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Article

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The Content of Knowledge-Intensive Business Services in International Trade: Evidence from European Union Countries[1]

Michał PRZYBYLIŃSKI – Joanna WYSZKOWSKA-KUNA***

Abstract

In this paper, we propose four measures to calculate the KIBS intensity of trade (i.e., KIBS terms of trade; an importance indicator; an indicator showing the relative KIBS intensity of exports; and an indicator showing the relative importance of KIBS). Finally, we examine the composition of KIBS output imputed to export. The study refers to the EU countries. Calculations are based on a set of input-output tables from the World Input-Output Database for the period 2000 – 2014. Empirical results demonstrate that the EU-15 has a clear and growing advantage over the EU-13 in KIBS direct exports, but when taking into account indirect KIBS trade, the EU-15's advantage is smaller, with a decreasing trend. Export appeared to be more KIBS-intensive than production for domestic final demand, and computer and information services were the main engine behind the growing KIBS intensity of export. Among the EU countries, Ireland is an outlier.

Keywords: *knowledge capital, European Union, exports, imports, input-output model, services sector*

JEL Classification: C67, F14

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Introduction

Contemporary economies are characterized by the dominance of service sectors (tertiarization) and economic processes by the dominance of service inputs (servitization). Technological progress has resulted in the main force driving this

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transformation being the dynamic development of a group of services called 'knowledge-intensive business services' (KIBS). Technological progress has also significantly increased the tradability of many services, and thanks to this, they have become the fastest-growing components of international trade. However, one should note that despite their rapid growth, international trade is still dominated by trade in goods, which is caused by the fact that most services' trade is embodied in the trade of goods, as a large share of total value added in the goods sector comes from services inputs to manufacturing. Thus, in an analysis based on balance of payments statistics (i.e., on gross trade value, which is also termed direct or disembodied trade), the value of services trade is rather small globally, relative to indirect (embodied) trade, which can be calculated on a value added basis. The pattern is quite different when we focus on international trade in goods, as the global subdivision of labor and the resulting increased roundaboutness of production means that value added is double-counted, and thus, the value of gross trade in goods is overestimated (Johnson, 2014; Francois, Manchin and Tomberger, 2015).

There are a few studies that estimate the content of services in international trade, but to the best of the authors' knowledge, there is no study that analyzes this issue with respect to KIBS. The present paper tries to fill this gap by examining the content of KIBS in products being traded internationally. The main motivation for this study is that the issue is of great importance, as we have been able to observe the growing importance of KIBS in developed countries over recent decades. Their rapid growth has taken place not only thanks to the increasing direct consumption of KIBS input by companies from different branches, but also thanks to the increasing embodiment of KIBS in the values of other products that are intermediate inputs used in production processes in the whole economy. KIBS intermediate inputs positively affect the competitiveness of companies using them, and similar results can be expected from their indirect use.

Finally, the growing consumption of KIBS, together with the increased tradability of services and the liberalization of service trade (European Single Market for Services), has led to the growing share of KIBS in international trade, which also contributes to increased productivity performance and fosters technological change in the economic system (Di Cagno and Meliciani, 2005). One should note, however, that the possibility of service delivery at a distance refers mainly to standardized services, whereas KIBS are usually tailored to the individual needs of a given consumer (Miles et al., 1995). This requires intensive relationships between KIBS providers and recipients, which limits their tradability. By contrast, goods produced using these services as intermediate inputs can be easily traded internationally. Thus, the analysis based on value added seems to be particularly relevant for KIBS trade.

The main objective of the paper is to track changes in the KIBS intensity of production of the EU member countries, with a distinction between goods and services delivered to the domestic market and those for exports.

The paper contributes to the research literature by presenting the content of KIBS in exports, its equivalent for imports, as well as the terms of trade (ToT) in KIBS. Four indicators are proposed and calculated to assess the role that KIBS play in the trade of EU countries. Finally, we examine the composition of KIBS output imputed to export.

There is no official definition of either knowledge-intensive business services nor of international trade in knowledge-intensive business services. As a result, in different studies, this group of services is termed different ways (such as KIBS, KIS – knowledge-intensive services, or financial, communication, and business services, although they usually include similar services. The paper contributes to the research literature by presenting a definition of KIBS trade in the light of the available data from an input-output table, as well as by comparing it with a definition of KIBS trade in the light of the balance of payments statistics (BoP).

The study is based on data derived from the World Input-Output Database (WIOD, 2016 release). Thanks to the availability of the data, the analyzed period covers the years 2000 – 2014. We use the input-output model. The study is carried out for EU countries, but to compare the results for more and less developed EU states, the sample is divided into two groups, i.e., members before 2004 ('old') and members since 2004 ('new'), hereinafter called EU-15 and EU-13.

The paper is organized as follows. Section 1 reviews the related studies. Section 2 defines KIBS and KIBS trade and indicates data source. Section 3 describes the methodology. Section 4 presents and discusses the empirical results. The last Section concludes.

1. Literature Review

Nowadays, it is increasingly believed that the significance of KIBS extends beyond their growing share in GDP and employment. KIBS are recognized as an important input in production processes (Oulton, 2001) and carriers of new knowledge developed in upstream sectors, which is then diffused into other industries (European Commission, 2011). They may positively affect competitiveness in various ways, i.e., 1. through the development of the KIBS sector, which entails the creation of highly qualified jobs in the economy, as well as through innovation activities (Shearmur and Doloreux, 2019) and productivity growth in the KIBS sector (Musolesi and Huiban, 2010); and 2. through the use of KIBS in production and innovation processes by enterprises from other industries, which

should stimulate their output, productivity, innovation, and export performance (Antonelli, 1998; Windrum and Tomlinson, 1999; Di Cagno and Meliciani, 2005; Baker, 2007; Castellacci, 2010).

Studies that refer to the indirect use of services are much less numerous. Katsoulacos and Tsounis (2000) were the first to estimate both the direct and indirect use of business services while identifying the most intensive users in the Greek economy. Francois and Woerz (2007) also point to the need to take into account the indirect use of producer services to reflect their full importance for manufacturing production. If a given sector (e.g., pharmaceuticals) increases its output, it not only requires additional producer services directly as inputs but also more output from the chemical industry, which also uses these services as inputs in production. This additional direct and indirect consumption of producer services appears to be positively correlated with GDP in all manufacturing industries (except the leather industry) in the OECD countries.

