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INNOVATIVENESS OF THE FOOD INDUSTRY ENTERPRISES IN THE EUROPEAN UNION IN CONDITIONS OF CHANGING ECONOMIC SITUATION

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Purpose: The main aim of the study is to assess a correlation coefficient between the level of economic growth and innovativeness of the food industry enterprises in the European Union countries.
Design/methodology/approach: The study period includes the years 2012, 2014, 2016 and 2018. The conducted studies focus on three types of variables relating to innovativeness of the food industry enterprises. The Spearman's rang correlations coefficient and its significance tests were used for the purpose of achieving the research aim.
Findings: The study results revealed significant differences in the innovation level in the European Union. It was also indicated that there is a statistically significant correlation between the value of per capita GDP and the level of expenditure on internal research and development per one enterprise in all analysed years and the expenditure on purchase of machines, equipment and software calculated per one innovative enterprise in 2014 and 2016. Additionally, it should be stated that there is no connection between the level of economic situation in the European Union countries and the number of innovative food industry enterprises.
Originality/value: The added value of the article is the answer to the question if there is a correlation between the economic development and the food industry innovativeness in the European Union countries.

Keywords: competitiveness of enterprises; innovative enterprises; innovation expenditure; correlation coefficient.

Category of the paper: Research paper.

1. Introduction

Innovation is one of the main factors increasing competitiveness of the food industry enterprises (Grunert et al., 1997; Rama, 2008). It is an essential feature of business entities necessary to conduct economic activity and compete with other entities on the global market. Their systematic generation and ability to adapt to constantly changing environmental conditions enable the entrepreneurs to remain on the market (Grosse, 2002). Therefore, it is important to constantly seek new solutions practically in all areas of functioning of enterprises, which as a consequence results in implementation of innovation.

The term of innovation has evolved considerably over the analysed years. It was introduced into the world literature by Schumpeter (1912), who considered innovation as new combinations taking place in the following cases:

- the manufacture of a new product or introduction of goods with new characteristics on the market;
- the introduction of new production methods;
- the opening of a new market;
- the obtaining new sources of raw materials;
- the implementation of new organisation and economic processes.

The Schumpeter's approach is a basis for discussion of the impact of innovation on the economy. Schumpeter created the concept of continues destruction of old structures, which are replaced by new, more effective ones. Then, the Porter's studies had a significant influence on the contemporary views on innovation processes (1998). In the literature on the subject there are narrow and broad definitions of innovation. For example, Freeman (1982) claims that innovation is the first commercial use of a new product, process or a device. Broader definitions are proposed by Kotler and Armstrong (1999), as well as Fagerberg (2005). Kotler and Armstrong emphasize that innovation refers to a good, service or an idea perceived as new, and Fagerberg proves that innovation is a new and better solution contributing to the improvement of living conditions of population. The Oslo Manual's definition is also worth mentioning (2018). It states that innovation is a new or improved product or a business process (or their combination) which significantly differs from the previous products or business processes and was introduced on a market or launched for use by enterprises.

The issue of innovation in enterprises has been frequently raised. Many authors emphasized the factors relevant to enterprises to introduce innovations, including Earle (1997), Avermaete et al. (2004), De Jong and Vermeulen (2006), Rama and von Tunzelmann (2008). Wakelin (1998) studied the connections between innovation and export activities. Bougheas (2004) focused on analyses of the importance of research and development in innovativeness of enterprises. Many authors, among others Fritsch and Lukas (2001), Tether (2002), Freel (2003),

as well as Freel (2003), concentrated on the importance of cooperation between entities in implementation of innovation.

