INTERNAL AND EXTERNAL FACTORS THAT DETERMINED THE CHANNELS OF INNOVATION DIFFUSION IN LITHUANIA

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Abstract. *The prevailing opinion in Lithuania is that the country's economic growth was determined by the inflow of foreign direct investments (FDI). Their influence on the Lithuanian economy remains unquestionable, however, there is a tendency to overestimate their impact, while other factors are under-estimated or ignored completely when conclusions on their influence on the country's economy are drawn. Based on the data of the Department of Statistics of Lithuania, Eurostat, other agencies and the analysis of the research of Lithuanian and foreign academics on FDI, and the impact of the innovations on the country's economy, the given study presents the analysis of the three main channels for the technological and innovation diffusion, which have exercised a decisive influence on the economic development in Lithuania over the last decade. They are foreign direct investments, international trade, and the country's knowledge capital. These diffusion channels were considerably important in the transition period, however, the creation of original knowledge and innovations, or the creative application of the technology created in other countries and application of the knowledge gained abroad was utilised least. In Lithuania,, the creation and adoption of extended modifying innovations and technologies was dominant in terms of innovation modes, while the strategic innovations were created by only 1 percent of Lithuanian enterprises[1]. A comparative analysis of surveys, statistical data, and academic studies was conducted and lead to the conclusion that the main technology and innovation diffusion channel, as well as the main driving force behind Lithuania's economy during the transitional period of 1996–2007 was neithert FDI nor the scientific potential of the country, but rather the international trade. In addition, the data suggests that the country's scientific potential was ill-prepared for the changes brought on by globalisation and had a very weak impact on the growth of the Lithuanian economy and the economy's technological and innovational reorientation, which led to the enterprises searching for other possible sources of innovation. The model for the creation of innovation eacompassing state institutions, the science community and enterprises was not functional during the said period in Lithuania.*

Keywords: *knowledge spillovers, innovation, R&D, FDI*

[1] Innovation Scoreboard 2005; http:/trendchart.cordis.lu/scoreboards/scoreboard2005/Lithuania .cfm

INTRODUCTION

Countries that aspire to secure a high position on the global competitiveness scale cannot rely only on the large financial and labour force resources. In the short and long term development programs of various countries, as well as in the state economic cohesion strategies, the importance of scientific research and technology development (R&D) is attracting more and more attention. It should be noted that knowledge creation and spillovers, as well as the institutional flexibility of market regulation, will be the main condition that will determine the economic future of each country (EC, 2006). Enterprise innovation strategies change as globalisation deepens due to technological developments. The geographic distribution of the research has also changed. Research centres not only develop innovations on the international scale, they also present their innovations to the global market by licensing their findings or selling technologies to foreign buyers. A global market for the technology and innovation is being formed. In the majority of countries, as much as 90 percent of their economic growth is brought about by the technology that has been sourced from abroad (Keller, 2004).

Lack of substantial financial resources and an overly excessive labour force meant that Lithuania‘s economy faced the challenges of the globalisation somewhat unprepared. Emigration of the present labour force, and the reduction and withdrawal of foreign direct investments over the last two years has no benefited the competitiveness of Lithuania‘s economy. However, technology, innovation, and knowledge can help to turn the country‘s economy around. What is important, is to ascertain the capability of Lithuania‘s scientific potential to satisfy the commercial demands, and find out whether business is prepared to cooperate with the country‘s scientific institutions, when it has the alternative of acquiring and adapting the already functional technology and innovation from abroad.

Should energy and resources be directed towards the technology adaptation, and at the same time urge the goverment to support and encourage the import of technology, while setting less ambitious goals for the state scientific institutions and universities? Or should the creation of the new, strategically important innovation and technology aimed at the development of the country‘s economy be the focus, channelling the appropriate funding and attention to those fields, while directing incentive policies towards the strengthening of Lithuania‘s scietific potential? Perhaps the middle road should be taken – supporting strategic innovation in certain “ground-breaking” fields, at the same time not ignoring the merits of innovation that can be adapted and assimilated. Whatever path is taken, a particular diffusion channel will be highlighted, to a lesser or greater degree – be it foreign direct investments, or international trade, or direct contact between the country’s business and science sectors in gaining patents or knowledge, in addition to the possible discovery of new diffusion channels for the technology and innovation. Although it may appear that the international economic integration itself boosts the spread of technology, this spread is not necessarily inevitable or automatic. A country must contribute in-

vestments intothe innovation in any case (Keller, 2004).