Ciriaci and Palma (2016), using input-output data for some European countries over the period 1995 – 2005, demonstrate the existence of a strategic relationship between KIBS and manufacturing subsystems, dominated by technologically advanced subsystems. This paper has been followed by several other studies that focused on the integration of KIBS into manufacturing substystems. The paper by Di Berardino and Onesti (2018) proves that the Baltic countries (Lithuania, Latvia, and Estonia) are characterized by a higher level of service activities than the Visegrad countries, although a gap between them and the 'old' EU countries remains. The relationships between manufacturing and services, considering the level of technological intensity and the contribution of KIBS to the final demand for manufacturing output, explain these differences.

The second paper by Di Berardino and Onesti (2020) shows that the growing importance of intermediate inputs has resulted from more than just the growing use of intermediate services in manufacturing industries because considering all the indirect linkages, more intermediate inputs are required in many parts of the service sector than in manufacturing. This study gives a clear indication of how service activities have evolved over time, considering that each unit of final demand for services has absorbed more intermediate inputs and has generated greater indirect demand for services.

Sarra, Di Berardino and Quaglione (2019) indicate that great differences in the deindustrialization process exist between the EU-12 ('old') and EU-15 ('new') countries, and among the technological classes of manufacturing. The higher the technological level of the subsystems, the larger the share of services within them. However, the weight of market services is much smaller in the EU-12 than in the EU-15 in each technological partition of the manufacturing subsystem.

Finally, Antonioli, Di Berardino and Onesti (2020) demonstrate that the core EU countries (central Economic and Monetary Union) show a higher level of KIBS integration in manufacturing than peripheral ones (southern and eastern EMU). The disaggregation by technological intensity shows a positive relation between KIBS integration and technological intensity over time; however, the last global financial crisis undermines the linkage between manufacturing and KIBS that emerged in the pre-crisis period.

The growing demand for KIBS has led to their increasing share in international trade. This trend has additionally been supported by the ICT revolution, which has significantly increased the tradability of many services (Miozzo and Soete, 2001) and has enabled the reorganization of production in the form of outsourcing (Abramovsky and Griffith, 2005). Rapidly falling communication and coordination costs have made it possible to perform most stages of production processes in different locations. Meanwhile, the cross-border fragmentation of production entails 'slicing up' the production stages or tasks required to produce output and distributing them across countries to minimize production costs. This has contributed to the rapid internationalization of the supply of input, in the form of global sourcing, international outsourcing, and offshoring (Miroudot, Lanz and Ragoussis, 2009).

Currently, these processes also refer to modern services that can be unbundled and splintered in a value chain, just like goods, and transported internationally through satellite and telecom networks at very low costs. Among the studies linking the development of service trade to the increasingly complex patterns of trade in intermediate goods and services that pass within and between countries before reaching the final consumer, one can mention Johnson and Noguera (2012a,b), Baldwin and Lopez-Gonzalez (2015), and Egger, Francois and Nelson (2017). As a result, KIBS have become the main engine of service trade development since 1980, and the level of KIBS internationalization through trade has been increasing in developed economies, with the highest advancement of this process in Europe (Wyszkowska-Kuna, 2016a).

Few studies analyze the issue of international competitiveness in this field. Guerrieri and Meliciani (2005) found that a country's ability to develop competitiveness in financial, communication, and business services depends on the structure of its manufacturing and service sectors, as some industries are more intensive users of these services than others.

The study by Wyszkowska-Kuna (2017a) proves that domestically produced KIBS positively determine the competitiveness of the KIBS sector in all EU countries, but imported KIBS have a positive impact on competitiveness in KIBS exports only in the 'old' EU countries. The 'new' member states are usually not

competitive in KIBS exports, and those that are successful in this field seem to have achieved their success mainly from international outsourcing rather than from building their own capacities. The 'old' EU countries compete in KIBS exports through technology advancement (measured by R&D expenditures), while the 'new' EU countries do it via lower labor unit costs and human capital resources.

Yap Co (2007) showed that KIS affiliated exports (intra-firm trade within multinational companies, e.g., research and development, testing services) generally arise to support other activities (e.g., manufacturing) in the importing countries, whereas non-affiliated KIS exports (transactions with foreigners that neither own nor are owned by a US party) do not require the presence of other activities. Brinkley (2007) highlighted the structural change in the UK economy from trade in other manufactured goods towards exports in knowledge-based services and high tech manufacturing, but increased competition from emerging economies in this field has become visible.

Javalgi et al. (2011) showed that major emerging markets have been building competitive advantage by focusing on KIBS, but their progress differs sharply – China leads, followed by India, Brazil, Russia, Mexico, Turkey, and Indonesia (although none has managed to reach parity with highly industrialized countries), whereas smaller nations lag behind them. KIS trade contributed more to economic growth in China than labor-intensive and capital-intensive services trade. However, overall, China lacks international competitiveness in KIS trade because of the immaturity of its KIS sector (Chen, 2011).

Warf (2012) indicated that a large and competitive domestic market, the development of US transnational corporations, and the GATS agreement contributed to the international development of KIS in the US, but he questions whether the US will be able to maintain a large enough surplus in KIS trade so that it is able to offset the growing deficit in merchandise trade. Camacho and Rodriguez (2008) stated that the exploitation of imported high-tech services is an important channel for R&D diffusion, sometimes even more important than the intermediate use of domestically produced R&D services (i.e., in Germany and Belgium). The study by Wyszkowska-Kuna (2016b) showed that the importance of KIBS in service exports of the 'new' EU member states is relatively low, but with an upward trend, and it is positively affected by their accession to the EU. Among this group, Romania appears to be most competitive in KIBS exports. Poland recorded the highest growth of KIBS in its service exports, and it has become competitive in the exports of Other business services and Computer and information services due to its labor productivity performance and endowment in human capital (Wyszkowska-Kuna, 2014).

Finally, one should note that in the EU countries, KIBS are mainly delivered by companies operating on domestic markets. The growing role of imports in providing KIBS has been visible (the growth was slightly higher than for total services), but this tendency is rather weak when compared with the growing importance of manufacturing intermediate imports (Wyszkowska-Kuna, 2018). This leads to the conclusion that there is still a need for direct proximity between service providers and customers in delivering most services, including KIBS. It also supports the idea that the value of KIBS exports and imports does not reflect the real importance of KIBS in international trade.

Empirical studies that analyze the services embodied in the trade of goods are not numerous, and to the best of the authors' knowledge, there is no study that analyzes this issue with respect to KIBS. Tucker and Sundberg (1988) showed that half of Australian services exports (in 1975) were embodied in goods exports, whereas the embodied services exports of Thailand (in 1975) and Singapore (in 1973) were relatively small. Grubel's (1987) study of Canadian services trade between 1973 and 1983 found that embodied services trade rapidly increased in that period, and the net surplus of indirect services trade was larger than the deficit of direct services trade (in 1983). Urata and Kiyota (2002) obtained similar findings when analyzing six East Asian countries. The analysis by Kiyota (2005) shows that in Japan the services content ratio was higher for R&D services than for other services during the period 1985 – 1995, with a growing tendency in the case of R&D, wholesale trade, and transportation services, while the opposite was true in the case of financial services. The paper also supports the validity of the assumption proposed by Coe, Helpman and Hoffmaister (1997), that R&D services are traded mainly through machinery exports (in this case from Japan to east and southeast Asian countries).

