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Aspects of Properly-Functioning National Innovation System: The Case of Latvia

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Abstract: *Innovation support policies should take into consideration all particular qualities of national innovation system in the country, not being one-size-fits-all, in this case, the analysis of strengths and weaknesses of national innovation system is extremely important. Most valuable in this context are policies aiming to improve co-operation between the enterprises and institutions in the innovation system and to increase the innovative capacity of enterprises, in particular their ability to identify and absorb new technologies. Until now, little analysis on the Latvian innovation system was made. The study aims to analyze the Latvian national innovation system and to discuss aspects of properly-functioning Latvian national innovation system. This research allows the policy-makers to investigate the mismatch between policies and problems and to identify policy gaps.*

Key Words: *National Innovation System; Innovation Co-operation; Statistical Information; Financial System; Innovative Technology; Latvia.*

Introduction

The concept of national systems of innovations has attracted the attention of many researchers working in institutional economics and innovation, as well as policy-makers of both developed and developing countries.[1] The concepts like national innovation system[2] and national innovative capacity as the ability of a country to produce and commercialize a flow of innovative technology over the long term[3] receive significant attention.

[1] AMABLE, B., R. BARRÉ and R. BOYER. *Les systèmes d'innovation à l'ère de la globalisation*. 1e éd. Paris: Economica, 1997. 401 p. ISBN 978-2-7178-3332-4; and SAVIOTTI, P. P. *Technological Evolution, Variety and the Economy*. 1st ed. Aldershot: Edward Elgar, 1996. 240 p. ISBN 978-1-85278-774-5.

[2] EDQUIST, Ch. ed. *Systems of Innovation: Technologies, Institutions and Organizations*. 1st ed. London: Pinter, 1997. 423 p. ISBN 978-1-85567-452-3.

[3] FURMAN, J. L., M. E. PORTER and S. STERN. The Determinants of National Innovative Capacity. *Research Policy*. 2002, vol. 31, no. 6, pp. 899-933. ISSN 0048-7333.

Innovation systems theory stresses that the relationships between actors of innovation system and system performance is often determined by the weakest link in the chain. That is why policy interventions should focus on the weaknesses. Nowadays, many different approaches to analyzing national innovation systems are proposed by researchers. As an example, innovation systems can be analyzed at different levels: sub-regional, national, pan-regional and international. The national level may be the most relevant due to the role of country-specific interactions in creating a climate for collaborations for innovation and international technology flows. Enterprise-level innovation surveys ask enterprises about their sources of knowledge most relevant to innovation and allow a ranking of different linkages by industrial sector and country. Cluster analysis focuses on the interactions between particular types of enterprises and sectors, which can be grouped according to their technological and networking characteristics. Patterns of knowledge flows can differ markedly from cluster to cluster and also within countries specialized around different industrial clusters, e.g. forestry, chemicals.[4]

Countries differ both in the quantity of introduced innovations and in the methods by which the innovations are adopted and in their sectoral composition.[5] There are two approaches in analyzing national innovation systems. The first one is based on the analysis of institutions and describing the ways countries have organized their national innovation systems,[6] the second approach is more "conceptual" as it is focused on knowledge and the process of learning: learning-by-using, learning-by-doing etc.[7]

Substantially national innovation system is the interactive system of existing research institutions, private and public enterprises (either large or small), universities and government bodies, aiming at the production of science and technology within national borders. Interaction among these actors may be legal, commercial, technical, social and financial as

[4] *National Innovation Systems* [online]. 1st ed. Paris: Organisation for Economic Co-operation and Development, 1997. 48 p. [cit. 2013-11-10]. Available at: http://www.oecd.org/science/innovationinsciencetechnologyandindustry/2101733.pdf.

[5] ARCHIBUGI, D. and J. MICHIE. Technology and Innovation: An Introduction. *Cambridge Journal of Economics*. 1995, vol. 19, no. 1, pp. 1-4. ISSN 0309-166X.

[6] NELSON, R. R. ed. *National Innovation Systems: A Comparative Analysis*. 1st ed. New York: Oxford University Press, 1993. 560 p. ISBN 978-0-19-536043-1.

[7] LUNDVALL, B.-A. ed. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. 1st ed. London: Pinter, 1992. 342 p. ISBN 978-1-85567-063-1.

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well as the target of these interactions may be development, protection, regulation or financing of new science and technology.[8]

Mainly research of national innovation systems focuses on the ability of the innovation system in any particular country to deal with production diffusion and use of knowledge in the innovation process.[9] Less attention has been given to the response from consumers to new or developed products or services, so called the demand side. Several researchers have highlighted that education and training, improving competencies, individual learning and creation of human capital, as significant determinants of innovation, are usually listed under functions and activities of national innovation systems.[10]

The broad aim of the national innovation system approach is to help explain a process of innovation by taking into account all significant factors those create and influence innovations.[11] When national innovation systems are organized appropriately and functioning well, they can be a powerful engine of economic and scientific development progress.[12]

The theoretical aspects of national innovation system

The profit motive stimulates a continual search by producers for newer, better or cheaper products and services. This process of "creative destruction", according to the economist Joseph Schumpeter, is what drives economic growth forwards. For the private enterprises, the ability to in-

[8] NIOSI, J., P. SAVIOTTI, B. BELLON and M. CROW. National Systems of Innovation: In Search of a Workable Concept. *Technology in Society*. 1993, vol. 15, no. 2, pp. 207-227. ISSN 0160-791X.