International trade

It is common knowledge that international trade had a massive influence on the manufacture of commodities in the country and its level of technological development. Coe, Helpman and Hoffmaister (1997) conducted research where they analysed the productivity levels of the developing countries depending on the scale of foreign R&D capital received, the import of machinery and equipment from economically developed countries, and the level of education of the country‘s labour force. Based on data from OECD countries, they found that for small countries, innovation and technology gained from abroad is more important than local technology at a ratio of 3:2, compared to larger countries, where this ratio was 1:4 (Lithuania can be grouped with the smaller countries, thereby showing the importance of innovation and technology from abroad). In their appraisal of international trade, Coe, Helpman and Hoffmaister identified its several main benefits. Firstly, the acquisition of capital and intermediate goods improves and strengthens the productivity of local potential. Secondly – international trade opens up the channels of communication, which stimulate education without borders in seeking to improve manufacturing methods, product design, marketing conditions, and organisation methods. Thirdly, international contact empowers the countries to copy technology from abroad, adapting it for their own needs. Fourth, international trade can boost a country‘s productivity by contributing to the development of a new technology or the imitation of the foreign technology, while at the same time indirectly boosting the level of productivity throughout the country.

International trade as a technology diffusion channel was viewed with considerable reserve due to its geographical restrictions, however over the last decades, with the such advantages as cheaper transportation costs, mass-scale freightage, and well-organised logistics brought about by the globalisation, those geographical restrictions have been minimized. With its excellent geographical location near the developed North and West European countries, as well as being situated at the crossroads of the Russian and EU routes for international trade, having a sea port and a comprehensive automobile and rail infrastructure Lithuania potentially had and still has very good opportunities to utilize the benefits of international trade, as illustrated by the analysis of cooperation partners of Lithuanian innovative enterprises (Table 1), which shows that suppliers, clients and consumers are the most important partners for innovative enterprises. It should be noted, that cooperation partners from foreign countries in 2002–2004 accounted for 42.9 % of the total number of partners, while in 2004–2006, this value had risen to 46.3 % (LSD, 2008).

Table 1. ***Cooperation partners of innovative enterprises 2004–2006***

	% of innovative enterprises	Rating according to their importance to the enterprise
State scientific research institutions	10.3	0.6
Universities or other higher education institutions	18.4	13.2
Consultants, laboratories, private scientific research institutions	21.3	5.0
Competitors or other enterprises	17.8	1.6
Clients or consumers	27.7	11.2
Equipment, materials, programming equipment suppliers	34.1	41.1
Other related enterprises	21.2	27.3

Source: LSD, 2008

A large part of contact and innovation as well as technology diffusion came about through international trade, especially imports, because as much as 34.1 % of innovative enterprises indicated that their cooperation partners were the suppliers of certain equipment, materials, and programming equipment, 27.7 % – clients and consumers, and 21.2 % – other related enterprises. Universities and other state scientific insitutions were identified as the cooperation partners 28.7 % of innovative enterprises, however, when they are rated according to their importance to enterprises, universities and state scientific research institutions take up only the third place, after the suppliers and the related enterprises. The priority scale of diffusion channels is further proven by the analysis of spending made by the enterprises on the innovative activities, in line with their aims. Over the 2002–2004 period, equipment and machinery acquisition costs made up 77 % of total spending, whereas external R&D costs made up only 2.6 % of total spending (LSD, 2008).

Over the 2004–2006 period, enterprises increased their share of external R&D expenditure to 7.7 % of total spending, and allocated more funds to the internal R&D expenditure, which reached the line of 26.7 % of all spending on innovative activities in this period. However, the acquisition of machinery and equipment continued to be the dominant spending area.

Coe, Helpman and Hoffmaister (1997) draw particular attention to the importance of machinery and equipment imports regarding the diffusion of R&D and bringing about an increase in the country‘s productivity. After a small rise in 2004, the import of machinery, equipment, electronic instruments and parts thereof remained rather stable within the total Lithuanian import structure (Table 2), which shows that Lithuanian enterprises are utilising the opportunities of international trade and technology diffusion[2]. It is noteworthy that the import of mechanical appliances, machinery, boilers and their parts from the 12 most technologically advanced countries is also stable.

The largest share of imports were intermediate goods, which, used in conjunction with local labour, energy, and engineering resources, are processed and destined for

[2] Compared to its neighbours, machinery and equipment imports as a share of total imports in Lithuania is the smallest, as in a 10 year period, on average, this value was 24.5 % in Estonia, 20.5 % in Latvia, and 25 % in Poland.

Table 2. ***Imports of machinery, mechanical appliances, electrical equipment and parts***

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Machinery, mechanical appliance, electrical equipment imports (mln. Lt*)	**4,265**	**3,560**	**3,418**	**4,251**	**4,939**	**5,638**	**6,537**	**7,737**	**9,344**	10,985
Percentage of total imports (%)	18.4	18.4	15.7	16.7	17.3	18.6	19.0	17.9	17.6	17.9
Mechanical appliance, machinery, boilers and parts imports (not including electrical equipment) from 12 developed countries ** (mln. Lt)	1,693	1,474	1,280	1,579	1,683	2,044	2,503	3,159	3,768	4,079
Percentage of total imports (%)	7.9	7.9	6.1	6.5	6.1	6.9	7.3	7.3	7.1	6.6

** fixed currency rate: 1998-2001: LTL/USD= 4.0;, 2002-2009: LTL/EUR= 3.4528*

*** USA, Denmark, Germany, Sweden, Finland, the UK, Italy, Japan, Canada, Spain, the Netherlands, France*

Source: LSD, 1998-2007.

further export. The export factor at an innovation adoption level, and especially during the transition period in Lithuania, also needs to be considered and is no less important, especially when 27.7 % of innovative enterprises identified the clients and consumers as their cooperation partners (LSD, 2008).

