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# ANALYSIS OF FOREIGN CAPITAL INFLOW IMPACT ON INNOVATIVE GROWTH: THE BALTIC STATES IN THE CONTEXT OF THE EUROPEAN UNION

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***Annotation***. *The article „Analysis of Foreign Capital Inflow Impact on Innovative Growth: the Baltic States in the Context of European Union" discusses the role of foreign direct investments (FDI) and innovations in economies of Lithuania, Latvia, Estonia and European Union countries.*

*Impact of FDI and innovations on the growth of economy of a country is being critically evaluated. Quantitative influence of foreign direct investment and innovations on economic indicators of the Baltic states and the European Union countries is also being tested. Hypotheses formulated by authors tackle relationships between foreign direct investment, gross*

*domestic product, labour costs, research and development expenditure (R&D), patent applications and summary innovation index in Lithuania, Latvia, Estonia and, respectively, in the European Union countries. In order to verify the presented hypotheses the correlation analysis and the Student's criteria method were used.*

*Quantitative evaluation of separate relations enables us to compare and economically interpret the role of foreign direct investment and innovations in the Baltic states and European Union countries economies and allows forming an attitude of states towards stimulation of foreign direct investment and innovations.*

***Keywords**: foreign direct investments, innovations, gross domestic product, factors of investment, quantitative evaluation, the Baltic states' economies.*

## Introduction

Nowadays countries of the world compete with each other for the foreign capital investments (hereinafter – FDI) into local projects. FDI bring new possibilities for residents to be employed, for created technologies to be applied in production, for new methods of services to be put into circulation. In case of the Baltic states FDI may be considered as one of the main factors of economic growth and as a crucial condition for the increase of productivity. Such attitude towards FDI determined certain economy policy towards foreign capital in the Baltic states: countries in every possible way stimulated the entrance of foreign capital[1]. FDI are granted tax concessions, special rights are provided to strategic investors in the processes of privatization of strategically important objects. Thus, in certain cases doubts appear: whether FDI *per se* always warrant the growth of productivity, the increase of sold products or supplied services?

Innovations are one of the main and the most important factors that provide competitive advantage to the companies. The role of innovations in nowadays world economy is constantly growing. Recently the role of innovations has been recognized as important not only for separate companies, and, hence, they are regarded as one of the most substantial factors of development of the economy of regions. According to the processes of globalization, the importance of implementation of innovations increases for all entities, which seek to compete successfully in the market.

As we can see, FDI and innovations often go together in countries, which target permanent development and seek status in international space. The object of the research presented in this article is twofold: the first, the influence of FDI and innovations on growth of the economy of the country is being considered, and, the second, factors having impact on the attracting of foreign direct investments into the country and creating and implementation of innovations are being evaluated. Hence, the purpose of this article is

1 Decision No. 853 of the Government of the Republic of Lithuania, 19 June 2002. The long term strategy of the development of the economy until 2015. *Official Gazette*. 2002, 60-2424; Runiewicz, M. *The Impact of Foreign Direct Investments on the Export Competitiveness of the Baltic States in the European Single market*. Vilnius: Kriventa, 2005, p.151.

to evaluate quantifiably the influence of FDI and innovations on the growth of economy of the country and to reveal the basic economic indicators, which are affected by foreign direct investment and innovations. In order to provide proper evaluation of FDI and innovations effect on economic growth and to ground the factors, which influence these two indicators, the statistical data of European Union countries and the Baltic states (Lithuania, Latvia and Estonia) has been employed.

This article embraces theoretical assumptions, based on the analysis of scientific literature. It must be noted that there are a lot of economic indicators, which have impact on FDI and innovations, but in this paper only the most important and unanimously accepted ones in scientific literature were evaluated. These assumptions are verified taking into account economic environment of analyzed countries. During the process of research, the final indicators of the countries in question for year 2008 were not published yet. Therefore statistical data of years 2000-2007 for calculations were used. ) Due to the changes in the methodology of evaluation in 2003, summary innovation index, (hereinafter – SII) is taken for the years 2003-2007. The intensity of relations (as well as the character of the types of connections) between the indicators of FDI, innovations and others is evaluated by applying method of correlation analysis. Significance of received correlation coefficients is evaluated by the method of the Student criteria. General model of research is showed in Figure 1. This model is used for analysis of indicators of European Union countries, Estonia, Latvia and Lithuania.

| | GDP | FDI | Monthly labour costs | R&D expenditure | Patent applications | SII |
|---|---|---|---|---|---|---|
| GDP | | | | | | |
| FDI | | | | | | |
| Monthly labour costs | | | | | | |
| R&D expenditure | | | | | | |
| Patent applications | | | | | | |
| SII | | | | | | |

*Figure 1.* Model of research

Accomplished research allows determining the effect of FDI and innovations on growth of countries' economies and enables predicting the most efficient directions of state policy in the fields of FDI and innovations.

## 1. Foreign direct investments and Gross domestic product

Foreign investments serve as factor of production in economies of all countries: big and small, developed and on the path of development. Even highly developed countries compete among each other for attracting successful investments. It must be stated that foreign direct investments contributed significantly to development of world economy. FDI serves as a source of capital channelled into projects, which appear to be too expensive for local investors. In developing countries FDI are one of the driving forces accelerating economic growth and reducing dependence of those countries from one or a few branches of economy. FDI create favourable conditions for incorporation of new companies, productions and creation of new working places.

**1st assumption:** *FDI has a positive impact on the growth of Gross domestic product.*

Generally, inward FDI in the EU in the year 2007 comprised 7,883,870 million Euro; Estonia received 11,332.1 million euro, Latvia and Lithuania, respectively, 6,294.7 million and 10,283 million Euro.

Analysis of inward FDI per capita in the Baltic states indicates that Estonia leads in that area. Average inward FDI per capita during the considered 2000-2007 year period is 4.9 thousands of Euro estimated, in Latvia and Lithuania that figure fluctuates around 1.6 thousands. The Baltic states, according this indicator, significantly lag behind if to compare to other the EU countries, in which average inward FDI per capita reaches about 10.3 thousands Euro.

