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Comparison of innovation performance of Slovak Republic and member states of European Union

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ABSTRACT :*The paper deals with comparison of innovative performance of Slovak republic and EU Member States. This issue is very actual today because of high level of competition in our economy.*
Keywords - *Summary innovation index, indicators, innovation*

I. INTRODUCTION

Innovation is the driving force of economic growth and is one of the most important element of improving business competitiveness and business environment. Innovations require comparison and measurement of different aspects. Mapping innovation potential is generally realized in two directions - the macroeconomic and microeconomic levels. Macroeconomic ranking focuses on ranking the level of innovation potential of countries and regions. One of the methods is the evaluation of the innovation potential of the Member States of the European Union by multicriterial assessment based on selected indicators of innovation. (

II. COMPOSITE INDICATORS

Due to the multi-dimensionality of the innovation process, which consists of various inputs and outputs, individual indicators can not characterize the innovative performance of countries with sufficient accuracy. For that reason a "composite indicators" are used for measurement of innovative performance. Their purpose is to provide a synthetic view of a key aspect of the innovation process by combining the indicators and other statistical data that reveal its sub-components into a single measure. [7]

Composite indicators that summarize data from two or more individual indicators allow to take into account the multidimensional nature of innovation performance. [5] Type of composite indicator that enables practical and comprehensible comparison of positions of countries according to a set of selected aspects, and their development in time, is called the Summary Innovation Index. [5], [6]

Summary Innovation Index – SSI

The issue of the evaluation of the level of innovation performance requires an analysis of its current state, as well as the development trends in this area. The part of analysis also to take into account the key indicators - the principles of the Lisbon strategy and the Barcelona strategy. Innovation performance is annually evaluated within the scope of the EU on the base of 3 main types of indicators and 8 innovation dimensions, capturing in total 25 different indicators. [3], [9]

The indicators included in each of 8 dimensions are listed in Table 1 [3].

Table 1: The innovation union scoreboard indicators[3]

MAIN TYPE	INNOVATION DIMENSION	Indicator
ENABLERS	Human resources	New doctorate graduates (ISCED 6) per 1000 population aged 25-34
		Percentage population aged 30-34 having completed tertiary education
		Percentage youth aged 20-24 having attained at least upper secondary level education
	Open, excellent and attractive research systems	International scientific co-publications per million population
		Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country

		Non-EU doctorate students3 as a % of all doctorate students
	Finance and support	**R&D expenditure in the public sector as % of GDP**
		Venture capital (early stage, expansion and replacement) as % of GDP
FIRM ACTIVITIES	**Firm investments**	**R&D expenditure in the business sector as % of GDP**
		Non-R&D innovation expenditures as % of turnover
	Linkages & entrepreneurship	**SMEs innovating in-house as % of SMEs**
		Innovative SMEs collaborating with others as % of SMEs
		Public-private co-publications per million population
	Intellectual assets	**PCT patents applications per billion GDP (in PPS€)**
		PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)
		Community trademarks per billion GDP (in PPS€)
		Community designs per billion GDP (in PPS€)
OUTPUTS	**Innovators**	**Number of patents (EU) per million habitant**
		Number of patents (USA) per million habitant
		Patents per million habitant
		New trademarks per million habitant
		New designs per million habitant
	Economic effects	**Employment in knowledge-intensive activities (manufacturing and services) as % of total employment**
		Medium and high-tech product exports as % total product exports
		Knowledge-intensive services exports as % total service exports
		Sales of new to market and new to firm innovations as % of turnover
		License and patent revenues from abroad as % of GDP

