



## INNOVATIONS, RESEARCH AND DEVELOPMENT IN EUROPEAN UNION: IMPACT ON REGIONAL ECONOMY

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**Abstract.** In the paper the analysis of the innovation and Scientific Researches and Experimental Development (R&D) policy of the European Union (EU) is analyzed, highlighting the impact of such a policy on the economic state and the prospects for economic development of the regions. This article emphasises the analysis of the Innovation Policy of the European Union, the financial and management instruments which implement the policy and its methods applied for correlative analysis, which allow us to consider the needs of the EU investments into R&D, and to measure impact of these investments on the economies of the Member States. In the comprehensive research the *Eurostat* database statistic data is used, which include all Member Countries of the European Union are divided into two groups according to the fields of financial intervention for stimulating cohesion. The obtained results are compared with the ones of the USA and Japan. The index chosen for the research undoubtedly shows the correlative inter-relationships between the R&D policy of the European Union, activities of the higher-education institutions, innovations of businesses, and regional economic growth. The research results are important to form directions for policy. The research results let to evaluate the European Union R&D policy and financial instruments in the EU cohesion regions, but they also show the economic development differences between various regions of the EU.

**JEL Classification:** P000, P510.

**Keywords:** Innovation policy; regional economy; the European Union; cohesion; R&D.

**Reikšminiai žodžiai:** inovacijų politika, regioninė ekonomika, Europos Sąjunga, sanglauda, moksliniai tyrimai ir eksperimentinė plėtra.

### Introduction

In the globalization the rise of innovations, stimulation of R&D activities and development of effectiveness become one of the most important factors which influence economic status and the prospects of economic development. Under the conditions of the European Union development and expansion, this factor is of extreme importance: the activation of the European Union innovations and development

of R&D activities is evaluated as a highly debatable topic for a subsequent social economic development and for the progress of science and technologies (Melnikas, Dzemydienė, 2007; Melnikas, 2008). Besides one of the most important European Union development aims are investments into innovations and stimulating R&D. These investments in the European Union states are fostered in the different sectors, using various financial instruments, according

to the Member States' economic status and prospects for economic development.

Innovations and R&D has big impact for the change of economic situation and growth of economy as whole, as well as main changes in various regional systems. The changes in regional systems may be evaluated on different scopes - as the changes of the major regions in the European Union or as the changes in the separate regions of the Member States. When changes in regional systems is evaluated, the main priority must be given for the impact of innovations and R&D for regional economy and social issues.

The impact of innovations and R&D for economic and social situation in various European Union regions is obvious. Noticed, that identification and evaluation of these impacts is complicated problem that needs scientific and practical studies. The key aspect of this problem is that rise of innovations and R&D activities make influences for development of society, that the extent and impact of the further development of society is specific and complicated on evaluation. Also there is difficult to adequately identify the significance of innovations and R&D.

This is caused by several circumstances. First of all innovations and R&D could be created in other regions that results applied, and impact of these innovations and R&D could come out in other regions. Besides innovations and R&D results could be used in different time periods, these results could come out in different forms, efficiency of application could be measured in different ways. It is noticed, that creation of innovations and R&D results could be applied in different sectors, then was thought will be used. It could be said, that evaluation of innovations and R&D is complicated and difficult to adequately identify the significance for the further development of society, and could be interpreted as problem for scientific research and decisions. Besides this problem is currently very relevant, in this case aiming to increase the efficiency of innovations and R&D in European Union. This problem is examined by research done in this article.

The research object is the scientific research and innovations policy of the European Union, and the influence of the EU on the member states' economic growth.

The aim of the research is to analyse the scientific research and innovations policy of the European Union and the financial and management instruments, to observe the policy's influence on the European Union and growth of regional economy of Member States.

In the paper the methods of double correlative analysis are used (Crocker and Algina, 1986; Fergu-

son and Takane, 1989; Tankard, 1984; Rodgers and Nicewander, 1988; Moore, 2006). With the help of the correlative analysis, inter-relationships between the European Union scientific R&D policy are to be observed; activities of the higher-education institutions, innovations of businesses, indexes of economic growth. Pearson's (1896) correlative coefficient (marked as  $r$ ) is examined, which, indeed, is a proper measure for the data analysis, where both variables are intervals (Schumacker and Lomax, 2004, Moore, 2006). This kind of analysis of the European Union R&D policy, activities of higher education institutions, innovative actions of businesses, and economy indexes are, however, not used much in literature. The data of European Union Statistical database *Eurostat* (2009) in the period 1996 – 2006 is used.

