

## ASSESSMENT OF NATIONAL INNOVATION PERFORMANCE OF THE BALTIC COUNTRIES

**Bahman Peyravi**

*Department of International Economics and Business Management, Faculty of Business Management, Vilnius Gediminas Technical University, VGTU Saulėtekio al. 11, LT-10223 Vilnius, Lithuania  
E-mail: bahman.peyravi@vgtu.lt; bahman.peyravi@gmail.com*

**Abstract.** This paper’s aim is to assess national innovation performance of Baltic countries (Lithuania, Latvia and Estonia) based on European innovation scoreboard results. The paper leans on the performance on each indicator and analyses the main factors behind the development in innovation performances in each country. The main underline of the paper is to explore the main factors which have been developed after being member of the European Union. The results of the paper indicates the inability achieve the standard of human capital, the impact of small economy. Estonia has higher innovation performance among other Baltic states; successful attraction of the foreign investment can be seen as the main cause. Furthermore, the positive relation with Nordic states and favorable tax policy in notable force for higher innovation performance in Estonia.

**Keywords:** innovation, innovation performance, indicators for innovation performance, Baltic countries, innovation scoreboard, Social and economic development.

**JEL Classification:** O30; O40.

### 1. Introduction

It is unquestionable that innovation is a main force for the economic growth and social development either in Europe or in the world. Without doubt, it is important to emphasize the dynamic of the innovation has great effect on the decision-making process of the investors.

The paper indicates that, the measuring the innovation performance is important from some aspects. Firstly, it is important to enforce development of the innovation theories and also for theoretical analysis. Secondly, it is important for the development of innovation policy and its implementation.

Finally, the importance of innovation assessment presents significant inputs for the companies in order to develop sustainable strategies in innovation activities.

The composite indicators take important role in order to measure innovation performance of the countries. However, it does not illustrate whole comprehensive overview but the role of the indicator has increased in the assessment of the innovation activities in recent history. Thus, it is possible to see the use of composite indicators in many key official documents including EIS reports. This paper’s aim is to assess national innovation performance of Baltic States based on EIS. The paper leans on the performance on each indicator and analyses the main

factors behind the development in innovation performances in each country.

The main underline of the paper is to explore the main factors which have been developed after being member of the EU. The results of the paper indicates the inability achieve the standard of human capital, the impact of small economy. Estonia has higher innovation performance among other Baltic states; successful attraction of the foreign investment can be seen as the main cause.

The aim of the study is to provide information for policy development and for decision making process that promotes the development process in innovation performance.

Theoretical and methodological framework for analysing national innovation performance, results of the comparative analysis of innovation performance in the Baltic States (comparative analysis based on EIS and IUS reports) and conclusions and discussion are the following parts of the paper.

### 2. Literature review

It is important to emphasize on the understanding of innovation process in literature. There are different approaches on innovation theories aiming to establish link with social and economic development (Table 1).

Table 1. Categories of innovation theories by some authors (Source: prepared by author)

Authors	Approach: categories of innovation theories
Rodriguez-Pose and Crescenzi (2008)	Linear model, system of innovation, knowledge spillover
Landry <i>et al.</i> (2002)	Engineering, Market pull, chain link, technological network, social network
Marinova, Phillimore (2003)	Black box model, linear models, interactive models, system models, evolutionary models, innovative milieu

This approaches above; in general, departure from science-market based innovation theories and ends with knowledge based economy approaches.

Fagerberg (2005), emphasis on the concepts to raise the perception of innovation phenomenon, including “system”, “network” and “national innovation system”. Furthermore, Lundvall *et al.* (2002) indicated the use of national innovation system concept to develop European countries and it has applied recently for the less developed states.

In some recent studies, it is strongly noted that during the crisis the countries with the strong national innovation system has given better respond in order to overcome the effect of the crisis (Filipetti, Archibugi 2011).

