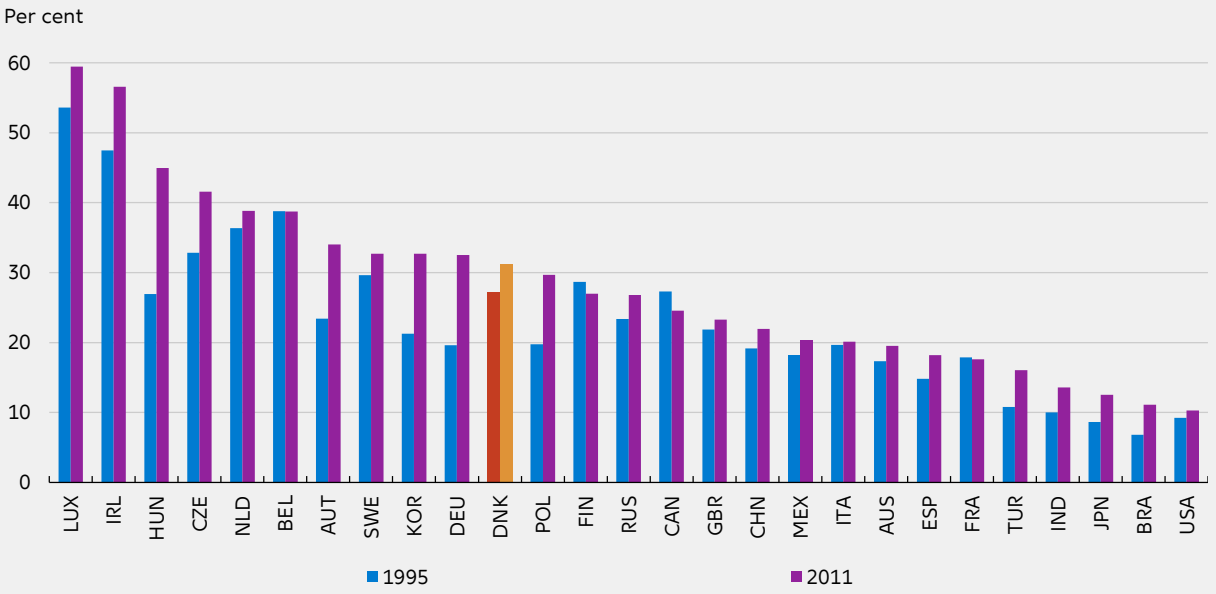


Note: The chart includes Denmark's 25 largest trade partners. The sum of the blue bars is almost 35 per cent which was the total share of foreign value added embodied in Danish exports in 2011, cf. Chart 3. If all trade partners were included the bars would sum up to the total share of foreign value added embodied in Danish exports. The sum of the purple bars is almost 25 per cent which was the total share of foreign value added embodied in Danish exports in 1995. An overview over the country codes can be found in appendix 1.

Source: WIOD and own calculations.

From 1995 to 2011 the share of Danish value added that is exported has gone up by 4 percentage points. Many other countries have had a similar development, cf. Chart 5.

Share of value added exported Chart 5



Note: An overview of the country codes can be found in appendix 1.
Source: WIOD and own calculations.

6. DOMESTIC VALUE CHAINS AND EXPORTS

Domestic value chains arise when industries use intermediate inputs produced within the same country. When products from one domestic industry are used as intermediates by another domestic industry, value added produced in the first industry is transferred into the latter industry's products. In this way, value added produced in one industry can end up as exports contained in products produced in other industries. As a result, total domestic value added in an industry's exports may exceed the value added created in the industry itself.

The share of domestic value added in an industry's exports gives an indication of how much it contributes to the exports of value added from the country. The domestic content of value added embodied in exports from Country A can be calculated as:

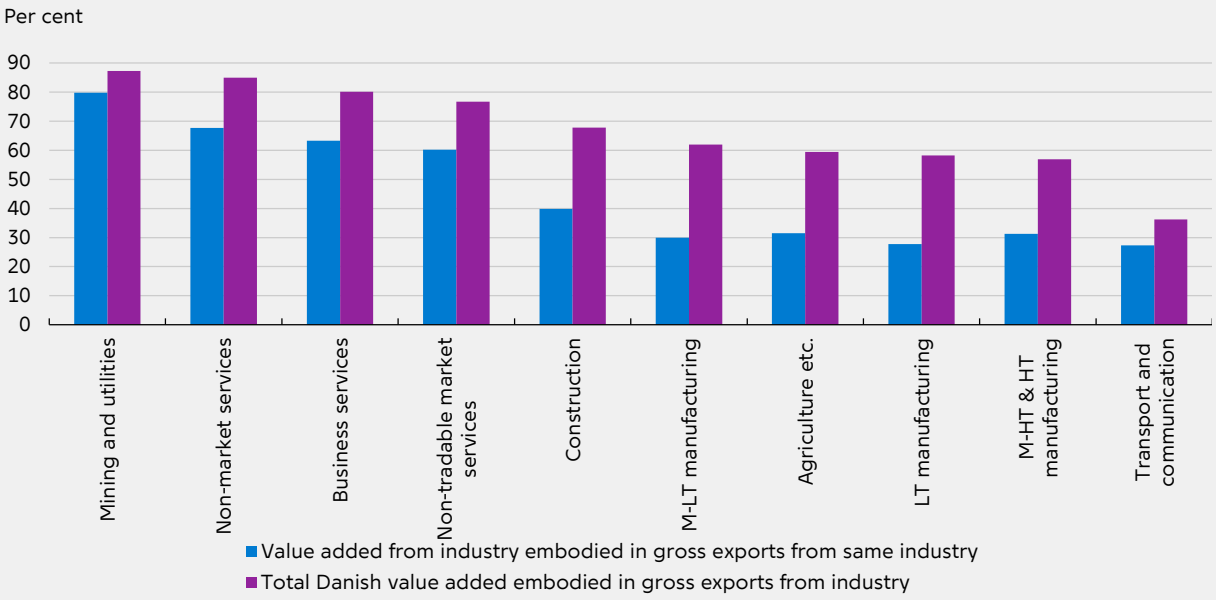
$$DVA^A = v^A L x^A \tag{6}$$

where and v^A is the row vector of value added coefficients for the industries in country A and zeros otherwise. To calculate the domestic content of a particular industry in country A v^A should only include the value added coefficient for that industry and zeros otherwise. The vector x^A is the export column vector of country A of both intermediate and final goods.

The share of value added embodied in exports from Danish industries is illustrated in Chart 6. The blue bars illustrate the share of value added in exports created in the industry itself, while the purple bars illustrate the share of total Danish value added embodied in the industry's export. This means that the purple bars measure the value added created by the industry itself and by the industry's domestic subcontractors in other industries. Consequently, the difference between the two bars illustrate to what extent the exports from the industry contains value added created in other domestic industries. Hence, the difference measure if the industry provides a "carrier function" for exports from other industries.

Exports from low-tech manufacturing contain approximately 60 per cent Danish value added. About half is created in the low-tech manufacturing industry itself and the other half is created in other domestic industries. For example exports from the food, beverages and tobacco industry (part of low-tech manufacturing) include a significant share of value added created in agriculture etc. In this way, the first industry provides a "carrier function" for exports of value added from the latter industry. Exports from the other manufacturing industries contain approximately the same share of value added created in other domestic industries as the low-tech manufacturing, and they thereby provide the same "carrier function". Stehrer and Stöllinger (2013) find that manufacturing exports in Austria provide a similar "carrier function" for other domestic industries.