[9] EDQUIST, Ch. ed. *Systems of Innovation: Technologies, Institutions and Organizations*. 1st ed. London: Pinter, 1997. 423 p. Science, Technology and the International Political Economy Series. ISBN 978-1-85567-452-3.

[10] E.g. EDQUIST, Ch. Systems of Innovation: Perspectives and Challenges. In: J. FAGERBERG, D. C. MOWERY and R. R. NELSON, eds. *The Oxford Handbook of Innovation*. 1st ed. New York: Oxford University Press, 2005. 656 p. ISBN 978-0-19-928680-5; and LIU, X. and S. WHITE. Comparing Innovation Systems: A Framework and Applications to China's Transitional Context. *Research Policy*. 2001, vol. 30, no. 7, pp. 1091-1114. ISSN 0048-7333.

[11] SURIYANI, M., A. H. FAUZIAH, K. ROKIAH and N. F. N. M. KAMIL. The Missing Link of Human Capital Development in National System of Innovation Model. *Advances in Natural and Applied Sciences*. 2012, vol. 6, no. 6, pp. 875-881. ISSN 1995-0772.

[12] NELSON, R. R. What Has Been the Matter with Neo-Classical Growth Theory?. In: G. SILVERBERG and L. SOETE, eds. *The Economics of Growth and Technical Change: Technologies, Nations, Agents*. 1st ed. Aldershot: Edward Elgar, 1994, pp. 290-324. ISBN 978 1 85278 958 9.

novate – to design, produce and market newer and more exciting products – is vital. Firms which fail in this process risk their own survival.

The several attempts were made to define the concept of national innovation system. Lundvall separates a broad and a narrow definition of the innovation system.[13] The narrow definition includes organizations and institutions involved in research and exploring, such as R&D departments, technological institutes and universities. In turn, the broad definition is a system of actors and relationships which interact for the production, diffusion and use of new and economically useful knowledge.

One can conclude that the main elements of national innovation systems are institutions and linkages. Johnson defines "institutions are set of habits, routines, rules, norms and laws, which regulate the relations between people, and shape social interaction."[14] In turn, linkages and flows include human flows between universities, enterprises, and government laboratories, financial flows between government and private organizations, regulation flows from government bodies towards innovative organizations, and knowledge flows among these institutions. Their characteristics may be helpful or harmful to the smart and efficient operation of the national innovation systems.[15]

Determining the strengths and weaknesses of the national innovation system is a difficult matter, as a mix of qualitative and quantitative indicators is required. Dr. Willie Golden proposed the following indicators to provide a holistic picture of the state of a national innovation system:[16]

- *Innovation*. Production of innovations is the ultimate goal of national innovation system: input measures are concerned with expenditure on innovation while outputs are considered to be at least one technically new or improved product or process from a firm, as well as the amount of patents applied for from the European Patent Office and

[13] LUNDVALL, B.-A. ed. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. 1st ed. London: Pinter, 1992. 342 p. ISBN 978-1-85567-063-1.
[14] JOHNSON, B. Institutional Learning. In: B.-Å. LUNDVALL, ed. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. 1st ed. London: Pinter, 1992, pp. 20-43. ISBN 978-1-85567-063-1.
[15] NIOSI, J. National Systems of Innovations Are "X-efficient" (and X-effective). Why Some Are Slow Learners?. *Research Policy*. 2002, vol. 31, no. 2, pp. 291-302. ISSN 0048-7333.
[16] GOLDEN, W., E. HIGGINS and S. H. LEE. *National Innovation Systems and Entrepreneurship*. 1st ed. Galway: National University of Ireland, Centre for Innovation and Structural Change, 2003. 24 p. Working Paper, no. 8.

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the production of scientific publications as evidence of the production of innovations.

- *Knowledge Flows*. To analyze this aspect an examination of statistics concerning R&D, human resource aspects, linkages between institutions and the technical balance of payments is required.
- *Policies*. Policies cannot be measured statistically but are vital to our estimation of the NSI as a process. As national innovation system is a relatively new concept, it is best only to look at recent policy implementations those directly affect constituent elements of the individual national systems of innovation.
- *Industrial Clusters*. In the national innovation system context, clusters allow us to see the functionality of the system in operation. Since there is no universal agreement on direct measurements of cluster productivity, analysis of clusters may be qualitative, focusing on the existence, purpose and obvious success of clusters rather than their compliance with theoretical models.