The trend of the importance of consumers and clients is also confirmed in research surveys of Lithuanian business enterprises by Adekola et al. (2008), which showed that the greatest influence on the implementation of innovation in businesses came from the clients (70 %), followed by competitors (46 %), and suppliers (14 %).

Sectors of the economy that have adapted imported technological equipment or modified the existing one, and who have used local labour, energy, and engineering resources to process the intermediate goods and successfully exported those end products remain the export leaders. The chemical materials and products industry exported 78.4 % of its total production, 77 % – the textiles manufacturing sector, 76.9 % – the clothing production sector, and 78.3 % – the radio and TV equipment sector (DnB NORD bank, 2008). However, the indicator showing the level of the strategic innovation and technology diffusion, i.e. the trade account balance of high level technology, was minus 595 mln. EUR among Lithuanian businesses in 2004 (Eurostat, 2006). Like its neighbours Latvia and Poland, in Lithuania, the share of high level technology exports in 2004 was only 3 % of total exports, and these were the lowest values in the European Union.

Foreign direct investments

As indicated by innovative enterprise survey data, knowledge and innovation gained from the related enterprises, most likely from foreign parent companies or corporations, was rated second in importance. Therefore, we can assume that the second most important factor for technology and innovation diffusion are foreign

direct investments (FDI). Over the last decade, changes to FDI streams across the whole world are a reflection of global fluctuations in economic activity. Eastern Europe, including the Baltic States, occupies a relatively high position in the investment confidence index calculations (A.T.Kearney Inc., 2006). Irrespective of the growing costs and greater regulation that came with the EU membership, the new EU member states became much more attractive to global companies due to their growing productivity and lower taxes (A.T.Kearney Inc., 2006). Eastern Europe was being seen as a promising region also for the favourable R&D investment opportunities it offered, due to lower costs and its strong human and academic resources and engineering capabilities. A certain share of investments (especially when the decision hinged on costs) were directed to the new EU member states, and did not go to China or India only because the new EU member states already had an existing social and economic infrastructure and investors did not need to spend extra funds on its establishment (Kalotay, 2006). The World Bank (2006) found that economic growth rates of the country depended not so much on the investments, as on the growth in productivity, which was achieved with the inflow of investments. In Lithuania, FDI as a share of GDP grew from 4.3 % in 1996 to 29.4 % in 2007, and the FDI annual growth percentage (Table 3) did not affect the growth of the country's GDP to the same or even similar extent. Since not all FDI can be identified as those that boost a country's labour productivity and bring innovation and technology into a country, this can be particularly true of at the enterprises that received investments or were privatised by the foreign capital in order to make use of the existing technology, a cheap labour force, and relatively cheap energy resources, or to oust a potential

Table 3. ***Dynamics of foreign direct investment in Lithuania in 1996–2007***

	1996	***1997***	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
FDI mln. Lt*	1,406	2,801	4,163	6,501	8,252	9,337	10,662	13,184	13,699	16,193	23,896	28,925
FDI per capita, Lt	390	784	1,173	1,845	2,358	2,682	3,073	3,817	3,987	4,727	7,022	8,545
FDI compared to the previous year, %		99.2	48.6	56.2	26.9	13.2	14.2	23.7	3.9	18.2	47.6	21.0
FDI as % of GDP	4.30	7.00	9.31	14.89	18.07	19.22	20.52	23.21	21.89	22.74	29.14	29.47
GDP, mln. Lt	32,740	39,998	44,699	43,667	45,674	48,585	51,971	56,804	62,587	71,200	81,991	98,138
GDP compared to the previous year, %		22.2	11.8	–2.3	4.6	6.4	7.0	9.3	10.2	13.8	15.2	19.7

*at the start of the year,

Source: LSD, 2007

competitor (in Lithuania, this refers to the sugar, tobacco and brewing sectors).

K. Kalotay (2006) conducted an analysis of FDI in the new EU member states, which showed that the majority of the investment into the new EU member states that was made by the international companies aimed at the expansion of their market share, increase of the sales in new markets, and making use of lower labour, energy, and public utility costs, allowing a larger and more rapid profit. The pursuit of strategic and long term goals in the new EU member states is a new phenomenon that was largely focused on IT investments and R&D only in the Czech Republic, Hungary, and Poland.

Proceeding from her own surveys of 50 Lithuanian companies, M.Runiewicz (2004) highlighted in particular the R&D knowledge gained from parent companies of enterprises run by the foreign capital. In her opinion, this helped those enterprises to stengthen their export potential by the increases in their R&D investment.