## 1. Policy of European Union Scientific Research and Innovations

The European Union does not have a single and legally defined by the juridical acts innovations policy. Disregarding that, issue of research and the recently created European Research Area is one of the most discussed and important policy topics in Europe.

The policy of the European Union scientific researches and legal commitments has been tried, for the first time, to be implemented with the **Treaty of Amsterdam** (1997). According to this document there is an explicit acknowledgement of the importance of the R&D, which is established as an essential element for ensuring the efficient functioning of industry sectors within the EU States. It is affirmed that the competitiveness ability of the enterprises greatly depends upon the R&D, and R&D is an essential condition to ensure the protection of consumers and environment, and that the social welfare depends on the R&D quality.

The European Union R&D policy is developed considering several aspects. First of all it is obvious that high-level scientific researches is complex and interdisciplinary. Besides, it is very expensive and demands ever growing "critical mass". These aspects constitute a number of challenges for any team of scientific researchers or laboratory, or for knowledge-open enterprises as well as for the European Union member states.

### 1.1. Lisbon Strategy and Instruments of Its Implementation

In March of 2000 the Lisbon European Council raised an ambitious aim – to become "most competitive and dynamic knowledge-based economy in the

World” till 2010 (it is called the Lisbon Strategy). This process provoked a lot of reforms, which included inner market, educational system, innovations and scientific researches and many others. Investments in R&D became an axial strategic element just after the Barcelona European Council (2002) raised the challenging aim – to increase investments into R&D up to 3 % of Gross Domestic Product (GDP) by 2010. The underlying reasoning for this ambitious aim was that it will have an important effect on the long-term growth and the creation of new places of employment in Europe. According to the studies, (Commission of the European Communities, 2002b) such investments would bring extra GDP growth of up to 0,5 % and 400 000 more jobs in a year starting from 2010. In order to reach this aim the investments into research would be growing on the average of 8 % a year and it would be made of 6 % of the growth of public expenditure and 9 % - of growth of the private expenditure (European Parliament, 2003).

The ways and means to reach this aim from the beginning were defined in 2002 Commission of the European Communities (2002a) Communication “More Research for Europe – toward 3% of GDP”. Many of the involved parties and the European Commission, which confirmed the plan of action for Europe in 2003, known as “Researchers in the European Union: One Profession, Many Careers”, supported this Communication. In the action plan the complex strategies for the expansion of the investment levels for research in Europe were included. From 2003 this activity plan had an effect on all Member States. Based on the approval of the plan almost all of the Member States defined their own goals of research in order to reach the aims of the 2002 European Commission action plan by 2010. Though a part of these aims has already been reached, R&D activity must be even more intensive. In most of the member states, including Lithuania, private and public investments in R&D are not sufficient to reach the European Union aim – to ensure 3 % of GDP for R&D activity. The common Lisbon Program was supplemented by the communication “More Research and Innovation – investing in Growth and Employment – a Common Approach” (Commission of the European Communities, 2003). This Communication reports the integrated action plan which includes a variety of fields of research and innovation. It includes a line of actions that supplement the 3% activities plan of 2003. This action plan may help to use even more the potential of the European research and innovation.

In 2005 the European Commission has reconsidered the Lisbon Strategy. This gave the European Council a lead to confirm that knowledge and inno-

vations are one of the three pillars for growth, whilst stimulating the increase and the creation of jobs. The means for the 3 % - aim for investment into the scientific research in Europe was also emphasised. In order to integrate these aspects the European Council in June of 2005 confirmed the Integrated Guideline for the Member States (Commission of the European Communities, 2005). It may be stressed that one of the recommendations in the documents was to increase and improve investment to R&D. In this document the Member States were asked to estimate their own R&D investment aims. Besides, another recommendation indicates that all the forms of innovations are needed. The Member States shall embody these aims based on the National Reforms Programs.

In 2006 the European Commission asked the expert group, under the leadership of the former prime minister of Finland Esko Aho, to evaluate the situation and to make recommendations on how to stimulate scientific research and innovation in Europe. In his report (European Communities, 2006) the experts notify that radical action should be taken in the field of scientific research and innovation before it is too late. In addition, the experts indicate that the current trends are unsustainable for in the face of global competition, therefore a new vision is needed to address a series of productivity and social challenges faced by Europe. The experts stated that that there was a large gap between the political rhetoric about the knowledge-society and the reality of nudgetary and other priorities. They suggested four- pronged strategy – the creation of innovation friendly markets, strengthening R&D resources, increasing structural mobility and fostering a culture which celebrates innovations.

