

Analysis of Peculiarities of Belgium Participation in International Trade in Technology

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Abstract

Objectives: The purpose of the research is to identify the peculiarities of Belgium participation in international trade in technology. **Methods/Statistical Analysis:** The following scientific methods have been used in the study: analysis of statistical data on peculiarities of Belgium participation in the international economic relations as a whole and in the international trade in technology in particular; correlation and regression analysis to define the impact of the rate of growth of overall price level and amount of domestic RandD expenditures in Belgium on the amount of technology import payments and export receipts for 2009-2014. **Findings:** The regression analysis testified the significant connection between growth rate and amount of RandD expenditures in the territory of Belgium, on one hand, and amount of receipts and payments within the framework of technological balance of payments of Belgium, on the other hand. The authors of the article have identified the peculiarities of economic development and participation in international economic relations of the major regions in Belgium: Flanders and Wallonia. The authors also revealed the influence of such indicators as inflation and amount of domestic RandD expenditures on figures in technological balance of payments of Belgium. **Improvements:** Results obtained in this article may be used by the international economic relations practitioners, public authorities developing key trends of the state participation in international economic relations, and international technological exchange in particular.

Keywords: Participation of Belgium in International Economic Relations, Participation of Belgium in International Technological Exchange

1. Introduction

International trade in technology refers to the most prospective forms of contemporary international economic relations development.

In recent years, scientific researches on investigating the concept of information and technology, their peculiarities as economic good and their role in stimulating the economic growth of a country are widespread all over the world.

Data of Organization for Economic Cooperation and Development (OECD), World Trade Organization (WTO), UN Conference on Trade and Development (UNCTAD), UN Commission on International Trade Law (UNCITRAL), International Monetary Fund (IMF) is of great importance for analyzing various aspects of the international trade in technology.

The following sources have been also used for this article: Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of WTO,¹ documents of World Intellectual Property Organization (WIPO),²⁻³ documents of UNCTAD,⁴⁻⁵ "World Integrated Trade Solution" (WITS) the World Bank database, databases on global patents of European Patent Office, OECD database on technological balance of payments.

Moreover, works by a series of Russian authors are devoted to the challenges of the international trade in technology. The main sources for the purpose of this research have been the works by,⁶⁻¹⁰

Works by foreign authors have also been under consideration within the research.¹¹⁻¹⁵

In the recent decades, a greater trend of absolutely new phenomena and processes dissemination in the global economy is observed, new factors of economic

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growth appear. World economy shifts to information society, the development basis of which are complication of economical, political, and social life of society, on the one side, and onrush of technology, on the other side.

The application of knowledge and information gives an impetus to scientific and technological progress, facilitating the improvement of product quality, resource saving, leading to reduction of environmental stress, and expanding human opportunities.

Therefore, the role of information consists in support of national economy viability, creation of conditions for social and economic development of countries and regions.

The article is devoted to the analysis of peculiarities of economic growth and participation in the international trade in technology of one of the pioneers in international technological exchange, Belgium.

2. Concept Headings

2.1. Concept and Role of Information and Technology as Economic Good

The definition of the concept of 'information' may vary significantly, namely depending on the sphere of application of the term.

According to authors, the most comprehensive definition is the following: "Information is a data about environment (objects, phenomena, processes, etc.) that reduces the existing degree of uncertainty, incompleteness of knowledge, alienated from its creator and having become messages (expressed in certain language as symbols, including recorded on physical media), that may be reproduced by transmission by humans in oral, written or otherwise (by means of conditional signals, technical means, computational tools, etc.)".¹⁶

However, this definition requires clarification: information shall be considered not only as means to reduce uncertainty, but means to reduce uncertainty that facilitate the fulfillment of certain goals of a subject.¹⁷ This definition, on one side, reflects the ability of information to provide one or the other benefits by reducing the uncertainty as regards to the current situation and its changes in future. On the other hand, the fact that information may reduce uncertainty, but be valuable for economic agent in view of the absence of needs that could be satisfied by such information, has been also

taken into account. Thus, this definition of information as means to reduce uncertainty includes such features as ability of information to ensure the achievement of goals or fulfillment of needs of a subject.

It should be noted that concept of 'information' and 'knowledge' are not totally equal, they need to be differentiated. Knowledge is processed information, which reflects the connection between concepts, identified consistency.

As opposed to information, which reduces the uncertainty of specific actions, knowledge expands common perception of the environment by humans.

