Assessing the Full Extent of Trade Integration between the EU and Russia – A Global Value Chain Perspective

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We analyze trade linkages between EU Member States and Russia, taking into account indirect trade links in global value chains. Our analysis is based on data for 2011 from the World Input-Output Database combined with gross trade flows between Russia and individual EU economies. We derive our conclusions from three indicators: gross exports in final use, value added in final use and value added in output. The latter two novel indicators are able to capture direct and indirect links jointly by allocating the full amount of value added from Russia in EU final domestic use and output, and inversely, the full amount of EU value added in Russia's final domestic use and output. Russia represents the EU's fourth-largest trade partner in terms of direct export shares, while the EU is Russia's largest trade partner. In the same vein, Russia's economy is considerably more dependent on European value added for both final use and output production than vice versa. However, the degree of integration varies greatly among EU Member States. For example, the Baltic states are notably more dependent on value added from Russia than vice versa, and certain economic sectors in the EU, such as the energy sector, utilities and air transport, are strongly dependent on inputs from Russia.

JEL classification: F12, F15, F51
Keywords: Trade integration, global value chains, Russia, European Union

Recent geopolitical tensions and discussions of trade sanctions have sparked widespread interest in economic linkages between the EU-27[2] and Russia. In this article, we assess the status quo of trade integration between Russia and individual EU-27 Member States. While we realize that it may well be impossible to cover all aspects of interconnectedness, we have nevertheless aimed to gauge the degree of interdependence as comprehensively as possible. We focus on trade linkages, but above and beyond existing studies, we take into account global (i.e. direct and indirect trade) linkages to get a fuller picture. We would like to emphasize that our analysis is not an attempt to estimate the impact of current and possible further sanctions, but a broad investigation of the state of trade links prior to the current crisis.

Several publications on global value chains (GVCs) have demonstrated that a narrow focus on direct trade flows that does not take into account global interdependencies gives an incomplete picture of mutual trade interdependencies. The international fragmentation of production is an important element of global economic activity today. Stehrer et al. (2012) find that international linkages have increased globally over the past ten years. More generally, they observe an overall increase in interconnectedness, i.e. stronger domestic and international linkages between industries. According to their results, the Central, Eastern and Southeastern European (CESEE) EU members appear to be the most interlinked region, exhibiting strong bilateral linkages with EU-15 members.

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[2] *Since we base our analysis on data for 2011, we focus on the EU-27, i.e. the EU prior to Croatia's accession.*

Riad et al. (2012) also observe an increase in trade interconnectedness, which increases the transmission of shocks between countries through the trade channel. Besides noting the rapid rise of China as a systemically important trading partner, they observe that European countries are "central" in the trade network primarily due to their high degree of interconnectedness rather than their economic size.

Baldwin and Lopez-Gonzalez (2013) also draw attention to the radical changes in trade linked to international production networks that they determine to have taken place between 1985 and 1995. Like Riad et al. (2012), they emphasize the rise of China in what they call "global supply-chain trade." Conceptually, they distinguish between "importing-to-produce (I2P)," which describes the use of foreign intermediates (goods and services) in a country's total production, and "importing-to-export (I2E)," which refers to the use of imported inputs in exported goods and services (and is thus a subset of I2P). The authors' analysis contains some stylized facts with possible relevance for the relationship between Russia and the EU-27. For example, they find that I2E trade is more regionally concentrated than aggregate trade. They further emphasize that GVCs in fact remain structured into three main regions ("Factory Asia, Factory Europe, and Factory North America") with the three corresponding hubs U.S.A., Germany and China. Another stylized fact postulates that countries which are smaller and more closely located to one of the three major supply networks are more dependent on intermediate inputs from other countries in the respective regional value chain. However, they also note that trade patterns for raw materials are less regionalized. In our context, this would imply an asymmetric relationship between Russia and EU countries, with Russia being more strongly dependent on intermediate inputs from EU members located closer to Russia while EU members are likely to depend on Russia for raw materials (especially energy products).

Overall, backward linkages are more important than forward linkages, highlighting the importance of sourcing from abroad. This finding is particularly relevant in our context, as Russia is a major source country of energy products. Stehrer et al. (2012) support this view by stating that backward linkages to the BRII countries (Brazil, Russia, India and Indonesia) are particularly relevant for the CESEE EU members in the chemical sector.

Our contribution to the analysis is to scrutinize the extent of interconnectedness between the EU-27 and Russia for final use and total output. Thus, in the notation introduced by Baldwin and Lopez-Gonzalez (2013), we analyze I2P patterns. Our analysis of trade integration is based on data for 2011 from the World Input-Output Database. This database offers a world input-output table by combining national input-output tables with global trade data. Hence, using this database enables us to take account of direct as well as indirect trade flows between EU-27 Member States and Russia. This means that in any bilateral comparison, we can identify the full amount of foreign value added in total output and final use. Calculations show that Russia's value added is more important for EU final use than direct imports suggest, while EU value added is even more important in Russia's final use. Also, EU-27 output shows a higher amount of Russia's value added compared to EU-27 final demand, while Russian producers are on average even more dependent on EU value added than vice versa. There are large differences within the EU-27: Some EU Member States (Latvia, Lithuania, Estonia, Finland, Bulgaria, Hungary) and certain industries could be severely affected by trade

disruptions with Russia, especially when the full amount of value added is taken into account.

