ETLA Raportti | Report | 89 14.3.2019

Brexit and Indirect Impact Routes through Global Value Chains

Jyrki Ali-Yrkkö
The Research Institute of the Finnish Economy
jyrki.ali-yrkko@etla.fi

Tero Kuusi
The Research Institute of the Finnish Economy
tero.kuusi@etla.fi

Suggested citation:
Ali-Yrkkö, Jyrki & Kuusi, Tero (14.3.2019). "Brexit and Indirect Impact Routes through Global Value Chains".

ETLA Report No 89. https://pub.etla.fi/ETLA-Raportit-Reports-89.pdf

Abstract

In this study, we analyze the trade linkages between the United Kingdom (UK), Finland, and the European Union (EU). We calculate the value-added content of trade through complex global value chains (GVCs), which may involve numerous production stages and third countries.

Our results show that the importance of the UK as a trading partner for Finland has decreased during the last 15 years, and the tendency has been stronger than that between the UK and other EU countries, on average. We compare the importance of the UK to that of other countries by extracting the total amount of the Finnish value added that is generated in the value chains involving individual countries. Through this comparison, we find that the UK ranks as the sixth most important country.

We further decompose the total value added into components that quantify the value added that is generated through direct trade with the UK and the indirect trade that is channeled through third countries. We find that roughly one third of the total value added is generated through indirect trade and two thirds through direct trade. Our analysis also suggests that one fifth of both the Finnish and EU value-added trade to the UK passes through the UK to other countries. The main destination countries are the United States (US), Germany, and France.

Tiivistelmä

Brexit – Millaisia ovat arvoketjut Suomen ja Britannian välillä?

Tutkimuksessa analysoidaan globaalien arvoketjujen kautta syntyviä yhteyksiä Ison-Britannian ja Suomen sekä muun EU-alueen välillä. Tulosten mukaan Britannian merkitys Suomelle on pienentynyt selvästi enemmän kuin EU-alueella keskimäärin viimeisten 15 vuoden aikana. Viennin arvonlisällä mitattuna Britannia oli Suomen kuudenneksi suurin kauppakumppani vuonna 2014. Tutkimuksessa jaetaan tämä Britanniaan kulkeutuva suomalainen arvonlisä lisäksi joko suoran kaupan kautta syntyvään tai epäsuoraan, jonkin kolmannen maan kautta ohjautuvaan arvonlisään. Laskelmien perusteella noin kolmasosa arvonlisäpohjaisesta viennistä kulkeutuu Isoon-Britanniaan jonkun kolmannen maan kautta, joten kaksi kolmasosaa syntyy suorasta viennistä. Analyysit myös osoittivat, että noin viidesosa sekä Suomen että koko EU:n arvonlisäpohjaisesta viennistä Britanniaan jatkaa matkaa muihin maihin. Tärkeimpinä kohteina ovat USA, Saksa ja Ranska.

Keywords: Global value chain, Brexit, United Kingdom, Gross domestic product, Impact, Indirect, Route, Value added

Avainsanat: Arvoketju, Brexit, Iso-Britannia, Epäsuora, Vaikutus, Toimitusketju, Bruttokansantuote, Kauppareitti, Arvonlisä

JEL: F13, F14, F23, L23

Contents

Executive summary

Value chains create indirect linkages between countries

Today, companies in the United Kingdom (UK) and elsewhere source many components and intermediates from suppliers and their sub-suppliers operating abroad. These value chains comprise the entire range of activities involved in providing a product or service. Previously, most firms were more or less vertically integrated, meaning that component manufacturing, sub-assemblies, and final assembly were all done within the same company. More recently, companies have increasingly focused on narrower ranges of activities that, in turn, have lengthened value chains. At the same time, these chains have become more international.

An outcome of globalized value chains is that international trade consists of not only final products but also intermediate ones. These intermediates are exported to another location, where they are used in the production process of the next stage; then, the output of that stage is potentially exported again. These long chains create indirect linkages between countries that cannot be tracked using only bilateral trade flows. Therefore, a careful analysis of Brexit calls for data that allows both production and consumption linkages between multiple countries to be mapped.

Brexit and preconditions for well-functioning chains

The smooth operation of a global value chain (GVC) requires the instant transfer of instructions and the cheap and frictionless movement of intermediate inputs and final outputs. This calls for a well-functioning transport infrastructure among regions, countries, and continents, as well as smooth and quick procedures at their borders. Depending on the forthcoming agreement between the UK and European Union (EU), Brexit would potentially increase cross-border costs for companies. In addition to the direct costs of potential customs and tariffs, fulfilling customs declarations and other documents creates indirect costs.

Another important issue concerns the effect of Brexit upon the lead time of value chains. Recently, the importance of frictionless material flows has increased, enabling to operate with minimal component and material stock. Brexit would potentially increase delays at borders, hurting particularly UK operations where components or other intermediate inputs are imported from the EU, processed in the UK, and exported to other areas of the EU. Multiple border crossings also multiplies delays, slowing down value chains.

What you see is *not* what you get

Businesses today increasingly uses imported components, services, and sub-assemblies in their own production, which has a striking implication for national economies. The gross domestic product (GDP) of a country participating in a value chain is increased only by that part of the value added that is generated in the country concerned, rather than by the total value of exports. The higher the share of imported inputs is, the smaller the contribution to the GDP of one euro generated from exports, highlighting the need to examine trade in not only gross terms but also value-added terms. Furthermore, to obtain an equal amount of value added from exports as before, more gross exports are needed.

The changing significance of the UK

Our results show that, in value-added terms, the UK ranks sixth in the list of Finland's most important trading partners. Based on the most recent figure, the total value-added content of gross exports to the UK, including both direct and indirect exports, constituted US$3.5 billion. This accounts for 5.7% of the total value added of Finnish exports. The share has dropped from the early 2000s, when the corresponding share reached 10%. In absolute value-added terms, however, the role of the UK in Finland has not diminished. This means that exports to other countries have increased.

The comparison between Finland and the entire EU area reveals an interesting difference. During the 2000s, the EU's value added generated by exports to the UK more than doubled, but trade to other regions grew even faster. As a result, in relative terms, the role of the UK as a

trading partner for the EU has slightly decreased, now representing 7.2% of the EU's value added generated by exports to all countries.

Overall, the UK is still an important trading partner for Finland (although not as important as the UK is for the entire EU area). Thus, Brexit would have a potentially non-negligible impact on these countries.

The importance of different trade routes to the UK

As mentioned before, goods and services created in one country do not necessarily travel directly to their destination (e.g., the UK). Instead, they potentially go through one or more other countries before reaching the UK.

Our results suggest that, from a Finnish perspective, other countries do play a limited role in trade routes to the UK. Approximately one third of the value added of UK trade comes via indirect links, where the products/services are first exported to a different country before being exported directly or indirectly to the UK. For Finland, the most important of these indirect routes are Germany, the Netherlands, and Ireland.