If information exists apart from its creator, being knowledge alienated from its creator, such knowledge is "a reflection of reality in human thinking".¹⁶

Both information and knowledge are types of economic goods, while it should be pointed that information may have present disutility and, being the case, refer to bads.

When discussing the issue of referring information to private or public goods, to resolve this issue, two distinguishing features of public goods shall be considered.

Firstly, according to Joseph Stiglitz,¹³ "each new individual that uses public goods does not have to pay for them". It is connected to the fact that marginal costs of public good consumption by additional individuals equal to zero. Joseph Stiglitz emphasizes that it is undesirable to exclude anybody from the use of public good, whereas "consumption by one individual does not reduce the aggregate consumption available to others"¹³ (or, in other words, "increase in the number of good consumers does not lead to reduction of utility provided to each consumer").¹⁸ Therefore, public goods feature such property as undesirability of their use limitation (undesirability of proportioning).¹³

Secondly, exclusion of individuals from the number of consumers of a certain public good "turns out to be complicated or impossible".¹³ Accordingly, the feature of public goods is the impossibility of their consumers being limited. Said otherwise: such feature of public goods becomes evident in the fact that "nature of a good does not allow the prevention of its use by individual, who does not satisfy the requirements being imposed or might have been imposed by the supplier (e.g. individual who violates the agreement provisions or does not enter into it at all)".¹⁸

Depending on the degree, in which various public goods possess such properties like undesirability of exclusion and impossibility of exclusion, it is common

practice to divide them into pure public goods and impure public goods.

Thus, there are goods that possess one or the other property to the different extent. For pure public good, “costs for their exclusion from use are unacceptable, and marginal costs per each additional individual using the good equal to zero”¹³

In general, it may be stated that impure public goods hold intermediate position between pure public goods and pure private goods (for pure private good, costs of its exclusion from use are low, but marginal costs per each additional individual using such good are high).

As to information, it may be referred rather to impure public goods: “in many regards information is a public good. Regardless of the relevance of knowledge, for example, on the balance of payments, as to the actions of various market players, the use of such information leads to zero marginal costs”¹⁹ It should be stated that sometimes information may be characterized not only by the said feature, undesirability of exclusion, but also by impossibility of exclusion. For instance, Stiglitz points that knowledge obtained as a result of scientific research pertains such feature as undesirability of exclusion, but in some cases knowledge may possess the second peculiarity of pure public goods, the impossibility of exclusion: “It should be noted that in those spheres where the product of obtained investigations may be patented, RandD refer only to one of the two features of public goods (whereas patent guarantee the exclusion of others from the use of RandD results). In those spheres, where the product of investigation can not be protected as confidential or by patent, and others may easily imitate the discovery, RandD fulfills both the main features of pure public good”¹³

Being the economic good, information is treated in economics as:

- good (information products, services);
- economic resource.
- Information product or information service is “a specific service when certain information content, as a data set, compiled by the producer for dissemination in material and non-material form, is provided for use to the consumer. Information product embodies the producer’s idea (information model) on specific subject area for which it has been created. Information product is recorded on physical medium”¹⁶ Information services are used to provide the opportunity of receiving and making information

products available to the user (to illustrate the difference between information product and service, consider the following example: if video tape is information product, then television broadcasting is information service).

Information goods and services differ in a series of peculiarities at the stages of development, production and circulation. Materials required for production of information goods and services are as follows: information and previously created knowledge. The main mean of production in the process of information goods creation is the intelligence, which provides for the human ability to create new knowledge. Respectively, the process of information production features special subjectivity which is expressed, among other things, in the absence of strict dependence between costs and results of new information and knowledge production. The unique product created as a result of intellectual activity brings profits to its creator in the process of distribution (dissemination of physical media with created information) or embodiment in technologies, production means, goods.¹⁷

Information goods and services being exchanged in the information market include: software, databases, educational services, consulting, RandD results, etc.

- When considering information as economic resource, it should be noted, first of all, that significant part of information the mankind possesses is public and may not be considered as limited resource.

The important feature of information as economic good is the combination of prevalence and rarity: on one hand, information is easily distributed and self-expanding in the process of consumption; on the other hand, information is a rare resource because of the uniqueness of the process of its production and use, where human is a main subject.

When talking about the use of information as economic resource, the information resource (along with the organizational one) may significantly increase the efficiency of economic system without any noticeable increase in labor, land, and capital consumption.

As mentioned above, the role of information lies in reduction of uncertainty and prevention of losses, which

explains the importance of information support in any decision-making.