Analysis of the investments into the industry sectors shows that foreign investors select low and mid-level technology sectors of the economy, and this fails to create significant positive structural changes in a country‘s economy. We may agree with the claim, that in terms of increasing a country‘s competitiveness, it is not the same whether specific “know how” and traditions are invested into one or another sector of the economy by investors that occupy a higher position in international markets, or accordingly, whether they are subjects merely seeking rapid profit gain (Jucevičius, 2006). In 2000, the distribution of investments in Lithuania according to the sectors of the economy (LSD, 2001) showed that the leader in attracting FDI was the manufacturing sector – drawing 28.8 % of all FDI, closely followed by the wholesale and retail trade (22.7 %), with the post and telecommunications sector in the third place (16.9 %), and the fourth – financial intermediation (16.2 %). Within the manufacturing sector, the manufacture of food products, beverages and tobacco attracted most investments – as much as 40 %, followed by the textile manufacture – drawing 13 %. Investment into machinery, equipment, furniture, medical, optical and other instruments amounted to 4.6 % of all FDI. A somewhat different situation unfolds when the 2006–2007 data is examined since the investments into the oil refinery produced a considerable impact on the statistical data. Manufacturing remained among the most attractive sectors of the economy with 36.3 % of all FDI, followed by the financial intermediation with 17.18 %; wholesale trade was the third with 11.45 %, and post and telecommunications – 10.87 %. FDI in 2006 increased significantly in already profitable market sectors as well as those that promised a rapid return: in construction, FDI annual growth was 53.1 %; in real estate and renting the growth was 41.3 %; and in timber and wood product manufacture – 46.5 %. Growth rates in 2007 had slowed down slightly due to the onset of the global economic stagnation, however the inertia of the construction (annual growth – 15.58 %), financial intermediation (29.15 %), and real estate and renting (28.12 %) sectors meant that their growth was strong. These sectors of the economy do not exhibit great technological or inno-

vational prospects, which repeatedly leads to the conclusion that a large share of FDI came to "claim the profits" from the promising and growing sectors. Investments into the machinery and equipment manufacture, and the manufacture of furniture, medical and other instruments at the end of 2007 made up only 4.7 % of all FDI invested into Lithuania's economy (LSD, 2008).

The main potential difference of Lithuanian enterprises that attracted foreign investment prior to 2006 was low costs (Kalotay, 2006; Urbonavičius, Brock, 2008), while incoming FDI usually went towards the low and mid-level technology sectors of the economy where adaptation and, to a certain degree, the creation of the extended modifying innovation prevailed. This means that technology created elsewhere is being transposed into Lithuanian enterprises, and in this way Lithuania can avoid the fate of being g completely left behind in the wider market. Investment in the higher level technology did increase (especially the percentage of the manufacture of the medical and precision instruments, the annual growth whereof reached 22 % in 2006), however, due to the unsuccessful activities of "Ekranas" (a manufacturer of colour TV picture tubes) and its related enterprises, the percentage of the higher level technology within the total FDI structure fell to 2.9 %.

FDI have had an impact on the technology diffusion. The diffusion has mainly manifested itself through the transfer of the technology from foreign parent companies to the enterprises acquired in Lithuania, in addition to the payments to the staff to work with the new equipment and implementation of the new management and organisation methods. Other technology and innovation reached Lithuanian enterprises that received intermediate goods to be manufactured into final goods. This is evident in the research conducted by Innobarometer into the innovative business enterprises[3], which showed that in terms of new products and services presented to consumers, Lithuanian enterprises are EU leaders in selling products or services created by other enterprises (55 % of all enterprises, where the EU-27 average is 34 %) and in carrying out modification or customization of products or services created by other enterprises (47 % of all enterprises, where the EU-27 average is 33 %). There was a fairly significant indirect benefit of FDI that resulted in the local service or supply enterprises, that previously had no access to the foreign markets, being forced to upgrade or improve their technologies once they entered the partnerships with foreign companies, adapting their existing technology and their entire manufacturing potential to meet the the requirements of foreign companies. In this way, the impact of FDI on the technology diffusion manifested itself not only in those industries where the foreign capital was invested, i.e. on the vertical plane, but also in other branches related to the maintenance of the supply and service links. Unfortunately, the technology diffusion process based on the cost economics and rapid profit returns is quite unstable, short-lived, and fails to suit the strategic goals of the country where the investments are being made (Jucevi-

[3] Innobarometer 2007, Analytical Report, *Innovation transfer*, Flash EB Series No. 215, p. 31.

cius,2007). V. Urbonavičius and G. Brock (2008) analysed the attraction of FDI into the individual districts in Lithuania and concluded that, having lost its low costs appeal, Lithuania could draw additional FDI by better implementation of the EU laws, whereby FDI would be maintained by the increased internal purchasing power, along with the additional international financial services. The said data related to the FDI into the "rapid profit return" areas and the burst of the real estate bubble, as well as the drop in consumption due to the global crisis show that the conclusion of these authors concerning measures to maintain FDI in Lithuania proved to be erroneous and even had a negative impact on the exagerrated growth of consumption.

