PRIME MINISTER'S OFFICE
FINLAND

# Finland in global value chains

Prime Minister's Office Publications | 12/2016

# Finland in global value chains

Prime Minister's Office Publications | 12/2016

Publisher
PRIME MINISTER'S OFFICE

DESCRIPTION
30.11.2016

Authors

Jyrki Ali-Yrkkö*, Petri Rouvinen*, Pekka Sinko** and Joonas Tuhkuri*

* The Research Institute of the Finnish Economy ETLA
** Secretariat of the Economic Council, Prime Minister's Office

Type of publication
Report

Commissioned by
Prime Minister's Office

Date of appointment

Name of publication

Finland in global value chains

**Abstract**

This report uses an international input-output dataset to present an analysis of Finland's position in global value chains. The results show that intermediate products account for a larger share – some three-quarters – of Finnish exports than they do in most other countries. The share of foreign value added in Finnish export production is around the international average, but it has grown more rapidly than average. A higher share of foreign value added means that exports, on average, have less capacity to generate economic growth. The share of domestic value added has fallen particularly sharply in the fuel refining industry as well as in metal processing and the manufacture of metal products. The share of domestic value added has decreased more in Finnish than in Swedish industry. A value added based analysis changes the picture of Finland's most important trade partners and our international economic dependencies. Based on the analysis Finnish economic growth is heavily dependent on Chinese and US final demand. Over 10% of Finland's value added exports are ultimately destined for China, and almost the same proportion goes to the United States. However, the combined final demand from EU-28 countries still outweighs the demand from these two countries.

Keywords
Value chains, foreign trade, competitiveness, input-output analysis

| Name of series and number of publication | | ISSN | ISBN (printed) |
|---|---|---|---|
| Prime Minister's Office Publications 12/2016 | | 1799-7828 | |
| Number of pages | Language | Confidentiality rating | ISBN (PDF) |
| 45 | English | Public | 978-952-287-286-9 |
| Publisher | | Layout | |
| Prime Minister's Office<br>PDF publication: www.vnk.fi/julkaisut<br>Further information: julkaisut@vnk.fi | | PMO/Government Policy Analysis Unit | |

# Contents

FOREWORD ..... 7
SUMMARY AND KEY CONCLUSIONS ..... 9
1 WHAT HAS CHANGED? ..... 12
2 WHAT DOES FINLAND EXPORT: FINAL PRODUCTS OR COMPONENTS? ..... 16
3 THE VALUE OF VALUE NETWORKS: WHERE IS IT CREATED? ..... 24
4 CONCLUSIONS ..... 35
5 REFERENCES ..... 38
6 APPENDICES ..... 39

# FOREWORD

Value chains in the production of goods and services have become globalised over the past few decades, which has profoundly changed the structure of foreign trade and its impact on the performance of national economies. The effect that globalisation has had value chains at the level of individual companies and products has been studied and documented fairly comprehensively. Studies conducted by the Research Institute of the Finnish Economy (Etla) for example on how value is distributed for individual products, such as in the production of Nokia mobile phones, are pioneering in the field.

To date, the impact that the internationalisation of value chains has on the whole economy has been studied less. What is Finland's position in global value chains? What kind of products and with whom does Finland trade in the complex network of value chains? How has the process of value chains impacted the potential for export-driven growth in Finland and the interdependency between Finland and its trading partners?

While it is transparent that value chains are becoming more international at the company level, assessing the effect of the phenomenon at the level of the whole economy is not entirely straightforward. Questions related to defining the value chains and the identifiers related to them as well as issues involving access to sufficiently detailed and comprehensive data have so far not been fully answered. In the latter case, significant progress has been made in recent years, as both the OECD and Groningen University have produced comprehensive international input-output data that can be freely accessed by researchers.

This study is the first attempt to examine the effect of globalized value chains at the macroeconomy level in Finland. The study is a collaborative effort between Etla and the Secretariat of the Economic Council at PMO. The WIOD database of Groningen University is the main data source, but the OECD's TiVa database was also utilised to compare the outcomes.

The findings provide new information on the structure and interdependencies of Finland's foreign trade and changes that have taken place in them between 1995 and 2011. However, since the project was executed within a relatively short timeframe, more extensive and comprehensive studies on the issues raised are warranted in the future.

At Etla, Jyrki Ali-Yrkkö, Petri Rouvinen and Joonas Tuhkuri were responsible for the study. At PMO, university trainee Lauri Mattelmäki assisted me by collecting background material. Iiris Koskela-Näsänen is responsible for the design and layout of the publication. Professor Gaaitzen de Vries of Groningen University made a significant contribution to the study by providing invaluable expertise. My warmest thanks to one and all.

Helsinki 30 November 2016

Pekka Sinko
Secretary General of the Economic Council

# SUMMARY AND KEY CONCLUSIONS

Economic and productivity growth are mainly driven by technological progress and advances in the international division of labour. These two factors are crucial to long-term welfare growth. The focus in this report is on the latter of these factors: gains from a more efficient division of labour between countries.

The division of labour between nations entered a qualitatively new phase after the mid-1980s. Politicians set about to liberalise global trade, and at the same time firms invested in developing new ICTs and data networks. These new technologies made possible and profitable an increasingly fine-grained and geographically extensive decentralisation of *value chains* in which goods and services were produced into the marketplace. Over the past three decades the global economy has continued to change to such an extent that traditional export and import statistics no longer provide an adequate and truthful picture of its workings.

The solution we propose to this key problem in economic policy debate is to apply input-output thinking to the supranational level. The calculations presented in this report are based on international input-output data. This will help us build a more accurate picture of Finland's net position in international trade.

## *Intermediates make up three-quarters of Finnish exports*

Our analyses indicate that rather than providing services for end users, Finland's principal role in the global economy is to serve the next stage of the value chain. Intermediates account for up to three-quarters (76%) of Finnish exports, which is an exceptionally high share by international comparison.

In Sweden, intermediate products account for 68% and in Denmark for 63% of exports – both figures that are relatively close to the EU average of 67%.

The high share of intermediates exports may be an indication that businesses in the country concerned have been successful in their attempts to engage with global value networks. On the reverse side of the coin, it is possible that producers of intermediate products are much more likely to have subcontracting roles. Producers of final products, on the other hand, are closer to end users and therefore in the position to decide how and where to source their intermediate products.

## *China more important to the Finnish economy than previously thought*

Since intermediates are used to make final products or services that are possibly further exported to third countries, the final destination of Finnish exports is not necessarily the same as the address label on the container shipped from Finland.

When we shift our focus from traditional exports to the final demand for value added produced in Finland – a more relevant perspective from the point of view of Finnish welfare – it becomes clear that the two most important destinations in Finnish international exchange are China and the United States. China in particular has rapidly gained in importance.

Germany's weight is roughly two-thirds of that of China or the United States; and Sweden's, Russia's, France's and the UK's about one-half.

The future direction of the Chinese and US economies will therefore have a significant impact on Finnish exports and Finnish economic growth. This impact will go largely unnoticed if we only examine national foreign trade statistics.

### *Exports require imports*

Value chains, of course, also work in the opposite direction. Finland would not be in the position to satisfy any significant amount of international demand if it could not import the inputs needed in local stages of production in the value chain.

The use of imported inputs has increased more sharply in Finland than in many other countries. Smooth and effective international exchange is now widely recognized as an integral part of Finnish competitiveness.

This, in turn, ties in with various infrastructure factors, such as the availability of adequate airports, ports and telecommunications networks. Without them, it is difficult for Finland to cost-effectively import the most internationally advanced intermediate products, which in turn may be decisive for the success of Finnish-based production.

### *Ability of exports to drive GDP growth has been reduced*

The growing share of imported intermediates means that the ability of Finnish exports to drive GDP growth has been reduced. Some 35–38% of Finnish exports consists of foreign value added. This means that an increase of one euro in exports increases Finnish GDP by just over 60 cents. In other words, a higher rate of gross exports is needed than before in order to achieve a certain degree of economic growth. The Finnish figures are at roughly the same level as in Sweden. In Denmark and Germany, by contrast, an increase in industry exports generates stronger GDP growth than in Finland.

In value added terms, it seems that Finland is not as heavily dependent on exports as previously thought: over one-quarter of our GDP is generated from satisfying foreign end-user demand. Finland is thus not exclusively or primarily dependent on exports, even though exports certainly are integral to the bigger picture. On the other hand, the role of foreign demand has declined since the financial crisis and probably explains much of the weakness of GDP growth in recent years. Exports and imports are more important to a small country than they are to bigger countries. Domestic markets in a small country are by definition small and do not allow for specialisation in the same way as the markets of a big country. For this reason international trade is particularly important for a small economy.

### *Not all streams of export revenue contribute to economic growth in the same way*

The amount of domestic value added contained in exports varies widely from industry to industry. From economic growth viewpoint it is not irrelevant what is exported from Finland. One additional euro of exports in the oil refining segment, for instance, has much lower effect on GDP growth than that in the paper industry.

In 1995–2011 the share of domestic value added has dropped considerably in a number of branches. In Sweden, these falls are almost without exception smaller than in Finland.

## *Competitiveness is not only a question of costs*

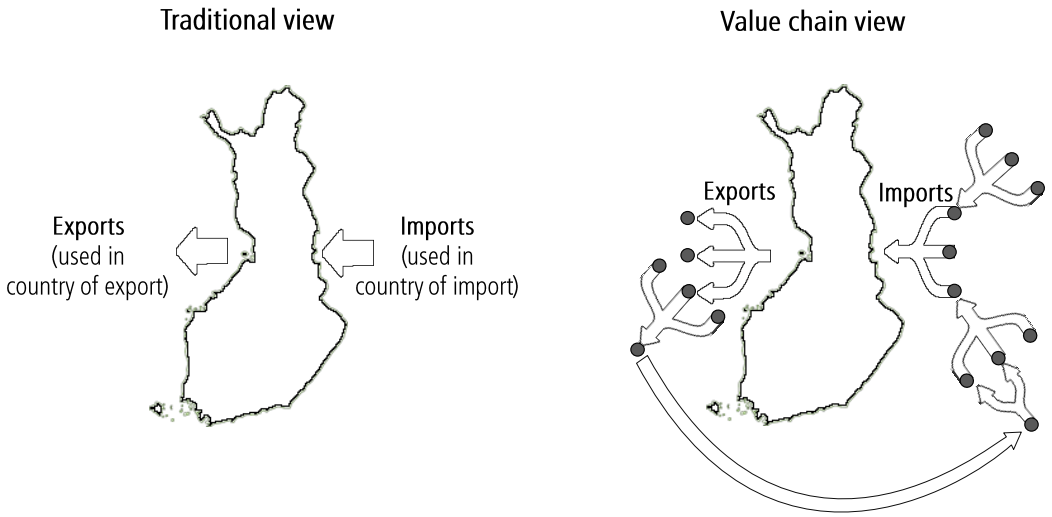
The competitiveness of Finnish exports is closely linked with the quality-price ratio of domestically sourced inputs, and services in particular. Competitive cost structures are important to helping domestic businesses integrate into global value chains. An exclusive focus on costs will not lead to the desired outcome, however. In Europe, Albania's, Bulgaria's and Macedonia's labour costs are close to those in China, yet their unemployment rates are in the region of 10–20%. Low costs alone do not guarantee success. In the longer term the main focus must be on generating as high amount as possible of valued added per hour worked. There are two main ways to achieve this. Either products or services must be produced with greater efficiency than elsewhere, or the products or services produced must set us apart from the competition. The former goal is increasingly difficult to achieve with countries like China investing more heavily than other countries in robotics (IFR, 2016). This is not to suggest that the latter route is an easy one, but certainly worth trying. It is possible to seek competitive distinction through superior quality and branding, delivery schedules and first-rate product characteristics. All this builds a case for investing in education, research and product development.

# 1 WHAT HAS CHANGED?

## *National clusters have become global value networks*

Just a few decades ago, business value chains were still predominantly *national*. In other words, raw materials were usually worked into final products in one and the same country, with the help of domestic subcontractors. Some products were of course exported and imported, but by and large the thinking was that exports and imports consisted largely of final products (Figure 1.1).

**Figure 1.1** Notions of global trade have changed




Today, the processing chain from raw materials to finished products has in many industries become internationalised. Raw materials are processed into concentrates that are then often exported to another country for further processing and then to a third country for further processing still. Export production is accordingly making increasing use of imported inputs. The production of even simple products or services may thus involve a large number of units from different companies based in many different countries. Indeed, more and more national clusters have turned into global value chains or value networks.

## *Intermediate products continue on their way from one country of export to another*

A good example of an international value chain is provided by ABB, which manufactures electric motors in Finland (Figure 1.2).

ABB is in the business of developing and manufacturing electric motors, a large part of which are destined for export. The motor components are imported from around the world: the castings are imported from India, the coiling is done in Estonia, and many steel components are imported from the Czech Republic. All of this counts as intermediates imports into Finland. Once the product has been assembled, there is a high likelihood that it will be exported out of Finland, say to a pump manufacturer in Germany (as in the example above). This is recorded as intermediates exports to Germany. However, this is not the final

destination of the product, but it is integrated as part of a larger installation. The German pump manufacturer sells its final products among others to oil refineries in Saudi Arabia.

**Figure 1.2** Manufacture of ABB electric motors in Finland: associated intermediates imports, intermediates exports and final products exports

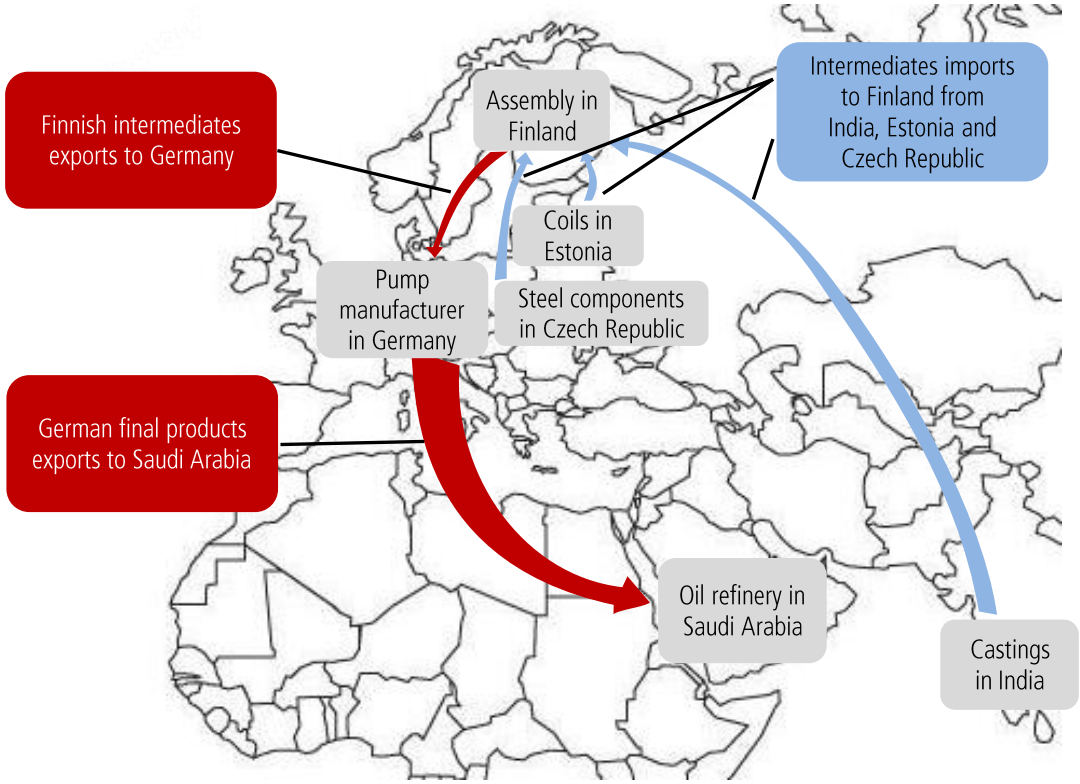



ABB Finland sells the product in question to Germany, which is recorded as Finnish exports to Germany. In fact the motor is integrated as part of the German pump manufacturer's product, which in this case is sold from Germany to Saudi Arabia. The figure shows only some of the locations from which the components are sourced.

The example above is a good illustration of how final products are a joint effort of several different countries and companies. In many cases the first country of export is not the same as the country where the product is ultimately used. However, the value chain can always be followed to final demand in some country: the various stages of the chain are geared to satisfying that demand. In our example the end consumption of the final product takes place in Saudi Arabia, whose demand is thus the ultimate driver of the whole value chain. We return more closely to this perspective in Chapter 3, where one of our aims is to identify the countries on whose final demand the Finnish economy is most dependent.

### *Intra-group trade accounts for a large part of global trade*

However the globalisation of value chains has changed not only inter-firm trade. Intra-firm trade, or more precisely trade within groups of firms, has continued to gain in importance. This involves trade between group units based in different countries. In the United States, for instance, intra-firm trade flows account for almost half of total imports and for some 30% of exports[1]. Statistics currently available shed no light on the role of intra-group trade in the Finnish economy.

[1] For more on intra-firm trade flows, see e.g. Lanz, R. & Miroudot, S. (2011): Intra-Firm Trade, PATTERNS, DETERMINANTS AND POLICY IMPLICATIONS, OECD Trade Policy Papers 114.

One key feature of value chain globalisation is that within multinational corporations, production factors themselves – capital, labour and information – are now moving across national borders. This marks a huge change. Companies and groups used to run their businesses more or less in one single country. Major companies have of course had sales units in different countries for decades, but production and product development have earlier been largely concentrated in their home country. Production factors were therefore also largely located in that same country.

### *Production factors also move across borders*

Today, production factors move freely across national borders: people, capital and information move quickly from one country to another. Flight connections allow for easy movement of employees, while real-time information networks make possible the transfer of capital and information to virtually any country in the world.

How, then, does the international mobility of production factors influence our notion of how the location of production is determined? If there is no movement of production factors, the location of production is not dependent on absolute country differences in cost levels. Rather than absolute differences, the location of production is determined by relative advantages between the options available. Even if producers in one country were able to produce every commodity at lower costs than others, it would still engage in international trade with other countries. In this case the country concerned would specialise in producing the goods where it has the greatest advantage: this would allow it to achieve the greatest possible benefit for itself. But when production factors move across national borders, both relative and absolute differences matter (Caves, Frankel & Jones, 2009, s. 151–162). There will necessarily be greater country competition over the location of production.

