TECHNOLOGY BALANCE OF PAYMENTS OF THE REPUBLIC OF SERBIA: TRENDS AND PERSPECTIVES OF TECHNOLOGY TRADE WITH FOREIGN COUNTRIES

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Technology balance of payments of the Republic of Serbia: trends and perspectives of technology trade with foreign countries

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Abstract: The technology balance of payments represents a statistical overview of international market transactions between residents and non-residents, resulting from technology transfers realised through intangible assets (patents, licenses, know-how, etc.) and the provision of services with a dominant technological component (research and development, technical assistance, engineering services, etc.). It is based on balance of payments and international trade in services statistics, in accordance with the international statistical standards. In this paper, the authors developed and examined the technology balance of payments of the Republic of Serbia, in order to determine the basic trends of technology trade with foreign countries and observe the analytical value of the technology balance of payments as an indicator of international technology trade.

Key words: inflation technology balance of payments, technology transfer, balance of payments, services account
JEL Code: F14, O33, O34, L84, L86

Non-Technical Summary

Technological development today is of great interest to researchers in various scientific disciplines, as well as to all those who participate in the creation of relevant policies and measures in this area. Special attention is devoted to international transfers of technology, which take place through business activities of companies from both more and less technologically developed countries. Given the importance they have for emerging and developing economies, foreign direct investment and trade in goods of high technological value are usually used as important indicators of technology transfer. However, with these indicators it is not possible to precisely isolate the transfer of technology that takes place between the parent company and its subsidiaries or between the buyer and the seller in the market.

In order to assess technology transfers between the country and abroad, it is necessary to first consider all the specifics of technology, the way it is transferred at the international level, as well as statistical methods which can be used to capture this exchange. For the purpose of enhancing the statistical coverage of international technology transfers, in 1990 the Organisation for Economic Co-operation and Development (OECD) published a manual for the preparation of the technology balance of payments, whose name indicates the international statistical standards it relies on. The balance of payments represents a statistical overview of all transactions between residents and non-residents, in a certain period of time, and is divided into the goods and services account, primary income, secondary income, capital account and financial account. The technology balance of payments represents a part of the balance of payments that concerns transactions between residents and non-residents based on intangible investments (in patents, licenses, know-how, etc.) and the provision of services with a dominant technological component. Although the methodological basis for its compilation has hardly changed since the development of this manual, the constant advancement of international balance of payments statistical standards helps improve the compilation of the technological balance of payments.

In this paper, the complexities of international technology transfers and the methodological basis for their statistical coverage within the technology balance of payments are discussed. For these purposes, the technology balance of payments of the Republic of Serbia was compiled, based on balance of payments and international trade in services statistics, which are under the remit of the National Bank of Serbia. The purpose of compiling the technology balance of payments is not only to evaluate the analytical value of this indicator, but also to determine the main trends of technological trade with foreign countries.

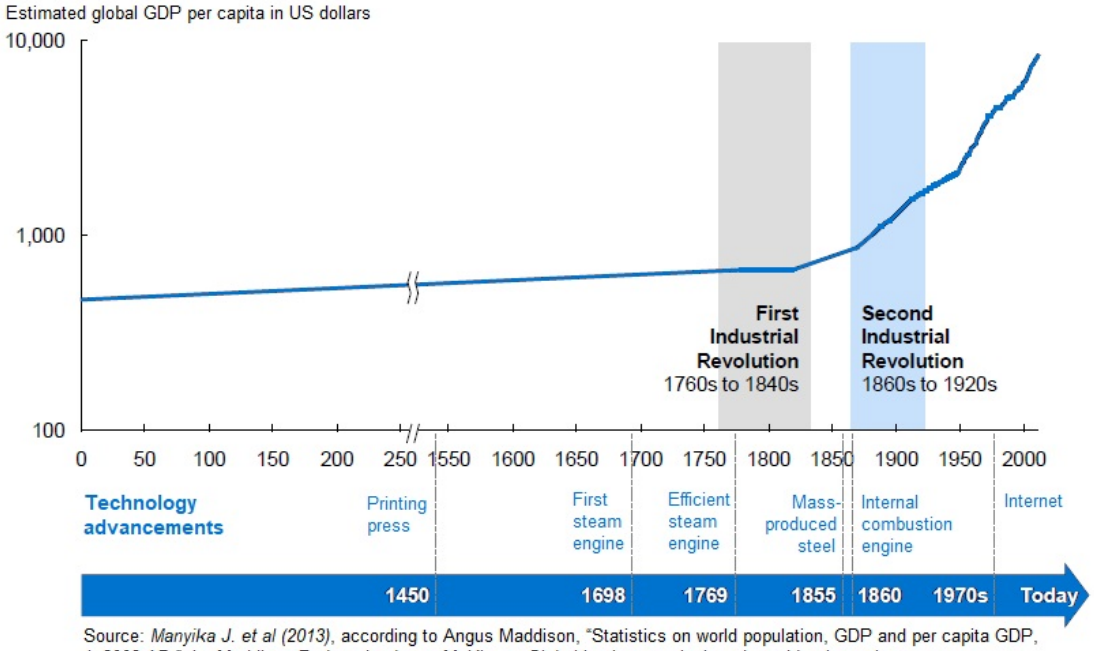
Contents

1 Introduction

Technology represents knowledge or information that enables the realisation of a task, provision of a service or production of a product. At the conceptual level, there is a difference between technology defined in this way and science, which organises and explains data and observations through theoretical relations, which are put into "practical" use through technology (Hall & Johnson, 1970). The term technology also includes production processes, organisational structures of companies, management techniques, means of finance, marketing methods, which individually or in combination contribute to the productivity of transforming inputs into outputs and creating their market value (Maskus, 2004).

In economic theory, there is a consensus about the importance of technology as a determinant of economic growth. According to Manyika J. et al. (2013), since the start of the First Industrial Revolution more than 250 years ago, the global economy has experienced significant growth fuelled by a series of technological advancements, as shown in Chart 1. From steam engines replacing water-powered mills, to electricity, telephones, automobiles, airplanes, transistors, computers and the internet, each new advancement in technology has brought about a leap in productivity and economic growth, generating efficient new methods to accomplish existing tasks and a significant number of entirely new jobs. Although not the only one, technological progress is, as we can see, a significant factor of economic growth.

Chart 1: **Economic growth and innovation** (estimated global GDP per capita in US dollars in periods that are vital for technology progress)



Source: *Manyika J. et al (2013)*, according to Angus Maddison, "Statistics on world population, GDP and per capita GDP, 1–2008 AD," the Maddison Project database; McKinsey Global Institute analysis, adapted by the authors.

However, Samuelson & Nordhaus (2010) correctly observe that technological progress represents a complex and multidimensional process, with no unique formula for success. Therefore, the focus of economists, as pointed out by Quah (2001), is on incentives for knowledge accumulation and technical progress.

Technology transfer, the process through which one party gains access to the information of another party and successfully adopts it and incorporates it into its production function, has an important role in this regard (Maskus, 2004). Looking at various definitions of the term 'technology transfer', Abd Wahab et al. (2012) indicate the multidimensional meaning of this term, depending on the topic of research, as well as the scientific discipline and direction of the researcher. Thus, the transfer of technology can be determined as the transfer of ideas and concepts from the laboratory to the market, the transfer of innovative activities to secondary users, as well as the transfer of knowledge and concepts from technologically developed countries to those that are less developed in this respect.

In order to catch up with technologically developed economies, those that are less developed in this regard can independently obtain knowledge that is not currently available to them, or they can open their economies to knowledge from abroad, through international trade, foreign direct investment and technology licensing (Garofalo & Parello, 2007). However, technology cannot be transferred on a large scale and is not ready for use immediately after the transfer. In addition to the transfer of technological knowledge, the knowledge required for the effective use of new technology is also important (Dahlman & Westphal, 1984). Also, the international spread of technology is not an inevitable process, nor does it happen automatically, so domestic investments are also necessary for technological development (Keller, 2004).

When it comes to the transfer of technology that takes place through international trade, a greater emphasis is placed on research into the competitive advantage that national economies achieve in trade in goods, in which technology is physically embodied, while the factors that influence trade and transfers of technology in disembodied form through patents and various technical services are much less studied (Athrey e& Yang, 2011). They are especially gaining importance in the modern world economy, which is characterised by the separation and geographical dispersion of different stages in the production process. As the statistical and analytical needs for better assessment and understanding of global value chains grow, this is reflected in the importance of accurately measuring trade in disembodied technologies (Neubig & Wunsch-Vincent, 2017).

International statistical standards and practice are abundant in data and indicators that can be used to statistically capture the technology trade that takes place in the market between enterprises located in different national economies. The subject of this paper is the technology balance of payments, which is used to measure and record international transfers of technology, in accordance with international methodological standards.

This paper is divided into five sections. After the introductory considerations, the ways in which international technology transfers take place are presented. Then, the methodological bases for compiling the technology balance of payments for the statistical coverage of certain international transfers of technology, as well as its preparation and application in statistical practice, are presented. The following section elaborates on these basics in practice and, for that purpose, the authors compiled the technology balance of payments of the Republic of Serbia, as the basis for presenting the main characteristics of technology trade between our country and foreign countries, with appropriate comparisons with other countries. The last chapter contains concluding remarks.

2 International technology transfers

According to Maskus (2004), international technology transfer includes numerous and complex processes, from innovation itself and international marketing of new technology, to its adoption and imitation. Therefore, in addition to technology, it includes trade and appropriate economic policies regarding investments, in order to facilitate the conditions for access to new knowledge. Appropriate policies in this area are particularly complex and require careful consideration, both in individual countries and at the multilateral level.

Their complexity also has consequences for the statistical coverage of these international activities of companies. Therefore, it is important to first consider the mechanisms by which they occur, and then the statistical data that can be collected and published.

2.1 Mechanisms for conducting international technology transfers

International technology transfers take place through market and non-market mechanisms (Breitwieser & Foster 2012, Madeuf 1984, Maskus 2004).

Market mechanisms imply a formal transaction that facilitates the movement of technology between market participants. The transfer of technology in this case takes place between the seller and the buyer of the technology, that is, between the parent company and the subsidiary, through:

1) foreign direct investment – the transfer of technology through multinational companies from the parent company to its subsidiaries that are located in other countries and do not possess this technology.
2) trade in goods and services – products such as industrial chemicals, artificial fertilisers or software can directly increase the productivity of the production process. The transfer of technological information can also occur by studying the characteristics of their design, which can then be reproduced.
3) acquisition of intangible assets protected by intellectual property rights[1] – the transfer of technology in this case takes place directly through the purchase of production or distribution rights, which are protected by intellectual property rights, such as patents, industrial designs, trade secrets, trademarks, etc., as well as technical information and know-how for their use. Know-how represents knowledge that cannot be fully formalised or transmitted through written documents, but derives from practical experience in using a machine or the development of a process. This knowledge can only be transferred through the direct and continuous participation of the company that owns it.