Some important scientific study has been made to unclosethe benefits of effective public innovation policies to display the necessity of innovation in CEE economic area. Taking into consideration all the indicated facts above, the role and conceptual models of public innovation support in fostering innovation in business (Barret, Hill 1984; Braczyk *et al.* 1998; Miles 2004; Earl 2004; Tan 2004; Melnikas 2005), provision of innovation support services in line with other public measures (Kox, Lejour 2006; Lundvall *et al.* 2002; Mackay 2007; Sherwood 2002), organization and institutional forms for public innovation support and public sector as a main developer of innovations.

There are many studies which emphasis the importance of the innovation in regional level.

Rodriguez-Pose and Crescenzi (2008) specified that “this level constitutes the essential thing that is changing in a process of evolutionary economic change”. As mentioned before, the reading of innovation has progressed in parallel with understanding of innovation process.

According to Arundel and Hollanders (2008), during the 1980s various methods has been developed to measure innovation. However, there are several issues that researchers have been faced in

order to use innovation indicators for the comparative assessment (see Smith 2005). Thus, the needs for wide innovation surveys were started in the beginning of 1990s for example community innovation survey (CIS).

In Europe, the main composite indicator is the EIS. Hollanders (2008) remarks three policy needs that innovation scoreboards can serve. Changes in national strengths and weakness, interest of policy makers and early warning of national problems. However, some researches such as Grupp and Schubert (2010) criticized the lack measurement system of the EIS.

Innovation surveys could be considered as two types: subject approach surveys and object approach surveys (Smith 2005). The subject approach surveys leans on the innovating firm and records information on the input to the innovation process. The object approach surveys leans on the innovation itself and records information on the output of the innovation process.

Paas and Poltimae (2010), explain that, as with significant changes in innovation history, innovation measurement has majorly based on unique indicators like number of patents, R&D investments etc. Nevertheless, these indicators usually show only single sight of the complex phenomenon of innovation. Furthermore, it do not present a comprehensive overview. The importance of composite indicators have significantly increased in the evaluation of the innovation capability in recent decades.

Various composite indicators are implemented by some international associations and organisations, for example, the Economic Commission, the World Bank, World Economic Forum, UN institutions and some others.

Innovation scoreboards primarily can serve three main policy demands (Arundel, Hollanders 2008). First of all, they move as an “early warning” system for expected issues at the national level. Secondly, if over time have used, then they can follow up alterations in national weaknesses and strengths. And as the third, they may have the attention of policy-makers, including civil authorities and selected officials. Actually, mass media and politicians use these composite indicators regularly in their activities (Paas, Poltimae 2010).

Although, there are some negative view pointed by some key authors on composite indicators, still, it can seen as the best tool in order to evaluate innovation performance and environment especially in national level.

In Europe, the most widely set of the composite innovation indicators is the European Innovation Scoreboard (EIS).

European Innovation Scoreboard is an assessment method of the European Commission, developed to provide a comparative assessment of the innovation performance of EU member States. The report is replaced by the Innovation Union Scoreboard since 2011.

### Technical evaluation: Calculating composite scores

The main difference between innovation leaders and other countries within EU is strong cooperation and it is the key element between private and public sector and the national R&D and innovation system.

The methodology used for calculating this composite innovation indicator consist seven steps (IUS 2013: 65–66);

1. Step: Identifying and replacing outliers. Positive outliers are identified as those relative scores which are higher than the mean across all countries plus 2 times the standard deviation. Negative outliers are identified as those relative scores which are smaller than the mean across all countries minus 2 times the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all countries.
2. Step: Setting reference years. For each indicator a reference year is identified based on data availability for all countries for which data availability is at least 75%. For most indicators this reference year will be lagging 1 or 2 years behind the year to which the IUS refers. Thus for the IUS 2013 the reference year will be 2010 or 2011 for most indicators.
3. Step: Imputing for missing values. Reference year data are then used for “2012”, etc. If data for a year-in-between is not available we substitute with the value for the previous year. If data are not available at the beginning of the time series, we replace missing values with the latest available year. The following examples clarify this step and show how “missing” data are imputed. If for none of the years data is available, no data will be imputed.
4. Step: Determining Maximum and Minimum scores. The Maximum score is the highest relative score found for the whole time period within all countries excluding positive outliers.