## *Role of nation-states blurred in value networks*

The globalisation of business operations and value chains is quite evident and easy to demonstrate at the firm level, but much more difficult at the level of national economies. This report explores the globalisation of value chains by using data sources that have only been available for the past few years. One key source is the international WIOD input-output database (see separate Text Box 1.1).

Some of the key questions addressed in this report are as follows:

- What is Finland's role and position in global value chains?
- What kind of products does Finland bring to international trade?
- What is the share of domestic value added in Finnish exports, how has it developed over time and how does it vary in different branches?
- What do Finland's and other countries' bilateral trade flows consist of, what is their trade balance like?
- On which countries' final demand is Finnish economic growth most dependent?
- How does value chain globalisation impact the prospects for export-driven growth?
- What policy implications can be drawn from the results?

## Text box 1.1. What data do we use to measure exports and imports?

The empirical analysis in this report is based on the *World Input-Output Database* (WIOD). WIOD combines input-output tables for different countries, providing national figures on trade between different industries. In other words, WIOD is an international version of national input-output data.

WIOD provides tools for measuring international trade and interaction in more detail than has been possible before. For example, it allows us to measure international inter-industry trade in intermediates and to combine this data with information on the domestic production structure. This means analysing inter-industry trade along international production chains.

WIOD has been developed and is maintained by an international working group based at the University of Groningen in the Netherlands. The data is publicly available at http://www.wiod.org. Timmer et al. (2015, 2014, 2013) and Los et al. (2015) have provided detailed descriptions of the database.

Technically speaking, WIOD is a time series of input-output tables for 1995–2011. Annual data is provided for 35 industries and 40 countries: 27 EU members and 13 other major economies. The data comprise 85% of the global economy.

WIOD has been assembled by combining national input-output data with UN *Comtrade* statistics on international trade. In addition, WIOD includes data on employment and wages based on EU KLEMS figures. Figure T.1 illustrates the part of the WIOD data that is used in this report. A one-year cross-section of WIOD is called a *World Input-Output Table* (WIOT).

**Figure T.1** One-year cross-section of WIOD data (WIOT)

| | | | Intermediate product use | | | | | | | Final product use | | | Total use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Country 1 | | | … | Country M | | | Country 1 | … | Country M | |
| | | | Industry 1 | … | Industry N | … | Industry 1 | … | Industry N | | | | |
| Production | Country 1 | Industry 1 | (a) | | | | (b) | | | (d) | | | (f) |
| | | … | | | | | | | | | | | |
| | | Industry N | | | | | | | | | | (e) | |
| | … | … | | | | | | | | | | | |
| | Country 2 | Industry 1 | | | | | | | | | | | |
| | | … | | | | | | | | | | | |
| | | Industry N | (c) | | | | | | | | | | |
| Value added | | | (g) | | | | | | | | | | |
| Total output | | | (f) | | | | | | | | | | |

The left-hand side of WIOT describes inter-industry intermediates trade in different countries. It is a description of the international production structure. For example, WIOT cell (a) describes the share of total production in industry (1) in country (1) that the same industry uses in the same country as an intermediate product. The same applies to all other cells on the diagonal. Cell (b), then, describes the use of intermediates produced by industry (1) in country (1) by industry (1) in country (M). This is intermediates exports for country (1) and intermediates imports for country (M). Cell (c) describes the value of imports in industry (1) in country (1) from a certain industry (N) in another country (M). This is intermediates imports for country (1) and intermediates exports for country (M). The part matrices on the WIOT diagonal thus describe each country's internal input-out structure. Cells outside the diagonal have corresponding exports and imports interpretations.

The right-hand side of WIOT describes the value of final consumption by country. Cell (d) describes the value of domestic final demand in country (1). Cell (e) indicates the value of foreign final demand in country (M) from industry (N) in country (1). This is final production exports for country (1) and final production imports for country (M).

In addition, the right-hand side of WIOT provides data on the total demand for production (f) in a certain industry in the country and accordingly, on the bottom line, data on the industry's total output (f). These two figures are analogous in WIOT. The table also includes data on value added in each industry (g). WIOD gives the value of output in US dollars of the year in question.

The export and import figures reported by different countries are not necessarily mutually consistent. National discrepancies are reconciled when assembling the WIOD data. For this reason the WIOD data for Finland, for instance, are not necessarily exactly the same as the exports and import figures reported by Statistics Finland.

# 2 WHAT DOES FINLAND EXPORT: FINAL PRODUCTS OR COMPONENTS?

In the past 20–30 years several firms have tended to concentrate increasingly on dedicated areas of specialisation and to withdraw from other areas. This has often involved selling off certain parts of the company to other operators. As a result, firms that used to be multi-industry operators have now become specialised in single industries.

The same has happened within industry branches: firms have specialised in certain operations and outsourced other functions. As a result of outsourcing, value chains have grown longer as firms have sold off their components manufacturing business, for instance, and concentrated exclusively on assembly.[2]

Components manufacturers produce part assemblies or services that are not used as they stand, but integrated as part of some larger assembly. These products are called intermediate products or 'intermediates'. Many B-to-B products are also classified as intermediates, even though they are rarely perceived as such: examples include paper products and diesel engines (see Text Box 1.1).

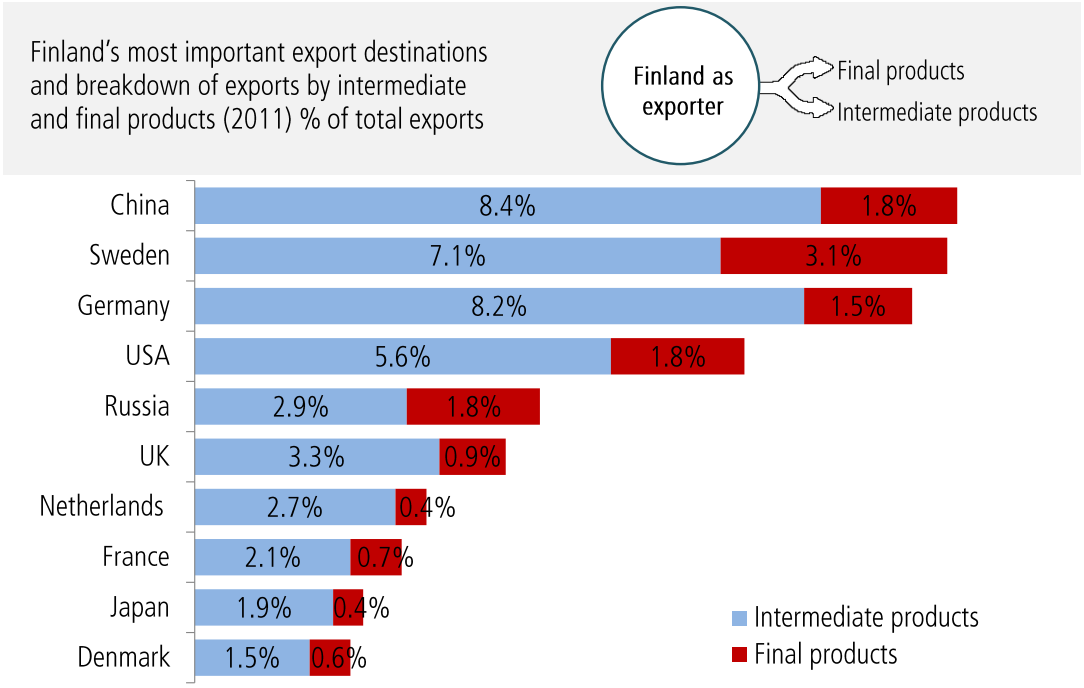
Specialisation has also opened up new opportunities for the use of foreign subcontractors and downstream producers. This internationalisation of production stages has contributed to further increase foreign trade in intermediates.

### *Intermediates account for the bulk of Finnish exports*

International data provide a different perspective on exports than national data sources. For instance, national export statistics are based on companies' reports on the countries to which they export their products. WIOD data (see Text Box 1.1), on the other hand, classifies export countries on the basis of import statistics. In theory the figures should be identical, but in practice this is rarely the case. This also applies to immediate Finnish export destinations, the most important of which are listed in Figure 2.1. The Figure also illustrates separately the exports of intermediate and final products.

[2] Interestingly enough, some very well-known and successful technology companies have recently diverted from this trend, see http://www.economist.com/news/business-and-finance/21696911-tech-fashion-old-management-idea-back-vogue-vertical-integration-gets-new.

**Figure 2.1** Finland primarily exports intermediate products to its main export destinations



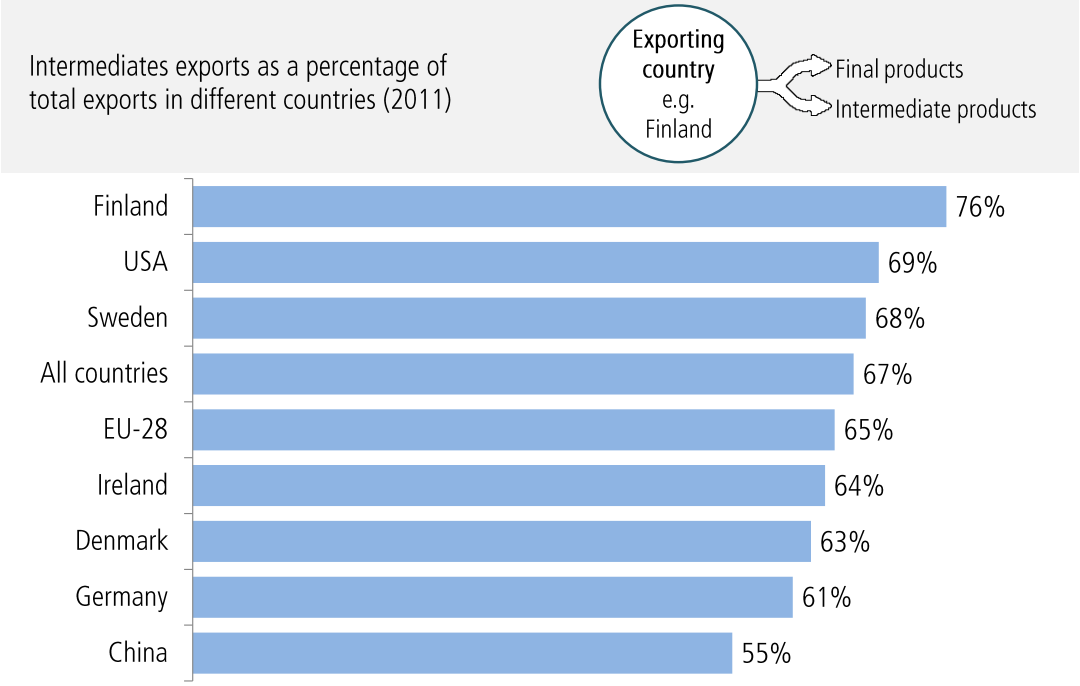

Percentages of total Finnish exports. For instance, the figure 8.4% in the blue bar for China indicates that 8.4% of total Finnish exports consist of intermediates exports to China; the figure in the red bar indicates that 1.8% of total Finnish exports consist of final products exports to China.

Source: Authors' calculations based on WIOD data for 2011.

The countries emerging as Finland's most important export destinations are China, Sweden and Germany. Together, they account for some 30% of total Finnish exports. The top ten export destinations account for a 57% share of Finnish exports. Intermediates are the most important export products in all these destinations.

So do intermediates account for an exceptionally large proportion of Finnish exports when compared with other countries? This question is addressed in the Figure below (Figure 2.2), which shows that exports of intermediates are often higher than exports of final products.

**Figure 2.2** Intermediates account for three-quarters of Finnish exports




Note: Intermediates exports as a percentage of total exports. Authors' calculations based on WIOD data. The category 'All countries' comprises the 41 countries that are included in the WIOD dataset. The EU-28 figure describes the absolute mean calculated for these Member States.

In Finland, however, exports of intermediate products as a proportion of total exports (76%) is clearly higher than in many other countries. In Sweden and Denmark the corresponding proportions are around two-thirds, very close to the average calculated for all countries (67%). In EU Member States intermediate products account on average for 65% of total exports.

Intermediates exports are also important for major countries such as the United States and Germany. Intermediate products account for over two-thirds of US exports, and in Germany for over 60%. In China, by contrast, the share of intermediates exports is lower than in many other countries. In reverse, this means that final products account for a larger proportion of Chinese exports than in many other countries.

How has the share of intermediates exports in total exports developed over time? It is rather surprising that by the mid-1990s, intermediates exports already accounted for the largest part of total exports in several countries (see Appendix, Figures A1 and A2): on average intermediates represented 62% of total exports in all countries. It is noteworthy that the Finnish figure for the share of intermediates exports at 69% was internationally quite high as early as 1995.

Since 1995 the share of intermediates in total exports has increased on average by 5%. In Finland and Sweden, the share of intermediates has increased at only a marginally faster rate (6–7 percentage points). In Denmark, Ireland and China, by contrast, the growth rate has clearly exceeded the average and reached 10–16 percentage points.

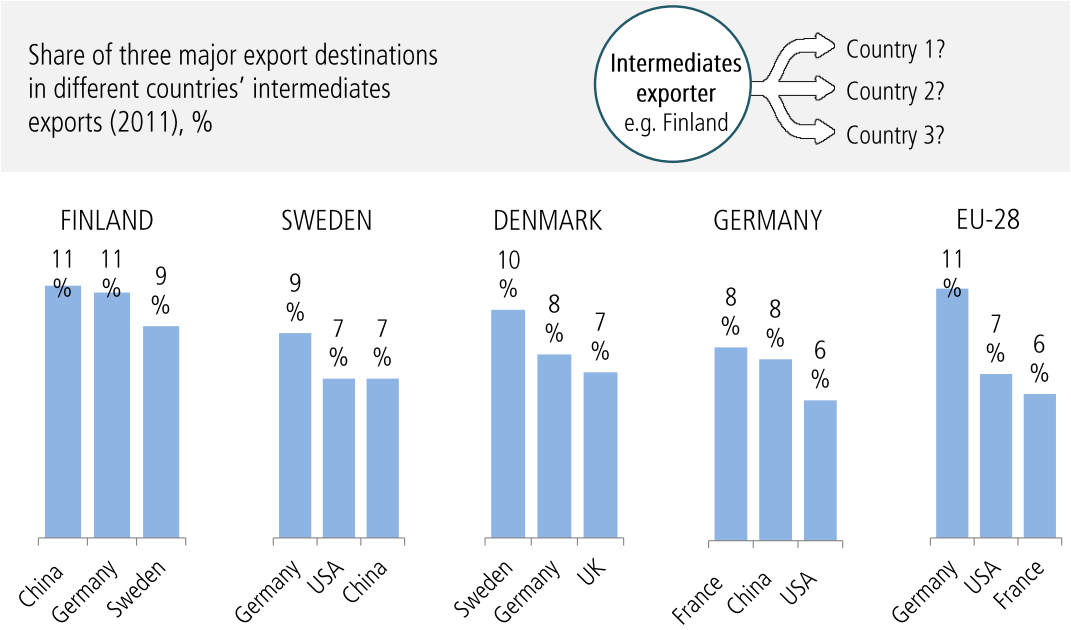
In the light of these observations it seems then that the exceptionally high share of intermediates in total Finnish exports has more to do with the traditionally high share of

semi-finished products and investment goods in our exports that with more rapid integration as part of international value networks.[3]

***Finnish intermediates exports go mainly to China, final products exports to Sweden***

As well as exploring the share of intermediate products in total exports, it is interesting to know the destination of intermediates exports and whether these destinations differ from the destinations of final products. The following considers the country breakdown of exports from Finland and from countries that are of particular interest from Finland's point of view (Figure 2.3).

**Figure 2.3** Intermediates are often exported to major countries




The three most important destinations to which Finland, Sweden, Denmark, Germany and the EU area export intermediate products. Intermediates exports to the destinations concerned as a proportion of each country's total intermediates exports. Authors' calculations based on WIOD data.

Intermediates exports go primarily either to neighbouring countries or to major economies. This applies to Finland, too. China and Germany are among the larger economies to which Finland exports a significant proportion of its intermediates. Sweden, in turn, represents a geographically neighbouring country that accounts for 9% of Finnish intermediates exports.

The most important destinations for intermediates exports in the countries included in our comparison observe the same logic. Germany and China rank among the top three destinations for intermediates exports in Sweden, too. Denmark exports its intermediate products above all to neighbouring Sweden, but also to major countries such as Germany and the UK.

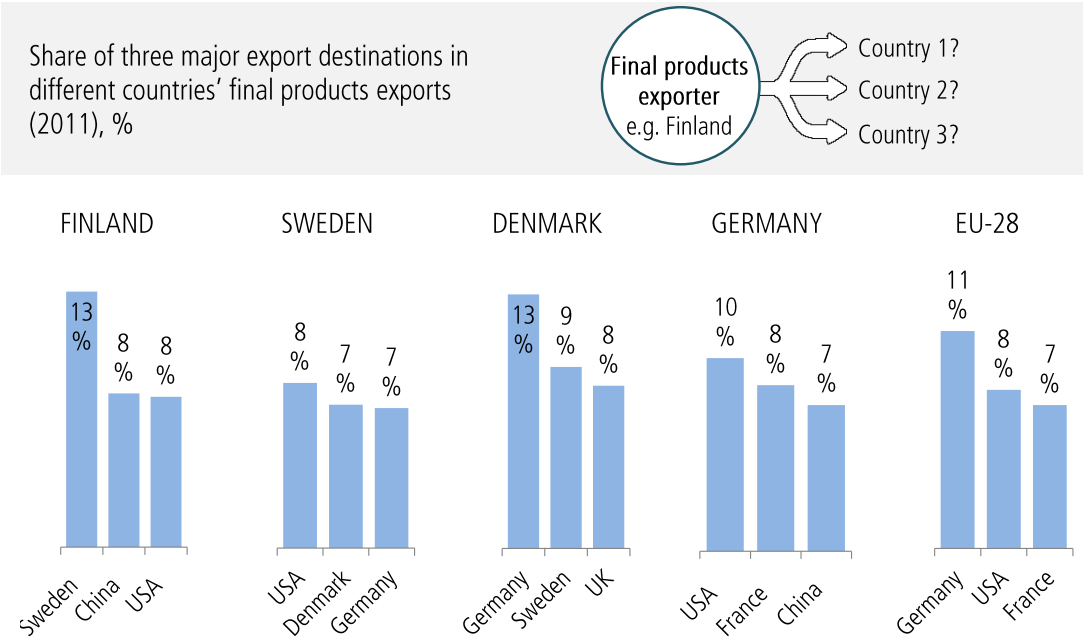
The most important destinations for German intermediates exports, then, are France, China and the USA. When all EU countries are considered together, their most important export destinations for intermediates are Germany, the USA and France.