The definition of national innovation systems has changed during time. Freeman defined national innovation system as "… the network of institutions in the public- and private-sectors whose activities and interactions initiate, import, modify and diffuse new technologies."[17] In 2003 Hall proposed a broader definition "at its simplest as innovation system is the groups of organizations and individuals involved in the generation, diffusion and adaptation, and use of knowledge of socio-economic significance, and the institutional context that governs the way these interactions and processes take place."[18]

Within one country – Latvia – several definitions of national innovation system exist. Enterprise Europe Network Latvia provides the following definition: "National Innovation System is defined as structure of national economy and environment necessary for productive innovation. Innovation system has four basic components: 1) research (science and education); 2) entrepreneurship; 3) investment (financial system);

[17] FREEMAN, C. *Technology Policy and Economic Performance: Lessons from Japan*. 1st ed. London; New York: Pinter, 1987. 155 p. ISBN 978-0-86187-928-1.

[18] HALL, A. J., B. YOGANAND, R. V. SULAIMAN and N. G. CLARK, eds. *Post-Harvest Innovations in Innovation: Reflections on Partnership and Learning*. 1st ed. Patancheru; Aylesford: Crop Post-Harvest Programme, South Asia; Natural Resources International, 2003. 180 p. ISBN 0-9539274-8-2.

4) legislation."[19] In authors' opinion this definition is uncertain as it does not explain how to ensure appropriate structure and environment of national economy for successful innovation activities and does not give any further explanation on the criteria to evaluate the compliance of structure and environment of national economy.

The national innovation system in Creating a 21st Century National Innovation System for a 21st Century Latvian Economy is defined as "way of interaction between the private sector, higher education institutions, research institutes and government policy to create inventions and innovations, the results of which can be converted into new products and production processes, which contribute to a competitive advantage of public enterprises."[20] This definition mentions only the necessity to achieve a competitive advantage of public enterprises; nothing is said about the consumer needs.

Latvian Program for Promotion of Business Competitiveness and Innovation 2007 – 2013 defines national innovation system as "aggregate of governmental, public and private sector institutions and events implemented by them, which promotes creation, storage, exchange and practical application of new knowledge. It includes research (education, science, and creation), business, financial system, legislation."[21] This definition does not take into account that a system is not just a set of government, public and private sector institutions, but rather some kind of their interaction.

The authors propose the following definition: the national innovation system is the system of close co-operation between private and public enterprises, universities, private and public research institutions, government bodies aiming at developing innovation in accordance with consumers' needs for new or developed products or services. According to the dictionary, the term "co-operation" is "an act or instance of working

[19] Innovation and Entrepreneurship. In: *Enterprise Europe Network Latvia* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.een.lv/pakalpojumi/inovacija-un-uznemejdarbiba/termini-un-skaidrojumi.

[20] WATKINS, A. and N. AGAPITOVA. *Creating a 21st Century National Innovation System for a 21st Century Latvian Economy*. 1st ed. Washington, D.C.: World Bank, 2004. 95 p. World Bank Policy Research Working Paper, no. 3457.

[21] *Program for Promotion of Business Competitiveness and Innovation 2007 – 2013: (Informative Part)* [online]. 1st ed. Riga: Ministry of Economics of the Republic of Latvia, 2007. 42 p. [cit. 2013-11-10]. Available at: http://www.em.gov.lv/images/modules/items/KVIP_eng%20(2).pdf.

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or acting together for a common purpose or benefit; joint action", in turn "interaction" is "a reciprocal action, effect, or influence".[22] The authors believe that the functioning of national innovation system should be based on co-operation rather than on interaction as for successful and productive innovation results; the financial, legal etc. decisions in any level of the system of innovations should be made in accordance with needs, strengths and weaknesses of all actors of the system. Only in these circumstances, all the actors will work as a team, as a single innovation system. One more significant issue that should be taken into consideration is that the production of novelty would be of little value to enterprises if there were no market for the consumption of novelty in households. That is why recognising the existence, and understanding the nature of this demand is essential.

The Latvian national innovation system

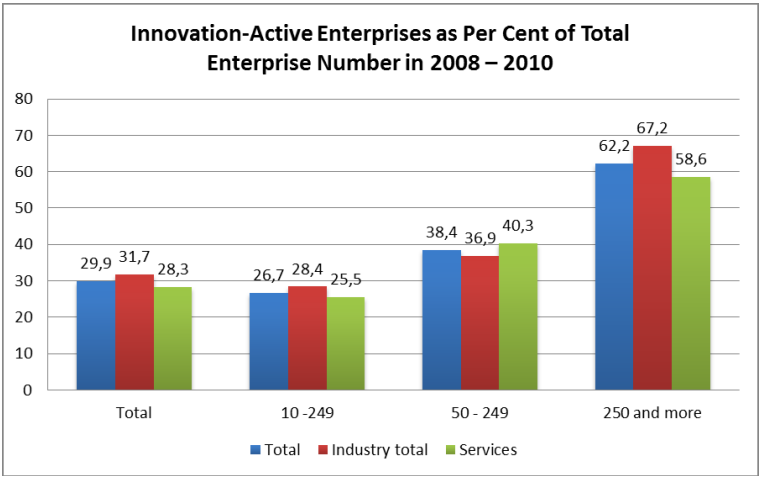
Latvia has performed badly in terms of R&D and innovation. According to the last innovation and R&D survey results, between the EU27 Member States Latvia is one of the countries with the lowest proportion of innovative enterprises. According to the EU rating of innovativeness in 2008 – 2010, Latvia was the third worst performer after Bulgaria and Poland. Survey data (see Graph 1) show that during the time period from 2008 till 2010 in Latvia 29.9 % of enterprises introduced innovations. The most popular way to innovate in 2008 – 2010 was through introducing new processes. The percentage of innovators who introduced process innovation is 19.2 %. Product innovations are less widespread. Only about 15.2 % of innovators offered new products. The majority of innovations were developed in large enterprises (62.2 %). About 31.7 % of innovation-active enterprises during 2008 – 2010 were active in industry and only 28.3 % in services spheres.

