

INNOVATION PERFORMANCE OF THE VISEGRAD GROUP COUNTRIES FROM 2007 TO 2015

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Abstract

The first part analyzes how the ability of the Czech Republic, Slovakia, Poland and Hungary (i.e., the Visegrad Group countries) to innovate developed during the period from 2007 to 2015. The aim was not to monitor only the situation in the Visegrad Group countries but the changes in their relative position, in comparison with other EU countries. Two composite indices of the innovation performance, the Summary Innovation Index of the European Commission and our own FBA Innovation Index, were applied for the analysis of the selected countries' innovative performance. The relationship is monitored on data from 2007 and 2013 for the 27 European countries and in 2015 on data from 2015 for 28 countries (Croatia recently became an EU member state). The second part of the contribution is focused on the relationship between innovation performance and competitiveness in member states of the European Union. For this analysis, both above-mentioned indexes are related to the Global Competitiveness Index, GCI.

Keywords: competitiveness, innovation performance, European Union

JEL Code: O31, O47

1. Introduction

The first part of the contribution analyzes the ability of the Czech Republic, Slovakia, Poland and Hungary (i.e. the Visegrad Group countries) to innovate during the period from 2007 to 2015. The aim is not to monitor only the situation in the Visegrad Group countries but also to analyze the changes in their relative position, in comparison with other EU countries.

Two composite indices of the innovations, the Summary Innovation Index of the European Commission and our own FBA Innovation Index, were applied for the analysis of the selected countries' innovative performance.

Results of the European Commission's Summary Innovation Index have been taken from the report (UNU-MERIT, 2015) for the year 2007 and from the report (UNU-MERIT, 2016) for the years 2013 and 2015.

The FBA Innovation Index was published in (Kislingerová & et al., 2011) for data from the year 2007. The same index was published in the monograph (Soukup, Rathouský, 2013). There

were used statistical data for EU member states from the year 2011, and so the index reflected the impact of a global recession from years 2008 -2009. In the monograph (Soukup et al., 2017), there were published the results based on data from the year 2015 for the first time. In that year, Croatia was already a member of the European Union and therefore the Innovation Index FBA included also this country.

The following part of the paper is focused on the innovation performance in member states of the European Union, with the stress on the Visegrad group countries.

2. The Innovation performance of the Visegrad Group countries

The results of both composite indices are summarized in Table 1. The first question is how different both indices are. For this purpose, we applied the Spearman's correlation coefficient. In 2007, the value of the correlation coefficient is $r = 0.93$ level. In the year 2013, the same coefficient shows the value $r = 0.88$ and finally, in 2015, its value is $r = 0.89$. Values are relatively close to one. We can therefore legitimately formulate the conclusion that the results of the Summary Innovation Index of the European Commission and the FBA Innovation Index are very similar and their explanatory power is very close.

Slight differences in the ranking of individual EU member states, however, can be observed. For example, these conclusions can be demonstrated on data from the year 2015.

Tab. 1: Ranking the EU countries according to the European Summary Innovation Index (SII) and the FBA Innovation Index (years 2007, 2013 and 2015)

Country	2007		2013		2015	
	FPH	EIS*	FPH	EIS	FPH	EIS
Austria	7	10	10	7	7	10
Belgium	8	6	11	9	11	7
Bulgaria	26	28	26	28	27	27
Croatia	X	23	X	23	23	26
Cyprus	20	12	21	13	20	13
Czech republic	15	17	14	16	15	16
Denmark	4	4	5	2	4	2
Estonia	13	14	12	12	12	14
Greece	25	19	25	19	26	19
Finland	3	2	3	5	3	3
France	9	11	8	11	10	11
Germany	1	3	2	3	6	4
Hungary	17	20	15	21	18	21
Ireland	10	8	9	8	8	6

Italy	16	16	22	15	22	17
Latvia	21	27	18	27	17	25
Lithuania	22	25	19	25	19	24
Luxembourg	5	5	4	4	2	9
Malta	18	21	17	20	14	15
Netherlands	5	7	6	6	5	5
Poland	23	24	23	24	24	23
Portugal	24	18	24	17	25	18
Romania	27	26	27	26	28	28
Slovakia	19	22	20	22	21	22
Slovenia	12	13	13	14	13	12
Spain	14	15	16	18	16	20
Sweden	2	1	1	1	1	1
UK	11	9	7	10	9	8

Note: In the case of the FBA Innovation Index, countries from the first quartile are marked in yellow colour, ones from the second quartile in red, ones from the third quartile in blue and countries from the fourth quartile are colourless. Similarly, in the case of the Summary Innovation Index of the European Commission, the innovative leaders are in yellow, the innovation followers are marked in red, moderate innovators are in blue colour and the modest innovators are colourless. Croatia is marked in green – it was not evaluated in the FBA Innovation Index in 2007 and 2013 because it was not an EU member.