With the reference to statistical data of the Baltic states, it is rather obvious that FDI in Baltic countries have been growing during the considered years (Figure 2).

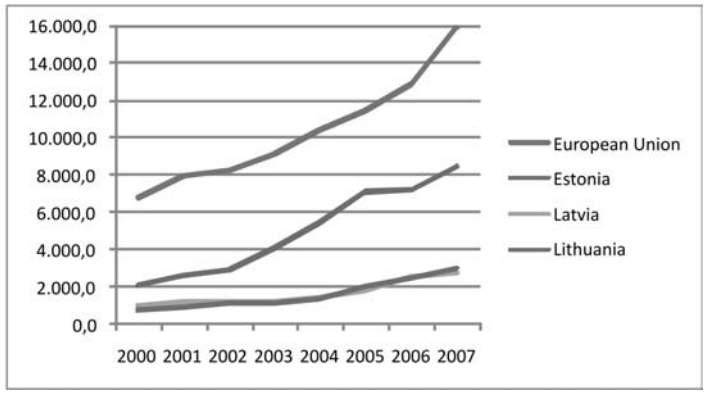


*Figure 2.* Foreign direct investment (FDI), Euros per capita

Economic growth in Baltic countries was especially turbulent in year 2007 (Figure 3), gross domestic product (hereinafter – GDP) of 2007 in Latvia increased by 24.2 percent, Lithuania and Estonia, respectively, by 18.5 and 16.5 percent. In the year 2007

the economies of the EU countries grew not so significantly: GDP increased about 5.7 percent.

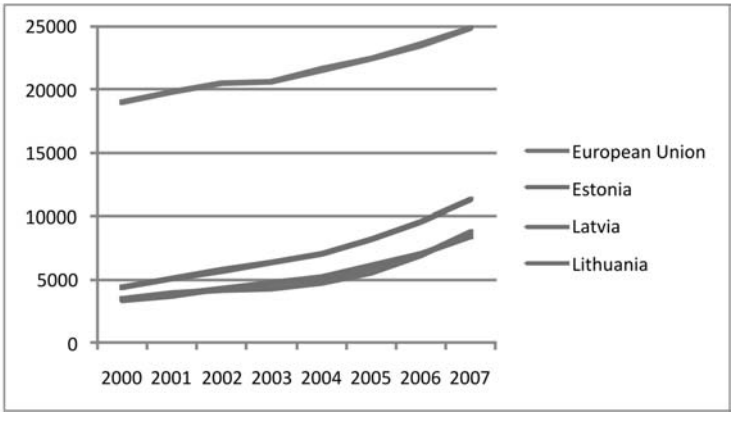


*Figure 3.* Gross domestic product (GDP), Euros per capita

In 2006 the economy of Latvia experienced the most rapid growth among the Baltic states: during the year 2006 Latvia's GDP increased by 23.3 percent, Estonia's by 18.1 percent and Lithuania's by 14.9 percent. In comparison, GDP of 27 EU countries went up 5.5 percent. The growth of economy in all countries was determined by growth of household consumption, which resulted in overall increase of demand and increase of investments.

Comparison of GDP per capita in the Baltic states indicates that Estonia leads considerably. Average GDP per capita in this country reaches 7.2 thousands Euro during the considered period. Respectively, GDP per capita in Lithuania comprises 5.4 thousands, and in Latvia 5.3 thousand Euro. The Baltic states lag behind European countries: in the EU GDP per capita reaches 21.6 thousands Euro.

In Table 1 the results of correlation analysis and evaluation of importance of absolute measures of FDI and GDP are presented.

*Table 1.* FDI and GDP interdependence characteristics

| | r | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9907 | 19,2816 | 2,3646 |
| Estonia | 0,9689 | 10,3626 | 2,3646 |
| Latvia | 0,9825 | 13,9610 | 2,3646 |
| Lithuania | 0,9936 | 23,1922 | 2,3646 |

(Here and below: *r - correlation coefficient*; $t_{observed\ and}\ t_{critical}$ – *observed and critical Student criteria*)

The results of correlation analysis show that the strong relation exists between the FDI and GDP of all three Baltic states and the EU countries. Obtained results verify the first assumption. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of

liberty because of the equal number of elements is 7. Results show that FDI is the important factor affecting GDP in all countries, as $t_{observed}$ is much bigger than $t_{critical}$.

To conclude, the first assumption appeared to be valid for all analyzed Baltic countries specifically, and European Union countries generally. Hence, it can be asserted that initial assumption about *positive FDI impact on the GDP growth was verified.*

## 2. Monthly labour costs and Gross domestic product

As it was mentioned above, is one of the major indicators showing the level of economy development in a certain region[2]. Generally, GDP may be defined as a final market value of production and services made up in a country during certain period of time. One of the methods to calculate volume of GDP is one of income evaluation. In case that method is applied, GDP is seen as comprised of all income received by owners of production factors. GDP accounted using the method of income evaluation consists of labour costs, rent income, interests and profit; also depreciation and indirect taxes must be included. According to Wikipedia[3], GDP accounting method of income and method of costs are two different attitudes towards GDP, because money that consumer pays for a product is gained by the subject who made that product. The parity between income and cots always exists.

According to Gontis[4], real GDP in Lithuania is a few times lower than the average of the EU countries. That means that the level of wages is lower too. If one element of GDP increases or decreases - GDP reacts accordingly, i.e. increases or decreases. This theoretical background suggests the second assumption.

**2nd assumption:** *Increasing average labour costs have a positive impact on GDP.*

Figure 4 shows tendencies of statistical monthly labour costs in the EU, Lithuania, Latvia and Estonia. As it can be noticed, during the considered period labour costs have increased in all analyzed regions. In the three Baltic states during this period average labour costs were the highest in Estonia: around 640 Euro. The lowest labour costs were in Latvia: about 440 Euro. These figures are significantly lower in comparison with the average of the EU countries, which was 2.4 thousand Euro during the analyzed period.