   When the transfer takes place between subsidiaries within one large company, the parent company retains control over the technological know-how that is protected by intellectual property rights. In the case when it takes place between companies that are

[1] See Appendix 1.

not connected by ownership, the right of access to this knowledge is provided directly to the license holder.

4) joint ventures – contractual arrangements between two or more companies in which each of the participants ensures a reduction in the costs of joint operations. They are characterised by a clear division of labour among the participants. Thus, a multinational company provides technological know-how through licensing, while its partners in local markets provide a distribution network, information on labour market characteristics, special management techniques, brand recognition, etc.
5) cross-border movement of employees – many technologies cannot be effectively transferred without certain services and the know-how possessed by engineers and other technical employees, who must be present on site. Multinational companies have a great advantage in this regard, while the transfer of these experts between companies that are not connected by ownership is not so easy.

The transfer of technology through non-market mechanisms does not involve formal transactions between participants and takes place through:

1) imitations – which do not bring any compensation to the owner of the technology in the formal market, because knowledge about a certain product is acquired through, for example, a detailed review of the construction of another company's product, by reproducing its basic functions (in the case of software). The extent to which imitation is legal or does not depend on the degree of protection of intellectual property rights.
2) hiring employees from competitor companies who possess technical and managerial knowledge about technology.
3) studying the patent application and confidential testing data submitted by the patent applicants.
4) temporary visits of students, scientists, technical and managerial staff to universities and laboratories and participation in conferences in developed countries.

In the period between the two world wars, technology transfers took place through the cross-border movement of scientific personnel, in which personal contacts and the networks of acquaintances among scientific personnel were important. After the Second World War, barriers to the movement of scientists made it difficult to transfer technology through this route, so foreign direct investment and licenses were used (Athreye & Yang, 2011). Today, technology transfers that take place through these mechanisms, along with those that take place through international trade, are considered the most common (Teixeira & Barros, 2019).

2.2 International technology transfer statistics

The above stated shows that the international movement of technology consists of transactions that are quite heterogeneous. Some of them are commercial and require the execution of certain payments, while the rest are more or less informal, without an accompanying financial counterpart (Madeuf, 1984). Saggi (2002) rightly points out that, given the large number of mechanisms through which technology transfer takes place, in

practice it is not easy to determine which of them is dominant and what is its exact contribution to economic growth. Instead, most of theoretical and empirical research in this field focuses on studying one or two mechanisms for technology transfer, with foreign direct investment and international trade being prominent among them.

Foreign direct investment is considered the most important mechanism of international technology transfer (Glass &Saggi, 2002). However, it is not possible to simply observe their impact on technological development. As these investments imply an inflow of capital, but also of goods and services, it is difficult to clearly determine the effects on the domestic market related to the transfer of technologies (Saggi, 2002). The contribution of foreign direct investment to the technological development of the country to which these capital flows arrive can therefore be viewed from several different perspectives, as demonstrated by numerous empirical studies. Chang (2021) studies the connection between these investments and activities that increase the innovativeness of the national economy, expressed as the number of patent and trademark applications. On the other hand, Glass & Saggi (2002) examine labour mobility as a technology transfer mechanism and the consequences it has on the country's policy for attracting foreign direct investment.

According to Athreye & Yang (2011), when international trade was studied in terms of technology transfer, the focus was initially on trade in goods, that is, final products with a high technological base. Based on the study of this type of trade, several definitions of high-tech industries have been developed, based on the employment of scientists or the intensity of research and development activities of industrial sectors, according to which exports are also classified (into the so-called high-tech and low-tech). However, this does not diminish the importance of trade in services, such as research and development and software services, which transfer disembodied technology.

Another form of trade in disembodied technology is the commercial licensing of technology under a contract and with a fixed payment, as well as the sale and purchase of a patented industrial process. If they occur through formal market transactions, with a buyer and a seller, they can be easily statistically determined. Unfortunately, this is not the case when the use of patented technologies occurs because of informal agreements between companies. Also, it is well established that the transfer of technology that takes place through the violation of intellectual property rights cannot be statistically recorded either (Neubig & Wunsch-Vincent, 2017).

In accordance with the above, it is important to observe the statistical data that are required to determine international technology transfers as accurately as possible. In order to monitor and study international transfers of technology that take place through market mechanisms, it is necessary to provide data on foreign direct investment, trade in goods and services, and patents and other intangible assets protected by intellectual property rights. The necessary statistical framework for systematic monitoring and recording of these transactions is provided by balance of payments statistics.

It is well known that the balance of payments represents a statistical overview of all transactions between residents and non-residents in a certain period of time, and is prepared in accordance with the methodology of the International Monetary Fund, i.e. the Balance of Payments and International Investment Position Manual, Sixth Edition (hereinafter: BPM6)

and the BPM6 Compilation Guide. Additional data are provided by the international trade in services statistics, in accordance with the Manual on Statistics of International Trade in Services 2010 (hereinafter: MSITS 2010). Based on this, it is possible to compile the technology balance of payments, which captures all the mentioned specificities of international technology trade.

3 Technology balance of payments

In order to contribute to the statistical coverage of international technology transfers, in 1990 the OECD published a manual for the preparation of the technology balance of payments – the Proposed Standard Method of Compiling and Interpreting Technology Balance of Payments Data: TBP Manual (hereinafter: TBP Manual). The methodological foundations were supplemented in 2005 and presented together with other indicators of technology trade with foreign countries in Measuring Globalisation: OECD Handbook on Economic Globalisation Indicators.

In addition to these methodological documents of the OECD and of the IMF in the field of balance of payments statistics, the compilation of the technology balance of payments also relies on the experience and activities of international organisations and central banks in this area.

3.1 Methodological foundations of the technological balance of payments

According to the TBP Manual, the international transfer of technology represents an activity with a clear technological content (not secondary) that implies contact between two companies, the transferor and the recipient, in which the formal ownership of the technology or the right to use it is transferred under commercial conditions. International technology transfer defined in this way concerns the trade in technological knowledge that is in the exclusive possession of one company, as an explicit right or something that is kept secret (non-disclosure).

Therefore, the presence of the technological component is the basic criterion for determining international transfers of technology and distinguishing them from other transactions of technology trade with foreign countries and other balance of payments transactions.

The foundations for defining the international transfers of technology in this way can be found in the research and considerations of the technology balance of payments that preceded the development of the methodology.

Madeuf (1984) refers to technology transfer as a process in which technology is transferred by a company that uses the same technology in its own production process. These transfers are therefore different from knowledge and information that are acquired as inputs and outputs for the production process. In practice this means that if a company manufactures equipment and sells it in the market, the machine containing such technology falls under the category of goods. However, if the machine being sold is developed by a company, which uses it for its

own needs and also sells it, it is a transfer of technology. On the other hand, if we consider the buyer's perspective, the acquisition of capital goods that will be included in the production process represents technology transfer. Taking this into account, technology transfers would be more broadly defined, which is not the case in the existing methodology (the TBP Manual).

A similar principle also applies to services. If a company provides engineering services, e.g. for making technical drafts and plans, they will be considered technology transfer only if acquiring them means obtaining knowledge about services required for the preparation of technical studies (Madeuf, 1984). Strictly speaking, these services, together with technical assistance, should not be included in the technology balance of payments. In practice, however, they are provided as part of the transfer of certain technologies, such as technical studies under the contract for the supply of a factory, together with the transfer of a patented or secret production process or technical assistance based on the licensing or transfer of the know-how agreement (the TBP Manual).

Also, according to the TBP Manual, data related to foreign direct investment are important for understanding the relationship between the parent company and its subsidiaries. However, there is a problem if these data were to be used to assess technology transfer. Technology transfer that occurs this way does not necessarily take place through a formal arrangement. Although one of the incentives for buying a company can be the technology it possesses, which can be added to the total technological capital of the buyer, it is difficult to assess the technological component within the framework of foreign direct investment, that is, to determine which part refers to the transfer of technology. The same also applies to income from direct investments, which includes an unquantified return on assets in the form of technology. In addition, when the transfer of technology occurs in exchange for a stake in capital, it is necessary that the flows generated by the transfer of technology and financial assets (equity) are clearly separated and recorded.

Trade in high-tech goods, especially capital goods, is usually used in assessing the technological competitiveness of a national economy, more so than trade in services. In the trade of consumer and capital goods produced in industrial sectors with the use of high technology, technology transfer takes place in two ways. On the one hand, the acquisition of these goods presents the trade in technology involved in their production, while, on the other hand, the transfer can also occur implicitly, through the use of these goods. However, it should be borne in mind that the transfer of technology is not the purpose of such trade, nor does it happen independently.

The delivery of these goods implies the provision of services such as training and technical assistance with installation and maintenance of equipment, all of which must be separated and recorded individually for statistical purposes. Finally, it is important to consider complex arrangements, such as turn-key facilities, which include the sale of equipment with engineering services before investment and during installation, the use of patents and the disclosure of know-how. Given the complex structure of these arrangements, it is not easy to identify all the individual components and financial flows.

Extracting the technological component and its statistical recording pose a particular challenge when it comes to technology transfers that take place through formal means – trade in goods and foreign direct investment – as well as through informal means. The case is

somewhat different with international technology transfers that take place through patents, licenses and services. For these reasons, foreign direct investment and exports and imports of goods with a high technological base are not included in the technology balance of payments.

Given the above, the technology balance of payments can be defined as a statistical overview of international market transactions between residents and non-residents in different countries, arising from the transfer of technologies realised with intangible assets (patents, licenses, know-how, etc.) and the provision of services with a dominant technological component (research and development, engineering services, etc.).

3.2 Basic components of the technology balance of payments

According to the TBP Manual, the technology balance of payments consists of the purchase and sale of patents, licenses and other intangible assets protected by intellectual property rights, as well as an agreement on the disclosure of know-how, research and development services performed abroad and financed from abroad and technological services, i.e. services with a high technological component.

