Institute of Economic Research Working Papers

No. 150/2017

Enhancing Polish firms' innovation activities in comparison to the other Moderate Innovators countries

Aleksandra Zygmunt

Article prepared and submitted for:

9th International Conference on Applied Economics Contemporary Issues in Economy, Institute of Economic Research, Polish Economic Society Branch in Toruń, Faculty of Economic Sciences and Management, Nicolaus Copernicus University, Toruń, Poland, 22-23 June 2017

Toruń, Poland 2017

© Copyright: Creative Commons Attribution 3.0 License

Aleksandra Zygmunt
a.zygmunt@po.opole.pl
Opole University of Technology, Opole, Poland

Enhancing Polish firms' innovation activities in comparison to the other Moderate Innovators countries

JEL Classification: *O30; O52; R11*

Keywords: *innovation activities; firm; the European Union; Moderate Innovators countries*

Abstract

Research background: Faced with circumstances of rapid changes, the crucial is stimulation of actions aimed at enhancing competitiveness. In this regard, the European Union strategy Europe 2020 should be mentioned. Concerning the role of firms' innovation activities in economic growth of regions and countries, it is important to explore how enhancing Polish firms' innovation activities differ between the EU countries with a similar to Poland level of innovation. Thus, the particular emphasis was put on the Moderate Innovators countries.

Purpose of the article: The aim of this paper is to investigate enhancing Polish firms' innovation activities against those from the other Moderate Innovators countries.

Methodology/methods: The study was based on data from the European Innovation Scoreboard 2016 related to firm activities dimensions: firm investments, linkage & entrepreneurship and intellectual assets. The time period was 2008–2015 and was limited by data availability. To study multivariate analysis and the zero unitarization methods were applied. These methods allowed to multivariate analysis of enhancing firms' innovation activities in Poland and those from the other EU countries with similar to Poland level of innovation.

Findings & Value added: This paper contributes to the existing literature by providing new insight on understanding the issues related to firms' innovation activities. The results reveal, among others, that although Polish firms' innovation activities have improved against those from the other Moderate Innovators counties, it requires further enhancing. The findings have practical and policy implications. It is assumed that the obtained results may be useful for firms, regions and country in enhancing competitiveness.

Introduction

The circumstances of rapid changes impact on the necessity of stimulation of actions aimed at enhancing competitiveness of firms, regions and

countries. Such actions are noticeable in the European Union strategy Europe 2020 (European Commission, 2016, pp. 4). Here, the special attention is put on innovation as an important driver of competitiveness. The ability of innovation to foster competiveness of countries, regions and firms has been widely argued in the economic literature (see, e.g., Acs *et al.*, 2002, pp. 1069-1085; pp. 1-50; Acs *et al.*, 2016, pp. 527-535) and is noticeable especially in endogenous growth theory and knowledge spillovers theory. With this regard, the particular emphasis should be put on firms' innovation activities as the core to build a competitive advantage of firms, regions and countries.

Regarding the above, it is very important to explore how enhancing firms' innovation activities differ between countries with a similar level of innovation. Thus, the aim of this paper is to investigate enhancing Polish firms' innovation activities against those from the other Moderate Innovators countries.

The study was carried out under theoretical and empirical analysis of the problem based on a related literature review and data from the European Innovation Scoreboard (EIS). The time period is 2008–2015 and is limited by data availability.

The paper is organized as follows: First part presents a brief overview of the literature on the innovation activities of firms. Second part presents method of the research. Next part provides the findings. Last part concludes the paper.

This paper contributes to the existing literature by providing new insight on understanding of the issues related to firms' innovation activities. To understand the differences in enhancing firms' innovation activities between Poland and the other EU countries with a similar to Poland level of innovation, multivariate analysis and the zero unitarization method was applied.