2 Wikipedia [interactive]. 2008 [accessed on 2008-12-02]. <www.en.wikipedia.org/wiki/Economic_growth>.

3 *Ibid*.

4 Gontis V. Dėsninga infliacija [interactive]. Vilnius, 2008 [accessed on 2008-12-02]. <http://mokslasplius.lt/lms/?q=lt/node/790>.

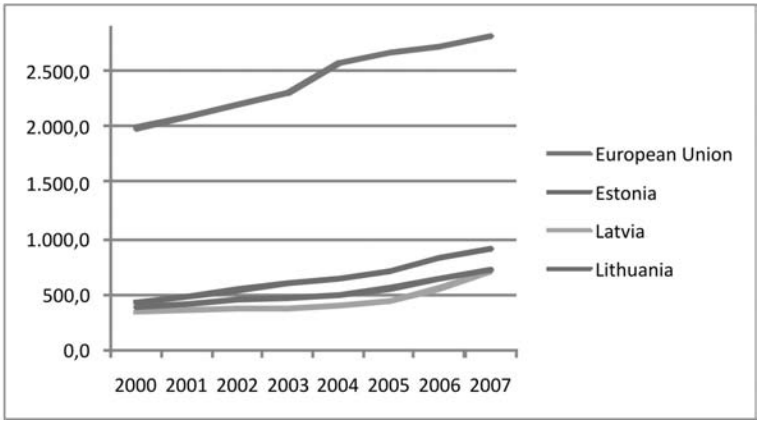


*Figure 4.* Average monthly labour costs, Euros

Quantitatively estimated interrelationships (i.e. the correlation and Student coefficients) between labour costs and GDP in the EU countries, Lithuania, Latvia and Estonia are presented in Table 2.

*Table 2.* Labour costs and GDP interdependence characteristics

| | r | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9626 | 9,3975 | 2,3646 |
| Estonia | 0,9969 | 33,4384 | 2,3646 |
| Latvia | 0,9930 | 22,1701 | 2,3646 |
| Lithuania | 0,9972 | 35,0159 | 2,3646 |

The results of correlation analysis show that the strong relation exists between the variables in all countries in question. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of liberty because of the equal number of elements is 7. Results show that monthly labour cots in a country are an important factor for GDP, because $t_{observed}$ in all cases is much bigger than $t_{critical}$.

Second assumption was proved in all cases. The results of analysis show, that if average labour costs increase, GDP increases simultaneously. This can be explained by the fact that the biggest part of labour costs is comprised by labour wages. Wages, consequently, is a component of GDP.

To conclude, it may be asserted that *increasing labour costs have a positive influence on GDP.*

## 3. Research and development expenditure and Gross domestic product

A country that innovates a lot may temporarily grow faster than the rest, but in the long run the technology currently in use in almost all its industries will be very close to the world frontier. Thus, each innovation, when it occurs, will represent a relatively small improvement over the technology already in place in that industry. In other words, a high frequency of innovations will ultimately generate a small size of innovations; the product of frequency and size will end up being the same as in the rest of the convergence club. By the same token, a country where conditions are relatively unfavourable to research and development (hereinafter – R&D) will have very infrequent innovations, but in the long run most innovations will represent a relatively large improvement over the technology already in place in the industry, which in most cases will be quite old relative to the world frontier. That is, a low frequency of innovations will result in a large average size, again with the same product as in the rest of the convergence club[5].

This is not to say that domestic R&D is unimportant. On the contrary, although the country that invests a lot in R&D will not grow any faster than countries that invest less, nevertheless its per capita GDP will be larger because producers in that country will be using more up-to-date, and hence more productive, intermediate products and processes in producing final goods and services. Countries will have parallel growth paths but the most innovative counties will have growth paths that lie permanently above those of less innovative countries[6].

As regards R&D, the goals of the European Union, as set by the Lisbon summit strategy, are to achieve R&D intensity of at least 3% of GDP for the EU as a whole by 2010, and to have two thirds of R&D expenditure financed by the business sector.

**3rd assumption:** R&D e*xpenditure has a positive impact on GDP.*

As it is showed in Figure 5, Lithuania, Latvia and Estonia spend much less for research and development in comparison with the EU countries in general. For example, in 2006 the EU countries spent on R&D more than 400 Euro per inhabitant, while Estonia only 125 Euro per inhabitant. The indicators of Latvia and Lithuania are even lower.

5 Streeten, P. Human Development: Means and Ends. *American Economic Review.* 1994, 84 (2):233.

6 Evans, P. Using Cross-Country Variances to Evaluate Growth Theories. *Journal of Economic, Dynamics and Control*. 1996, 20:1031.

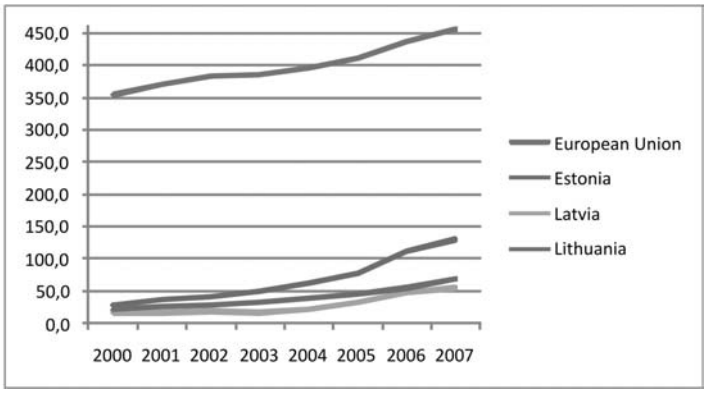


*Figure 5.* R&D expenditure, Euros per capita

The results of correlation analysis and evaluation of importance of the research and development and GDP in the EU countries, Lithuania, Latvia and Estonia are presented in Table 3.