Similarly, the Minimum score is the lowest relative score found for the whole time period within all countries excluding negative outliers.

5. Step: Transforming data if data are highly skewed. Most of the indicators are fractional indicators with values between 0% and 100%. Some indicators are unbound indicators, where values are not limited to an upper threshold.

These indicators can be highly volatile and can have skewed data distributions (where most countries show low performance levels and a few countries show exceptionally high performance levels).

For the following indicators skewness is above 1 and data have been transformed using a square root transformation: Non-EU doctorate students, Venture capital investments, Public-private co-publications, PCT patent applications, PCT patent applications in societal challenges and License and patent revenues from abroad.

A square root transformation simply means taking using the square root of the indicator value instead of the original value.

6. Step: Calculating re-scaled scores. Re-scaled scores of the relative scores for all years are calculated by first subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum re-scaled score is thus equal to 1 and the minimum re-scaled score is equal to 0. For positive and negative outliers and small countries where the value of the relative score is above the Maximum score or below the Minimum score, the re-scaled score is thus set equal to 1 respectively 0.
7. Step: For each year a composite Summary Innovation Index is calculated as the un-weight average of the rescaled scores for all indicators.

On the other hand, annual growth rate is calculated in accordance generalized approach. Growth for each country (c) per indicator *i* as  $(y_{ic}^t / y_{ic}^{t-1})$  i.e. is as the ratio between the non-normalized values for year *t* and year *t*-1 as obtained after Step 5 in the previous section.

Moreover, to calculate the average yearly growth rate ( $\tau_c^t$ ), aggregate these indicator growth rates between year *t* and year *t*-1 using a geometric average.

It is formulating as:

$$1 + \tau_c^t = \prod_{i \in I} \left( \frac{y_{iC}^t}{y_{iC}^{t-1}} \right)^{W_i}, \quad (1)$$

where:  $I$  – is the set of innovation indicators used for calculating growth rates;  $W_i$  – all indicators receive the same weight;  $\tau_c^t$  – yearly growth rate;  $y_{iC}^t$  – growth for each country;  $c$  – country;  $i$  – indicator (i.e. 1/25 if data for all 25 indicators are available).

The average yearly growth rate is invariant to any ratio-scale transformation and indicates how much the overall set of indicators has progressed with respect to the reference year t-1.

For each average yearly growth rate receives:

$$1 + InnovationGrowthRate_c = \prod_t (1 + \tau_c^t)^{W_t}, \quad (2)$$

where:  $W_t$  – same weight;  $t \in (2007, 2011)$ .

The methodology for calculating average innovation performance for the EU27 and its major global competitors is similar to that used for calculating average innovation performance for the EU Member States:

First step, Calculate normalized scores for all indicators as follows:  $Y_i = ((X_i - \text{smallest } X \text{ for all countries}) / (\text{largest } X \text{ for all countries} - \text{smallest } X \text{ for all countries}))$  such that all normalized scores are between 0 and 1.

Second step, Calculate the arithmetic average over these index scores (CI<sub>i</sub>) and third step, Calculate performance relative to that of the EU27 (For detailed information see IUS 2013:66 and also IUS 2015: 80).

The results which obtained for the country (i) are based on data of other countries. The smallest and largest values are calculated in the process of normalization for all countries.

In general, although some approaches do not find see measurement indicators as the proper way to assess innovation ability and performance, this paper departs from the usefulness of the EIS and Innovation union scoreboard (IUS) regarding the majority of the key researchers in order to assess the progress in innovation performances of the Baltic States.

### 3. The research methodology

There are various methods to assess and measure the innovation performance at state level. The methodology aim to identify the impact of innovation performance in social and economic development in Baltic States.

The methodology of research is specific for the aim and contains comparative analysis of data from EIS, IUS and literature review, continued by express a personal interpretation based on the research results.

The literature review is based on studies in order to emphasize the importance of the subject.