The availability of information is the main determinant of economic and political markets functioning efficiency: “In modern economic and social life the availability of information is the determining factor for increasing the quality of decisions made by citizens and consumers”²⁰

Enterprises, consumers, and government agencies require information.

As to the companies, they (apart from the data on their own state of business) collect information both on other companies – potential and actual competitors or partners, and on consumers, their opinions and preferences, as well as measures and plans of governmental agencies in economic, political and social domains.

In general, it may be stated that almost all processes occurring within a company are anyway related to the search of information and its dissemination.

Take the information content of three stages, into which A. Movsesian⁷ divided the process of production.

The process of production consists of the following basic stages:

- 1. RandD (research and development), preproduction and trial run;
- production process itself;
- realization of goods.

This research shall be devoted to the trade in technologies that are created and implemented at the first of the mentioned above stages of the production process.

The first stage of reproduction is related to the development of new goods/services.

At this stage, companies are in need of information required for RandD purposes and marketing researches (moreover, today RandD, marketing research and accompanying activity are considered to be the most valuable stage of the reproduction process).

Information products (as inventions, know-how, methods, designs, etc.) that replenish intangible assets of the company owners, upon appropriate licensing, and have their own information market outlets, are created exactly at the RandD stage.

Finally, it should be noted that transfer of technology at the global market is possible both in intangible (patents, know-how, for instance) and tangible form (for example, high technology products).

The peculiarities of the global technology market shall be discussed by the authors below.

2.2. Trends in the Global Technology Market

Global technology market experiences dynamic development for the recent decades. If gross expenditures on Research and Development, GERD, in all countries of the world in 2014 constituted USD 1.803 trillion, experts estimate this value for 2015 as USD 1.883 trillion, and forecast for 2016 is USD 1.948 trillion.

The top ten countries in the world as to gross domestic expenditures on RandD (GERD) are listed in Table 1.

Table 1. Forecast of gross expenditures on research and development (GERD)

No.	Country	GERD in 2014, bln USD	GERD in 2015 (estimated), bln USD	GERD in 2016 (estimated), bln USD
1	USA	485	497	514
2	China	344	373	396
3	Japan	163	165	167
4	Germany	103	107	109
5	South Korea	64	75	77
6	India	62	66	71
7	France	58	59	60
8	Russia	54	51	51
9	Great Britain	44	45	46
10	Brazil	37	37	37

Source: Compiled by the authors on the basis of the source²¹

To characterize the export and import of technologies at the global market, the concept of technology balance of payments (TBP) and data on countries with the highest TBP balances shall be discussed.

Technology balance of payments is a document that reflects receipts and payments of a country related to the international technological exchange. Moreover, intangible form of technological exchange is meant here: licenses, patents, know-how, scientific research results, and technical support. It is important to note that, unlike GERD expenditures, when speaking of TBP we mean payments and receipts for off-the-shelf technologies.

Overwhelming majority of such agreements are executed within the framework of operations between mother and affiliated companies. Therefore, we may suggest that significant number of operations reflected

in TBP is executed inside of specific TNC as a part of corporate transfer of technologies.

Starting from 1990s, global scope of technological exchange increased significantly both in intangible and in tangible forms.

The authors provide data on TBP receipts for 34 out of 35 OECD member countries in Table 2 (TBP data for Latvia is absent because this country joined OECD in summer 2016).

Table 2. Technology balance of payments in 2014: receipts, mln USD

Country	TBP receipts, mln USD
Australia	4,767.6
Austria	13,178.4
Belgium	19,055.9
Canada	-
Chile	-
Czech Republic	4,022.7
Denmark	8,288
Estonia	489.6
Finland	11,542.2
France	-
Germany	71,436.7
Greece	1,017.1
Hungary	5,014.8
Iceland	443.4
Ireland	72,508.7
Israel	15,227.8
Italy	13,896.2
Japan	34,549.4
South Korea	-
Luxembourg	4,578
Mexico	-
Netherlands	62,101
New Zealand	-
Norway	-
Poland	6,020.8
Portugal	1,997.3
Slovakia	-
Slovenia	-
Spain	19,187.6
Sweden	27,237.2
Switzerland	31,358.2
Turkey	-
Great Britain	45,607.5
USA	136,271

Source: Compiled by the authors on the basis of OECD, Technology Balance of Payments database²²

Table 3 represents data on TBP payments of 34 out of 35 OECD member countries.