*Table 3.* R&D expenditure and GDP dependence indicators

| | r | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9970 | 34,1526 | 2,3646 |
| Estonia | 0,9933 | 22,7361 | 2,3646 |
| Latvia | 0,9773 | 12,1960 | 2,3646 |
| Lithuania | 0,9981 | 42,3827 | 2,3646 |

The results of correlation analysis show that the strong relation exists between the variables in all countries. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of liberty because of the equal number of elements is 7. Results show that R&D expenditure in a country is an important factor for GDP, because $t_{observed}$ in all cases is much bigger than $t_{critical}$.

The third assumption was proved in all cases. The results of analysis show that in case of increasing of expenditure for research and development, GDP also increases.

Consequently, R&D e*xpenditure has a positive impact on gross domestic product.*

## 4. Patent applications and GDP

Patent application is one of the indicators describing the level of science and technologies in the country. It is common to notice that one country has more inventors than other. The number of patent application depends on the level of development of science in a country. The patent application is an element of R&D indicator. Previously the re-

lation between R&D and GDP was proved. Respectively, it is interesting to check the direct relation between patent applications and GDP.

**4th assumption:** *the increase of patent applications has a positive influence on GDP.*

As it is showed in Figure 6, the amount of patent applications per million inhabitants is significantly lower in the Baltic states to compare with the European countries; Lithuania, Latvia and Estonia lag behind significantly. For example, in 2006 in EU countries the inventors applied for more than 135 patents per million of inhabitants, while the same index does not reach 20 in the Baltic states.

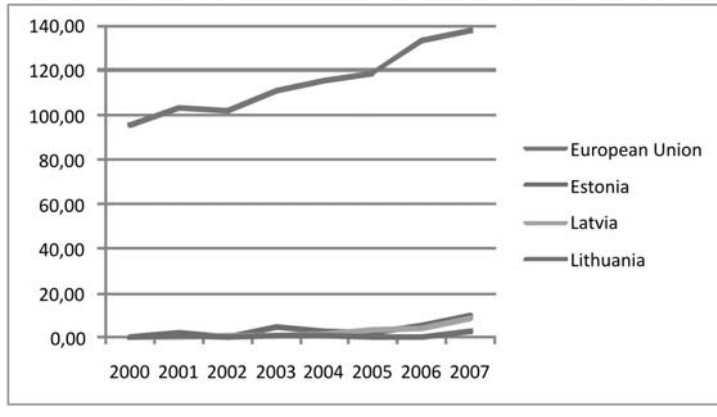


*Figure 6.* Patent applications to EPO per million inhabitants

The results of correlation analysis and evaluation of importance of the patent application and GDP in the EU countries, Lithuania, Latvia and Estonia are presented in Table 4.

*Table 4.* Patent applications and GDP dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9866 | 15,9750 | 2,3646 |
| Estonia | 0,8423 | 4,1346 | 2,3646 |
| Latvia | 0,9850 | 15,1008 | 2,3646 |
| Lithuania | 0,7110 | 2,6750 | 2,3646 |

The results of correlation analysis show that the relation between the patent application and GDP exists in all countries except Lithuania. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of liberty because of the equal number of elements is 7. Results show that patent application is an important factor for GDP, because $t_{observed}$ in cases of the EU countries, Latvia and Estonia is bigger than $t_{critical}$.

The fourth assumption was proved in cases of the EU countries, Latvia and Estonia, but failed in case of Lithuania.

Consequently, *the increase of patent application has a positive impact on gross domestic product in the EU countries, Latvia and Estonia.*

## 5. Summary Innovation Index and Gross domestic product

Nowadays economies are developing mostly with the help of new technologies and other innovations. According to European Innovation Scoreboard[7], innovation is regarded as one of the key drivers of economic welfare. In other words innovation is one of the ways to achieve high income levels. In order to determine whether this proposition is true, the relation between innovations and GDP has to be analysed.

**5th assumption:** *the increase of SII has a positive impact on GDP growth.*

Figure 7 presents values of SII in years 2003-2007 in the EU countries, Lithuania, Latvia and Estonia. The highest SII is noticed in the EU countries. SII of the Baltic states is significantly lower. SII in the EU countries is stable and has no substantial changes during the analyzed period. Lithuania's and Latvia's SII has increased during the analyzed period. The SII is the highest of all three Baltic states in Estonia; however, the Estonian SII has been decreasing since 2006.

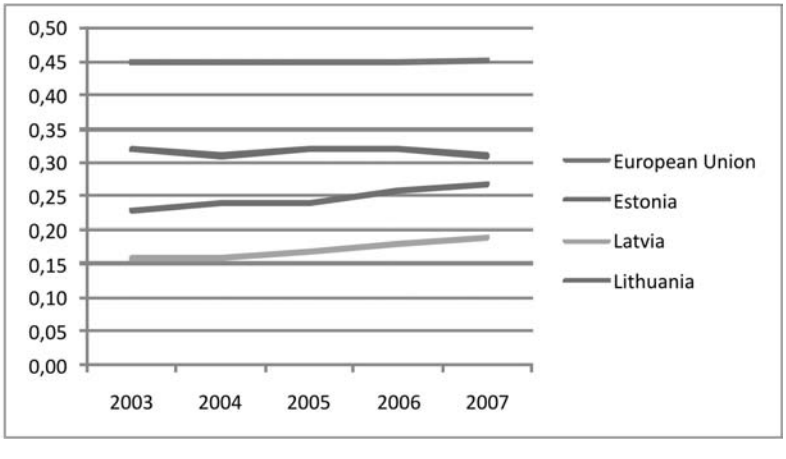


*Figure 7.* Summary Innovation Index (SII)

The results of correlation analysis and evaluation of importance of the SII and GDP in the EU countries, Lithuania, Latvia and Estonia are presented in Table 5.