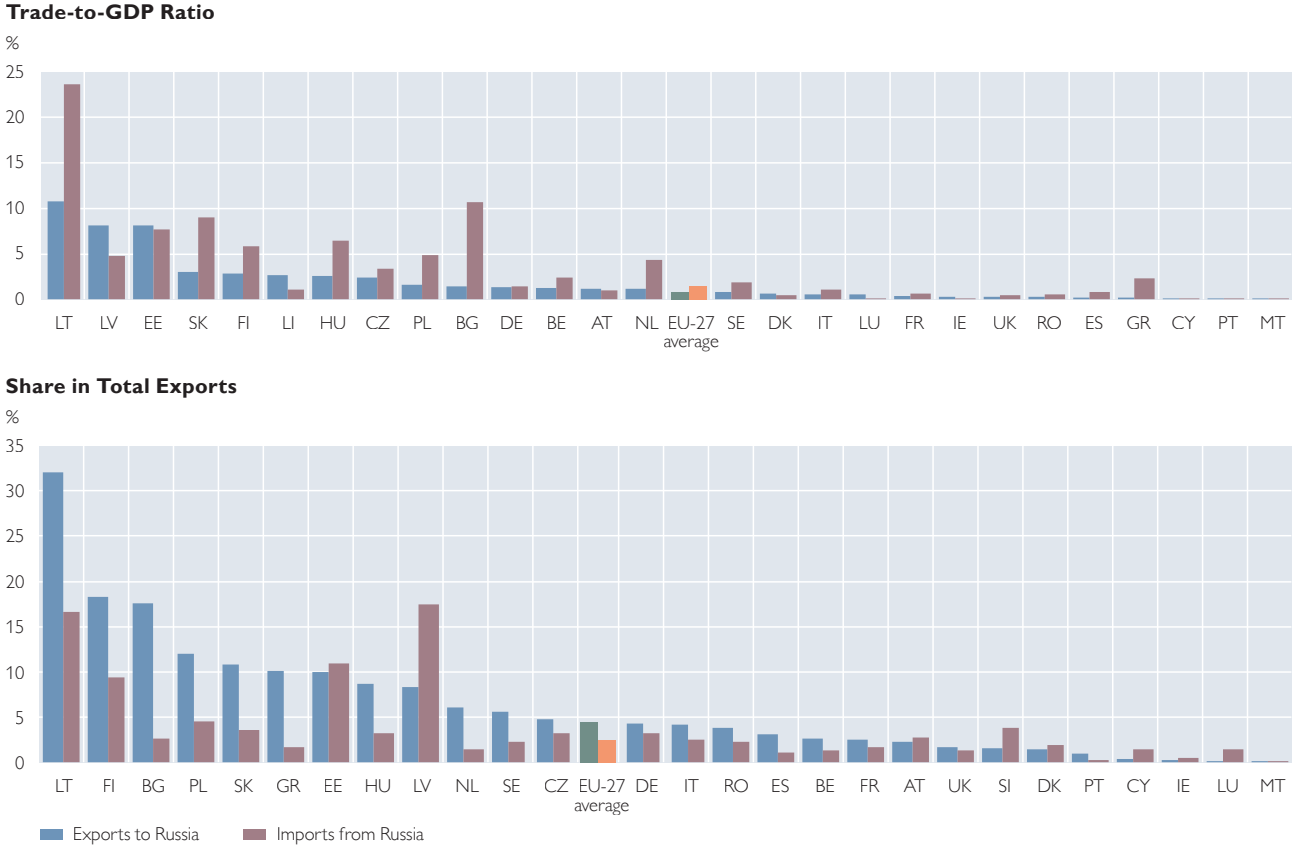
The article is structured as follows. In section 1, we provide an overview of bilateral trade relations between Russia and EU Member States based on traditional statistics. In section 2, we review the methodology used in the article to identify the extent of trade linkages between the EU and Russia using the GVC approach. We describe our findings in detail in section 3, and section 4 concludes.

1 Direct Bilateral Integration through Trade

If we restrict our focus to direct trade flows in goods between the EU and Russia, we find that Russia is the EU's fourth-most important trading partner (excluding intra-EU trade), while the EU represents the most important export destination for Russia's goods. Including intra-EU trade, Russia accounted for 2.5% of total EU-27 exports in 2011, equivalent to 0.8% of EU-27 GDP.[3] However, there are large differences between individual Member States (chart 1). Russia plays a much greater role as an export destination for the Baltic countries than for other EU

Chart 1

Bilateral Goods Trade between the EU-27 and Russia in 2011



Source: Latvijas Banka, OeNB calculations based on Eurostat.

[3] *These figures do not change much over time. In 2013, 2.6% of total EU-27 exports went to Russia. This corresponds to 0.9% of Russia's GDP.*

countries (Lithuania: 11% of GDP; Latvia and Estonia: 8%). The following eastern and northern European EU Member States recorded exports to Russia of about 2% to 3% of their respective GDP: Slovakia, Finland, Slovenia, Hungary, the Czech Republic and Poland.

Russia has traditionally been a more important trade partner for the EU countries in terms of imports, which averaged out at 1.5% of EU countries' GDP in 2011. Again, some Member States posted much higher figures, e.g. Lithuania (23.6% of GDP), followed by Bulgaria (10.7%), Slovakia (9.0%), Estonia (7.7%), Hungary (6.4%) and Finland (5.9%). However, for the following eight EU Member States, Russia's importance as a destination for exports exceeds its importance as a source of imports: Austria, Denmark, Estonia, Ireland, Latvia, Luxembourg and Slovenia.

The importance of Russia's imports for EU Member States is very strongly concentrated on raw materials. Russia is a main supplier of energy products for many EU Member States. Again, this dependence differs greatly among Member States. Slovakia is most dependent on energy imports from Russia; 70% of its oil and gas imports came from Russia in 2011. This share equaled between 30% and 50% in Finland, Latvia and Estonia. It has to be noted, though, that these figures only represent direct oil and gas supplies from Russia to Latvia and Estonia. Russia's oil and gas also enters those two countries indirectly via Lithuania and Belarus.[4] Austria's and Germany's shares were slightly lower at 28.8% and 27.3%, respectively. Some countries, e.g. Ireland, Cyprus, Malta, but also Portugal, do not report any direct oil or gas imports from Russia at all. Hence, Russia is an important direct trading partner for energy products and for some Member States (i.e. the Baltic countries).

2 Capturing Indirect Linkages

The international fragmentation of production has changed the nature of the international economy. As a result, trade flows (gross exports and imports) are no longer an appropriate indicator of a link between two countries. Products exported from country *s* to country *r* are only partly produced in country *s*, while, on the other hand, country *s* may reach consumers in country *r* via intermediate inputs in any third country. Thus, the simple analysis of Russia's exports to the EU-27 will ignore e.g. energy from Russia used in third countries to produce goods and services for the EU-27 market. This calls for refined indicators that are able to capture direct and indirect links jointly. To avoid double counting of gross trade flows that arise from imported intermediate goods embodied in exports, such indicators should in addition account for the share of value added in production.

In this article, we make use of three indices: a traditional one that relies on gross exports, and two novel GVC-compatible indices that focus on value added instead of trade flows. We further look at the importance of inputs from Russia for both final use (private and government consumption, gross fixed capital formation and changes in inventories) in EU-27 economies and total output. Thus, we capture both the demand side and the supply side of the economy. Our first two indicators calculate the relevance of inputs from Russia for final domestic demand (i.e. consumption and investment) in the EU-27. We distinguish between direct trade

[4] *In section 3 below, we focus on such indirect trade linkages and their respective importance for economic activity.*

flows from Russia (restricting our attention to gross exports of goods and services) and Russia's value added that enters the EU directly and indirectly through goods and services imported from third countries. Our third indicator assesses the importance of value added from Russia for EU-27 producers. Of course, we also calculate all three indicators with respect to the importance of EU-27 inputs for the Russian economy.