[3] Based on aggregate-level data it is difficult to distinguish between traditional raw materials exports and the exports of intermediate inputs, which are often higher valued added products (cf. Figure 2.7).

China thus ranks among the top three export destinations both in Finland, Sweden and Germany. This is in marked contrast to the situation in the mid-1990s, when China did not feature among the top three destinations in any of these countries (Table A3).

So what about the exports of final products and their destinations? The most important destinations for final products are largely the same as for intermediate products (Figure 2.4). The only exceptions are the US, which now appears among Finland's top three trading partners, and Denmark, which ranks among Sweden's three most important partners.

**Figures 2.4** Final products exports often destined to major countries




The three most important destinations to which Finland, Sweden, Denmark, Germany and export final products. Final products exports to the destinations concerned as a proportion of each country's total final products exports. Authors' calculations based on WIOD data.

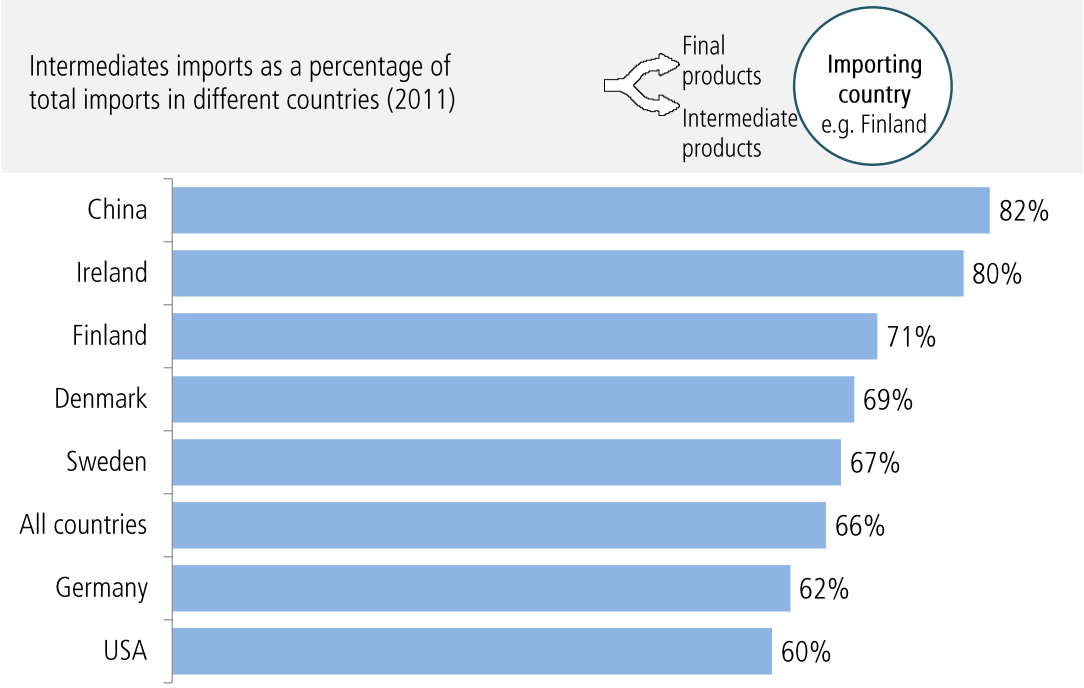
The principal export destinations for Finnish final products are Sweden, China and the United States (Figure 2.4). Germany does not rank among Finland's top three export destinations for final products, in contrast to the situation in Sweden. Denmark in turn is a more important export destination for Swedish final products than China.

As for the whole group of EU countries, the three most important export destinations for final products exports are Germany, the USA and France – the exact same countries that are the top three destinations for intermediates exports. For Denmark and Germany, too, the same countries appear as the top three export destinations for intermediates and final products, although not in the same order.

### *Imports also dominated by intermediate products*

What for one country is exports is always imports for another country. Based on the high shares of intermediates in exports it is apparent then that intermediates also account for a relatively large part of imports in different countries (Figure 2.5). The following looks more closely at intermediates imports in Finland and selected other countries.

**Figure 2.5** Intermediates account for more than two-thirds of Finnish imports



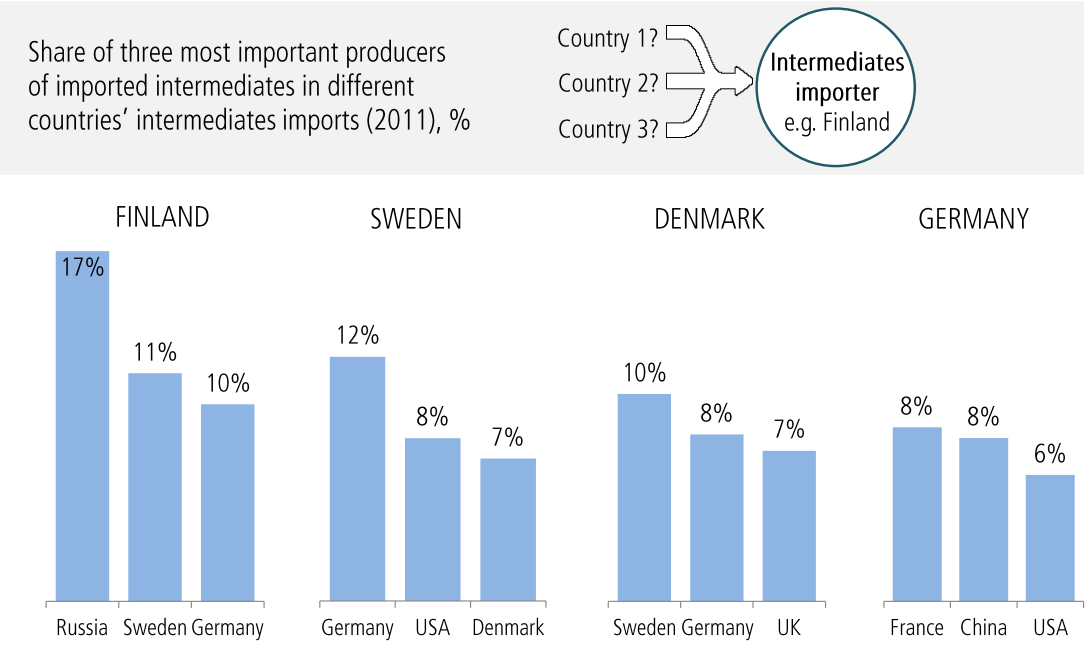

Note: Share of intermediates imports in different countries' total imports. Authors' calculations based on WIOD data.

Intermediates imports account for over 70% of total Finnish imports (Figure 2.5). This is higher than the average (66%), but well below the figures for China and Ireland. Danish and Swedish intermediates imports are quite close to the figures for Finland. It seems then that there are no specific obstacles that hamper Finnish intermediates imports from other countries.

At a global level there has been hardly any change since 1995 in intermediates imports as a proportion of total imports (Table A4). At a country level, however, there have been some changes, most notably in the cases of China and Denmark. In both cases the share of intermediates imports has increased by more than 10 percentage points since 1995. The growth figure for Finland is a more modest 4 percentage points. In Sweden the share has increased by one percentage point.

The three major sources for Finnish intermediates imports are Russia, Sweden and Germany (Figure 2.6). Imports from Russia are particularly high as Finland imports large quantities of oil and other raw materials from its eastern neighbour. Indeed Russia's role as a producer of imported intermediates in Finland is quite different from its corresponding role in Sweden, Denmark and Germany.

**Figure 2.6** Most important producers of imported intermediates




Note: The three major countries from which Finland, Sweden, Denmark and Germany import intermediate products. Imports of intermediates as a proportion of total intermediates imports. Authors' calculations based on WIOD data.

The second most important producer of intermediate products imported into Germany is China. In Finland, Sweden and Denmark, by contrast, China does not rank among the top three producers of intermediates. China has emerged as a major producer of intermediates that are exported in increasing volumes for processing and assembly around the world.

***What does trade in intermediates tell us about national economies?***

The high share of intermediates in international trade raises the question about the role and position of different countries as importers and exporters of intermediate products. Is it true to say that some countries are more specialised in importing than exporting intermediates, and vice versa? What does the variation in the significance of intermediates exports and imports tell us about the structures of national economies?

It is difficult to give unequivocal answers to these questions based on the data available. However, it is interesting to consider the structural systematics that possibly lies behind these observations. Figure 2.7 cross-tabulates the countries included in the data by shares of intermediates exports and imports into a fourfold table. The fields of the table show which countries have higher than average and lower than average intermediates imports and intermediate exports.

Countries clustering in the top left-hand field (*assembly countries*) have a higher than average share of imported intermediates, whereas the share of exported intermediates is lower than average. This is typical of countries where the assembly of final products depends largely on imported inputs. A typical case is China.

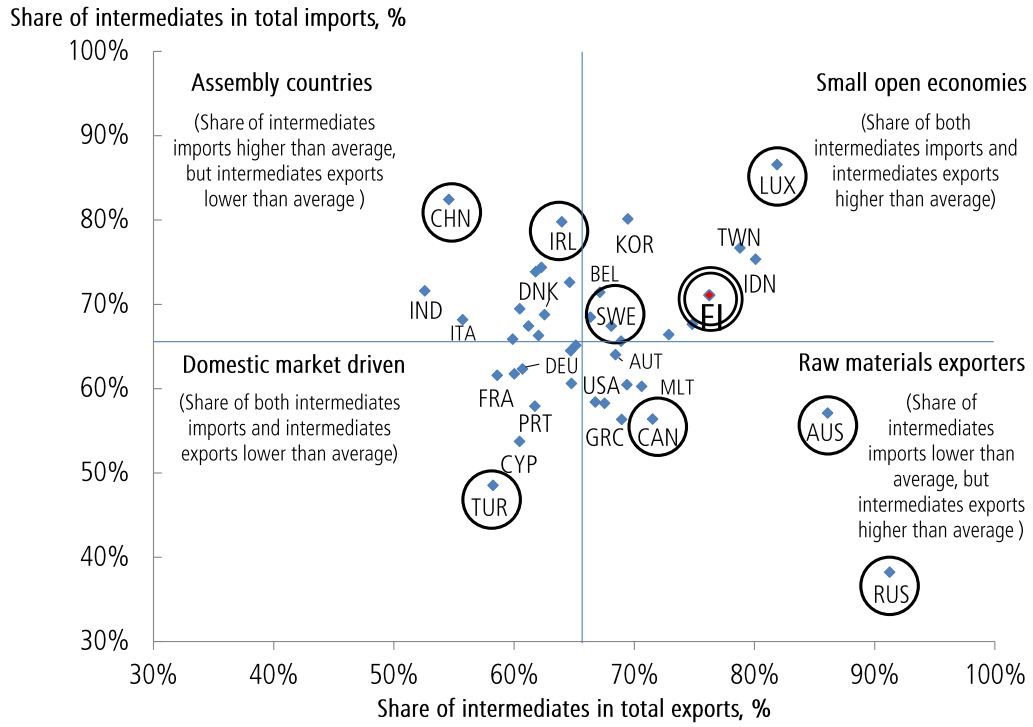
Countries clustering in the bottom right-hand field *(raw materials exporters)* are characterised by a higher than average share of intermediates exports in total exports, and a lower than average share of intermediates imports. This is typical of relatively large

economies that export large quantities of raw materials, but that do not need significant imported inputs to support their exports. Countries in this group include Russia and Australia.

Applying the same logic, the countries clustering in the top right-hand field (*small open economies*) are those where intermediates account for a higher than average share of both total imports and total exports. It seems that in our material, this group includes a large number of small open economies that for various reasons have actively integrated into global value chains. Finland ranks among these countries.

It is somewhat harder to define distinctive characteristics of the last field in the figure, a group of countries where intermediates account for a lower than average share of both total imports and total exports. The relatively low level of intermediates imports may be explained by the large size of the country, which will allow it to depend primarily on domestic subcontractors in its export production. The foreign trade of these countries depends more than average on trade in final products, and they are not as closely integrated with international value chains as small open economies. In Figure 2.7 this group of countries, which among others includes France, is described as *domestic market driven.*

**Figure 2.7** Intermediates have a central role in both Finnish imports and exports




Note: Share of intermediates imports in total imports and in total exports in different countries. Blue vertical line and horizontal line describe the means for all countries. Authors' calculations based on WIOD data.

International trade in intermediates is more important for Finland than for most other countries: they account for a larger share of both Finnish imports and exports than in many other countries. The same applies to other countries in the category of small open economies, such as Sweden, Belgium and Luxembourg. Somewhat surprisingly, Denmark does not belong to this group according to our data. This is because the share of intermediates in Danish exports is somewhat lower than average.

# 3 THE VALUE OF VALUE NETWORKS: WHERE IS IT CREATED?

As we have seen, businesses today are making increasing use of imported components, services and part assemblies in their own production, which is often further exported for use as an intermediate product in some other country. The total value of exports increases with the evolution of the value chain towards the final product, through different stages of production.

However, the GDP of a country participating in the value chain is only increased by that part of the value added that is generated in the country concerned – not by the total value of exports. The higher the share of foreign inputs, the smaller the contribution of one euro generated from exports to GDP. It is therefore interesting to consider to what extent foreign value added contributes to the total value of Finnish exports, for instance, and how the globalisation of value chains has impacted the ability of exports to drive GDP growth.

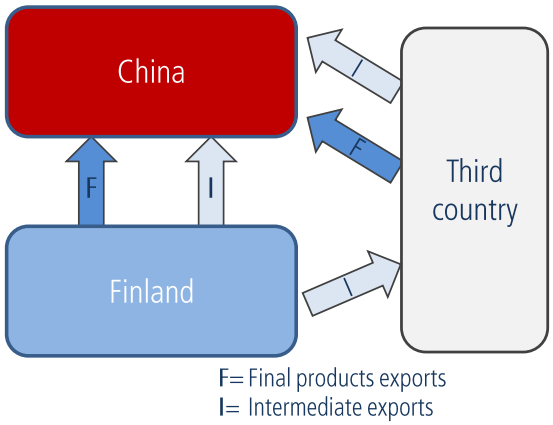
WIOD data provides a unique opportunity to analyse the creation of value added in different countries in the context of the whole value chain. In other words, rather than basing our analysis on bilateral import and export figures, we take into account all the countries involved in each value chain.

Our examination is based on the WIOT matrix above (see Text Box 2.1.). In order to get to grips with the process of value formation, the gross production flows shown in the matrix are first converted into value added form. Then, to trace the formation of value added in such a way that the use of intermediates is taken into account, the matrix is resolved in relation to final demand by using the so-called Leontief inverse matrix (see Appendix for a more detailed and technical description of the method).

This method allows us to break down production in Finland, for instance, into constituent parts that satisfy domestic and foreign final demand. In this section our focus is on the latter, or on what can broadly be described as Finnish export production. More precisely speaking, this refers to the part of Finnish value added and GDP that is produced in response to foreign final demand.

Foreign final demand is channelled into Finland either directly via demand for Finnish final products, or indirectly via demand for foreign final products that incorporate Finnish intermediate inputs. The former channel is reflected in Finnish exports of final products, and the latter in exports of intermediate products from Finland. Exports of intermediate products may go to the destination of final demand either directly or through third countries (see Figure 3.1) In addition to exports proper, this includes value added created in various support functions (transport, cleaning, administration, etc.). This is not understood as exports in the traditional sense, but the creation of this value added is closely tied up with exports and therefore dependent on foreign demand.

**Figure 3.1** How Chinese final demand is channelled into Finnish GDP

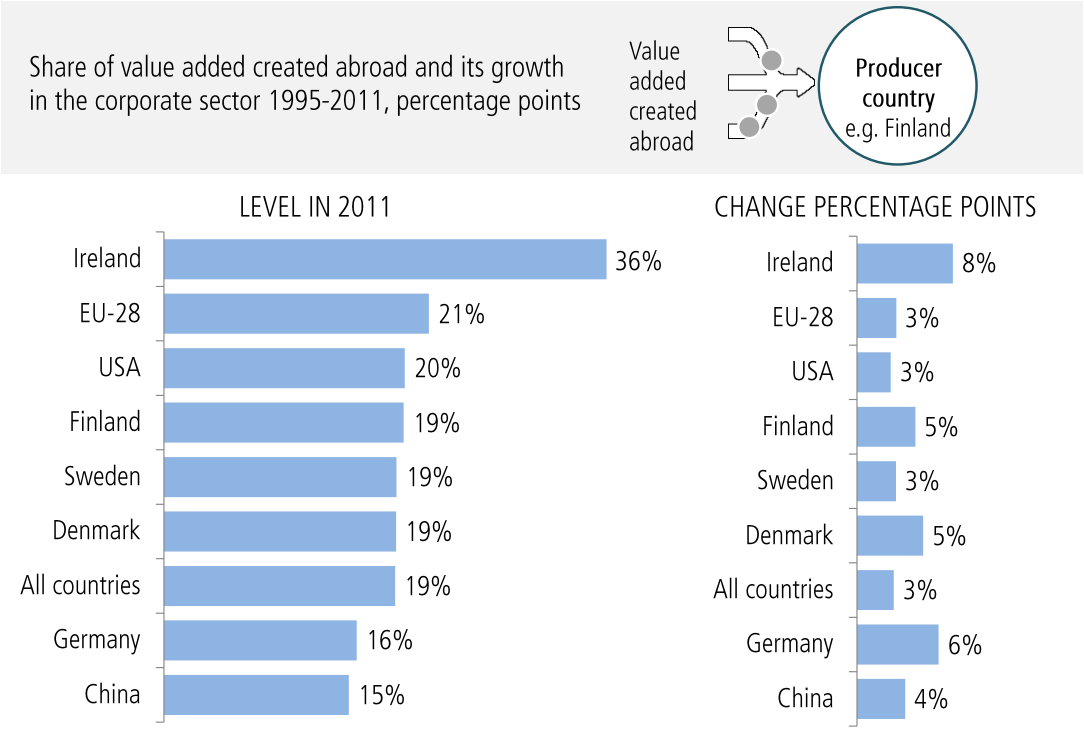



We work from the premise that this value added based measure that takes account of the various production stages provides a more accurate picture of the international dependencies of the Finnish economy than traditional indicators based on gross foreign trade flows. But before proceeding to describe our results concerning these dependencies it is useful to examine how the share of foreign value added, a crucial underlying factor, has developed over time.