Knowledge capital

After the restoration of Lithuania's independence and especially after the accession to the European Union, new opportunities for the participation in various conferences and training opened up to many of the country's academics and business people, both in the EU and in other countries throughout the world. International trade, foreign direct investments, and membership in the international organisations stimulated and encouraged the establishment of new contacts with foreign partners who had (i.e. managed) advanced technologies and innovative knowledge. In the general context of the technology and innovation assimilation, it is very important to ascertain whether Lithuania has sufficient potential to understand and accept the global innovative achievements.

Data on the technology diffusion via knowledge capital is estimated differently compared to the international trade and FDI, and is not calculated directly, however, surveys conducted by the Department of Statistics of Lithuania (LSD) reveal the external factors that have had the greatest impact on the innovation (Table 4), and the research of business enterprises conducted by the Innobarometer (2007) present the sources of innovation from within an enterprise. Innobarometer's data show that top t level leaders understand the importance of innovation – 80 % of the surveyed enterprises identified top level leadership as the source of innovation (EU-27 average – 76 %), however, in terms of the engineering and technical personnel, and especially professionals of marketing as a source of internal innovation, Lithuania was found to be lagging far behind the EU-27 average. There was a similar trend in the participation of the internal R&D department of the enterprise in the creation of innovation (engineering-technical personnel as a source of innovation – 35 % of the surveyed enterprises; marketing departments – 25 %; internal R&D department – 9 %; the EU-27 averages are 40 %, 39 % and 25 % respectively)[4]. The development of creative thinking and innovation implementation processes requires a solid foundation – culture of an organisation and a system of its values and norms, where particular attention goes to the people that work for the enterprise (Poškienė, 2006), and only organisations based on the culture of creativity and knowledge can encourage innovation to spring up from within. In her analysis

[4] Innobarometer 2007, Analytical Report, *Innovation transfer*, Flash EB Series No. 215, p. 21-22

of the organisation culture and innovation, A. Poškienė (2006) presented data showing that the staff that seeks innovation and change in business enterprises are mostly influenced by the motivation (in 5 cases out of 6). General enterprise policies on innovation and management came in the second place. Unfortunately, the ability of the Lithuanian leaders to adopt and apply motivational measures was found to be one of their weakest skills. The main method of motivation used by the leaders of business enterprises was monetary encouragement, a method not even considered a stimulus by some people since it forces them to take up complicated tasks. The specific desire of leaders to apply monetary remuneration as a motivator often becomes a measure of manipulation, thereby losing its stimulatory role (Diskienė, et al., 2008). Other factors that are described as a foundation for a creative organisation, such as staff involvement, tolerance, trust, openess to change, etc., are only starting to be adopted by the Lithuanian leaders. However, a centralised management style, decision-making and taking of the responsibility at the toplevel, and excessive control are still the dominant characteristics on the general scale of the leaders‘ abilities (Diskienė, et al., 2008). The above data from Innobarometer showing that the internal enterprise resources are not used to create innovation are completely understandable and explicable; in addition, these potential resources are neither supported by their leadership, nor are they encouraged by the organisation‘s internal culture or see any motivational benefits as to why they should be creative. It is no wonder then, that so much research by both the LSD (2008) and Adekola et al. (2008) on the factors that inhibit innovative activities indicate a shortage of qualified personnel, which, when coupled with the limited financial resources and the expansion of the dominant market leaders, becomes the main inhibitor of innovative activities within an enterprise. However, when the internal resources are limited, there is always an opportunity to search for external sources, and primarily among the country‘s scientific potential.

Data from the surveyed Lithuanian innovative enterprises show that in 2002-2004, universities and other state scientific institutions were identified as cooperation partners by only 19.9 % of business enterprises (see Table 1). In 2006 this percentage grew to 28.7 % due to the financing conditions of EU structural funds and other European programs that encouraged cooperation between the science and business communities and a more flexible approach to the management of certain state scientific institutions, when, due to insufficient government financing, institutes and universities carried out more commissioned research for business enterprises, seeking to attract additional funds.

Irrespective of the slightly increased cooperation between the innovative enterprises and the state scientific institutes, the importance of scientific institutes in the innovation diffusion weakened in terms of diffusion channels, which were determined by the trade relationships or information from the related enterprises (Table 4). In 2002-2004, state scientific institutes and universities were identified as sources of innovation by only 2.6 % of the innovative enterprises. As has been mentioned, the increase in the universities in 2004-2006 was