Data for compiling the technology balance of payments can be collected using specialised questionnaires, but they more often come from existing data that fall under the remit of central banks, i.e. institutions responsible for monetary policy (Frascati Manual, 2002). Within that approach, the technology balance of payments is based on data on services performed between the country and abroad, which are in the goods and services account of the balance of payments. Among the different types of services, it is necessary to choose those whose provision results in the transfer of technology, in accordance with the OECD methodology.

3.2.1 Charges for the use of intellectual property

According to the international methodological standards for compiling balance of payments statistics (BMP6), within the balance of payments we can distinguish two groups of intellectual property and, accordingly, two categories of charges for their use:

1) charges for the use of proprietary rights, such as: patents, trademarks, copyrights, industrial processes and designs including trade secrets and franchises – arising from research and development, as well as marketing;
2) charges for licenses to reproduce and/or distribute intellectual property embodied in produced originals or prototypes, such as: copyrights, books and manuscripts, computer software, cinematographic works, sound recordings and related rights such as for live performances and television, cable, or satellite broadcasting.

The first category of intellectual property and charges related to its use is the basic part of the technology balance of payments, as stated in the previous section, while the second category should not be included (OECD, 2005).

The use of intellectual property concerning both of these categories is ensured by the payment of a fee, which is recorded in the services account under charges for the use of

intellectual property. From the point of view of the technology balance of payments, it is necessary to single out only two subtypes of these services, i.e. fees, within this item:

a) franchises and trademarks licensing fees;

b) licenses for the use of outcomes of research and development.

3.2.2 Research and development services

According to the TBP Manual, research and development services that need to be included in the technology balance of payments refer to industrial and technological research and development services, which take place:

1) between the parent company and its affiliates, within a multinational company – when these operations are performed by subsidiaries or by the parent company for its subsidiaries as a form of payment for the subsequent transfer of technology;
2) between companies that are not connected by ownership, which jointly carry out research and development, in existing research facilities or in a company that they jointly founded for that purpose.

Research and development services that take place through scientific cooperation, i.e. contributions from intergovernmental research bodies such as CERN, are not included in the technology balance of payments. However, if these services are jointly performed by the private sector and university laboratories, that is, if they are carried out through cooperation on technological projects that are, for example, ensured by the European Union, they need to be included in the technology balance of payments.

According to BPM6, research and development services consist of services related to basic and applied research, as well as experimental development of new products and processes. In principle, this means that activities in the physical, social sciences and the humanities are included in these services, together with the development of operating systems that represent technological advancements, as well as commercial research related to electronics, pharmaceuticals and biotechnology.

According to MSITS 2010, these services are divided into two categories:

1) provision of research and development services that are customised to the needs of the customer who ordered the service, as well as the development of services that cannot be arranged in this way;
2) sale of proprietary rights arising from research and development, i.e. patents, copyrights arising from research and development, industrial processes and designs (including trade secrets) and others, which need to be separately identified.

Licenses to reproduce and licenses to use outcomes of research and development should be included under the appropriate category in charges for the use of intellectual property.

From the point of view of the technology balance of payments, in principle it is necessary for all research and development services to be included in its creation, except those related to the humanities (OECD, 2005).

3.2.3 Computer services

According to BPM6 and MSITS 2010, computer services are presented within the services account in the balance of payments as part of the telecommunications services, computer and information services item. Computer services consist of services related to hardware and software and data processing services, which together can be broken down into services related to computer software and other computer services.

Computer software includes general business productivity software, computer game software, and other applications. This category includes the following services:

a) sales of customised software (however delivered) and related licenses to use;

b) development, production, supply and documentation of customised software, including operating systems, made to order for specific users;

c) non-customised (mass-produced) software downloaded or otherwise electronically delivered, whether with a periodic license fee or a single payment;

d) licenses to use non-customised (mass-produced) software provided on a storage device such as a disk or CD-ROM with a periodic license fee;

e) sales and purchases of originals and ownership rights for software systems and applications.

Other computer services include:

a) hardware and software consultancy and implementation services, including the management of subcontracted computer services;

b) hardware and software installation, including installation of mainframes and central computing units;

c) maintenance and repairs of computers and peripheral equipment;

d) data recovery services, and provision of advice and assistance on matters related to the management of computer resources;

e) analysis, design and programming of systems ready to use (including web page development and design) and technical consultancy related to software;

f) systems maintenance and other support services, such as training provided as part of consultancy;

g) data-processing and hosting services, such as data entry, tabulation and processing on a timesharing basis;

h) web page hosting services, i.e. provision of server space on the internet for the hosting of clients' web pages;

i) provision of applications, hosting clients' applications, and computer facilities management.

As can be seen from the above types of computer services, the provision of many of them does not lead to the transfer of technology. According to the OECD (2005), in order to compile a technology balance of payments, it is necessary to include only those computer services that

are related to software protected by intellectual property rights and that enable the transfer of technology. This is consistent with international statistical standards, which, according to MSITS 2010, recommend that for the purposes of national accounts statistics within computer services, transactions related to original software, i.e. sales and purchases of originals and ownership rights for software systems and applications should be specifically identified.

3.2.4 Architectural, engineering, scientific and other technical services

According to the OECD (2005), the provision of technical services, i.e. "services with technical content" aims to enable the user, i.e. the customer, to be productive in performing a specific activity. These services do not enable the transfer of technology in the strict sense, because the used technical skills are not transferred to the customer. Only their result is transferred, which allows the customer to increase or mobilise his technological potential. Since this is the case, only those technical services that undoubtedly have an engineering content should be included in the technology balance of payments.

In the services account of the balance of payments, within the other business services item, there is a category of technical, trade and other business services. This category consists of several subcategories, of which architectural, engineering, scientific and other technical services are important from the point of view of the technology balance of payments. According to MSITS 2010, they are subdivided into:

1) architectural services, related to the design of buildings;
2) engineering, which includes the design, development and utilisation of machines, materials, instruments, structures, processes and systems;
3) scientific and other technical services, which include surveying, cartography, product testing and certification, and technical inspection services.

3.3 Technology balance of payments in statistical practice

International experience in the compilation of technology balance of payments statistics allows us to observe the complexity of applying the presented methodological bases in practice.

The OECD is certainly the starting point for data on the technology balance of payments. In addition to methodological handbooks, it compiled an international database with detailed data series, classified by industry, type of activity and geographical area.

These data were published for the first time in 1997 in the Main Science and Technology Indicators. From 1997 to 2000, aggregated data by member countries were published in this publication, namely: exports, imports and their balance, i.e. the difference between inflows and outflows based on transactions that enable technology trade, and as supplementary indicators – the total volume of technology trade (the sum of inflows and outflows) and the ratio of coverage of outflows to inflows. From 2001 to 2017, only aggregated data for exports and imports by member countries were published, with a new supplementary indicator – the share of outflows in gross domestic expenditure on research and development (GERD), which

shows the relationship between technology imports and domestic activities based on research and development. Data on the technology balance of payments in this publication were last published in 2017, for the 2005–2015 period.

The central bank of Portugal has been publishing a series of data on the technology balance of payments since 1996 on its website, within the balance of payments and international investment position statistics. Data regarding exports and imports of technological services, as well as their balance, are given at the overall level and by individual components, which, according to the OECD methodology, are divided into four groups: rights to purchase/use patents, trademarks, etc., technical assistance services, research and development services and other technical services.

Based on the balance of payments statistics, the central bank of Italy publishes annual data on the technology balance of payments on its website as part of data in the field of foreign economic relations statistics. The basic components are shown in Table 1.

Table 1: **Central bank of Italy's methodology for producing the technology balance of payments**

No	Technology balance of payments component	EBOPS 2010 service code	Services category included in the technology balance of payments (according to BPM6)
1	Transactions of purchase and sale of patents, licenses and contracts for disclosure of know-how	SH1	Franchises and trademarks licensing fees (within charges for the use of intellectual property)
		SH2	Licenses for the use of outcomes of research and development (within charges for the use of intellectual property)
2	Technology services	SI2	Computer services (within telecommunications, computer and information services)
		SJ31	Architectural, engineering, scientific and other technical services (within other business services > technical, trade-related and other business services)
3	Research and development services performed abroad and financed from abroad	SJ1	Research and development services (within other business services)

Source: Technology balance of payments – Methodological Notes, 2017, Banca d'Italia.

The published data cover the 2016–2021 period and include inflows and outflows by basic components, sectoral structure, geographic region and individually by partner countries. The central bank of Italy publishes, together with the data, an analysis of the annual trends in the components of the technology balance of payments, at the aggregated level, as well as by partner countries, the sectoral structure of exports and imports, company characteristics (foreign/domestic ownership and the number of employees) and a comparison with EU member states (at the total level, as a whole).

3.4 Challenges in producing technological balance of payments statistics

The main problems in using the technology balance of payments as an indicator of technology trade with foreign countries arise from the consistency and international comparability of the collected data, depending on which sources are used, as well as the quality of the obtained data.

Data for the technology balance of payments can be collected via questionnaires or by relying on balance of payments statistics.

The use of specialised questionnaires enables better differentiation of the technological component in international transactions, collection of data with a higher level of detail (by sector, geographical area, etc.), as well as monitoring technology trade between parent companies and their affiliates abroad. The problem in conducting such surveys is the selection of a representative sample. In some countries, the sample is designed on the basis of companies engaged in research and development activities, which can significantly underestimate the total outflows of technology trade with foreign countries, because companies whose activity is not research and development, but which in fact import technology, are excluded from the technology balance of payments (OECD, 2005).

On the other hand, the use of balance of payments statistics for these purposes depends on the successful detection and selection of services with a clear technological component and their inclusion in the technology balance of payments. Using balance of payments statistics as a data source implies relying on internationally recognised statistical standards, which only somewhat reduces data heterogeneity (Coelho et al. 2010).

The main cause of this problem is that the basic categories of the technology balance of payments are not defined in the same way in all countries. This occurs because, in practice, it is difficult to determine which part of the service is related to technology transfer and which is not. Thus, the transactions that get included in the technology balance of payments are also those related to intellectual property rights based on films, audio-visual services and related copyrights, which, as already stated, should not be included in the technology balance of payments.

Some technology transfers do not have to lead to any payment at all, that is, they can be made without compensation, while for some technology transfers, payment is made through dividends or high costs of purchasing capital equipment. There are also special contract provisions that may include hidden payments through forced procurement of plant and equipment or products to start the production process (OECD, 2005). A special challenge arises with technology transfers that take place between the parent company and its subsidiaries, using transfer prices, i.e. the price of a certain technological service is determined in accordance with the global strategy of the multinational company to transfer revenues and costs to its subsidiaries (Coelho et al. 2010).

