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Competitiveness and innovation of the Polish food industry

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Abstract: Agribusiness is the biggest production sector in the European Union taking into account both the value of turnover and the creation of added value as well as employment size. In this context, the food industry deserves a special distinction. In the publication, the analyses of the food industry competitiveness in Poland are presented. For analysing and assessing competitiveness of the Polish food industry, the following factors were used: the orientation of export (OE), covering of import by export (TC), the import penetration (MP) and the revealed comparative advantages according to the Balassa (RCA) and Lafay (LFI). The study also presents the findings of empirical research on an innovative character of the food industry in Poland.

Keywords: competitive edge, food industry, food products, foreign trade

The subject of competitiveness takes an important place in economic studies/sciences, in spite of different definitions and methods of measurement. The competitiveness studies/research can be conducted at different levels: enterprises and sectors, regions and national economies. Depending on the analysed context in the economic literature, there many approaches to the term 'competitiveness'. In the microeconomic analyses at the enterprises level, competitiveness is treated as an ability to face up the competition, to maintain or increase the market shares and to make profit from the conducted business activity (Frohberg and Hartmann 1997). Competitiveness is the main condition of functioning not only enterprises. A special attention in economic sciences also deserves an analysis of competitiveness at the sector and regional level (Piwowar 2012). According to Porter (2003), international competitiveness of sectors is a source of the nation's competitiveness.

An essential determinant of a competitiveness level is an innovation (Mowery and Oxley 1995). Innovations are closely connected with enterprises and their implementation is the result of progress in science and technology. In the contemporary market, the basic source of competitiveness advantages is an ability of enterprises to develop and implement new or significantly improved products and processes (Piwowar 2015). Innovations can take place at different levels and in different fields of an enterprise activity. There can be singled out the product innovations, process innovations, organizational innovations and marketing innovations (Bigliardi and Dormino 2009; Kowalska 2016). Innovations in the food industry are to a larger degree based on the newest technologies, especially being a result of progress in the bio- and nanotechnology. In the literature on the subject, the necessity of cooperation of many agribusiness entities in the creation of innovative solutions in the food industry is often underlined (Costa and Jongen 2006).

The following study presents the problems of competitiveness and innovation of the Polish food industry. In Poland, like in the other Central and Eastern European countries at the beginning of the 90s in the 20th century, there went on many processes of privatization and restructuring transformations in the food industry which changed its structure and adapted it to the market economy. A significant developmental impulse for the food industry in Poland was joining the European Union in 2004. Including Poland into the area of the common European market reveals comparative advantages compared with the

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other European Union countries, especially the EU-10 countries. In particular, the first four years of the membership in the European Union were the period of a fast turnover growth of the Polish international trade of agricultural and food products. The sector agricultural and food production is one of the few in the Polish national economy which has a positive balance in the trade exchange (Kowalska 2014).

An interesting subject matter are the changes in the competitiveness of food industry in the individual member countries in the context of extending the EU. In the literature on the subject, the studies on the above-mentioned subject range in the Central and Eastern European countries were conducted among others by Puticova and Mezera (2011), Juhász and Wagner (2013) and Širá (2015). The main aim of the following publication is an analysis and assessment of the Polish food industry competitiveness. The basic time range of the analysis included the years 2003–2014. Additionally, the study demonstrates the results of the research on an innovative character of the Polish food industry companies.

MATERIAL AND METHODS

With the aim of studying a change of the competitive position of the food industry in Poland, several factors were used: the orientation of export (OE), covering import by export (TC), the import penetration (MP), as well as the factors of the revealed comparative advantages of the Balassa (RCA) and Lafay (LFI).