A considerable part of these studies focused on the issues of innovation in the food industry. Rama (1996) as well as Martinez and Briz (2000) indicated that the level of innovation in this sector is usually lower than in other sectors. Earle emphasized (1997) the complexity of innovation processes in the food industry. On the other hand, Firlej et al. (2017) indicate that innovations are at different levels and in various areas of company activity. Acs and Audretsch (2005) state that the level of investment in research and development has a direct influence on an innovation process. Firlej et al. agree with this opinion and claim that innovations are strictly connected with enterprises and their implementation is a result of scientific and technical progress. It is also worth mentioning that very important factors influencing the level of innovation are uncertainty about their effectiveness, level of knowledge and enterprises ability to collect know-how (Teece, 1996; Christensen, 2008). In the literature on the subject the necessity of cooperation between many agribusiness entities to create innovative solutions in the food industry is also emphasized (Costa and Jongen, 2006). Additionally, K. Firlej (2018) proves that innovation in the market economy is a comprehensive set of tools including heterogeneous strategic tools taking part in a proper modern production of the entire range of food products and stimulating the investment activities of enterprises.

It should be noted that in the last decade there were significant changes in the food sector in a social, economic and technological aspect. In addition, Costa and Jongen (2006) reveal that the food sector is characterized by more competitive environment, which has a significant impact on the changes in food demand and the organization of a supply chain. That results in a strong drive for innovation among the enterprises belonging to the sector (Rama, and Tunzelmann, 2008; Capitanio et al., 2010).

A highly important issue regarding the innovation is also the level of a business cycle impact on an innovative activity of enterprises. The connection of these two aspects is confirmed by the studies of D'Estea et al., (2012), Archibugi, Filippetti and Frenz (2013), as well as Tomaszewski and Świadek (2017).

The undertaken innovation activities are considered as one of the main factors of the economic development. However, in spite of the significant role of the food industry in the contemporary economy, the studies regarding the innovativeness of this sector in all the European Union countries are relatively rarely undertaken. Therefore, the main aim of the study was to assess a correlation coefficient between the level of economic situation in the European Union countries and innovativeness of the food industry enterprises. The added value of the article is the answer to the question if there is a correlation between the economic development and the food industry innovativeness in the European Union countries.

2. Research methodology

The studies cover all the European Union member countries. The food industry enterprises producing food goods, beverages and tobacco are analysed. Due to the limited access to statistical data the study period includes the years 2012, 2014, 2016 and 2018.

The conducted studies focus on three types of variables referring to the innovativeness of the food industry enterprises: the number of innovative enterprises, the level of spending on internal research and development per one innovative enterprise, the level of expenditure on machines, equipment and software per one innovative enterprise. The number of innovative enterprises presents the main picture of tendencies and abilities of companies to develop and assimilate innovation. On the other hand, the variables referring to the level of expenditure on innovation reflect the ability of the economy for innovation. The eligibility of presenting the expenditure in two categories is based on the European Commission recommendation indicating that research and development expenditure is a much narrower category than spending on an innovative activity (European…, 2020). The statistical data referring to innovativeness of enterprises was derived from the Structural Business Statistics Database (Eurostat) using the results of the studies CIS-8, CIS-9, CIS-10 and CIS-11. The value of per capita GDP was adopted as a variable representing the economic situation. Its value was derived from the World Bank database.

In order to implement the research aim, the Spearman's coefficient of rank correlation and tests of its significance were used. This measure describes the power of correlation of two characteristics, when they are measurable, of a qualitative nature, can be put in order and the analysed population is small. The Spearman's coefficient of rank correlation is calculated in accordance with the following formula:

$$r = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n\cdot(n^2-1)} \quad (1)$$

where:

r – the Spearman's coefficient of rank correlation,

di –the difference between the ranks assigned to i- observation in relation to the first variable and the second variable,

n – the number of analysed objects.

When the observations of each variable in a trial are repeated, the coefficient of rank correlation is additionally corrected due to related ranks. The measure of coefficient has the values ranging from <-1, to +1>. The closer they are to unity, the stronger the relation between the analysed characteristics. The sign of coefficient informs about the direction of correlation between the analysed variables, the module of a number about its strength. The assessment of correlation strength is based on the following ranges: <0.0-0.2) – very weak correlation, <0.2-0.4) – weak correlation, <0.4-0.6) – moderate correlation, <0.6-0.8) – strong correlation,

<0.8-1.0> – very strong correlation. Due to the small number of observations during the null hypothesis testing, their exact distribution was used. The lack of correlation between the analysed variables was assumed as the null hypothesis, whereas the existence of correlation as the alternative hypothesis. In attributing ranks, the variables were put in order from the highest to the lowest values. Due to the limited access to statistical data certain observations were not included in calculations.