2.1 Gross Exports in Final Use

As a first indicator, we calculate the share of gross exports from country *s* that is to be found in domestic final use of country *r*. This reflects the portion of final domestic demand in country *r* that is served by imports from country *s* and is evaluated as follows:

$$E_{sr}^{ratio} = \frac{\sum_{n} E_{sn,r}}{\sum_{i}\sum_{n} Y_{in,r}}, \qquad (1)$$

where E_{sr}^{ratio} is the share of final use products exported from country *s* to country *r*, while $E_{sn,r}$ denotes the exports of final use product supplied by sector *n* of country *s* to country *r*. Equation (1) can be modified to calculate the share of final use products coming from a particular sector of country *s*. *E* denotes exports of the source country *s*, *Y* refers to final domestic demand of destination country *r*, with *i* being a running index of all source countries.

This indicator does not tell us anything about the value added produced in country *s*. Rather, it reflects the perception of country *r*'s consumers based on "made in country X" stickers. In our analysis, this indicator reflects the share of "made in Russia" products in EU-27 consumption and investments, as well as the share of "made in the EU" products in Russian final domestic demand. As mentioned before, reference to a country on a sticker is usually not equivalent to the country's ultimate role in the production process. Moreover, it does not account for the importance of a country via indirect links (e.g., it does not fully capture oil and gas from Russia, as a large part of mineral oil products are not consumed directly). However, the share of direct exports can serve as a useful benchmark.

2.2 Value Added in Final Use

It is useful to compare the rather traditional measure of gross exports in final use to the importance of value added that moves directly and indirectly from one country to another. This measure was initially introduced by Johnson and Noguera (2012) and is also termed "value-added exports" or "value-added trade." Value-added exports again focus on final use and can be described as "value added produced in source country *s* and absorbed in destination country *r*" (see Koopman et al., 2014, p. 462). This measure would decompose the final domestic demand (which contains private consumption, government consumption, and investments) of e.g. Russia into value added produced by various source countries (including Russia).

The decomposition of final domestic demand by the source of value added is given by:[5]

[5] *This decomposition is based on standard input-output analysis using the industry-specific technology assumption.*

$$VA^{USE} = V \cdot B \cdot Y = V \cdot \left(\mathrm{I} - A\right)^{-1} \cdot Y,$$

$$V \equiv \begin{bmatrix} diag\left(V_1\right) & 0 & \cdots & 0 \\ 0 & diag\left(V_2\right) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & diag\left(V_K\right) \end{bmatrix}, \quad V_r \equiv u\left(\mathrm{I} - \sum_s A_{sr}\right), \tag{2}$$

where:

- VA^{USE} is a $KN \times K$ matrix that provides disaggregated value added by producer country and sector in final domestic demand for each country. K is the number of countries and N is the number of sectors. Each row of VA^{USE} represents the particular country and sector from which the value added originates. Each column of VA^{USE} reflects a specific destination country. $VA^{USE}_{sn,r}$, an individual element of the VA^{USE} matrix, shows the value added produced by country s in sector n that is consumed in country r.
- Y is the $KN \times K$ matrix of final domestic demand (private consumption, government consumption, and investment). It contains blocks Y_{sr}, that is, the $N \times 1$ final domestic demand vector that describes demand in country r for final goods shipped from country s. $Y_{sn,r}$, the individual element of Y, denotes the final domestic demand of country r for the product of sector n supplied by country s.
- V is a $KN \times KN$ diagonal matrix, and V_r is a $1 \times N$ direct value-added coefficient vector. Each element gives the share of direct domestic value added in total output for each sector of country r.
- A is the $KN \times KN$ matrix of input-output coefficients that is constructed from the $N \times N$ blocks A_{rs}. Those blocks contain information on intermediate use by country s of the goods produced in country r.
- B is the Leontief inverse matrix $B = (I - A)^{-1}$.
- u is a 1×N unity vector.
- I denotes the $KN \times KN$ identity matrix.

The matrix VA^{USE} contains information on the decomposition of final domestic demand for the entire set of countries present in the world input-output table. If we want to calculate a particular subset of countries (source country s and destination country r), we use the following formula:

$$VA_{sr}^{USE\_ratio} = \frac{\sum_n VA_{sn,r}^{USE}}{\sum_i \sum_n Y_{in,r}}, \tag{3}$$

where $VA_{sr}^{USE\_ratio}$ denotes the share of value added directly and indirectly coming from country s and absorbed in country r. The denominator of equation (3) is the total final domestic demand of country r, while the numerator contains the total value added from s consumed in final destination country r. Equation (3) can be easily modified to show the share of value added coming from a particular sector of country s.

Unlike the gross exports indicator, value added in final use is not tied to the final assembly country only. It goes much deeper and reflects the direct and indirect contribution of every country in the production of a consumption or

investment good. More specifically, this indicator captures the indirect contribution of Russia's energy sector in EU-27 final domestic demand, but also accounts for inputs not coming from Russia in "made in Russia" final use products.

2.3 Value Added in Output

Both indicators described above characterize intercountry links from the expenditure side of the economy. However, we also need an indicator that describes the role of one country's inputs in another country's output, i.e. an indicator that takes into account vertical specialization (a country's specialization on particular stages of the production process). The usual way to assess vertical specialization is to calculate "value added in gross exports" (see Koopman et al., 2010; the indicator is closely related to "value added in trade" as presented in Stehrer, 2012). Value added in gross exports makes it possible to decompose gross exports by producer countries.

Value added in gross exports is useful to analyze the effect of globalization on international trade, while our goal is somewhat different and our focus is on total supply (output). However, the methodology used by Koopman et al. (2010) in decomposing gross exports can be applied to total output by simply replacing the gross exports matrix by the total output matrix:

$$VA^{OUTPUT} = V \cdot B \cdot X = V \cdot \left(\mathrm{I} - A\right)^{-1} \cdot X,$$

$$X \equiv \begin{bmatrix} diag\left(X_1\right) & 0 & \cdots & 0 \\ 0 & diag\left(X_2\right) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & diag\left(X_K\right) \end{bmatrix}, \tag{4}$$

where:

- VA^{OUTPUT} is a $KN \times KN$ matrix that decomposes the output of all sectors in all countries into value added by source country and sector. Each row of VA^{OUTPUT} represents the producer country and sector from which value added is originated. Each column of VA^{OUTPUT} shows the country and industry that uses this value added in its total output. $VA^{OUTPUT}{}_{sn,rm}$, an individual element of VA^{OUTPUT}, denotes the value added of country s's sector n that is contained in the output of country r's industry m.
- X is the $KN \times KN$ diagonal matrix of output. It contains $N \times N$ diagonal blocks X_s of output in country s. X_{sn}, the diagonal element of X, denotes the output of country s in sector n.

Information about a particular pair of countries (source country s and destination country r), can be derived using the following equation:

$$VA_{sr}^{OUTPUT\_ratio} = \frac{\sum_m \sum_n VA_{sn,rm}^{OUTPUT}}{\sum_m X_{rm}}, \tag{5}$$

where $VA_{sr}{}^{OUTPUT\_ratio}$ is the share of value added from county s directly and indirectly included in output of country r. X is total output and m refers to all industries of the destination country r that are producing output, while n refers to all industries

of the source country *s* that are delivering inputs. The numerator of equation (5) shows total value added of country *s* used in output of country *r*, while total output of country *r* appears in the denominator. Equation (5) can also be modified to assess more detailed information on particular sectors.