In another study, Johnson (2014) compared the values of gross and value added trade, showing large disparities in the role of manufacturing and services in gross exports (for the world as a whole, manufacturing accounted for 67%, and services for 20% of gross exports in 2008). In contrast, the shares of both sectors in value added exports were at the same level (39% and 41%, respectively). Similar results can be found in the study by Francois, Manchin and Tomberger (2015), which also proves that: 1. the ratio of value added to gross trade decreased over the period 1992 – 2011, for both goods and services, which is consistent with growing vertical production fragmentation; 2. with some notable exceptions, such as India and Singapore, more developed countries generally have more service-intensive exports.

Finally, Rodriguez, Melikhova and Camacho (2018) showed that in three Baltic countries (Estonia, Latvia, and Lithuania), the annual percentage change over

the period 2005 – 2014 was substantially higher for exports in intermediate commercial services than for exports in intermediate merchandises. In contrast to the Euro area, where the leading role is attributed to the renting of machinery and other business activities and financial intermediation, the Baltic States do not specialize in trade in intermediate services, except for transport and wholesale trade. However, based on the service content diffused through net trade in intermediate services, in Estonia, the industry of renting machinery and other business activities ranks second. All these empirical studies indicate that in the case of services, indirect trade is considerably larger than direct trade because of the high volume of trade in services embodied in goods.

This study discusses the changing role of the EU-13, compared with the EU-15, in KIBS trade (both direct and indirect). In the light of international trade theory, KIBS should play a more important role in the EU-15's exports, and in the EU-13's imports, as more developed countries tend to be better endowed with knowledge than less developed ones.

2. Defining KIBS and Data Source

The starting point for defining KIBS and KIBS trade is Eurostat's definition of knowledge-intensity. According to Eurostat (2019), on the basis of the share of people with tertiary education, services are classified into: 1. KIS and 2. less knowledge-intensive services (LKIS). Based on NACE Rev. 2, KIS include: water transport (50); air transport (51); publishing activities (58); motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities (59 – 60); telecommunications (61); computer programming, consultancy and related activities; information service activities (62 – 63); financial and insurance activities (64 – 66); legal and accounting activities; activities of head offices; management consultancy activities (69 – 70); architectural and engineering activities; technical testing and analysis (71); scientific research and development (72); advertising and market research (73); other professional, scientific, and technical activities; veterinary activities (74 – 75); employment services (78); security and investigation services (80); public administration and defence, compulsory social security (84); education services (85); human health and social work activities (86 – 88); and arts, entertainment, and recreation (90 – 93).

Of particular interest within the group of KIS are knowledge-intensive business services (KIBS). Eurostat contains no official definition of KIBS, but generally, KIBS are characterized as knowledge-intensive services provided for other firms (Schricke, Zenker and Stahlecker, 2012). While most services are

delivered both to consumers and producers, KIBS should be defined as those KIS that are mainly aimed at producers, which is in line with splitting the service activities into: 1. intermediate (distributive and producer) and 2. final services (Browning and Singelman, 1978). This refers to the following divisions: 61, 62 – 63, 64 – 66, 69 – 74, 78, 80, and, therefore, they are recognized as broadly defined KIBS. A review of the literature shows that KIBS are defined in different ways, quite often in a narrower sense, as comprising only divisions: 62 – 63 and 69 – 74, or 62 – 63 and 69 – 73 (Schnabl and Zenker, 2013).

The problem is that the divisions identified as KIBS comprise some services that are less knowledge-intensive, and there is no possibility to exclude them because of the lack of relevant data for classes or groups within these divisions (which is particularly visible in studies based on input-output data). It should be noted that the narrower definition of KIBS, to a larger extent than the broad one, is focused on those services that are knowledge-intensive. Therefore, the study carried out later in the paper refers to KIBS narrowly defined, as including sections 62 – 63 and 69 – 73.

The abovementioned definition of KIBS is relevant in the present study as it is based on data from the WIOD database. One should note, however, that in the analyses of KIBS trade based on the BoP, KIBS trade in a narrow sense should be defined as comprising computer and information services; charges for the use of intellectual property rights (royalties and license fees); and other business services (OBS),[2] as the BoP uses a different set of categories (which are less disaggregated) than national accounts. As a result, the definition of KIBS based on the BoP includes more service categories than the one based on national accounts statistics. Therefore, the KIBS share in exports in the former is higher than that in the latter.

Finally, it should be mentioned that data on KIBS exports and imports cover transactions between resident and non-resident entities, which refers only to international KIBS trade through modes 1, 2, and 4, excluding trade through mode 3.[3] One should note that mode 3 is an important means of entry in the

[2] OBS consist of: merchanting and other trade-related services; operational leasing services and miscellaneous business; professional and technical services (including: legal services; business and management consultancy, public relations services; accounting, auditing, book-keeping and tax consulting services; advertising, market research and public opinion polling; research and development services; architectural, engineering and other technical consultancy; agricultural, mining, and on-site processing; other miscellaneous business, professional and technical services; services between affiliated enterprises, n.i.e.).

[3] According to the GATS agreement (WTO, 1995), international trade in services can take place through four modes of supply: 1. cross-border supply; 2. consumption abroad; 3. commercial presence; 4. presence of natural persons. The value of trade in services through mode 3 is captured by Foreign Affiliates Statistics (FATS), which means that only the value of trade in services through modes 1, 2, and 4 (almost entirely) is captured within the 'services' components in the balance of payments (WTO, 2010).

KIBS sector, where co-operation with a client is crucial, and thus the value of KIBS exports and imports does not capture a significant part of KIBS trade. Unfortunately, all empirical studies on services trade suffer from this difficulty, and currently, there is no way to overcome it.

The data used to estimate the model come from the WIOD 2016 Release (Timmer et al., 2015; 2016). It provides a series of world input-output tables (WIOT) for 43 countries (including all 28 EU members), covering the period from 2000 to 2014. The WIOD 2016 Release was developed based on the International Standard Industrial Classification, Revision 4 (ISIC Rev. 4, which corresponds to NACE Rev. 2). The data are also presented in the form of national input-output tables (NIOT – each table describes only one country). WIOT presents the economy divided into 56 industries (branches), and NIOT into 64 industries in an industry-industry system. They are expressed in USD. The source data expressed in other currencies have been converted into USD at exchange rates used in constructing WIOTs (WIOD, 2016). The following calculations are based on NIOTs.