7 European Regional Innovation Scoreboard [interactive]. 2006 [accessed on 2008-12-02]. <http://www.proinno-europe.eu/doc/EIS2006_final.pdf >.

*Table 5.* SII and GDP dependence indicators

| | r | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,7533 | 3,0303 | 2,3646 |
| Estonia | -0,3089 | -0,8593 | 2,3646 |
| Latvia | 0,9897 | 18,2924 | 2,3646 |
| Lithuania | 0,9713 | 10,8024 | 2,3646 |

The results of correlation analysis show that the strong relation between the patent application and GDP exists in Lithuania and Latvia. In case of the EU countries correlation is low. It should be noted that in case of Estonia the correlation is very low. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of liberty because of the equal number of elements is 7. Results show that patent application is an important factor for GDP in case of Lithuania and Latvia, because $t_{observed}$ in cases of Lithuania and Latvia is bigger than $t_{critical}$.

The fifth assumption was proved in cases of Lithuania and Latvia, but failed in case of the EU countries and Estonia.

Consequently*, the increase of SII has a positive impact on GDP in Lithuania and Latvia.*

## 6. Monthly labour costs and Foreign Direct Investment

In comparison to all 27 countries of the EU, the Baltic states have the lowest labour costs (evaluating labour costs in branches of economy oriented into export). Labour costs in production sector are significantly lower than in developed EU countries. Such advantage enjoyed by other EU countries creates possibilities to attract more foreign investments. Thus, increasing wages decreases this advantage[8]. In order to evaluate the influence of average labour costs in the process of attracting FDI into the country, the sixth assumption will be checked.

**6th assumption:** Increasing monthly labour costs in the country have a negative impact on FDI.

Table 6 presents the results correlation analysis and evaluation of importance of average labour costs and attracted FDI in the EU countries, Lithuania, Latvia, Estonia.

8 Hsiao, C.; Shen, Y. Foreign Direct Investment and Economic Growth: The Importance of Institutions and Urbanization. *Economic Development & Cultural Change*. 2003, 51(4): p. 885.

*Table 6.* Labour costs and FDI dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9362 | 7,0459 | 2,3646 |
| Estonia | 0,9699 | 10,5352 | 2,3646 |
| Latvia | 0,9589 | 8,9385 | 2,3646 |
| Lithuania | 0,9924 | 21,3738 | 2,3646 |

The coefficients of correlation shows strong direct relation between the variables in all analyzed countries. Evaluating the importance of every variable used in analysis the Student criteria method was used. Selected level of importance – 0.05, level of liberty because of the same number of elements is 7. The results of the analysis show that average labour costs is an important factor for FDI, because $t_{observed}$ in all cases is bigger than $t_{critical}$.

The sixth assumption must be denied. Correlation analysis showed strong direct connection between analyzed variables in the EU countries as well as in Lithuania, Latvia and Estonia, thought it was believed otherwise. The results of analysis show that when the labour costs in the country increase, the amount of attracted direct investments increases also. This can be ascertained by taking into account general level of development of economy: if country is competitive its infrastructure is developed well, the environment of business is favourable, and these advantages counterbalance disadvantages, related with the costs of working power. Also it is important to evaluate the trend, in accordance to which low paid workers often have low qualification and they work relatively non-productively. These trends eventually determine the level of attracted FDI in the country.

According to the results of the analysis, increasing average labour costs in the country have no negative influence on the attracted FDI.

## 7. R&D Expenditure and Foreign Direct Investment

As mentioned above, the factors of FDI also are high values of the indicators determining or characterising innovativeness, such as general industrial technology level, general level of spending on research and experimental development. Also foreign investors need of well trained working power. Talking about scientific innovations in Lithuania it is also important to mention that the specialist training systems in universities and other schools of higher education are too slow in adapting to the changing labour market requirements[9]. According to the listed factors the seventh assumption may be suggested.

**7th assumption:** *Increasing R&D expenditure has a positive impact on FDI.*

9 Government of the Republic of Lithuania [interactive].Vilnius, 2008 [accessed on 2008-12-15]. <http://www.lrv.lt/?cat=23>.

Table 7 presents the results of correlation analysis and evaluation of importance of R&D expenditure and inward FDI in the EU countries, Lithuania, Latvia and Estonia.

*Table 7.* R&D expenditure and FDI dependence of indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9881 | 17,0268 | 2,3646 |
| Estonia | 0,9482 | 7,8984 | 2,3646 |
| Latvia | 0,9908 | 19,3535 | 2,3646 |
| Lithuania | 0,9905 | 19,0665 | 2,3646 |

The coefficients of correlation show strong direct relation between the variables in all analysed countries. Evaluating the importance of every variable used in analysis the Student criteria method was used. Selected level of importance – 0.05, level of liberty because of the same number of elements is 7. The results of the analysis show that R&D expenditure is important factor for FDI, because $t_{observed}$ in all cases is bigger than $t_{critical}$.

The seventh assumption is proved in all cases. Correlation analysis showed strong direct connection between analysed variables in the EU countries as well as in Lithuania, Latvia and Estonia. The results of analysis show that in the situation of increasing R&D expenditure in the country the amount of attracted direct investments also increases. This can be ascertained taking into account one fact: if the government supports science and innovations in the country, the foreign investors wish to profit from the achieved advantage.

According to the results of the analysis, *increasing R&D expenditure has positive impact on FDI.*

## 8. Patent Applications and Foreign Direct Investment

The previous proved assumption suggests researching the relation between the number of patent application and FDI. The growing number of patent applications may be named as result of R&D expenditure, so the increasing number of patent applications may also have a positive effect toward FDI.

**8th assumption:** *Increasing number of patent applications in the country has a positive impact on FDI.*

The results correlation analysis and evaluation of importance of patent application numbers and inward FDI in the EU countries, Lithuania, Latvia, Estonia are presented in Table 8.