Theoretical background and hypothesis development

Faced with the dynamic environment, firms' innovation activities become an important driver of innovation and competitiveness (see, e.g., Acs *et al.*, 2002, pp. 1069-1085). Hence, the essential is cooperation between regions and firms (see, e.g. Huggins & Williams, 2011, pp. 909-910; Tödtling& Grillitsch, 2015, pp. 1741-1758). In this regard, regions should develop regional innovation ecosystems and build backgrounds for stimulation firms' innovation activities (see, e.g., Acs *et al.*, 2016, pp. 527-535; Huggins & Williams, 2011, pp. 909-910; Spencer *et al.*, 2005, pp. 321–337). This issue is emphasised particularly in endogenous growth theory and knowledge spillovers theory.

Concerning the rank of firms' innovation activities in competitiveness of firms, regions and countries, the emphasis is put on indicators connected with innovation performance of firms. Thus, in the past decades a number of studies deal with a key indicators of firms' innovation (see, e.g., Asheim *et al*., 2016, pp. 1-19; Zahra & George, 2002, pp. 185-203; Tödtling& Trippl, 2005, pp. 1203-1219; Cooke *et al*., 2000, pp. 1-183; Fritsch & Franke, 2004, pp. 245-255). These indicators are also an increasingly considered by the European Union, especially in the place-based approach. Based on this approach, the combination of endogenous and exogenous indicators of regional development is essential for building competitive advantage of firms, regions and countries (Barca, 2009, pp. 1-244). Thus, the special importance is also put on a diversity of economic, social and territorial conditions of regions as the essential component of policy-making to support firms to stimulate innovation.

An increasing rank of firms' innovation activities in enhancing competitiveness of firms, regions and countries requires undertake studies how enhancing innovation activities of firms differ between the EU countries with a similar level of innovation.

Thus, the following hypothesis was posed: despite Poland belongs to the group of the EU countries with a similar level of innovation, enhancing Polish firms' innovation activities differ from those from the other Moderate Innovators counties.

Methods of the Research

The data of this study were gathered from the last report of the European Innovation Scoreboard (European Commission, 2016). The special emphasis was put on data related to firms' innovation activities. In this respect, the EIS contains three dimensions regarding to firm investments, linkage & entrepreneurship and intellectual assets. These dimensions and their nine specific indicators stay in accordance with endogenous growth theory and knowledge spillovers theory. The study uses data related to the Moderate Innovators countries, which contains such countries as: Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, and Spain. The time period was 2008–2015 and was limited by data availability. The descriptive statistics of diagnostic variables are presented in Table 1.

Table 1. Descriptive statistics of diagnostic variables

Variables			Mean	St. dev.	Min	Max
Firm investments	x_{1t}	Business R&D expenditure	0.49	0.27	0.08	0.99
	x_{2t}	Non-R&D innovation expenditure	0.98	0.51	0.45	2.31
Linkages &	x_{3t}	SMEs innovating in-house	25.41	8.59	11.73	39.44

entrepre-neurship	x_{4t}	Innovative SMEs collaborating with others	9.93	5.37	4.42	22.76
	x_{5t}	Public-private co-publications	14.40	7.37	3.19	24.89
Intellectual Assets	x_{6t}	PCT patent applications	0.91	0.56	0.32	2.13
	x_{7t}	PCT patent applications in societal challenges	0.26	0.17	0.04	0.57
	x_{8t}	Community trademarks	6.33	6.40	0.91	23.73
	x_{9t}	Community designs	2.94	2.89	0.33	11,08

Source: own calculations based on data from the European Innovation Scoreboard 2016 (European Commission, 2016).

All diagnostic variables distinguish sufficient variability (coefficient of variation is higher than 0.1).

To analyze how enhancing Polish firms' innovation activities differ between the EU countries with a similar to Poland level of innovation multivariate analysis and the zero unitarization method was applied. Such combination of methods allows an analysis the differences between the European Union countries (Balcerzak, 2015, pp. 190-205) and "enables comparing the values of synthetic index for all years" (Balcerzak, 2015, pp. 191). The application of these methods was used for each of the EIS innovation dimensions related to firm activities: firm investments, linkage & entrepreneurship and intellectual assets.