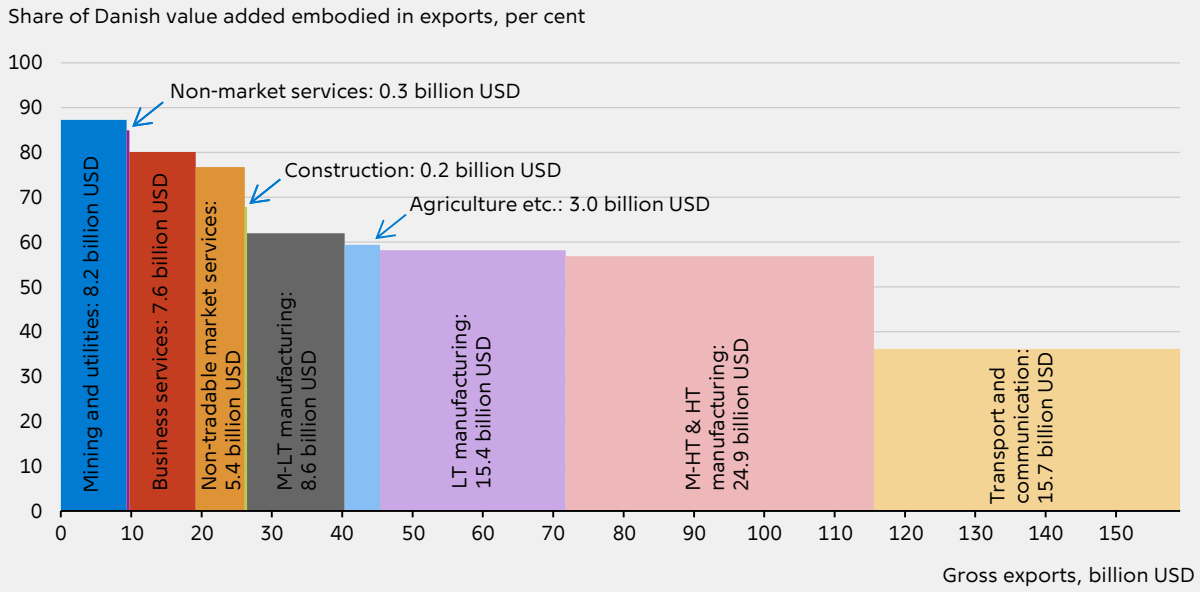
Share of Danish value added embodied in gross exports from industry, 2011 Chart 6



Note: The definition of the industry groups can be found in Appendix 2. LT manufacturing: Low-tech manufacturing, M-LT manufacturing: Medium-low-tech manufacturing, M-HT & HT manufacturing: Medium-high- and high-tech manufacturing.
Source: WIOD and own calculations.

Total Danish value added in exports from each industry can be calculated as the share of Danish value added embodied in exports multiplied by the value of gross exports as illustrated in Chart 7. The horizontal length of each rectangle shows gross exports from each industry and the height of each rectangle measures the share of total Danish value added embodied in the exports from each industry. The product of these two factors – the area of the rectangle – measures the total value of Danish value added exported from each industry. The chart illustrates that more than half of the exported Danish value added is exported through the manufacturing industries. Gross exports from the transportation and communication industry is about equal to gross exports from medium-high- and high-tech manufacturing. However, the larger value added share in manufacturing makes the value added export higher.

Gross exports and share of Danish value added embodied in gross exports, 2011 Chart 7



Note: The definition of the industry groups can be found in Appendix 2. The horizontal length of each rectangle measures the value of gross exports from the given industry denominated in billions of USD. The vertical height of each rectangle measures the share of Danish value added created in any domestic industry embodied in exports from the given industry. The area of the rectangle measures the total value of Danish value added denominated in USD exported through the industry. This value is also stated in the rectangles. LT manufacturing: Low-tech manufacturing, M-LT manufacturing: Medium-low-tech manufacturing, M-HT & HT manufacturing: Medium-high- and high-tech manufacturing.

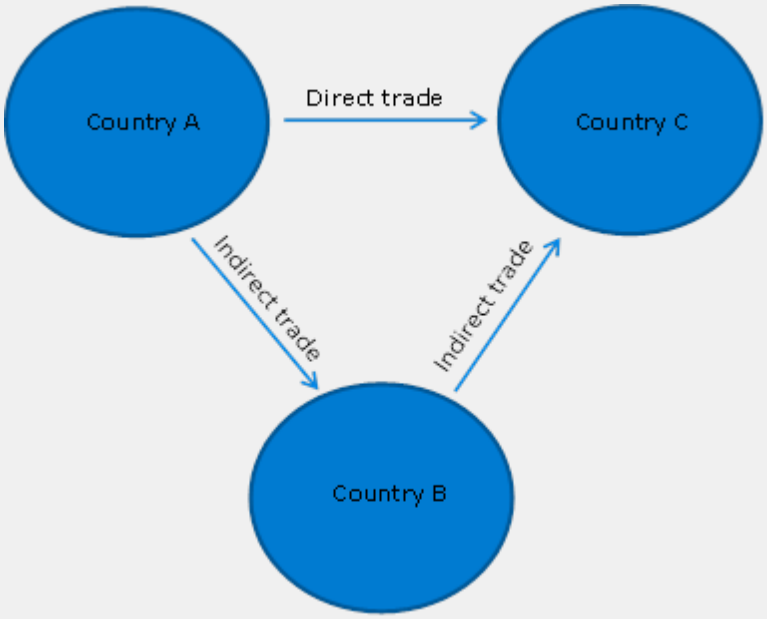
Source: WIOD and own calculations.