3. The study results

In the first stage of the study the individual variables from the years 2012, 2014, 2016 and 2018 were analysed. The detailed results of the values of per capita GDP in the European Union countries are presented in figure 1.

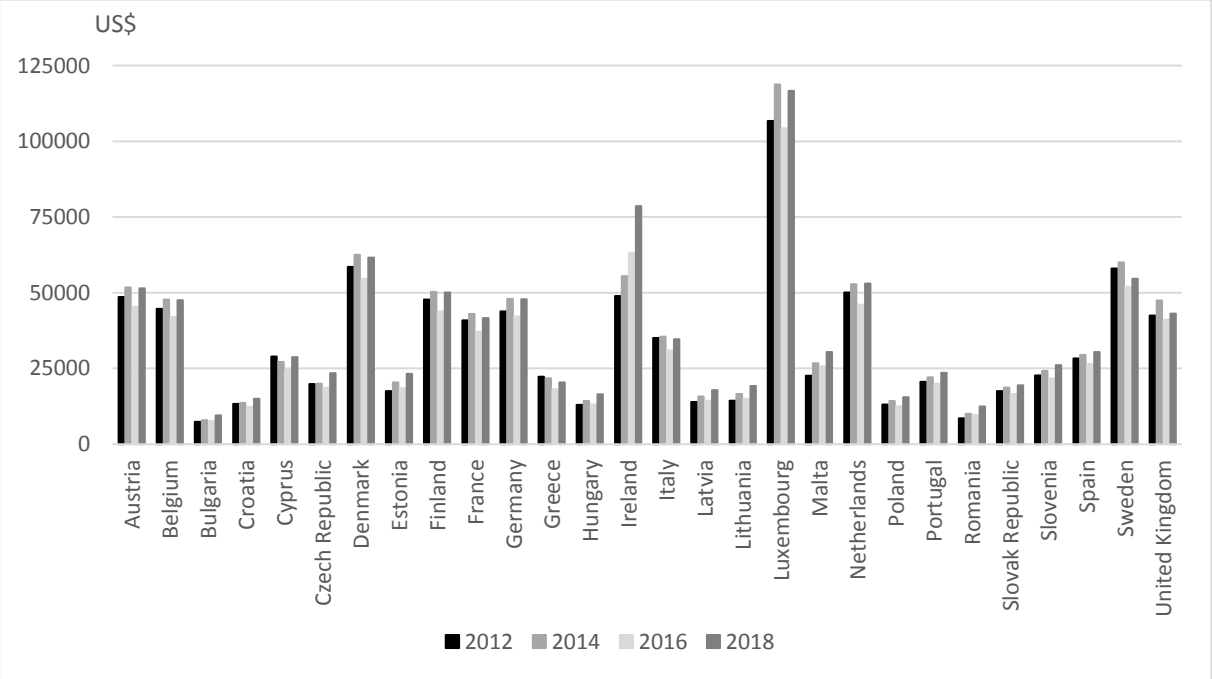

Figure 1. The value of per capita GDP in the European Union countries in the years 2012, 2014, 2016 and 2018 (US$). Source: own studies based on (World Bank, 2021).

As it is presented in figure 1, the highest value of per capita GDP in the all analysed years was observed in Luxembourg, the lowest values in Romania and Bulgaria. Taking into consideration all the European Union countries the increase is observed between 2012 and 2014 as well as 2016 and 2018 (successively from 32467.75 US$ to 34856.23 US$ and from 31305.45 US$ to 36141.69 US$). In 2012, 2014 and 2016 the values over the EU average were noticed in 12 countries, whereas in 2018 in 11 countries. Comparing the values between 2012 and 2018 the highest increase of the GDP per capita value was in Ireland, then in Romania, Malta, Lithuania and Estonia (successively by 60.72%, 45.76%, 35.11%, 33.42% and 32.14%). The decrease of the value is observed in four countries: Cyprus, Italy, Sweden and Greece.