At first, on the ground of zero unitarization method, the normalisation of diagnostic variables was carried out. In this context, constant reference point (the range of the normalized variable) was calculated, according to the following formula (Kukuła & Bogocz, 2014, pp. 7):

$$R(X_{jt}) = \max_{it} x_{ijt} - \min_{it} x_{ijt} \qquad (1)$$

Regarding that all diagnostic variables are the stimulants to normalisation of diagnostic variables the following formula was used (Kukuła & Bogocz, 2014, pp. 7):

$$z_{ijt} = \frac{x_{ijt} - \min_{it} x_{ijt}}{\max_{it} x_{ijt} - \min_{it} x_{ijt}} \qquad (2)$$

, where $z_{ijt} \in [0,1]$; $(i = 1,2,\dots,n)$; $(j = 1,2,\dots,m)$; $(t = 1,2,\dots,l)$

Next, the synthetic measure was calculated using the formula (Balcerzak, 2015, pp. 196):

$$SM_{it} = \frac{1}{m}\sum_{j=1}^{m} z_{ijt} \qquad (3)$$

, where $z_{ijt} \in [0,1]$; $SM_{it} \in [0,1]$; $(i = 1,2,\dots,n)$; $(j = 1,2,\dots,m)$; $(t = 1,2,\dots,l)$

Above procedure allowed to investigate how enhancing Polish firms' innovation activities differ between the EU countries with a similar to Poland level of innovation.

Findings

The results of multivariate analysis of firms' innovation activities between the Moderate Innovators countries are presented in Tables 2 to 4 (in appendix). According to the obtained results, in the period 2008-2015 enhancing Polish firms' innovation activities differed from those from the other the EU countries with similar to Poland level of innovation. Considering firm investments dimension, the results indicate relatively high diversity in enhancing level of business R&D expenditure and non-R&D innovation expenditure in the most the Moderate Innovators countries and between this countries (Table 2). Against this background, Polish firms distinguished relatively high development in the field of investments (especially in the period 2008-2012). This situation, in relation to decrease of the level of business R&D expenditure and non-R&D innovation expenditure in the most the Moderate Innovators countries, should be treated as positive in the context of enhancing competitiveness of firms, regions and country. According to the obtained results, such development highlighted also firms from Cyprus and Lithuania (especially in the period 2011-2013).

Concerning linkage & entrepreneurship dimension, the obtained results distinguished relatively low changes in the most of the Moderate Innovators countries (Table 3). Among the EU countries with similar to Poland level of innovation, Polish firms highlighted lack of enhancement of SMEs innovating in-house, innovative SMEs collaborating with others and public-private co-publications. This situation, in relation to the lowest rank of Polish firms in terms of linkage & entrepreneurship dimension, should be treated as negative, especially in the context of enhancing competitiveness of firms, regions and country.

Regarding intellectual assets dimension, the results imply relatively high changes in enhancing level of PCT patent applications, PCT patent applications in societal challenges, community trademarks and community designs, in the most of the Moderate Innovators countries and between this countries (Table 4). In line with the obtained results, Polish firms distinguished relatively high rank in terms of intellectual assets dimension. Within the EU countries with similar to Poland level of innovation, Polish firms

highlighted also the decrease of level PCT patent applications, PCT patent applications in societal challenges, community trademarks and community designs. This situation concerned the period 2010-2013 and was improved in the next years.

Conclusions

The results confirm that despite Poland belongs to the group of the EU countries with a similar level of innovation, enhancing Polish firms' innovation activities differ from those from the other Moderate Innovators counties. The results reveal that although Polish firms' innovation activities have improved against those from the other Moderate Innovators counties, it requires further enhancing. This concerns all firm activities' dimensions with special interest in improvement of linkage & entrepreneurship dimension.

These findings have policy and practical implications. In this regard, the findings call for strengthening actions concerning firms' capabilities to competitive advantage, especially in the area of the network between universities, institutional environment and research organisations. On the other hand, the findings imply the necessity to further supporting firms 'innovation activities in all dimensions.

This study is not without limitations. This paper based on firms' innovation activities indicators and data from the European Innovation Scoreboard. It would be interesting to investigate whether the obtained results also hold in regions context.

