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INDUSTRIES AND SECTORS: ISSUES AND POLICIES

A COMPARISON OF THE LITHUANIAN AND RUSSIAN BIOTECHNOLOGY SECTORS

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Abstract: The goal of this paper is to compare the development of the Lithuanian and Russian biotechnology sectors. In case of Lithuania we tried to uncover what are the circumstances surrounding the favorable development of the biotechnology sectors in Lithuania. In case of Russian Federation we looked at encouraging as well as discouraging circumstances surrounding this segment of economy. Drawing upon Schumpeter's ideas of innovation and Porter's business cluster theory, we argue that Lithuania is "at the right place and the right time" to make it a regional leader in Baltic biotechnology. Russia, on the other hand, is in the process of developing biotech sector in order to at least to catch up with other countries (including Lithuania). It will take time and continuous governmental support for Russia before this sector starts contributing significantly to Russian economy.

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Introduction

The goal of this paper is to compare the development of the Lithuanian and Russian biotechnology sectors. A task of the paper is to provide an overview of the current state of Lithuania and Russia in the context of the global economy by focusing on the ability of the countries to innovate in the field of biotechnology. We use a comparative-historical methodological approach using secondary data to illustrate our points. Russia is far from being highly developed and is in the process of modernization of its economy, but Lithuania is rapidly increasing in the global core-periphery hierarchy. Purely economic measures, such as annual gross domestic product (GDP) per capita do not consider traditionally non-economic factors, such as innovation. Developmental economists in 1990 conceptualized the human development index (HDI), which combines measures of life expectancy, literacy, educational attainment, and GDP per capita (Haq, 1996). Lithuania's HDI was 0.762 in the year 2000, to 0.798 in 2005, than further increased to 0.802 in 2010, which placed it in the "highly developed" category according to the United Nations ranking system (United Nations, 2009). According to Regional and National Trends in the Human Development Index 1970-2010, Russia's HDI was 0.723

in the year 2000. It is slightly lower than Lithuania's. It grew up to 0.741 in 2005 and 0.766 in 2010, also showing a steady upward trend.

It is interesting to note that taking into account Russian huge territory, its HDI varies from the highest value of 0.929 in Moscow region to medium value of 0.717 in Tuva republic (National Human Development Report, Russian Federation, 2010). Other indicators that suggest an upward trend for Lithuania is the Economist Intelligence Unit's quality of life index. Compared to the other Baltic countries, Lithuania rates the highest on this indicator, which is based on such factors as health, family life, political stability, and political freedom (The Economist, 2007). Russia's quality of life index is much lower placing it almost towards the end of the list (only 105th position out of 111). To what degree might biotechnology contribute to macroeconomic indicators suggesting national economic growth in both Lithuania and Russia?

Theoretical frameworks

One way to understand innovation is the world-systemic perspective, which developed as a reaction to dependency theorists (Amin, 1976 and 1994, Kohler and Tausch 2002; Yotopolous and Sawada 2005). During the 1970s, historical economic sociologists such as Wallerstein (1974) and Gunder Frank (1978) began to theorize an expanding European economic world-system beginning approximately in the 16th century, which could be used to explain the historical economic development (or lack thereof) of countries around the world. This model sees capitalist market relations as a means of wealth redistribution, from the poor peripheral regions to rich core countries, or from the global South to the global North (Arrighi, 1995; Turchin, 2007).

One of the structural definitions of the world-systemic perspective is the assumption of centuries old business cycles. This emphasis on 45 to 60 year Kondratiev business cycles have been criticized by some for not explaining the origins of the cycle, or Kondratiev waves as being simply economic correlations rather than a cause of economic growth or depression (Solomou, 2004). Unlike world-systems analysis, we emphasize Schumpeterian agency in the form of innovation, rather than blind adherence to historical business cycles, as an important means by which Lithuania's and Russia's economy can focus on what Ricardo (1817) may have called its comparative advantage in the field.

The ideas of Joseph Schumpeter (1943) can be drawn upon in the case of the regions to emphasize the importance of innovation on one hand, and the danger of stagnation on the other. Schumpeter popularized the term "creative destruction," by which he meant that innovation by entrepreneurs has the ability to radically change stagnant industries or an even an entire economy.

Generalized clusters emerge when human activities are likely to agglomerate to shape urban areas. This phenomenon has traditionally been labeled urbanization economies. The clustering of activities produces the basis for sharing the costs of a variety of services. Larger aggregate demand in an urban area leads to the emergence and growth of various infrastructural, economic, social and cultural activities which cannot occur when costumers would be geographically dispersed. Specialized clusters emerge when firms in the same or closely related industries establish in the same locations to form what is sometimes coined industrial zones. This phenomenon is known as localization

economies. The bases of specialized clusters emerge because of the geographical proximity of firms that perform different but linked functions within certain production networks (Dicken, 2003).