While in spirit, value added in output is similar to value added in final use, it describes linkages from a different perspective: Value added in output focuses on direct and indirect inputs from Russia in EU-27 output (and vice versa). For instance, it shows the contribution of Russia's energy sector in EU-27 production, capturing also the indirect inputs via third countries.

2.4 Database

We use the recently established World Input-Output Database (WIOD)[6] that combines information from national supply and use tables, National Accounts time series on industry output and final use, and data on bilateral trade in goods and services for 40 countries, 59 commodities and the period from 1995 to 2011 (see Timmer, 2012, for more details on the database and Stehrer, 2012, for empirical calculations based on WIOD). The database covers all EU Member States except Croatia. Therefore, we have to restrict our analysis of direct and indirect trade linkages to the EU-27. Further, although the latest available data are for the year 2011, we argue that they still reflect bilateral links between Russia and EU countries well, since input-output structures do not change rapidly.

3 Importance of Direct and Indirect Trade Linkages

In section 1, we sketched the importance of Russia as a direct trading partner for EU members, which is not fully representative in the presence of internationally fragmented production processes. In addition, we restricted our attention to trade in goods only. In this section, we broaden the view and employ the conceptual framework described in section 2 to assess the importance of Russia for economic activity in the EU Member States. In other words, we analyze how dependent EU economies are on inputs from Russia, regardless whether these inputs are sourced directly or whether they are embedded in intermediate inputs sourced from elsewhere in the world. As we base our calculations on globally connected input-output tables, we also capture the role of service inputs.

3.1 Importance of Bilateral Gross Exports and Value Added in Final Use Differs Between the EU and Russia

At first sight, inputs from Russia play only a minor role for European economies. On the demand side, direct imports from Russia amount to 0.07% of EU-27 final use (top panel of chart 2). If the full amount of Russian value added in European final domestic demand is taken into account, the share of Russian value added – which is absorbed directly and indirectly in the EU-27 through integration into GVCs – increases to 1.1% (bottom panel of chart 2).

Individual EU Member States exhibit very different degrees of integration with Russia's economy. The share of direct imports from Russia in final domestic use ranges from 0.01% for Portugal to 1.1% for Latvia. Including indirect inputs from Russia, Lithuania shows the highest dependence on value added from Russia (6.8%

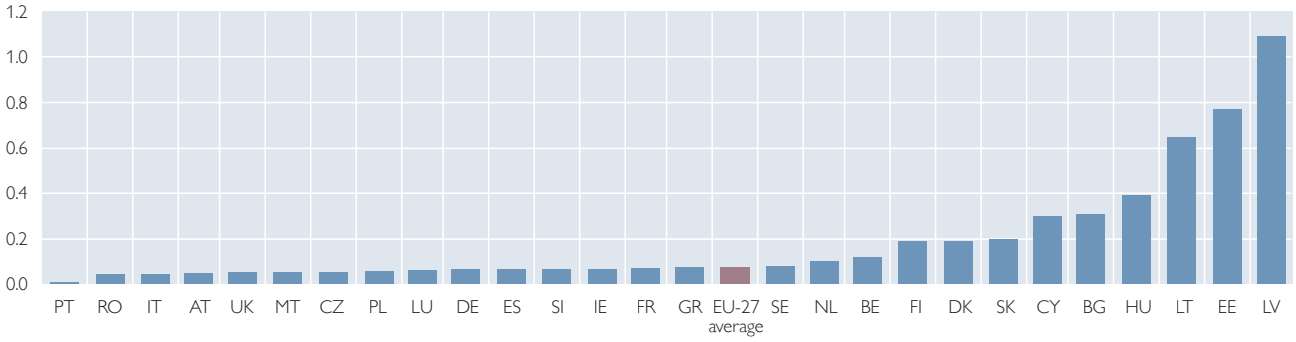
[6] *See www.wiod.org for details on the database.*

Chart 2

Share of Russian Gross Exports of Final Products and Value Added in EU-27 Domestic Final Use in 2011

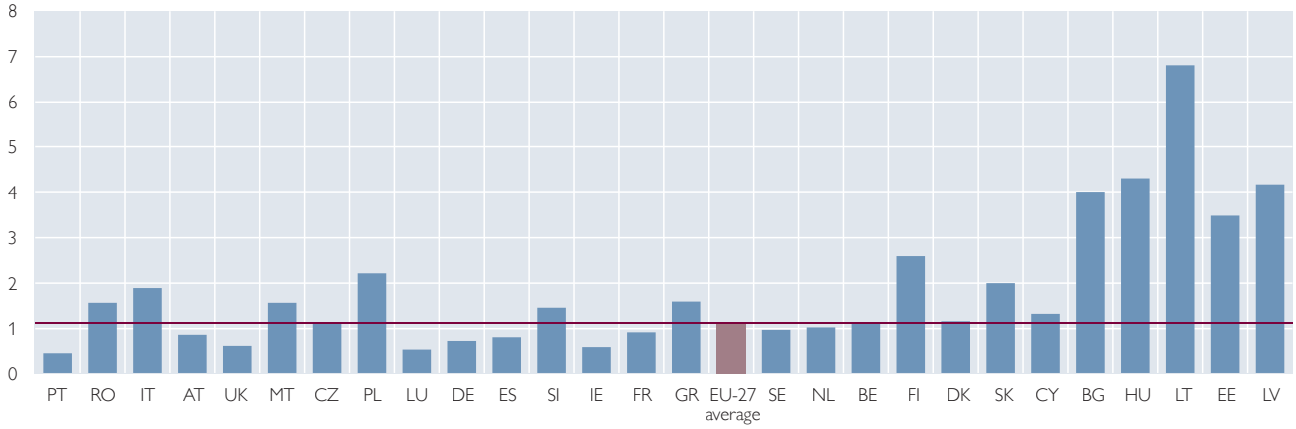
Gross Exports (Direct Trade Flows)

% of domestic final use



Value Added (Direct and Indirect Trade Flows)

% of domestic final use



Source: Latvijas Banka, OeNB calculations based on WIOD data.