The complexity of firms' innovation activities requires further studies. It seems necessary to investigate the causes of differences in terms of enhancing firms' innovation activities between Poland and the other EU countries with similar to Poland level of innovation.

References

Acs, Z.J., Anselin, L., & Varga, A. (2002). Patents and innovation counts as measures of regional production of new knowledge. *Research Policy*, 31. DOI: http://dx.doi.org/10.1016/S0048-7333(01)00184-6.

Acs, Z.J., Audretsch, D.B., Lehmann, E.E. & Licht G. (2016). National Systems of Entrepreneurship, *Small Business Economics*, 16(4). DOI: http://dx.doi.org/10.1007/s11187-016-9705-1.

Asheim, B. T., Grillitsch, M., & Trippl, M. (2016). Regional innovation systems: past–present–future. In R. Shearmur, C. Carrincazeaux & D. Doloreux (Eds.), *Handbook on the Geographies of Innovation.* Cheltenham: Edward Elgar.

Balcerzak, A. P. (2015), Europe 2020 Strategy and Structural Diversity Between Old and New Member States. Application of Zero Unitarization Method for

Dynamic Analysis in the Years 2004-2013, Economics and Sociology, 8 (2). DOI: http://dx.doi.org/10.14254/2071-789X.2015/8-2/14.

Barca, F. (2009). *An Agenda for a Reformed Cohesion Policy. A place-based approach to meeting European Union challenges and expectations.* European Commission, Brussels.

Cooke, P., Boekholt, P. & Tödtling, F. (2000). *The Governance of Innovation in Europe: Regional Perspectives on Global Competitiveness*, London, Pinter.

Fritsch M. & Franke, G. (2004). Innovation, regional knowledge spillovers and R&D cooperation. *Research Policy*, 33. DOI: http://dx.doi.org/10.1016/S0048-7333(03)00123-9.

Huggins R, & Williams N. (2011). Entrepreneurship and regional competitiveness: The role and progression of policy. *Entrepreneurship & Regional Development*, Vol. 23. DOI: http://dx.doi.org/10.1080/08985626.2011.577818.

Kukuła, K.& Bogocz D. (2014). Zero Unitarization Method and its Application in Ranking Research in Agriculture. *Economic and Regional Studies*, 7 (3).

Spencer, J. W., Murtha, T. P., & Lenway, S. A. (2005). How governments matter to new industry creation. *Academy of Management Review*, 30. DOI: http://dx.doi.org/10.5465/AMR.2005.16387889.

The European Commission (2016), European Innovation Scoreboard 2016.

Tödtling, F. & Grillitsch M. (2015). Does Combinatorial Knowledge Lead to a Better Innovation Performance of Firms?, *European Planning Studie*s, Vol.23, No.9 DOI: http://dx.doi.org/10.1080/09654313.2015.1056773.

Tödtling, F. & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. Research Policy 34. DOI: http://dx.doi.org/10.1016/j.respol.2005.01.018.

Zahra, S. A. & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension, *Academy of Management Review*, 27 (2). DOI: http://dx.doi.org/10.5465/AMR.2002.6587995.

Annex

Table 2. The results of multivariate analysis of firms' innovation activity between the Moderate Innovators countries – Firm investments dimension (in the period 2008-2015)