Source: UNU-MERIT (2007), UNU-MERIT (2015), UNU-MERIT (2016) and own calculation.

The European Commission divides the EU countries into four groups. The first group consists of "innovation leaders". These countries show in terms of the Summary Innovation Index (SII) performance at or above 120% of the EU average. The second group is the "innovation followers", the SII value for these countries ranges from 90 to 120% of the EU average. The third group is "moderate innovators". The value of the SII is in the range 50-90% of the EU average for them. The fourth group includes countries that have the SII value below 50% of the EU average. These countries are designated as "modest innovators".

Also, the FBA Innovation Index divides EU countries into four groups according to their performance. The methodology, however, is somewhat different. The following calculation was applied: firstly, an overall score of each country was calculated. Then, the difference between the highest and lowest individual score was calculated and a resulted difference was divided by four. The obtained value (difference) is subtracted from the highest score and so the 100th to 76th percentile was received. The same method was used for the other three quartiles. As a result of the calculation, quartiles do not necessarily contain the same number of countries.

According to the Summary Innovation Index, only three Nordic countries (Denmark, Finland, Sweden), accompanied by Germany, are among the "innovative leaders". According to the FBA Innovation Index, this group consists of the same countries, but in addition, some countries that are close to Germany - Luxembourg, the Netherlands and Austria - also belong here.

The European Commission includes to the group of "innovation followers" the majority of Western European countries - Luxembourg, the Netherlands, Austria, Belgium, France, Ireland, United Kingdom and Slovenia. According to the FBA Innovation Index, here are Belgium, France, Ireland, United Kingdom, Slovenia, and Estonia.

Consider the two above mentioned groups together. Both indices consent that the same countries are above the EU average. An exception is Estonia, which is above the EU average only by the FBA Innovation Index. But it is necessary to stress that, in terms of the European Commission, Estonia is in the third group but it is rated here as the best country.

More important differences can be observed in the distribution of the countries that fall under the EU average. By the European Commission, the third group consists of Central European countries (Czech Republic, Slovakia, Poland, and Hungary), Estonia and most of the Southern European countries (Malta, Spain, Italy, Cyprus, Croatia, Portugal, and Greece).

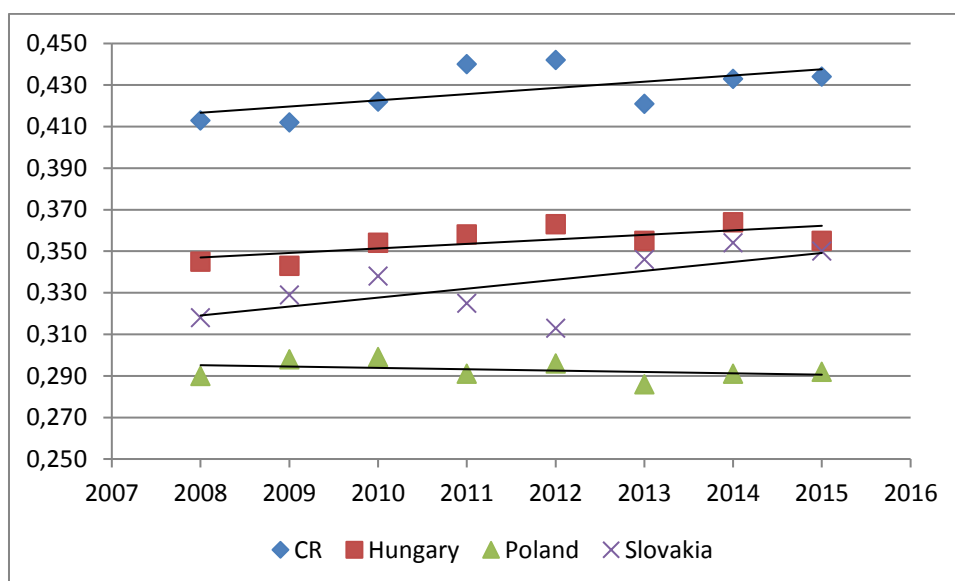
The FBA Innovation Index and the SII agree the Central European countries belong to this group. However, the FBA Innovation Index evaluates the South of Europe as weaker innovators. The FBA Innovation Index does not include Portugal and Greece here. On the other hand, the FBA Index includes two Baltic States (Latvia and Lithuania) in the group. The reason is probably an advantage that these two countries have due to their geographical proximity to the Nordic countries as innovation leaders.