The orientation of export factor (OE) shows the pro-export specialization of a given country in the specific trade, sector, group of products or a specific product and it is calculated with the following formula (Lubiński et al. 1995):

$$\mathrm{OE} = \frac{Ex}{Q} 100\ (\%)$$

where:
Ex = a given trade export
Q = sale of a given trade in total

In the study, the factor of covering import by export (TC) is also calculated (Juchniewicz and Łukiewska 2014), this factor determines the relation of the export value to the import value. Thus it allows to determine in what degree the revenues from the export of products of the given sector cover the expenses incurred for import. The TC factor is calculating with the following formula:

$$\mathrm{TC} = \frac{Ex}{Im}$$

where:
Ex = export
Im = import

The level of the factor higher than 1 means that the given sector is characterised by the export specialization. This factor also demonstrates the real satisfaction by the national producers of the effective demand for the trade products.

With the aim of checking a degree of demand for international products in the studied range subject, the factor of import penetration (MP) is counted (Sarris 2005), it determines the share of the imported products of a sector to the total demand of a given market for these products. The factor is calculated with the formula:

$$\mathrm{MP} = \frac{Im}{Q + Im - Ex}$$

where:
Q = sale of a given trade in total
Ex = export
Im = import

The assessment of competitiveness is also determined with the use of the factor of the comparative advantages RCA proposed by Balassa (1965), showing the share of the given sector in the export of a given country to the share of the same sector in the export of the other countries. The factor is calculated with the following formula:

$$RCA_j^i = \frac{Ex_j^i / Ex_j}{Ex_G^i / Ex_G}$$

where:
Ex = export
i = food industry
j = Poland
G = European Union

The value of the factor higher than 1 means that a country has a comparative advantage against the reference market.

In the study, the Lafay's factor (LFI) is also calculated, which is based on the export and import streams of a given country (the character of trade turnovers balance) with the formula (Lafay 1992):

$$LFI_j^i = \left[\frac{Ex_j^i - Im_j^i}{Ex_j^i + Im_j^i} - \frac{\sum_{j=1}^{n}(Ex_j^i - Im_j^i)}{\sum_{j=1}^{n}(Ex_j^i + Im_j^i)}\right] \times \frac{Ex_j^i + Im_j^i}{\sum_{j=1}^{n}(Ex_j^i + Im_j^i)}$$

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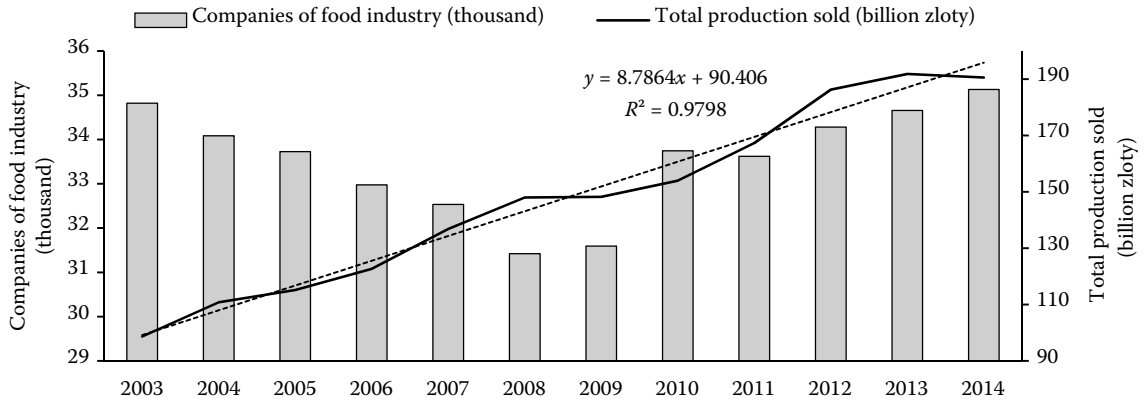

Figure 1. The number of business entities and the value of the sold production of the food industry in Poland in 2003–2014

Source: own studies on the basis of the CSO data

where:
Ex = export
Im = import
i = food industry
j = Poland

The value of LFI factor higher than 0 means that the studied country has a comparative advantage against the foreign countries in the given sector export.

RESULTS AND DISCUSSION

According to the CSO (Central Statistical Office), the business activity in the food and beverages production in Poland in 2014 was conducted by over 35.1 thousand business entities (Figure 1). Over the studied years, the number of these entities fluctuated and two periods can be distinguished:

– 2003–2008, the number of business entities functioning in the food industry shows a decreasing tendency.
– 2009–2014 – a clear increasing tendency.