### *Share of foreign value added has increased*

The impact of foreign final demand on GDP depends critically on the share of domestic value added in production and especially in export production. Our data show that in most countries, foreign value added accounts for around one-fifth of the total value of output (Figure 3.2). In Ireland this share is clearly higher than in many other countries, which is probably explained by Ireland's role as a European base for many US companies. Ireland's special role is at last in part attributable to its corporate tax regimes and practices.

**Figure 3.2** Increasing share of output value in corporate sector is generated abroad



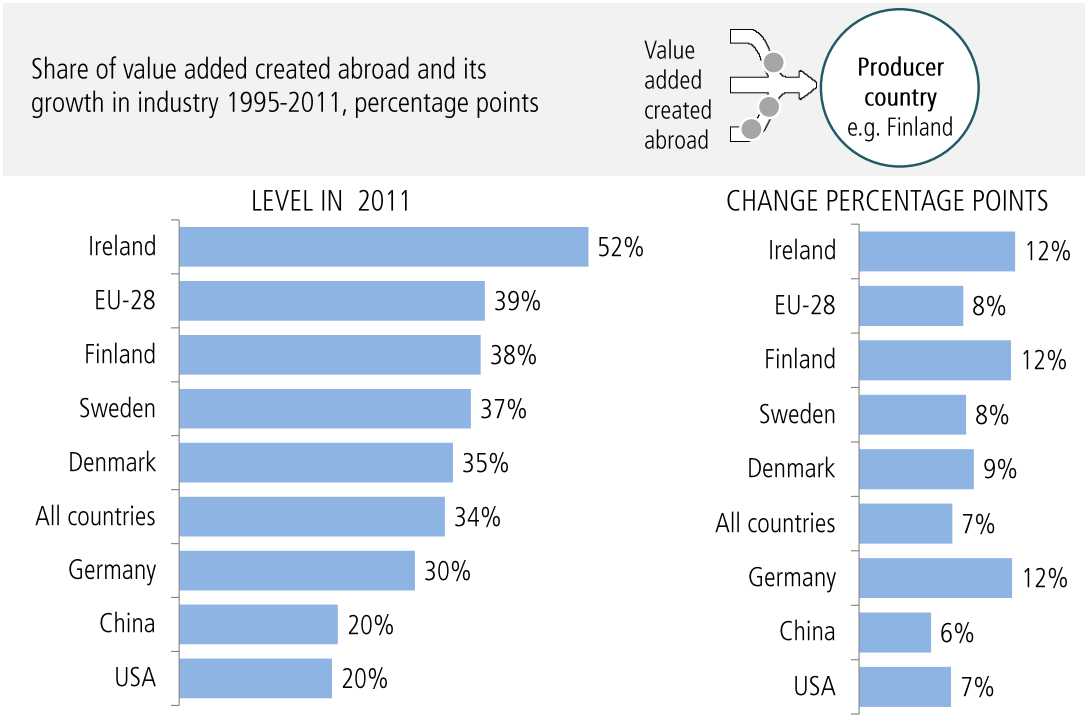

Authors' calculations based on WIOD data.

In Finland, the share of value added generated abroad (19%) is close to the world average and as well as to the EU average.

While there are only minor country differences in the shares of value added created abroad, the rate at which those shares have changed differs noticeably (right-hand side column in Figure 3.2). In Finland, Ireland, Denmark and Germany, the share of foreign value added has increased much more rapidly than average.

Growth has been particularly rapid in industry, where the share of foreign value added in different countries has increased on average by some 7 percentage points and in the EU area by some 8% (Figure 3.3). In Finnish industry this growth has been faster still, 12 percentage points. In Ireland and Germany, too, the share of foreign value added has increased equally rapidly.

**Figure 3.3** Increasing share of output value in industry is generated abroad, percentage points




Authors' calculations based on WIOD data.

In industry the share of foreign value added is clearly higher than in the economy as a whole. Well over one-third or 38% of the total value of Finnish industry is nowadays generated abroad. On average the figure for the whole EU area is roughly the same. By contrast the world average (34%) is lower than the Finnish figure.

The increasing share of foreign value added undermines the ability of total demand and exports to generate domestic GDP. When it is assumed that the share of foreign value added is the same in industrial products sold on both the domestic and export markets, the following conclusion can be drawn from the observations above: one euro worth of industrial exports contributes to increase GDP by no more than 0.62 euros (1–0.38). In service branches the share of domestic value added is higher, but as services still account for a

relatively small proportion of exports, the figure for industry can be considered representative of exports.[4]

It is important to stress that the increase in the share of foreign inputs gives no indication as to how the total value of domestically produced services and products has developed. It is possible that the use of foreign inputs improves competitiveness and thereby increases the domestic value added, i.e. GDP volume. However in order to achieve a certain GDP effect it is necessary to have a higher volume of exports.

### *Finnish growth depends heavily on Chinese and US final demand*

Next, we move on to discuss the dependence of the Finnish economy on final demand in different countries. As a small open economy, Finland's GDP depends on both domestic and foreign demand. Indeed, it is often said that Finland "lives off its exports" and depends on "export-driven growth". How large a part of Finnish GDP is attributable to exports, and which countries are the most important trading partners as far as Finnish growth is concerned?

National export and import statistics only provide information for the part of immediate trading partners. For instance, Finnish statistics indicate that our most important export destinations are Sweden, Germany and Russia, when measured in terms of traditional gross exports (in 2014). With the globalisation of value chains, however, the immediate export destinations may be completely different from the countries where the products and services exported from Finland are ultimately consumed and on the final demand for which Finland is ultimately dependent.

Table 3.1 shows a so-called VAX matrix (see Johnson and Noguera, 2012) which illustrates the mutual dependence of Finland and its key trading partners. The figures are calculated using 2011 WIOT data (see Appendix for a more detailed description of the method). The contribution of different countries' final demand to Finnish GDP can be seen in the corresponding columns on the Finnish row. In other words, the figure 3.6 on the Finnish row and in the Swedish column indicates that 3.6 billion dollars of Finnish GDP is attributable to meeting Swedish final demand[5].

As can be seen in Table 3.1, the most important foreign drivers of Finnish economic growth, under this definition, are China and the US. The contribution of both to Finnish GDP is around 3% (close to USD 7 billion)[6].

The combined contribution of all foreign countries is around USD 61 billion or 27% of Finnish GDP. This figure clearly demonstrates the dependence of the Finnish economy on foreign total demand, and thus provides an overall indicator of the openness of the Finnish economy. The corresponding proportion for Sweden was 32%, Denmark 31% and Germany 31%. In 2007 the figure was still higher in Finland, too, at 31%.

---

4 This estimate is more or less in line with the indicator for the domestic value added content of exports as reported in the OECD Tiva database. This Finnish figure for 2011 was 65% (Mattelmäki, 2016).

5 Put crudely, it can be suggested that Finland's GDP would be this much smaller without Sweden's contribution. The literature also uses the term Finnish value added exports to Sweden (see e.g. Johnson & Noguera, JIE 2012).

6 For consistency, the percentages are calculated on the basis of the GDP figures calculated from WIOT-data.A closer analysis of the Chinese case shows that most (80%) of the effect is attributable to intermediates exports, either directly or through third countries.

The Finnish column in the table furthermore allows us to see the contribution of Finnish final demand on different countries' GDP. These figures make apparent the small size of the Finnish economy. The only GDP figures in which the contribution of Finnish final demand exceeds one per cent are those of Estonia (4.7%) and Sweden (1.1%).[7]

**Table 3.1** Mutual dependencies among Finland's most important trading partners in 2011 according to a VAX matrix.

| | Australia | Brazil | China | Germany | Spain | Finland | France | UK | India | Italy | Japan | Nether-lands | Russia | Sweden | USA | Other countries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | 1123.8 | 2.8 | 75.5 | 7.5 | 1.6 | 0.5 | 4.0 | 8.4 | 7.1 | 2.9 | 40.9 | 1.5 | 2.7 | 0.9 | 25.6 | 89.7 |
| Brazil | 2.4 | 1833.3 | 27.0 | 16.8 | 4.3 | 2.0 | 6.9 | 6.2 | 2.3 | 6.6 | 8.2 | 4.8 | 4.3 | 2.9 | 30.7 | 106.6 |
| China | 53.2 | 30.8 | 5755.1 | 85.7 | 20.6 | 4.0 | 44.2 | 47.9 | 57.2 | 33.9 | 133.7 | 20.9 | 52.7 | 7.8 | 339.5 | 636.3 |
| Germany | 12.4 | 20.9 | 87.3 | 2263.8 | 32.1 | 7.1 | 72,4 | 58,4 | 11,6 | 53,9 | 21,2 | 28,0 | 32,8 | 16,9 | 104,1 | 486,7 |
| Spain | 2.1 | 3.3 | 7.4 | 23.7 | 1129.7 | 1.0 | 29.3 | 15.5 | 1.8 | 18.1 | 3.4 | 5.2 | 4.9 | 2.4 | 25,2 | 109,1 |
| Finland | 1.0 | 1.3 | 6.7 | 4.3 | 1.3 | 165.6 | 2.1 | 2.7 | 1.3 | 1.5 | 1.9 | 1.2 | 2.9 | 3.6 | 6,4 | 23,9 |
| France | 5.3 | 9.7 | 28.1 | 46.0 | 26.0 | 1.8 | 2094.1 | 27.3 | 3.4 | 27.1 | 9.9 | 8.8 | 9.6 | 4.9 | 42,8 | 193,3 |
| UK | 9.9 | 8.2 | 25.4 | 49.7 | 13.0 | 3.0 | 27.6 | 1702.1 | 7.3 | 17.4 | 10.5 | 18.7 | 8.7 | 7.1 | 75,1 | 240,2 |
| India | 5.7 | 3.3 | 16.9 | 14.2 | 3.7 | 2.4 | 6.9 | 13.6 | 1543.6 | 5.4 | 8.3 | 6.4 | 4.2 | 2.9 | 57,3 | 96,6 |
| Italy | 5.4 | 8.9 | 25.1 | 38.8 | 17.3 | 1.7 | 32.3 | 18.3 | 4.6 | 1586.4 | 9.0 | 5.0 | 15.8 | 3.5 | 37,1 | 174,8 |
| Japan | 16.3 | 9.2 | 131.1 | 25.9 | 6.3 | 0.8 | 12.7 | 14.7 | 9.2 | 7.9 | 5144.1 | 5.5 | 19.9 | 2.4 | 115,6 | 350,0 |
| Netherlands | 3.4 | 3.1 | 18.2 | 39.6 | 11.6 | 2.7 | 17.7 | 27.6 | 2.3 | 16.9 | 4.2 | 468.0 | 4.9 | 4.6 | 25,1 | 573,0 |
| Russia | 4.2 | 5.0 | 43.6 | 21.2 | 11.0 | 5.9 | 23.2 | 13.5 | 4.7 | 38.4 | 22.9 | 6.9 | 1178.7 | 4.2 | 41,6 | 185,6 |
| Sweden | 2.7 | 2.3 | 11.6 | 10.2 | 3.1 | 5.4 | 5.8 | 7.5 | 1.7 | 4.0 | 3.2 | 3.3 | 3.8 | 320.5 | 16,3 | 76,2 |
| USA | 33.3 | 36.4 | 148.3 | 69.8 | 29.9 | 4.8 | 43.7 | 76.9 | 31.7 | 27.1 | 73.5 | 28.1 | 16.1 | 11.8 | 13647 | 837,4 |
| Others | 90.9 | 107.9 | 578.3 | 312.3 | 111.1 | 18.8 | 178.2 | 184.5 | 148.8 | 167.5 | 334.8 | 73.2 | 127.1 | 46.1 | 984,8 | 4691,0 |

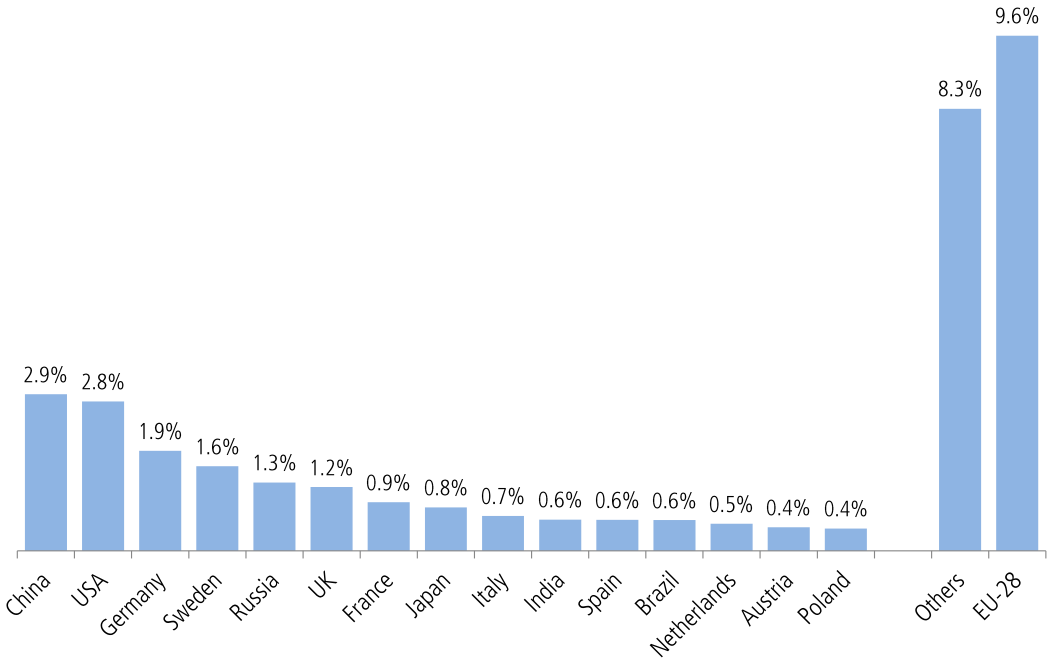
When the rows in the table are interpreted as value added exports and columns accordingly as value added imports, we can also examine the value added trade balance between different countries. In countries showing a trade surplus (such as Germany), the row sum is typically higher than the column sum, i.e. the effect of final demand from other countries on their GDP is greater than the effect of their final demand on other countries' GDP.[8]

Finland's value added based trade balance in 2011 was more in less in balance. A closer examination of bilateral relations shows that Finland's value added trade balance with China is in higher surplus than with the USA. This is because Finnish final demand strengthens US GDP to a greater extent than Chinese GDP.

7 Estonia is not included in Table 3.1 because of its minor significance. The figures for Estonia are presented in an Appendix Table A1.

8 Following this terminology, Germany is also a net exporter of value added. This observation is explained in part by the view according to which Germany should consume more, that is, import more value added and thereby support the growth of other countries.

**Figure 3.4** The effect on Finnish GDP of final demand by individual countries and areas, % of GDP in Finland.




EU-28 includes all current Member States except Finland. We have first calculated the effect of final demand in these areas on value added generated in Finland, and then compared this value added to Finnish GDP at basic prices. Authors' calculations based on WIOD data.

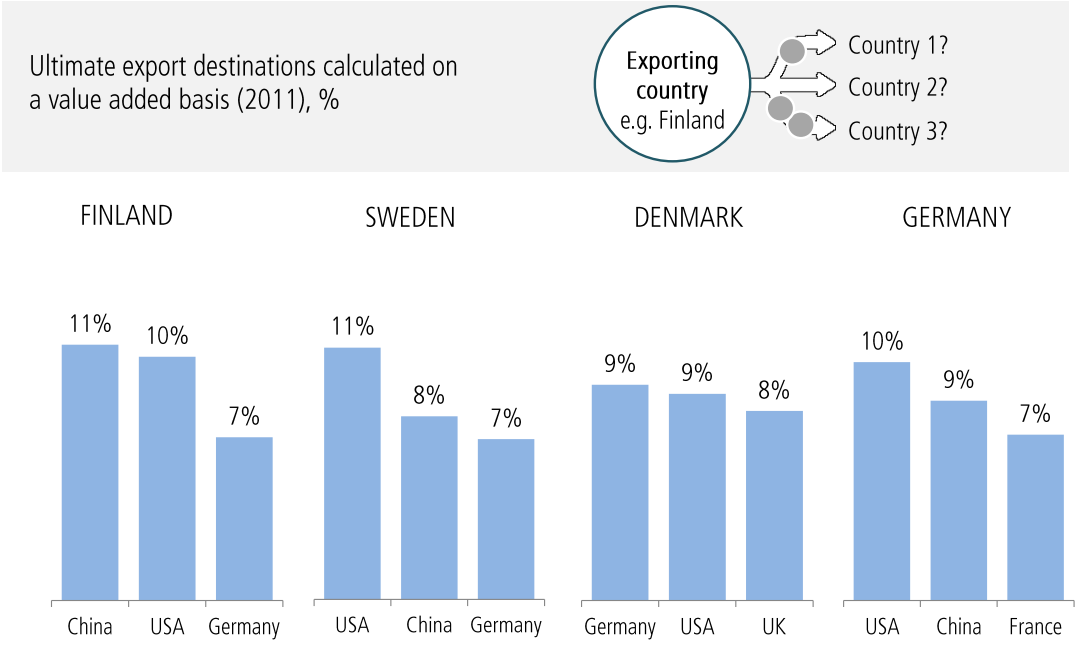
The performance of the US and Chinese economies thus has a major impact on overall Finnish exports. These effects come not only from direct, but also indirect exports: intermediates may be exported to, say, Sweden or Germany, via which they then often end up either directly or through third countries in China or the United States. This effect will go completely unnoticed if we only consider traditional, bilateral foreign trade statistics.