Given these limitations, it is important to consider how appropriate the technology balance of payments is as an indicator of technology trade with foreign countries, i.e. to what extent it can be used to assess technological development. The TBP Manual states that the technology balance of payments is not a direct indicator of the technological competitiveness of the national economy, rather that it is a statistical indicator with analytical purposes, as evidenced by numerous studies.

Pak & Ku (2017) observed the relation between technology imports and the ratio of technological exports and imports of South Korea from 1981 to 2013. Their results show that the ratio of technological exports and imports responds negatively to technological imports in

the short term, but positively in the long term, which means that technology imports have a positive impact on the technological competitiveness of the economy in the long run.

Teixeira & Barros (2019) considered the net technology balance of payments as one of the determinants of international competitiveness in 26 OECD countries in the 2000–2017 period. Their research showed that, if other factors remain constant, the surplus in technology trade with foreign countries (as a percentage of GDP) has a positive effect on the country's international competitiveness. Same authors in Barros & Teixeira (2021) observed the technology balance of payments of Spain, Greece, Italy and Portugal in the period from 2000 to 2017, supplementing the model from the previous work. They found that the percentage share of the technology trade balance with foreign countries in GDP plays an important role in improving international competitiveness, and their results suggest that this is especially the case in sectors where the increase in productivity is based on intangible assets such as patents and trademarks.

According to Technopolis Consulting Group (2010), the technology balance of payments provides an indication of the degree of independence of a country in terms of technology in intangible form, i.e. the origin of technology used in the production system or in exports, the relationship between research and development activities in the national economy and technology imports, as well as technologies that the country can develop itself and those that come from abroad or must be developed in cooperation with other countries.

Although the technology balance of payments reflects a country's ability to sell its technology abroad, as well as its use of foreign technologies, a deficit in the technology balance of payments does not necessarily indicate low competitiveness. In some cases, it occurs because of increased imports of foreign technology or declining export inflows. On the other hand, if a country records a surplus, it may be a consequence of a low level of technology imports, a high degree of technological autonomy or a lack of capacity to assimilate foreign technologies. Therefore, to carry out a proper analysis of the country's deficit or surplus on this basis, it is necessary to provide additional quantitative and qualitative information, so that appropriate conclusions can be drawn (OECD, 2009).

Considering all the said, the technology balance of payments is important as an indicator of technological trade with foreign countries, but when interpreting the data one must be cautious, given that caution is also exercised by the above mentioned authors in their research.

4 Technology balance of payments of the Republic of Serbia

4.1 Methodological foundations for the technology balance of payments of the Republic of Serbia

The balance of payments statistics in the Republic of Serbia, under the remit of the National Bank of Serbia (hereinafter: NBS), is compiled in accordance with the methodology of the International Monetary Fund, and for these purposes, the main data sources are reports submitted to the NBS and data of the Statistical Office of Republic of Serbia (hereinafter:

SORS). Data on exports and imports of services are obtained from the statistics of foreign payment transactions, which are carried out through banks and the NBS.

In addition to the balance of payments, the NBS publishes on its website data on international trade in services, namely: the total of exports and imports of services by type (balance of services) as well as by country (services by country), and separately, total exports and imports of tourism services by type of these services (tourism) and also by country (tourism by country). Data on international trade of all categories of services are also regularly submitted to Eurostat.

Based on the balance of payments and international trade in services statistics, for the purposes of this working paper the authors compiled the technology balance of payments of the Republic of Serbia. In doing so, the methodology of the central bank of Italy served as a starting point. The basic components of the technology balance of payments of the Republic of Serbia are shown in Table 2.

Table 2: **Main components of the technology balance of payments of the Republic of Serbia**

No	EBOPS 2010 service code	Services category included in the technology balance of payments (according to BPM6)
1	SH	Charges for the use of intellectual property
2	SI2	Computer services (within telecommunications, computer and information services)
3	SJ31	Architectural, engineering and other technical services (within other business services > technical, trade-related and other business services)
4	SJ1	Research and development services (within other business services)

Source: authors.

Services related to charges for the use of intellectual property for the purposes of balance of payments statistics are presented at the aggregated level for all types of these services, that is, they are currently not broken down into groups. Computer services are also presented at the aggregated level, i.e. computer services related to original software – the sale and purchase of originals and ownership rights for software systems and applications – are currently not presented separately. The remaining two categories of services correspond to those that the central bank of Italy has included in its technology balance of payments.

Based on these services, a technology balance of payments for the 2007–2021 period was compiled, with exports, imports and balance, as the difference between exports and imports at the total level, as well as individual services.[2] Also, the authors performed an analysis of the trend of exports and imports of technological services, at the total and individual level, by sectors of exporters and importers, as well as appropriate international comparisons with European countries.

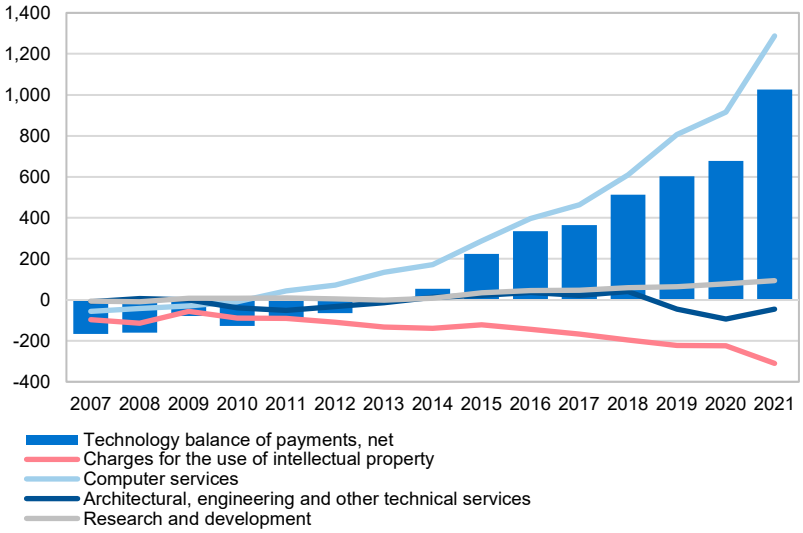
[2] See Appendix 2.

4.2 Analysis of trends in the technology balance of payments of the Republic of Serbia

As mentioned above, because of the specificities of international technology transfers, as well as their monitoring through the technology balance of payments (hereinafter: TBP), caution must be exercised in evaluating exports and imports, i.e. the deficit or surplus at the total level, as well as by specific type of service.

Chart 2 shows net TBP by service categories it consists of. The decline in the TBP deficit recorded in 2007 was slowing until 2014, when it became positive. The surplus recorded almost constant growth thanks to, on average, faster growth of exports than imports as the average coverage of imports by exports was around 115% during the period observed.

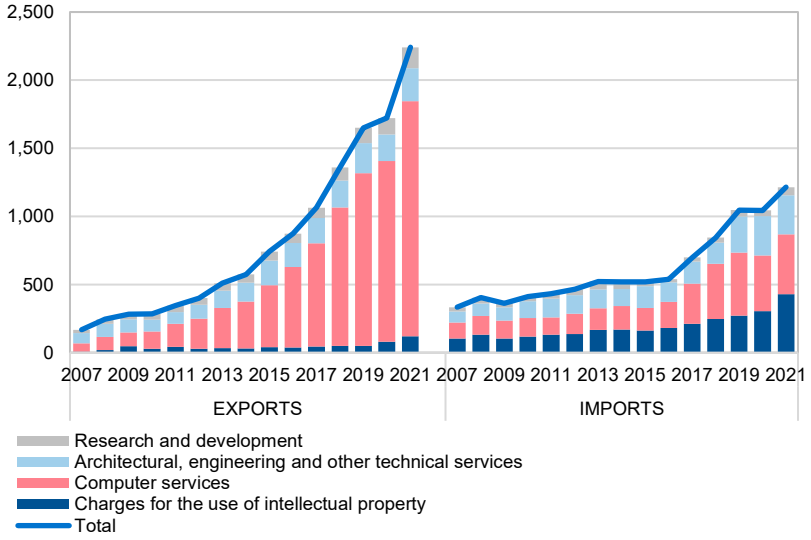
Chart 2 **Technology balance of payments, net**
(in EUR million)



Source: NBS, authors' calculation.

As regards the services structure, shown in Chart 3, since the beginning of 2009 the exports of computer services became dominant in the total exports of technological services, and are recording constant growth. In 2021 the share of these services in exports increased by 41.6 pp compared to 2009 (35.5% in 2009 vs. 77.1% in 2021), with the largest contribution to the total services growth going up from 1.8 pp in 2009 to 23.3 pp in 2021. They are followed by architectural, engineering, and other technical services, which show a trend of a constant decline of their share in total exports since 2009 (the average share in the observed period of 24%), research and development (10.4%) and charges for the use of intellectual property, n.i.e. (6.7%).

Chart 3 **Technology balance of payments structure**
(in EUR million)



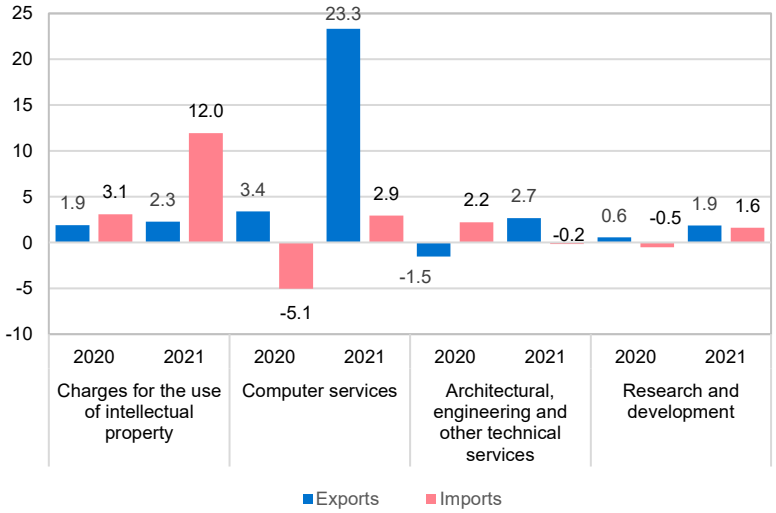
Source : NBS, authors' calculation.

As it is the case with exports, Chart 3 shows that, within the imports structure, the imports of computer services dominated all other services, but their share in total technological imports was also relatively stable (around 36% on average), followed by charges for the use of intellectual property (around 30.6%), architectural, engineering and other technical services (26.1%), and research and development services (7.2%).