The biggest differences in GDP per capita values in the analysed period were in Ireland, Romania and Lithuania, the smallest in Denmark, Belgium and Spain.

Considering the variables referring to innovativeness of the food industry enterprises it should be emphasized that there is a diverse number of innovative enterprises in the European Union (figure 2).

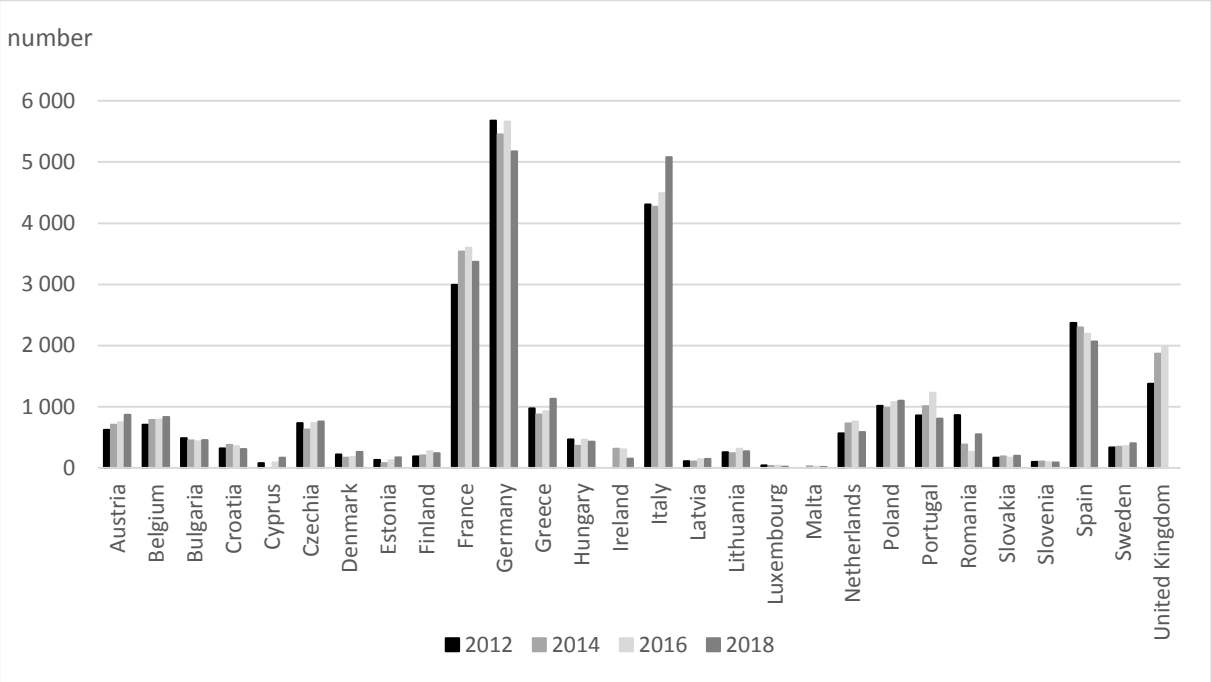

Figure 2. The number of innovative food industry enterprises in the European Union countries in the years 2012, 2014, 2016 and 2018. Source: own studies based on (Eurostat, 2021).

Analysing the individual years, it should be emphasized that the largest number of innovative enterprises in the food industry was observed in three countries – Germany, Italy and France. Relatively large numbers were also in Spain and Great Britain (except 2018). On the other hand, the lowest level of variable is observed in Luxembourg and Malta every year. The larger increase of innovative enterprises between 2012 and 2018 was in Cyprus, then Austria, Latvia and Estonia (successively the increase by 106.17%, 39.42%, 33.93% and 31.06%). The decrease was observed in eight countries: Croatia, Portugal, Bulgaria, Slovenia, Hungary, Germany, Spain and Romania.

The various quantities were also observed in the level of expenditure on internal research and development calculated per one innovative enterprise (figure 3).