### 4. The research results

Economic globalization and dynamics in the last decades in the world have given great energy to Baltic States in the context of Socio-economic development.

Taking into the consideration in significant role of innovation in the global economic changes, the relation and interaction between innovation performance and Socio-economic development must be emphasized.

The key agencies and government departments involved in innovation takes significant role in innovation performance. Innovation is a priority of all EU countries and of the European Commission (EC).

Along Europe, myriad of policy measures and assistance schemes aimed at innovation have been applied or are under process. The variety of these schemes and measures projects the diversity of the framework terms, cultural preferences and political priorities in the Member States.

European Union with the strategic programmes such as Lisbon strategy and Europe2020, have aims to be the world's most competitive economy. The Lisbon Strategy and the Europe2020, the main factor of economic growth has been defined as innovation.

The RIS and IUS (RIS 2012; IUS 2013, 2014, 2015) with its criteria, and other statistical reports indicate the innovation performance of the Baltic States over the years since 2002, before and after membership.

Lithuania is a Moderate innovator. Between 2002 and 2006 Lithuania innovation performance Scores 18–25%. Despite some fluctuations the total innovation performance has been improving among 2010–2014 which place Lithuania from modest to moderate innovator.

The efficiency relative to the EU has been improving in the last few years, which moved the country to the group of Moderate innovators. Due to rapid rates of improvement from 2010 to 2014 Lithuania is currently performing at 39% within EU states (see Fig. 1 and Fig. 4).

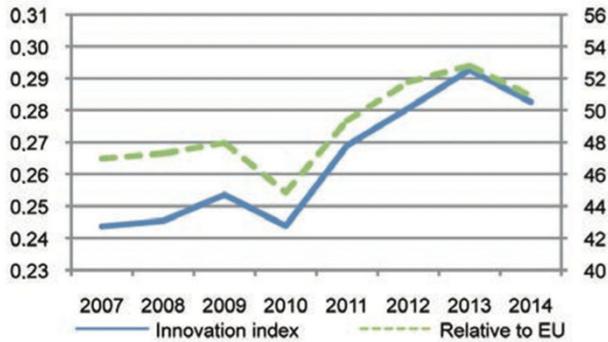


Fig. 1. Lithuania Innovation Performance Relative to EU (2007–2014) (Source: IUS 2015)

Latvia is a Modest innovator. Innovation performance has been increasing at a steady rate until 2012 but dropped in 2013, in particular due to a worsened performance in patent applications.

Latvia has been improving from 20% in 2006 to 26% in 2014.

Although Latvia has lowest performance among Baltic States, Latvia has higher growth performance among them and also comparing with many EU member states and perform as innovation growth leader (see Fig. 2 and Fig. 4).

Among the Modest innovators (2014), the highest innovation progress is recorded in Latvia and whereas a strong performance decline occurred in, Although, in 2010, relatively small or even negative changes were observed in Latvia (−0.1%). Thus, Latvia is close to become moderate innovator.

In general, Latvia is the only countries which managed to significantly improve innovation performance compared to last year among Baltic States.

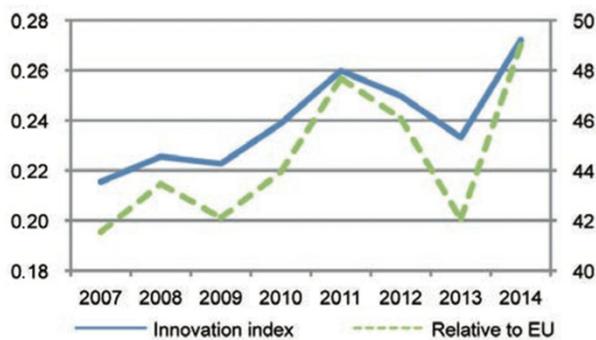


Fig. 2. Latvia Innovation Performance Relative to EU (2007–2014) (Source: IUS 2015)

Estonia is a Moderate innovator although was Innovation follower before 2014. Innovation performance has been increasing at a steady rate since 2007 although the growth rate has slowed down since 2009. Estonia's performance has been improving passing 45% in 2013, which is just above

the threshold between the Innovation followers and Moderate innovators. In general Estonia has higher performance in innovation activities within Baltic States (see Fig. 3 and Fig. 4).