Source: Innovation Union Scoreboard

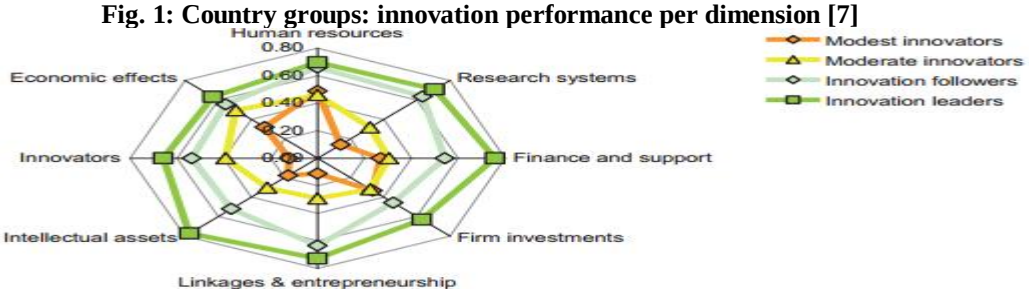
Summary innovative index is determined on the base of the measurements of 25 indicators. Accoridng to this, the set of surveyed countries is divided into four groups:

Innovative leaders: Denmark, Finland, Germany, Sweden all show a performance well above that of the EU27 average.

Innovative followers: Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg, Netherlands, Slovenia and the UK all show a performance close to that of the EU27 average.

- **Moderate innovators**: The performance of Czech Republic, Greece, Hungary, Italy, Malta, Poland, Portugal, Slovakia and Spain is below that of the EU27 average.
- **Modest innovators**: The performance of Bulgaria, Latvia, Lithuania and Romania is well below that of the EU27 average.

Fig. 1: Country groups: innovation performance per dimension [7]



Source: Innovation Union Scoreboard

The methodology of calculation of SII consists of the following steps: [2]

- calculates the ratio of the scores for each indicator of each country to the scores achieved for the EU as a whole, according to the formula:

100*(the scores of the country/ scores of the EU as a whole)

- calculates the score for each indicator calculated by subtracting the lowest value indicator achieved in the EU-27 group, Iceland, Norway, Switzerland and then it is divided by difference between the highest and lowest value in these countries. Calculated score can move within a range from zero to one.
- summary innovation index is then calculated as the average of all calculated scores
- summary innovation index has a value in the range from 0 to 1

On the basis of the values obtained by summary innovation index in the time interval longer than 5 years, the intensity of growth of the summary innovation index is quantified as the annual percentage change in the summary innovation index (in the current year compared to the development in previous years). [2]

The convergence time is quantified through the application of the summary innovation index (the period during which the country with lower indicators reach the EU average, respectively, the period that will be needed to ensure that the EU on the basis of achieved values will approach to the values of indicators of most developed countries, so-called innovative leaders).

Time convergence is calculated in 2 ways: [2], [4]

- linear approach according to the following equation:

$$SII_x^T = SII_x^{T-1} * \left(1 + \frac{TREND\_SII_x}{100}\right) \quad (1)$$

$TREND\_SII_x$ - intensity of growth of SII

SII_x^T - SII in period T

- nonlinear approach: [2], [4]

Non-linear approach is based on the fact that the intensity of each country's growth is decreasing with the intensity decrease depending on the size of assumed differences between countries.

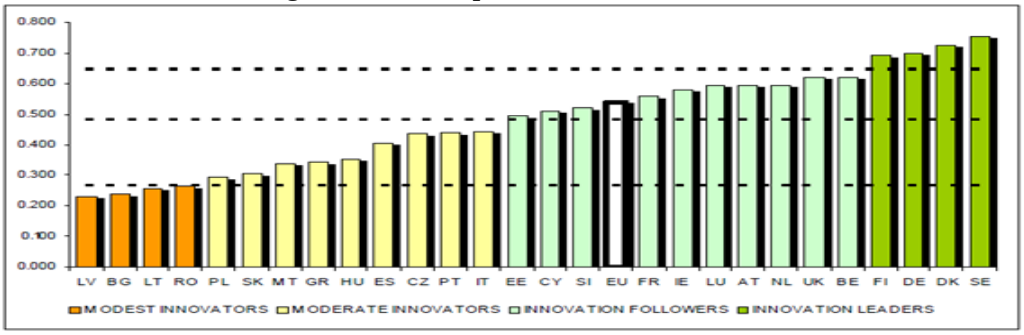
$$SII_x^T = SII_x^{T-1} * \left(1 + \left(\sqrt{\frac{SII_{EU}^{year}}{SII_x^{year}}}\right)^{\sqrt{T}} * \frac{TREND\_SII_x}{100}\right) \quad (2)$$