*Table 8.* Patent applications and FDI dependence of indicators

| | $r$ | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9784 | 12,5260 | 2,3646 |
| Estonia | 0,7594 | 3,0883 | 2,3646 |
| Latvia | 0,9443 | 7,5940 | 2,3646 |
| Lithuania | 0,6733 | 2,4091 | 2,3646 |

The coefficients of correlation show strong direct relation between the variables in all analysed countries, except Estonia and Lithuania. Evaluating the importance of every variable used in analysis the Student criteria method was used. Selected level of importance – 0.05, level of liberty because of the same number of elements is 7. The results of the analysis have shown that patent applications are important factor for FDI, because $t_{observed}$ in all cases is bigger than $t_{critical}$

The eighth assumption was proved in case of the EU countries, Latvia. The assumption was refuted in case of Estonia and Lithuania. Correlation analysis shows a connection between analysed variables in the EU countries, as well as in Latvia. The results of the analysis show that in the situation of increasing number of patent application in the country, the amount of attracted foreign direct investments increases also.

According to the results of analysis, *increasing number of patent application has a positive impact on FDI in the EU countries and Latvia.*

## 9. Summary Innovation Index and Foreign Direct Investment

Usually foreign capital investments into companies of a country foster the implementation of new technologies and renewal of production, improving of quality and on this basis, innovations. Foreign investors together with foreign capital also transfer their "know-how". That determines the development of innovations in the country, which is advantageous not only for companies, but also for the whole country[10].

It is possible to assume that a big part of FDI in the production and service sector is intended towards the development of innovations. If a country does not attract foreign capital, it risks to be not noticed on the world market. In order to reduce the gap with the developed countries and to secure high indicators of economic growth, the rate of increasing of FDI should be higher than in developed countries. Other countries aware of the fact that in certain country the amount of FDI is quickly increasing, support that country's independence and membership in international organisations.

**9th assumption:** SII *has a positive impact on FDI.*

10 Kruger, J. *Foreign Investment. Namibia Economist. Part V of VII.* Windhoek: 2001, p. 31.

The development of SII and FDI indicators in countries in question was presented before.

Table 9 consist of the results of the correlation analysis and evaluation of importance of SII and FDI in the EU countries, Lithuania, Latvia and Estonia.

*Table 9.* SII and FDI dependence of indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,8515 | 4,2964 | 2,3646 |
| Estonia | -0,2732 | -0,7514 | 2,3646 |
| Latvia | 0,9760 | 11,8491 | 2,3646 |
| Lithuania | 0,9496 | 8,0150 | 2,3646 |

The results of correlation analysis show that very strong relation between SII and FDI exists in Latvia and Lithuania. In other EU countries such relation is slightly lower. In Estonia it is very low. The importance of every used variable was evaluated using the Student criteria method. Selected level of importance is 0.05, level of liberty is 7 because of the same number of elements.

Results reveal that SII is an important factor towards FDI in cases of EU, Lithuania and Latvia, because in these cases $t_{observed}$ is much bigger then $t_{critical}$.

The ninth assumption was proved in cases of EU, Lithuania and Latvia. It is possible to declare that SII *has a positive impact on FDI in the EU, Lithuania and Latvia.*

## 10. R&D expenditure and monthly labour costs

The development of R&D expenditure and monthly labour cost indicators in considered countries were presented above.

**10th assumption:** *R&D expenditure has a positive impact on monthly labour costs.*

Table 10 consists of the results of the correlation analysis and evaluation of importance of R&D expenditure and monthly labour costs in the EU countries, Lithuania, Latvia and Estonia.

*Table 10.* R&D expenditure and monthly labour costs interdependence

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9434 | 7,5292 | 2,3646 |
| Estonia | 0,9877 | 16,7254 | 2,3646 |
| Latvia | 0,9624 | 9,3738 | 2,3646 |
| Lithuania | 0,9955 | 27,7348 | 2,3646 |

The results of correlation analysis show that strong connection between R&D expenditure and monthly labour costs exists in all analysed countries. With the help of the Student criteria method the importance of every used variable was evaluated. Selected level of importance is 0.05, level of liberty is 7 because of the same number of elements.

Results reveal that R&D expenditure is an important factor toward monthly labour costs in EU, Lithuania, Latvia and Estonia.

The tenth assumption was proved. It is possible to assert that R&D expenditure has *a positive influence on monthly labour cost in the EU, Lithuania, Latvia and Estonia.*

## 11. Patent applications and monthly labour costs

The development of patent applications and monthly labour cost indicators in analyzed countries were presented above.

**11th assumption:** *Increasing number of patent applications has a positive influence toward monthly labour costs.*

Table 11 consists of the results of the correlation analysis and evaluation of importance of patent applications in the EU countries, Lithuania, Latvia and Estonia.

*Table 11.* Patent applications and monthly labour costs dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9465 | 7,7586 | 2,3646 |
| Estonia | 0,8320 | 3,9685 | 2,3646 |
| Latvia | 0,9906 | 19,1114 | 2,3646 |
| Lithuania | 0,7148 | 2,7043 | 2,3646 |

The results of correlation analysis show that strong relation between patent applications and monthly labour cots exists in the EU countries, Latvia and Estonia. In case of Lithuania the level of relation between the variables is low. With the help of the Student criteria method the importance of every used variable was evaluated. Selected level of importance is 0.05, level of liberty is 7 because of the same number of elements.

Results reveal that the number of patent applications is an important factor toward monthly labour costs in EU, Latvia and Estonia, but not in Lithuania.

The eleventh assumption was proved in cases of the EU countries, Latvia and Estonia. It is possible to declare that *patent applications have a positive impact on monthly labour costs in the EU countries, Latvia and Estonia.*

## 12. Summary Innovation Index and monthly labour costs

The development of summary innovation index and monthly labour cost indicators in pending countries was presented before.