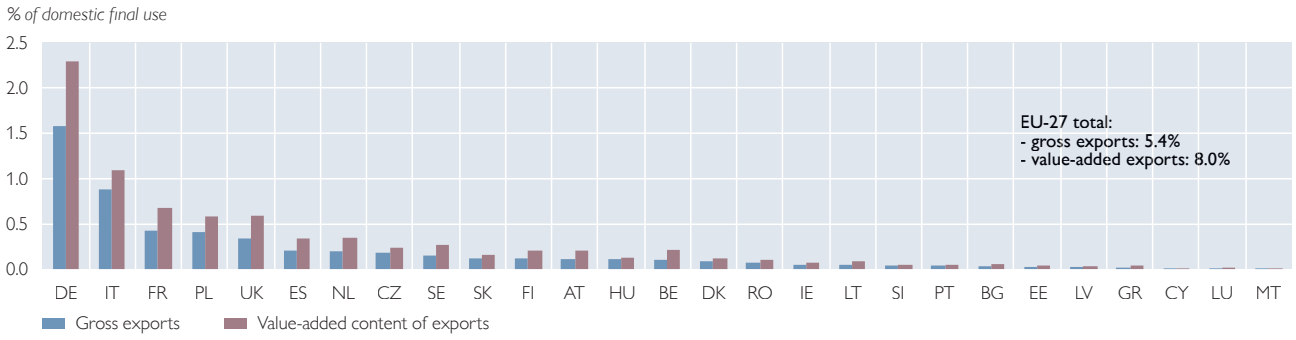
of final domestic demand). Portugal is again least integrated with a share of 0.4%. The integration in value-added terms is particularly pronounced for Hungary, Latvia, Bulgaria and Finland. Differences between direct trade exposure and value-added trade exposure are particularly pronounced for Poland, Italy and Greece. In Poland, the share of direct imports from Russia in final domestic use is 0.06%, while Russian value added in final domestic use amounts to 2.2%. The corresponding figures for Italy are 0.04% and 1.9%, respectively. This large discrepancy may be related to Fiat producing in Russia. Finally, for Greece, the importance of products from Russia in final domestic use rises from 0.07% (direct imports only) to 1.6% (value added).

More than half of the demand for direct imports from Russia emerges from the coke and petroleum industry. Even if the importance of Russia for EU final domestic use remains limited and highly concentrated, value added from Russia is more important for EU final use than direct imports only suggest.

Conversely, examining the impact of EU-27 exports on Russia, chart 3 reveals that EU value added is even more important in Russia's final domestic use than vice versa. Around 5.4% of the final domestic demand in Russia is directly depen-

Chart 3

Share of EU-27 Gross Exports of Final Products and Value Added in Russia's Domestic Final Use in 2011



Source: Latvijas Banka, OeNB calculations based on WIOD data.

dent on final products imported directly from the EU-27. The level of dependence increases to 8% when we also take into account indirect effects – i.e. when we focus on EU-27 value added instead of goods exported directly from the EU-27 to Russia. For instance, final goods that reach Russia may come from elsewhere in the world than the EU-27 via the participation of EU-27 exporters in global value chains. Hence, imports from non-EU countries also contain EU-27 value added.

A closer look at the data shows Germany as the most important EU-27 counterpart for Russia's final users, with 1.6% of Russia's final demand goods sourced from Germany directly. This figure increases to 2.3% including indirect effects. Less important, but nevertheless accounting for a significant share of Russia's final domestic use, are Italy, France, Poland and the United Kingdom. The other EU Member States play a less prominent role, both directly and indirectly.

The following industries in the EU-27 have the greatest relevance for final domestic use in Russia in terms of direct exposure: Transport equipment (European exports account for 1.4% of Russia's final use), chemicals and chemical products (0.6%), machinery (0.9%), and textiles and textile products (0.8%).[7] It is difficult to single out other industries, since some exposure is evident in many of them (never exceeding 0.5%, though). When considering the full value added content from the EU-27 (i.e. including European value added that is traded through third countries), two other categories emerge as more important than the rest, namely basic metals and fabricated metals (0.5%), and renting of machinery and equipment and other business activities (0.9%).[8]

To sum it up, Russia's consumers and investors are more dependent on EU inputs than vice versa. Thus we may assume that if trade is disrupted, Russia might need to refocus on other trading partners for substitution.

3.2 Value Added from Russia Is More Important for EU Output than for EU Final Use

The output approach allows us to assess to what extent European industries are dependent on inputs from Russia and how this dependence differs among countries

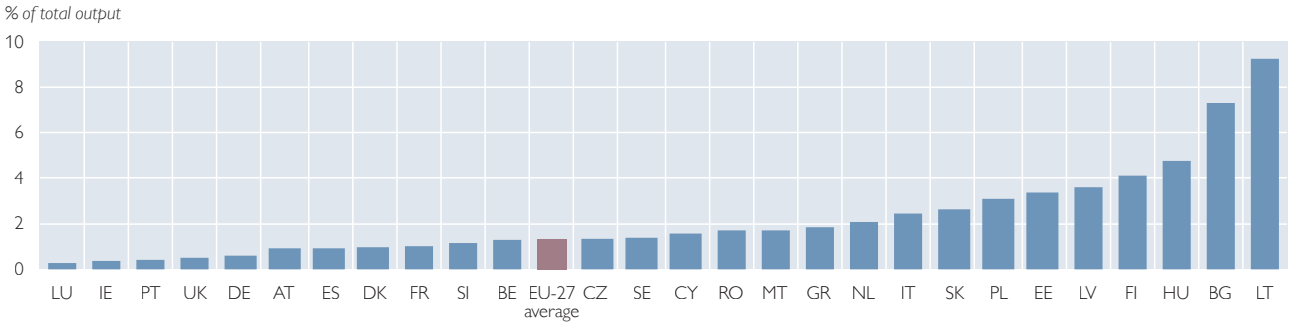
[7] *The classification of economic activities is taken from WIOD (see Timmer et al., 2012).*