During 2021, the TBP recorded a surplus of EUR 1.0 bn, up by EUR 348 mn compared to 2020 (51.3% vs. 12.3% y-o-y in 2020), with a positive TBP recorded for the eighth year in a row (EUR 54.0 mn in 2014). Technological services exports recorded an increase of 30.1% y-o-y in 2021 vs. 4.3% in 2020. This was due to the accelerated increase in computer services exports (30.3% y-o-y), which account for 77% of total technological services exports. Chart 4 shows the contributions of specific service categories to the growth in services exports and imports.

As Chart 4 demonstrates, the contribution of computer services to total exports was 23.3 pp, up by as much as 19.9 pp compared to the previous year, followed by architectural, engineering and other technical services (2.7 pp), charges for the use of intellectual property, n.i.e. (2.3 pp), and research and development (1.9 pp). Technological imports recorded an increase of 16.3% y-o-y, as opposed to a 0.3% y-o-y decline in 2020. The largest contribution to the increase in imports came from the charges for the use of intellectual property, n.i.e. (12 pp), followed by computer services (2.9 pp), and research and development services (1.6 pp), while negative contributions came from architectural, engineering and other technical services (-0.2 pp).

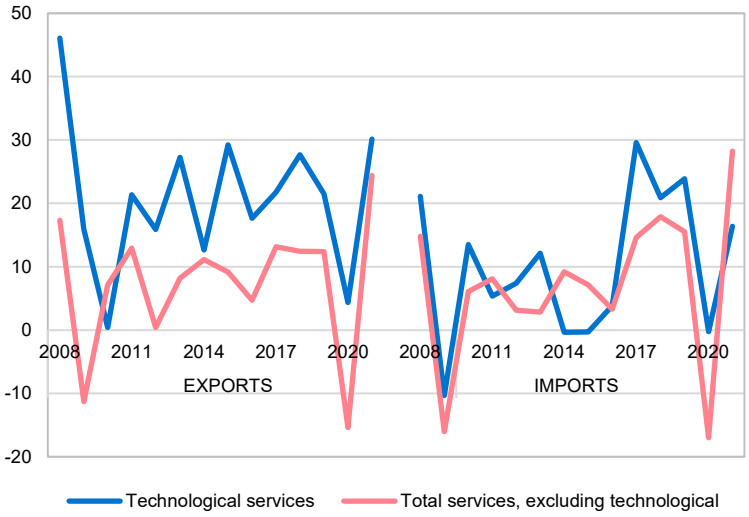
Chart 4 **Contribution to TBP exports and imports, by structure**
(in pp)



Source : NBS, authors' calculation.

If we compare technological services and other remaining services of the balance of payments (Chart 5), growth rates of the technological services exports in the last 15 years were significantly above the growth rates of other services. The average growth in technological services exports was 20.8%, vs. 7.6% in other services. Regarding imports, despite a much smaller gap, the average growth in technological services was 10.2%, vs. 7% in other services. During 2021, the sale of technological services increased by 30.1% y-o-y (4.3% in 2020), while the exports of other services recorded an increase of 24.4% y-o-y (as opposed to a 15.4% y-o-y decline in 2020). During 2020, technological services trade proved much more resilient to the Covid-19 pandemic than trade in other services.

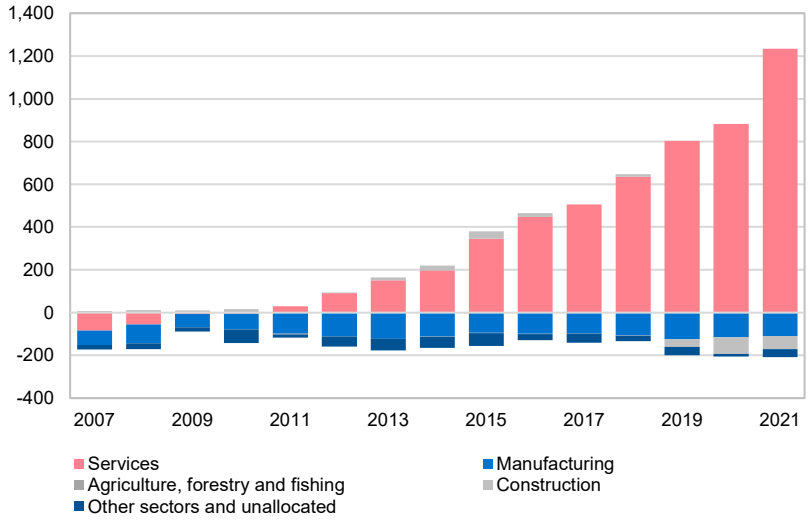
Chart 5 **Technology balance of payments: exports and imports**
(y-o-y growth rate, in%)



Source: NBS, authors' calculation.

In terms of particular sectors of exporters and importers of these services (Chart 6), since 2011, within the **services sector** a surplus has been recorded in technological services trade with foreign countries. The surplus amounted to EUR 1.2 bn in 2021, up by 39.9% y-o-y (vs. 9.8% y-o-y in 2020).

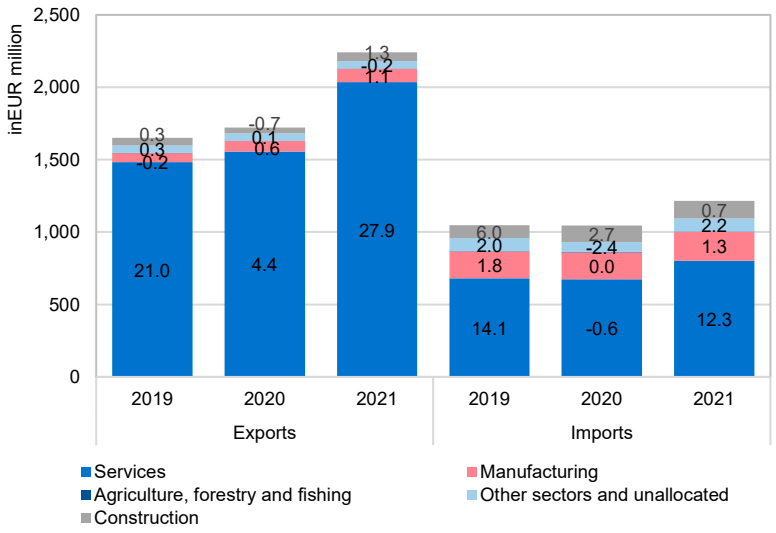
Chart 6.**Technology balance of payments (net), by sector**
(in EUR million)



Source: NBS, authors' calculation.

On the other hand, since the beginning of 2007 a deficit has been constantly recorded in the exchange of technological services concerning companies in manufacturing. In 2021, though somewhat lower compared to 2020, the deficit amounted to EUR 109.0 mn. As regards companies operating in the construction sector, the TBP deficit narrowed somewhat in 2021 (around 19.6% y-o-y). The deficit in the technological services trade of companies operating

Chart 7 **Technology balance of payments structure by sector**
(in EUR million) **and contribution to total growth** (in pp)



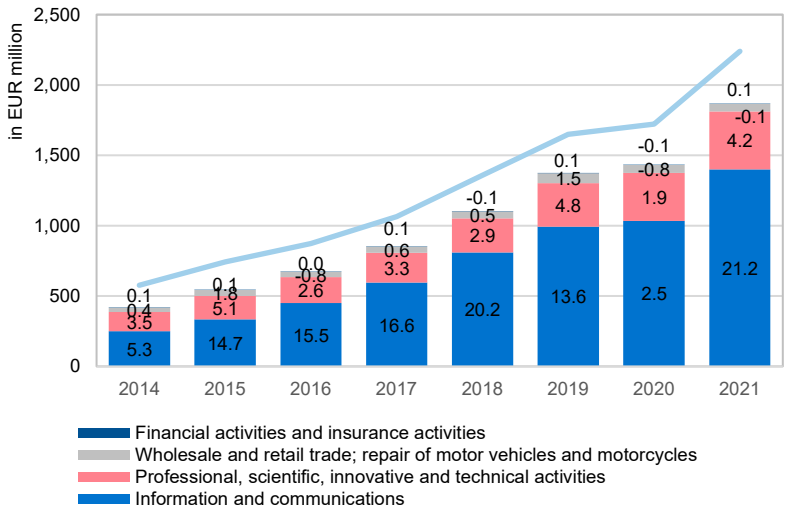
Source: NBS, authors' calculation.

in agriculture recorded an upward trend since early 2008, while in 2021 it narrowed (62.6% y-o-y).

Regarding **exports**, more than a decade-long dominance of the **services sector** is seen in the exports of technological services (with an average share in total exports of more than 80%), followed by manufacturing, which accounted for 7.3% on average, followed by construction and agriculture with 5.9% and 0.1%, respectively.

In terms of exports (Chart 8), the highest growth rates within the services sector were recorded for information and communications, which, since early 2007, have had an average share of 45% in total exports. In 2021, they accounted for 62.5% of total exports, providing the most important contribution to the growth in technological services (21.2 pp), followed by professional, scientific, innovation and technical activities (4.2 pp), and financial and insurance activities (0.1 pp), while wholesale trade recorded a negative contribution (-0.1 pp).

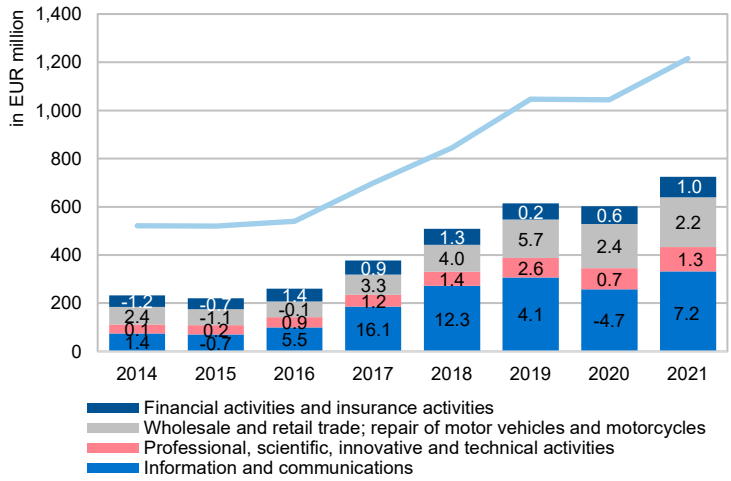
Chart 8 **Services sector**: **exports of technological services** (in EUR million) **and contribution to export growth** (in pp)



Source: NBS, authors' calculation.