**12th assumption:** *Increasing SII has a positive impact on monthly labour costs.*

Table 12 consists of the results of the correlation analysis and evaluation of importance of SII and monthly labour costs in the EU countries, Lithuania, Latvia and Estonia.

*Table 12.* SII and monthly labour costs dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,5814 | 1,8907 | 2,3646 |
| Estonia | -0,2835 | -0,7823 | 2,3646 |
| Latvia | 0,9767 | 12,0289 | 2,3646 |
| Lithuania | 0,9821 | 13,7845 | 2,3646 |

The results of correlation analysis show that strong relation between SII and monthly labour cots exists in Latvia and Lithuania. In case of the EU countries the level of relation between the variables is low. The lowest level of relation exists between variables of Estonia. With the help of the Student criteria method the importance of every used variable was evaluated. Selected level of importance is 0.05, level of liberty is 7 because of the same number of elements.

Results reveal that SII is an important factor toward monthly labour costs in Latvia and Lithuania, but not in the EU countries and Estonia.

The twelfth assumption was proved in cases of Latvia and Lithuania. It is possible to declare that SII has *a positive impact on monthly labour costs in Latvia and Lithuania.*

## 13. Patent applications and R&D expenditure

The development of summary innovation index and monthly labour cost indicators in pending countries was presented before.

**13th assumption:** *Increasing number of patent applications has a positive impact on R&D expenditure.*

Table 13 consists of the results of the correlation analysis and evaluation of importance of patent applications and R&D expenditure in the EU countries, Lithuania, Latvia and Estonia.

*Table 13.* Patent applications and R&D expenditure dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,9848 | 15,0151 | 2,3646 |
| Estonia | 0,8320 | 3,9673 | 2,3646 |
| Latvia | 0,9453 | 7,6699 | 2,3646 |
| Lithuania | 0,7114 | 2,6780 | 2,3646 |

The results of correlation analysis show that strong relation between patent applications and R&D expenditure exists in all countries, except Lithuania. In case of Lithuania relation between the variables is low. With the help of the Student criteria method the importance of every used variable was evaluated. Selected level of importance is 0.05, level of liberty is 7 because of the same number of elements.

Results reveal that the number of patent applications is an important factor toward R&D expenditure in the EU countries, Latvia and Estonia, but not in Lithuania.

The thirteenth assumption was proved in cases of the EU countries, Latvia and Estonia. It is possible to declare that *the number of patent application has a positive impact on R&D expenditure in the EU countries, Latvia and Estonia.*

## 14. Summary Innovation Index and R&D expenditure

The development of summary innovation index and R&D expenditure indicators in pending countries was presented before.

**14th assumption:** Increasing SII has a positive impact on R&D expenditure.

Table 14 consists of the results of the correlation analysis and evaluation of importance of SII and R&D expenditure in the EU countries, Lithuania, Latvia and Estonia.

*Table 14.* SII and R&D expenditure dependence indicators

| | r | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,7626 | 3,1194 | 2,3646 |
| Estonia | -0,2524 | -0,6902 | 2,3646 |
| Latvia | 0,9850 | 15,0815 | 2,3646 |
| Lithuania | 0,9802 | 13,1015 | 2,3646 |

The results of correlation analysis show that strong relation between SII and R&D expenditure exists in Lithuania and Latvia, but not in the EU countries and Estonia. In case of Estonia relation between the variables is very low. With the help of the Student criteria method the importance of every used variable was evaluated. Selected level of importance is 0,05, level of liberty is 7 because of the same number of elements.

Results reveal that SII is an important factor toward R&D expenditure in Lithuania and Latvia, but not in Lithuania.

The fourteenth assumption was proved in cases of Latvia and Lithuania. It is possible to declare that *SII has a positive impact on R&D expenditure in Latvia and Lithuania.*

## 15. Summary Innovation Index and Patent Applications

Patents play an increasingly important role in innovation and economic performance. Between 2000 and 2007, the number of patent applications filed in Europe, Japan and the United States increased by more than 30%. The increasing use of patents to protect inventions by businesses and public research organisations is closely connected to recent evolutions in innovation processes, the economy and patent regimes.

Scientific and technological advances have created new waves of innovation, notably in information and communications technology and biotechnology, and innovation processes themselves have become centred less on individual firms and more dependent on interactions among global networks of actors in the public and private sectors. Shifts in the legal and regulatory framework of patent regimes have resulted in more expansive domains of patentable subject matter (patent regimes in many countries now include biotechnology and software), and more robust and more valuable patents.

Patents aim to foster innovation in the private sector by allowing inventors to profit from their inventions. The positive effect of patents on innovation as incentive mechanisms has been traditionally contrasted with their negative effect on competition and technology diffusion. Patents have long been considered to represent a trade-off between incentives to innovate on one hand, and competition in the market and diffusion of technology on the other. However, recent evolutions in science and technology and patent policy and progress in the economic analysis of patents have nuanced this view: patents can hamper innovation under certain conditions and encourage diffusion under others. The impact of patents on innovation and economic performance is complex, and fine tuning of patent design is crucial if they are to become an effective policy instrument.

**15th assumption:** *Patent applications have a positive impact on summary innovation index.*

Table 15 presents the results of correlation analysis and evaluation of importance of patent applications and summary innovation index in the EU countries, Lithuania, Latvia and Estonia.

*Table 15.* SII and patent applications dependence indicators

| | R | $t_{observed}$ | $t_{critical}$ |
|---|---|---|---|
| European Union | 0,6984 | 2,5818 | 2,3646 |
| Estonia | -0,3980 | -1,1480 | 2,3646 |
| Latvia | 0,9622 | 9,3505 | 2,3646 |
| Lithuania | 0,6730 | 2,4072 | 2,3646 |

The results of correlation analysis show that the strong relation exists between the variables only in Latvia. In cases of European Union countries and Latvia this relation is slightly low. In order to evaluate the importance of each variable used in analysis, Student criteria method was applied. Selected level of importance is 0.05, the level of liberty is 7 because of the same number of elements.