Table 3. Technology balance of payments in 2014: payments, mln USD

Country	TBP payments, mln USD
Australia	9,212.5
Austria	8,040
Belgium	18,257.2
Canada	-
Chile	-
Czech Republic	3,239.6
Denmark	6,503.7
Estonia	362
Finland	6,527.6
France	-
Germany	54,364.2
Greece	1,144.6
Hungary	4,896.9
Iceland	294.8
Ireland	74,112.7
Israel	2,761.3
Italy	14,861.9
Japan	4,842.6
South Korea	-
Luxembourg	6,121.4
Mexico	-
Netherlands	34,718.6
New Zealand	-
Norway	-
Poland	5,709.5
Portugal	1,913.3
Slovakia	-
Slovenia	-
Spain	10,729.6
Sweden	16,667
Switzerland	34,676.9
Turkey	-
Great Britain	19,377
USA	89,415

Source: Composed by the authors on the basis of: OECD, Technology Balance of Payments database²²

Table 4 represents data on TBP balance of 34 out of 35 OECD member countries.

We may observe that out of 34 OECD member countries, for which data is available for 2014, there is no information yet for 10 countries. For the remaining 24 countries, six countries have negative TBP balance and 18 countries have positive TBP balance for 2014.

The largest net exporters of technologies according to TBP in 2014 are the following countries: the USA < Japan, the Netherlands, Great Britain, Germany, Israel, Sweden, Spain, Austria, and Finland.

Table 4. Technology balance of payments balance in 2014, mln USD

Country	TBP balance, mln USD
Australia	-4,444.9
Austria	5,138.4
Belgium	798.7
Canada	-
Chile	-
Czech Republic	783.1
Denmark	1,784.3
Estonia	127.6
Finland	5,014.6
France	-
Germany	17,072.5
Greece	-127.5
Hungary	117.9
Iceland	148.6
Ireland	-1,604
Israel	12,466.5
Italy	-965.7
Japan	29,706.8
South Korea	-
Luxembourg	-1,543.4
Mexico	-
Netherlands	27,382.4
New Zealand	-
Norway	-
Poland	311.3
Portugal	84
Slovakia	-
Slovenia	-
Spain	8,458
Sweden	10,570.2
Switzerland	-3,318.7
Turkey	-
Great Britain	26,230.5
USA	46,856

Source: Calculated by the authors on the basis of: OECD, Technology Balance of Payments database²²

In addition, the scope of international trade in technology continuously grows. By comparison, in 1997 TBP balance of the ten countries listed above (largest net exporters of technologies in 2014) constituted respectively:

- 24,265 mln USD – in the USA;
- 3,250.4 mln USD – in Japan;
- 69.3 mln USD – in the Netherlands;

- -689.1 mln USD – in Great Britain;
- -2,050.9 mln USD – in Germany;
- no data available for Israel (it was not a member to OECD in 1997);
- 407.2 mln USD – in Sweden;
- -912.1 mln USD – in Spain;
- -502.0 mln USD – in Austria;
- -398.9 mln USD – in Finland.

Insufficient informativity of such indicator as TBP balance for the purpose of determining the scope of country participation in international trade in technology should be stressed.

To justify such thesis, comparative analysis of TBP balance and its elements for 1997²⁶ and 2014 has been performed by the authors of research.

Thus, for example, for the period of 1997 to 2014, Belgium increased the volume of TBP payments in five times: 3,447.7 mln USD in 1997 to 18,257.2 mln USD in 2014.

The amount of receipts in TBP in Belgium for the period considered increased in 4 times: 4,350.3 mln USD in 1997 to 19,055.9 mln USD in 2014.

As to the TBP balance itself of this country, it slightly decreased for the given period: 902.6 mln in USD 1997 to 798.7 mln USD in 2014.

Therefore, we may suggest a conclusion that when characterizing the participation of the country in international trade in technology TBP balance analysis shall be complemented by the analysis of such indicators as TBP receipts and payments.

Prior to identifying the peculiarities of Belgium participation in international trade in technology, authors have discussed the peculiarities of economic development of the country under consideration.

2.3. Peculiarities of Economic Development and Participation of Belgium in International Economic Relations

Gross domestic product of Belgium demonstrates the continuous development within the decades.

For instance, GDP of the country for the period 2009-2014 is shown in Table 5.

Low rate of inflation in the country for the period under consideration has been observed (Table 6).