III. COMPARISON OF INNOVATION PERFORMANCE OF SR AND EU

The report of EIS which has been published since 2000, is filled up by new indicators with the aim of capture the complex nature of innovation processes. EIS is focused on comparison and assessment of the innovation level across the EU and is based on aggregate macroeconomic data.[3]

The level of innovation performance of Slovakia, characterized by SII (Innovation Scoreboard Index) and its comparison with other EU countries is shown in the chart below. [7], [3]

Fig. 2: Innovation performance in 2011 [3]



The European innovation Assessment (European Innovation Scoreboard EIS 2011) shows that Slovakia in international comparison is still one of the countries with the lowest innovation performance, which has fallen far below the average of EU countries. [3], [7]

Among the 27 EU countries Slovakia is in term of innovation performance on 22nd place (a slight improvement compared to 2010 by 1 point) and belongs to a group of moderate innovators. [3]

In the long term Slovakia gets behind in the intensity of innovation activities at the enterprise level, in expenditures on research projects, development and innovation, which outputs implementation end in practice, in technology transfer, using of cooperative potential in patent activity, with collaboration research and industry, in the utilisation of venture capital bur also in a number of aspects which qualifies the efficient use of human resources. [2], [3]

One of the main reasons are the low cost of public and private sector for research and development in 2011. The average expenditure of EU 27 is 1.82% of GDP, in Slovakia it is only 0.48% of GDP, while public funds represent 55% of total spending on research and development. [7]

One of the problems is also continuing low level of effective cooperation of scientific research, educational and economic potential for development and growth of the competitiveness of the industrial base, in conjunction with competitive, innovative products, technologies and services. [1], [7]

For improving the knowledge of basic research in the subsequent stages of industrial research, experimental development and experience, it is necessary to start with principled restructuring of centre of exellence and it is also necessary to rejuvenate the university activities to increase their innovation potential for the needs of Slovak industry. [3]

In 2011, the trend of interannual disinvestment of private sector to reserach and innovation activities kept on. [7]

The production structure of Slovak industry is characterized by low share of production with high added value, low share of innovative products and low export of its own high-tech products. The weakness is also a slow transition from material-intensive production to industries utilizing modern technologies. [7]

Examples of some EU countries point to the fact that in the process of public support in strategic areas it is possible to achieve the worldwide success. [3]

The priority of the next period: [3], [7]

- providing support tools for modernization of industry and agriculture for purpose of increasing the efficiency of utilization of raw materials and energy,
- development of industrial innovation as a key tool for economic growth and maintain competitiveness,

the involvement of businesses in innovative international cooperation, networking to promote international cooperation Slovak research and development capabilities and manufacturing companies, with the participation of universities.

IV. CONCLUSION

The limiting factor in achieving positive results is especially the lack of financial backing and adverse conditions in which the innovation process takes place in Slovakia. Therefore the first priority is a complex and coordinated public support for innovation activities in the private and public sectors and creating favourable conditions for their development.

According to analyses listed above it is possible to summarize the most important priorities of the next period for increasing the innovation potential [3], [7]:

- providing support tools for modernization of industry and agriculture for purpose of increasing the efficiency of utilization of raw materials and energy,
- development of industrial innovation as a key tool for economic growth and maintain competitiveness,
- the involvement of businesses in innovative international cooperations, networking to promote international cooperation Slovak research and development capabilities and manufacturing companies, with the participation of universities.

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