Both indices include Romania and Bulgaria to the modest innovators. However, as already indicated above, the FBA Innovation Index includes here also Portugal and Greece. The lowest level of innovation performance so can be observed in the southeast part of the EU, in three above mentioned Balkan countries.

In conclusion, we formulate fundamental results concerning the development of the innovation performance in the EU countries during the period 2007 to 2015. If we look at the classification of countries into four groups in terms of their innovation performance, it can be stated stability of their positions. Usually, each country remains throughout the whole decade in one group.

Let's look at the changes in the relative position of the Visegrad Group countries (V4). We are not concentrated here on a precise mathematical calculation and regression, but a qualitative analysis. Figures 1 and 2 illustrate these changes; data were compiled from the Summary Innovation Index published in the report "European Innovation Scoreboard 2016". Symbols in Figure 1 correspond to values assigned to individual countries V4 in the European Commission's report. In a figure, there are trend lines inserted that indicate how the innovative capacity of V4 countries was improving (with the except of Poland, where this value is substantially constant).

Figure 1: The Position of Visegrad Group Countries from the Perspective of the Summary Innovation Index



Source: UNU-MERIT. (2016) and own calculation.

On Figure 2, the same values of V4 countries are related to the average value of the Summary Innovation Index for the 28 EU member states (i.e. including Croatia). It shows all Visegrad group countries are below the EU average. From the perspective of our analysis, however, other information is important.

We have already mentioned, the innovative performance of most V4 countries was improving. However, the innovative performance of most other EU member states was also improving. The question is how the position of the V4 countries was changing as compared to other EU countries.

In 2008, the Czech Republic reached 83% of the EU-28 average. This index fluctuated in the years 2008 - 2015 in the range 82-86%, but in 2015 the Czech Republic was again at 83% of the EU average.

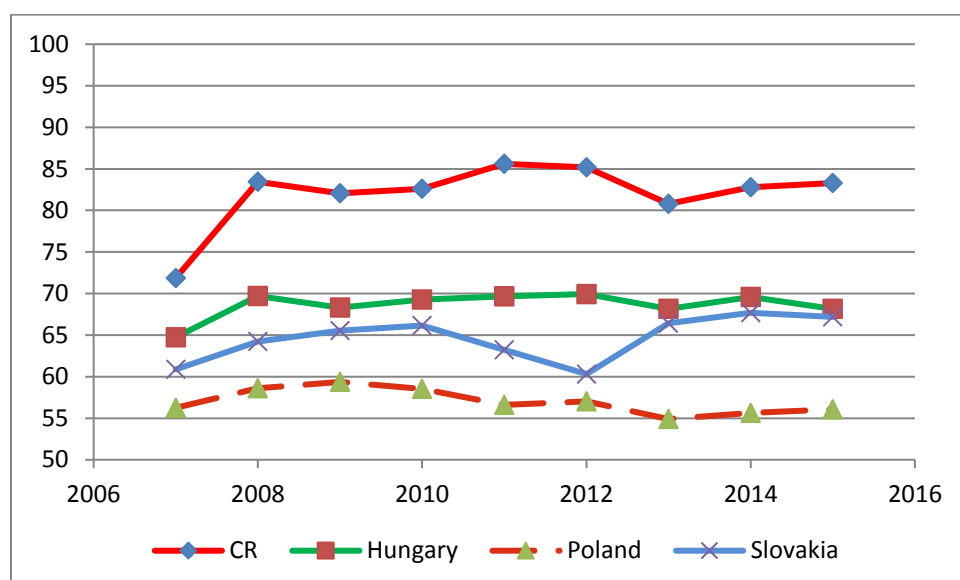
In 2008, Slovakia reached 64% of the EU-28 average. This index fluctuated in the years 2008 - 2015 in the range 63-68% and in 2015 Slovakia reached in terms of its innovation performance 67% of the EU average.

In 2008, Hungary reached 70% of the EU-28 average. This index fluctuated in the years 2008 - 2015 in the range 68-70% and in 2015 Hungary was only at 68% of the EU average.