According to Innovation Union Scoreboard 2011 results Latvia is one of the modest innovators with a below average performance. Relative strengths are in human resources, firm investments, intellectual assets and economic effects. Relative weaknesses are in open, excellent and attractive research systems, finance and support, linkages & entrepreneurship and innovators. High growth is observed in Community trademarks and Community designs. A strong decline is observed for innovative

[22] Co-operation. In: *Dictionary.com* [online]. 2013 [cit. 2013-11-10]. Available at: http://dictionary.reference.com/browse/.

SMEs collaborating with others and license and patent revenues from abroad. Growth performance in human resources, open, excellent and attractive research systems and intellectual assets is well above average.[23]

Graph 1 Innovation-Active Enterprises as Per Cent of Total Enterprise Number in 2008 – 2010



Source: *Research and Development and Innovation Statistics 2012*. 1st ed. Riga: Central Statistical Bureau of Latvia, 2012, p. 13. ISBN 978-9984-06-435-2.

Although some scientists have made a contribution to developing the Latvian national innovation system concept,[24] study on national innovation system concept in Latvia as a whole is still at the early stage because of lack of legislation, officially adopted and approved definition and concept of national innovation system.

Why do we need to study the Latvian national innovation system, to analyze its strengths and weaknesses and as a result to develop its structure? The innovative performance reflects the preconditions for innovative output provided by the institutional and socio-economic structures

[23] *Innovation Union Scoreboard 2011* [online]. 1st ed. Brussel: European Union, 2012. 98 p. [cit. 2013-11-10]. ISBN 978-92-79-23174-2. Available at: http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf.

[24] E.g. BOĻŠAKOVS, S. *Inovatīvā darbība Latvijā*. 1. izd. Rīga: Jumava, 2008. 324 p. ISBN 978-9984-38-465-8; and WATKINS, A. and N. AGAPITOVA. *Creating a 21st Century National Innovation System for a 21st Century Latvian Economy*. 1st ed. Washington, D.C.: World Bank, 2004. 95 p. World Bank Policy Research Working Paper, no. 3457.

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of the national innovation system as a whole.[25] Each country should develop its own national innovation system as each country has its own institutional profile depending on the governance regime for enterprises, the organization of the university sector, the level and orientation of government-funded research, priority sectors etc. With a richer understanding of national innovation system concept, it may then be possible for policy-makers to develop policy recommendations those help to produce more systemic and effective NIS in Latvia.

In Latvia the most important state authorities those ensure the development and implementation of the science, technology and innovation development policy which are mentioned in the Law on Scientific Activity are the Cabinet of Ministers, the Ministry of Education and Science, the Ministry of Economics, Latvian Council of Science, Latvian Academy of Sciences.

According to the Law on Scientific Activity, one of the functions of the Cabinet of Ministers is to "determine the State policy for the development of science and technology, as well as innovation," the Ministry of Education and Science shall "develop the State policy for the development of science and technology."[26]

The Ministry of Economics of the Republic of Latvia is the lead government body in the field of economic policy, and is responsible for the development and implementation of innovation and industrial policy in Latvia. According to the Law on Scientific Activity, the Ministry of Economics shall "develop innovation policy; and may enter into delegation and participation agreements regarding the introduction and implementation of international technology transfer projects and programmes."[27]

The Latvian Academy of Sciences facilitates the development of sciences, carries out scientific research. The Latvian Academy of Sciences may associate with scientific research institutions, societies, foundations, scientific technical organizations, universities, and higher educational in-

[25] LUNDVALL, B.-Å., J. VANG, K. J. JOSEPH and C. CHAMINADE. Innovation System Research and Developing Countries. In: B.-Å. LUNDVALL, K. J. JOSEPH, C. CHAMINADE and J. VANG, eds. *Handbook of Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Setting*. 1st ed. Cheltenham; Northampton: Edward Elgar, 2009, pp. 1-30. ISBN 978-1-84980-342-7.

[26] The Law on Scientific Activity. In: *Latvijas Vēstnesis* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.likumi.lv/doc.php?id=107337.