The UK as a passthrough and ultimate destination for exports

Some goods and services exported to the UK continue their journey to other countries. This type of passthrough trade accounts for 22% of Finnish exports to the UK. Typically, these goods and services continue their journey to the United States (US), Germany, or France. Of the 10 most important next destinations, no fewer than six were EU member states. Thus, value chains of the UK and other EU members are deeply intertwined, creating a potentially large impact in the case of a so-called "hard Brexit." However, close to 80% (i.e., 100-22=78%) of Finnish exports to the UK do not continue on to other countries but instead remain in the UK, highlighting the importance of the UK as an ultimate export destination.

Compared to Finland, the significance of passthrough UK trade in the entire EU area seems to be slightly smaller, accounting for 18% of the EU's total value added generated by exports to the UK. The list of the top 10 next destinations consists of the same countries as those observed in the Finnish case. The US ranks first, but, similar to the Finnish case, the list also includes six EU countries, highlighting the importance of EU countries as trading partners with the UK.

Final remarks

This study contributes to the expanding literature on Brexit by bringing new information concerning the indirect links between the UK and EU member states through value chains. To our knowledge, we are also among the first to analyze the role of passthrough trade in the UK.

Our findings suggest that the UK is heavily involved in European value changes and GVCs, having both backward and forward linkages. These linkages could have unexpected effects for a number of countries if their expectations are based only on bilateral trade flows with the UK. Is many cases, components or other products cross the UK border several times, which could result in multiple delays and tariffs if a hard Brexit materializes. Companies will probably react to these increased delays by changing their value chains.

Our analyses concerning the most important of these linkages help policymakers and civil servants to prepare for Brexit and to ensure that trade agreements with those countries are adequate and updated. Finally, negotiations between the UK and other regions will not end the day Brexit materializes; only time will tell what kinds of new trade agreements will be signed in the future.

1 Background

On May 13, 2018, Reuters reported: Mandy Ridyard [Chief Financial Officier of Produmax Ltd.] knew Brexit was going to be a challenge for her aviation components firm, but it was still a shock when she heard a French company bluntly ruling out British suppliers from an international bid for a contract in China. This example well illustrates how global value chains (GVCs) generate unexpected outcomes for firms and, potentially, for national economies.

Throughout the last few decades, value chains have become more complex and internationalized, consisting of an increasing number of production stages located in multiple countries (Baldwin, 2006; Grossman & Rossi-Hansberg, 2008). This means that the direct destination country of exports is not necessarily the country in which the product is finally consumed. Rather, the value added created in one country passes through other countries before reaching the ultimate destination. For instance, in the first step, Finnish companies produce goods that are exported to Sweden. In the second step, Swedish companies use these as intermediates in their own goods, which, in turn, are exported to China, where the final product is assembled. In the final step, China exports these final goods to the UK. Thus, the gross imports of the UK from China consist of value added from not only China but also Finland and Sweden.

Therefore, an analysis of Brexit calls for data that allows both production and consumption linkages between multiple countries to be mapped. Only then can the full complexity of the international trade patterns associated with Brexit be fully understood. When the UK leaves the European Union (EU[1]), the web of changing bilateral tariffs not only has direct implications for the two regions but it also has indirect implications through the GVCs that involve third parties, such as China. However, the underlying trade linkages are not observable in the bilateral trade flows published by national statistical authorities.

In this paper, we analyze the indirect routes from Finland to the UK using the World Input-Output Database (WIOD).[2] Furthermore, we analyze the extent to which the UK is only an intermediate destination – that is, the extent to which value added created in exporting countries flows directly or indirectly to the UK but has a final destination that is not the UK. To map the value chains, we take an accounting approach, similar to Chen et al. (2018), in which value added is split into two categories: 1) value added that is embodied in trade between the UK and other countries (e.g., in downstream stages of value chains or when the final product is delivered) at least once, and 2) value added that is embodied in trade that does not have this quality.

This paper is part of the expanding collection of literature related to Brexit. A few attempts to measure its impact upon different countries, including Finland, have been made during the last few years. For example, the National Institute's Global Econometric Model (NiGEM) was used by Her Majesty's (HM) Treasury (2016a; 2016b), Baker et al. (2016), and Ebell and Warren (2016) for the UK, and by Lehmus and Suni (2016) for Finland. Lehmus and Suni (2016) find that the effects on the Finnish economy seem to be, to some extent, more positive than they are for other analyzed countries. This more positive development is due to the improved price competitiveness born by adjustments in the effective exchange rates and by a favorable combination of relevant trade partners – comprising, for instance, Russia and China – that are relatively immune to the negative effects of Brexit (Lehmus & Suni, 2016).

Vandenbussche, Connell, and Simons (2017) analyzed the impacts of a "soft" and "hard" Brexit using the gravity equation. In terms of value added, the most affected EU countries would be Ireland, Malta, and the Netherlands. In the case of a hard Brexit, the total loss in value added would be 5.7% in Ireland, 4.9% in Malta and 2.6% in the Netherlands. The corresponding losses for Finland and Sweden would be 0.95% and 1.24%, respectively. In Finland, the most affected sector would be the paper industry and in Sweden, the chemicals industry. Other approaches are taken by Dhingra et al. (2018) and Lawless and Morgenroth (2016) based on estimated trade models. Their findings support the view that Finland is not among the countries that suffer the most from Brexit.

However, there is still fairly little knowledge about the trade linkages between the UK and other countries through GVCs. The previous literature suggests that GVCs may have a large impact on the ultimate economic cost of Brexit. For example, the results of a recent study by Cappariello et al. (2018) suggest that the export path

towards the final destination of goods/services matters. If the back-and-forth trade between the EU and the UK is not taken into account, the actual impacts of tariffs will be underestimated. Thus, given the density of intra-EU linkages and the sizeable share of indirect trade between the two regions, exporters in both the UK and the EU member states face higher costs after Brexit when indirect trade is taken into account.

Finally, while steps could be taken to quantify the impact of Brexit further through value chains, we suggest that the impact would not be trivial. The previous literature argues that there remain large hurdles in the quantification of Brexit's effect upon value chains. Even if the complexity of the value chains could be recognized when assessing the effect of Brexit, it remains unclear whether the trade elasticities that are used to measure the impact of increased trade costs suitably describe the behavioral changes that will occur as a consequence of Brexit. Typically, these have been estimated on the basis of data in a period of (generally small) reductions in trade barriers (Chen et al., 2018). Moreover, it could be that large, dynamic effects will occur as a result of Brexit. For example, Dhingra et al. (2018) show that an empirical approach that aims to capture the dynamic effects of Brexit on productivity more than triples its welfare losses. Even harder to answer is the question concerning the cost of the financial reaction to Brexit, especially given the vulnerable state that the European financial markets are still in, given the aftermath of the Great Recession.