The changeability of the number of business entities in the food industry in Poland in the studied period did not significantly influence the sold production in total which had an increasing tendency. The value of the sold production of the food industry in 2014 amounted to over 190 billion zloty and was nearly two times higher compared to the production in 2003. The average annual growth rate of the sold production in 2003–2014, with the very good trend line adjustment (R = 0.98), was 8.79 billion zloty and may prove its further growth in the next years.

The data analysis also showed that the Polish export of the food industry products in 2003–2014 increased

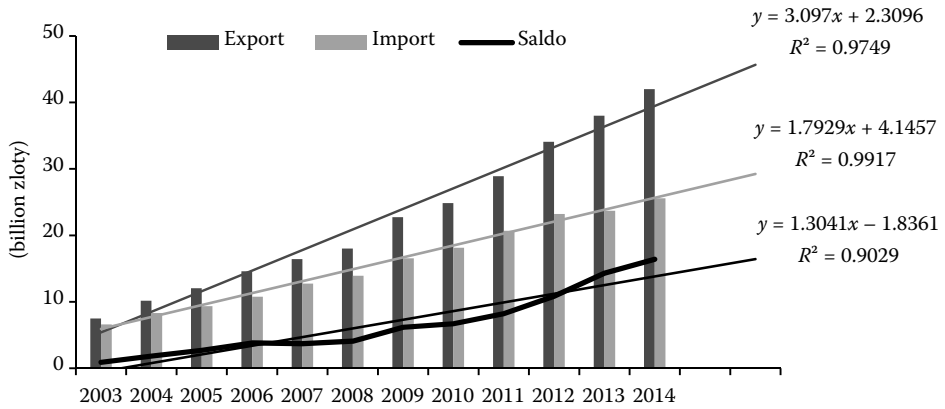

Figure 2. Polish export, import and balance of the food products turnovers in the years 2003–2014 (billion zloty)

Source: own studies on the basis of the CSO data

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systematically (Figure 2). Its value in 2014 was 42 billion zloty and was by over 5.5 times bigger compared to the export in the year 2003. An average annual growth of the food industry products value over the analysed years was about 3.1 billion zloty and a very good trend line adjustment (R = 0.97) predicts the further increase of the Polish food products on the international market.

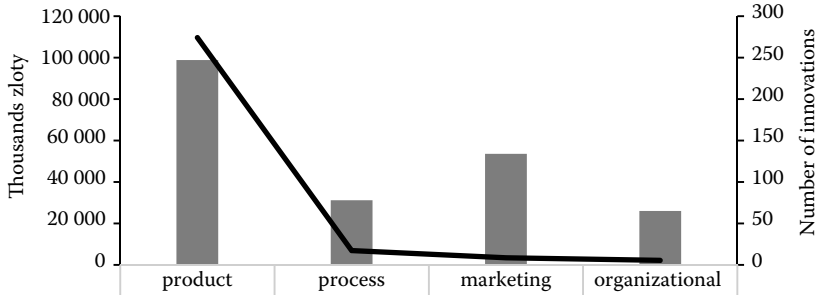
The import of food products for the Polish market is also increasing, although not in such rate like the export. In the years 2003–2014, its value increased almost four times and in 2014 it amounted to 25.6 billion zloty. The average annual growth rate in the analysed years with a very good adjustment (R = 0.99) was on the level 1.8 billion zloty. An increasing trend line, which was determined, shows that in the next years, the import of the food industry products will be still growing.

Innovative character of the Polish food industry

An innovative character of the food industry in Poland was researched with the model used by the OECD and Eurostat (the so-called Oslo Manual) acknowledging that an innovative activity accumulates scientific, technical, organizational, financial and trade activities. These innovations have a direct share in the implementation of new or significantly improved products onto the market as well as in the use of new or improved production processes (Firlej 2014a).