Regarding imports, in the period observed (Chart 9), the services sector recorded an average share of more than 57.7% of total imports, while manufacturing accounted for around 25.1%. Within the services sector, during 2021, the largest contribution to the growth in technological imports was provided by information and communication activities (7.2 pp), followed by wholesale trade (2.2 pp), professional, scientific, innovation and technical activities (1.3 pp), and financial and insurance activities (1.0 pp).

Chart 9 **Services sector**: **imports of technological services** (in EUR million) **and contribution to import growth**(in pp)

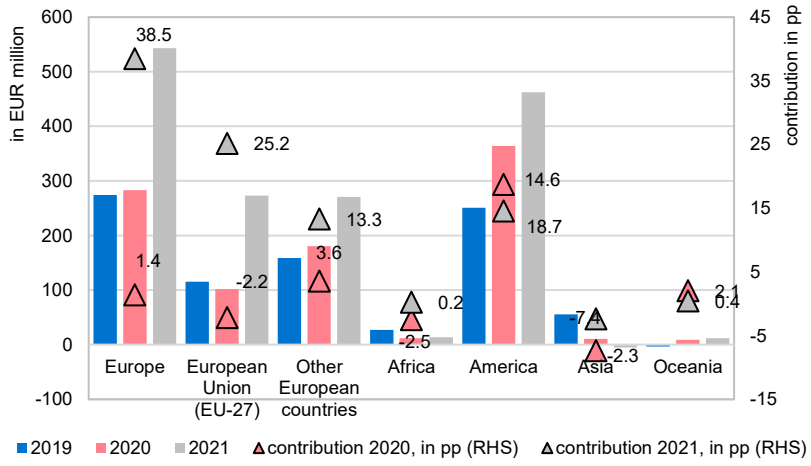


Source: NBS, authors' calculation.

Within manufacturing, over the past 15 years the highest export growth rates were recorded for computers and peripheral equipment production, with a relatively stable share (17.5%), and pharmaceuticals production (8.9%). Although electrical and electronic equipment production recorded lower participation in total imports on average (a 0-3% range), in 2021 this activity provided the largest contribution to the exports growth (14.0 pp), followed by pharmaceuticals production (13.9 pp). The strongest negative contribution came from the production of basic food products (-11.0 pp). Similarly to exports, the most dominant activity in imports was computers and peripheral equipment production, while the production of electrical and electronic equipment recorded the largest contribution in 2021 (2.9 pp), despite an average lower contribution in total imports (1.3%).

In terms of geographical distribution, most of the transactions registered in Serbia's technology balance of payments took place with European countries (Chart 10). After a multiannual TBP deficit, since 2015 a growing surplus was recorded with Europe, reaching EUR 543.3 mn in 2021 (92.1% y-o-y), i.e. around 53% of the total surplus. In terms of individual European countries, the major contribution to the increase in Serbia's total technological surplus came from almost a doubled surplus with the Netherlands and Germany (8.3 pp and 6.7 pp, respectively), Great Britain (6.5 pp) and Switzerland (5.8 pp). The surpluses in exchange with EU countries and other European countries participated to an almost same extent in the total surplus with Europe. As regards countries in the region, the major negative contribution to the total surplus growth was recorded for Montenegro (-2.3 pp).

Chart 10 **Technology balance of payments by geographical area**

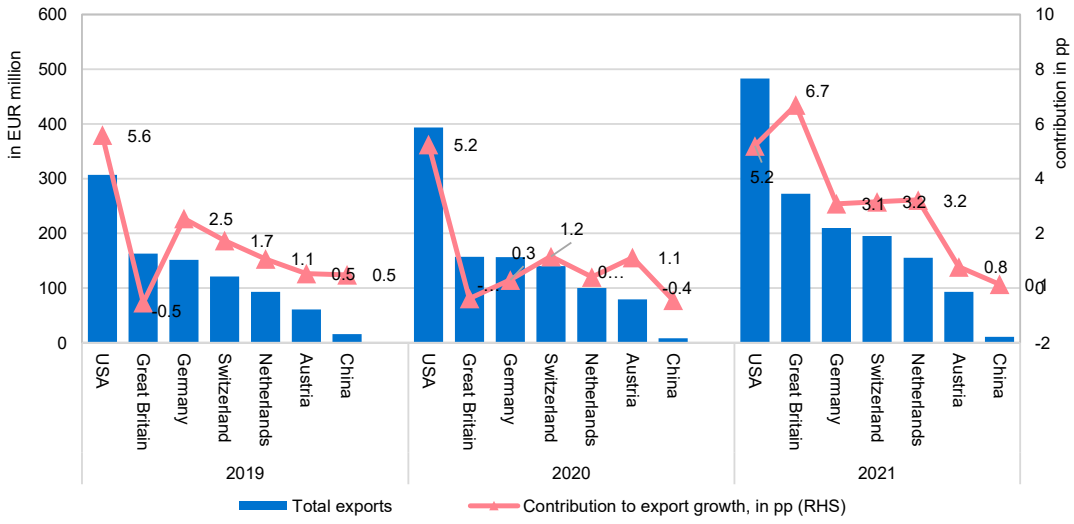


Source: NBS, authors' calculation.

As for the rest of the world, the USA provided by far the largest positive contribution to the growth in Serbia's total surplus (13.4 pp). Technological services trade with China recorded a multiannual deficit and, as a result, in 2021 technological trade with this country gave the largest negative contribution to the net technological balance (-2.0 pp).

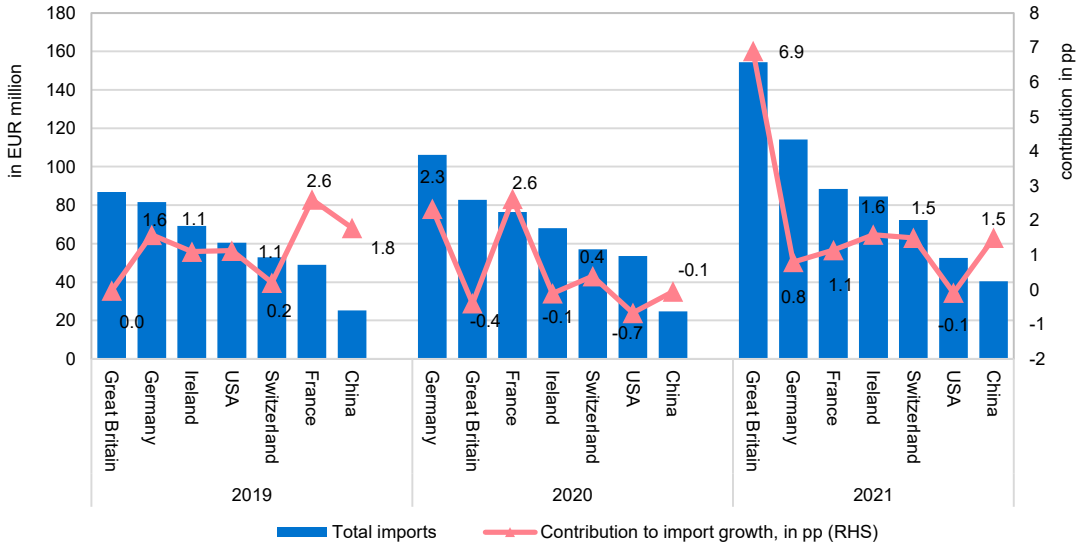
In 2021, as shown in Chart 11, technological services exports to EU countries increased by 27.2% (up by 21.2 pp from 2020). EU countries where the most of technological services were exported and had the largest contribution to total exports growth were the Netherlands and Germany (3.2 pp and 3.1 pp, respectively), while Great Britain dominated in terms of exports to other European countries (6.7 pp). Regarding the countries outside of Europe, exports to the USA recorded the largest participation in total exports and provided the largest contribution to its growth (5.2 pp).

Chart 11 **Technological services exports by country**



Source: NBS, authors' calculation.

Chart 12 **Technological services imports by country**



Source: NBS, authors' calculation

Technological services imports from European countries recorded an increase of 15.9% y-o-y (up by 10.4 pp compared to the previous year), with imports from Germany, France, and Ireland being the most dominant (0.8, 1.1 and 1.6 pp, respectively). As for the countries outside the EU, most services were imported from Great Britain and Switzerland (6.9 pp and 1.5 pp, respectively).

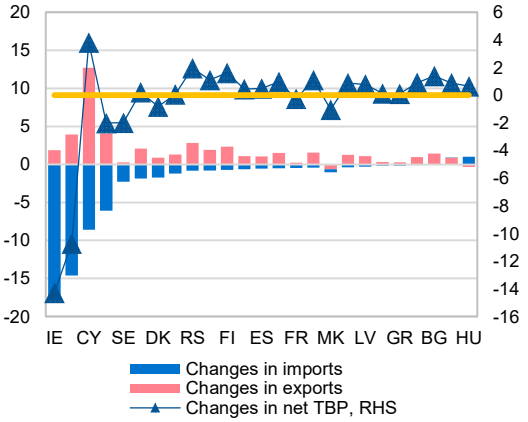
4.3 International comparison of exports and imports of technological services with European countries

According to the balance of payments data of individual countries, published by Eurostat, for the purposes of this paper the authors compiled the technological balance of payments (TBP) for 25 European countries, which includes charges for the use of intellectual property (patents and copyright fees), as well as trade in computer services, research and development and architectural services, engineering and other technical services. TBP structured in this way provides an adequate comparability with data on exports and imports of these services for Serbia.

Chart 13 shows changes in net TBP (% of GDP) from 2013 to 2021, indicating whether the countries are net technology exporters or importers. Also, Chart 14 shows the exports and imports of technological services (% of GDP), indicating the share of exported and imported technology.

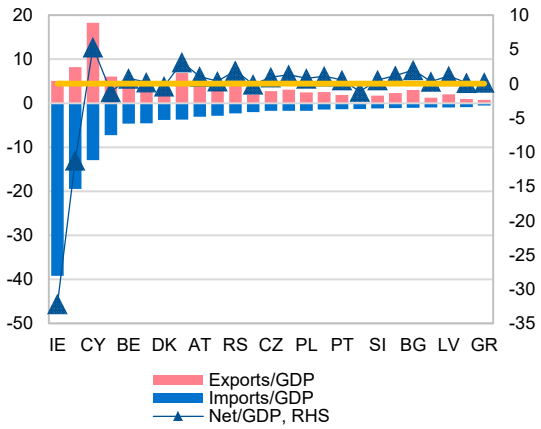
In the period observed, Cyprus recorded the largest increase in the net surplus in 2021 – 3.8 pp compared to 2013, i.e. an increase in exports and imports by 12.7 pp and 8.6 pp, respectively, followed by Serbia (2 pp), Finland (1.6 pp) and Bulgaria (1.4 pp). Ireland recorded the largest deficit increase of as much as 14.2 pp (an increase in imports and exports of 17.8 pp and 1.9 pp, respectively), followed by Luxembourg, which has been recording a multiannual deficit (a deficit increase of 10.7 pp) and Estonia (a 2.0 pp decline in net TBP).