Table 5. GDP of Belgium in 2009-2014

GDP Total, million US dollars	2009	2010	2011	2012	2013	2014
	406,266	427,737	451,397	466,615	481,501	487,539

Source: Main Science and Technology Indicators²⁴**Table 6.** Inflation rate in Belgium in 2009-2014

Inflation (CPI) Total, Annual growth rate (%)	2009	2010	2011	2012	2013	2014
	-0.05	2.19	3.53	2.84	1.11	0.34

Source: Composed by the authors on the basis of Inflation (CPI) Total, Annual growth rate (%), 2011 – 2015²⁵

At the same time, the availability of peculiarities in participation in the international division of labor of the main regions in Belgium should be stressed. As an example, we consider discuss two of the three regions of Belgium: Flanders and Wallonia. History of development and basic trends of participation in international economic relations of these two regions are different.

In the course of its historical events, Belgium was influenced by various European states. As a result, in 1830 a contradictory state formation, comprising three territorial communities, was established. Flanders on the north, populated by the Flemish, and Wallonia on the south, populated by the Walloons, and the capital of Brussels, consisting of both of almost equal shares and situated in the territory of Flanders.

It has been 200 years so far when dichotomy of the north and the south as the Flemish and the Walloons tears apart this country, and today it gives rise to suggestion of possible dissipation of the state. One of the tasks of this research is to identify the peculiarities of participation of Belgium regions in international economic relations under conditions of their differences in social and economic development.

For years, Flemish region has been an agricultural annex to Wallonia, where Industrial Revolution, originating in England, evolved in the 19th century. South regions were engaged in coal production, steel making, railways construction. However, after the World War II, Flanders rapidly outrun its neighbor. There are some reasons for such rapid development, namely: The importance of coal production and heavy industries decreased after the war. Countrywide transition to hydrocarbon fuel and then to gas at thermal power plants, and 1970s energy crisis made Belgium to shift to the coal import.²⁶

According to Michelle Cevit, Belgian politologist, the second reason lies in various interstate unions, such as NATO and EU, being seated in Brussels.²⁷

The third reason, as specialists distinguish, is also a baby boom in the north: today, the share of Flemish population is 58 % of the ethnic groups versus 31 % of the Walloons.

The fourth reason consists in the sea lanes available in the territory of the Flanders, for example, the port of Antwerp is in largest twenty ports in the world, and Gent and Zeebrugge are in ten largest commercial ports of the Europe.²⁸

Business sector analysis testifies to such figures. According to the research by Graydon, out of 77 thousand enterprises operating in 2015, 61 % run their business in Flanders and 27 % in Wallonia.²⁹

Now, the structure of Flanders export shall be discussed. Chemical industry takes the share of 25 %, but shall we add the related industry of plastics and resin products manufacture, chemical industry takes one third of the exported products.³⁰ Simultaneously, the overwhelming majority of large national and foreign companies have their headquarters on the north of the country. For instance, according to the research by the largest oil and chemical agency ICIS, 12 of 15 of the largest transnational corporations in the world in this sphere have their representative offices in Belgium.³¹ If we track the geography of each of them, it turns out that absolutely all affiliates are located in Flanders and only two companies (BASF and Linde Group) also have their affiliates in Wallonia. Similar situation may be observed at the market of mineral products manufacturers. Five of eight largest companies have their seats in Flanders, in Brussels and two companies in Wallonia.²⁹

Moreover, Eurostat specialist estimates that major part of agricultural sector products are provided by using Flemish lands. In addition, Antwerp is the global center of diamond cutting and sale. Other export items of Belgium, for which there are no clear leaders among the regions of the country, shall be also kept in mind.

The conclusion is that for five export items of the Flemish, the Walloons may respond only by conventional iron and steel industry, with Liege being the center of the industry. Brussels itself may boast of car assembly plants of VOLVO, SKODA, TRUCO and other world-famous corporations.

The same dominance of Flanders may be demonstrated in international service exchange: e.g. as per data of Belgium Central Bank, net export of services by Flanders constituted 4 million Euros in 2012 as opposed to 1.5 million by Wallonia.

As to the participation of the country in international flows of capital, the prevalence of TNC in the north of Belgium testifies to different investment opportunities of both regions.