7. TRACKING TRADE IN VALUE ADDED

In order to track value added exported from a country we need to account for indirect trade. The concept of indirect trade of value added takes into account the fact that exports from country A to country B is often re-exported to country C as illustrated in Figure 3. This could be the case because the export from country A is used in Country B to produce goods which are exported to country C. In this way, value added created in Country A is indirectly exported to Country C. To analyse the relative importance of other countries when measuring where exported value added is finally consumed indirect trade needs to be accounted for.

Direct and indirect value added and trade-linkages

Figure 3



The WIOD contains the necessary information for tracking the value added from each country and industry to the final use in other countries. Tracking the value added can contribute to the understanding of export market shares, as it reveals where exported value added is finally consumed. This calculation takes into account both direct and indirect linkages, using trade in intermediates and the share of value added in exports. The best measurement for the direct and indirect trade in value added is to calculate the domestic value added embodied in foreign final use as.

$$FUVA^{A,B} = v^A L f^B \tag{7}$$

where $FUVA^{A,B}$ is the value added of country A embodied in the final use of country B, v^A is the row vector of value added coefficients for the industries in country A and f^B is the vector of final demand in country B. The value added embodied in foreign final use can be interpreted as the total exports of value added from country A to country B.

Since the share of Danish value added in exports differs between industries the value added exported to a given country depends not only on gross exports, but also on the mix of products exported. For this reason, the share of Danish gross exports to a given country may differ from the share of Danish value added exports, cf. Table 1. For instance, the United Kingdom and Sweden import Danish products from industries, which has a high share of Danish value added such as energy products extracted from the North Sea. This implies that the United Kingdom and Sweden are more important markets for Danish exports when exports are measured in value added instead of gross exports. In fact, each of these two countries is more important than the German market when it comes to measuring Danish value added exports.

However, part of Danish exports to a given country is intermediate products, which are used in that country to produce exports. As a consequence Danish value added may be re-exported and consumed elsewhere. This means that Danish value added exported to a country may differ from the Danish value added consumed in the country. As it turns out, due to re-exports less Danish

value added is indeed consumed in the United Kingdom and Sweden than indicated by value added exports data, whereas the United States and China turn out to be a more important markets for final consumption of Danish value added. China is gradually becoming a more and more important market for final consumption of Danish value added and is now the fifth largest consumer of Danish value added. Germany continues to be the most important export market for Danish products, but when it comes to the amount of Danish value added actually consumed in a country then the US is almost as important.

Danish gross exports, value added exports and final consumption of Danish value added exports, 2011 Table 1

Per cent	Share of Danish gross exports	Share of Danish value added exports	Share of exported Danish value added consumed in country
Germany	9,8	9,4	9,3
United States	5,7	6,1	8,9
United Kingdom	7,6	10,2	8,1
Sweden	9,7	12,2	6,6
China	3,8	3,9	5,3
France	2,6	2,7	3,6
The Netherlands	2,7	3,3	2,5
Italy	1,9	1,7	2,5
Japan	1,4	1,3	2,2
Spain	1,8	1,8	2,2

Note: The difference between the first and the second row reflects differences in the share of Danish value added in gross exports to the different partner countries. The difference between the second and the third row reflects re-exports and indirect imports of Danish value added.
Source: WIOD and own calculations.

8. JOBS LINKED TO EXPORTS

Labour inputs are needed to produce value added. In the same way as the Leontief Inverse Matrix and value added coefficients can be used to calculate the value added embodied in exports, it is also possible to calculate labour inputs linked to exports (see e.g. Stehrer and Stöllinger (2013)). To do this, we assume that the labour input needed to produce one unit of output within a given industry and a given country is independent of use of the output. This implies that labour productivity varies across industries and countries, but productivity within an industry in a given country does not vary. Consequently, productivity of producing goods in a given industry and country is independent of whether they are exported or consumed domestically and whether they are used as intermediate or final goods. These assumptions allow us to compute how much employment is dependent on exports by substituting the vector of value added coefficients in Equation 6 with the vector of employment coefficients:

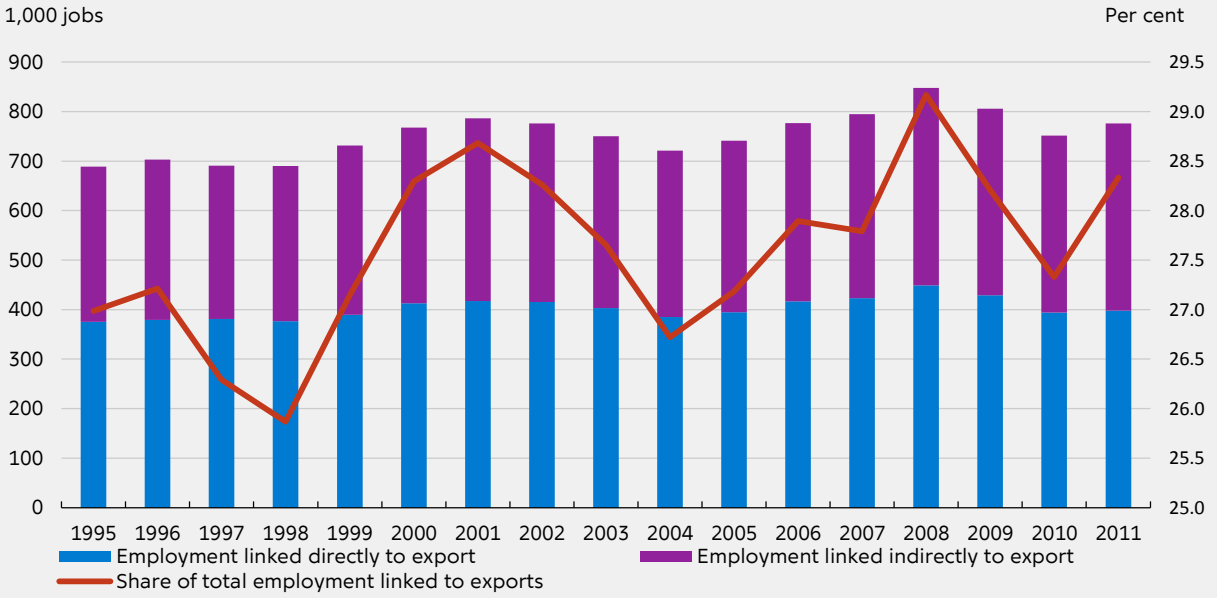
$$DEA^A = e^A L x^A \quad (8)$$

where DEA^A is the number of jobs in country A associated to exports, and e^A is the row vector of employment coefficients for each industry, calculated as the number of jobs in the industry divided by gross output. The vector x^A is the export vector of country A. To derive employment dependent on gross exports to a particular country, the export vector should include only exports

to that particular country. To derive the number of jobs in country A linked to final consumption in a particular country, the export vector should contain all consumption of final products in the partner country. The calculations include only jobs linked to production of exports. Employment created by exports could affect private consumption in Denmark and further boost Danish employment. However, such effects are not accounted for in the calculations.

Almost 800.000 jobs – equivalent to more than 28 per cent of all Danish jobs – were dependent on exports in 2011. There has been a moderate increase in the share of jobs dependent on exports since 1995 and the share seems to be pro-cyclical, cf. Chart 8. This is in line with the fact that the share of value added exported has increased to about 32 per cent of total Danish value added in 2011, cf. figure 5. The procyclicality reflects the Danish jobs linked to exports are more cyclical than jobs linked to domestic demand which include jobs in the public sector.

Employment linked to exports Chart 8



Source: WIOD and own calculations.