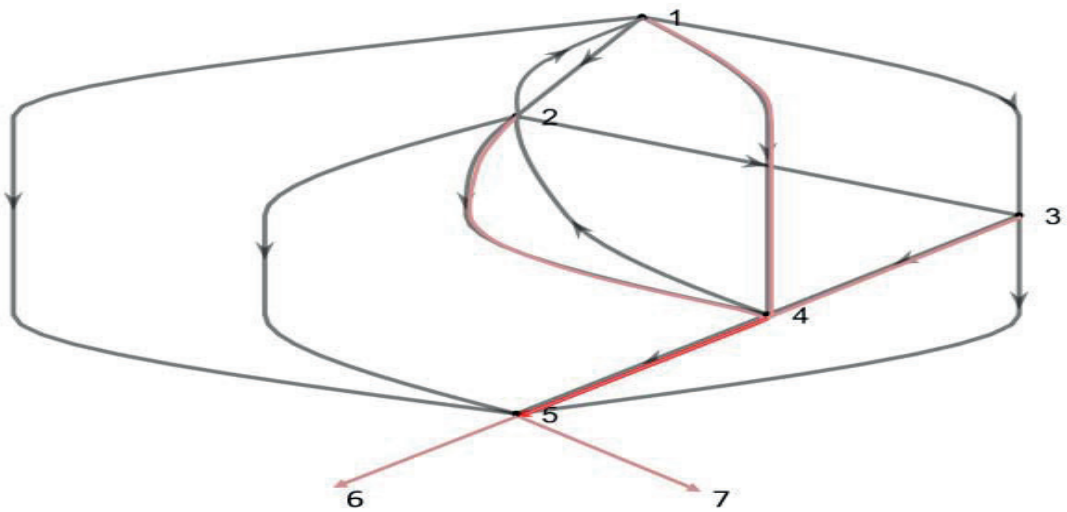
2 Data and methodology

In our analysis, we use the 2016 release of the WIOD database (Timmer et al., 2015; 2016). The data contains sector-level World Input-Output Tables (WIOTs) with underlying data for 44 countries and 56 sectors, including services.[3] These countries account for more than 85% of the world's gross domestic product (GDP) (at current exchange rates). WIOTs are built based on National Accounts data, which are extended by means of disaggregating imports by country of origin and using categories to generate international supply and use tables (Timmer et al., 2016).

We apply a measurement framework for the decomposition of value-added trade to the UK grounded on hypothetical extraction, a parsimonious mathematical technique based on an input–output representation of the global economy (Los, Timmer & de Vries, 2016; Los & Timmer, 2018). This approach has a clear economic intuition and can be easily applied to the data. It compares the actual GDP in a country with a hypothetical GDP in cases where there are no production activities related to exporting. The difference is defined as the domestic value added in exports.

We illustrate the exclusion of direct trade linkages between two countries or regions using a simplified example (Figure 1). It illustrates the value-added trade of countries 1–4 to country 5 (i.e., the UK), with nodes marking

Figure 1 An illustration of the hypothetical extraction method



the countries. An edge marks a direct trade relationship between two countries, and the associated arrow marks the direction of trade. The trade may include both final and intermediate goods and services; thus, the figure illustrates value chains by linking several countries. For example, country 1 exports intermediate goods to country 2, which uses these goods to produce another intermediate good that is then exported, via country 3, to country 5 as part of a final product. This type of value chain has three stages. Even our simple exercise illustrates how complex the system of value chains can be. In principle, the example includes a limitless number of value chains with different numbers of stages, due to the link from country 4 back to country 2. Its existence ensures that the length of the individual value chains does not have an upper limit. Thus, countries may contribute value added to a vast number of potential value chains and trade patterns. As such, the key challenge of GVC analysis is accounting for the total value added included in such trade patterns (i.e., the value-added trade).

In this example, the direct trade link from country 4 to country 5 is excluded (i.e., the dark red edge). As a result, the direct and last mile of trade from country 4 to country 5 stops. Despite the direct trade ending, country 4 can still trade with country 5 via indirect trade (i.e., via country 2). Typically, we allow such trade to be unaffected when direct trade barriers are raised. However, the exclusion of direct trade from country 4 to country 5 also has indirect trade effects. In particular, all trade routes and value chains that include exporting first from countries 1–3 to country 4 and then to country 5 are blocked (i.e., the light red edges). Ultimately, the indirect trade that is affected includes all exporting countries through the potentially limitless number of value chains that have these linkages. Another interesting aspect of trade is that country 5 may be a passthrough country for value chains that ultimately serve the demand of other countries (e.g., 6 and 7). Any obstacles in the trade of country 5 will also affect these value chains.

We next formally represent the exclusion method. Similar to Los, Timmer, and de Vries (2016) and Ali-Yrkkö and Kuusi (2017), we partition the global input–output table such that we have a country s and a region r containing all other countries c in the world, and we construct a matrix **A** as follows:

$$(1) \quad \boldsymbol{A} = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}} \\ \boldsymbol{A_{rs}} & \boldsymbol{A_{rr}} \end{bmatrix}$$

A contains the input coefficients a_{ij}, which give the value units of intermediate goods from industry i required to produce one value unit of gross output in industry j. $\boldsymbol{A_{ss}}$ represents the domestically purchased requirements of industries in country s, $\boldsymbol{A_{sr}}$ while gives the requirements by industries in r of products bought from industries in s. For the final demand block, we can similarly write as follows:

$$(2) \quad \boldsymbol{y} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}} \\ \boldsymbol{y_{rs}} & \boldsymbol{y_{rr}} \end{bmatrix}$$

in which the vectors $\boldsymbol{y_{ss}}$ and $\boldsymbol{y_{sr}}$ represent the values of flows from industries in country s to all domestic final users and to final users in r.

For any country c, ratios of value added to gross output in industries in country c are contained in a row vector $\boldsymbol{v_c}$. The length of this vector equals the numbers of industries in s and r (with r containing multiple countries), with value-added ratios for industries in c as elements ($\overline{\boldsymbol{v}}_c$) and zeros elsewhere: $\boldsymbol{v_c}$=[**0** $\overline{\boldsymbol{v}}_c$ **0**]. The actual value added in country c ($\boldsymbol{GDP_c}$) then equals

$$(3) \quad \boldsymbol{GDP_c} = \boldsymbol{v_c}(\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{Y} * \boldsymbol{i}$$

in which **i** is a column vector where all elements are unity, implying that it sums the two elements in each of the rows of the matrix **Y**. The element $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ is the well-known Leontief inverse, in which **I** is the identity matrix of appropriate dimensions. The expression is the key to accounting for the complexity of the trade patterns. In particular, $\boldsymbol{GDP_c}$ can be interpreted as the limiting value of the infinitely long sum of value-added contributions, with the number of stages varying from 1 to ∞.