[27] The Law on Scientific Activity. In: *Latvijas Vēstnesis* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.likumi.lv/doc.php?id=107337.

stitutions. Their collaboration with the Latvian Academy of Sciences is based on mutual agreement. In order to fulfil the goals of the Academy, groups of scientists or institutions are formed, which may function within the Latvian Academy of Sciences.[28]

In accordance with the Law on Scientific Activity, the Latvian Council of Science is a collegiate institution of the scientists with the rights of a legal entity. The Council's tasks include advancement, evaluation, financing and coordination of scientific research in Latvia. The Latvian Council of Science prepares, jointly with the Ministry of Education and Research of Latvia, the draft of the state's science budget for the next year, elaborates draft decisions and drafts of laws aimed at the development and organization of science in Latvia. The Latvian Council of Science distributes funding earmarked for projects among the branch commissions of different fields of science.[29]

Investment and Development Agency of Latvia (LIAA) provides support to innovation by administering a range of programs nationally, which assist scientists and companies to share ideas and develop partnerships, as well as by helping entrepreneurs get their start. For example, LIAA manages 13 incubators located in cities around the country, providing new businesses with infrastructure and services to grow into self-sustaining enterprises. The agency also administers activities those stimulate innovation and entrepreneurialship, including training and information sessions, consultations for new entrepreneurs and an annual competition of business plans.[30]

In Latvia, the opportunities of demand-side innovation policy seem not to be specifically studied, by 2008; the main objective of innovation policy was to implement the majority of supply-side measures (for instance clusters, competence centers, start-ups etc.) which had already been introduced in the majority of European countries. Global financial crisis at the end of 2008 hit Latvia particularly hard and the existing economic circumstances were and still are the key barrier towards introducing demand-side innovation policy in Latvia.

[28] The Law on Scientific Activity. In: *Latvijas Vēstnesis* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.likumi.lv/doc.php?id=107337.

[29] The Law on Scientific Activity. In: *Latvijas Vēstnesis* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.likumi.lv/doc.php?id=107337.

[30] Innovation and R&D Opportunities. In: *Investment and Development Agency of Latvia* [online]. 2013 [cit. 2013-11-10]. Available at: http://www.liaa.gov.lv/invest-latvia/competitive-advantages/innovation-and-rd-opportunities.

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Conditions for properly-functioning Latvian National Innovation System

Technology and R&D nowadays are examined in the innovation system context, which usually means the existence of several related institutions and the development and utilization of technology improvements those take place through the complex processes. Moreover, the utilization of the research results needs some additional institutions, like technology transfer centre, a bank, a consulting company, an enterprise etc.

As authors see, the core factors necessary for properly-functioning Latvian national innovation system are the following:

- informational support;
- capabilities and co-operation of Latvian NIS institutions;
- organization of financial system;
- development of human capital;
- structure of economy;
- distribution of enterprises by size-class;
- cultural and historical facts.

One of the most important factors for properly-functioning of Latvian NIS is informational support, including statistical data. In today's rapidly changing, increasingly interdependent world, productive debate and policy decisions require trustworthy, comparable, and understandable statistical information.[31] The importance of statistics is captured in the following statement: "Why do statistics matter? In simple terms, they are the evidence on which policies are built. They help to identify needs, set goals and monitor progress. Without good statistics, the development process is blind: policy-makers cannot learn from their mistakes and the public cannot hold them accountable."[32] Othman shows that proper and efficient use of statistics leads to better policy and development outcomes, e.g. good statistics help to inform the design and choice of policy, in forecasting the future, to monitor policy implementation.[33] Statisticians should be involved in the policy making process at an early stage to

[31] JESIĻEVSKA, S. Methodological Aspects of Innovation Statistics and the Innovativeness of Latvia. *Lithuanian Journal of Statistics*. 2012, vol. 51, no. 1, pp. 57-65. ISSN 1392-642X.

[32] *2010 World Development Indicators*. 1st ed. Washington, D.C.: World Bank, 2000. 464 p. ISBN 978-0-8213-8232-5.

[33] OTHMAN, A. *The Role of Statistics in Factual-Based Policy-Making* [online]. 1st ed. Department of Statistics Malaysia, 2005. 16 p. [cit. 2013-11-10]. Available at: http://www.statistics.gov.my/portal/download_journals/files/2005/Volume1/Contents_Article_Aziz.pdf.

advise on how the impact of a new policy will be assessed.[34] According to the laws of the Republic of Latvia, Cabinet Regulations and the By-Laws of the Central Statistical Bureau, the CSB is a direct administration body subordinated to the Ministry of Economics and acting as the main performer and coordinator of the official statistical work in the country. That is why authors decided to include the CSB in the Latvian national innovation system.

Capabilities and co-operation between NIS institutions is a broad concept, here we can mention quality of relationship between customers and suppliers, degree of competitive or co-operative behaviour among institutions, enterprises' willingness to co-operate with research institutions and universities, closeness of relationship between enterprises and technology policy. Enterprises play a crucial role in the development of innovations, but the process of development and dissemination of technological improvements includes a complex interaction among enterprises, universities, research centers, government bodies and other organizations. According to Graph 3, in Latvia in 2008 – 2010 co-operation between government or public research institutes and enterprises was very low (13.0 %), co-operation between universities or other higher education institutions and enterprises was higher (19.1 %); the highest co-operation was with other enterprises within the same enterprise group (45.8 %).