3. Methodology

The method is based on the Leontief model (Leontief, 1936; 1941), which is a widely used tool for estimating the factor content of trade, starting with the famous Leontief paradox (Leontief, 1953). The broadest discussion of the basic concepts and development directions of the input-output model was presented by Miller and Blair (2009).

The main advantage of the method is its ability to include the value added transmitted via intermediate products. It is possible thanks to the flow matrix, which is the core of an input-output table. The flow matrix shows the value of intermediate goods and services produced by branch i and used by branch j. The cost structure of production (input-output coefficients) can be calculated by dividing each element of the flow matrix by the value of the output of the j-th branch. The matrix ($\boldsymbol{A}$) obtained in this way shows the composition of intermediate inputs.

The model is derived from the equation:

$$\boldsymbol{x} = \boldsymbol{A}\boldsymbol{x} + y \tag{1}$$

where

$\boldsymbol{x}$ – the vector of the output;
$\boldsymbol{A}$ – the matrix of the input-output coefficients;
$\boldsymbol{y}$ – the vector of final demand.

The model may be reduced to the form:

$$\boldsymbol{x} = \left(\boldsymbol{I} - \boldsymbol{A}\right)^{-1} \boldsymbol{y} = \boldsymbol{L}\mathbf{y} \tag{2}$$

and the output ($\boldsymbol{x}$) may be decomposed into two parts: $\boldsymbol{x}_D$ – necessary for producing the final products going to the domestic market ($\boldsymbol{y}_D$), and $\boldsymbol{x}_E$ – the part necessary for producing exports ($\boldsymbol{y}_E$):

$$\boldsymbol{x}_D = \boldsymbol{L}\boldsymbol{y}_D \tag{3}$$

$$\boldsymbol{x}_E = \boldsymbol{L}\boldsymbol{y}_E \tag{4}$$

The so-called Leontief inverse matrix ($\boldsymbol{L}$) contains multipliers, showing cumulated direct and indirect inputs that are necessary to satisfy the final demand for the products of each branch.

As can be seen, this method assumes that the technologies used for production in both parts are identical. This assumption is quite common, as there is no data allowing the distinction of technologies. The value added of each branch (vector $\boldsymbol{v}$) might be imputed to either the final products going to the domestic market or to exports, according to the formulas:

$$\boldsymbol{v}_D = \hat{\boldsymbol{v}}\hat{\boldsymbol{x}}^{-1}\boldsymbol{L}\boldsymbol{y}_D \tag{5}$$

$$\boldsymbol{v}_E = \hat{\boldsymbol{v}}\hat{\boldsymbol{x}}^{-1}\boldsymbol{L}\boldsymbol{y}_E \tag{6}$$

This method has been widely used and was the basis for the calculations presented by Francois, Manchin, and Tomberger (2015). However, from the point of view of national statistics, export (like other final products) is the last stage of the value chain, where the value added is accumulated. It means that the value of export is equal to the value added embodied in it. Thus, estimating the value added embodied in export is actually splitting this value added into imported and domestically produced value added. Such an approach leads to calculating the domestic KIBS' contribution to exports and ignoring imported KIBS. It is suitable for investigating the role of the KIBS sector in the economy in the sense of the share in GDP generated. But, if the value added of the KIBS sector of a country is insignificant, the country's production may still be KIBS intensive, thanks to imports.

The same problem appears when the content of KIBS is measured in terms of employment, instead of value added. Ciriaci and Palma (2016)[4] noticed the problem of imported KIBS; however, they ignored it because their research concerned

[4] Ciriaci and Palma (2016) use the so called 'subsystem approach' for input-output analyses. Lately this approach has been applied by several other authors in the context of KIBS (Antonioli, Di Berardino and Onesti, 2020; Di Berardino and Onesti, 2018; 2020; Sarra, Di Berardino and Quaglione, 2019). These papers focused on investigating the vertical integration of subsystems of production.

countries where the imported intermediate inputs appeared to be below 10% of total KIBS used as intermediate inputs. When considering other EU member countries, the shares are significantly higher, so this problem cannot be ignored.

That is why what we want to impute to exports is the KIBS in terms of output, not the domestic value added in KIBS sectors. Consequently, the last stage of the calculations was omitted. Our procedure ends at formula 4.

Finally, the KIBS content of exports was calculated as the sum of the elements of vector $\boldsymbol{x}_E$, which represents sections 62 – 63 and 69 – 73.

$$KIBS_E = \sum_{i=62,63,69-73} x_{Ei} \tag{7}$$

The same method was used to estimate the hypothetical value of KIBS which would be produced if all imports were replaced by domestic production :

$$\boldsymbol{x}_M = \boldsymbol{Lm} \tag{8}$$

$$KIBS_M = \sum_{i=62,63,69-73} x_{Mi} \tag{9}$$

where $\boldsymbol{m}$ is the vector of imports.

In other words, it is the value of KIBS not produced thanks to imports. This interpretation of $KIBS_M$ makes the assumption of product homogeneity within branches extremely important.[5]

Values based on formulas 7 and 9 may be presented in the form of intensities (per unit of exports and imports respectively):

$$\frac{KIBS_E}{E}, \ \frac{KIBS_M}{M} \tag{10}$$

where E is total exports and M total imports. The intensities show how much KIBS were used (on average) to produce a unit of exports and (hypothetically) would be used to produce a unit of imports.

These two numbers may be compared in the form of terms of trade (see, for example, Antweiler, 1996):

$$KIBS_{ToT} = \frac{KIBS_E}{KIBS_M} \times 100 \tag{11}$$

ToT above 100 means that the products exported by the country are more KIBS intensive than those that are imported (or to be more precise, products that

[5] With another assumption that imported products are based on the same technology as domestic products (expressed by matrix A), these numbers could be interpreted as KIBS content of imports.

would have to be produced in this country to replace imports). Following the Heckscher-Ohlin theory, this indicates the abundance of KIBS production in the domestic economy. ToT below 100 means that KIBS production is scarce.

In addition to the intensity indicator, we can propose three other measures showing the role of KIBS for export. The first is the share of the KIBS sector in all output imputed to exports, which is an importance indicator:

$$\frac{KIBS_E}{\sum x_{Ei}} \tag{12}$$

The next one is the value of the KIBS sector output imputed to 1 USD of export over the value of the KIBS sector imputed to 1 USD of domestic final demand:

$$\frac{KIBS_E}{E} / \frac{KIBS_D}{D} \tag{13}$$

where D means the domestic part of the final demand. It can be referred to as the relative KIBS intensity of exports.