What amount of domestic value added should then be attributed to exports to s from the region r? To measure this, we create a hypothetical world in which r (or its member country c) does not export anything to s, while leaving the rest of the economic structure of the world unaffected (an analogy for the exclusion of trade from country 4 to country 5, in our example). In the case of region r, blocks from $\boldsymbol{A_{rs}}$ that represent trade from r are set to zero. We define the matrices $\boldsymbol{A}^*$ and $\boldsymbol{Y}^*$ as

$$(4) \quad \boldsymbol{A}^* = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}} \\ \boldsymbol{0} & \boldsymbol{A_{rr}} \end{bmatrix}$$

and

$$(5) \quad \boldsymbol{Y^*} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}} \\ \boldsymbol{0} & \boldsymbol{y_{rr}} \end{bmatrix}$$

The hypothetical GDP in *c* can be obtained by post-multiplying the hypothetical Leontief inverse with the hypothetical final demand as

$$(6) \quad \boldsymbol{GDP_r^* = v_r(I - A^*)^{-1}Y^* * i}$$

Following the logic of hypothetical extraction, the domestic value added in exports to country *s* can be derived as the difference between the GDP in the actual and hypothetical situations:

$$(7) \quad \boldsymbol{\Delta VA_r = GDP_r - GDP_r^*}$$

$\boldsymbol{\Delta VA_r}$ correctly measures the indirect and direct effects on the value chains and trade routes that follow from the exclusion of the direct trade linkage for region *r*.

More generally, the effects can be allocated to any single country, including the importing country *s*, via indirect trade. In this paper, we are interested in the following counterfactual measurements for individual countries:

- The total value added of country *c* in all trade from region *r* to country *s* (in this case, we use
  $\boldsymbol{A^*} = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}} \\ \boldsymbol{0} & \boldsymbol{A_{rr}} \end{bmatrix}$ and $\boldsymbol{Y^*} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}} \\ \boldsymbol{0} & \boldsymbol{y_{rr}} \end{bmatrix}$,
  and the corresponding measure is $\boldsymbol{\Delta VA_c^{total}}$ with the value-added vector $\boldsymbol{v_c}$ entering $\boldsymbol{GDP_c^*}$);

- The direct value added of country *c* in trade to country *s* (in this case, we use
  $\boldsymbol{A^*} = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}} \\ \boldsymbol{A_{rs}^{a_{cs}=0}} & \boldsymbol{A_{rr}} \end{bmatrix}$ and $\boldsymbol{Y^*} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}} \\ \boldsymbol{y_{rs}^{y_{cs}=0}} & \boldsymbol{y_{rr}} \end{bmatrix}$,
  and the corresponding measure is denoted as $\boldsymbol{\Delta VA_c^{direct}}$ with the value-added vector $\boldsymbol{v_c}$ entering $\boldsymbol{GDP_c^*}$);

- The indirect value added of country *c* via the exports of country *k* to *s* (in this case, we use
  $\boldsymbol{A^*} = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}} \\ \boldsymbol{A_{rs}^{a_{ks}=0}} & \boldsymbol{A_{rr}} \end{bmatrix}$ and $\boldsymbol{Y^*} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}} \\ \boldsymbol{y_{rs}^{y_{ks}=0}} & \boldsymbol{y_{rr}} \end{bmatrix}$,
  and the corresponding measure is $\boldsymbol{\Delta VA_c^{via\,k}}$ with the value-added vector $\boldsymbol{v_c}$ entering $\boldsymbol{GDP_c^*}$); and

- The indirect value added of country *c* via the pass-through of exports of country *s* to *k* (in this case, we use
  $\boldsymbol{A^*} = \begin{bmatrix} \boldsymbol{A_{ss}} & \boldsymbol{A_{sr}^{a_{sk}=0}} \\ \boldsymbol{A_{rs}} & \boldsymbol{A_{rr}} \end{bmatrix}$ and $\boldsymbol{Y^*} = \begin{bmatrix} \boldsymbol{y_{ss}} & \boldsymbol{y_{sr}^{y_{sk}=0}} \\ \boldsymbol{y_{rs}} & \boldsymbol{y_{rr}} \end{bmatrix}$,
  and the corresponding measure is $\boldsymbol{\Delta VA_c^{s\,to\,k}}$ with the value-added vector $\boldsymbol{v_c}$ entering $\boldsymbol{GDP_c^*}$).

3 Value-added trade to the UK

3.1 Total direct and indirect value-added trade

In the world of GVC, an increasing number of goods and services are produced in long and geographically fragmented value chains. Often, this means that companies buy their inputs from multiple countries, do their own value-added activities, and export their output again to third countries that use them as intermediates, which, in turn, export more finalized output to other countries. As a result, the exports' direct destination is not necessarily the same as its ultimate destination country. We use the term "indirect trade," from country *c* to country *s*, to describe trade that originates from country *c*, goes to country *k*, and is re-exported directly or through multiple countries to country *s*.

To determine the total value added of UK trade, we calculate the hypothetical GDP in case there are no production activities related to direct exports from any country to the UK and compare it to the actual GDP. The difference is defined as the total value-added content of gross exports to the UK ($\boldsymbol{\Delta VA_c^{total}}$). The calculation was described in more detail in Section 2.

For Finland, the total value-added content of gross exports to the UK, including both direct and indirect exports, constituted US$3.5 billion in 2014. Between 2000 and 2008, the value added of Finnish exports to the UK increased from $3.6 billion to $4.6 billion. The following years witnessed a downward trend and a recovery at the end of the period (see column *a* in Table 1).[4] At the industry level (see Table A3 in the Appendix), the overall decline of the value-added trade from 2007 to 2014 (-$1.14 billion) mostly originates from the manufacturing of computer, electronic, and optical products (-$0.67

billion), and the manufacturing of paper and paper products (-$0.16 billion).

In relative terms, the total significance of UK trade to the Finnish economy has decreased. In the early 2000s, the UK accounted as much as 10% of the total value added of Finnish exports, while in 2014, the share had dropped to 5.7% (column *b* in Table 1). To compare the importance of UK trade to that of other countries' trade, we repeat the corresponding calculations for other countries. The results for the top 10 countries in terms of their total Finnish value-added content of gross exports (ΔVA_c^{total}) in 2014 are reported in Table A1 in the Appendix.

Our calculations show that, in value-added terms, the most important trading partners to Finland are Germany, Sweden, and the United States (US). The total value-added content of gross exports for each of these countries exceeds 10% of the total value-added content in Finnish trade. These large numbers indicate that there is likely substantial overlap. Closing one trade channel will also reduce the value added in other channels. The UK ranks in position six, after Russia and before the Netherlands. It is noteworthy that the UK also has the same position in terms of direct gross trade in 2014, despite there being other differences in the top 10 partner lists based on value added and gross export terms (tables A1 and A2 in the Appendix).