Chart 13 **Changes in TBP as percent of GDP in 2013-2021**
(in pp)



Source: NBS, Eurostat, authors' calculation.

Chart 14 **Technology balance of payments in 2021**
(% of GDP)



Source: NBS, Eurostat, authors' calculation.

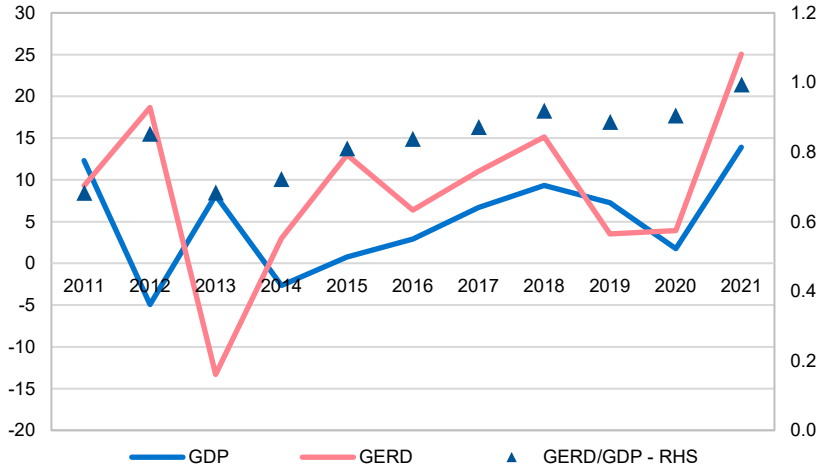
In 2021, all countries recorded a TBP surplus, except for four countries that registered a deficit – Ireland, Luxembourg, Estonia and North Macedonia. Ireland is a specific case as it has been recording a technological services trade deficit for more than ten years, as well sizeable exports and imports, most probably due to the presence of a significant number of multinational companies engaging in both technology exports and imports.

The main indicator used in international comparisons is GERD, which measures domestic expenditure on scientific and research development (R&D) for the given year, i.e. the country's efforts in the field of innovations. This includes innovation through new products and processes, and investment in knowledge. Serbia's Statistical Office publishes this indicator annually, while R&D data are collected in line with the OECD Frascati Manual.[3] Chart 15 shows the basic trend of GDP and GERD, as well as the percentage share of GERD in GDP.

As shown in the Chart, since 2013 the share of R&D investment (% of GDP) has been constantly growing. In 2021 R&D expenditure reached a decade-high of EUR 530.1 mn, i.e. around 1% of GDP, vs. 0.6% in 2011.

[3] Statistical Office of the Republic of Serbia, 2022 "Research and Development Activity, 2021", Statistics of science, technology and innovation, Statistical Release IR30, number 231, year LXXII.

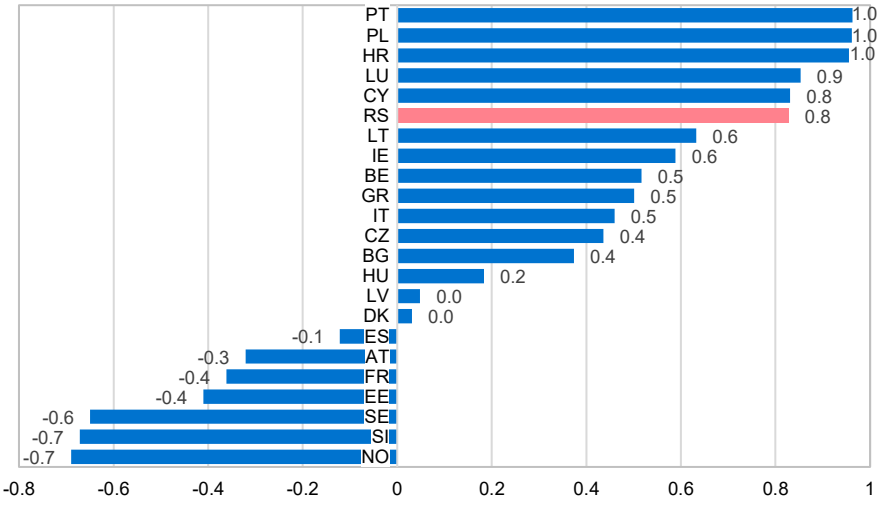
Chart 15 **Gross expenditure on research and development**
(y-o-y growth rates, in %)



Source: NBS, Eurostat, authors' calculation.

The Chart below shows the Pearson correlation coefficient that measures the relationship between R&D investment (% of GDP) and net TBP (% of GDP).

Chart 16 **Coefficient of correlation between expenditure on R&D and TBP in 2012-2021**
(in % of GDP)

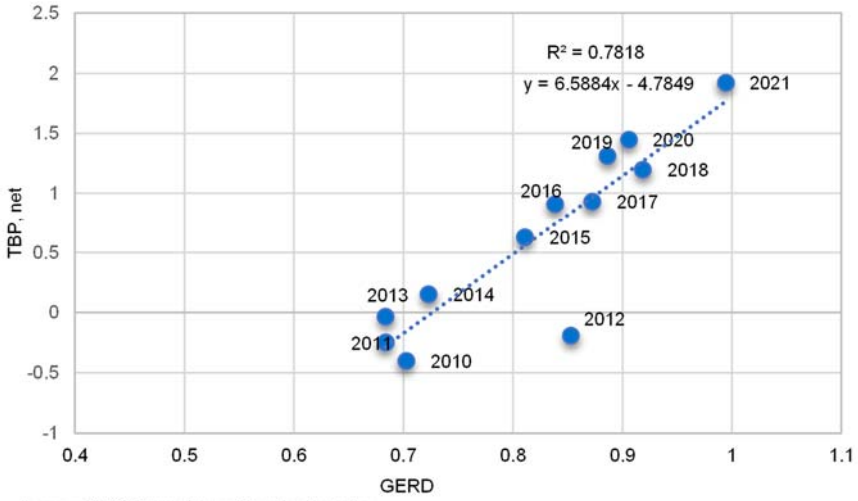


Source: NBS, Eurostat, authors' calculation.

These results show a strong positive correlation between R&D investment (% of GDP) and net TBP (% of GDP) in case of Portugal, Poland, Croatia, Luxembourg, Cyprus and Serbia, and a strong negative correlation in case of Norway, Slovenia and Sweden.

To observe the degree of elasticity of R&D investment (% of GDP) and net TBP (% of GDP), a regression analysis was carried out for the case of Serbia, as shown in Chart 17.

Chart 17 **Republic of Serbia: relationship between gross expenditure on R&D and net TBP**
(in % of GDP)



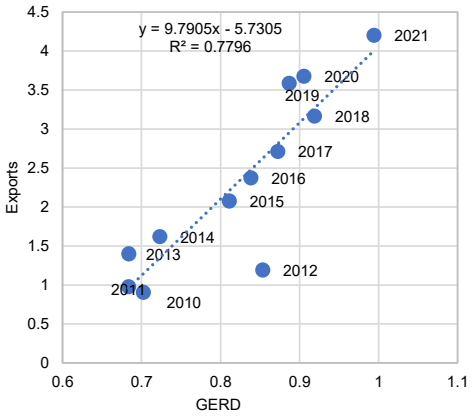
Source: NBS, Eurostat, authors' calculation.

The scatter plot shows a strong linear relation between R&D investment (% of GDP) and net TBP (% of GDP). The obtained evaluated TBP equation for the 2010–2021 period is statistically significant (*t* statistics = 5.6, with the probability threshold below 0.05), with each change in R&D investment (% of GDP) of 0.1% leading to a TBP change of 0.7%.

The determination coefficient of 0.78 demonstrates that around 78.2% of the total variability of the R&D investment share in GDP is explained by the variability of net TBP in the observed years. The rest of around 21.8% is not explained by the regression line.

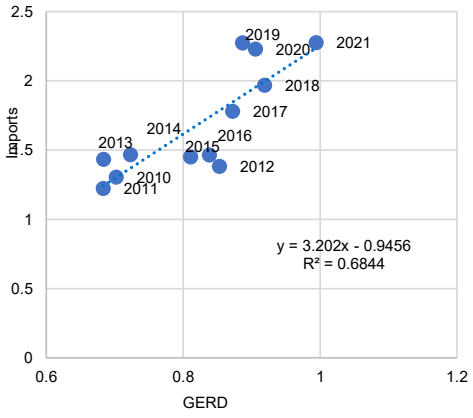
Charts 18 and 19 obtained by the regression analysis show the equation for elasticity of R&D investment (% of GDP) and export TBP (% of GDP), and R&D investment (% of GDP) and import TBP (% of GDP), respectively, for the 2010–2021 period.

Chart 18 **Republic of Serbia: relationship between gross expenditures on R&D and TBP exports**
(in % of GDP)



Source: NBS, Eurostat, authors' calculation.

Chart 19 **Republic of Serbia: relationship between gross expenditure on R&D and TBP imports**
(% of GDP)

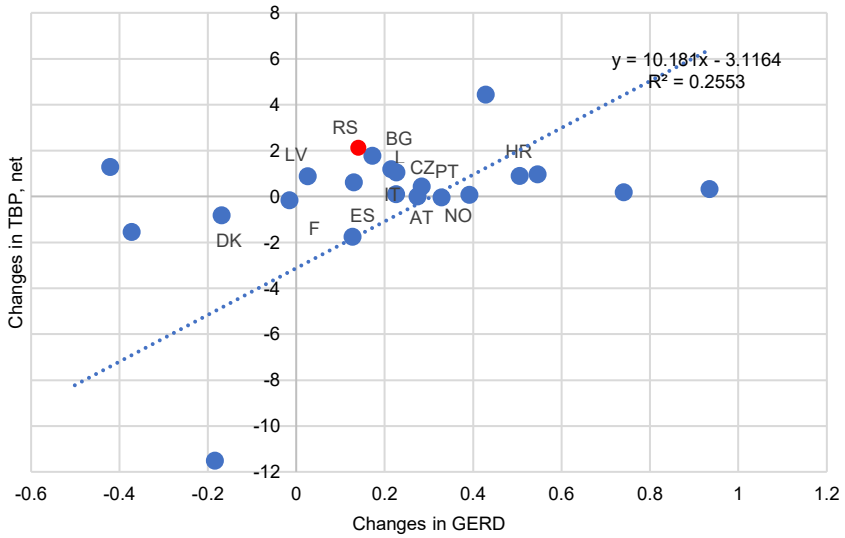


Source: NBS, Eurostat, authors' calculation.