The last one is the share of the KIBS sector in all output imputed to export over the share of the KIBS sector in all output imputed to the domestic final demand:

$$\frac{KIBS_E}{\sum x_{Ei}} / \frac{KIBS_D}{\sum x_{Di}} \tag{14}$$

which shows the relative importance of KIBS.

Finally, we examined the composition of the KIBS sector output imputed to export according to the formula:

$$\frac{x_{Ei}}{KIBS_E} \times 100\% \tag{15}$$

which shows the percentage share of each KIBS component in total KIBS sector output imputed to export.

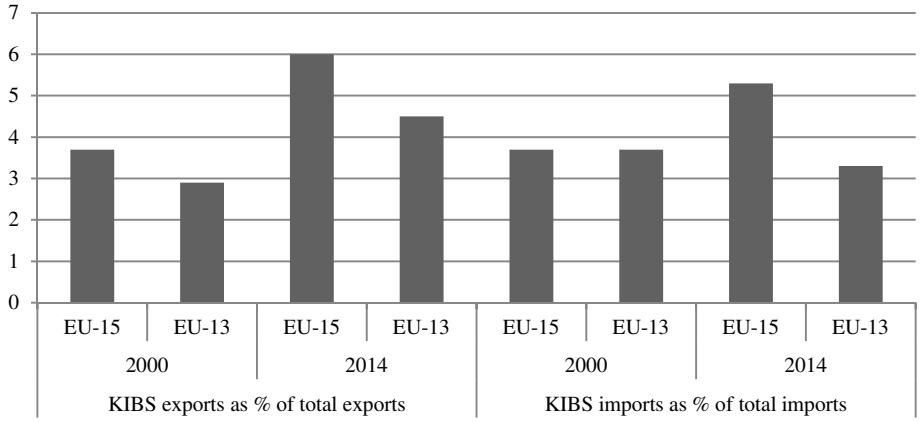
4. Empirical Results

We start our empirical analysis by showing the direct share of KIBS in international trade. Figure 1 presents the average shares of KIBS exports/imports in total exports/imports in the EU-15 and the EU-13 countries (they are calculated as weighted averages, with weights assigned based on each country's share in

the EU-15's and EU-13's GDP). As far as the export side is concerned, KIBS accounted for higher shares in the EU-15's exports than the EU-13's during the whole analyzed period. A growing tendency is visible in both groups, with a higher growth rate in the EU-15 than the EU-13. Therefore, the gap between the two groups increased during the analyzed period (in 2000, it amounted to 0.8 pp, and in 2014 it increased to 1.6 pp). In the case of imports, the situation was different because, in 2000, KIBS accounted for similar shares in both groups. However, in subsequent years, KIBS increased their share only in the EU-15's imports (on average by 1.6 pp), whereas in the EU-13's imports, the situation was reversed (the average drop amounted to 0.4 pp).

Figure 1

Weighted Average Shares of KIBS Exports/Imports in Total Exports/Imports in the EU-15 and the EU-13



Source: Own calculations based on data derived from *National Input-Output Tables*, World Input-Output Database (Timmer et al., 2015).

Comparing the role of KIBS in exports and imports, in 2000, in the EU-15 countries, both ratios were at the same level, but then the growing tendency was stronger (by 0.7 pp) for exports than for imports. In the EU-13 countries, the situation was different because, in 2000, the ratio for imports was higher than for exports (the difference amounted to 0.8 pp). However, in 2014, the situation reversed, and the ratio for exports surpassed the ratio for imports by 1.1 pp. The reason for that was the substitution of imported KIBS by growing domestic production.[6]

[6] The decline in the share of KIBS in imports in the EU-13 was mainly due to the decline in the index value for Poland. The downward trend in Poland resulted from the declining KIBS intensity (measured by the ratio of KIBS input and gross output – see Wyszkowska-Kuna, 2017b) and the substitution of imported KIBS by domestic production (Wyszkowska-Kuna, 2018).

In the further part of the empirical study, we examine the indirect share of KIBS in international trade. Table 1 presents the values of two indicators used to measure KIBS intensities of exports and imports. The values in columns 2 – 5 are calculated based on formula (10), whereas the values in columns 6 – 7 are calculated based on formula (11). The interpretation of the values obtained for these two indicators is explained on the example of Austria. To produce a unit (1 USD) of Austrian exports in 2000, it was necessary to produce KIBS worth 0.07 (7 cents). By importing products worth 1 USD, the Austrian economy saved 6 cents of KIBS. The value of ToT (95.6) indicates that in 2000, Austrian trade was slightly KIBS-saving. This situation changed in 2014, but the KIBS terms of trade are quite close to 100, which allows Austrian trade to be described as KIBS-neutral.

T a b l e 1

Indicators of KIBS Intensity of Exports and Imports

Indicator	**KIBS content of exports per unit of exports**		**KIBS necessary for replacing imports per unit of imports**		**KIBS terms of trade**	
Country	*2000*	*2014*	*2000*	*2014*	*2000*	*2014*
AUT	0.07	0.11	0.08	0.11	95.6	101.7
BEL	0.12	0.18	0.11	0.16	116.1	110.5
DNK	0.09	0.11	0.07	0.11	121.6	104.0
FIN	0.08	0.13	0.14	0.19	57.7	70.5
FRA	0.15	0.16	0.15	0.16	99.1	100.5
DEU	0.12	0.12	0.13	0.14	87.6	85.7
GBR	0.12	0.17	0.09	0.11	141.3	160.5
GRC	0.04	0.05	0.08	0.08	54.9	64.4
IRL	0.11	0.23	0.14	0.12	74.2	186.5
ITA	0.13	0.11	0.13	0.11	99.4	97.1
LUX	0.05	0.14	0.06	0.05	96.8	255.0
NLD	0.13	0.18	0.15	0.11	83.2	163.1
PRT	0.06	0.07	0.05	0.06	111.2	132.7
ESP	0.10	0.10	0.07	0.07	147.9	139.5
SWE	0.14	0.17	0.18	0.19	78.4	92.8
BGR	0.03	0.10	0.04	0.06	79.3	184.2
CYP	0.08	0.15	0.06	0.07	123.6	213.6
CZE	0.10	0.08	0.07	0.08	131.5	91.9
EST	0.05	0.09	0.08	0.07	66.9	117.5
HRV	0.06	0.13	0.08	0.09	80.1	141.5
HUN	0.06	0.07	0.05	0.06	109.3	106.8
LTU	0.04	0.04	0.03	0.03	129.6	152.6
LVA	0.06	0.10	0.06	0.07	103.4	156.4
MLT	0.05	0.11	0.14	0.24	37.8	47.9
POL	0.08	0.09	0.10	0.09	81.3	107.8
ROU	0.03	0.16	0.05	0.09	76.0	173.0
SVK	0.05	0.07	0.05	0.05	94.6	148.6
SVN	0.06	0.09	0.08	0.09	73.3	97.1
EU-15[a]	0.12	0.14	0.12	0.13	106.1	115.1
EU-13[a]	0.07	0.10	0.08	0.08	93.2	124.6

Note: [a] EU-15 and EU-13 denotes the weighted averages with weights assigned based on each country's share in the EU-15's and EU-13's GDP, respectively.