[8] *Results are available from the authors on request.*

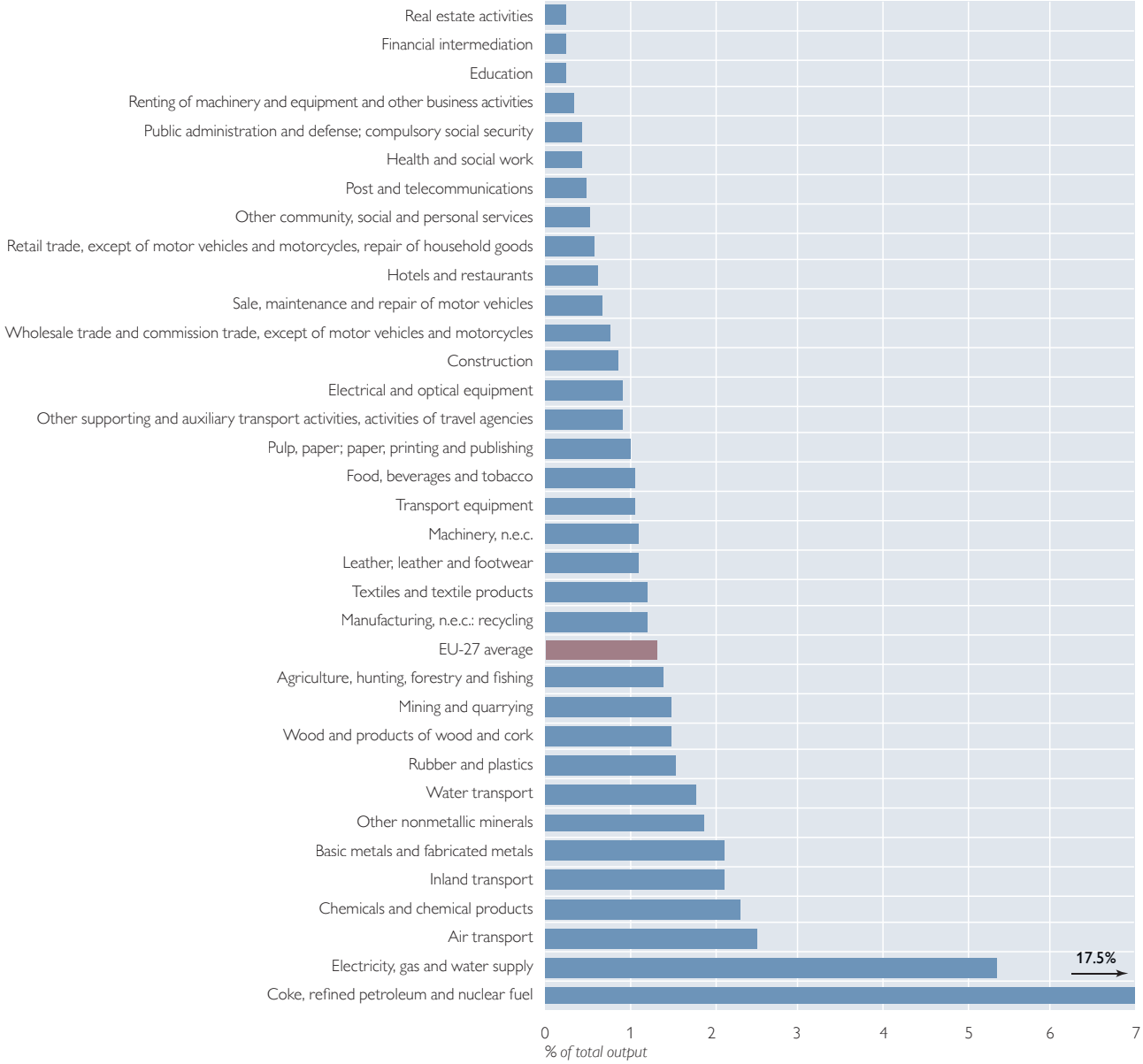
Chart 4

Share of Value Added from Russia in EU-27 Total Output in 2011

By Member States



By Industries



Source: Latvijas Banka, OeNB calculations based on WIOD data.

(chart 4). For the EU-27 as a whole, value added from Russian is more important for the production of output (including the production of intermediate goods, final domestic use and exports) than for final use. On average, 1.3% of EU-27 output falls on value added by Russia. Again, linkages with Russia's economy vary greatly between individual EU members, ranging from 0.3% (Luxembourg) to 9.2% (Lithuania). Lithuania, followed by Bulgaria, Hungary, Finland, Latvia and Estonia, exhibits the strongest dependence on Russian value added.

We can determine which industries show the highest share of value added from Russia in EU-27 output: Besides the coke and petroleum industry (value added from Russia amounts to 17.5% of total EU-27 output), utilities (5.3%) and transportation services (around 2%) are most dependent on value added from Russia.

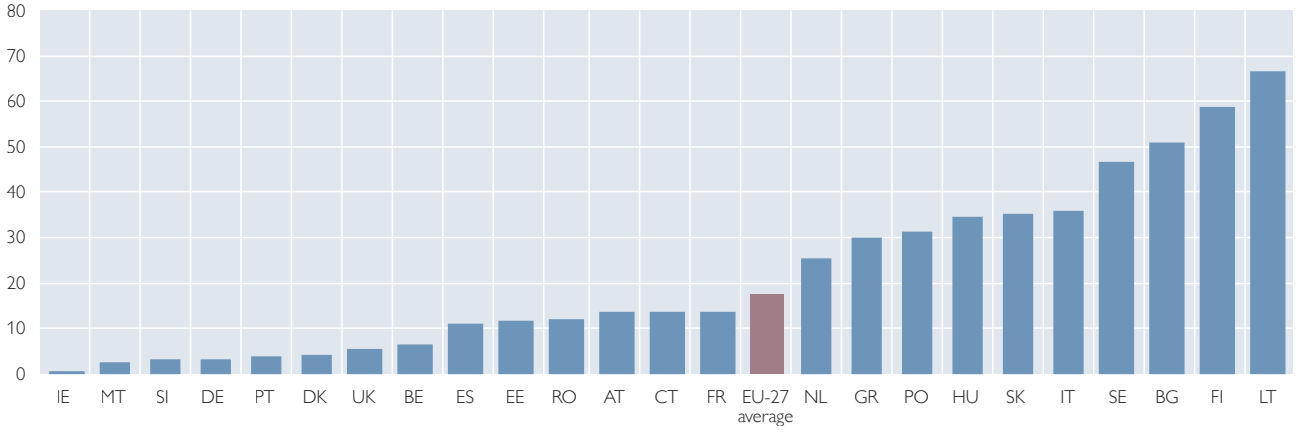
Chart 5 focuses on the regional differences within the EU-27 in the two industries where EU Member States show the highest share of value added from Russia in output (i.e. coke and petroleum, utilities). In line with our observation in chart 4, the CESEE EU Member States, Finland and Italy exhibit the largest share of value added from Russia in total output also in these two industries. Clearly, the actual impact that reducing trade flows between Russia and the EU would have depends not only on the importance of industrial linkages, but also on substitution possibilities. In this respect, some of the countries which are most strongly integrated

Chart 5

Share of Value Added from Russia in EU-27 in Selected Industries

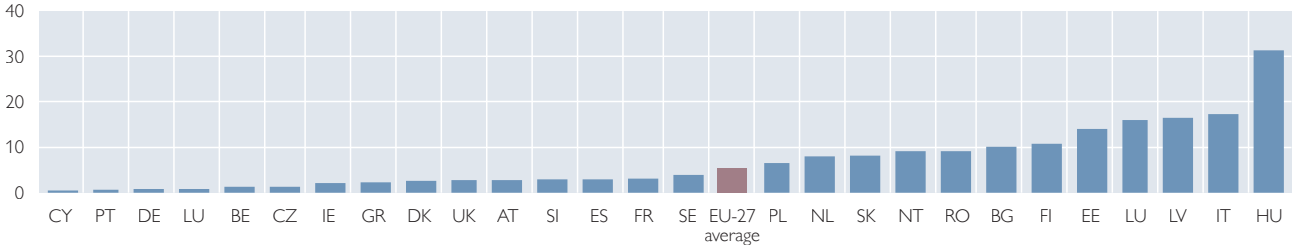
Coke, Refined Petroleum and Nuclear Fuel