Import and export evaluated equations obtained by the regression analysis are statistically significant (with *t* statistics values above 2). However, it can be concluded that the exports change is considerably more elastic to changes in R&D investment (% of GDP) compared to imports. Regarding exports, each increase in R&D investment (% of GDP) of 0.1% leads to an export increase (in % GDP) of 1% (in case of imports, to an increase of 0.3%).

Chart 20 represents a regression analysis on the sample of 23 European countries for the 2012–2021 period, showing the elasticity of R&D investment (% of GDP) and net TBP (% of GDP). The obtained evaluated regression is statistically significant (*t* statistics above 2 and probability threshold below 0.05) and indicates that each increase in R&D investment (% of GDP) of 0.1% leads to the improvement in net TBP (% of GDP) of 1.0%.

Chart 20 **R&D expenditure and net TBP in 2012-2021**
(in % of GDP)



Source: NBS, Eurostat, authors' calculation.

The countries investing more in R&D are expected to export more, while those not investing much in R&D are likely to import technology more. However, the results show that some countries investing more in R&D do not export more systematically, which implies that there are other factors influencing the net TBP position, which are not included in the analysis.

Negative values appear in the case of Luxembourg, Estonia, Denmark and Sweden. Chart 20 excludes data for Ireland as we aimed to have a clearer TBP picture since extreme negative values were obtained. As already mentioned, due to a large number of multinational companies, Ireland is recording sizeable IT services exports underpinning R&D investment growth. However, this volume is more than compensated for by the strong R&D services imports and charges for the use of intellectual property, which is why Ireland contributes negatively to the EU technological balance.

5 Conclusion

International technology transfers represent complex processes that are not easy to statistically capture and record. For these purposes, data on foreign direct investment, international trade in high-tech goods and technological services, as well as charges for the use of intellectual property can be used, but it is important for the technological component in these transactions to be clearly determined and recorded, which is not always the case in practice.

The technology balance of payments represents a statistical overview of international market transactions between residents and non-residents in different countries, arising from the transfer of disembodied technologies, i.e. through investments in intangible assets protected by intellectual property rights (patents, licenses, know-how, etc.) and the provision of services with a dominant technological component (research and development, engineering services, etc.). Although it is compiled based on the balance of payments and international trade in services statistics, in international practice there is a large heterogeneity of data as the basic components of the technology balance of payments are not defined in the same way in all countries. Also, certain transactions related to the transfer of technology, which do not take place in the market or do not involve payment in money, are not included in the technology balance of payments at all.

For the purposes of this paper, the authors created the technology balance of payments of the Republic of Serbia for the 2007–2021 period, based on the methodology of the central bank of Italy. The analysis of the obtained data showed that since 2014, our country has recorded almost constant growth in the technological services trade surplus with foreign countries. On the exports side, computer services exports dominate, while on the imports side, in addition to these services, charges for the use of intellectual property also play a significant role. The services sector, and within it the information and communications subsector, recorded the largest share on the exports and imports side. The most important trading partners in these areas are European countries and the USA, while technology trade with the People's Republic of China has been in a deficit for a number of years. The authors also carried out a regression analysis, indicating a clear linear relationship between R&D investment, on the one hand, and exports, imports and the net technology balance of payments on the other, i.e. a relationship with each of these indicators individually. As part of international comparisons, the same analysis was also carried out, showing that certain countries with higher R&D investment do not systematically export more, and it is concluded that there are other factors, not included in the analysis, that affect the net TBP position.

Given the above limitations, the technology balance of payments, nevertheless, is a statistical indicator important for the assessment of technology trade with foreign countries. It records market transactions involving the international transfer of disembodied technology, where the technological component, i.e. the transfer of technology can be – although not without certain effort – more easily determined compared to data on foreign direct investment or trade in goods with a high technological basis. Foreign direct investment, in addition to the inflow of capital, goods and services, has numerous effects on the national economy of the country of destination, and it is difficult to single out the international transfer of

technology. On the other hand, technology transfer does not serve as an exclusive goal of trade in high-tech goods.

The technology balance of payments is not an indicator of the national economy's technological competitiveness. Therefore, when analysing the data it provides, it is necessary to be careful in assessing the country's technological position abroad. It can be used to gain insight into the degree of independence or the origin of technology, through the connection between research and development activities in the national economy and the imports of technology, as well as technologies that the country develops alone or in cooperation with other countries. For a comprehensive assessment of the country's technological position abroad, it is necessary to consider other quantitative and qualitative information.

Considering the importance of computer services in our country's exports and imports, the technology balance of payments as an indicator of technology trade with foreign countries will surely gain importance in the coming period. It is therefore important to further develop the international trade in services statistics, so that certain categories of services could be viewed in more detail, by specific categories, such as a more detailed breakdown of charges for the use of intellectual property and computer services, which would ensure additional data for the preparation of appropriate economic policies in this area. Also, it is necessary to supplement the analysis of the technology balance of payments with other data and indicators, which are recommended by the international methodology in this area (e.g. GERD) and with the development of new indicators, such as the trade in goods with a high technological base by individual sectors, in order to better record the technological component of this trade.

All of this is necessary to determine the country's technological position abroad as adequately as possible.

Appendices

Appendix 1: Intangible assets that enable technology transfers

Table 3**: Type of intangible assets and the way they ensure technology transfer**

Instrument of protection	Subject of protection
Patents	Monopoly over the invention, its industrial and commercial exploitation, granted to the patent holder by law by an official agency (national or regional), for a limited time (ranging from fifteen to twenty years) and within a certain territory. A patent can be assigned or transferred based on a license and can be bought or sold in whole or in part (when a part of its possible applications is assigned).
Licenses	The right to use all or some possible applications of the patent, which the patent owner (or licensor) assigns to the licensee, under precisely predefined conditions (e.g. period and territory in which it is valid, as well as the form of payment for the license).
Industrial design	Aesthetic or decorative aspects of a particular commercial product.
Trademarks	Using a specific distinctive sign or name as a mark of the product.
Franchises	Several different rights (trademarks, industrial design, logo, etc.), mainly commercial know-how and provision of technical assistance, in order to distribute goods and services.

Source: Breitwieser & Foster (2012), OECD (2005),authors' adjustments.

Appendix 2: Technology balance of payments of the Republic of Serbia

Table 4: **Republic of Serbia: technology balance of payments** (in EUR million)

Year	Charges for the use of intellectual property	Computer services	Architectural, engineering and other technical services	Research and development	TOTAL
			EXPORTS		
2007	7.6	61.5	73.8	25.0	167.8
2008	18.7	96.2	97.5	32.8	245.1
2009	47.0	100.7	97.7	38.7	284.1
2010	29.2	126.8	86.2	43.0	285.2
2011	41.4	170.9	86.7	47.2	346.2
2012	27.4	221.3	103.9	48.3	401.0
2013	33.3	295.8	125.6	55.5	510.3
2014	31.2	344.4	139.1	60.1	574.8
2015	40.8	454.7	180.4	66.9	742.8
2016	38.3	589.8	176.7	68.8	873.6
2017	44.2	759.7	184.3	75.4	1,063.6
2018	49.1	1,016.1	196.8	96.0	1,358.0
2019	48.3	1,269.6	220.4	111.6	1,649.9
2020	79.5	1,325.7	195.5	120.8	1,721.5
2021	118.8	1,727.0	241.3	152.8	2,240.0
			IMPORTS		
2007	103.8	116.7	82.5	31.0	334.0
2008	132.5	138.2	91.2	42.6	404.5
2009	103.4	130.9	98.3	30.2	362.8
2010	117.4	135.2	124.7	34.4	411.7
2011	132.1	126.8	137.4	37.6	433.8
2012	136.2	149.3	137.0	43.4	465.9
2013	166.0	160.8	139.2	56.4	522.4
2014	169.5	172.3	126.5	52.2	520.5
2015	162.6	166.9	157.8	31.7	519.0
2016	181.0	193.3	141.3	23.4	539.0
2017	211.2	296.3	162.3	28.8	698.6
2018	246.2	406.5	155.7	36.4	844.7
2019	271.9	462.0	265.5	47.2	1,046.6
2020	304.2	409.0	288.7	41.9	1,043.9
2021	429.0	439.8	287.1	58.7	1,214.5
			BALANCE		
2007	-96.3	-55.2	-8.7	-6.0	-166.2
2008	-113.8	-42.0	6.3	-9.8	-159.4
2009	-56.4	-30.1	-0.6	8.4	-78.7

Year	Charges for the use of intellectual property	Computer services	Architectural, engineering and other technical services	Research and development	TOTAL
			BALANCE		
2010	-88.3	-8.4	-38.5	8.7	-126.5
2011	-90.7	44.1	-50.7	9.6	-87.7
2012	-108.7	72.0	-33.1	4.9	-64.9
2013	-132.7	135.0	-13.6	-0.8	-12.1
2014	-138.3	172.1	12.6	7.9	54.3
2015	-121.8	287.8	22.6	35.1	223.7
2016	-142.6	396.5	35.4	45.4	334.6
2017	-167.0	463.4	22.0	46.6	365.1
2018	-197.2	609.6	41.2	59.7	513.3
2019	-223.5	807.5	-45.1	64.4	603.3
2020	-224.8	916.7	-93.2	78.9	677.6
2021	-310.2	1,287.3	-45.8	94.1	1,025.5

Source: NBS, authors' calculation.

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Abbreviations

GDP – Gross Domestic Product

TBP – technology balance of payments

GERD – gross domestic expenditure on research and development

OECD – Organisation for Economic Co-operation and Development

NBS – National Bank of Serbia

SORS – Statistical Office of the Republic of Serbia

TBP Manual – methodological manual for compilation of technology balance of payments, published in 1990 as the Proposed Standard Method of Compiling and Interpreting Technology Balance of Payments Data: TBP Manual

BPM6 – methodological manual for compilation of balance of payments and international investment position statistics, published in 2009 as the Balance of Payments and International Investment Position Manual, Sixth Edition (BPM6)

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