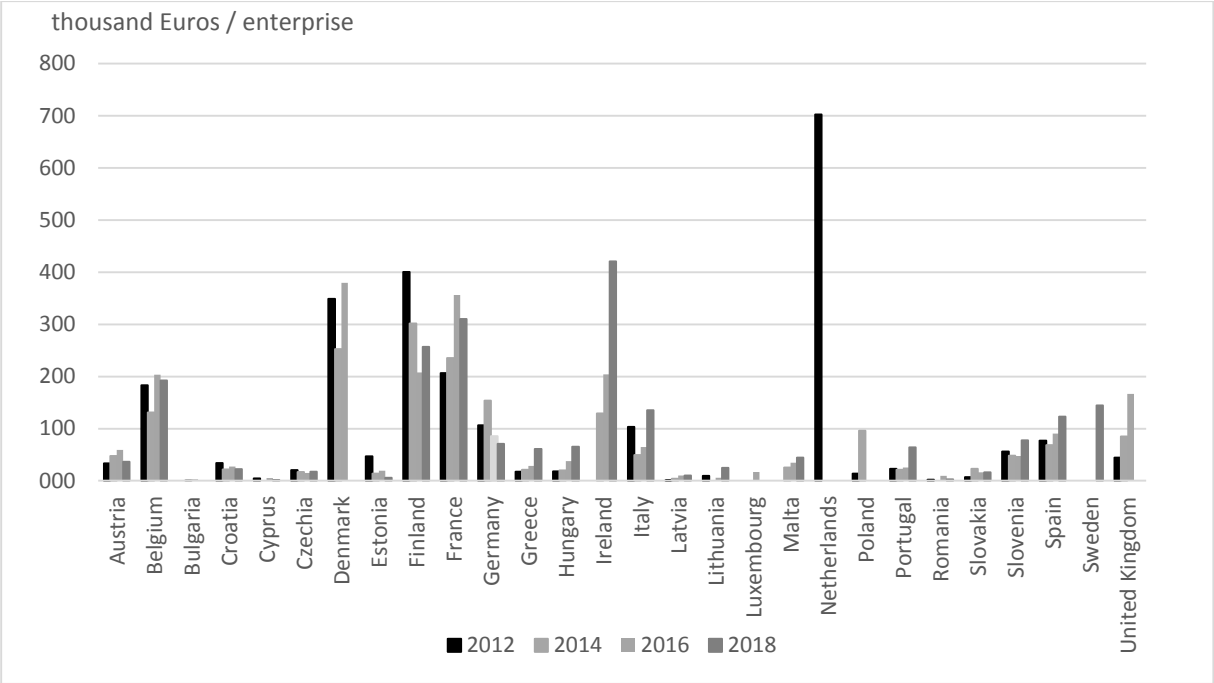

Figure 3. The value of expenditure on internal research and development calculated per one innovative enterprise in the European Union countries in the food industry in the years 2012, 2014, 2016 and 2018 (in thousand Euros/enterprise). Source: own studies based on (Eurostat, 2021).

The average value of expenditure on research and development incurred by innovative enterprises in the European Union in the food industry has had an increasing trend since 2014. The highest level of expenditure per one innovative enterprise in 2012 was observed in the Netherlands. In other years the highest values were in Denmark, France, Belgium and Ireland. At the same time, it should be emphasized that the expenditure on internal research and development per one innovative enterprise in the Netherlands in 2012 was seven times bigger than the EU average. However, there is no statistical data to analyse this issue in the Netherlands in the subsequent years. The lowest values were recorded in Latvia (in 2012), Bulgaria (in 2014 and 2016) and in Cyprus (in 2018). Analysing the dynamics between 2012 and 2018 it was observed that the highest increase of the value was in Latvia (by 1006.56%), then in Hungary, Greece, Portugal, Lithuania and Slovakia. On the other hand, the decrease of spending on internal research and development per one innovative enterprise between 2012 and 2018 was noticed in six countries, the biggest in Estonia, Cyprus and Finland.