### *1.2. The European Research Area and Its Development*

In order to encourage economic development and cohesion of the European Union member states’, the Lisbon European Council announced establishment of the European Research Area (ERA) in March of 2000 (Lisbon European Council, 2000). The aims to be pursued:

- Enable researchers to move and interact seamlessly, benefit from world-class infrastructures and work with excellent networks of research institutions;
- share, teach, value and use knowledge effectively for social, business and policy purposes;
- Optimize and open European, national and regional research programmes in order to

maintain the best research throughout Europe, and coordinate these programs to address major challenges together;

- Develop strong links with partners around the World so that Europe benefits from the worldwide progress of knowledge, contributes to global development and takes a leading role in international initiatives to solve global issues.

The European Research Area should inspire the best talents to enter research careers in Europe, incite industry to invest more in European research contributing to the EU objective to devote 3 % of GDP for research, and strongly contribute to the creation of sustainable growth and jobs. Eight years on, the creation of European Research Area has become a central pillar of the EU Lisbon Strategy for growth and jobs, together with the completion of the single market. In the creation of ERA the European Commission, the member states, the European Parliament, research community and industry participate. Many initiatives have been taken by the European Union and Member States. But there are still strong barriers which prevent European Research Area from becoming a reality. Therefore, the European Commission has published a Green Paper, reviewing the progress made and raising further questions for debate:

- researchers still see career opportunities curtailed by legal and practical barriers hampering their mobility across institutions, sectors and countries;
- businesses often find it difficult to cooperate and enter into partnerships with research institutions in Europe, especially across countries;
- National and regional research funding remains largely uncoordinated;
- Short European dimension and cohesion in the reforms that have been initiated.

In the documents it is said that due to these reasons in the European Union the resources become dissolved, not all the possible resources are being used, and they do not manage to take the leading positions in the World.

According to the Public consultation results (European Communities, 2008), the Member States began a new initiative to revive the ERA, called "Ljubljana Process". In a period of its implementation five new initiatives of specific fields were being installed based on the Green Paper. They are dedicated to the career and mobility of the researchers, research infrastructures, knowledge sharing, to joint programming and international science and technology cooperation. They aim at establishing durable

partnerships with the Member States and stakeholders, including business, universities and research organizations in order to develop the ERA jointly in the specific areas of focus.

### *1.1. The Policy of European Union Scientific Researches and Innovations: Funding Schemes*

The European Commission funds the scientific research and innovation in ways such as are developed in the framework programs, also concerning financial mean of risk sharing, by knowledge regions and using structural funds.

The framework programs are the most important mean of funding the scientific researches and innovations, which started from 1989. In a period of implementation of the 6<sup>th</sup> framework program (2003-2006), 20 billion euro was invested into the research and innovation. In a period of implementation of the 7<sup>th</sup> framework program (2007-2013) it is planned to increase the sponsorship by 75 %, according to the European Union financial perspectives.

The most important means of the 7<sup>th</sup> framework program are transnational projects and networks of cooperation that would include public research and industry. The European Commission also stimulates high results of individual groups' fundamental researches which are under control of the European Research Council. Also the Commission suggests new means such as joint technology initiative.

Financial markets and financial enterprises reluctantly invest their stock into R&D projects because these projects are encompassing higher risk in comparison with more traditional business projects. In order to increase their opportunities to get credits, the European Commission suggested a means of risk sharing which is sponsored by the cooperation of the European Commission and the European Investment Bank (EIB). This means tries to improve opportunities for project participants of European researches to use the EIB credits. This mechanism is programmed in a decision of the European Leader Board regarding Financial Prospects for 2007-2013 (Council of the European Union, 2005b). The means was started to be implemented on the 5<sup>th</sup> of June, 2007 after a contract between the European Commission and the EIB was signed.

The credits are issued for those R&D projects (including infrastructural projects) which warrant European dimension. Besides, the contribution of the European Union can be used several times (i.e. after the finishing the project, the credit is given for the second time and so on), so the credits can be re-

peatedly given for the longer period. Project partners can apply to the EIB individually or according to the united activity contracts. Benefit recipient can be big enterprises, small or medium enterprises, private research organizations, partnerships of public and private sectors. If the projects take part in the 7<sup>th</sup> framework program, it always has a possibility to get the EIB credit. The right applications are analysed based on the common banking practice. A good practice is shown by such a financial initiative when R&D agents and financial enterprises work jointly to reach the common aims.