What possible measures may be taken by Wallonia? The authorities of the region, as authors state, act wisely and do not strive to overrun their industrially developed northern neighbors in their dominating fields. Instead they focused on pioneering industries of the economy. Thus, within the framework of multiple programs, such as “Creative Wallonia” and “Green Marshall Plan – 2”, the region endeavors to attract capital to such perspective industries as aviation, space, microelectronics, biotechnologies and other.³² The results are obvious, since Belgium now owns about 15 per cent of global market in biotechnologies,³⁰ and most of TNC in this field, like JohnsonandJohnson and GlaxoSmithKline, are seated in Wallonia. David Valentine, one of the managers of “Creative Wallonia”, points out on good results achieved by the region within short period of time, and specialists state that this program has attracted about 3 million Euros for modernization of the economy.³³ Moreover, it involves the international investing, whereas “Green Marshall Plan – 2” has been initially agreed with the Netherlands and intended exactly to attract the Dutch capital. Wallonia also may count on receipts of money from the EU budget within the framework of program aimed at allocation of receipts and expenditures of the common budget of the EU. According to K.A.Zimarin,³⁴ the amount of such receipts for the period of 2007 to 2013 equals 39 billion Euro in total for Belgium.

On the basis of all mentioned above, we may state that differences in participation of Belgium regions in international economic relations are predetermined by social and economic reasons. We should emphasize

different structure of the economy that determines the peculiarities of participation in international economic relations of Belgium regions. While Flanders is a developed subject in terms of economy, with broad external trade and investment opportunities, Wallonia has to take part in international economic relations rather as a platform for international technological and scientific exchange. However, under conditions of changing technological mode, Wallonia may well become a locomotive of the country, counting on perspective spheres of the economy development. One way or other, the confrontation of Belgium regions, including economical one, is far from being over.

As a conclusion to this issue, it should be noted that the response of different regions of Belgium to the issue of cooperation of the EU with the USA and Canada turns out to be different as well. As of October 25, 2016, two of three regions of Belgium were against the agreement on trade and economic cooperation between the EU and Canada (CETA). Wallonia was the first region to speak against the agreement. Considering the peculiarities of this region’s participation in international economic relations, the decision of Wallonia is not unexpected.

The authors have analyzed the peculiarities of Belgium participation in international trade in technology, which is discussed below.

2.4. Participation of Belgium in International Trade in Technology

Over the decades Belgium remains to be net exporter of technologies, based on TBP. As it has been already mentioned, the amount of receipts in Belgium TBP for technology export increased in four times for the period from 1997 to 2014. At the same time, the amount of payments for technology import increased in five times for the same period. TBP balance remains positive, but reduced for the period under consideration: 902.6 mln USD in 1997 to 798.7 mln USD in 2014.

Data on changes in the amount of payments by Belgium for technology in 2009-2014 import are given in Table 7.

Then, Table 8 presents data on receipts in TBP of Belgium from export for the same period.

Data on TBP balance of Belgium for the period under consideration are discussed in Table 9.

Table 7. Technology balance of payments of Belgium in 2009-2014: payments, mln USD

Technology balance of payments: payments, million USD	2009	2010	2011	2012	2013	2014
As per current prices and exchange rates in June 2016	10,720.4	9,968.9	11,249	12,631.5	14,370.1	18,257.2

Source: OECD, Technology Balance of Payments database²²**Table 8.** Technology balance of payments of Belgium in 2009-2014: receipts, mln USD

Technology balance of payments: receipts, million USD	2009	2010	2011	2012	2013	2014
As per current prices and exchange rates in June 2016	11854.	11771.5.	12979.7.	14727.1.	17080.1.	19055.9.

Source: OECD, Technology Balance of Payments database²²**Table 9.** TBP balance of Belgium in 2009-2014, mln USD

TBP balance, million USD	2009	2010	2011	2012	2013	2014
	1,133.6	1,802.6	1,730.7	2,095.6	2,710	798.7

Source: Calculated by the authors on the basis of: OECD, Technology Balance of Payments database²²**Table 10.** Gross Domestic Expenditures on Research and Development (GERD) of Belgium in 2009-2014, mln USD

GERD at current prices and PPPs, June 2016, million USD	2009	2010	2011	2012	2013	2014
	8,065.9	8,772	9,729.1	11,023.9	11,705	12,023.3

Source: OECD, Technology Balance of Payments database²²

Then, authors give data on the amount of gross domestic expenditures on research and development in Belgium for the period under consideration (Table 10). It is suggested that this indicator affects TBP balance of the country, stimulating the production of new technologies within the territory of the country and facilitating the reduction in prices for technologies exported abroad.

3. Result

By means of the correlation and regression analysis we are to verify the assumption on the correlation of import payments and export receipts for technologies in Belgium with the amount of gross domestic expenditures of the country for RandD and inflation rate.