The role of China and the US may in fact be even greater if we additionally consider the impacts of these countries on the final demand in third countries – and thereby further on Finland. For instance, German economic growth and thereby overall demand are also partly dependent on developments in the United States and China, which therefore will also affect German final demand for Finnish production[9].

Although our analyses suggest that the two countries making the greatest contribution to Finnish GDP are China and the US, the combined contribution of the EU area is certainly greater than that of individual countries. Figure 3.4 relates the Finnish value added figure associated with final demand from our most important trading partners and the EU-28 area to Finnish GDP. Almost 10% of Finland's GDP is directly or indirectly related to satisfying final demand in other EU countries. The corresponding proportion for China and the United States is around 3%.

[9] This analysis does not take into account these kinds of intercountry multiplier effects. A careful examination of these kinds of cross-effects would require a general balance model that also takes account of dynamic effects.

**Figure 3.5** More than 10% of the domestic value added in Finnish exports is ultimately destined for China.




Figures calculated as follows: (domestic value added generated by exports to ultimate destination)/(total domestic value added generated by exports). Authors' calculations based on WIOD data.

China's role is underscored by the rapid growth of the Chinese economy in recent decades. In a straightforward application of the above observations, a 10% increase in final demand in China will drive Finnish GDP growth by some 0.3 percentage points. Accordingly a 1% increase in EU-28 final demand will increase Finnish GDP by roughly 0.1 percentage points.

What about Finland's so-called competitor countries: Does China have as great an effect on their economic performance? For comparison, Figure 3.5 shows Finland's, Sweden's, Denmark's and Germany's most significant trading partners in terms of their contributions to GDP. As we can see, Chinese and US final demand has great significance for all four countries with the exception of Denmark. However, it seems that China is somewhat more important for Finland than for it is for Sweden and Germany.[10]

### *In what industries is value added created?*

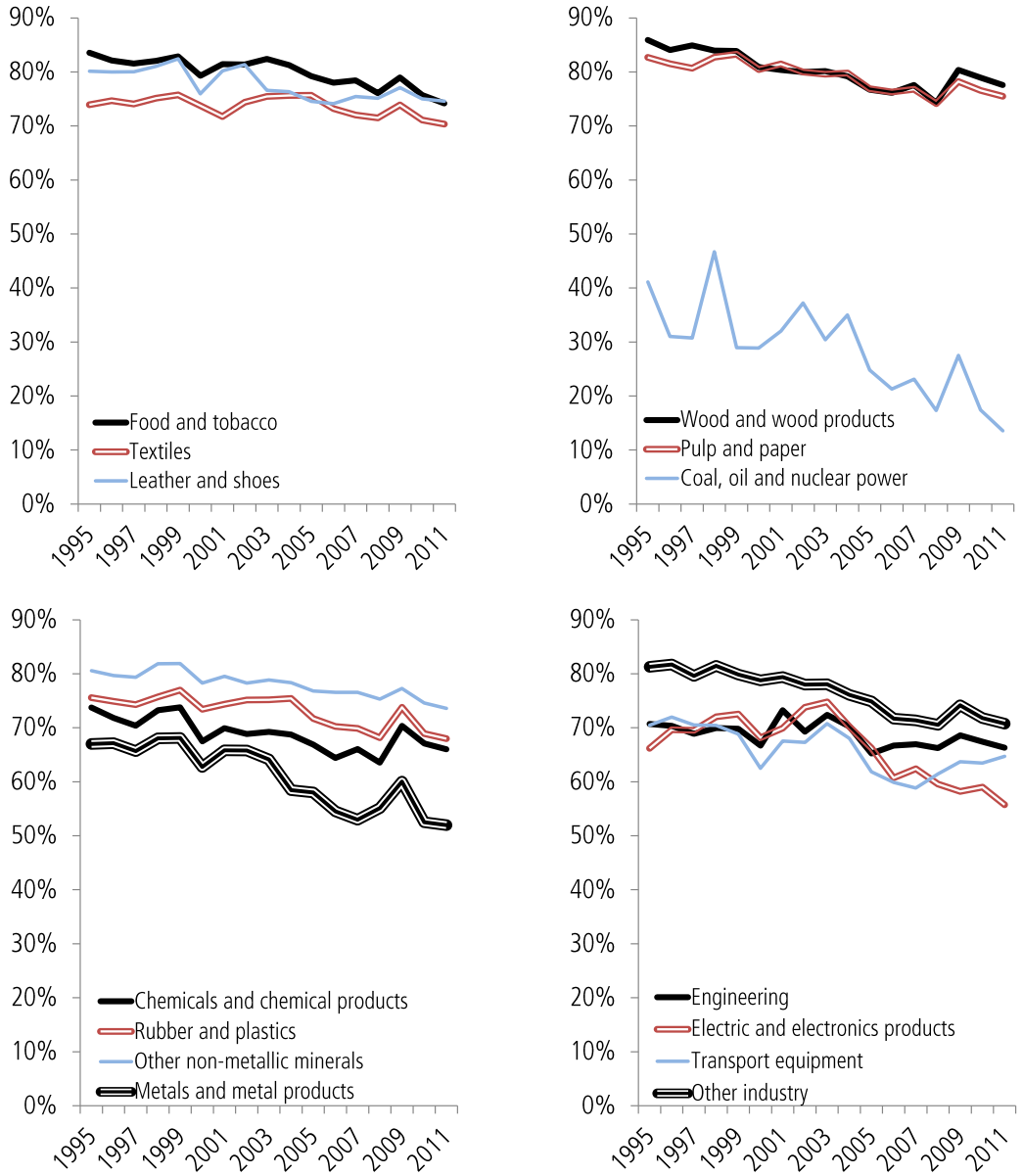
Different products and thereby different industries have different effects on the domestic economy. The differences in value chains stem from the fact that the share of domestically produced value added is greater in some products or services than it is in others. In other words, not all euros earned from exports have the same value from the vantage point of the national economy.

If large amounts of imported raw materials and components have been used in generating export revenue, the domestic benefit from an increase in exports may be quite limited – especially in the case of low value added products or services. In other words, one additional euro earned from exports does not always translate into an equivalent increase in GDP.

[10] The figures shown for Finland in Figure 3.4 differ from those in Figure 3.5 because they are compared not to GDP, but to total value added included in exports.

The share of domestic value added in exports is high in agriculture, raw materials and services. In industry the share is often lower (Johnson & Noguera, 2011). This difference does not, however, mean that the economy should be geared only to exporting primary production products or services. The export potential of primary products in particular depends largely on whether the country happen to have access to raw materials. If not, products aimed at the export market must be created – which in the case of physical products is usually done by industrial companies. Furthermore, it is necessary to bear in mind that a small share of value added remaining at home is not necessarily a severe drawback if the volume of production is high enough.

**Figure 3.6** Share of domestic value added has increased in all industries.




Figures describe share of domestic value added in total value added in different Finnish industries. Authors' calculations based on WIOD data.

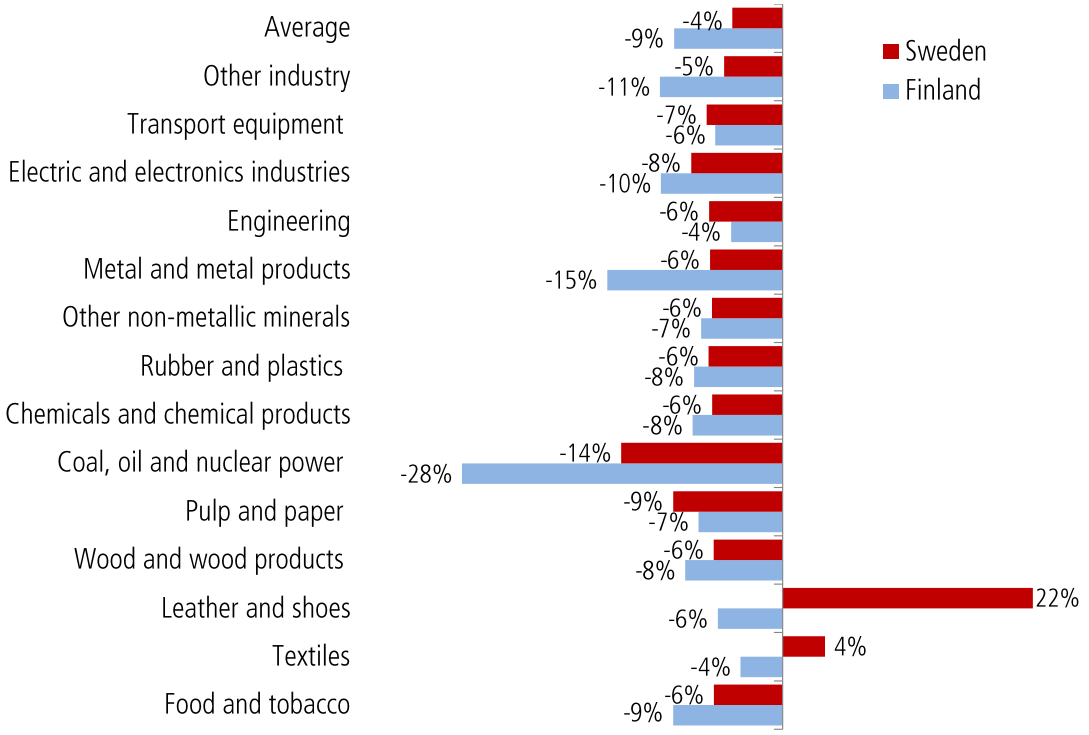
Figure 3.6 shows the development of the share of domestic value added for different industry branches in 1995–2011. Since 1995, domestic value added as a proportion of output value has fallen in all industries. However the patterns of change have varied in different

industries. In wood and paper products, for instance, the share has dropped in all by no more than 7–8 percentage points.

A much sharper fall (28 percentage points) is recorded for the coal, oil and nuclear power industry. In metal processing and the manufacture of metal products, too, the share of domestic value added has clearly declined (by 15 percentage points).

But do recent trends in Finland differ from those seen in other countries? A good point of reference is provided by Sweden, which shares many features in common with the Finnish economy (Figure 3.7). In almost all industries the share of domestic value added has fallen more in Finland than it has in Sweden. The only exceptions are the pulp and paper industry, engineering and the transport equipment sector.

**Figure 3.7** Share of domestic value added has decreased less in Swedish than in Finnish industry, percentage points




Change in the share of domestic value added from 1995 to 2011, percentage points. The yellow bars describe the change in Sweden and the blue bars the change in Finland. The average describes the unweighted average calculated for different industry branches. Authors' calculations based on WIOD data.

The biggest differences are found in perhaps rather surprising industries. In the leather and shoe industry the share of value added in Sweden has increased by more than one-fifth, whereas in Finland it has fallen by around 6%. This difference is surprisingly stark. It is possible that the explanation lies in well-known Swedish clothes brands (e.g. H&M, Peak, Haglöfs, Fjällräven, Björn Borg), part of which may be recorded in this branch. The second major difference concerns the coal, oil and nuclear power industry, where the fall recorded in Sweden has been only half of that seen in Finland. The third difference is found for the metal and metal products industry. In Finland domestic value added has dropped by 15 percentage points, but in Sweden by no more than 6 percentage points.

**Text Box 3.1. Comparison of WIOD and OECD data**

In recent years the OECD has been working to compile data and develop methods for the analysis of global value chains. An important part of this effort has involved collaborating with the World Trade Organization WTO to create a database on value added in foreign trade, known as *Trade in Value-Added* (TiVa). The principal source for the current report is the *World Input-Output Database* (WIOD), which has been compiled for purposes of independent academic research (see Text Box 1.1).

In the planning stage of our project a major focus was to establish the applicability of these databases to resolving the research questions in focus. In order to validate and compare the results we also did some background work that involved drawing corresponding and the closest equivalent indicators from the TiVa database (Mattelmäki, 2016).

The greatest weakness of the TiVa database when compared with WIOD is that it mainly consists of precalculated indicators and does not allow access to the underlying raw data. For example, TiVa's figures for foreign value added in Finnish exports are given in terms of total volume as a proportion of gross exports, effectively precluding any analysis of the shares of different countries in total foreign value added. The same goes for other TiVa indicators describing value chains. For this and other reasons we decided for this study to use the more flexible and more transparent WIOD data – even though this requires the performance of large matrix operations, which were done using Matlab software.

Despite its shortcomings, TiVa is in fact quite extensively used in value chain studies (Cappariello et al. 2014; Sturgeon 2013). It comprises both direct and value added based foreign trade statistics for goods and services in 61 countries and 34 industries. TiVa covers 95% of total world production and 90% of global trade in 1995, 2000, 2005 and 2008–2011. The TiVa database is formed on the basis of global input-output tables, which have been created by combining each country's national input-output tables using bilateral trade statistics.

OECD's input-output matrices have the same structure as the WIOT input-output matrices in WIOD data, and therefore there are no differences between the two datasets in how they measure intermediates and final products exports and imports. Furthermore, value added is calculated in both datasets as the difference between the export price of the commodity or service and the acquisition costs of the intermediates and raw materials produced at home and abroad.

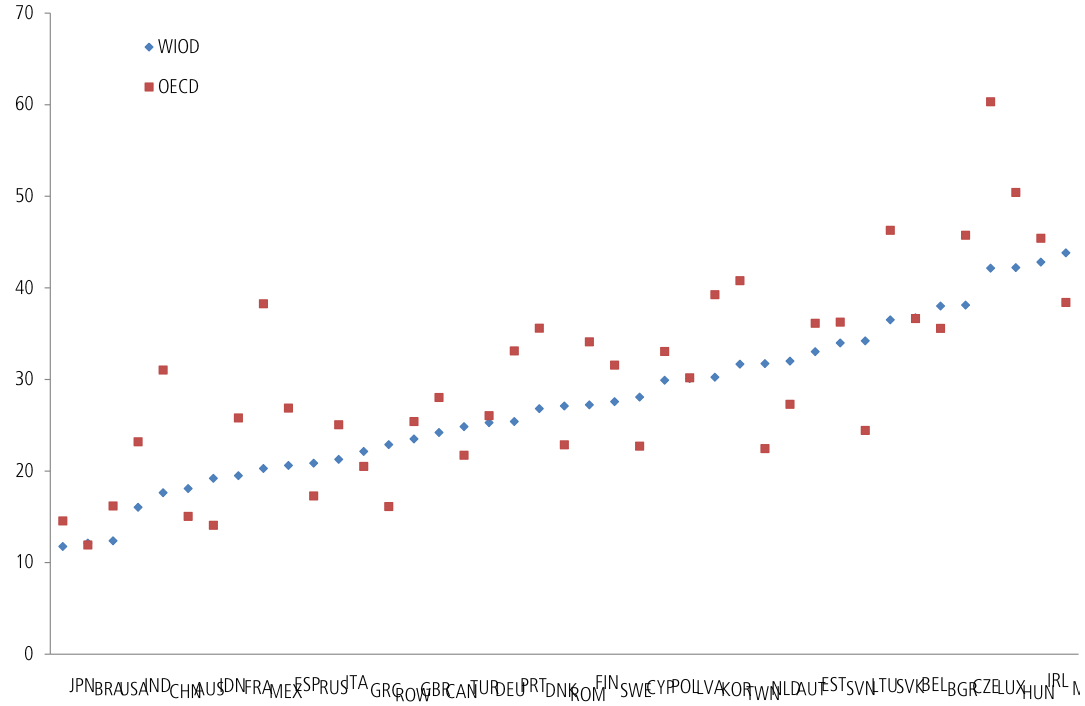
The *backward linkage* matrix formed in this study on the basis of WIOD data to describe global value chains does not differ conceptually from the corresponding TiVa matrix. The only difference comes from the observations used: in TiVa they are defined as a proportion of total exports. In this study the position of countries in value chains is illustrated using import and export indicators of intermediate and final products, which differs from TiVA's estimate of the number of production stages outside the country concerned. In practice, however, the country's degree of specialisation is defined by reference to country indicators of export and import intermediates.

The differences between the two datasets are illustrated in the figure below, which describes the share of foreign value added in different countries' value added exports (VAX) in both materials in 2011. The figures differ significantly for several countries. Depending on the data used, this may have a substantial effect on the conclusions drawn from the study. The differences may stem from the source materials or methods used in compiling the input-output tables, for example.

Despite these differences, Timmer et al. (2015) report that the two datasets have a correlation of over 0.9. Degain et al. (2014), for their part, analysed data for 2005 and found marked differences between OECD and WIOD datasets in the amounts of domestic and foreign value added in intermediates exports as compared with the amounts of value added in final products. They suggest that the differences may reflect dataset differences in intermediate demand matrices.

Both TiVa and WIOD are based on estimates of national input-output tables, which in themselves are estimates. In several situations the formation of databases and the balancing of statistics has required strong assumptions (regarding firm homogeneity, for instance), which is why GDP and other indicators derived from them are not fully consistent with official statistics.

**Figure T.2** Share of foreign value added in final products exports in different countries in 2011 (VAX)




Sources: WIOD and TiVa.

References


Antràs, P., Chor, D., Fally, T. ja Hillberry, R. (2012). "Measuring the Upstreamness of Production and Trade Flows", American Economic Review, Vol. 102, No. 3, pp. 412-16.

De Backer, K. ja Miroudot, S. (2013), "Mapping Global Value Chains", OECD Trade Policy Papers, No. 159, OECD.

Koopman, R., Powers, W., Wang, Z. ja Wei, S.-J. (2010). "Give credit to where credit is due: tracing value added in global production chains", NBER Working Papers Series 16426. Sturgeon, T. (2013) "Global Value Chains and Economic Globalization - Towards a New Measurement Framework", Report to Eurostat.

Mattelmäki, L. (2016): OECD:n ainestoon perustuva katsaus Suomen osallistumiseen kansainvälisiin arvoketjuihin, julkaisematon muistio 23.6.2016, Valtioneuvoston kanslia.