In the European Union there are a lot of dynamic clusters that stimulate industry and research, though they are smaller and not as well integrated as the ones in the USA. Research and innovation in the European Union clusters have their disadvantages because of the resolution of the internal market. To improve the attractiveness of the clusters for the foreign investors they should be more depended upon the strong relationships between the industry and research. Consolidation into the regional systems in which educational and research centres, financial institutions, consultants of innovations and intellectual property and other supporting organizations such as local authorities would be involved in, is the main factor to reach successful clusters development. This is why the European Commission stimulates initiatives of joining the systems based upon the knowledge region.

The region of knowledge initiative aims to strengthen the research potential of European regions, in particular by encouraging and supporting the development, across Europe, of regional research driven clusters, associating universities, research centres, enterprises and regional authorities. The main activities are:

- Analysis and development of activity plans, help for implementing them and stimulating the cooperation for regional clusters that typically have R&D;
- Purposeful cooperation between regions that have less R&D activities development and those which have more;
- Activities that increase regional integration of economic of research institutions.

The initiative has started to be implemented in 2003 in the frames of the 6<sup>th</sup> framework program, and in the meantime it is being continued as Europe-INNOVA initiative.

Structural funds play the main role to help the research and innovation of all fields. In a period of 2000-2006 about 13 billion euro – that is 6 % of the European Union structural funds have been inves-

ted into the infrastructure of scientific researches and webs, new business ideas and modernization of small and medium enterprises. From 2007 even more finance of structural funds were designed for scientific researches and innovations, because the European Union regional policy becomes even more knowledge-orientated. It is predicted to provide as much as 60 % of structural funds stock for the Lisbon aims implementation, especially for R&D and innovations. This is reflected in the decision at the 6<sup>th</sup> of October, 2006 of the Community Strategic Guideline of Cohesion Policy (Council of the European Union, 2005a).

Regions and member states can flexibly use structural funds for the supplementation of common programs and other Community means. Very different activities, related to the scientific research and innovation, such as regional and inter-regional clusters, poles of growth, technology transfer, business support, development of human capital, and help for workers and enterprises to adjust themselves to the economic changes, can be supported by the structural funds.

## **2. The Evaluation of the Impact of R&D for Social and Economic Development in the European Union Regions**

Aiming to evaluate the effectiveness of European union policy and to identify R&D impacts for social and economic development issues in various European Union cohesion regions, was made comprehensive study, based on correlation analysis methods. In the study was identified practice involving correlation dependencies between various indexes, characterizing R&D policy, higher education sector and changes in this sector, the innovation activities of business enterprises, and growth of economies in country and regional level. Besides, comparative research is made, aimed to evaluate accumulated experience in United States of America (USA) and Japan, and European Union regions, where cohesion is not stimulated. In the methodology of comprehensive study was used for correlation analysis of the various ways and algorithms.

In the first stage Analysis is exercised with the aim to explore how the higher education influences the economy growth in the European Union regions (in the Member States), which get support from the Cohesion Fund in a period of 2007-2013 (in regions where cohesion is stimulated). These Member States are those whose common national incomes are less than 90 % average of the European Union. The re-

regions of cohesion stimulated are all regions of Bulgaria, Czech Republic, Estonia, Greece, Cyprus, Latvia, Hungary, Malta, Portugal, Romania, Slovenia and Slovakia. In the second stage it is aimed to rate inter-relationships of these indexes as the GDP per capita in purchasing power standarts (PPS), labour productivity per hour worked, interest-bearing part of expenditure for R&D activity of GDP, the number of higher-education institution students per capita, patent applications to European Patent Office (EPO), patents granted by the United States Patent and Trademark Office (USPTO) index. Employing the correlation analysis research the inter-relationships between these indicators are being examined, the results of correlation analysis are being compared with the results of the same analysis performed in other European Union countries that do not get any support from the Cohesion Fund, as well as in Japan, and in the USA. In the analysis The *Eurostat* (2009) data of period 1996-2006 was used.