Results show that patent applications is an important factor for SII in Latvia, because $t_{observed}$ in all cases is much bigger than $t_{critical}$.

The fifteenth assumption was proved only in case of Latvia. So, *patent applications have a positive impact on summary innovation index in Latvia, but not in the European Union countries, Estonia and Lithuania*.

## Conclusions

FDI and innovations in economic policy unconditionally considered as positive factors and often are used in order to reach economical growth. FDI and innovations are also regarded as one of the most important measures for the developing of economy of new members of the EU during the transitional period.

The main task of this article was to identify and to evaluate main aspects and factors of FDI and innovations, which have a direct influence toward attracting of FDI into the country. During the research 15 theoretically founded assumptions about certain relations between FDI, GDP, SII, monthly labour costs, patent applications, R&D expenditure and etc. were analysed. These assumptions were examined with regard to economies of the EU countries, Lithuania, Latvia and Estonia. For the verifying of assumptions the method of correlation analysis was used. The importance of gained results of correlation analysis was checked with a help of Student criteria method.

Concluding the results of the research, it must be noted that in all three Baltic states there is a strong relation between FDI and GDP, monthly labour costs and GDP, R&D expenditure and GDP, Monthly labour costs and FDI, R&D expenditure and FDI, R&D expenditure and monthly labour costs. Analysing the factors, which may have negative impact on FDI, it was found that increasing monthly labour costs do not have negative impact on FDI. The analysis of factors of innovations was not homologous. For example, increasing number of patent applications has a positive influence toward FDI in Latvia and Lithuania, as well as in the EU countries, but not in Estonia. The same is true in case of analysis of the relations between SII and FDI. It has to be noticed that SII has

a positive influence toward monthly labour costs and R&D expenditure only in Latvia and Lithuania.

Fulfilled research showed that the biggest part of theoretically based relationships between various factors founded in scientific literature and explored in the context of other countries in case of the Baltic states were also confirmed. It must be remarked that during the transition period the main trends of the world economy in the field of relationships between various economy indicators were reflected in the economies of the Baltic states.

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# UŽSIENIO KAPITALO ĮPLAUKŲ POVEIKIO INOVACINIAM AUGIMUI TYRIMAS: BALTIJOS ŠALYS EUROPOS SĄJUNGOS KONTEKSTE

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***Santrauka***. *Straipsnyje siekiama nustatyti ir palyginti tiesioginių užsienio investicijų ir inovacijų reikšmę Lietuvos, Latvijos ir Estijos ekonomikai, lyginant jas su bendrais Europos Sąjungos valstybių narių rodikliais.*

*Teoriškai pagrindžiamas tiesioginių užsienio investicijų ir inovacijų poveikis investicijas gaunančios ir inovacijas kuriančios šalies ekonominiam augimui. Nagrinėjama, kiek tiesioginės užsienio investicijos ir inovacijos turi įtakos kitų Baltijos ir Europos Sąjungos šalių ekonominių rodiklių augimui. Suformuluotos konkrečių tiesioginių užsienio investicijų, bendrojo vidaus produkto, darbo sąnaudų išlaidų tyrimams ir plėtrai, paraiškų patentams ir suminio inovacijų indekso Lietuvoje, Latvijoje, Estijoje ir Europos Sąjungos šalyse sąryšių prielaidos. Prielaidoms tikrinti taikoma koreliacinė analizė, o tiriamųjų faktorių ryšio reikšmingumui įvertinti – Stjudento kriterijaus metodas. Kiekybinis atskirų sąryšių įvertinimas leidžia palyginti ir ekonomiškai interpretuoti tiesioginių užsienio investicijų ir inovacijų reikšmę Baltijos ir Europos Sąjungos šalių ekonomikai, leidžia suformuoti valstybių požiūrį į tiesioginių užsienio investicijų ir inovacijų skatinimą.*

*Tyrimo rezultatai visiškai ar iš dalies patvirtino daugelį mokslinėje literatūroje įvardytų ir šiame darbe iškeltų prielaidų. Nustatyta, jog Baltijos šalyse ir apskritai Europos Sąjungoje egzistuoja stiprus tiesioginių užsienio investicijų ir bendrojo vidaus produkto, darbo sąnaudų ir bendrojo vidaus produkto, išlaidų tyrimams ir plėtrai ir tiesioginių užsienio investicijų, darbo sąnaudų ir tiesioginių užsienio investicijų ryšys. Stiprus ir reikšmingas koreliacinis ryšis Latvijos, Estijos ir apskritai Europos Sąjungos atvejais buvo nustatytas ir tarp paraiškų išduoti patentus skaičiaus didėjimo ir bendrojo vidaus produkto, darbo sąnaudų ir išlaidų tyrimams ir plėtrai augimo. Lietuvos atveju minėtos prielaidos nepasitvirtino. Tai, matyt, lėmė palyginti nedidelis Lietuvos išradėjų paraiškų gauti patentus skaičius. Taip pat nustatyta, kad Lietuvos ir Latvijos atvejais suminio inovacijų indekso augimas lėmė ir bendrojo vidaus produkto bei darbo sąnaudų augimą. Šiose valstybėse, kaip ir Europos Sąjungoje apskritai, skirtingai nei Estijoje, tiesiogines užsienio investicijos turi teigiamą įtaką suminio inovacijų indekso didėjimui. Atitinkamai suminio inovacinio indekso didėjimas reiškia ir išlaidų tyrimams ir plėtrai augimą. Tik Latvijos atveju paraiškų išduoti patentus skaičiaus didėjimas lėmė suminio inovacijų indekso didėjimą.*

***Reikšminiai žodžiai**: tiesioginės užsienio investicijos, bendrasis vidaus produktas, investicijų veiksniai, kiekybinis vertinimas, Baltijos šalių ekonomika.*

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