In 2008, Poland reached 59% of the EU-28 average. This index fluctuated in the years 2008 - 2015 in the range 55-59% but in 2015 the indicator was lower than in the initial year and reached only 56% of the EU average.

Let us summarize the conclusions for the Visegrad group countries. If we compare the years 2008 and 2015, we see that the position of one country (Slovakia) improved, the position of one country remained unchanged (Czech Republic) and the position of two remaining V4 countries (Hungary and Poland) slightly declined. The overall position of the V4 countries in comparison with other EU members so remained in the years 2008-2015 virtually unchanged.

Figure 2: The Visegrad Group Countries Position from the Perspective of the Summary Innovation Index (EU-28 = 100 %)



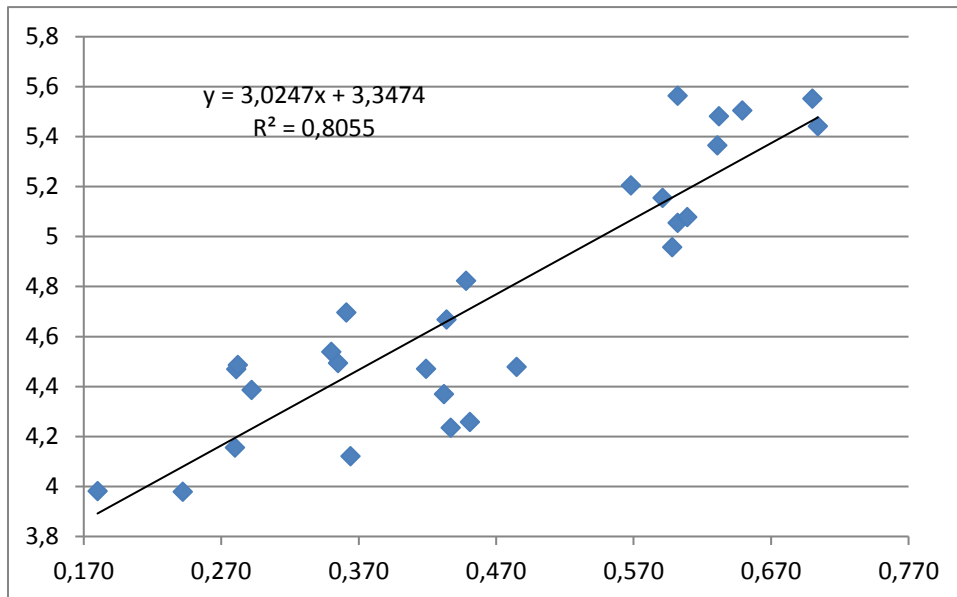
Source: UNU-MERIT (2016) and own calculation.

3. The relationship between the innovation performance and competitiveness in the EU member states

The aim of the analysis is not to evaluate only the innovation performance of the EU member states. The second part of the contribution is so focused on the relationship between innovation performance and competitiveness in EU member states. The relationship is monitored on data from 2007 and 2013 for the 27 European countries and in 2015 on data for 28 countries (Croatia became an EU member state in 2013). Two composite indices of the innovation performance, the Summary Innovation Index of the European Commission and the FBA Innovation Index,

were applied for the analysis. Both indexes are related to the Global Competitiveness Index, GCI, which is published by the World Economic Forum.

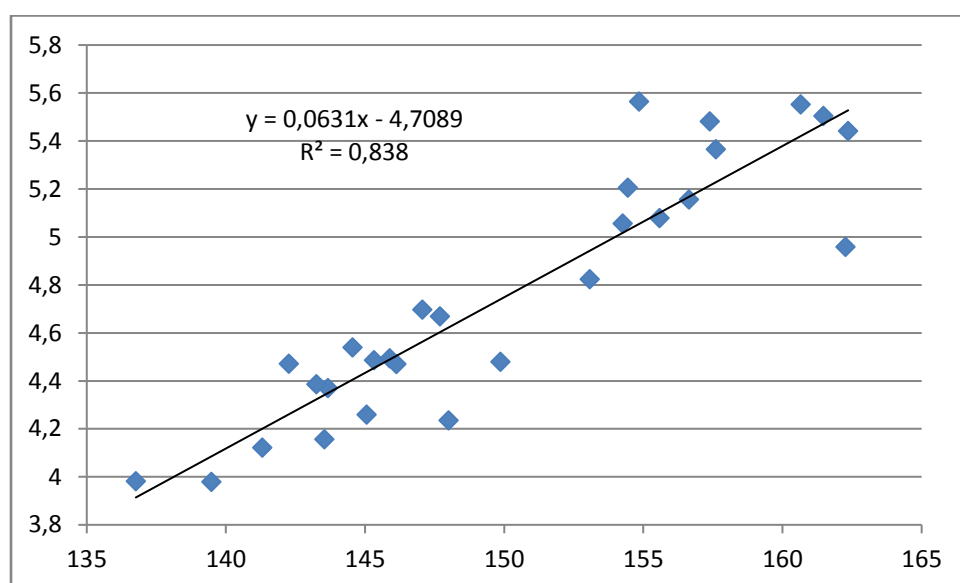
Figure 3: The Global Competitiveness Index and the Summary Innovation Index (2015)