Table 4. ***Sources for innovation activities 2002–2004 and 2004–2006***

(percentage of innovative enterprises indicating high importance of selected sources)		
Sources	***2002–2004***	***2004–2006***
Professional and industrial associations	2.00	4.30
Scientific journals and trade/technical publications	6.70	12.40
Conferences, trade fairs, exhibitions	12.30	17.40
Government or public research institutes	1.60	0.50
Universities or other higher education institutions	1.00	6.10
Consultants, commercial labs or private R&D institutes	5.80	8.20
Competitors or other enterprises in your sector	7.70	8.00
Clients or customers	17.70	17.70
Suppliers of equipment, materials, components or software	17.00	23.60
Enterprise or enterprise group	29.90	30.10

Source: LSD, 2008

more related to the appearance of external requirements. Many more enterprises gained information by way of participation in the conferences, trade fairs, and exhibitions. It can also be noted, that there was a definite increase in the importance of the scientific journals and trade/technical publications as a source of innovation. A survey conducted in October 2008 in the 300 largest Lithuanian enterprises revealed that 85 % gained their information about innovations from the Internet ("Vilmorus", 2008).

The fact itself s does not mean that every country that has access to the Internet can assimilate everything that exists in the virtual global technology market equally well. Nor is it the innovation discoverer's aim that the innovation they worked hard to create and develop should make its way to other countries with no recompense. Every inventor protects his/her discovery

Table 5. ***The most important inconsistencies between Lithuania and the EU average in R&D activities.***

Inconsistency indicator	Year	Lithuania	EU-25 average	Evaluation
Innovation index (SII), points	2005	0.27	0.42	Large inconsistency
Number of patent applications presented to the European Patent Office per 1 mln. inhabitants.	2002	2.6	133.6	Very large inconsistency
R&D expenditure (% GDP)	2005	0.76	1.9	Large inconsistency
Public expenditure on R&D (% GDP)	2004	0.6	0.69	Small inconsistency
Business expenditure on R&D (% GDP)	2004	0.16	1.26	Very large inconsistency
Annual risk capital investments, per 1 mln. inhabitants, mln. Lt	2004	74.5	233.5	Large inconsistency

Source: Economic Growth Action Programme of the Republic of Lithuania, 2007–2013 (2007).

and is concerned about keeping his/her technology a secret by taking out a patent. Those who obtain a patent or a license are concerned about the technology protection to prevent the competitors from copying the technological achievement or discovery (Keller, 2004).

The level of Lithuania's scientific potential is illustrated quite well by the inconsistencies, compared to the EU-25 average, concerning the R&D activity of those countries (Table 5).

This inconsistencies comparison table and the data presented earlier allow us to make the following assumption: the weak potential of patents, as an outcome of the entire scientific potential field, was in part determined by the popularity of adaptation and modification of innovation in Lithuania. That is to say that Lithuanian scientists did not have much to offer to the businesses, since they were adequately financed by the fundamental research allocations covered by the budget spending, and business people were not inclined to invest in the scientific research and technological development themselves, as the opportunities that were made available through the international trade and the FDI allowed to acquire innovative products and services from abroad. This conclusion is slightly different from those that were reached by the working group led by V. Daujotis (2006), who saw the divide between business and science lie in the business enterprises being unaware of the necessity of scientific research for the innovative development of the enterprises. The above mentioned internal sources of innovation showed that top level management understood perfectly the importance of scientific research and was an initiator of innovation, yet, when there was an opportunity to compete on cost rather than on innovation, or when a rapid result and not the results requiring years of research overshadow the strategic decisions of enterprises, it is unlikely to hope that without the appearance of artificial, government-stimulated programs or university-iniated programs there would be any accord between business and science in the transfer or the creation of innovation.

Louis et al. (1989) present five ways in which the academic community and scientists can transfer innovative and more advanced products and services to business: through consultancy, by financed research, via research companies, the issuance of patents and licenses and via *spin-offs*.

Innovation diffusion that was carried out by the universities and scientific institutions by way of providing consultations held for business enterprises, or by carrying out commissioned research, made up only 4.7 % of the total income of the universities and scientific institutions from scientific research (LSD, 2005). Analysis of the income gained from the scientific research and scientific consultancy for Lithuanian business enterprises of the three largest and most innovative universities, and comparison of it to all their other sources of income, it becomes apparent that the former source of income is not a priority, and accordingly, this problem receives insufficient attention of the universities. However, considerable differences between the income of the universitiess-how that within some universities attention to the services for business and innovation diffusion is greater than at others, which

Table 7. ***Dynamics and the proportion of income for R&D of three universities received from the business sector (BS), (thousand Lt)***

Indicator \ year	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***
KTU total income	121,503	130,918	153,408	171,247	178,521	200,005
KTU income for R&D from contracts with the BS	4,599	5,167	5,027	3,656	3,939	5,343
KTU income from the BS as % of total income	**3.79**	**3.95**	**3.28**	**2.13**	**2.21**	**2.67**
VGTU total income	61,936	65,111	80,486	91,291	100,434	118,237
VGTU income for R&D from contracts with the BS	1,901	3,203	2,161	3,567	5,286	3,925
VGTU income from the BS as % of total income	**3.07**	**4.92**	**2.69**	**3.91**	**5.26**	**3.32**
VU total income	112,098	123,493	140,052	151,093	180,191	219,277
VU income for R&D from contracts with the BS	1,933	1,730	1,664	1,658	1,606	1,508
VU income from the BS as % of total income	**1.72**	**1.40**	**1.19**	**1.10**	**0.89**	**0.69**
Total income of all three universities	295,537	319,522	373,946	413,631	459,146	537,519
Income of all three universities for R&D from the BS	8,433	10,100	8,852	8,881	10,831	10,776
% of total income	**2.85**	**3.16**	**2.37**	**2.15**	**2.36**	**2.00**