The studies on the innovative character of the food industry in Poland were conducted in 2012 and 2013 by Firlej and included all the food industry enterprises. Choosing the research entities, a random choice was used taking into account the companies listed on the register REGON (as of 30. 10. 2012) which according to the Polish Classification of Business Activity (PKD 2007) were included in the Section C Industry processing, Section 10 Production of food articles, Section 11 Drinks production and Section 12 production of tobacco. In the studies, a representative trial of units was determined using the probabilistic choice technique and as a research tool, a questionnaire was used. Using the formula for the minimal number of trial, it was determined that the study had to include 267 enterprises (with the population of 33 662 business entities).

Food industry enterprises have to take into account the following factors and specifics: the production seasonal character, a sell-by-date, not standard conditions of storing raw materials and products, high standards and quality norms and many others that are not in effect in other production branches (Firlej 2015). In the conducted studies, the role of knowledge and the diffusion of innovation as the main factors having influence on the company's development was researched and thus the factors and dependences of their development in the aspect of carried out innovation processes were characterized. Within the scope of the observations made, an analysis of strategies of enterprises supporting the development of innovations was performed and it was determined whether the implemented innovations had a random character and how often they were realized. The results of the conducted studies explicitly proved that in the years 2006–2011, the most important process influencing the enterprises activities was the grow-



	product innovations	process innovations	marketing innovations	organizational innovations
Number of innovations	247	78	134	65
The expenditures on innovations	109 637	6 862	3 405	2 117

Figure 3. Expenditures on innovations and their types in the researched food industry companies/enterprises in Poland in the years 2006–2011

Source: own studies

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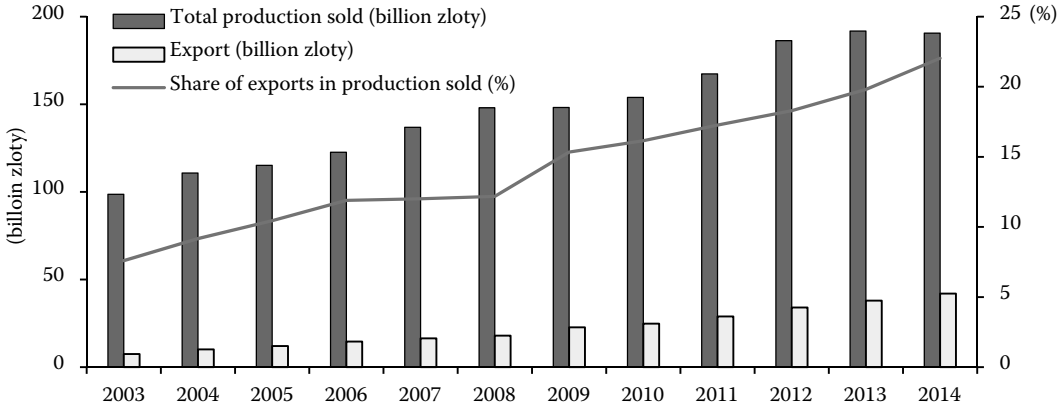

Figure 4. The total production sold and the export of food products in Poland in the years 2003–2014 (billion zloty, %)

Source: own studies on the basis of the CSO data

ing competitiveness on the market and later on the pressure on implementation of innovations and the Poland membership in the European Union. It was explicitly stated that the level of knowledge and the diffusion of innovations do not play the main role in the functioning of enterprises. The innovation processes often have an incidental character and the significant influence on them have the internal factors of the enterprise and its environment. The innovations at the enterprise level were found dominant both regarding the number and cost. It was observed that along with extending of their range, the expenditures on them were increasing. During the studies, it was stated that in the years 2006–2011, the expenditures on innovations were over 122 million zloty in the researched enterprises and the effect of spending that money was the realization of 524 enterprises directed on the implementation of innovations which the approximate amounts of expenditures 232 865 zloty per one enterprise. The expenditures on innovations and their types in the researched companies are presented in Figure 3.