Inputs from Russia in % of output



Electricity, Gas and Water Supply

Inputs from Russia in % of output



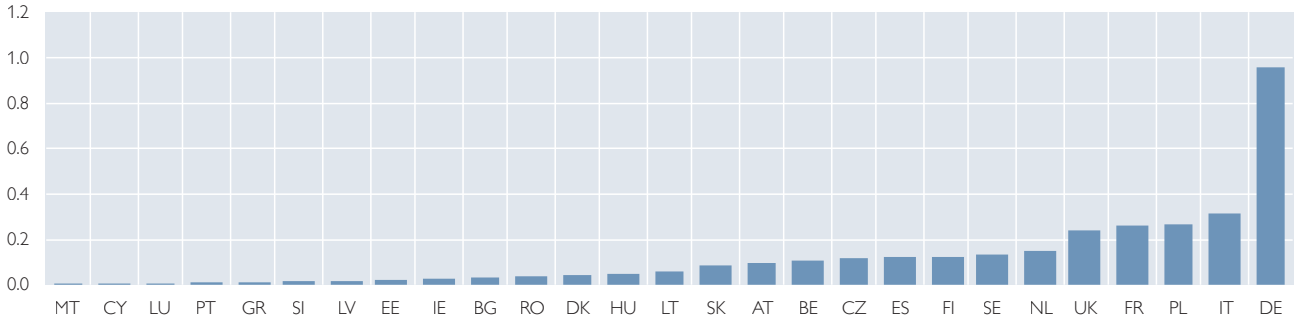
Source: Latvijas Banka, OeNB calculations based on WIOD data.

Chart 6

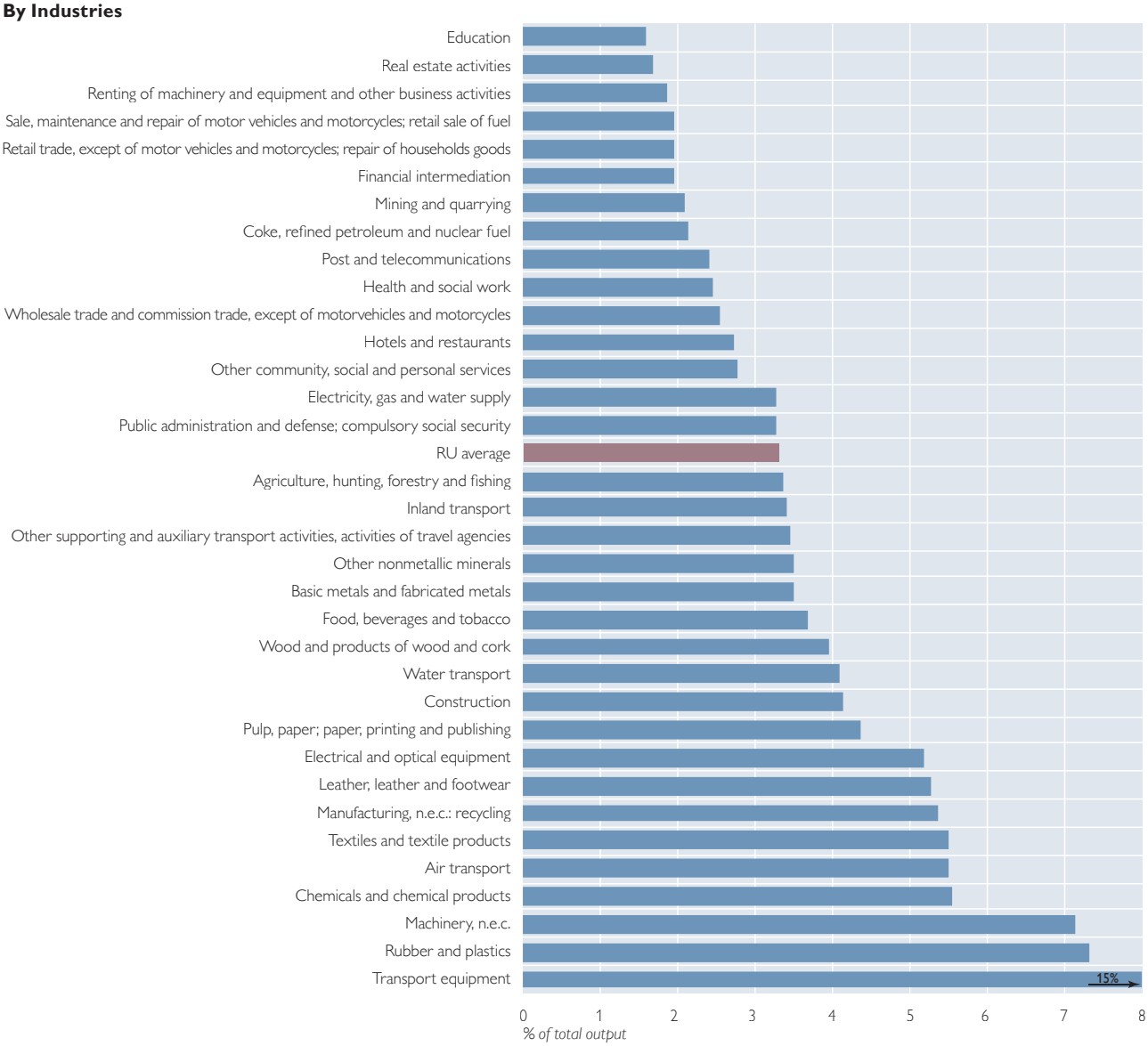
Share of EU-27 Value Added in Russia's Total Output in 2011

By Countries

% of total output



By Industries



Source: Latvijas Banka, OeNB calculations based on WIOD data.

with Russia's economy (in particular the Baltic countries) have very limited possibilities of switching from Russian suppliers to other suppliers in the short to medium run, especially in the most affected industries.

To sum it up, EU-27 output contains more value added from Russia than EU-27 final use. Yet as in the case of gross exports in final use, Russian producers are on average far more dependent on the EU in absolute terms. Chart 6 shows the dependence of Russia's output on EU-27 value added. On average, summing up over all Member States, about 3.3% of Russia's industrial output is (directly or indirectly) dependent on inputs from the EU-27 (see "RU average" in bottom panel). Country-wise, the most important counterpart for Russia's industrial production enterprises is Germany (about 1%), followed by Italy, Poland, France and the U.K. (top panel).