An organization of financial system includes the following brightest problems in Latvia: the low level of public and private sector investment; all support programs are financed by the EU Structural funds rather than by the public funds. Latvia is aware that an effort in R&D is necessary to ensure a sustainable development of the country, which has badly suffered from the financial crisis. Latvia increased its R&D intensity during the period 2000 – 2008 by an average annual growth rate of 4.1 %, passing from 0.44 % in the year 2000 to 0.61 % in 2008. This increase has been fuelled thanks to an increase in public R&D investment, which rose at an average annual growth rate of 7.1 % (from 0.26 % to 0.46 %).

On the other hand, private R&D fell from 0.18 % to 0.15 %. However, with the deterioration of the economic situation in the country, the public

[34] Fundamental Principles of Official Statistics. In: *United Nations Statistics Division* [online]. 2013 [cit. 2013-11-10]. Available at: http://unstats.un.org/unsd/methods/statorg/FP-english.htm.

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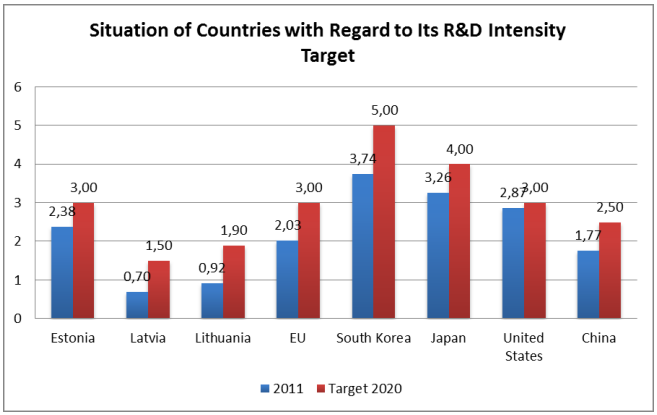
and private sector investment in R&D decreased in 2009 (0.46 %) and again in 2010.

Graph 2 Situation of Countries with Regard to Its R&D Intensity Target



Source: Europe 2020 Targets: Research and Development. In: *European Commission* [online]. 2013, p. 5 [cit. 2013-11-10]. Available at: http://ec.europa.eu/europe 2020/pdf/themes/15_research_development.pdf.

Table 1 Explanations to Figure 1 Latvian National Innovation System

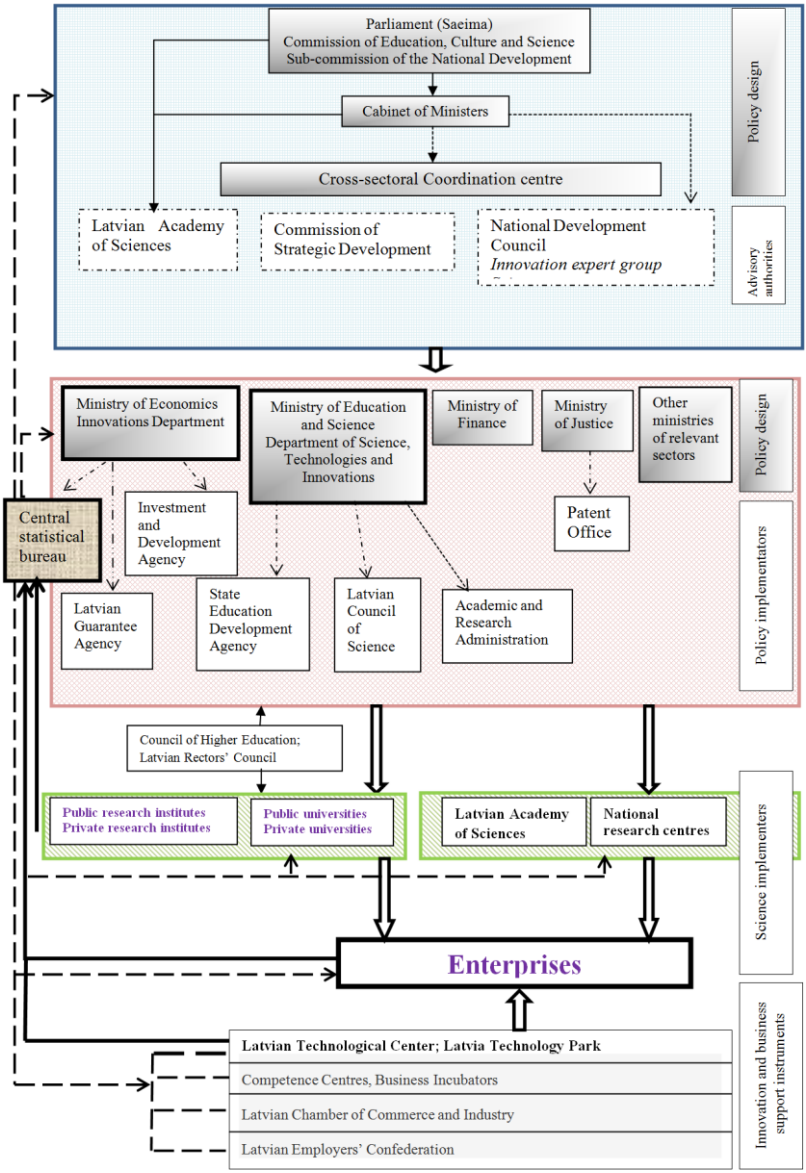
Explanations to Figure 1 Latvian National Innovation System	
---------->	Control of the institution
-·-·-·-·->	Supervision of the institution
—··—··—>	Shareholder of the institution
——▶	Superior institution can give specific tasks or power
▬▬▶	Information flow from respondents while submitting a survey to CSB
▬ ▬ ▶	Statistical information flow from CSB to data users