Source: As in Figure 1.

At the beginning of the analyzed period, the most KIBS-intensive exports came from France (0.15), Sweden (0.14), and the Netherlands (0.13), whereas the least KIBS-intensive exports were delivered by Bulgaria, Romania (0.03), Lithuania, and Greece (0.4). Between 2000 and 2014, the KIBS-intensity of exports increased in most EU countries, with the highest increase in Romania (0.13), Ireland (0.12), Luxembourg (0.9), and Bulgaria (0.7). The opposite tendency was observed only in Italy and the Czech Republic, while in Germany, Spain, and Lithuania, the KIBS-intensity of exports remained at the same level. In 2014 the most KIBS-intensive exports came from Ireland (0.23), followed by the Netherlands and Belgium (0.18), Sweden, and the United Kingdom (0.17). The least KIBS-intensive products were delivered by Lithuania (0.4) and Greece (0.5). The EU-15's exports were more KIBS-intensive than the EU-13's, but in the analyzed period, the gap between these two groups decreased – in 2000, the KIBS-intensity of the EU-13's exports was almost half that of the EU-15's exports, while in 2014, it was lower by only 30%.

As far as the KIBS-intensity of imports is concerned, it was lower in the EU-13 than in the EU-15 countries, and in the analyzed period, the gap between these two groups slightly increased. Most EU countries recorded an increase in their imports' KIBS-intensity, with the highest increase taking place in Malta (from 0.14 to 0.24). In a few countries, the tendency was reversed, but the declines were generally small. The least-KIBS-intensive products were imported by Lithuania, followed by Slovakia, Portugal, Bulgaria, and Hungary. In turn, the most KIBS-intensive products can be found in the imports of Sweden and Malta, and then Finland, Belgium, and France.

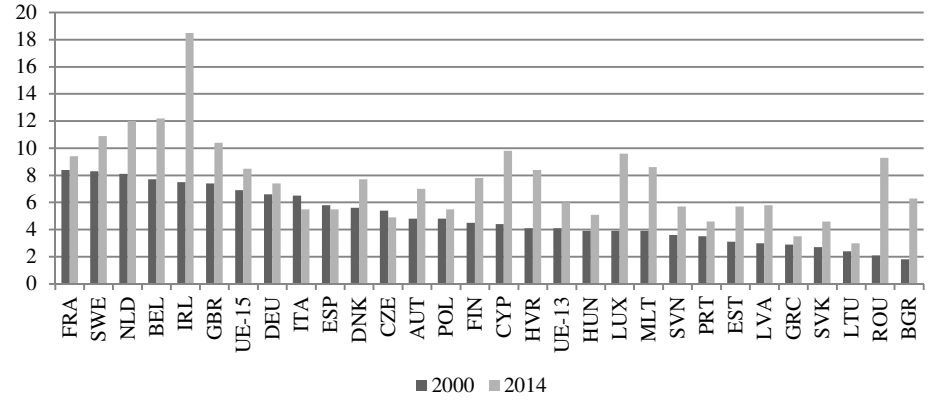
In the EU-13 countries, the value of the ToT index was initially below 100, but as a result of strong growth in 2014, it reached 124.6, which was higher than in the EU-15 (115.9). Most EU countries improved their ToT between 2000 and 2014. As a result, in 11 countries (Austria, France, Ireland, Luxemburg, the Netherlands, Bulgaria, Estonia, Croatia, Poland, Romania, and Slovakia), the trade pattern shifted towards a KIBS-augmenting one. The highest growth in the value of ToT took place in Luxembourg, Bulgaria, Romania, and Cyprus. Meanwhile, Belgium, Denmark, Spain (with a downward trend in ToT value), Great Britain, Cyprus, Lithuania, and Latvia exchanged KIBS for other factors of production for the whole analyzed period. The trade of Germany, Finland, Greece, Malta, and Slovenia is KIBS-saving – in most of these countries, the value of ToT increased, but only in Slovenia did it reach a value of nearly 100. Malta recorded the lowest value of ToT.

In Figure 2, the values calculated based on formula (12) are presented. They prove the growing importance of KIBS for export in the EU countries. In some

cases, like Romania, Bulgaria, or Ireland, the growth is impressive. Only in three cases is the change negative. The role of KIBS is still more important in the EU-15 countries than in the EU-13, but the difference is diminishing.

F i g u r e 2

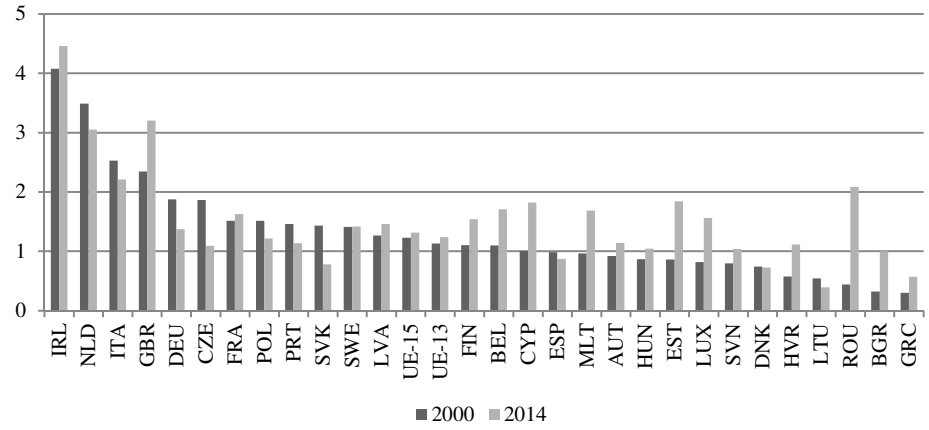
Shares of the KIBS Sector in All Output Imputed to Export
(the results were put in descending order according to the year 2000, in %)



Source: As in Figure 1.

F i g u r e 3

Values of the KIBS Sector Output Imputed to 1 USD of Exports over the Values of the KIBS Sector Imputed to 1 USD of Domestic Final Demand
(the results were put in descending order according to the year 2000)



Source: As in Figure 1.