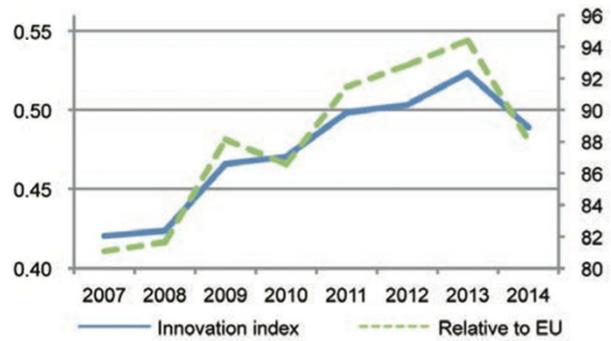


Fig. 3. Estonia Innovation Performance Relative to EU (2007–2014) (Source: IUS 2015)

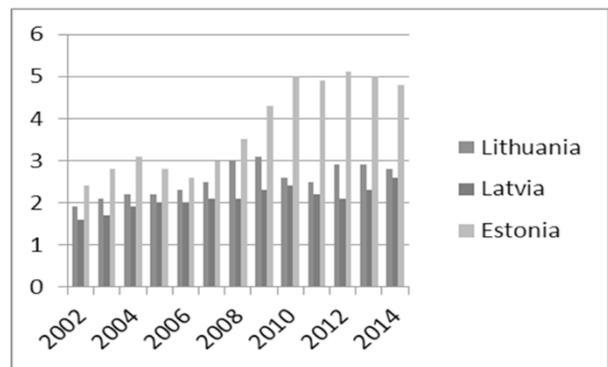


Fig. 4. Innovation Performance of the Baltic States (2002–2014), (Source: prepared by author with reference to EIS 2003–2015)

According to Innovation union Scoreboard 2015 Lithuania has been improved average growth performance (2007–2014) and scores 2.1%. This performance is the lowest rate within Baltic States performance. Latvia has scored 3.4% and Estonia has scored as 2.2%. EU average Growth Performance has scored 1.7% (see Fig. 5).

According to IUS 2015, Relatively Lithuania has worst growth rates are in Non-EU doctorate students, license and patent revenue from abroad, PCT patent applications in social challenges. Non-R&D innovation expenditure and youth with secondary level education have growth rate above EU average.

Lithuania has performed highest growth in license and patent revenue from abroad approximately 61%. Furthermore, community trademarks and community design scored high performance.

Latvia's worst performance license and patent revenue from abroad as well as Non-EU doctorate students and Public-private co-publications. Relative strengths for Latvia are in Non-R&D innovation