Timmer, M., Dietzenbacher, E., Los, B., Stehrer, R., ja de Vries, G. (2015). An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production. Review of International Economics 23 (3), 575-605.

Jones, L., Wang, Z., Xin, L., Degain, C. (2014). The Similarities and Differences among Three major Inter-Country Input-Output Databases and their Implications for Trade in Value-Added Estimates. UCIT, No. 12B.

# 4 CONCLUSIONS

The globalisation of value chains in goods and services production has profoundly changed the structure of foreign trade and its impact on the performance of national economies. Today, exports and imports from and to advanced economies consist predominantly of various types of intermediates, which are processed into final products somewhere else. A significant part of imported intermediates are specifically intended for use by export companies. The intermediates imported into Finland by these companies continue on their way and are further exported to some third country.

At the firm level, it is quite easy to see and follow the workings of value chains, but at the level of national economies it is much harder to weigh their significance. In Finland, for instance, intermediates have long accounted for a rather large share of total exports. In recent decades this share has increased at more or less the average rate, but because of its high initial level the current share of intermediates at 76% is exceptionally high by international comparison.

These trends in development are changing traditional notions of the benefits of foreign trade and recommended policy measures. Firstly, ***the opportunity for low-cost imports is a crucial part of international competitiveness***. When different kinds of intermediates cross national borders, possibly several times, even minor costs and delays associated with these border crossings add up into cost factors that will undermine profitability. The ability to cost-effectively import the most advanced types of intermediates may be decisive for the success of Finnish-based production.

Secondly, the growing share of foreign intermediates means that the ***ability of Finnish exports to drive domestic GDP growth is weaker than before.*** Our estimate is that in 2011, foreign value added accounted for 35–38% of Finnish exports. This means that on average, our exports contribute to driving GDP growth by a weight of no more than just over 0.6 (1–0.38). In industry, the GDP contribution is 0.62 euros. In order to achieve a certain level of economic growth, then, it is necessary to have higher gross exports growth than earlier. On the other hand, a fall in exports will not result in as sharp a fall in GDP as has earlier been the case.

***The amount of domestic value added contained in exports varies sharply from industry to industry***. Not all euros generated from exports contribute to economic growth with the same weight. In other words, it is not irrelevant what is exported from Finland. The share of domestic value added is highest of all in the food industry and in the wood and paper industry. Exports in the oil refining segment, by contrast, include a very large share of foreign value added, and therefore do not increase GDP as effectively. In 1995–2011 the share of domestic value added has dropped particularly sharply in metal processing and in the manufacture of metal products, by as much as 15 percentage points. In Sweden the corresponding fall has been no more than 6 percentage points. A similar difference is seen in many other sectors, too: in Finland the share of domestic value added has fallen more sharply than in Sweden.

Indirect exports via third countries constitutes an integral element of global value chains. ***Indirect exports profoundly affect our notions of the interdependencies between different economies***. The consequences of trends in Chinese domestic demand for Finland,

for instance, depend not only on direct Finnish exports to China, but also on other exports of intermediates that are used to produce the goods and services exported to China.

The up-to-date international input-output data used in this study allows us to conduct analyses that are not possible using Finnish national statistics alone. It also allows us to take into account the impacts of indirect exports when exploring the interdependencies between different countries and regions. According to the results the Finnish economy is most heavily dependent[11] on Chinese and US demand for final products. In particular, ***China's significance to Finnish economic growth has increased rapidly***. At the same time the roles of our biggest EU trading partners and Russia have been declining.

***The most recent data indicate that over one-quarter of (27%) of Finnish GDP is attributable to meeting foreign demand for final products.*** Both China and the US account for around one-tenth each. Although neighbouring Sweden and Russia are important trading partners for Finland, their contribution to Finnish GDP is no more than around one-half of the US and Chinese contributions and roughly the same as the French and British contributions. Germany's contribution is around two-thirds of that of the United States and China.

As well as providing access to inexpensive and high-quality intermediates, ***being part of global value chains offers many potential advantages for economies like Finland***. These include increased productivity through specialisation and technology transfer. Value chains may also attract foreign investment and provide SMEs a more efficient avenue to internationalisation than they could hope to achieve through their own export efforts.

To further fasilitate the participation in global value chains it is paramount to ***take steps to ease and streamline foreign trade procedures and to maintain and develop the infrastructure required by foreign trade***. This applies equally to ports, airports and fast data communications.

However, success in global value chains requires that firms in the traditional domestic market sector adopt a competitive pricing strategy, as the high costs for business services, for instance, can no longer be hidden in the gross margin. This underscores the significance of ***domestic market competition policy***.

***Competitive cost levels*** are crucial in helping domestic business integrate into global value chains. This can be achieved by replacing imported inputs for export production by domestic intermediate products and services. On the other hand, so-called internal devaluation is less significant for export success than before as a significant part of export costs is tied up with imported inputs.

An exclusive focus on costs, however, will not yield the desired end result. Labour costs in, Bulgaria, Albania and Macedonia, for instance, are close to the levels in China, yet the unemployment rate in these countries is still around 10–20%. Costs are not the only relevant factor. ***In the longer term the focus must be turned to generating high levels of value added per hour worked. This will require developing products or services that allow for distinction from the competition – presenting a strong case for investing in education, research and product development.***

[11] Countries whose final demand contributes the most to Finnish GDP.

***Global value chains also involve risks***, such as excessive specialisation and heavy dependence on economic performance in individual countries. When businesses integrate into value chains through their own efforts, the prevailing view is that government has no chance nor indeed reason to interfere directly in the markets. In the longer term, however, government can promote an education policy, for instance, that will encourage businesses to base operations that require high skill levels and high productivity in Finland.

It is important to continue to monitor cross-country interdependencies. Despite China's growing role and significance, the "country portfolio" of Finnish foreign demand remains firmly biased towards the EU. Indeed from a regional risk-sharing point of view the growing role of China can also be seen as a positive trend in development. On the other hand, with the slowdown of economic growth in China, the multiplier effects for Finland will also be more pronounced.

# 5 REFERENCES


Ali-Yrkkö, J. (2013). *Mysteeri avautuu. Suomi globaaleissa arvoverkostoissa*. Etla B 258, Elinkeinoelämän tutkimuslaitos, Helsinki.

Ali-Yrkkö, J., Rouvinen, P., Seppälä, T. & Ylä-Anttila,P. (2011). Who Captures Value in Global Supply Chains? Case Nokia N95 Smartphone. *Journal of Industry, Competition and Trade*, 11(3), 263-278.

Autor, D., Dorn, D., & Hanson, G. H. (2016). The China Shock: Learning from Labor Market Adjustment to Large Changes in Trade. *NBER Working Paper 21906*.

Baldwin, R. (2006). Globalisation: The great unbundlings(s). In: Prime Minister's Office. *Globalisation challenges for Europe. Report by the Secretariat of the Economic Council – Part I. Prime Minister's Office Publications 18/2006*, Helsinki.

Baldwin, R. (2012). Global Supply Chains: Why They Emerged, Why They Matter, and Where They Are Going. CTEI Working Papers 2012-13. Centre for Trade and Economic Integration. Graduate Institute of International and Development Studies, Geneva, Switzerland.

Baldwin, R. & Evenett, S. (2012). Value Creation and Trade in 21st Century Manufacturing: What Policies for UK Manufacturing. Teoksessa: Greenaway, D. (ed.). *The UK in a Global World – How can the UK focus on steps in global value chains that really add value?* Centre for Economic Policy Research, London, UK.

Caves, E. R., Frankel, J. A. & Jones, R.W. ( 2007). World Trade and Payments: An Introduction, 10th Edition. Pearson International Edition. Addison Wesley, ISBN 9780321226600.

Dedrick, J., Kraemer, K. L. & Linden, G. (2009). Who Profits from Innovation in Global Value Chains?: a Study of the iPod and Notebook PCs*. Industrial and Corporate Change*, 19, Number 1, 81-116.

IFR (2016). *World Industrial Robots 2015.* World Robotics Federation (IFR), Frankfurt, Germany.

Johnson, R. B. & Noguera, G. (2012). Accounting for Intermediates: Production Sharing and Trade in Value Added. *Journal of International Economics, 86*, 224-236.

Kee, H. L. & Tang, H. (2016). Domestic Value Added in Exports: Theory and Firm Evidence from China. *American Economic Review* , 106,

Leontief, W. (1936). Quantitative Input-Output Relations in the Economic System of the United States. *Review of Economics and Statistics,* 18 (3), 105-25.

Los, B., Timmer, M. & de Vries, G. (2015). How Global are Global Value Chains? A New Approach to Measure International Fragmentation. *Journal of Regional Science*, 55, 66-92.

Timmer, M., Erumban, A., Los, B., Stehrer, R., & de Vries, G. (2014). Slicing Up Global Value Chains. *Journal of Economic Perspectives* 28 (2), 99-118.

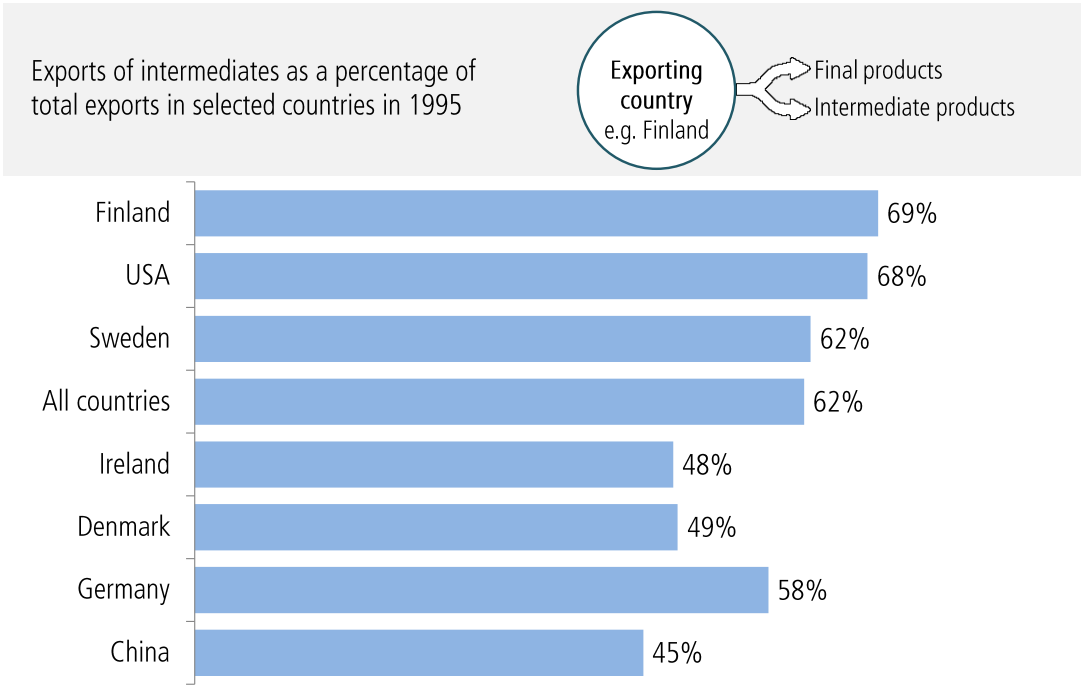
Timmer, M., Los, B., Stehrer, R., & de Vries, G. (2013). Fragmentation, Incomes and Jobs: An Analysis of European Competitiveness. *Economic Policy*, no. October, 613-61.

Timmer, M., Dietzenbacher, E., Los, B., Stehrer, R., & de Vries, G. (2015). An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production. *Review of International Economics* 23 (3), 575-605.

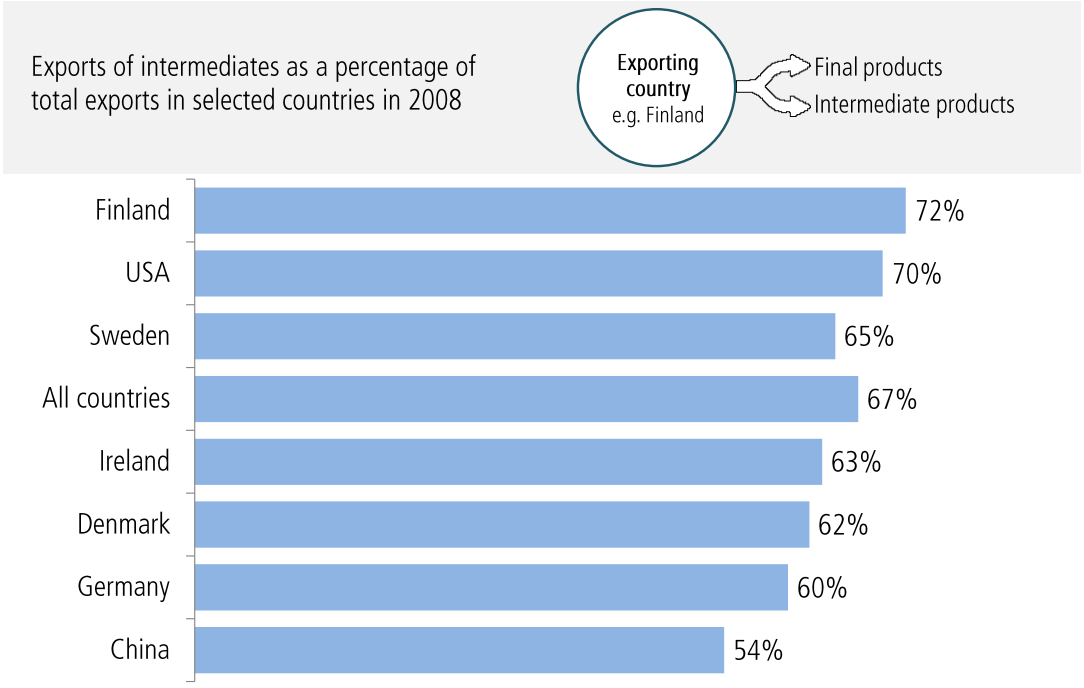
Tuhkuri, J. (2016). Trade and Innovation: Matched Worker-Firm-Level Evidence. *ETLA Working Papers* no 39. ETLA – The Research Institute of the Finnish Economy, Helsinki.

# 6 APPENDICES

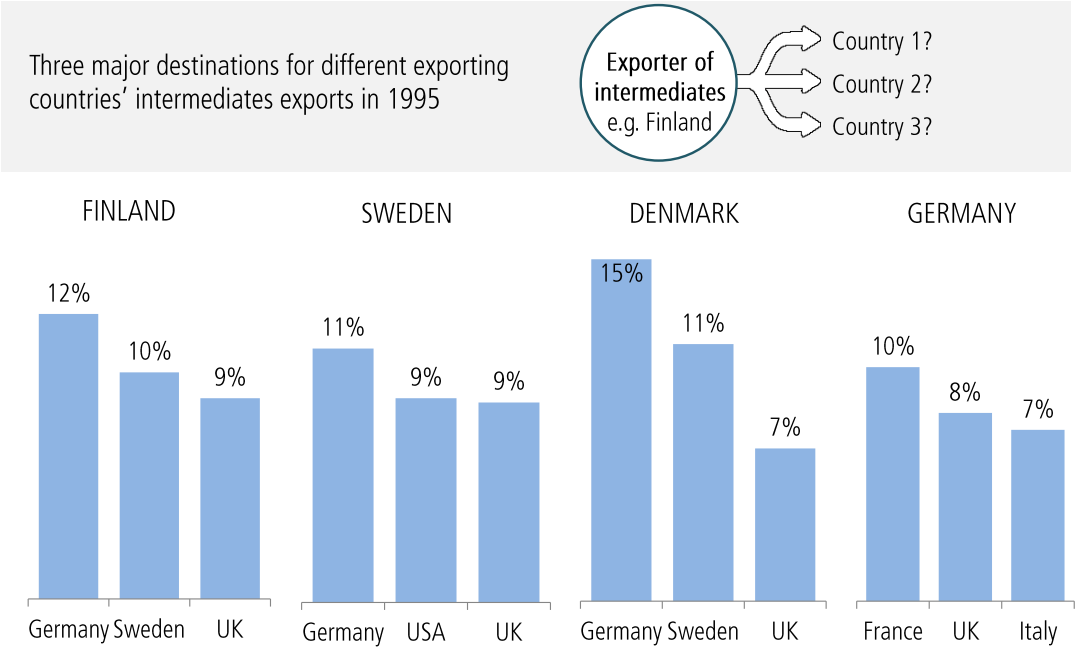
**Appendix Table A1. Exports of intermediates as a percentage of total exports in selected countries in 1995**