All in all, the importance of Finnish value-added trade to the UK has declined both in absolute and relative terms due to the (Finland-specific) decline of trade in information technology and paper products. The changes in value added for the entire EU area with the UK have not been similar to those of Finland. From 2000 to 2014, the valued added generated by exports to the UK more than doubled (column *c* in Table 1). In relative terms, however, the significance of UK trade for the EU has slightly decreased. In 2014, EU exports that went directly or indirectly to the UK generated in total as much as $327

Table 1 Value added of total direct and indirect exports to the UK (billion $ and %)

	From Finland to the UK		From the EU to the UK	
	(a) Value added, in billion $	(b) Share of total value added in exports, %	(c) Value added, in billion $	(d) Share of total value added in exports, %
2000	3.56	10.0	154.01	8.3
2001	3.77	10.6	161.90	8.6
2002	3.95	10.3	184.21	9.0
2003	4.04	9.1	213.28	8.7
2004	4.46	8.6	248.36	8.6
2005	3.90	7.4	254.35	8.3
2006	4.13	7.1	271.96	8.0
2007	4.64	6.5	316.62	7.9
2008	4.64	5.9	308.96	7.0
2009	3.17	5.3	253.41	6.9
2010	3.22	5.5	274.79	7.1
2011	3.36	5.4	298.49	6.9
2012	3.25	5.6	298.41	7.2
2013	3.00	4.9	287.94	6.5
2014	3.50	5.7	326.80	7.2

Note: Column (a) describes the Finnish value added in production of the Finnish intermediate and final goods that are directly or indirectly exported to the UK (billion $) in current prices, and column (b) describes its share of the value added of Finnish exports to all countries. Column (c) describes the EU value added in production of the EU intermediate and final goods that are directly or indirectly exported to the UK (billion $) in current prices, and column (d) describes its share of the value added of EU exports to all countries. In each calculation, we exclude the Finnish value added that is generated in the Finnish production of final goods that are used in Finland.

Source: Authors' calculations based on WIOD data, 2000–2014.

billion of value added to member countries, representing 7.2% of the value added of exports to all countries. In relative terms, there has been a broad decline in the importance of the UK as new trade routes have emerged – for example, through China.

Table 2 The value added of exports by EU countries ending up in the UK (billion $ and %), 2014

	(a) Value added of direct and indirect exports to the UK, in billion $	(b) Share of total value-added exports (to all countries), %
Ireland	19.4	15.2
France	51.4	10.1
Netherlands	34.0	9.9
Belgium	17.4	9.1
Slovakia	3.4	8.8
Cyprus	0.5	8.3
Denmark	8.4	8.3
Germany	90.2	8.0
Poland	12.6	7.8
Italy	31.4	7.7
Spain	17.2	6.9
Sweden	10.2	6.4
Portugal	3.1	6.4
Latvia	0.6	6.4
Czech	5.0	6.3
Hungary	3.1	6.1
Finland	3.5	5.7
Luxembourg	1.9	5.0
Greece	1.8	4.8
Romania	2.5	4.7
Austria	5.9	4.6
Estonia	0.4	4.6
Bulgaria	0.8	4.4
Lithuania	0.8	4.0
Croatia	0.6	4.0
Slovenia	0.7	3.7
Sum	326.8	
Average (unweighted)		6.8

In the calculation, we exclude the Finnish value added that is generated in the Finnish production of final goods that are used in Finland. As part of the other countries' exports to the UK may serve their own production of domestic final-demand goods, this may moderately downplay the importance of the UK to Finland as a trading partner when compared to other countries. Note that the unweighted average is different from the overall EU's value-added share, which accounts for the differences in the size of the individual countries' trade with the UK.

Source: Authors' calculations based on WIOD data.

A country breakdown, however, reveals remarkable differences between EU member states (Table 2). When the importance of UK trade is measured in relative terms (column *b* in Table 2), the most UK trade-dependent country is Ireland. The UK accounts for as much as 15.2% of the value added generated from Irish exports to all countries. UK trade is also important for France (10.1%) and the Netherlands (9.9%), but it is not as important for countries such as Bulgaria, Lithuania, Croatia, and Slovenia, where the UK accounts for approximately 4% of their exports.

3.2 The importance of different trade routes to the UK

Next, we analyze the value-added exports to the UK in more detail by investigating the alternative trade routes through which value added is generated. In particular, we index the trade routes of countries that operate as (1) the last-mile exporters of goods and services to the UK, or (2) the producer of the final goods or services that are consumed in the UK market.

In case (1), we calculate the hypothetical GDP where there are no production activities related to direct exports from a particular country *k* to the UK and compare it to the actual GDP. Using the notation described in Section 2, we calculate the contributions of Finland and the EU ($\boldsymbol{\Delta VA^{via\,k}}$), and $\boldsymbol{\Delta VA^{direct}}$ as their special case.

In case (2), we instead use the *total* value-added contribution ($\boldsymbol{\Delta VA^{total}}$). We first calculate the hypothetical GDP where there are no production activities related to direct exports from *any* country to the UK and compare it to the actual GDP. We then assign the changes in the value added to different final producer countries. We measure changes in the GVC matrix[5] and collect the rows of the matrix that decompose the contribution of a certain country/industry to final production within different countries.

This latter approach is particularly useful because the different scenarios in case (1) may overlap. For example, the contribution of Finland to the Swedish trade route to the UK may decrease when the German trade route is also cancelled. This is the case when part of the Finnish contribution to the Swedish trade route is channeled through Germany. For this reason, the total contributions

of the alternative scenarios that cancel trade routes one by one may exceed the total value-added trade. Therefore, it is also useful to decompose the *total* value-added contribution by the final producer country – a measurement that does not suffer from similar aggregation problems.

We consider the different trade routes in Table 3. The results suggest that other countries play a limited role as trade routes, a result that is not sensitive to whether it is calculated from the decomposition based on the final producer in the total trade (column *b*) or the exclusion of the direct trade of a country (column *a*).

Thus, a large majority of the Finnish value added goes directly to the UK (Table 3, column *a*). Direct trade accounts for approximately two thirds of the total Finnish value added created by UK trade.[6] The value added is associated with either the Finnish final product ($0.56 billion) or the final production in the UK ($2.0 billion). This $2.0 billion can be interpreted as the Finnish value added of intermediates that have been exported directly or indirectly to the UK, where the final production has taken place. The large role of the Finnish trade route is likely to reflect the importance of trade in paper products, forestry, and logging, which have predominately domestic value chains. Furthermore, a sizable portion of the value added is generated by Finnish transportation and business services. The other most important trade route is through Germany, for which trade constitutes $0.13 to $0.22 billion, depending on the calculation method. While the importance of any single trade route is not very high, the overall size of the indirect trade is non-negligible.