Source: Authors' construction.

Control means the rights of higher institutions or officials to issue orders to lower institutions or officials, as well as to revoke decisions of lower institutions or officials. Supervision means the rights of higher institutions or officials to examine the lawfulness of decisions taken by lower institutions or officials and to revoke unlawful decisions, as well as to issue an order to take a decision in case of unlawful failure to act.[35]

[35] State Administration Structure Law. In: *Valsts valodas centrs* [online]. 2002. 28 p. [cit. 2013-11-10]. Available at: http://www.vvc.gov.lv/export/sites/default/docs/LRTA/Likumi/State_Administration_Structure_Law.doc.

Figure 1 Latvian National Innovation System



Source: Authors' construction.

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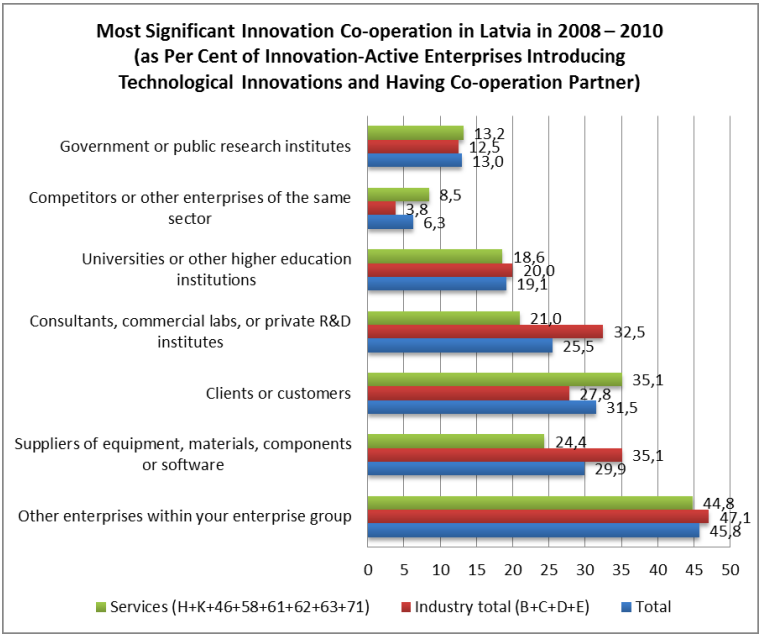
Graph 3 Most Significant Innovation Co-operation in Latvia in 2008 – 2010 (as Per Cent of Innovation-Active Enterprises Introducing Technological Innovations and Having Co-operation Partner)

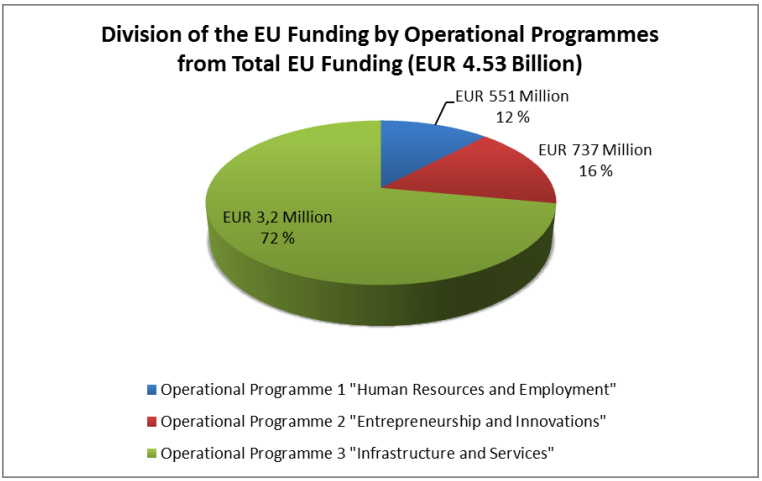


Source: *Research and Development and Innovation Statistics 2012*. 1st ed. Riga: Central Statistical Bureau of Latvia, 2012, p. 24-25. ISBN 978-9984-06-435-2.