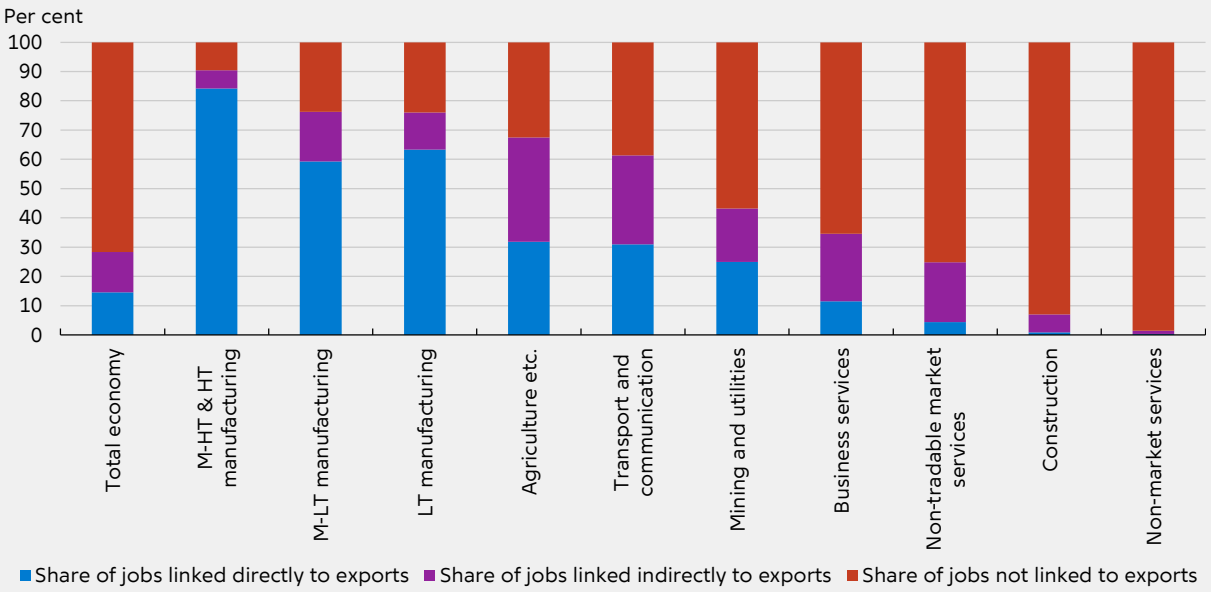
Employment in an industry can be dependent on exports both directly and indirectly. When output from one industry is exported, employment in the industry related to the exported output is defined as directly dependent on exports. When output from an industry due to domestic value chains ends up as exports contained in output produced in another industry, jobs in the first industry are defined as indirectly linked to exports. In total, Danish jobs dependent on exports are split about equally between jobs directly and indirectly dependent on exports and these shares has been fairly stable.

In manufacturing – and in particular in medium-high- and high-tech manufacturing – a large share of employment is directly dependent on exports and a smaller share is indirectly dependent on exports, cf. Chart 9. This reflects that most of the output produced in these industries is exported. On the contrary, only a small share of jobs in domestic market oriented industries, such as non-tradable market services and business services, are linked directly to exports. However, a significant share of jobs is indirectly linked to exports since a significant share of the value added ends up as exports from other industries through domestic value chains. For this reason some of

the jobs in domestically oriented industries are dependent on exports, even though the share of output being directly exported is small.

Jobs linked directly and indirectly to Danish exports, 2011

Chart 9

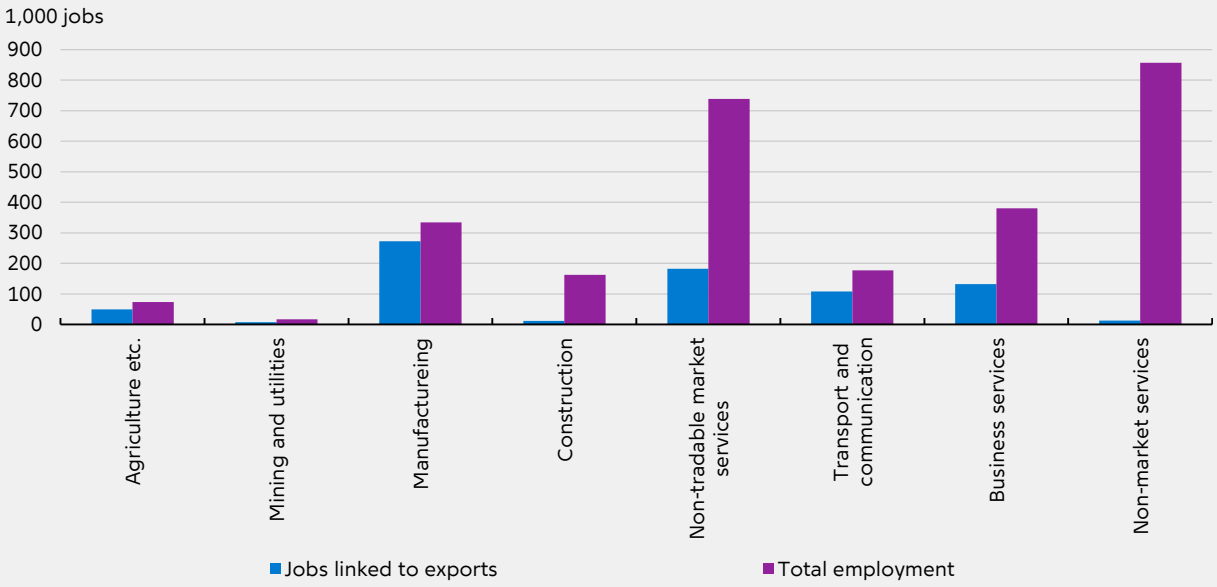


Note: The definition of the industry groups can be found in Appendix 2. LT manufacturing: Low-tech manufacturing, M-LT manufacturing: Medium-low-tech manufacturing, M-HT & HT manufacturing: Medium-high- and high-tech manufacturing.
Source: WIOD and own calculations.