We next investigate further the value-added exports from the entire EU area to the UK (Table 4). Similar to the Finnish case, the table isolates the value-added contribution by the countries that operate as either the last-mile exporters of the goods and services to the UK (column *a* in Table 4) or the producer of the final goods or services that are consumed in the UK market (column *b* in Table 4).

Table 3 Decomposition of the Finnish value-added trade by the main (i.e., top 10) trade routes

(a) Finnish value added that would be lost without a country's direct final and intermediate exports to the UK, in billion $		(b) The Finnish value-added contribution of UK exports by the producer of the final good or service, in billion $	
Finland	2.35	UK	2.00
Germany	0.22	Finland	0.56
Netherlands	0.12	Germany	0.13
Ireland	0.11	Ireland	0.08
Sweden	0.10	US	0.08
Belgium	0.07	France	0.06
France	0.06	Netherlands	0.05
Norway	0.05	Belgium	0.04
Poland	0.04	China	0.04
Italy	0.04	Sweden	0.04

Note: In column (a), we calculate the value-added contents of different trade routes using method (1), described above; in column (b), we use method (2). In order to interpret the figures, let us consider the role of Germany, for example. The second row in column (a) implies that the absence of Germany's intermediate and final exports to the UK would decrease the Finnish value added by $0.22 billion. In column (b), we first measure the total Finnish value added contributed to direct exports to the UK from any country, and then decompose the trade by the final producer country. In the example, Finland exports $0.13 billion in intermediate products to Germany for final assembly, which are then exported to the UK as final goods, as the third row of column (b) denotes. In each calculation, we exclude the Finnish value added that is generated in the Finnish production of final goods that are used in Finland.

Source: Authors' calculations based on WIOD data.

Column *a* in Table 4 shows that extracting Germany's direct exports to the UK would decrease the EU's value added by a total of $85.4 billion. The second largest effect would be caused by extracting France's direct exports, for a total of $49.3 billion. In terms of the producer of the final goods (column *b* in Table 4), 47% (not shown in the table) of the EU's total value added attributed to UK trade is generated in the production of UK-made final goods. Thus, EU countries export intermediates to the UK, where the final production is done. Other important final producers are Germany, France, Italy, and Ireland, which together compose roughly 29% of the exported value added.

3.3 The UK as a passthrough destination of exports

Up to this point, we have analyzed both direct and indirect exports to the UK while leaving out the possibility that the UK is not necessarily the final destination of these exports. Indeed, some goods and services imported by the UK continue their journey to other countries. We use the term "passthrough trade" to describe this issue, and next analyze it further. In particular, we measure the value-added content of passthrough trade from the UK to the immediate destination country *k*. The measurement is done for Finland as well as for other countries. In order to measure the quantity, we extract from the WIOD data all direct trade relations between the UK and country *k* in terms of both intermediate and final goods. We denote the resulting change in the value-added content of trade for any country *c* as $\Delta VA_c^{UK\ to\ k}$. The details of this measurement can be found in Section 2. The results for the selected immediate destination countries of UK exports are available in Table 5.

In total, as much as $766 million of the Finnish value added passes through the UK and continues to other countries (see column *a* in Table 5). This accounts for approximately 22% of the total Finnish value added created by UK trade, presented earlier in Table 1. Hence, close to 80% (i.e., 100-22 = 78%) of Finnish exports to the UK

Table 4 Decomposition of the EU's value-added trade to the UK by the main (i.e., top 10) trade routes

(a) The EU's value added that would be lost without a row country's direct final and intermediate exports to the UK, in billion $		(b) The EU's value-added contribution of UK exports by the producer of the final good or service, in billion $	
Germany	85.43	UK	149.71
France	49.25	Germany	42.28
Netherlands	31.42	France	21.33
Italy	28.35	Italy	14.86
Ireland	21.80	Ireland	12.73
Belgium	19.58	Netherlands	10.16
Spain	16.98	Spain	10.07
Poland	11.41	Belgium	9.18
Sweden	8.61	US	5.80
Denmark	8.43	Poland	5.74

Note: In column (a), we calculate the value-added contents of different trade routes using method (1), described above; in column (b), we use method (2). In order to interpret the figures, let us consider the role of Germany, for example. The first row in column (a) implies that the absence of Germany's intermediate and final exports to the UK would decrease the EU's value added by $85.43 billion. In column (b) we first measure the EU's total value added contributed to direct exports to the UK from any country, and then decompose the trade by the final producer country. To interpret the results, let us consider the case where Germany produces final goods and services and exports them to the UK. The value added of this type of export is $42.28 billion (created by EU members), as the second row of column (b) indicates.

Source: Authors' calculations based on WIOD data.

Table 5 The immediate destinations of the UK's passthrough trade (i.e., the top 10 countries), 2014

(a) Finnish value added that passes through the UK, in million $		(b) The value added of the EU that passes through the UK, in billion $	
US	93.1	US	7 376.0
Germany	62.0	Germany	4 908.3
France	47.3	France	3 627.6
Ireland	42.2	China	3 127.6
China	34.4	Ireland	2 705.1
Netherlands	27.1	Netherlands	2 058.7
Belgium	21.9	Belgium	1 749.6
Italy	21.9	Italy	1 747.5
Switzerland	19.6	Russia	1 598.7
Russia	18.7	Switzerland	1 516.3
Others	377.9	Others	29 490.9
Total	766.2		59 906.3

Source: Authors' calculations based on WIOD data. As the focus is on the Finnish exports (column a), we have excluded Finland as a possible passthrough destination.

do not continue to other countries but stay in the UK, highlighting the importance of the UK as an ultimate export destination.

We find that the most important next destinations of goods and services for Finnish exports that pass through the UK are the US, Germany, and France. For example, the Finnish value added involved in the trade linkages between the UK and the US amounted to $ 93.1 million in 2014.

The role of UK passthrough trade for the entire EU area seems to be slightly smaller than it is for Finland (see column *b* in Table 5). Passthrough trade accounts for 18% of EU's total value added generated by exports to the UK. The most important next destinations are the US, Germany, and France, the same countries as those in the Finnish case. The lists of the most important next destinations (columns *a* and *b* in Table 5) highlight the importance of EU member states as the UK's trading partners.

4 Conclusions

In this study, we analyzed the trade linkages between the UK, Finland, and the EU. We calculated the value-added content of trade through complex GVCs, which may involve numerous production stages and third countries. The indirect links created by GVCs are not observable when bilateral trade statistics are used. Thus, we used WIOD data to map both production and consumption linkages between multiple countries.