The product innovations were most often used and they mainly included the purchase of new machines, the means of transport or new equipment. The marketing innovations were also realized as an introduction of a new packaging or a new way of promotion. The implemented process innovations involved most often the change of the production technology. Innovative changes in the organization were essentially connected with the changes of the work organization and implementation of new functioning procedures. Only about 53% of the researched food industry companies hired employees who dealt with work connected with the research and development and for these kinds of projects, they spent merely a little over 10 million zloty in total (Firlej 2014b).

Assessment of competitiveness of the Polish food industry export

In the years 2003–2014, a significant growth of the export share in the production sold of the food industry enterprises in Poland was noticed (Figure 4).

The analysis of the export orientation factor (OE) proved that the Polish export of food industry products in the years 2003–2014 compared to the total sale of these products was systematically increasing. During the studied period, the share of the export value to the value of the total sale increased by 14.4% and in 2014 it amounted to over 22%. Such situation means that the export specialization is increasing and thus also its competitiveness in the international market. The selected factors of international competitiveness of the food industry in Poland are presented in Table 1.

According to the analyses performed during the whole researched period, there was an export surplus over an import which means that Poland had a relative advantage over the competitors. The surplus was as follows: in 2003, the TC factor amounted to 1.26; in 2014 it was 1.54, which means that the export-import advantage of the food industry increased to 54%. The growing factor also means that the domestic food producers increasingly supply the consumers' demand for their products.

The advantage of export over the import may prove that the Polish food market is only in a relatively slight degree supplied by the imported products. The exceptions are the products (raw materials)

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Table 1. Selected factors of the international competitiveness of the Polish food industry products

Factors	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Orientation of export (OE) (%)	7.60	9.17	10.45	11.89	12.01	12.18	15.33	16.15	17.27	18.29	19.81	22.04
Covering import by export (TC)	1.26	1.32	1.42	1.45	1.33	1.24	1.34	1.32	1.33	1.45	1.52	1.54
Import penetration (MP)	0.07	0.08	0.08	0.09	0.12	0.12	0.14	0.15	0.16	0.16	0.16	0.18
Assessment of trade competitiveness according to Balassa (RCA)	1.42	1.61	1.91	1.84	1.85	1.82	1.94	1.88	1.85	2.01	2.04	1.95
Lafay (LFI)	1.47	1.49	1.78	1.81	1.68	1.59	1.74	1.70	1.71	2.12	2.16	2.23

Source: own studies on the basis of the CSO data

that, because of the climate, are not produced in the amounts supplying the internal demand. A part of food products (raw materials) imported from the other climatic zones is then re-exported as highly processed products. According to the performed analysis, the share of the imported food industry products is gradually increasing. The MP factor in 2014 amounted to 0.18, which means that the share of the imported products of this industry amounts to18% of the market supply while in 2003 it was 7%. Such situation is connected with Poland joining the European Union and a free flow of products.

The RCA factor analysis shows that the food industry in Poland during the whole analysed period had a comparative advantage in the international food products export over the European Union countries. Competitiveness of the Polish food industry is influenced by a systematic upturn in the social-economic sphere, relatively low costs of labour as well as an access to a large amount of domestic raw materials. The RCA factor had the biggest value in 2013 (over 2). Significantly higher values of the factor are observed after 2004 when Poland joined the European Union structures and as a result, there was an easier access to the EU community markets.

The value of the Lafay's factor (LFI) amounted to 1 during the whole researched period, what also proves that the Polish food industry has a comparative advantage in the export of food industry products ii the international market (especially in the last three years when the value of this factor increased to over 2). The growing value of the factor proves that the Polish food industry is increasing year by year and its products are more and more popular in the international market. The changes of the amount of this factor, especially in 2008 when it decreased significantly, were caused by the turbulences in the international market connected with the world financial crisis.