By the use of correlation analysis the level of influence of the European Union R&D policy on the economy of member states is evaluated. The interpretation of used indicators is:

- GDP per capita in PPS is a relative index, that helps to eliminate price differences that are between the countries, influence on levels, and to compare national economy situation as absolute dimension;
- Labour productivity per hour worked is a relative index that shows the GDP per capita in PPS per hour worked, in comparison with 15 European Union countries (EU-15). It is considered that EU-15 average is 100;
- R&D expenditure (% of the GDP) includes all private and public expenditure for R&D activity, including business enterprises, and authority institutions, higher-education institutions, non-governmental organizations. In the analysis this index is divided into expenditure of business sector for R&D activity (% of the GDP), expenditure of public sector for R&D activity (particular % of the GDP), and expenditure of higher education sector for R&D activity (% of the GDP);
- In the research two indexes, related with the patent recorded, have been analyzed in the regions explored. A patent application to the EPO per million inhabitants is a relative index that is calculated according to patent applications to the EPO. Patents granted by the USPTO per million inhabitants – it is a

relative index that shows recorded (but not applications) patents to USPTO.

In the research relative dimension of students and inhabitants are also analyzed which shows how many students there are per capita.

By the analysis of the European Union cohesion regions it was noticed that there is a correlative relationship between all the indexes explored – GDP per capita in PPS, labour productivity per hour worked, expenditure for R&D activity, the number of students per capita higher-education institution, patent applications to EPO per million inhabitants, patents granted by the USPTO per million inhabitants.

One of the indexes that have relation with the other indexes of the European Union regions, where cohesion is stimulated, is the part of percentage of GDP designed for R&D activity. This index has a positive statistical relationship with the number of patent applications to EPO per million inhabitants ( $r=0,574$ ,  $p=0,000$ ,  $n=124$ ) and patents granted by the USPTO per million inhabitants ( $r=0,627$ ,  $p=0,000$ ,  $n=81$ ). The total part of percentage of GDP for the R&D activity has statistical link, though not very strong, on the labour productivity per hour worked ( $r=0,205$ ,  $p=0,023$ ,  $n=123$ ), the number of students per capita ( $r=0,288$ ,  $p=0,002$ ,  $n=118$ ) and the GDP per capita in PPS ( $r=0,326$ ,  $p=0,000$ ,  $n=138$ ).

Analyzing the components of expenditure designed for the R&D activity it can be observed that expenditure of business sector for R&D activity has a stronger statistical relationship with economy indexes than other parts. The expenditure of business sector for R&D activity has a positive relation with patent applications to the EPO number per million inhabitants ( $r=0,558$ ,  $p=0,000$ ,  $n=127$ ), and patents granted by the USPTO per million inhabitants ( $r=0,558$ ,  $p=0,000$ ,  $n=84$ ), a weak positive link with labour productivity per hour worked ( $r=0,219$ ,  $p=0,014$ ,  $n=126$ ), and the GDP per capita in PPS ( $r=0,308$ ,  $p=0,000$ ,  $n=141$ ). The research shows that expenditure of public sector for the R&D activity has a weak negative statistical link with the GDP per capita in PPS ( $r=-0,170$ ,  $p=0,046$ ,  $n=138$ ). Also expenditure of higher educational institutions for the R&D activity has a positive statistical link with the number of students ( $r=0,610$ ,  $p=0,000$ ,  $n=117$ ).

The research shows that strong number of patents applied to the EPO per million inhabitants and patents granted by the USPTO per million inhabitants has a positive statistical relation with the labour productivity per hour worked (accordingly  $r=0,515$ ,  $p=0,000$ ,  $n=116$  and  $r=0,430$ ,  $p=0,000$ ,  $n=73$ ) and the GDP per capita in PPS (accordingly  $r=0,553$ ,

$p=0,000$ ,  $n=137$  and  $r=0,453$ ,  $p=0,000$ ,  $n=94$ ) in the European Union cohesion regions.

Summarizing R&D of the European Union regions where cohesion is stimulated, the correlation analysis of indexes, it can be concluded that expenditure of business sector for the R&D activity statistically creates preconditions to increase the GDP per capita, labour productivity per hour worked, but the expenditure of public sector has a weak negative statistical relation with the GDP. The expenditure of the higher education institutions for the R&D activity statistically creates preconditions to increase the number of students, but we can not notice any statistical link on the economy indexes. It is notable that number of patents applied to the EPO and the patents granted by the USPTO has statistically creates preconditions to rise labour productivity per hour worked and the GDP per capita.