*KTU – Kaunas University of Technology, VGTU – Vilnius Gediminas Technical University, VU – Vilnius University

Source: University reports data, 2002–2007.

is determined by the different attitude towards the management of the innovation. Yet this assumption should be tested in the further research, analysing the innovation management systems and commonalities in Lithuanian universities.

An important parameter determining the knowledge potential and its use in innovation diffusion is the number of patents registered by a country‘s inventorssince the majority of patents are registered “standing on the shoulders of former inventors” (Keller, 2004), citing or using information that has already been revealed. Lithuania‘s potential in patent statistics among the new EU member states is among the lowest (Eurostat, 2006), even though the percentage of growth in patent registration and applications for patent registration can be viewed quite positively. It can be accounte for by the particularly weak cooperation links between science and business that failed to encourage general commissioned research and the acquisition or citation of foreign patents for the creation of new innovations. This is also most likely a reflection of a kind of inertia, which affected the state scientific research institutes and universities. Another reason that inhibited patent registration, as indicated by the Lithuanian inventors, were the relatively high expenses incurred in patent registration.

The last method presented by Louis et al. (1989) for innovation transfer from science to business via *spin-offs* of common enterprises has not existed in Lithuania to this day, since neither the legislation concerning both the management of state

scientific institutions‘ property and the disposition of intellectual property encouraged the creation of such enterprises. In addition, there were no risk capital enterprises created to facilitate the appearance of such enterprises, while banks prefered to finance the growing construction bubble rather than invest in start-up enterprises.

The innovation system, encompassing state institutions, academic science fields, and business representatives (Etzkowitz, 2000) in Lithuania did not function, and took on a different shape (Figure 1).

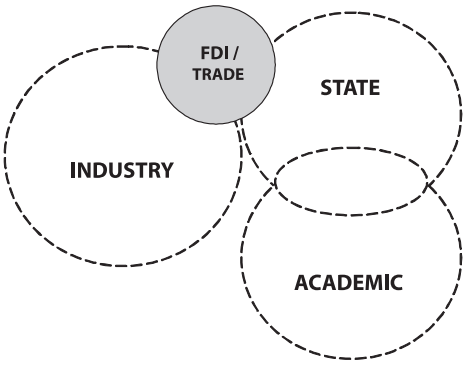

Figure 1. ***The distorted Helix Concept in the lithuanian innovation system***

Conclusions

Knowledge capital, both within enterprises, and in the process of the evaluation ol Lithuania‘s scientific potential over the last decade, was insufficient to guarantee the creation of an innovation system in the country. Due to limited resources, such as qualified personnel (primarily researchers), inadequate financing, and the lack of strategic partners, enterprises that wished to survive were forced to resort to the adaptation and modification of innovations, which they could embrace only by developing the international trade from their internal resources, or by attracting FDI.

The vitality, flexibility and ability of business to adapt to the changing conditions determined that Lithuania‘s economy, in the absence of a stimulus from the government and failing to support the sciences over the last decade, managed to survive in a fiercely competitive battlefield by adapting to market conditions. Lithuanian enterprises and organisations use all possible contacts to gain information about the new technologies and innovations. Top level leaders are perfectly aware of the importance of scientific research and are the initiators of innovation within their enterprises, but bringing about innovation and change in an enterprise is still encumbered by the existing management style and the organisation culture within Lithuanian enterprises, which discourages creativity and initiative. It is hoped that due to the influence of foreign partners, and the application of effective and flexible management styles, some of Lithuanian business leaders will come to understand the importance of an internal organisation culture that encourages creativity and people‘s initiative, and will prompt its appearance in Lithuanian enterprises.

The main potential of Lithuanian enterprises to attract foreign investments prior to 2006 was low costs, while the incoming FDI was mostly directed at low and mid-level technology sectors of the economy, where the creation of adaptation and to a degree, extended modifying innovation prevailed, which means that technology created elsewhere was transfered into the Lithuanian enterprises only to prevent the country completely falling behind in the market. A large part of FDI in 2005-2007

came to "milk profits" from sectors showing promising growth. An unmanaged and non-government supported process to attract investments is rather unstable, short-lived, and fails to correspond to the strategic goals of the country receiving the investments, therefore the policies for attracting FDI should be reviewed at a state level, and be associated with something more than just a momentary gain of funds.