3.1. Peculiarities of Correlation and Regression Analysis Application

The idea of correlation and regression analysis presumes the statistical method of investigating the impact of one or more independent variables on dependent variable. Independent variables are also referred to as regressors or predictors, and dependent variables are known as criteria. This type of analysis comprises two components: correlation and regression analysis.³⁶

Correlation and regression analysis is one of the methods to resolve tasks and search for information. It allows determining the combined influence of multiple interrelated and simultaneous attributes, as well as separate impact of each attribute on the economic phenomenon (process). By using this type of analysis, the degree of connection between several attributes, between attributes and obtained result may be estimated; and simulate the regression equation that describes the form of such connection.

The aim of regression analysis is to measure the connection between dependent variable and one (paired regression analysis) or several (multiple) independent variables. Independent variables are also called factor, explanatory, determining, regressors and predictors. Dependent variable is sometimes called determining, explanatory, "response". Regression analysis is widely used in empirical studies, which may be related to this tool being convenient for assumption testing. Regression, especially multiple one, is an efficient method of modeling and forecasting.³⁷

The most essential indicators (see tables 11-18) which may affect the amount of export receipts and import payments for technologies in Belgium have been taken for analysis.

The following indicators have been considered to analyze the influence on TBP balance figures for Belgium:

- Inflation. CPI, % comparing to previous period;
- Gross domestic expenditures on RandD (GERD);
- Resulting indicator – amount of export receipts in TBP (RECEIPTS) or amount of TBP payments (PAYMENTS) of Belgium.

Regression analysis starts with the analysis of sample correlations. Correlation analysis, developed by K. Pearson and G. Yule, is one of the methods of statistical analysis of multiple attributes, random vector components, interrelation.

The main task of correlation analysis lies in the estimation of the degree of dependence between random values. By means of statistical tool EViews (version 3.1), authors have calculated the figures of correlation dependence, listed in the tables (see Tables 11-16).

Table 11. Input data

TBP receipts in Belgium	Aggregate expenditures	Inflation
Payments	Gerd	Inflation
10,720.4	1 8,065.9	-0.05
9,968.9	1 8,772	2.19
11,249	1 9,729.1	3.53
12,631.5	1 11,023.9	2.84
14,370.1	1 11,705	1.11
18,257.2	1 12,023.3	0.34

Source: calculated by authors

Table 12. Description of variables

Variable	Description
Receipts	TBP receipts, million USD
Gerd	Aggregate expenditures, million USD
Inflation	Inflation rate in per cent

Source: calculated by authors

Table 13. Analysis of sample correlations

	Receipts	Gerd	Inflation
Receipts	1.0000	0.957	-0.815

Source: calculated by authors

Table 14. Input data

Balance payments	Aggregate expenditures	Inflation
Receipts	Gerd	Inflation
11,854	1 8,065.9	-0.05
11,771.5	1 8,772	2.19
12,979.7	1 9,729.1	3.53
14,727.1	1 11,023.9	2.84
17,080.1	1 11,705	1.11
19,055.9	1 12,023.3	0.34

Source: calculated by authors

Table 15. Description of variables

Variable	Description
PAYMENTS	TBP payments, million USD
GERD	Aggregate expenditures, million USD
INFLATION	Inflation rate in per cent

Source: calculated by authors

Table 16. Analysis of sample correlations

	Payments	Gerd	Inflation
Payments	1.0000	0.862	-0.417

Source: calculated by authors

- Analysis of Inflation Rate and GERD Influence on Amount of TBP Receipts in Belgium in 2009-2014
- Analysis of Inflation rate and GERD Impact on TBP Payments Amount in Belgium in 2009-2014

4. Discussion

1) Analysis of Inflation Rate and Aggregate Domestic RandD Expenditures Impact on TBP Receipts Amount in Belgium in 2009-2014

As a result of calculations performed, we may conclude that GERD and INFLATION variables have the greatest impact on the amount of export receipts in TBP of Belgium, whereas respective absolute correlations with GDP variable exceed 0.5 (Table 17). With increasing expenditures or reducing inflation, the receipts increase (direct dependence).