2008			2009			2010			2011			2012			2013			2014			2015		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
1	EE	0,8015	1	EE	0,8516	1	EE	0,9015	1	EE	1,0000	1	EE	1,0000	1	EE	0,7526	1	EE	0,6432	1	EE	0,764
2	CZ	0,5593	2	PT	0,5645	2	PT	0,5723	2	CZ	0,7064	2	CZ	0,5006	2	CZ	0,5057	2	CZ	0,6178	2	CZ	0,669
3	ES	0,4632	3	CZ	0,5593	3	CZ	0,5441	3	HU	0,5376	3	CY	0,4843	3	CY	0,5000	3	CY	0,5000	3	HU	0,5893
4	PT	0,4326	4	ES	0,4922	4	ES	0,4621	4	PT	0,5207	4	MT	0,3670	4	LT	0,4241	4	HU	0,4732	4	MT	0,5606
5	IT	0,3791	5	IT	0,4255	5	HU	0,4558	5	CY	0,4843	5	PL	0,3578	5	MT	0,4138	5	LT	0,4351	5	PL	0,4648
6	HU	0,3257	6	HU	0,3675	6	IT	0,4357	6	IT	0,4674	6	HU	0,3491	6	PL	0,3654	6	MT	0,4325	6	LT	0,4225
7	MT	0,2961	7	MT	0,3007	7	MT	0,2794	7	MT	0,4540	7	PT	0,3040	7	IT	0,3526	7	IT	0,4196	7	IT	0,4122
8	CY	0,2788	8	HR	0,2890	8	CY	0,2788	8	ES	0,4296	8	IT	0,2682	8	HU	0,3364	8	PL	0,4104	8	HR	0,4020
9	SK	0,2379	9	CY	0,2788	9	SK	0,2551	9	PL	0,3785	9	HR	0,2510	9	PT	0,3231	9	PT	0,3476	9	PT	0,3620
10	HR	0,2237	10	SK	0,2577	10	HR	0,2440	10	HR	0,3313	10	ES	0,2199	10	ES	0,2672	10	ES	0,3125	10	EL	0,3226
11	EL	0,1365	11	PL	0,1504	11	PL	0,1480	11	SK	0,2256	11	LT	0,1752	11	SK	0,2183	11	HR	0,2637	11	SK	0,3152
12	PL	0,1311	12	EL	0,1429	12	EL	0,1396	12	LT	0,2206	12	EL	0,1630	12	EL	0,2146	12	SK	0,2634	12	ES	0,2740
13	LT	0,1193	13	LT	0,0945	13	LT	0,0997	13	EL	0,2119	13	SK	0,1627	13	HR	0,2073	13	EL	0,2412	13	CY	0,1074

Legend: HR – Croatia, CY – Cyprus, CZ – Czech Republic, EE – Estonia, EL – Greece, HU – Hungary, IT – Italy, LT – Lithuania, MT – Malta, PL – Poland, PT – Portugal, SK – Slovakia, ES – Spain.

Source: own calculations based on data from the European Innovation Scoreboard 2016 (European Commission, 2016).

Table 3. The results of multivariate analysis of firms' innovation activity between the Moderate Innovators countries – Linkage & entrepreneurship dimension (in the period 2008-2015)

2008			2009			2010			2011			2012			2013			2014			2015		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
1	EE	0,8591	1	EE	0,8591	1	CY	0,8848	1	CY	0,9738	1	CY	0,8597	1	CY	0,9218	1	CY	0,8438	1	EE	0,6308
2	CY	0,7241	2	CY	0,7241	2	EE	0,8488	2	EE	0,8599	2	EE	0,7677	2	EE	0,6557	2	EE	0,6653	2	CY	0,6254
3	CZ	0,6515	3	CZ	0,6515	3	CZ	0,6515	3	HR	0,6134	3	HR	0,6134	3	IT	0,5963	3	IT	0,5995	3	CZ	0,6215
4	EL	0,5651	4	EL	0,5651	4	IT	0,6123	4	CZ	0,6066	4	CZ	0,6063	4	HR	0,5844	4	CZ	0,5421	4	IT	0,6129
5	HR	0,5406	5	HR	0,5406	5	HR	0,5581	5	IT	0,5699	5	IT	0,5532	5	CZ	0,5673	5	EL	0,5317	5	EL	0,5743
6	IT	0,5989	6	IT	0,5989	6	EL	0,5543	6	EL	0,5166	6	PT	0,5178	6	EL	0,5491	6	HR	0,4557	6	PT	0,4633
7	PT	0,4179	7	PT	0,4179	7	PT	0,4149	7	PT	0,5006	7	EL	0,5173	7	ES	0,4455	7	ES	0,4444	7	HU	0,3880
8	ES	0,3973	8	ES	0,3973	8	ES	0,3898	8	HU	0,3464	8	ES	0,3434	8	PT	0,4302	8	PT	0,4279	8	ES	0,3557
9	HU	0,3374	9	HU	0,3374	9	HU	0,3334	9	ES	0,3208	9	HU	0,2795	9	HU	0,3472	9	HU	0,3859	9	HR	0,3543
10	SK	0,2457	10	SK	0,2457	10	SK	0,2386	10	LT	0,1918	10	LT	0,1906	10	SK	0,3187	10	SK	0,2862	10	MT	0,2811
11	LT	0,1923	11	LT	0,1923	11	LT	0,2283	11	SK	0,1751	11	SK	0,1437	11	LT	0,1593	11	MT	0,1752	11	SK	0,2414
12	MT	0,1720	12	MT	0,1720	12	MT	0,1702	12	MT	0,1428	12	MT	0,1049	12	MT	0,1550	12	LT	0,1521	12	LT	0,1487
13	PL	0,1387	13	PL	0,1387	13	PL	0,1387	13	PL	0,0369	13	PL	0,0369	13	PL	0,0000	13	PL	0,0208	13	PL	0,0304