The analysis of the European Union regions in which the cohesion is not being stimulated shows different results.

The R&D expenditure percentage part of the GDP has an insufficient statistical link with economy indexes in the European Union regions, where the cohesion is not being stimulated. This index has a very strong positive statistical link with the number of patent applications to the EPO per million inhabitants ( $r=0,794$ ,  $p=0,000$ ,  $n=124$ ) and the Patents granted by the USPTO per million inhabitant ( $r=0,848$ ,  $p=0,000$ ,  $n=82$ ) and a weak positive link with the number of students per capita ( $r=0,261$ ,  $p=0,006$ ,  $n=108$ ).

Analyzing the components of the expenditure for the R&D activity we can notice more different results. The research shows that the expenditure of business sector for the R&D activity has a strong positive statistical link with the number of patent applications to the EPO per million inhabitants ( $r=0,783$ ,  $p=0,000$ ,  $n=114$ ) and the patents granted by the USPTO per million inhabitant ( $r=0,822$ ,  $p=0,000$ ,  $n=76$ ), but the statistical link with the economy indexes has not been noticed. The research shows that expenditure of public sector for the R&D activity has a weak negative statistical link with the GDP per capita in PPS ( $r=-0,229$ ,  $p=0,008$ ,  $n=132$ ) though it has a positive link with the number of patent applications to the EPO per million inhabitants ( $r=0,445$ ,  $p=0,000$ ,  $n=116$ ) and the patents granted by the USPTO per million inhabitants ( $r=0,429$ ,  $p=0,000$ ,  $n=78$ ). The expenditure of higher-education institutions sector for the R&D activity has a weak negative statistical link with the economy indexes – the GDP per capita in PPS ( $r=-0,356$ ,  $p=0,000$ ,  $n=126$ ), though it has a positive link with the number of patent applications

to the EPO per million inhabitants ( $r=0,504$ ,  $p=0,000$ ,  $n=103$ ) and the patents granted by the USPTO per million inhabitants ( $r=0,593$ ,  $p=0,000$ ,  $n=77$ ) in the European Union regions where the cohesion is not being stimulated.

The expenditure of higher-education institutions sector for the R&D activity has a positive statistical link with the number of students per capita ( $r=0,552$ ,  $p=0,000$ ,  $n=101$ ). But the number of students per capita in the European Union regions, where the cohesion is not being stimulated, has a negative statistical link with the GDP per capita in PPS ( $r=-0,624$ ,  $p=0,000$ ,  $n=115$ ) and the labour productivity per hour worked ( $r=-0,733$ ,  $p=0,000$ ,  $n=115$ ).

The number of patent applications to the EPO per million inhabitants in the European Union regions, where the cohesion is not being stimulated, has a strong positive link with the GDP per capita in PPS ( $r=-0,247$ ,  $p=0,005$ ,  $n=130$ ).

Summarizing the correlation analysis of the education and economy indexes in the European Union regions, where the cohesion is not being stimulated, we can affirm that in these regions the expenditure for the R&D activity statistically positively influence the number of patent applications to the EPO and the patents granted by the USPTO, but this index has insufficient influence on the GDP growth. The investments of public and higher-education institutions sector into the R&D activity statistically have a negative influence on the GDP growth. The number of students statistically has a strong negative influence for the GDP growth and for the labour productivity per hour worked.

After the index correlation analysis in the USA we did not notice any statistical link between the expenditure for the R&D activity, the number of patent applications to the EPO per million inhabitants, the patents granted by the USPTO per million inhabitant and many others economy indexes. But the study shows that there exists a very strong statistical relation between the expenditure of the higher-education institutions for the R&D activity and the economy indexes – the GDP per capita in PPS ( $r=-0,872$ ,  $p=0,000$ ,  $n=11$ ) and the labour productivity per hour worked ( $r=-0,789$ ,  $p=0,007$ ,  $n=110$ ). It is clear that the expenditure of higher educational institutions in the USA for the R&D activity statistically has a positive influence on the economy indexes.