While more than 80 percent of manufacturing jobs are dependent on exports, only 35 per cent of all Danish jobs dependent on exports – directly or indirectly – are in manufacturing. This reflects that manufacturing employment only account for about 12 per cent of total employment. More than 40 per cent of all jobs linked to exports are located in the two domestic market-oriented industries non-tradable market services and business services, cf. Chart 10. Hence, more jobs are dependent on exports in these two industries taken together than in manufacturing, even though most of them are indirectly dependent on exports. This highlights the importance of value chains linking jobs to exports.

Employment, 2011

Chart 10



Note: The definition of the industry groups can be found in Appendix 2. Manufacturing includes both Low-tech manufacturing, Medium-low-tech manufacturing and Medium-high- and high-tech manufacturing.
Source: WIOD and own calculations.

The Danish employment dependent on gross export can be split up by partner countries. However, due to global value chains the number of jobs dependent on gross export to a country may deviate from the number of jobs dependent on final consumption in the country. There are two reasons for this: Firstly, some intermediate Danish goods exported to a country are used in production and then re-exported and consumed elsewhere. Consequently, some of the jobs linked to gross exports to the country can be ascribed to final consumption elsewhere. Secondly, some of the products imported for final consumption in a country may include Danish value added even though they are not imported directly from Denmark. Consequently, some Danish jobs can be ascribed to final consumption in the country despite the fact that they were not linked to gross export to the country.

In 2011, gross exports to Germany created 95,000 Danish jobs. However, only 82,000 jobs were linked to final consumption in Germany, cf. Table 2. Likewise, gross export to Sweden created more jobs than final consumption in Sweden. On the other hand, due to indirect imports of Danish value added, final consumption in the US and China created more Danish jobs than gross exports to these countries.

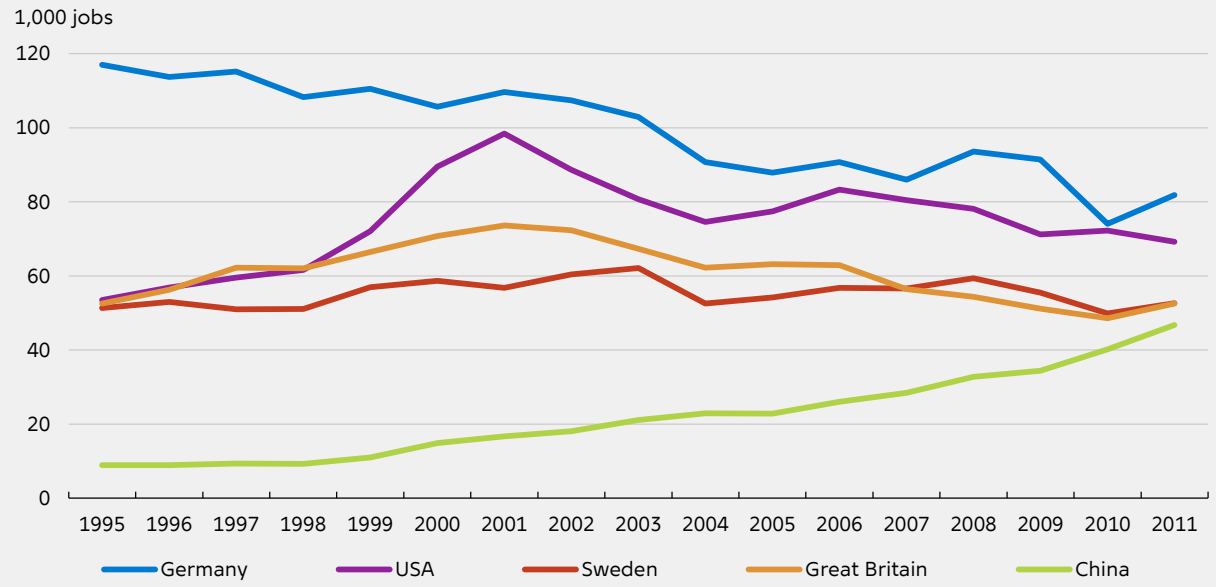
Danish jobs linked to gross exports and final consumption abroad, 2011 Table 2

1,000 jobs	Danish jobs linked to gross exports	Danish jobs linked to final consumption of Danish value added
Germany	95	82
USA	54	69
Sweden	73	53
Great Britain	54	53
China	40	47
France	23	27
Italy	18	22
Netherlands	29	21
Japan	14	19
Other countries	380	384
Total	780	776

Source: WIOD and own calculations.