Legend: Like in table 1.

Source: own calculations based on data from the European Innovation Scoreboard 2016 (European Commission, 2016).

Table 4. The results of multivariate analysis of firms' innovation activity between the Moderate Innovators countries – Intellectual assets dimension (in the period 2008-2015)

2008			2009			2010			2011			2012			2013			2014			2015		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
1	IT	0,8011	1	IT	0,8256	1	IT	0,8021	1	IT	0,7738	1	IT	0,7603	1	EE	0,6215	1	IT	0,5810	1	MT	0,6546
2	ES	0,5572	2	ES	0,5538	2	EE	0,6067	2	EE	0,7150	2	EE	0,7220	2	IT	0,5735	2	MT	0,5536	2	IT	0,5804
3	CY	0,4886	3	EE	0,4855	3	ES	0,5533	3	ES	0,5813	3	ES	0,6137	3	MT	0,5532	3	ES	0,4963	3	ES	0,4774
4	HU	0,4006	4	MT	0,4206	4	MT	0,4704	4	CY	0,4420	4	HU	0,4088	4	ES	0,4965	4	HU	0,3371	4	HU	0,2618
5	HR	0,3522	5	HU	0,3633	5	HU	0,4630	5	HU	0,3832	5	MT	0,3872	5	HU	0,3516	5	EE	0,2856	5	EE	0,2552
6	PT	0,3366	6	PT	0,3438	6	PT	0,3474	6	PT	0,3654	6	PT	0,3833	6	PT	0,2548	6	CY	0,2465	6	CZ	0,2150
7	MT	0,3334	7	HR	0,3151	7	CZ	0,3280	7	CZ	0,3264	7	CZ	0,3681	7	CY	0,2462	7	CZ	0,2438	7	CY	0,1943
8	EE	0,3208	8	CZ	0,2976	8	CY	0,3094	8	MT	0,3179	8	CY	0,3566	8	CZ	0,2146	8	PT	0,2120	8	PT	0,1923
9	CZ	0,2841	9	CY	0,2618	9	PL	0,2266	9	PL	0,2592	9	PL	0,3050	9	PL	0,1444	9	HR	0,1847	9	PL	0,1367
10	PL	0,2124	10	PL	0,1941	10	HR	0,1659	10	LT	0,1872	10	HR	0,1695	10	HR	0,1375	10	PL	0,1598	10	HR	0,0932
11	SK	0,1173	11	SK	0,1141	11	EL	0,1121	11	HR	0,1244	11	SK	0,1429	11	LT	0,1121	11	EL	0,1194	11	LT	0,0690
12	EL	0,1068	12	EL	0,0908	12	SK	0,1114	12	SK	0,0921	12	LT	0,1358	12	SK	0,0963	12	LT	0,1130	12	EL	0,0629
13	LT	0,0835	13	LT	0,0515	13	LT	0,0806	13	EL	0,0848	13	EL	0,1081	13	EL	0,0765	13	SK	0,0928	13	SK	0,0538

Legend: Like in table 1.

Source: own calculations based on data from the European Innovation Scoreboard 2016 (European Commission, 2016).