Based on our results, the UK continues to be an important source of value added for Finland, but its significance has diminished during the past 15 years. Currently, the UK accounts for 5.7% of the total value of Finnish exports, while in the early 2000s, the share reached 10%. We compared the importance of the UK to other countries by extracting the total amount of the Finnish value added that is generated in the value chains involving individual countries, finding that the UK ranks as the sixth most important trading partner for Finland.

In a majority of other EU member states, the role of the UK as a trading partner is more important than it is for Finland, but there exist remarkable differences between EU countries. In terms of value added, the UK is particularly important for Ireland, France, and the Netherlands but not as important for Bulgaria, Croatia, and Slovenia.

The main contributions of this paper concern the quantification of the different trade routes that relate to UK trade. The analyses suggest that UK passthrough trade is not a marginal issue. Approximately one fifth of the EU's value added – and of Finnish value added – is generated in UK trade that passes through the UK to other countries. The most important next destinations are the US, Germany, and France in both cases. The list of top 10 most common next destinations includes six EU countries, highlighting the importance of EU countries as the UK's trading partners.

We also analyzed the role of direct and indirect exports to the UK. Our results concerning Finland suggest that, while direct trade to UK is dominant, indirect linkages through other countries are not negligible. Approximately one third of the value added of the UK's trade comes via indirect links, where the products/services are first exported to one country and are then exported again (directly or indirectly) to the UK.

In sum, our findings suggest that the UK is heavily involved in GVCs, including both backward and forward linkages to third countries. In many cases, components or other products cross the UK border several times, implying multiple delays and tariffs if a hard Brexit materializes. We hope that our analyses concerning the most important of these linkages help policymakers and civil servants to prepare for Brexit and to ensure that trade agreements with those third countries are adequate and updated.

Endnotes

1 In this paper, we use the term "EU" to describe EU-27 countries (i.e., EU countries excluding the UK).

2 Currently, two datasets exist that enable an analysis of these indirect paths (i.e., the Trade in Value Added [TiVA] database by the Organisation for Economic Co-operation and Development [OECD] and the WIOD database by the EU and Groningen University).

3 The countries were chosen by considering whether there was a sufficient level of data availability and by attempting to cover a major part of the world economy. The selected countries include 27 EU countries and 15 other major countries. Data for the 56 sectors are classified according to the International Standard Industrial Classification Revision 4 (ISIC Rev. 4). The tables adhere to the 2008 version of the System of National Accounts (SNA). The dataset provides WIOTs using current prices, denoted in millions of US dollars (Timmer et al., 2016).

4 We have compared the results and the underlying data to the corresponding numbers in the OECD's TiVA dataset. In terms of the data, we note that gross exports from Finland to the UK are similar in the WIOD but moderately larger in the TiVA dataset. Accordingly, the value-added content of the Finnish exports (i.e., that which most directly corresponds to our WIOD-based total value-added number) is larger by few hundred million dollars. The TiVA numbers are available at https://stats.oecd.org/.

5 In this GVC matrix, every 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 is the value of final production in a certain country and industry.

6 The share of direct trade can be approximated by dividing $2.35 billion (the first row in column *a* of Table 3) by $3.5 billion (the value added of total direct and indirect exports to the UK; see the last row in column *a* of Table 1).

Bibliography

Baker, J., Carreras, O., Kirby, S., Meaning, J. & Piggott, R. (2016). "Modelling events: The short-term impact of leaving the EU," *Economic Modelling*, 58, 339–350.

Baldwin, R. (2006). *Globalisation: The Great Unbundling(s)*. Helsinki, Finland: The Economic Council of Finland, Prime Minister's Office.

Chen, W., Los, B., McCann, P., Ortega-Argilés, R., Thissen, M. & van Oort, F. (2018). "The continental divide? Economic exposure to Brexit in regions and countries on both sides of the Channel," *Papers in Regional Science*, 97, 25–54.

Dhingra, S., Huang, H., Ottaviano, G., Pessoa, J.P., Sampson, T. & Van Reenen, J. (2017). "The costs and benefits of leaving the EU: Trade effects," *Economic Policy*, 32(92), 651–705.

Ebell, M., Hurst, I. & Warren, J. (2016). "Modelling the long-run economic impact of leaving the European Union," *Economic Modelling*, 59, 196–209.

Grossman, G.M. & Rossi-Hansberg, E. (2008). "Trading tasks: A simple theory of offshoring," *American Economic Review*, 98(5), 1978–1997.

HM Treasury (2016a). *HM Treasury Analysis: The Immediate Economic Impact of Leaving the EU*. London, UK: HM Treasury.

HM Treasury (2016b). *HM Treasury Analysis: The Long-Term Economic Impact of EU Membership and the Alternatives*. London, UK: HM Treasury.

Kuhn, S. & Viegelahn, C. (2017). *Foreign Trade Barriers and Jobs in Global Value Chains*. International Labour Organization (ILO) Research Paper No. 19. Geneva, Switzerland: International Labour Office.

Lawless, M. & Morgenroth, E.L.W. (2016). *The Product and Sector Level Impact of a Hard Brexit across the EU*. Economic and Social Research Institute (ESRI) Working Paper No. 550. Dublin, Ireland: ESRI.

Lehmus, M. & Suni, P. (2016). *Brexit ja Suomen talous* [*Brexit and the Finnish Economy*]. Research Institute of the Finnish Economy (ETLA) Memorandum No. 48. Helsinki, Finland: ETLA. Available at http://pub.etla.fi/ETLA-Muistio-Brief-48.pdf

Los, B. & Timmer, M. (2018). *Measuring Bilateral Exports of Value Added: A Unified Framework*. National Bureau of Economic Research (NBER) Working Paper No. 24896. Cambridge, MA, USA: NBER.

Los, B., Timmer, M.P. & de Vries, G.J. (2016). "Tracing value-added and double counting in gross exports: Comment," *American Economic Review*, 106(7), 1958–1966.

Melitz, M.J. (2003). "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, 71(6), 1695–1725.

Office of the United States Trade Representative (2017). *2017 Trade Policy Agenda and 2016 Annual Report of the President of the United States on the Trade Agreements Program*. Washington DC, USA: Office of the United States Trade Representative.

Statistics Denmark (2008). *International Sourcing, Moving Business Functions Abroad*. Copenhagen, Denmark: Statistics Denmark.

Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R., & de Vries, G.J. (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.

Timmer, M.P., Los, B., Stehrer, R. & de Vries, G.J. (2016). *An Anatomy of the Global Trade Slowdown Based on the WIOD 2016 Release*. Groningen Growth and Development Centre (GGDC) Research Memorandum No. 162. Groningen, Netherlands: University of Groningen.

Vandenbussche, H., Connell, W. & Simons, W. (2017). *Global Value Chains, Trade Shocks and Jobs: An Application to Brexit*. Centre for Economic Policy Research (CEPR) Discussion Paper 12303. London, UK: CEPR.