Poland gains the biggest value of turnovers of the international trade of the food industry products from the export to the European Union. The largest consumers of the Polish food products in 2014 were Germany, France, the Great Britain, the Czech Republic and the Netherlands (Table 2). Despite

Table 2. The biggest importers from Poland and exporters to Poland of the food industry products (million dollars)

	Country	2003	Country	2005	Country	2010	Country	2014	Growth dynamics 2014/2003 (%)
	Importers								
1	Germany	452.9	Germany	804.3	Germany	1 384.6	Germany	2 301.4	508.1
2	Russia	156.6	Russia	322.7	Great Britain	694.0	France	1 243.9	4 916.6
3	Czech Rep.	137.6	Hungary	276.1	France	635.5	Great Britain	1 189.7	1 476.1
4	Hungary	99.0	Czech Rep.	247.7	Czech Rep.	520.0	Czech Rep.	668.4	485.7
5	Great Britain	80.6	Great Britain	227.2	Netherlands	407.7	Netherlands	632.8	1 354.5
	Exporters								
1	Germany	312.3	Germany	562.8	Germany	1 430.6	Germany	1 932.8	618.9
2	Netherlands	200.6	Argentina	334.8	Argentina	496.8	Argentina	687.6	578.9
3	Argentina	118.8	Netherlands	282.1	Netherlands	392.4	Netherlands	454.0	226.3
4	Ivory Coast	100.8	France	140.5	France	352.8	France	408.1	290.4
5	Czech Rep.	73.2	Czech Rep.	130.8	Italy	287.5	Italy	364.7	557.7

Source: http://wits.worldbank.org/CountryProfile/en/Country/ (accessed May 2, 2016)

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the fact that Germany is a greater importer of the Polish food products (2301.4 million dollars), the biggest dynamics of the export value growth of the food industry products in the years 2003–2014 was towards France. The growth of export value to France increased in the researched period from 25.3 million to 1243.9 million dollars which means by over 4816%. Among the biggest importers of the food industry products from Poland before joining the European Union apart from Germany and the Czech Republic, there were Russia and Hungary.

In 2003, the significant exporters of food products were Germany, the Netherlands, Argentina, Ivory Coast and the Czech Republic. In 2014, Poland imported food products mainly from Germany, Argentina, the Netherlands, France and Italy. The value of the imported food products from Germany was nearly 2 billion dollars that is 3 times more than the import value from Argentina and 4 times more than from the Netherlands. The biggest dynamics of changes among the main food products exporters to Poland in the years 2003-2014 was observed in Germany with the growth of export from 312.3 million to 1932.8 million dollars, that is nearly 520%.

CONCLUSION

Since 2003, the Polish food industry has been characterized by a systematic growth and improvement of the trade results with other countries. The dynamic growth of the trade exchange after Poland joined the European Union was continued in the successive years. Even the world crisis did not significantly influence its dynamics. The share of the food products export in the total sale in the years 2003–2014 increased from 7.6% to 22%. The analyses of the selected competitiveness factors conducted in the study proved the existence of competitive advantages of the Polish food industry. They are confirmed by the high level of the factor covering export by import, increasing international trade balance of food industry products, the high and growing factor of the export orientation. Only the factor of import penetration weakens the Poland competitiveness in the researched area, however, because of the free flow of products in the European Union, it is unavoidable.

The performed analyses indicated the high growth of the Polish food industry competitiveness over the analysed years. It should be underlined that the food industry is one of the biggest beneficiaries of the Polish accession to the European Union. The integration of Poland with the European Union enabled the inflow of the direct foreign investment and the flow of technologies in the food economy area. As it is evident from the conducted analyses, the Polish food industry has a comparative advantage in the export on the international market. The competitiveness of Polish food industry is determined by the relatively lower products prices and the costs of production. One of the attributes of the functioning of the food industry enterprises in Poland is their innovative character. The original research proved that the food industry enterprises in Poland implemented both the technological and non-technological innovations. These innovations decided about the pace and directions of the enterprises development. The majority of the researched enterprises implemented various innovations, and there was a relatively small value of them. As it was previously mentioned, the high competitive position of the Polish food industry results mainly from the price advantages. In the longer perspective, in order to maintain the pace of growth, it will be necessary to intensify the expenditures on innovations in the food industry enterprises, especially those focused on the enhancement of the labour output and the quality of products.