In the next step the analysis of expenditure level on the purchase of machines, equipment and software per one innovative enterprise was performed (figure 4).

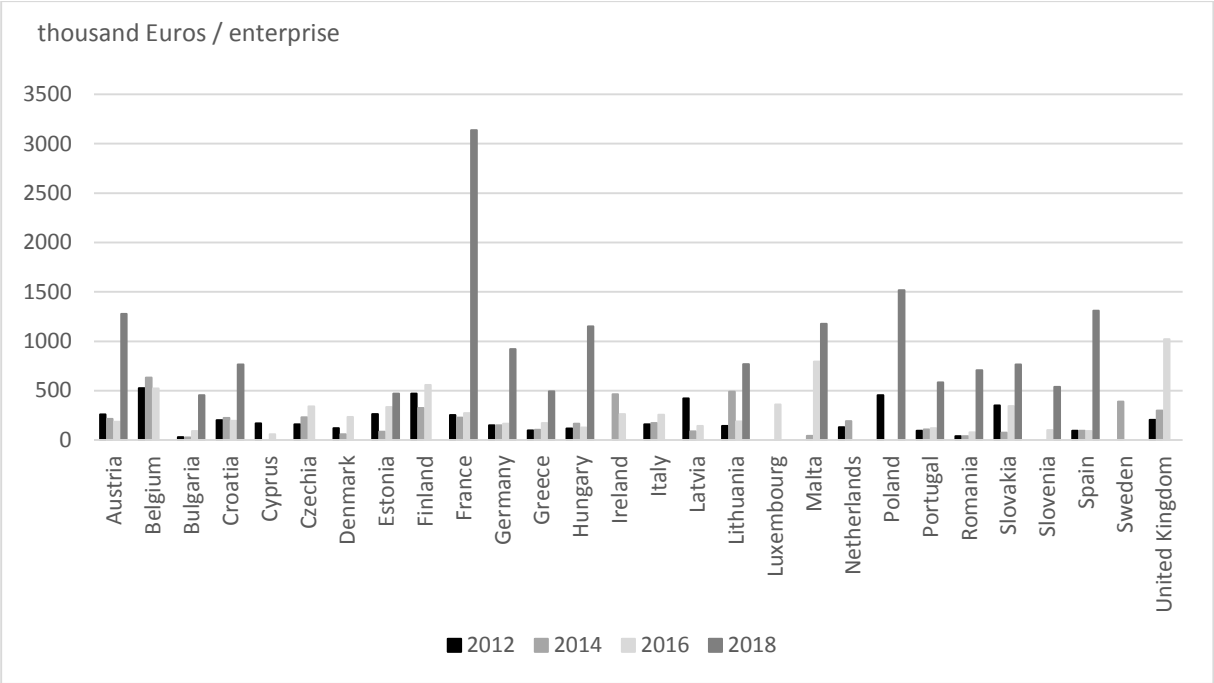

Figure 4. The expenditure on the purchase of machines, equipment and software per one innovative enterprise in the European Union countries in the food industry in the years 2012, 2014, 2016 and 2018 (in thousand Euros/enterprise). Source: own studies based on (Eurostat, 2021).

The average value of expenditure on the purchase of machines, equipment and software per one innovative enterprise in the European Union countries in the food industry has had an increasing tendency since 2014. Considering the highest level of this measure, diverse results can be observed. In the years 2012, 2014 and 2016 the highest level was in Belgium and Finland, additionally in Poland in 2012, in Lithuania and Ireland in 2014, and in Great Britain and Malta in 2016. On the other hand, in 2018 the highest level was observed in France, Poland and Spain. The lowest values of expenditure on the purchase of machines, equipment and software per one innovative enterprise were in Bulgaria (in all analysed years), in Romania and Spain (in 2012, 2014 and 2016) as well as in Portugal (in 2012 and 2016).

In the next stage of the study the correlation between the value of GDP per capita and variables referring to the innovativeness of the food industry enterprises was calculated. During the calculations the observations were ordered from the highest values (the lowest rank) to the lowest values (the highest rank). The assigned ranks are presented in table 1.