Vandenbussche, H., Connell, W., Simons, W. & Zaurino, E. (2017). *"America First!" What are the Job Losses for Belgium and Europe?* VIVES Discussion Paper No. 57. Leuven, Belgium: University of Leuven.

Appendix

Table A1 Value added of total direct and indirect exports from Finland to top 10 largest trading partners (billion $ and %)

	(a) Value added, billion $	(b) Share of total value added in exports, %
Germany	8.5	14.0
Sweden	6.8	11.1
US	6.5	10.6
China	4.8	7.8
Russia	3.9	6.4
UK	3.5	5.7
Netherlands	2.9	4.8
France	2.8	4.7
Italy	2.1	3.4
Norway	2.0	3.2

Source: Authors' calculations based on WIOD Data.

Table A2 Gross exports from Finland to top 10 largest trading partners (billion $ and %)

	(a) Gross exports, billion $	(b) Share of Finnish total gross exports, %
Sweden	10.7	12.7
Germany	8.6	10.1
Russian	7.3	8.6
US	6.5	7.7
China	5.7	6.8
UK	4.1	4.9
France	3.2	3.8
Japan	2.5	2.9
Norway	2.5	2.9
Poland	2.4	2.8

Source: Authors' calculations based on OECD data (dataset: TiVA Principal Indicators).

Table A3 Value added by industries, in million $ and %

Industry (ISIC revision 2)		2007		2014	
		Value added, million $	Share of total value added in UK exports, %	Value added, million $	Share of total value added in UK exports, %
C17	Manufacture of paper and paper products	481.0	10.4	320.3	9.2
N	Rental and leasing activities, employment activities, travel services, etc.	132.8	2.9	227.6	6.5
A02	Forestry and logging	169.8	3.7	208.5	6.0
G46	Wholesale trade, except of motor vehicles and motorcycles	217.8	4.7	184.4	5.3
H49	Land transport and transport via pipelines	172.9	3.7	169.3	4.8
C28	Manufacture of machinery and equipment n.e.c.	173.8	3.7	164.9	4.7
D	Electricity, gas, steam and air conditioning supply	121.9	2.6	141.0	4.0
C26	Manufacture of computer, electronic and optical products	801.7	17.3	137.1	3.9
C20	Manufacture of chemicals and chemical products	168.4	3.6	133.7	3.8
H52	Warehousing and support activities for transportation	100.4	2.2	122.6	3.5
J62–J63	Computer programming, consultancy and related activities, etc.	91.7	2.0	91.1	2.6
M69–M70	Legal and accounting activities; activities of head offices;	60.2	1.3	89.6	2.6
C24	Manufacture of basic metals	185.0	4.0	87.1	2.5
C16	Manufacture of wood and of products of wood and cork, etc.	142.0	3.1	85.4	2.4
L	Real estate activities	113.6	2.4	84.4	2.4
C25	Manufacture of fabricated metal products, except machinery and equip.	136.3	2.9	80.7	2.3
C27	Manufacture of electrical equipment	63.7	1.4	74.1	2.1
M71	Architectural and engineering activities; technical testing and analysis	72.8	1.6	71.9	2.1
E37–E39	Sewerage; waste collection, treatment and disposal activities; etc.	41.0	0.9	68.2	2.0
C22	Manufacture of rubber and plastic products	75.1	1.6	61.2	1.7
B	Mining and quarrying	33.6	0.7	58.4	1.7
C33	Repair and installation of machinery and equipment	64.0	1.4	58.0	1.7
O	Public administration and defence; compulsory social security	68.5	1.5	56.3	1.6
C19	Manufacture of coke and refined petroleum products	45.1	1.0	54.8	1.6
F	Construction	42.7	0.9	47.8	1.4
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	47.4	1.0	44.5	1.3
C21	Manufacture of basic pharmaceutical products, etc.	37.8	0.8	44.2	1.3
M72	Scientific research and development	54.9	1.2	41.6	1.2
C10–C12	Manufacture of food products, beverages and tobacco products	52.2	1.1	41.3	1.2
K64	Financial service activities, except insurance and pension funding	48.2	1.0	37.6	1.1
P	Education	14.2	0.3	33.4	1.0
C23	Manufacture of other non-metallic mineral products	53.0	1.1	30.6	0.9
A01	Crop and animal production, hunting and related service activities	33.4	0.7	27.6	0.8
C31–C32	Manufacture of furniture; other manufacturing	42.4	0.9	26.6	0.8
J58	Publishing activities	37.5	0.8	25.4	0.7
J61	Telecommunications	35.4	0.8	23.4	0.7
H51	Air transport	40.3	0.9	22.4	0.6
G47	Retail trade, except of motor vehicles and motorcycles	44.7	1.0	21.1	0.6
C30	Manufacture of other transport equipment	62.5	1.3	20.5	0.6
H53	Postal and courier activities	37.0	0.8	20.2	0.6
H50	Water transport	20.2	0.4	19.2	0.5
M74–M75	Other professional, scientific and technical activities; veterinary activities	13.9	0.3	18.9	0.5
M73	Advertising and market research	20.6	0.4	18.2	0.5
R–S	Creative, Arts, Sports, Recreation and entertainment activities, etc.	24.0	0.5	15.0	0.4
I	Accommodation and food service activities	32.4	0.7	15.0	0.4
K65	Insurance, reinsurance and pension funding	13.5	0.3	14.4	0.4
C18	Printing and reproduction of recorded media	27.9	0.6	12.4	0.4
C29	Manufacture of motor vehicles, trailers and semi-trailers	15.1	0.3	11.5	0.3
K66	Activities auxiliary to financial services and insurance activities	10.9	0.2	11.2	0.3
C13–C15	Manufacture of textiles, wearing apparel and leather products	17.1	0.4	8.2	0.2
J59–J60	Motion picture, video and television programme production, etc.	14.3	0.3	7.9	0.2
Q	Human health and social work activities	8.2	0.2	3.9	0.1
E36	Water collection, treatment and supply	2.6	0.1	2.5	0.1
A03	Fishing and aquaculture	1.3	0.0	0.7	0.02
T	Activities of households as employers	0.0	0.0	0.0	0.00
U	Activities of extra-territorial organisations and bodies	0.0	0.0	0.0	0.00
Total		4 638.4	100.0	3 497.7	100.0

Source: Authors' calculations based on WIOD Data.

Elinkeinoelämän tutkimuslaitos

The Research Institute of the Finnish Economy

ISSN-L 2323-2447,
ISSN 2323-2447,
ISSN 2323-2455 (Pdf)

Tel. +358 (09) 609 900
www.etla.fi
firstname.lastname@etla.fi

Arkadiankatu 23 B
FIN-00100 Helsinki