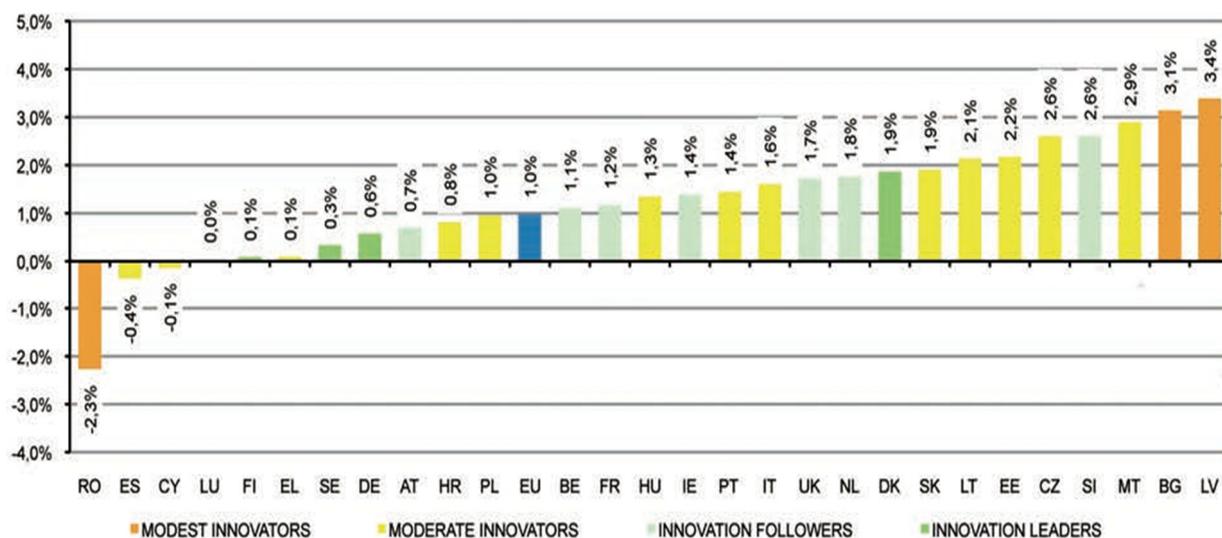


Fig. 5. EU Member States' growth performance (2007–2014) (Source: IUS 2015)

expenditures, Population with completed tertiary education and Youth with upper secondary level education.

High growth performance is observed in new doctorate graduates, Non-EU doctoral students and community trademarks.

Finally, examination of innovation performance in Estonia indicates that, Non-EU doctorate students and license and patent revenue from abroad are scored below EU average.

Relative strengths in dimensions are Finance and support and Firm investments. Estonia scores above EU average on International scientific co-

publications, Non-R&D innovation expenditures and Community trademark.

Performance has improved most strongly in the dimensions of Open, excellent and attractive research systems (14%) and Intellectual assets (17%), in particular due to a strong performance increase in Non-EU doctorate students (26%) and Community designs (24%).

Growth has been negative in three dimensions: Innovators (–3.5%), Firm investments (–1.9%) and Linkages and entrepreneurship (–1.1%) (see Table 2).

Table 2. Innovation growth rate (%) in each indicator (2007–2014) (Source: prepared by author with reference to IUS 2015)

Indicator growth rate % (2007–2014)	EU	LT	LV	EE
<b>Human Resources</b>	2.2	3.6	5.4	3.3
New doctorate graduates	2.6	6.7	14	5.2
Population with completed tertiary education	3.6	3.8	1.8	4.3
Youth with secondary level education	0.5	0.4	0.9	0.3
<b>Open. Excel. Research Systems</b>	3.9	3.3	15	14
International scientific co-publications	6.7	9.8	7.6	12
Most cited scientific publication	1.5	11	6.3	4
Non-EU doctorate students	3.5	–10	32	26
<b>Finance and Support</b>	–3.1	3.2	3.9	6
R&D expenditures on public sector	1.9	3.2	3.9	6
Venture capital investment	–7.9	N/A	N/A	N/A
<b>Firm Investments</b>	1.9	4.6	–3.7	–1.9
R&D expenditures in the business sector	1.9	1.3	–9	7.5
Non-R&D innovation expenditures	1.9	8	2	–10

Continued Table 2

<b>Indicator growth rate % (2007–2014)</b>	<b>EU</b>	<b>LT</b>	<b>LV</b>	<b>EE</b>
<b>Linkages and Entrepreneurship</b>	1.3	8.8	-2.8	-1.1
SMEs innovation in-house	-0.8	-3.5	-0.6	-4.2
Innovative SMEs collaborating with others	2.5	-4.4	-3	-1.9
Public-private scientific co-publications	2.3	8.8	-2.8	-1.1
<b>Intellectual Assets</b>	2.1	6.5	5.9	17
PCT patent applications	-0.4	3.2	2.5	6.9
PCT patent applications in societal challenges	2	-11	4.5	18
Community trade marks	5.1	18	17	22
Community designs	1.7	18	0.6	24
<b>Innovators</b>	-1.5	-2	1.8	-3.5
SMEs with product/process innovations	-1.7	-2.9	1.2	-4.6
SMEs with marketing/organizational innovation	-3.3	-1.7	7.5	-6.1
Fast-growing innovative firms	0.5	-1.4	-2.9	0.3
<b>Economic Effects</b>	1.8	7.5	1.9	0.3
Employment in knowledge-intensive activities	0.6	2.6	4.2	3.3
Contribution in MHT exports to trade balance	-0.8	-0.9	2.3	2
Knowledge-intensive service exports	0.7	-1.4	-0.5	3.1
Sales shares of new innovations	-0.8	-11	5.9	-7.7
License and patent revenues from abroad	9.8	61	-2.1	1.2