The number of Danish jobs related to German final consumption has gradually declined since 1995, cf. Chart 11, whereas Danish jobs created by final consumption in China has increased from less than 10,000 in 1995 to almost 50,000 in 2011. Danish employment linked to final consumption in Sweden and the United Kingdom has been fairly stable over the past 15 years. Chinese final consumption was almost equally important to Danish employment as Swedish and British final consumption in 2011.

Number of Danish jobs linked to final consumption of Danish value added Chart 11



Source: WIOD and own calculations.

9. CONCLUSION

We have shown that the importance of global value chains has increased and led to a growing share of foreign value added embodied in exports in almost all countries. In Denmark the increase in foreign value added embodied in exports is mainly driven by an increased use of intermediate inputs from outside the euro area.

Domestic value chains implies that some industries – in particular manufacturing – work as "carrier industries", exporting value added produced in other domestic industries. Due to domestic value chains, part of production and employment in domestic market-oriented industries is indirectly dependent on exports. Indeed our analyses show, that more than 40 per cent of Danish jobs, which are directly or indirectly dependent on exports, are located in domestic market oriented industries.

We have shown that more Danish value added end up being consumed in the United States, the United Kingdom and China than indicated by the share of Danish gross export to these countries. There are two reasons for that: Firstly, Danish gross exports to these countries contain a larger share of Danish value added than average Danish exports. Secondly, due to global value chains there is an extra indirect import of Danish value added in the US and China. On the contrary, less Danish value added is consumed in Germany and Sweden than indicated by their shares of Danish gross exports.

Final consumption in Germany creates more than 80,000 Danish jobs, making Germany the most important country for Danish employment, even though its importance has been declining. On the other hand, final consumption in China has become increasingly important to Danish employment, while the importance of final consumption in Sweden and the United Kingdom to Danish employment has been fairly stable over the past 15 years.

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APPENDIX 1

Country code	Country
AUT	Austria
BEL	Belgium
BGR	Bulgaria
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
DNK	Denmark
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HUN	Hungary
IRL	Ireland
ITA	Italy
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MLT	Malta
NDL	Netherlands
POL	Poland
PRT	Portugal
ROU	Romania
SVK	Slovak Republic
SVN	Slovenia
SWE	Sweden
AUS	Australia
BRA	Brazil
CAN	Canada
CHN	China
KOR	South Korea
IDN	Indonesia
IND	India
JPN	Japan
MEX	Mexico
RUS	Russia
USA	United States
TUR	Turkey
TWN	Taiwan
ROW	Rest of the World

APPENDIX 2

Industry group	Industry description (NACE)
Agriculture etc.	Agriculture, Hunting, Forestry and Fishing
Mining and utilities	Mining and Quarrying Electricity, Gas and Water Supply
Low-tech (LT) manufacturing	Food, Beverages and Tobacco Textiles and Textile Products Leather, Leather and Footwear Wood and Products of Wood and Cork Pulp, Paper, Paper, Printing and Publishing Manufacturing, Nec; Recycling
Medium-low-tech (M-LT) manufacturing	Coke, Refined Petroleum and Nuclear Fuel Rubber and Plastics Other Non-Metallic Mineral Basic Metals and Fabricated Metal
Medium-high- and high-tech (M-HT & HT) manufacturing	Chemicals and Chemical Products Machinery, Nec Electrical and Optical Equipment Transport Equipment
Construction	Construction
Non-tradable market services	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods Hotels and Restaurants Real Estate Activities Other Community, Social and Personal Services Private Households with Employed Persons
Transport and communication	Inland Transport Water Transport Air Transport Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies Post and Telecommunications
Business services	Financial Intermediation Renting of M&Eq and Other Business Activities
Non-market services	Public Admin and Defence; Compulsory Social Security Education Health and Social Work