Table 17. Exponential model of regression

Dependent Variable: LOG(RECEIPTS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GERD	1.476002	0.122775	12.02205	0.0068
INFLATION	-1,243.11	177.982	-6.98447	0.0199
C	-71.8081	1,365.478	-0.05259	0.9628
R-squared	0.996705	Mean dependent var	15122.86	
Adjusted R-squared	0.99341	S.D. dependent var	2,969.889	
S.E. of regression	241.0923	Akaike info criterion	14.09195	
Sum squared resid	116,251	Schwarz criterion	13.85761	
Log likelihood	-32.2299	F-statistic	302.4895	
Durbin-Watson stat	3.211402	Prob(F-statistic)	0.003295	

Source: calculated by authors

Table 18. Exponential model of regression

Dependent Variable: LOG(PAYMENTS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GERD	1.214856	0.20595	5.898799	0.0097
INFLATION	-0.06487	0.023467	-2.76425	0.0699
C	-1.65415	1.89869	-0.87121	0.4478
R-squared	0.932685	Mean dependent var	9.440722	
Adjusted R-squared	0.887808	S.D. dependent var	0.223	
S.E. of regression	0.074694	Akaike info criterion	-2.04398	
Sum squared resid	0.016738	Schwarz criterion	-2.1481	
Log likelihood	9.131936	F-statistic	20.78323	
Durbin-Watson stat	2.499008	Prob(F-statistic)	0.017465	

Source: calculated by authors

Whereas P-value of variable held constant is less than set significance value 0.05, parameters are significant (with possible 5 % error).

With adjusted coefficient of determination (Adjusted R-squared) exceeding 0.7, the model is favorable for the available data description.

Since the probability of missing the critical range, F significance, is less than set significance value of 0.05, the basic assumption has been rejected in favor of alternative one; therefore, the model is significant (with possible 5 % error).

$$\text{LN(RECEIPTS)}=1.47\text{GERD}-1,243.1\text{INFLATION}-71.8$$

$$\text{RECEIPTS}=e^{1.47\text{GERD}-1,243.1\text{INFLATION}-71.8}$$

2) Analysis of Inflation Rate and Gross Domestic RandD Expenditures Impact on TBP Payments Amount in Belgium in 2009-2014

GERD variable has a strongest impact on the level of import payments in TBP of Belgium, whereas absolute correlation with GDP variable exceeds 0.5.

With this variable being increased, payments rise (direct dependence). INFLATION variable has less significant impact on the level of payments, whereas absolute correlation with PAYMENTS variable is significantly less than 0.5 (Table 18).

Whereas P-value of variable held constant is less than set significance value 0.05, parameters are significant (with possible 5 % error).

With adjusted coefficient of determination (Adjusted R-squared) exceeding 0.7, the model is favorable for the available data description.

Since the probability of missing the critical range, F significance, is less than set significance value of 0.05, the basic assumption has been rejected in favor of alternative one; therefore, the model is significant (with possible 5 % error).

$$\text{LN(PAYMENTS)}=1.21\text{GERD}-0.06\text{INFLATION}-1.65$$

$$\text{PAYMENTS}=e^{1.21\text{GERD}-0.06\text{INFLATION}-1.65}$$

5. Conclusion

Thus, the following scientific methods have been used in this article with the aim of identifying the peculiarities of Belgium participation in international trade in technology: analysis of statistical data on peculiarities of Belgium participation in the international economic relations as a whole and in the international trade in technology in particular; correlation and regression analysis to estimate the impact of the inflation rate and amount of gross domestic expenditures on RandD in Belgium on the amount of payments made by Belgium for technologies import and amount of receipts of Belgium from technologies export for 2009-2014.

Authors have characterized the concept and role of information and technology as economic good; based on analysis, the basic trends of global technology market development have been identified; peculiarities of Belgium economic development and participation in international economic relations have been considered.

Factors that influence the participation of Belgium in international trade in technology have been also identified. The main factors that influence the amount of technology export receipts and import payments in Belgium in 2009-2014 include the inflation rate and amount of gross domestic expenditures on RandD.

The regression analysis has given evidence to the fact that GERD and INFLATION variables have the strongest impact on the amount of export receipts in TBP of Belgium: with RandD expenditures being increased and inflation being decreased, receipts in TBP from technology export increase as well.

At the same time, it has been proved that GERD variable has the strongest impact on the amount of import payments in TBP of Belgium. With this variable being increased, the amount of payments in TBP for technology import increase as well.

Moreover, it has been concluded that analysis of such indicator as TBP balance of the country is insufficiently informative to judge the scope of the country participation in international trade in technology. Analysis of the country participation in international technological exchange requires consideration of two TBP balance components: amount of technology export receipts and import payments.

Results obtained in this article may be used by practitioners in the sphere of international exchange

in technology, as well as public authorities regulating the participation of countries in international trade in technology.

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