Compared to the IUS 2014, according to IUS 2015, Estonia have changed group membership from the Innovation followers to the Moderate innovator. In addition to Estonia, only Lithuania has managed to significantly improve its performance compared to IUS 2014 now performing above the EU average.

In general, Estonia has scored the best innovation performance from 2002 till 2014 (before and after membership).

High interaction between Estonia and Nordic countries especially Finland can be seen as the primary factor of the high innovation performance. Lithuania takes second place within Baltic states and takes 4<sup>th</sup> place in EU regarding to its innovation performance just after modest innovators as the moderate innovator.

Latvia has lowest innovation performance among Baltic States and takes 3<sup>rd</sup> place as modest innovator after Romania and Bulgaria. On the other hand, Latvia has highest growth performance within all EU countries (IUS 2015).

## 5. Conclusions and discussion

The paper assesses national innovation performance of the based on the composite indicators of the EIS. The main aim of the study was the assessment of the innovation performance in the Baltic States.

The composite indicators take important role in order to measure innovation performance of the countries. However, it does not illustrate whole comprehensive overview but the role of the indicator has increased in the assessment of the innovation activities in recent history. Thus, it is possible to see the use of composite indicators in many key official documents including EIS reports.

The results of the study indicate that the indicators of human resources take only some important part of education system. Moreover, although there are some issues regarding interaction between human resources and innovation activities which linked to illustrate status of in research and higher education, the EIS indicators shows the Baltic States are performing well in terms of human capital especially in Latvia.

The mutual issue in Baltic States is non-efficient integration between enterprises and research which can be observed in EIS.

Another important problem is the dependency of the economy on single enterprises which can easily impact on their performance due to investment by single enterprises (for example, Non-R&D expenditure).

Estonia has higher innovation performance among other Baltic states; successful attraction of the foreign investment can be seen as the main cause. Furthermore, the positive relation with Nordic states

and favorable tax policy in notable force for higher innovation performance in Estonia.