Source: own calculation.

The relationship between the Global Competitiveness Index and the Summary Innovation Index for 2015 is illustrated in Figure 2-3. Analogously, Figure 2-4 shows the relationship between the Global Competitiveness Index and the FBA Innovation Index for the same year (2015). Both figures confirm there is a positive correlation between the ability to innovate and the achieved level of competitiveness of individual countries. More competitive states show better results in the ability to innovate. Similar conclusions can be observed if we prepare the pictures for both remaining reference years (2007 and 2013).

Figure 4: The Global Competitiveness Index and the FBA Innovation Index (2015)



Source: own calculation.

In Table 2, the regression equations are presented. The competitiveness of the respective country (the Global Competitiveness Index) as a dependent variable and the relevant innovation indices (the Summary Innovation Index, SII or the FBA Innovation Index) as an independent variable are included into these equations. The determination coefficients and their roots - correlation coefficients - are also calculated and included in Table 2.

It should, however, be noted that the correlation coefficients show only a strong linear relationship among variables. Coefficient does not say whether the ability to innovation performance is a reason for increasing competitiveness or on the contrary, only a more competitive economy creates conditions for the development innovation performance. However, we can rely on the economic growth theory at this point. E.g., AK models consider technological development and knowledge as a factor that leads to economic growth (for example, see Romer (2012), Sirůček (2007), Varadzin (2004) or Soukup (2017)). For this reason, we consider both above mentioned innovative indices as the independent variables in the functions. Therefore, this statement is not given by a mathematical model, but from implemented theory of endogenous growth.

Determination indices presented in Table 2 show a relatively strong dependence between economic competitiveness and innovation performance.

The equations in Table 2 can be written in the general form $y = a + b x$. The interpretation of the regression coefficients b is important for us. Coefficients indicate how the increase of the mean value of y (i.e. competitiveness) corresponds to the unit increase of the variable x (i.e. relevant innovation index). E.g., in 2015, the unit increase in the value of the FBA Innovation

Index increased the competitiveness by 0.0631 units (in terms of the Global Competitiveness Index).

Tab. 2: The Global Competitiveness Index and innovation indices

Indices	Year	Regression function	Determination coefficient R ²	Correlation coefficient R
SII and GCI	2007	$y = 3,5543 + 2,6733 x$	0,7406	0,860579
	2013	$y = 3,3491 + 2,9777 x$	0,841	0,917058
	2015	$y = 3,3474 + 3,0247 x$	0,8055	0,897482
FBA Index and GCI	2007	$y = - 2,1258 + 0,0583 x$	0,7584	0,870872
	2013	$y = - 4,3566 + 0,0668 x$	0,8326	0,912443
	2015	$y = - 4,7089 + 0,0631 x$	0,838	0,915412

Note: in equations, a corresponding innovation index (the SII or the FBA Innovation Index) is always independent variable x and the Global Competitiveness Index is always dependent variable y.

Source: own calculation.

The aim, however, is not an exact calculation, but a qualitative analysis. And its conclusion is apparent: the ability of economies to innovate contributes to the competitiveness of each country in an international context.

4. Conclusion

The first part of the contribution deals with the relative position of Visegrad group countries in the innovation performance in comparison with other EU countries. If we regard period from 2008 to 2015, we can see that the overall position of the V4 countries against other EU members remained virtually unchanged.

The second part of the contribution was focused on the relationship between innovation performance and competitiveness in EU states. The analysis confirms that the ability of economies to innovate contributes to the competitiveness of each monitored country.

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