The importance of EU-27 value added for Russia's output is also somewhat more evenly distributed across industries than the highly skewed distribution of value added from Russia in EU output in chart 5. Transport equipment is the sector with the greatest share of EU value added (almost 15%, with more than one-third originating in Germany). Other heavily dependent sectors are rubber and plastics (7.3%) as well as machinery (7.1%) – with more than one-third originating in Germany again in both cases. Air transport (5.5%) and manufacturing (5.4%) follow closely behind. Russia's output in the remaining sectors contains at least 2% of value added from the EU-27.

In contrast to the pattern of dependence of EU-27 economies on Russia, Russia's economy emerges as being more dependent on EU-27 value added on the demand side than on the production side. The substantial reliance of Russia's industrial sector on EU value added means that in case of a trade disruption, Russian producers and consumers would need to find new input sources.

3.3 Summary of Mututal Dependence between the EU and Russia

To summarize the results, we find that Russia is clearly more dependent on the EU-27 than vice versa. This finding remains unaltered when we shift from direct trade linkages (gross exports) to direct and indirect linkages (value added), as well as when we study dependence from the consumer (final domestic use) and producer (output) perspective. The headline figures are reported in the table 1 below.

The importance of Russia for EU-27 consumers and investors increases more than tenfold when accounting for indirect linkages. This simply reflects that Russia's economy is an upstream producer mainly focused on intermediate goods and raw materials (i.e. oil, gas and metals). However, the relatively low importance of Russia for EU-27 final domestic demand and output flags the generally low degree of Russia's integration into GVCs.

Table 1

Summary of EU-Russia Trade Integration (Data for 2011)

	Gross exports in final use	Value added in final use	Value added in output
	%		
Importance of Russia for the EU-27	0.1	1.1	1.3
Importance of the EU-27 for Russia	5.4	8.0	3.3

Source: Latvijas Banka, OeNB calculations based on WIOD data.

For several reasons, the importance of the EU-27 for Russia's economy is significantly higher than Russia's importance for the EU-27: First, the EU-27 economy is much larger than that of

Russia. Second, many European producers are positioned downstream in the GVCs, which explains the larger share of gross exports from the EU-27 in final domestic use in Russia. Finally, higher participation in GVCs increases the importance of EU-27 value added for Russian consumers and producers.

4 Conclusions

This article summarizes the importance of trade integration between the EU-27 Member States and Russia. In our analysis, we go beyond the description of direct trade links; we take account of the international fragmentation of production and assess the importance of value added from Russia (from the EU) for final use and total output in the EU economies (in Russia). Our analysis of trade linkages across global value chains (GVCs) is based on data for 2011 from the World Input-Output Database. This database combines national input-output tables with global trade data. Hence, we examine direct as well as indirect trade flows between the EU-27 Member States and Russia. This means that in any bilateral comparison, we can identify the full amount of foreign value added in total output and final domestic use.

As an export destination, Russia is not really important for EU countries on average (0.9% of GDP), though it is the fourth-most important export destination when intra-EU trade is excluded. Russia attains a slightly more important position as a source of imports to the EU (1.6% of GDP, especially energy imports). Looking at direct trade flows, we already note that the importance of Russia as a trading partner differs greatly across individual EU Member States. We also observe strong differences between individual industries. Thus, the importance of Russia for the EU is highly concentrated both geographically and by industries.

However, a country's integration into GVCs implies that bilateral trade flows do not reflect the actual amount of linkages between modern economies well. If we include intermediate linkages to their full extent in our analysis, we find that both Russia and the EU would suffer to some extent from potential trade disruptions. On average, the degree of mutual integration through trade linkages remains low for EU Member States, even when indirect linkages are taken into account. However, among EU members, the degree of integration again varies greatly, with some Member States (i.e. the Baltic countries) being notably more dependent on value added from Russia than vice versa. Russia's economy is more dependent on EU direct imports and value added than vice versa. Furthermore, in line with the results for direct trade linkages, certain economic activities in the EU are strongly dependent on inputs from Russia, such as the energy sector, utilities and air transport.

Our results indicate the degree of trade integration by contrasting two different views: The results obtained from looking at direct trade flows (section 1) are relevant, as direct trade flows would be immediately affected by administrative measures such as trade sanctions. However, direct trade flows at the same time understate and overstate the real importance of Russia's economy for the EU: On the one hand, goods from Russia may be passed through European production processes, and hence the net value of trade with Russia for European consumers may be lower than these direct trade figures suggest. On the other hand, direct and all indirect trade flows are captured in the value-added view (section 3). This method reflects the full importance of value added originating from Russia for European producers and consumers.

Summing up the results we have calculated for the three proposed indicators of integration (two of which are compatible with GVCs), we find that Russia is more dependent on EU value added than vice versa. Final domestic use in Russia would be significantly affected by trade disruptions, as the share of EU inputs in final domestic use in Russia is between 5.4% (only direct inputs) and 8% (share of all direct and indirect value added of the EU inputs entering Russia, including via third countries). The corresponding figures for the EU-27 are as low as 0.07% and 1.1%, respectively. These findings reflect two features of Russia's economy: Its position in GVCs as an upstream producer that relies strongly on imports of final goods, and its generally low degree of integration into GVCs.

3.3% of Russian total output (comprising intermediate goods, final domestic use and exports) is based on EU-27 value added, while the fraction of Russia's value added in EU-27 total output is 1.3%. Hence, the extent of bilateral integration through global value chains is small, but clearly nonnegligible, especially not for Russia's economy.

While the share of value added from Russia is larger in EU total output than in EU final domestic use, the opposite holds for EU inputs in Russia: The share of EU value added is higher in final domestic use in Russia than in Russia's total output.

Notwithstanding the lower dependence of the EU-27 economic aggregate on imports and value added from Russia than vice versa, one has to take into account wide-ranging differences among the EU-27 Member States as well as among industries. Some countries (Latvia, Lithuania, Estonia, Finland, Bulgaria, Hungary) and particular industries (i.e. the coke and petroleum industry) could be severely affected by trade disruptions, especially if the full amount of value added from Russia is taken into account. The fraction of value added from Russia in total output ranges from 0.3% (Luxembourg) to 9.2% (Lithuania). Producers in Lithuania, followed by those in Bulgaria, Hungary, Finland, Latvia and Estonia, exhibit the strongest dependence on value added from Russia. Besides the coke and petroleum industry (value added from Russia amounts to 17.5% of total output), utilities (5.3%) and transportation services (around 2%) are most dependent on inputs from Russia (including indirect linkages).

The dependence on imports is greater for some goods and services than for others: Energy products from Russia exhibit a low degree of substitutability for several EU countries in the short to medium term. In fact, the great variation between individual Member States' dependency on energy imports calls for the completion of the single market in the energy and utility sector, the establishment of a suitable physical infrastructure across Europe, and the reduction of dependencies on single source countries.

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