## References

- Arundel, A.; Hollanders, H. 2008. Innovation scoreboards: indicators and policy use, in C. Nawelaers, R. Wintjes (Eds.). *Innovation policy in Europe: measurement and strategy*. Massachusetts: Edward Elgar publishing Ltd, 29–50.
- Barret, S.; Hill, M. 1984. Bargaining and structure in implementation theory: towards an integrated perspective, *Policy and Politics* 12(3): 219–240.  
<http://dx.doi.org/10.1332/030557384782628291>
- Braczyk, H.; Cooke, P.; Heidenreich, M. 1998. *Regional innovation systems*. London: UCL Press Limited, 122–123.
- Earl, L. 2004. *An historical comparison of technological change, 1998–2000 and 200–2002, in the private and public sectors*, Working paper 79. Statistics Canada, Ottawa.
- Fagerberg, J. 2005. Innovation: a guide to the literature, in *The Oxford handbook of innovation*. Oxford university press, 148–177.
- Filipetti, A.; Archibugi, D. 2011. Innovation in times of crisis: National systems of innovation, structure and demand, *Research Policy* 40(2): 179–192.  
<http://dx.doi.org/10.1016/j.respol.2010.09.001>
- Grupp, H.; Schubert, T. 2010. Review and new evidence on composite innovation indicators for evaluating national performance, *Research Policy* 39(1): 67–78. <http://dx.doi.org/10.1016/j.respol.2009.10.002>
- Hollanders, H. 2008. *Rethinking the European innovation scoreboard. A new methodology for 2008–2010: INNNO-metrics, UNU-MERIT*. Maastricht.
- IUS 2013. *Innovation Union Scoreboard* [online], European Commission [cited 12 December 2015]. Available from Internet: [https://era.gv.at/object/document/365/attach/ius-2013\\_en.pdf](https://era.gv.at/object/document/365/attach/ius-2013_en.pdf)
- IUS 2014. *Innovation Union Scoreboard* [online]. European Commission [cited 6 November 2015]. Available from Internet: <http://bookshop.europa.eu/en/innovation-union-scoreboard-2014-pbNBAY14001/?pgid=IqIEkni0.1ISR00OK4MycO9B0000rh8EDWB9;sid=L-vUKX-xTFvUPCiRIG1Kjh2UYojKW91yU7s=?Catalog-CategoryID=C5gKABstvcoAAAEjZJEY4e5L>
- IUS 2015. *Innovation Union Scoreboard* [online]. European Commission [cited 6 November 2015]. Available from Internet: [http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/files/ius-2015\\_en.pdf](http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/files/ius-2015_en.pdf)
- Kox, H.; Lejour, A. 2006. Dynamic effects of European services liberalization: more to be gained, in Secretariat of the Economic Council (Eds.). *Globalisation Challenges for Europe*. Prime Minister's Office Economic Council of Finland, 1–26.
- Landry, R.; Amara, N.; Lamari, M. 2002. Does social capital determine innovation? To what extend?, *Technological Forecasting and Social Change* 69: 681–700.  
[http://dx.doi.org/10.1016/S0040-1625\(01\)00170-6](http://dx.doi.org/10.1016/S0040-1625(01)00170-6)
- Lundvall, B. A.; Johnson, B.; Anderson, E. S.; Dalum, B. 2002. National system of production, innovation and competence building, *Research policy* 31: 213–231.  
[http://dx.doi.org/10.1016/S0048-7333\(01\)00137-8](http://dx.doi.org/10.1016/S0048-7333(01)00137-8)
- Mackay, R. 2007. Services in the context of EU policy for enterprise and industry, in *RESER Conference*, May 2007, Brussels, Belgium.
- Marinova, D.; Phillimore, J. 2003. Models of innovation, in L. V. Shavinina (Ed.). *The international handbook on innovation.*, Oxford: Elsevier science Ltd., 44–50.  
<http://dx.doi.org/10.1016/B978-008044198-6/50005-X>
- Melnikas, B. 2005. Creation of knowledge-based economy in the European Union: the main typicalities and new ideas of clusterization, *Journal of Business Economics and Management* 6(2): 87–100.
- Miles, I. 2004. Innovation in public services, in *PRIME Conference*, June 2004, Manchester, UK.
- Paas, T.; Poltinae, H. 2010. *A comparative analysis of national innovation performance: the Baltic States in the EU context*, Working paper No. 78. University of Tartu, 10–12.
- Rodriguez-Pose, A.; Crescenzi, R. 2008. Research and development, spillover, innovation systems, and the genesis of regional growth in Europe, *Regional Studies* 42(1): 55–65.  
<http://dx.doi.org/10.1080/00343400701654186>
- Sherwood, D. 2002. *Creating an innovative culture*. UK, Capstone Publishing.
- Smith, K. 2005. Measuring innovation, in J. Fagerberg, D. C. Mowery, R. R. Nelson (Eds.). *The Oxford handbook of innovation*. Oxford, New York: Oxford university press, 148–170.
- RIS 2012. *Regional Innovation Scoreboard* [online]. European Commission [cited 10 November 2015]. Available from Internet: <http://bookshop.europa.eu/en/regional-innovation-scoreboard-2012-pbNBAX12021/?CatalogCategoryID=cKYKABsttvUAAAEjrpAY4e5L>
- Tan, B. S. 2004. The consequences of innovation, *The Public Sector Innovation Journal* 9(3): 23–39.