The limited human resources of state scientific institutions and their inefficient innovation management model revealed their disinterest and inability to participate in the general innovation diffusion process taking place in Lithuania, alongside with business and government institutions. The efforts of recent years to encourage artificially, and with the assistance of EU structural funds, an allegiance between science, government, and business through the creation of science and technology parks, or valleys, is commendable, yet highly overdue. In other words, as was shown by the material presented in the given article, business that will not be "admitted" into those valleys yet will comprise a lion's share of the market will seek innovation independently, or will search for the ways to gain a technological advantage in the market. That is why it is important on the state level, that the cooperation between the three elements of business, government, and science should not be concentrated only on a few valleys, leaving other industries with no support.

REFERENCES

1. Adekola A., Korsakienė R., Tvaronavičienė M. (2008), Approach to innovative activities by Lithuanian companies in the current conditions of development. *Technological and economic development of economy.* Vol. 14 (4), p. 595-611.
2. Becker B., Gassmann O. (2006). Corporate Incubators: Industrial R&D and What Universities can Learn from Them. *Journal of Technology Transfer*, No. 31, p. 469-483.
3. Brock G., Urbonavičius S. (2008), Regional FDI growth in Lithuania, 1996-2003. *Transformation in business and economics,* Vol. 7, No. 1 (13) p.80-88.
4. Coe D. T., Helpman E., Hoffmaister A. W., (1997). North-South R&D spillovers. *The Economic Journal*, No. 107, p. 134-149.
5. Daujotis V. et al., (2006), Report on the study of financial incentives for technology development and scientific research; Vilnius – National Bureau of European Technology Platforms and Industrial Clusters.
6. Denis C., Mc Marrow K., Roger W., (2006) Globalisation: Trends, Issues and Macro Implications for the EU. EC, *Economic papers*, No. 254.
7. Department of Statistics Lithuania (2008). Development of innovation activities. Statistical bulletin.
8. Department of Statistics Lithuania (2008), Foreign direct investment in Lithuania. Statistical bulletin.
9. Department of Statistics Lithuania (2006), Scientific staff and their activities, 2005. Statistical bulletin.
10. Diskienė D., Galinienė B., Marčinskas A. (2008), Managerial attitudes in the context of global challenges: The Lithuanian survey. *Transformation in business and economics,* Vol. 7, No. 3(15) p. 21-38.
11. DnB Nord Bankas (2008), Vilnius. The Lithuanian Economic Outlook, 2008.
12. Etzkowitz H.&Leyderdorff L. (2000). The dynamics of innovation: from national system and 'Mode 2' to a Triple Helix of university- industry- government relations. *Research Policy,* No.32, p.109-123.
13. Eurostat (2008) Science, technology and innovation in Europe. Pocketbooks, 2008 edition, EC.

14. FDI Confidence index ©, (2005) Global Business Policy Council, Volume 8, A.T.Kearney Inc.
15. Felix B., (2007) National patent statistics. Trade in high-tech products. *Statistics in focus. Science and technology*. No. 7/2007, Eurostat.
16. Felix B., (2007) High-tech enterprises. *Statistics in focus. Science and technology*. No. 37/2007, Eurostat.
17. Government of the Republic of Lithuania (2007), *Economic Growth Action Programme 2007-2013.*
18. Grundey D., Toluba B., Pilinkus B. (2008), The role of institutional policy in developing innovative entrepreneurship in Lithuania. *Transformation in business and economics*, Vol. 7, No. 2(14), p. 86-101.
19. Innobarometer (2007), Analytical Report, *Innovation transfer*, Flash EB Series Nr.215 -The Gallup Organization. EC.
20. Jucevičius R., et al., (2007), Complex study of sources (causes) of Lithuania's economic growth and competitiveness. KTU Institute of Business Strategy, Knowledge Society Institute.
21. Kalotay K., (2006) New Members in the European Union and Foreign Direct Investment. *Thunderbird International Business Review,* Vol. 48(4), p. 485-513.
22. Keller W., (2004), International Technology Diffusion. *Journal of Economic Literature*, Vol. XLII, (September 2004), p. 752-782.
23. Louis K.S., Blumenthal D., Gluck M., Stoto M.(1987). Entrepreneurs in academie: An exploration of behaviors among life scientists. *Administrative Science Querterly*, No. 34(1), p.111-131.
24. Poškienė A. (2006), Organizational Culture and Innovations. *Engineering economics*. 2006, No.1 (46), p. 45-50.
25. Runiewicz M., (2004) The Baltic states in new economy: FDI, Technology Flows and Innovativeness. Tiger Working paper series, No. 71, Warsaw, December 2004
26. The public opinion and market research institution "Vilmorus", a conference „Innovations: What will Lithuanian business be like tomorrow?", organised by the Ministry of Economy Republic of Lithuania, Vilnius 07-11-2008.
27. Zedtwitz M., Gassmann O., Boutellier R., (2004) "Organizing global R&D: challenges and dilemmas", *Journal of International Management*, Nr.10 p. 21– 49.