Table 1.
The ranking list of the values of per capita GDP and variables referring to the food industry innovative enterprises

	GDP per capita value				The number of innovative enterprises				The level of expenditure on internal research and development per one innovative enterprise				The level of expenditure on the purchase of machines, equipment and software per one innovative enterprise			
	2012	2014	2016	2018	2012	2014	2016	2018	2012	2014	2016	2018	2012	2014	2016	2018
Austria	6	6	6	6	12	11	11	7	13	12	10	14	7	10	15	4
Belgium	8	9	9	9	11	9	9	8	5	5	5	4	1	1	4	x
Bulgaria	28	28	28	28	14	13	14	13	x	22	25	x	23	24	22	16
Croatia	24	26	26	26	17	15	16	16	12	15	15	16	10	9	13	9
Cyprus	13	14	15	15	25	x	26	22	21	x	24	22	11	x	25	x
Czechia	19	20	18	18	10	12	12	10	15	19	20	17	13	7	7	x
Denmark	2	2	3	3	19	22	21	18	3	2	1	x	17	21	12	x
Estonia	20	19	19	19	22	25	24	21	10	20	17	20	6	19	8	15
Finland	7	7	7	7	20	20	19	19	2	1	3	3	2	5	3	x
France	11	11	11	11	3	3	3	3	4	3	2	2	8	8	9	1
Germany	9	8	8	8	1	1	1	1	6	4	8	9	14	14	17	7
Greece	17	18	20	20	7	8	8	5	17	17	14	12	19	16	16	14
Hungary	26	25	24	24	15	16	13	14	16	18	12	10	18	13	19	6
Ireland	5	4	2	2	x	18	18	23	x	6	4	1	x	3	10	x
Italy	12	12	12	12	2	2	2	2	7	10	9	6	12	12	11	x
Latvia	23	23	23	23	23	23	23	24	23	21	21	19	4	18	18	x
Lithuania	22	22	22	22	18	19	17	17	19	x	23	15	15	2	14	8
Luxembourg	1	1	1	1	26	26	27	26	x	x	18	x	x	x	5	x
Malta	16	15	14	13	x	27	28	27	x	13	13	13	x	22	2	5
Netherlands	4	5	5	5	13	10	10	11	1	x	x	x	16	11	x	x
Poland	25	24	25	25	6	7	7	6	18	7	x	x	3	x	x	2
Portugal	18	17	17	17	9	6	6	9	14	16	16	11	20	15	20	12
Romania	27	27	27	27	8	14	20	12	22	x	22	21	22	23	24	11
Slovak Republic	21	21	21	21	21	21	22	20	20	14	19	18	5	20	6	10
Slovenia	15	16	16	16	24	24	25	25	9	11	11	8	x	x	21	13
Spain	14	13	13	14	4	4	4	4	8	9	7	7	21	17	23	3
Sweden	3	3	4	4	16	17	15	15	x	x	x	5	x	4	x	x
United Kingdom	10	10	10	10	5	5	5	x	11	8	6	x	9	6	1	x

Source: own studies.

Analysing the correlation between the variables (table 2), it should be stated that the obtained results indicate different phenomena.

Table 2.
The value of the Spearman's coefficient of ranks correlation between the value of per capita GDP and variables referring to the innovativeness of the food industry enterprises

2012		2014		2016		2018	
Correlation between the value of per capita GDP and the number of innovative enterprises							
R	test	r	test	r	test	r	test
-0.022	n=26 α=0.05 r^0_d=0.329	0.008	n=27 α=0.05 r^0_d=0.323	0.061	n=28 α=0.05 r^0_d=0.317	-0.051	n=27 α=0.05 r^0_d=0.323

Cont. table 2.