Graph 4 shows that during Programming Period 2007 – 2013 only 16 % of EU funding was directed to the Operational Programme 2 "Entrepreneurship and Innovations", which aimed to promote entrepreneurship with higher value added by providing aid in developing and producing new products and technologies, ensuring highly-qualified human resources in enterprises, as well as cooperation of the research and business sectors. About 72 % of EU funding was directed to the Operational Programme 3 "Infrastructure and Services". Authors argue such an allocation of financial resources as in authors' view the development of Latvian national economy cannot be just a "service-based". It is impossible to achieve sustainable development or at least economic stability by reducing manufacturing, continuing to import consumption goods from abroad and expanding financial sector to pay for it. The larger proportion of funding should be directed to the development of science and research

to facilitate knowledge-based national economy. The EU funds in Latvia are administered by the Investment and Development Agency of Latvia.

Graph 4 Division of the EU Funding by Operational Programmes from Total EU Funding (EUR 4.53 Billion)



Source: Programming Period 2007 – 2013. In: *EU Funds* [online]. 2012-06-20 [cit. 2013-11-10]. Available at: http://www.esfondi.lv/page.php?id=658.

Under the development of human capital we would mention not only development of technical human capital base initially, but also the actions to attract foreign human resources, those would make a decisive contribution to the transfer of technical knowledge and know-how to Latvia, and this would facilitate early acquirement of developed technology. Innovation economics continuously demands new skills and competences, creates the need for repeatedly and regularly improve one's knowledge and skills, for return to school in order to adapt to the changing needs of the labour market. However, the educational system of Latvia is not sufficiently flexible in responding to the needs of adult further education.

Distribution of enterprises by size-class is one more essential factor for properly-functioning Latvian national innovation system. The micro and small enterprises are not only providers of services or goods for consumers, but they also help large enterprises to operate more efficiently as they serve as suppliers for large enterprises and as sellers of the products made by large enterprises. According to Eurostat data (see Table 2),

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in Latvia the small and medium-sized enterprises (SMEs) constitute 99.8 % of the national economy and are very important for the creation of gross domestic product and employment. Innovative activities in Latvia are dominated by large companies (see Table 2), whereas the small innovative enterprises should be encouraged by the implementation of special financial support policies.[36]

Table 2 Enterprise Size Class Analysis of Non-Financial Business Economy by Country, 2009

Enterprise Size Class Analysis of Non-Financial Business Economy by Country, 2009					
	Total number of enterprises (thousands)	**Micro (%)**	**Small (%)**	**Medium-sized (%)**	**Large (%)**
EU-27	20 791 190	92.2	6.5	1.1	0.2
Latvia	78 280	88.3	9.6	1.8	0.2
Lithuania	113 059	88.0	9.9	1.9	0.2
Estonia	50 600	86.8	10.7	2.1	0.3

Source: Small and Medium-Sized Enterprises. In: *Eurostat* [online]. 2013 [cit. 2013-11-10]. Available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Small_and_medium-sized_enterprises.

By cultural and historical factors we can mention national values and attitudes towards risk aversion, innovative spirit, mutual trust, time preference, attitude towards technological progress, historical development of the educational, science and financial system.

Conclusions

The authors propose the following definition of national innovation system – the system of close co-operation between private and public enterprises, universities, private and public research institutions, government bodies aiming at developing innovation in accordance with consumers' needs for new or developed products or services.

The authors believe that the functioning of national innovation system should be based on co-operation rather than on interaction as for successful and productive innovation results; the financial, legal etc. decisions in any level of the system of innovations should be made in accordance with needs, strengths and weaknesses of all actors of the system.

[36] JESIĻEVSKA, S. Statistical Aspects of Collecting Innovation Data. *Journal of Economics and Management Research*. 2012, vol. 1, pp. 54-66. ISSN 2255-9000.

Only in these circumstances, all the actors will work as a team, as a single innovation system.

The production of novelty would be of little value to enterprises if there were no market for the consumption of novelty in households. That is why recognising the existence, and understanding the nature of this demand is essential.

As authors see, the core factors necessary for properly-functioning Latvian national innovation system are the following: informational support, capabilities and co-operation of Latvian NIS institutions, organization of financial system, development of human capital, structure of economy, distribution of enterprises by size-class as well as cultural and historical facts.

One of the most important factors for properly-functioning of Latvian NIS is informational support, including statistical data. That is why authors decided to include the CSB in the Latvian national innovation system.

An organization of financial system includes the following brightest problems in Latvia: the low level of public and private sector investment; all support programs are financed by the EU Structural funds rather than by the public funds.

The allocation of financial resources in Latvia is more "service-based". It is impossible to achieve sustainable development or at least economic stability by reducing manufacturing, continuing to import consumption goods from abroad and expanding financial sector to pay for it. The larger proportion of funding should be directed to the development of science and research to facilitate knowledge-based national economy.

By cultural and historical factors authors mean national values and attitudes towards risk aversion, innovative spirit, mutual trust, time preference, attitude towards technological progress, historical development of the educational, science and financial system.

Reshaping and improving the organization of the Latvian national innovation system is needed.

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