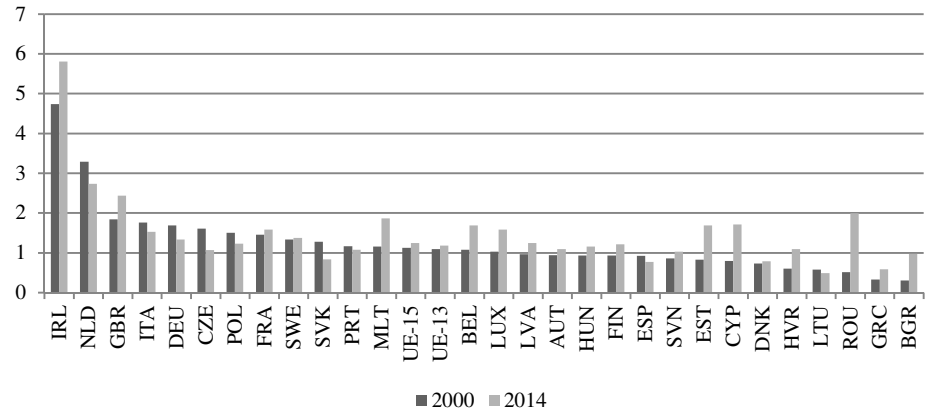
Figure 3 shows the relative KIBS intensity of exports, which is defined as the value of the KIBS sector output imputed to 1 USD of exports over the value of the KIBS sector imputed to 1 USD of domestic final demand (calculated based

on formula (13)). In the case of Ireland, exported products were four times more KIBS-intensive than those produced for domestic final users (in 2000), with an upward trend. Romania also deserves attention, as it recorded the highest increase in the value of this indicator – in 2000, Romania exported products that were half as KIBS-intensive as those produced for the domestic market, while in 2014, the situation reversed. The conclusion here is that export is the main driving force for the development of the Irish and Romania KIBS sectors. The averages for both the EU-15 and the EU-13 take values above 1, and they went up.

The relative importance of KIBS for exports, defined as the share of the KIBS sector in all output imputed to exports over the share of the KIBS sector in all output imputed to domestic final demand (calculated based on formula (14)), is shown in Figure 4. In the case of Ireland, the role played by KIBS in the production of exported goods was almost six times bigger than the role played by these kinds of services in production for domestic purposes.

F i g u r e 4

Shares of the KIBS Sector in All Output Imputed to Exports over the Shares of the KIBS Sector in All Output Imputed to Domestic Final Demand
(the results were put in descending order according to the year 2000)



Source: As in Figure 1.

This indicator confirms the great importance of KIBS for Irish exports and the highest dynamics in the importance of KIBS for Romanian exports. The averages for the EU-15 and the EU-13 achieved similar levels, slightly higher than 1, with a slight upward trend.

Finally, we used formula (15) to examine the sectoral composition of the KIBS content of exports in the EU countries. The values showing the percentage shares of particular components of the KIBS-sector output imputed to export in 2014, as well as their changes in the period 2000 – 2014, are presented in Table 2.

T a b l e 2

Composition of KIBS Sector Output Imputed to Export

Divisions	62 – 63	69 – 70	71	72	73	62 – 63	69 – 70	71	72	73
Country	*2014 (in %, rows sum to 100)*					*Change 2000 – 2014 (in pp)*				
AUT	23.9	40.7	17.4	2.8	15.2	8.2	5.0	–3.3	–2.6	–7.3
BEL	15.7	35.7	20.7	5.4	22.5	4.0	–20.6	7.7	3.2	5.6
DNK	33.9	24.2	24.6	8.2	9.1	5.6	3.5	–1.2	3.3	–11.3
FIN	39.6	28.5	18.7	8.4	4.8	12.5	5.6	0.1	–10.0	–8.2
FRA	13.5	54.2	17.4	5.4	9.5	2.0	21.7	4.6	–26.8	–1.5
DEU	29.6	40.9	17.2	3.6	8.8	14.5	–1.8	0.1	–8.0	–4.8
GBR	26.8	38.8	21.5	3.8	9.1	4.1	1.6	1.8	–8.0	0.5
GRC	15.7	61.5	8.7	3.6	10.5	9.2	11.9	–6.6	1.5	–16.0
IRL	86.9	7.9	3.0	1.2	0.9	36.7	–14.7	–13.6	–2.4	–6.0
ITA	21.4	38.9	21.9	6.9	10.8	2.7	2.5	1.1	–3.7	–2.6
LUX	58.9	28.3	5.5	2.8	4.5	34.2	–16.7	–8.2	–5.3	–4.0
NLD	19.3	65.9	7.3	1.5	6.0	4.7	9.2	–3.0	–5.3	–5.6
PRT	23.5	41.6	19.7	0.8	14.4	11.6	2.4	–4.8	0.6	–9.8
ESP	39.9	27.3	21.0	1.0	10.8	19.3	–0.7	–6.1	–5.6	–6.9
SWE	35.6	31.3	14.8	7.7	10.6	13.7	0.5	–1.7	–7.8	–4.7
BGR	43.1	19.1	14.2	7.7	15.8	24.2	–5.3	–11.7	–6.9	–0.2
CYP	24.5	63.8	3.4	0.0	8.3	3.9	12.4	–4.7	0.0	–11.6
CZE	27.6	33.4	17.7	5.1	16.2	12.6	–4.9	0.3	1.0	–8.9
EST	39.2	31.6	10.1	2.2	17.0	26.6	–11.6	–4.5	1.6	–12.1
HRV	14.7	31.8	34.8	4.5	14.2	7.4	–1.2	–10.1	–1.1	5.0
HUN	33.5	36.8	14.6	7.6	7.6	10.7	1.2	–3.7	–5.1	–3.1
LTU	21.2	41.8	11.1	0.7	25.3	15.0	1.4	–3.9	–0.1	–12.5
LVA	38.4	25.2	7.2	1.5	27.9	19.9	–5.0	–7.6	–0.4	–6.9
MLT	31.5	39.1	4.2	0.1	25.1	0.4	–11.3	–1.4	0.1	12.2
POL	25.5	34.0	11.7	2.6	26.1	12.7	–1.4	–1.7	–7.0	–2.5
ROU	37.9	28.6	18.9	2.5	12.1	18.0	8.4	–12.1	–4.1	–10.2
SVK	29.1	37.9	21.3	1.8	9.9	20.3	6.5	–16.8	–3.3	–6.7
SVN	19.9	32.6	26.2	6.7	14.7	10.3	4.0	–14.7	1.8	–1.3
EU-15[a]	26.3	41.4	18.2	4.3	9.8	8.6	3.6	0.3	–9.2	–3.3
EU-13[a]	28.9	33.5	15.6	3.6	18.4	14.2	–0.7	–4.8	–4.0	–4.7

Notes: 62 – 63 – computer programming, consultancy, and related activities; information service activities; 69 – 70 – legal and accounting activities; activities of head offices; management consultancy activities; 71 – architectural and engineering activities; technical testing and analysis; 72 – scientific research and development; 73 – advertising and market research. [a] EU-15 and EU-13 denote the weighted averages with weights assigned based on each country's share in the EU-15's and EU-13's GDP, respectively.