After correlation analysis of economy, R&D, education indexes in Japan there a very strong statistical relationship was noticed between the expenditure for the R&D activity, the number of patent applications to EPO per million inhabitants ( $r=0,809$ ,  $p=0,005$ ,  $n=10$ ) and the GDP per capita in PPS ( $r=-$

0,872,  $p=0,000$ ,  $n=11$ ). A strong statistical relation with the two last indexes has the expenditure of the business sector for the R&D activity (with the number of requests to the EPO per million inhabitants the link is  $r=0,743$ ,  $p=0,014$ ,  $n=10$ , with the GDP per capita in PPS the link is  $r=0,948$ ,  $p=0,000$ ,  $n=10$ ). Also a very strong statistical relationship was noticed between the GDP per capita in PPS and the number of patent applications to the EPO per million inhabitants the link is  $r=0,789$ ,  $p=0,007$ ,  $n=10$ ). We can affirm that in Japan the GDP statistically directly depends upon the expenditure of the business sector for the R&D activity and the number of patent applications to the EPO.

### Conclusions and recommendations

Analysed the European Union policy of innovation and R&D, and the implementation of financial and management instruments reflect the creation and dissemination of innovation in the area of European Union, as well as complexity of the R&D policy and implementation processes. In the research is conducted, that innovations and R&D in the context of the European Union policy is determining factors for the growth of regional economy and the stimulation of competitiveness. Also various financial mechanisms are created that induce R&D activities, business participation in pursuing them, partnership between higher education and private sector. Regarding political context, consolidated investments in R&D activities are particularly promoted to be enhanced, especially in business sector.

Correlation analysis of the European Union R&D policy, higher education activities, innovative business participation and regional economic growth justifies the European Union R&D policy and financial mechanisms applied in the European Union regions, where coherence is stimulated. According to the conducted research it can be stated that in these regions expenditure of business sector on R&D activities increases the GDP per capita in PPS, the labour productivity per hour worked, but governmental sector expenditure on R&D activities has a small negative influence on the GDP per capita in PPS. Higher education sector expenditure on R&D activities in these regions induces the increase of the number of students, but no influence on economic indicators is noticed.

However, the correlation analysis shows the differences exist regarding the influence on regional economic development between the different regions of the European Union, the USA and Japan. Some premises could be made, which may create

difficulties in the European Union regions, where cohesion is stimulated, to implement some financial and management mechanisms, aimed to stimulate R&D activities, and that are used in the European Union regions, where cohesion is not stimulated, in the USA and in Japan.

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## INOVACIJOS, MOKSLINIAI TYRIMAI IR EKSPERIMENTINĖ PLĖTRA EUROPOS SĄJUNGOJE: ĮTAKA REGIONŲ EKONOMIKAI

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**Santrauka.** Straipsnyje analizuojama Europos Sąjungoje vykdoma inovacijų, mokslinių tyrimų ir eksperimentinės plėtros (MTEP) politika bei vertinama jos įtaka regionų ekonominei padėčiai ir ekonominės raidos perspektyvoms. Straipsnyje pateikiama Europos Sąjungos inovacijų politikos ir ją įgyvendinančių finansinių ir vadybos mechanizmų analizė bei taikomi koreliacinės analizės metodai, leidžiantys pagrįsti Europos Sąjungos investicijų į MTEP įtaką šalių narių ekonomikai. Tyrime naudojami naujausi Eurostat duomenų bazės rodiklių statistiniai duomenys, apimantys visas Europos Sąjungos šalis, Jungtines Amerikos Valstijas (JAV) ir Japoniją. Europos Sąjungos šalys skirstomos į dvi grupes pagal sanglaudos skatinimo finansinės intervencijos sritis. Gauti rezultatai lyginami su JAV ir Japonijos rezultatais. Tyrimui pasirinkti rodikliai tiksliai atspindi koreliacinius Europos Sąjungos MTEP politikos, aukštųjų mokyklų veiklos, verslo subjektų inovacijų veiklos ir ekonomikos augimo tarpusavio ryšius. Tyrimo rezultatai reikšmingi formuojant MTEP finansinės politikos kryptis. Tyrimo rezultatai pagrindžia Europos Sąjungos MTEP politiką bei finansinius mechanizmus Europos Sąjungos sanglaudos skatinimo regionuose, tačiau atskleidžia skirtingų Europos Sąjungos regionų, JAV ir Japonijos ekonominės raidos skirtumus. Tai gali trukdyti tam tikrus finansinius arba vadybos mechanizmus, taikomus Europos Sąjungos regionuose, kuriuose nėra skatinama sanglauda, JAV ir Japonijoje, skirtus mokslinių tyrimų ir eksperimentinės plėtros veiklai skatinti, perkelti į Europos Sąjungos sanglaudos skatinimo regionus.

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