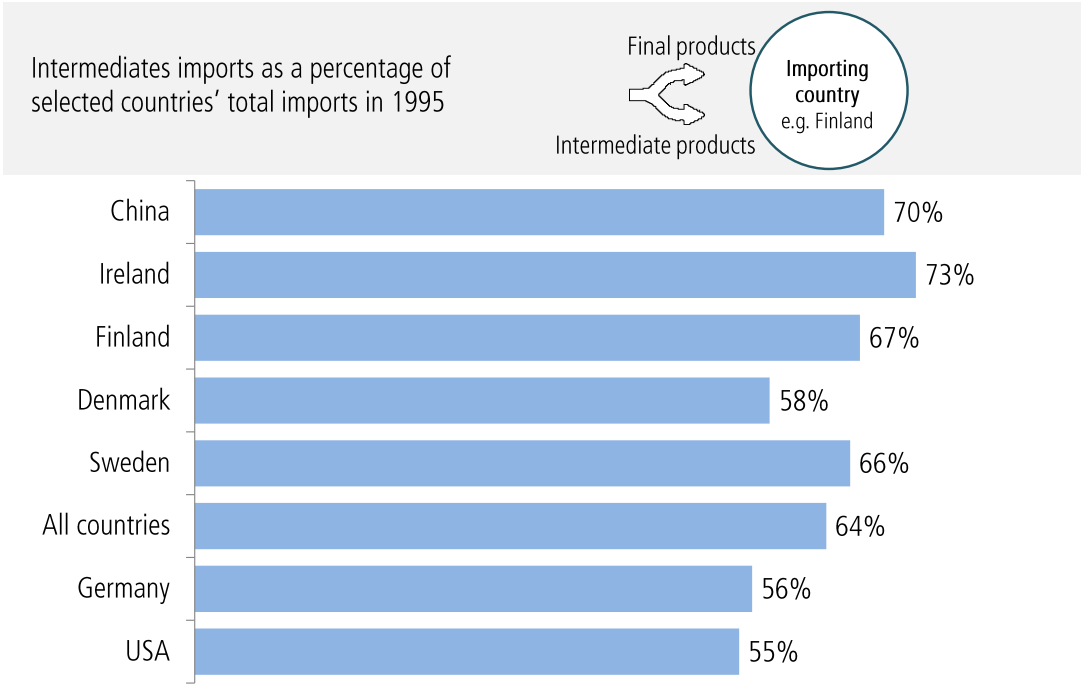

**Appendix Table A2. Exports of intermediates as a percentage of total exports in selected countries in 2008**



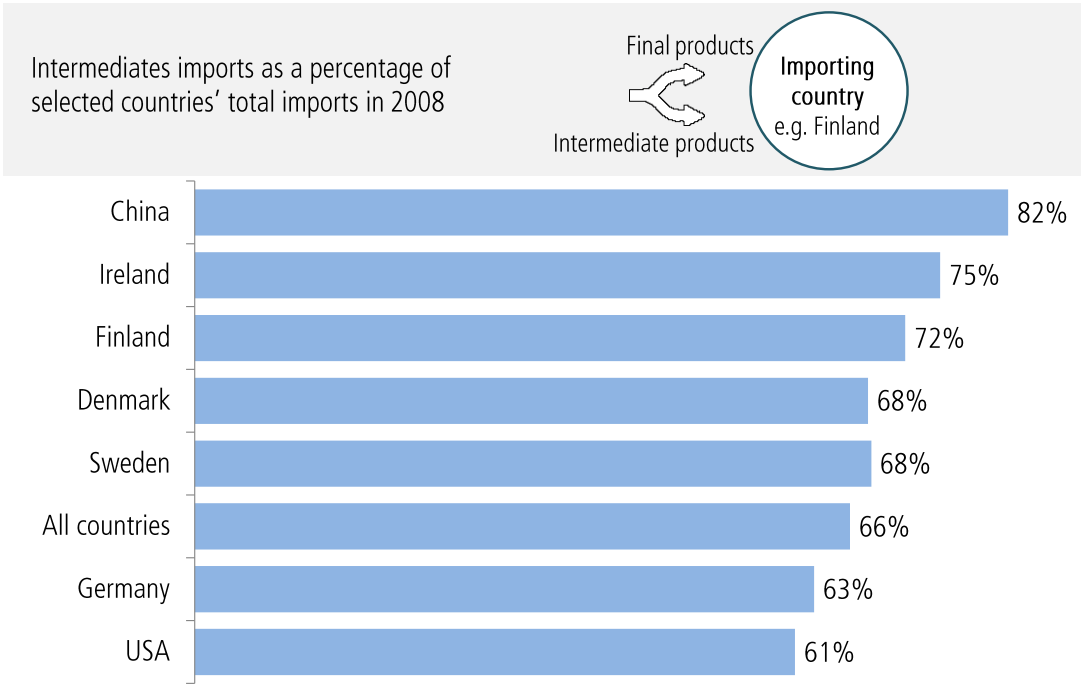
Appendix Table A3. Three major destinations for different exporting countries' intermediates exports in 1995



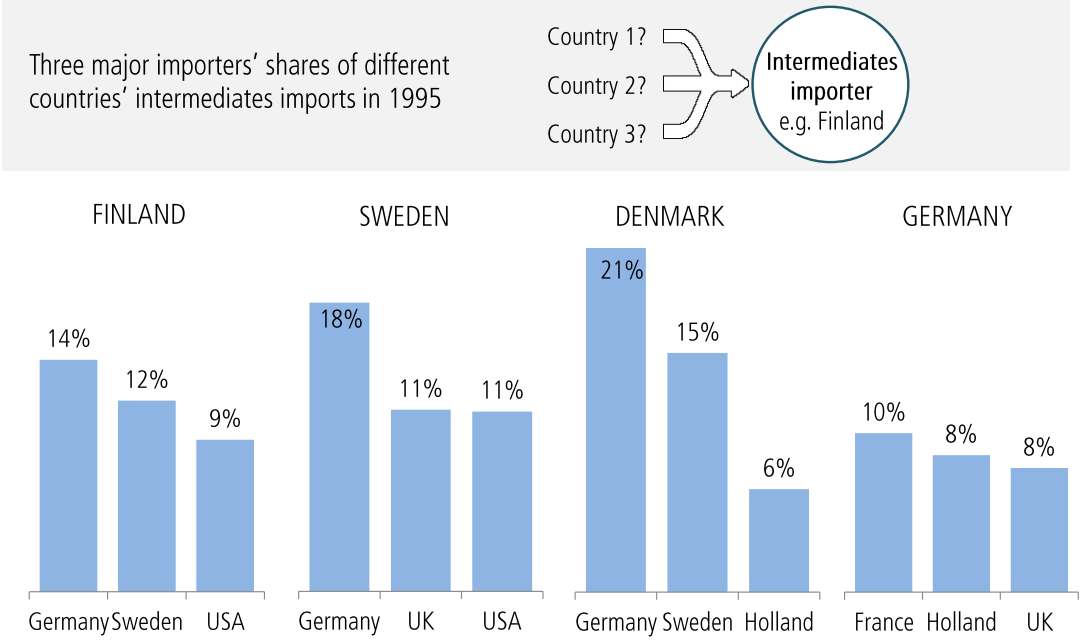

Appendix Table A4. Intermediates imports as a percentage of selected countries' total imports in 1995



Appendix Table A5. Intermediates imports as a percentage of selected countries' total imports in 2008




Appendix Table 6. Three major importers' shares of different countries' intermediates imports



**Appendix. Description of the method used in measuring global value chains**

In this report, a global value chain refers to a production chain leading to a final product. The final product is a good (a physical commodity or a service) that is consumed via either private or public consumption/investment. The chain begins, for instance, from the production of a raw material and proceeds through intermediate products made out of the raw material and the assembly of the final product to its consumption.

The Apple *iPod*, for instance, is designed in California, but manufactured in China (Dedrick et al. 2010; Autor et al. 2016; Tuhkuri 2016). Using WIOD data, we can estimate the production chain within a certain industry from beginning to end. In the case of the Apple *iPod*, this means distributing the value of the Chinese electronics industry's end production between different industries in different countries, which are involved in the chain either directly or indirectly.

A distinctive feature of global value chains is that imports are embedded in exports. This can be measured using WIOD data.

More precisely, we measure global value chains by using the method presented by Johnson and Noguera (2012). This is a multi-country elaboration of Leontief's (1936) famous input-output method. Timmer et al. (2015, 2014, 2013) and Los et al. (2015) have presented a version of the model applied to WIOD data.

The premise of the method is simple: output is either consumed or used as an intermediate input in production. This also forms the basis of the World Input-Output Table (WIOT) – output is divided between intermediate and final products.

In mathematical terms, this is described by the following equation:

$$\mathbf{q} = \mathbf{Bq} + \mathbf{c}, \qquad (1)$$

where **q** is total output vector, **c** is final demand vector and **B** is the coefficient matrix for the intermediate inputs used in production. The figures in matrix **B** are input coefficients and indicate the level of demand for intermediates. **Bq** is the total amount of these intermediates. Total output **q** is thus divided between the element **Bq** that goes towards intermediates and the element **c** that goes to final demand. These matrices are highlighted in the earlier figure illustrating the WIOD data.

Equation (1) can be rewritten as

$$\mathbf{q} = (\mathbf{I} - \mathbf{B})^{-1}\mathbf{c}, \qquad (2)$$

which describes the ratio of total output **q** to final consumption **c**. **I** is the identity matrix. The element $(\mathbf{I} - \mathbf{B})^{-1}$ is called Leontief's inverse matrix. It estimates the value **q** of total output that is needed in all stages of the production chain to generate final demand **c**.

To estimate the global value chain, equation (2) is multiplied by the value added produced by each industry in each country in relation to their total output. This is indicated by the diagonal matrix **F**. The end result is equation (3). This describes the value added produced by the industries that are directly and indirectly involved in producing the end product of a certain industry:

$$\mathbf{K} = \mathbf{F}(\mathbf{I} - \mathbf{B})^{-1}\mathbf{c}. \qquad (3)$$

Matrix **K** describes the value added that is needed at all stages of the production chain to generate final demand **c**. The individual element in matrix **K** indicates the value added produced by a certain industry in a certain country in the final production of the selected country and industry. The series of these values added is called the value chain.

Another interpretation of equation (3) is to describe the production chain as an infinite geometric sum. For example, Chinese electronics industry end production uses German components as imported inputs. The German components, for their part, require Finnish design as an imported input. And Finnish design, in turn, contains in itself other imported inputs. This chain can be perceived as an infinite geometric series in accordance with the Leontief (1936) principle. In the method we employ, the value of the total output required to produce the final product can be estimated on the basis of the sum of this geometric series. In other words, we are effectively estimating the value of each element in the value chain. In this way we can calculate, for instance, how much of the value added in the Chinese electronics industry's final production is generated in China, and how much comes from Finland or the United States. The intermediate input matrix **B** has a key role here: it describes the international relations of inputs and outputs.

The value chain is identified according to final production, whereby all production is either final production or intermediate production. Intermediate production is always related to some value chain that ultimately ends in final production. The reason for this is simple: in order to ensure that the chain is estimated only once, it must have no more than one end point.

Ultimately the method produces a GVC table that describes global value chains.[12] The following Table M1 illustrates the structure of the GVC table.

**Table M1.** GVC table

| | | | Value chains<br>Value chains identified by country-industry in which the final product is produced | | | | | | | Total value added |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Country 1 | | | … | Country M | | | |
| | | | Industry 1 | … | Industry N | … | Industry 1 | … | Industry N | |
| **Value added** Value added produced in value chains by countries-industries participating in the value chain | Country 1 | Industry 1 | (a) | | | | | | (b) | |
| | | … | | | | | | | | |
| | | Industry N | | | | | | | | |
| | … | … | | | | | | | | |
| | Country 2 | Industry 1 | | | | | | | | |
| | | … | | | | | | | | |
| | | Industry N | (c) | | | | | | | |
| Value of total output | | | | | | | | | | World GDP |

[12] Global Value Chain Table

Matrix **K** is highlighted in Table M1. In this table every vertical row is a value chain whose figures indicate the participation of industries in different countries in final production within a certain industry. The sum of these values added is the value of final production in a certain country and industry.

For instance, cell (a) shows the value added produced by industry *1* in country *1* within its own final production. Cell (b), then, describes the value added produced by industry *1* in the same country country *1* within the final production of industry *N* in country *M.* The generation of value added into the value chain may happen directly through exports, but also indirectly through intermediaries in production.

The vertical and horizontal rows are summed up in the margins of the table. The sum for the vertical row indicates the value of final production in the country and industry concerned. The sum of the horizontal row is the sum of the value added produced in a certain country and industry domestically and internationally. Both rows add up to give world GDP.

As an expansion to the method we have outlined here, final demand can be understood in terms of only a certain part of world final demand, say only Chinese final demand. In this case the end result is the value added serving Chinese final demand by country and by industry. We have also used a method where final demand covers only the final demand outside each country. This can be interpreted as value added exports or VAX[13] (Timmer et al. 2015). It is not direct exports, but production generated by final demand from outside the country concerned, which is a slightly different matter. Furthermore, the GVC table we use can be aggregated to country level, and separate analyses conducted based on this data.

[13] Value Added Exports.

Appendix Table 1. Interdependencies between different countries (see Table 3.1).