In the international turnover of the Polish food industry products, the biggest importance have such EU countries like Germany, France, the Great Britain and the Czech Republic. One of the biggest Polish food products importers in the years 2003-2005 not being in the EU structures – Russia – is currently in decline.

REFERENCES

Balassa B. (1965): Trade liberalization and 'revealed' comparative advantage. Manchester School of Economic and Social Studies, 23: 99–123.

Bigliardi B., Dormino A.I. (2009): An empirical investigation of innovation determinants in food machinery enterprises. European Journal Innovation Management, 12: 223–242.

Costa A.I.A., Jongen W.M.F. (2006): New insights into consumer-led food product development. Trends in Food Science and Technology, 17: 457–465.

Firlej K. (2014a): Analysis of the factors increasing the competitiveness of the food industry enterprises results. In: Peer-Reviewed Proceedings of the International

doi: 10.17221/111/2016-AGRICECON

Scientific Conference Hradec Economics Days, Hradec Králové, Feb 4–5, 2014: 141–148.

Firlej K. (2014b): Transfer wiedzy i dyfuzja innowacji jako źródło konkurencyjności przedsiębiorstw przemysłu spożywczego w Polsce. Fundacja Uniwersytetu Ekonomicznego w Krakowie, Kraków.

Firlej K. (2015): Economic conditions of the functioning of the food industry companies in Poland. In: Peer-Reviewed Proceedings of the International Scientific Conference Hradec Economics Days, Hradec Králové, Feb 2–3, 2015: 121–132.

Frohberg K., Hartmann M. (1997): Comparing Measures of Competitivenes. Discussion Paper No. 2, Institute of Agricultural Development in Central and Eastern Europe, Halle. Available at http://econstor.eu/bitstream/10419/28566/1/241163463.pdf (accessed Jan 18, 2016).

Juchniewicz M., Łukiewska K. (2014): International competitiveness of the food industry in European Union member states. European Journal of Social Sciences. Education and Research, 2: 254–265.

Juhász A., Hartmut W. (2013): An analysis of Hungarian agri-food export competitiveness. Studies in Agricultural Economics, 11: 150–156.

Kowalska A. (2016): Changes in the level of innovation of enterprises in Lower Silesia. In: Peer-Reviewed Proceedings of the International Scientific Conference Hradec Economics Days, Hradec Králové, Feb 2–3, 2016: 422–431.

Kowalska A. (2014): Udział Polski w handlu międzynarodowym mlekiem i jego przetworami w latach 2003–2014. Ekonomia XXI Wieku, 3: 35–48.

Lafay G. (1992): The measurement of revealed comparative advantages. In: Dagenais M.G., Muet P.A. (eds): International Trade Modeling. Chapman & Hill, London.

Lubiński M., Michalski T., Misala J. (1995): Międzynarodowa konkurencyjność gospodarki. Pojęcie i sposób mierzenia, IRiSS, Warszawa.

Mowery D.C., Oxley J.E. (1995): Inward technology transfer and competitiveness: the role of national innovation systems. Cambridge Journal of Economics, 19: 67–93.

Piwowar A. (2012): Assessment of the social-economic development level of the chosen Lower Silesian districts. In: Peer-Reviewed Conference Proceedings of the International Conference Hradec Economics Days, Hradec Králové Jan 31–Feb 1, 2012: 153–158.

Piwowar A. (2015): Innowacje w przemyśle chemicznym w Polsce. Aspekty teoretyczne i praktyczne. Przemysł Chemiczny, 94: 12–15.

Porter M.E. (2003): The economic performance of regions. Regional Studies, 37: 549–578.

Putićová M., Mezera J. (2011): Competitiveness of the Czech food industry. Agricultural Econonomic – Czech, 57: 413–421.

Sarris A. (2005): Greek accession and EC commercial policy toward the south. In: Kol J., Mennes L.B.M. (eds): European Trade Policies and Developing Countries. Routledge, London & New York.

Širá E. (2015): Slovak food processing industry in the context of globalisation and integration tendencies. Polish Journal of Management Studies, 11: 158–167.

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