Source: As in Figure 1.

Divisions 69 – 70 (legal and accounting activities; activities of head offices; management consultancy activities) accounted for the highest share in both groups, but they played a more important role in the EU-15 than in the EU-13. Most of the EU-15 recorded an increase in their share, whereas, in the EU-13, the tendency was usually reversed. The highest growth took place in France (22 pp), whereas Belgium was on the opposite side with a steep decline. In 2000, division 71 (architectural and engineering activities; technical testing and analysis) was ranked second, but in 2014 it was overtaken by divisions 62 – 63 (computer programming, consultancy, and related activities; information service activities), which increased their importance in all EU countries and, in general, recorded the highest growth. This growth was particularly impressive in the EU-13 (nearly

twice as high as in the EU-15), and it was the only category that increased its share in this group of countries. One should note, however, that the highest growth occurred in Ireland (37 pp), and in 2014, 87% of the Irish KIBS sector output imputed to exports was derived from divisions 62 – 63. Only a slightly lower increase was visible in Luxembourg (34 pp), where the share of these divisions reached a value of 59% in 2014. Among the EU-13 countries, this category increased its importance to the greatest extent in Estonia and Bulgaria (by 27 pp and 24 pp, respectively), but, in general, in most countries, it recorded a high growth by about 20 pp. In this group, divisions 62 – 63 reached the highest share in Bulgaria (43%), Estonia (39%), Latvia, and Romania (38%). Overall, at the beginning of the analyzed period, computer and information services were ranked first only in three countries (Denmark, Finland, and Ireland), while at the end, this number had increased to ten. Division 71 also experienced a slight increase in the EU-15, whereas divisions 72 (scientific research and development) and 73 (advertising and market research) decreased their importance in most countries.

Conclusions

The aim of this paper was to assess the content of KIBS in EU trade. Four indicators were proposed and calculated: the KIBS intensity of exports, the importance of KIBS for export, the relative KIBS intensity of exports, and the relative importance of KIBS for exports. Additionally, the hypothetical KIBS intensity of imports was also calculated, which allowed for the assessment of the KIBS terms of trade. All these indicators measure KIBS intensity in terms of output. Based on the estimates of these indicators, we may draw some general conclusions:

1. The KIBS-intensity of export, as well as the importance of KIBS for export, increased in most EU countries. It decreased only for Italy and the Czech Republic. Both indexes were significantly higher in the EU-15 than the EU-13 countries, but due to the stronger growth in the EU-13, the difference was reduced. Romania and Ireland recorded the highest dynamics, and as a result, Ireland reached much higher values than other EU countries, while Romania moved from last to sixth place in the period 2000 – 2014.

2. The KIBS-intensity of import was also higher in the EU-15 than in the EU-13, but in this case, the disparity slightly increased. The growing tendency is visible in most countries, but in a few countries, the trend was reversed.

3. Based on data on gross KIBS exports, the EU-15 has a clear advantage over the EU-13, with a stronger tendency to improve competitiveness in the EU-15. However, while taking into account indirect KIBS trade, the EU-15's advantage decreases.

4. Export appeared to be more KIBS-intensive than production for domestic final demand. On average, this difference is not high, but it is growing. However, the variation within the whole group is high, and Ireland is again an outlier. The average for the EU-15 was slightly higher than for the EU-13, with an upward trend in both cases.

5. Computer and information services were the main engine behind the growing KIBS intensity of export. This trend was the most impressive in the case of Ireland, where these services increased their share in KIBS sector output imputed to export by 37 pp, reaching a value of 87% (2014). In the EU-13, it was the only KIBS category that increased its share, with the growth rate twice that of the EU-15.

These conclusions complement the results of previous studies, which show the growing importance of KIBS in the economy along with its economic development, and the higher service-intensity of exports in more developed countries. They are also consistent with the theory of international trade, indicating that more developed countries export relatively more knowledge-intensive products than less developed countries because they are better equipped with knowledge. In turn, a higher increase in the importance of KIBS in imports in the EU-15 countries than the EU-13 is not consistent with the theory of trade that less developed countries import more knowledge-based products due to their weaker equipment in knowledge. This can be explained as follows: 1. the demand for KIBS increases with a country's economic development with respect to both domestically produced and imported KIBS (Wyszkowska-Kuna, 2018); 2. KIBS trade is an intra-industry trade; 3. a significant part of KIBS trade is carried out by multinational corporations, which may hide a country's real export potential and import needs in this field.

The difference between KIBS shares in trade and value added was lower than for total services, which indicates a relatively higher level of internationalization of the KIBS sector than the services sector. This may seem surprising, because, on the one hand, KIBS are recognized as non-traded services due to their need to be adjusted to individual customer's needs. On the other hand, however, the rapid internationalization of services refers to producer services to the greatest extent, and KIBS constitute a fairly large part of them. It is also significant that while using input-output data, it is not possible to fully distinguish the KIBS category – less knowledge-intensive services that may not require such direct contact in their delivery cannot be excluded.

The findings of the study are subject to some limitations which have implications for further research. First, while analyzing the services trade (including KIBS trade), data are required that show the part of a country's exports carried

out by foreign-controlled enterprises concerning individual categories of services. Such data have become available recently (OECD, 2017), but they are incomplete and collected at too low levels of disaggregation. Therefore, it is recommended that international organizations (e.g., Eurostat, year – it is not a reference, we just mention this organization as an example, thus there is no year; WTO, year – as before) start collecting it on a regular basis, as well as improve it. Second, the balance of payments statistics uses a different set of categories (and less disaggregated ones) than national accounts, which makes the results of analyses based on data derived from BoP not fully comparable with those based on input-output data. Third, the present study, as well as all works on international trade, suffer from a lack of theoretical studies on international service trade and the incompleteness of data on service trade, which cover, to a varying extent, three of the four modes of service delivery.

The authors of the paper are going to continue their research in this field by including the KIBS-intensity of export and import indicators in economic growth models to answer the question of whether KIBS embodied in trade positively affect output and productivity growth.

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