Correlation between the value of per capita GDP and the level of expenditure on internal research and development per one innovative enterprise							
r	test	r	test	r	test	r	test
0.767	n=23 α=0.05 r^0_d=0.351	0.754	n=22 α=0.05 r^0_d=0.323	0.714	n=25 α=0.05 r^0_d=0.336	0.700	n=22 α=0.05 r^0_d=0.359
Correlation between the value of per capita GDP and the level of expenditure on the purchase of machines, equipment and software per one innovative enterprise							
r	test	r	test	r	test	r	test
0.236	n=23 α=0.05 r^0_d=0.351	0.418	n=24 α=0.05 r^0_d=0.343	0.452	n=25 α=0.05 r^0_d=0.336	0.415	n=16. α=0.05 r^0_d=0.425

Source: own studies.

There is no correlation between the GDP per capita value and the number of innovative enterprises in none of the analysed years. On the other hand, the value of the Spearman's coefficient of ranks correlations between the GDP per capita value and the level of expenditure on the internal research and development per one innovative enterprise in all analysed years indicates the strong correlation (r value from 0.700 to 0.767). However, the power of correlations had a decreasing tendency, which means that year by year there is a lower connection between the economic situation and the value of expenditure on the internal research and development incurred by innovative enterprises. During the testing of the null hypothesis between these variables, in all cases the null hypothesis indicating the lack of correlation between the analysed variables was rejected in favour of the alternative hypothesis indicating the existence of correlation. In the case of the analysis of a connection between the value of GDP per capita and the level of expenditure on the purchase of machines, equipment and software by the innovative enterprises a moderate correlation is observed (statistically significant) in 2014 and 2016. In other years a compliance between these variables was not observed.

The studies are in accordance with the results obtained by Galindo and Mendez (2014) who analysed the effect of a feedback between the level of innovation and the economic growth as well as Pece et al. (2015) whose results prove the positive relationship between the economic growth and innovation. The results also confirm the studies by Wolniak (2010) who claims that the high level of industry innovativeness results in the higher quality of industrial products manufactured by an organization, which fosters the increase of national wealth.

4. The final conclusions

The conducted studies analysing the correlations between the level of the economic growth of the European Union countries and the innovativeness of the food industry enterprises allow to formulate the following conclusions:

- Enterprises incurring the largest expenditure both on internal research and development as well as on the purchase of machines, equipment and software come from the following three countries: Belgium, Finland and France. Relatively high level of these categories of expenditure is observed in Ireland and Great Britain. At the same time, there was the high level of expenditure on internal research and development per one enterprise in Denmark (in years 2012, 2014 and 2016) and the high level of expenditure on the purchase of machines, equipment and software per one enterprise in Poland (in 2012 and 2018).
- Central and Eastern Europe countries (Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Romania and Slovakia) as well as Cyprus are characterized by the lowest level of expenditure on the internal research and development per one innovative enterprise. The similar situation may be observed in the case of the purchase of machines, equipment and software per one innovative enterprise. The lowest values are observed in Central and Eastern Europe (Bulgaria, Estonia, Latvia [in 2016 and 2018], Romania and Slovenia) and additionally in Greece and Portugal.
- the expenditure growth incurred on innovativeness by individual enterprises is observed in the analysed period. It may foster the increase of abilities and motivation in creating and implementing of system changes in the area of conducted business activity.
- there is a significant statistical correlation between the level of economic growth measured by the value of per capita GDP and the level of expenditure on internal research and development per one enterprise in all analysed years and expenditure on the purchase of machines, equipment and software counted per one innovative enterprise in the 2014 and 2016. It means that the innovative activities undertaken in this period are strictly connected with the economic situation of the European Union countries. However, the gradual decrease of the existing correlation between the value of per capita GDP and the level of expenditure on the internal research and development per one innovative enterprise is observed, which may indicate that this correlation is becoming less important. In addition, it should be stated that there is no connection between the level of economic growth of the European Union countries and the number of food industry innovative enterprises.

It should be taken into consideration that there is no statistical data in some of the analysed countries, which may influence, to a certain degree, the achieved results. Additionally, a number of other indicators referring to innovativeness of enterprises may be identified and taken into account in explaining the impact of economic situation on the level of innovativeness. However, gathering appropriate statistical data presenting the phenomena, which would enable the extension of the studies on the subject, may be a serious obstacle.

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