| | AUS | AUT | BEL | BGR | BRA | CAN | CHN | CYP | CZE | DEU | DNK | ESP | EST | FIN | FRA | GBR | GRC | HUN | IDN | IND | IRL | ITA | JPN | KOR | LTU | LUX | LVA | MEX | MLT | NLD | POL | PRT | ROM | RUS | SVK | SVN | SWE | TUR | TWN | USA | ROW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUS | 112,4 | 0,7 | 1,1 | 0,2 | 2,8 | 6,3 | 75,5 | 0,0 | 0,4 | 7,5 | 0,8 | 1,6 | 0,0 | 0,5 | 4,0 | 8,4 | 0,4 | 0,2 | 6,3 | 7,1 | 0,7 | 2,9 | 40,9 | 14,8 | 0,0 | 0,1 | 0,0 | 1,9 | 0,1 | 1,5 | 0,9 | 0,2 | 0,2 | 2,7 | 0,2 | 0,1 | 0,9 | 1,4 | 4,9 | 25,6 | 46,3 |
| AUT | 1,2 | 250,0 | 1,6 | 0,5 | 3,0 | 1,6 | 8,9 | 0,1 | 2,2 | 21,2 | 0,5 | 2,6 | 0,1 | 0,6 | 4,8 | 4,6 | 0,7 | 2,2 | 0,6 | 1,1 | 0,3 | 7,2 | 2,2 | 1,3 | 0,1 | 0,3 | 0,1 | 0,8 | 0,1 | 1,6 | 2,0 | 0,5 | 1,7 | 3,0 | 0,8 | 0,8 | 1,3 | 1,9 | 0,7 | 10,0 | 32,6 |
| BEL | 1,6 | 1,9 | 283,5 | 0,3 | 3,7 | 2,2 | 9,7 | 0,1 | 1,2 | 19,0 | 1,6 | 6,7 | 0,1 | 1,3 | 17,4 | 13,2 | 1,5 | 1,0 | 1,3 | 3,8 | 0,9 | 8,9 | 2,7 | 1,3 | 0,2 | 2,1 | 0,1 | 1,1 | 0,1 | 11,0 | 2,4 | 1,2 | 0,8 | 3,0 | 0,4 | 0,2 | 3,0 | 3,0 | 0,7 | 15,9 | 29,0 |
| BGR | 0,1 | 0,3 | 0,3 | 29,2 | 0,1 | 0,1 | 0,5 | 0,0 | 0,1 | 1,2 | 0,1 | 0,3 | 0,0 | 0,0 | 0,6 | 0,4 | 0,7 | 0,1 | 0,1 | 0,1 | 0,0 | 0,9 | 0,1 | 0,1 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,1 | 0,2 | 0,1 | 0,7 | 0,8 | 0,0 | 0,0 | 0,1 | 1,2 | 0,0 | 0,6 | 3,9 |
| BRA | 2,4 | 1,7 | 2,9 | 0,2 | 1833 | 5,7 | 27,0 | 0,1 | 0,6 | 16,8 | 1,0 | 4,3 | 0,1 | 2,0 | 6,9 | 6,2 | 1,3 | 0,5 | 1,8 | 2,3 | 0,3 | 6,6 | 8,2 | 3,0 | 0,1 | 0,1 | 0,0 | 3,6 | 0,1 | 4,8 | 1,5 | 2,0 | 0,6 | 4,3 | 0,2 | 0,2 | 2,9 | 2,1 | 1,5 | 30,7 | 70,6 |
| CAN | 3,7 | 1,4 | 2,8 | 0,1 | 8,1 | 1220 | 26,6 | 0,1 | 0,6 | 11,4 | 0,8 | 2,6 | 0,1 | 0,8 | 6,7 | 13,1 | 1,9 | 0,4 | 2,0 | 5,8 | 0,8 | 4,2 | 13,6 | 4,4 | 0,1 | 0,4 | 0,0 | 9,7 | 0,1 | 3,1 | 1,3 | 0,5 | 0,7 | 2,6 | 0,3 | 0,1 | 2,2 | 1,4 | 1,9 | 209,6 | 42,5 |
| CHN | 53,2 | 8,1 | 10,7 | 0,9 | 30,8 | 47,3 | 5755 | 0,4 | 5,9 | 85,7 | 4,6 | 20,6 | 0,5 | 4,0 | 44,2 | 47,9 | 5,2 | 2,8 | 28,8 | 57,2 | 6,8 | 33,9 | 133,7 | 55,5 | 0,6 | 0,6 | 0,3 | 25,3 | 0,2 | 20,9 | 12,4 | 2,5 | 2,6 | 52,7 | 2,5 | 1,0 | 7,8 | 27,6 | 14,5 | 339,5 | 347,9 |
| CYP | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,0 | 0,1 | 18,9 | 0,0 | 0,1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,2 | 0,4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,2 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,1 | 1,6 |
| CZE | 0,7 | 3,5 | 1,5 | 0,3 | 0,6 | 1,0 | 2,8 | 0,0 | 111,0 | 14,9 | 0,5 | 1,8 | 0,0 | 0,4 | 4,1 | 4,2 | 0,3 | 1,3 | 0,2 | 0,6 | 0,3 | 3,2 | 0,8 | 0,6 | 0,1 | 0,2 | 0,1 | 0,4 | 0,0 | 1,7 | 2,8 | 0,3 | 0,9 | 3,3 | 3,2 | 0,2 | 0,9 | 1,2 | 0,2 | 4,8 | 13,4 |
| DEU | 12,4 | 33,1 | 21,9 | 2,4 | 20,9 | 14,8 | 87,3 | 0,7 | 13,5 | 2264 | 10,0 | 32,1 | 0,5 | 7,1 | 72,4 | 58,4 | 7,5 | 9,0 | 5,1 | 11,6 | 4,0 | 53,9 | 21,2 | 12,7 | 1,3 | 2,8 | 0,9 | 10,0 | 0,3 | 28,0 | 22,8 | 6,4 | 7,3 | 32,8 | 4,5 | 2,1 | 16,9 | 15,5 | 6,2 | 104,1 | 243,5 |
| DNK | 1,1 | 0,5 | 1,0 | 0,1 | 1,0 | 1,2 | 4,7 | 0,0 | 0,5 | 8,2 | 196,9 | 2,0 | 0,1 | 1,6 | 3,2 | 7,2 | 0,5 | 0,2 | 0,5 | 0,6 | 0,4 | 2,2 | 2,0 | 0,8 | 0,2 | 0,1 | 0,1 | 0,5 | 0,0 | 2,2 | 1,5 | 0,3 | 0,3 | 1,7 | 0,2 | 0,1 | 5,8 | 0,6 | 0,3 | 7,8 | 27,1 |
| ESP | 2,1 | 2,4 | 4,7 | 0,4 | 3,3 | 2,5 | 7,4 | 0,3 | 2,0 | 23,7 | 1,8 | 1130 | 0,1 | 1,0 | 29,3 | 15,5 | 2,2 | 0,9 | 0,7 | 1,8 | 1,1 | 18,1 | 3,4 | 1,2 | 0,2 | 0,3 | 0,1 | 2,9 | 0,1 | 5,2 | 3,7 | 14,2 | 1,6 | 4,9 | 0,4 | 0,4 | 2,4 | 6,4 | 0,6 | 25,2 | 52,5 |
| EST | 0,1 | 0,1 | 0,1 | 0,0 | 0,1 | 0,1 | 0,2 | 0,0 | 0,0 | 0,4 | 0,1 | 0,1 | 12,2 | 0,9 | 0,2 | 0,2 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,2 | 0,1 | 0,0 | 0,2 | 0,0 | 0,3 | 0,0 | 0,0 | 0,1 | 0,1 | 0,0 | 0,0 | 0,6 | 0,0 | 0,0 | 0,6 | 0,1 | 0,0 | 0,4 | 1,7 |
| FIN | 1,0 | 0,5 | 0,8 | 0,1 | 1,3 | 0,9 | 6,7 | 0,0 | 0,3 | 4,3 | 0,7 | 1,3 | 0,4 | 165,6 | 2,1 | 2,7 | 0,3 | 0,2 | 0,4 | 1,3 | 0,2 | 1,5 | 1,9 | 0,8 | 0,2 | 0,1 | 0,2 | 0,4 | 0,0 | 1,2 | 0,9 | 0,2 | 0,2 | 2,9 | 0,1 | 0,1 | 3,6 | 0,7 | 0,3 | 6,4 | 13,7 |
| FRA | 5,3 | 3,6 | 14,2 | 0,8 | 9,7 | 7,4 | 28,1 | 0,3 | 2,5 | 46,0 | 2,1 | 26,0 | 0,1 | 1,8 | 2094 | 27,3 | 3,2 | 1,8 | 2,2 | 3,4 | 1,9 | 27,1 | 9,9 | 5,2 | 0,3 | 1,9 | 0,2 | 3,2 | 0,1 | 8,8 | 5,6 | 3,7 | 2,4 | 9,6 | 1,1 | 0,6 | 4,9 | 7,0 | 2,1 | 42,8 | 111,0 |
| GBR | 9,9 | 4,0 | 10,8 | 0,5 | 8,2 | 15,2 | 25,4 | 0,7 | 2,5 | 49,7 | 5,2 | 13,0 | 0,3 | 3,0 | 27,6 | 1702 | 2,2 | 1,9 | 2,1 | 7,3 | 15,0 | 17,4 | 10,5 | 5,0 | 0,3 | 0,6 | 0,3 | 3,3 | 0,5 | 18,7 | 6,2 | 2,7 | 2,0 | 8,7 | 0,9 | 0,4 | 7,1 | 8,6 | 3,7 | 75,1 | 126,4 |
| GRC | 0,2 | 0,1 | 0,2 | 0,4 | 0,3 | 0,2 | 1,0 | 0,5 | 0,1 | 1,2 | 0,1 | 0,4 | 0,0 | 0,1 | 0,5 | 0,7 | 241,7 | 0,0 | 0,2 | 0,3 | 0,1 | 0,9 | 0,4 | 0,3 | 0,0 | 0,0 | 0,0 | 0,2 | 0,0 | 0,2 | 0,2 | 0,1 | 0,2 | 0,6 | 0,0 | 0,0 | 0,1 | 0,9 | 0,3 | 2,0 | 17,4 |
| HUN | 0,4 | 2,1 | 0,7 | 0,4 | 0,5 | 0,5 | 2,4 | 0,0 | 0,9 | 7,6 | 0,3 | 2,4 | 0,0 | 0,2 | 2,5 | 2,4 | 0,3 | 67,5 | 0,3 | 0,4 | 0,1 | 2,6 | 0,9 | 1,3 | 0,1 | 0,1 | 0,1 | 0,3 | 0,0 | 0,8 | 1,4 | 0,2 | 2,1 | 1,8 | 0,7 | 0,2 | 0,6 | 0,9 | 0,2 | 3,0 | 13,4 |
| IDN | 7,4 | 0,7 | 1,4 | 0,1 | 2,0 | 2,3 | 26,7 | 0,0 | 0,5 | 8,2 | 0,6 | 2,8 | 0,0 | 0,3 | 3,8 | 3,9 | 0,6 | 0,2 | 664,4 | 6,4 | 0,2 | 4,0 | 27,0 | 9,0 | 0,1 | 0,1 | 0,0 | 1,3 | 0,0 | 1,8 | 0,9 | 0,3 | 0,2 | 2,5 | 0,3 | 0,1 | 0,6 | 2,5 | 3,7 | 17,7 | 43,6 |
| IND | 5,7 | 1,5 | 4,2 | 0,1 | 3,3 | 6,8 | 16,9 | 0,1 | 0,7 | 14,2 | 1,3 | 3,7 | 0,1 | 2,4 | 6,9 | 13,6 | 0,7 | 0,4 | 4,1 | 1544 | 0,5 | 5,4 | 8,3 | 2,7 | 0,1 | 0,1 | 0,0 | 2,2 | 0,1 | 6,4 | 1,6 | 0,5 | 0,6 | 4,2 | 0,3 | 0,1 | 2,9 | 5,3 | 1,7 | 57,3 | 54,7 |
| IRL | 1,4 | 0,5 | 1,7 | 0,1 | 0,6 | 2,5 | 4,2 | 0,0 | 0,5 | 6,7 | 0,6 | 3,3 | 0,0 | 0,4 | 4,1 | 11,6 | 0,3 | 0,2 | 0,3 | 0,6 | 86,5 | 3,4 | 2,1 | 0,7 | 0,0 | 0,2 | 0,0 | 0,8 | 0,0 | 1,7 | 0,7 | 0,5 | 0,3 | 1,1 | 0,2 | 0,1 | 1,0 | 0,5 | 0,5 | 23,8 | 34,7 |
| ITA | 5,4 | 6,5 | 5,8 | 1,1 | 8,9 | 6,1 | 25,1 | 0,6 | 2,9 | 38,8 | 2,0 | 17,3 | 0,2 | 1,7 | 32,3 | 18,3 | 5,6 | 2,1 | 1,9 | 4,6 | 1,3 | 1586 | 9,0 | 4,2 | 0,5 | 0,5 | 0,3 | 3,7 | 0,5 | 5,0 | 6,5 | 2,8 | 4,5 | 15,8 | 1,1 | 1,6 | 3,5 | 10,5 | 2,0 | 37,1 | 95,1 |
| JPN | 16,3 | 2,4 | 3,7 | 0,2 | 9,2 | 14,4 | 131,1 | 0,1 | 1,6 | 25,9 | 1,0 | 6,3 | 0,1 | 0,8 | 12,7 | 14,7 | 1,5 | 0,9 | 14,4 | 9,2 | 0,9 | 7,9 | 5144 | 28,7 | 0,1 | 0,3 | 0,1 | 10,3 | 0,1 | 5,5 | 3,3 | 0,7 | 0,6 | 19,9 | 0,7 | 0,3 | 2,4 | 7,1 | 23,8 | 115,6 | 227,2 |
| KOR | 6,1 | 1,0 | 1,7 | 0,2 | 6,6 | 6,0 | 65,8 | 0,1 | 1,1 | 14,0 | 0,8 | 2,7 | 0,0 | 1,0 | 6,8 | 6,6 | 3,4 | 0,7 | 7,1 | 4,7 | 0,4 | 7,0 | 24,7 | 680,9 | 0,1 | 0,1 | 0,1 | 5,7 | 0,0 | 2,1 | 2,5 | 0,4 | 0,5 | 13,3 | 1,3 | 0,2 | 1,9 | 6,0 | 3,2 | 43,5 | 76,2 |
| LTU | 0,1 | 0,1 | 0,2 | 0,0 | 0,1 | 0,1 | 0,3 | 0,0 | 0,1 | 0,9 | 0,2 | 0,2 | 0,1 | 0,2 | 0,5 | 0,4 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,3 | 0,1 | 0,1 | 25,6 | 0,0 | 0,6 | 0,0 | 0,0 | 0,2 | 0,4 | 0,0 | 0,0 | 1,4 | 0,0 | 0,0 | 0,3 | 0,2 | 0,0 | 0,5 | 4,9 |
| LUX | 0,2 | 0,3 | 1,7 | 0,0 | 0,2 | 0,2 | 1,1 | 0,0 | 0,2 | 2,6 | 0,1 | 0,4 | 0,0 | 0,1 | 2,1 | 0,7 | 0,1 | 0,2 | 0,1 | 0,3 | 0,2 | 1,1 | 0,4 | 0,2 | 0,0 | 22,3 | 0,0 | 0,1 | 0,0 | 0,4 | 0,3 | 0,1 | 0,1 | 0,3 | 0,1 | 0,0 | 0,2 | 0,3 | 0,1 | 1,4 | 16,8 |
| LVA | 0,0 | 0,1 | 0,1 | 0,0 | 0,0 | 0,0 | 0,2 | 0,0 | 0,0 | 0,4 | 0,1 | 0,1 | 0,2 | 0,2 | 0,2 | 0,2 | 0,0 | 0,0 | 0,0 | 0,1 | 0,1 | 0,1 | 0,1 | 0,0 | 0,5 | 0,0 | 18,1 | 0,0 | 0,0 | 0,1 | 0,1 | 0,0 | 0,0 | 0,5 | 0,0 | 0,0 | 0,2 | 0,1 | 0,0 | 0,3 | 3,2 |
| MEX | 2,4 | 0,5 | 0,8 | 0,0 | 3,4 | 13,0 | 8,3 | 0,0 | 0,4 | 7,1 | 0,5 | 4,3 | 0,0 | 0,3 | 4,2 | 2,6 | 0,6 | 0,2 | 0,6 | 1,6 | 0,2 | 2,3 | 3,6 | 1,3 | 0,0 | 0,1 | 0,0 | 893,4 | 0,0 | 1,0 | 0,7 | 0,4 | 0,2 | 1,3 | 0,1 | 0,1 | 0,5 | 0,8 | 0,5 | 128,6 | 31,7 |
| MLT | 0,0 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,2 | 0,0 | 0,0 | 0,3 | 0,0 | 0,1 | 0,0 | 0,0 | 0,1 | 0,4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,1 | 0,2 | 0,1 | 0,2 | 0,0 | 0,0 | 0,0 | 4,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,3 | 0,6 |
| NLD | 3,4 | 3,1 | 15,0 | 0,5 | 3,1 | 3,1 | 18,2 | 0,2 | 1,9 | 39,6 | 4,3 | 11,6 | 0,1 | 2,7 | 17,7 | 27,6 | 2,5 | 2,0 | 1,2 | 2,3 | 1,9 | 16,9 | 4,2 | 2,9 | 0,5 | 1,0 | 0,2 | 1,6 | 0,1 | 468,0 | 4,1 | 2,0 | 1,3 | 4,9 | 0,8 | 0,3 | 4,6 | 2,9 | 2,4 | 25,1 | 49,2 |
| POL | 1,0 | 2,3 | 2,2 | 0,4 | 1,1 | 1,5 | 4,8 | 0,1 | 3,5 | 22,3 | 1,6 | 3,4 | 0,2 | 1,0 | 7,7 | 9,0 | 0,6 | 1,8 | 0,4 | 0,7 | 0,5 | 6,8 | 1,3 | 0,7 | 1,2 | 0,2 | 0,5 | 0,6 | 0,0 | 3,1 | 317,6 | 0,5 | 1,6 | 8,2 | 1,1 | 0,3 | 2,8 | 2,9 | 0,6 | 7,7 | 25,9 |
| PRT | 0,2 | 0,3 | 0,6 | 0,0 | 1,7 | 0,5 | 1,1 | 0,0 | 0,2 | 3,0 | 0,2 | 6,3 | 0,0 | 0,1 | 3,5 | 2,2 | 0,1 | 0,1 | 0,1 | 0,2 | 0,2 | 1,6 | 0,5 | 0,1 | 0,0 | 0,1 | 0,0 | 0,3 | 0,0 | 0,7 | 0,3 | 171,2 | 0,1 | 0,7 | 0,1 | 0,0 | 0,4 | 0,5 | 0,1 | 3,1 | 7,6 |
| ROM | 0,2 | 1,0 | 0,5 | 0,7 | 0,3 | 0,6 | 1,1 | 0,0 | 0,3 | 3,9 | 0,1 | 1,2 | 0,0 | 0,1 | 2,0 | 1,4 | 0,4 | 0,7 | 0,2 | 0,4 | 0,1 | 3,3 | 0,6 | 0,3 | 0,0 | 0,0 | 0,0 | 0,2 | 0,0 | 0,5 | 0,6 | 0,1 | 131,5 | 1,5 | 0,2 | 0,1 | 0,3 | 1,8 | 0,1 | 1,7 | 11,8 |
| RUS | 4,2 | 3,2 | 4,9 | 1,9 | 5,0 | 4,3 | 43,6 | 0,3 | 2,0 | 21,2 | 3,1 | 11,0 | 0,6 | 5,9 | 23,2 | 13,5 | 4,8 | 5,1 | 3,7 | 4,7 | 0,9 | 38,4 | 22,9 | 8,4 | 2,6 | 0,2 | 1,1 | 3,1 | 0,1 | 6,9 | 10,2 | 1,0 | 2,8 | 1179 | 1,8 | 0,6 | 4,2 | 6,4 | 2,4 | 41,6 | 103,2 |
| SVK | 0,2 | 1,4 | 0,4 | 0,2 | 0,2 | 0,4 | 1,5 | 0,0 | 2,3 | 4,8 | 0,2 | 1,0 | 0,0 | 0,1 | 1,8 | 1,5 | 0,2 | 1,3 | 0,1 | 0,1 | 0,1 | 1,8 | 0,3 | 0,2 | 0,1 | 0,1 | 0,0 | 0,1 | 0,0 | 0,7 | 1,3 | 0,1 | 0,5 | 2,1 | 55,7 | 0,1 | 0,5 | 0,6 | 0,1 | 1,4 | 4,4 |
| SVN | 0,1 | 0,7 | 0,2 | 0,1 | 0,1 | 0,1 | 0,5 | 0,0 | 0,2 | 2,2 | 0,1 | 0,2 | 0,0 | 0,1 | 0,8 | 0,4 | 0,1 | 0,3 | 0,0 | 0,1 | 0,0 | 1,2 | 0,1 | 0,1 | 0,0 | 0,0 | 0,0 | 0,1 | 0,0 | 0,2 | 0,3 | 0,0 | 0,2 | 0,7 | 0,1 | 29,2 | 0,1 | 0,2 | 0,0 | 0,7 | 3,7 |
| SWE | 2,7 | 1,2 | 2,8 | 0,2 | 2,3 | 2,5 | 11,6 | 0,1 | 0,8 | 10,2 | 5,2 | 3,1 | 0,2 | 5,4 | 5,8 | 7,5 | 0,6 | 0,6 | 1,2 | 1,7 | 0,4 | 4,0 | 3,2 | 2,3 | 0,3 | 0,2 | 0,3 | 1,1 | 0,0 | 3,3 | 2,1 | 0,6 | 0,4 | 3,8 | 0,2 | 0,1 | 320,5 | 1,4 | 0,8 | 16,3 | 47,2 |
| TUR | 0,8 | 1,5 | 2,0 | 1,1 | 1,1 | 1,3 | 3,9 | 0,0 | 0,8 | 12,6 | 0,8 | 3,5 | 0,1 | 0,4 | 6,4 | 6,1 | 2,1 | 0,4 | 0,6 | 1,2 | 0,3 | 6,9 | 1,4 | 0,9 | 0,1 | 0,2 | 0,1 | 0,5 | 0,1 | 1,7 | 2,1 | 0,2 | 1,7 | 7,7 | 0,3 | 0,2 | 1,1 | 569,8 | 0,3 | 6,8 | 29,1 |
| TWN | 3,9 | 0,9 | 0,7 | 0,1 | 2,7 | 4,9 | 42,3 | 0,0 | 0,5 | 6,7 | 0,4 | 1,6 | 0,0 | 0,3 | 3,0 | 3,9 | 0,4 | 0,2 | 2,6 | 2,5 | 0,2 | 2,6 | 11,3 | 3,8 | 0,0 | 0,1 | 0,0 | 2,6 | 0,0 | 1,4 | 0,9 | 0,2 | 0,3 | 2,0 | 0,3 | 0,1 | 0,7 | 1,5 | 276,9 | 32,8 | 26,9 |
| USA | 33,3 | 7,2 | 14,3 | 0,7 | 36,4 | 167,5 | 148,3 | 0,5 | 5,4 | 69,8 | 7,0 | 29,9 | 0,4 | 4,8 | 43,7 | 76,9 | 4,4 | 3,8 | 11,3 | 31,7 | 15,0 | 27,1 | 73,5 | 38,6 | 0,4 | 2,1 | 0,3 | 98,7 | 0,2 | 28,1 | 10,1 | 3,5 | 2,1 | 16,1 | 1,5 | 0,8 | 11,8 | 10,1 | 16,3 | 1364,7 | 386,8 |
| ROW | 57,9 | 17,2 | 24,5 | 2,6 | 70,3 | 44,1 | 359,7 | 1,6 | 9,3 | 131,4 | 12,0 | 61,2 | 1,0 | 8,3 | 91,4 | 87,6 | 10,9 | 5,4 | 55,3 | 117,2 | 8,4 | 94,7 | 238,3 | 81,2 | 2,2 | 1,3 | 1,0 | 30,7 | 0,5 | 36,7 | 20,3 | 9,1 | 6,3 | 66,1 | 5,9 | 3,3 | 20,8 | 46,1 | 31,8 | 460,1 | 8360 |

PRIME MINISTER'S OFFICE
FINLAND

SNELLMANNINKATU 1, HELSINKI
PO BOX 23, 00023 GOVERNMENT, FINLAND
Tel. +358 295 16001
info@vnk.fi
vnk.fi/en

ISBN PDF 978-952-287-286-9
ISSN 1799-7828