Taking a closer look at the geo-economic map, geographical concentrations of economic activity can be distinguished in Lithuania and Russia. This phenomenon in which economic activities tend to agglomerate in specific locations is known as localized geographical clustering. Two types of clustering can be distinguished: generalized clusters and specialized clusters. These two types are based on the concept of externalities, which are the positive spillovers that emerge when economic activities in a particular location are connected with each other, both directly in the form of specific transactions and indirectly. The main idea is that the whole (the cluster) is greater than the sum of its parts, because of the advantages which are provided by spatial proximity (Dicken, 2003).

Clusters tend to create two forms of interdependency, which are traded interdependencies and untraded interdependencies. Traded interdependencies are direct transactions between firms in a production network, such as the supply of intermediate goods from one firm to another. In these cases, spatial proximity reduces transaction costs because of lower transport costs and by a reduction of the uncertainties that are related to customer-supplier relationships. Untraded interdependencies capture less tangible benefits from geographical clustering. Examples of untraded interdependencies are the development of a skilled labor pool, research and development in universities, business associations and government institutions. Three important processes underlie geographical clusters: face-to-face contact, social and cultural interaction and the development of knowledge and know-how (Dicken, 2003).

Porter (1998) defined clusters as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated organizations (such as universities, standard agencies, and trade associations) in particular fields that compete, but also co-operate. Porter's definition contains two core aspects. First, the firms in the cluster are linked in a certain way. Clusters are composed of interconnected firms and associated institutions which are linked by commonalities and complementarities. Links can be both vertical and horizontal. Vertical links reflect the buying and selling of chains, while horizontal links are comprised of complementary goods and services, the use of similar particular inputs, technologies and institutions. Porter argued that these linkages comprise social relationships or networks which are beneficial to the firms. These networks guarantee certain forms of shared aims increasing the frequency and impact of transactions. The second aspect is that clusters are groups of firms that are located on geographical proximity. This locating together creates benefits in the form of networks of interaction among firms.

The case of Lithuania: Innovation and Lithuania in the World-System

After the break-up of the Soviet Union, Lithuania transformed rapidly, politically as well as economically. Lithuania embarked on a path that strived for the adoption of two main features of core economies: the capitalist market

system and the system of electoral democracy. In 2004, Lithuania obtained full membership of the European Union and thus integrating itself more deeply into the capitalist world-system. In the same year, Lithuania was also incorporated into NATO, thereby institutionally aligning itself with the hegemonic core state: the United States.

Economic data (e.g., World Bank, 2008; Eurostat, 2008) show that Lithuania clearly falls short to be classified as a core country, although it has several characteristics of a core state. For example, Lithuania's economy is industrialized and diversified. The service sector dominates, adding 61% to GDP, while the industry sector adds 38% to GDP and agriculture only 5%.

Lithuania is a small and open economy. Integration into the EU boosted growth in foreign trade. The 26 other member states of the EU accounted for 60.3% of Lithuania's total exports and for 57.3% of total imports. In 2008, Lithuania saw its total exports of goods and services increasing with 28.4%. Minerals made up 24.8% of total exports, electrical machinery and mechanical equipment 10.6%, chemical products 9.7%, transport vehicles and equipment 8.6%, agricultural products 6.1% and plastic products 6.0% (Lithuanian Department of Statistics, 2009). Despite minerals topping the list of exports in 2008, the overwhelming majority of Lithuania's exports consisted of manufactured commodities, rather than raw materials. Lithuania's increasing export of manufactured goods as another example of Lithuania's rise in the global hierarchy (Giedraitis, 2007).

However, Lithuania is relatively poor compared to the western European member states of the European Union, although during the recent decade the gap with these countries is gradually closing as a result of high economic growth. This gap is far from being closed tough. Lithuania has several characteristics that are typical for the periphery. Lithuanian GDP per capita in Purchasing Power Standards (PPS) is only at 60% of the average GDP per capita in PPS of all the EU-25. Compared to the EU average, labor costs in Lithuania are five times less expensive (Eurostat, 2008).

TABLE 1. EDUCATION LEVELS IN VARIOUS COUNTRIES

CEEC Country	Labor Force with Secondary Education (% of labor force)	Labor Force with Tertiary Education (% of labor force)
Bulgaria	51.8	30.5
Hungary	60.4	23.3
Latvia	61.7	27.4
Lithuania	59.0	34.2
Poland	66.0	23.2
Romania	57.5	12.8
Slovakia	75.0	15.3

Source: World Bank Edstats, 2008.

Table 1 shows, for as a semi-peripheral country, Lithuania has a highly skilled labor force. 59% of the total labor force in Lithuania has secondary education. This is comparable to other CEECs that are member states of the European Union (Table 1). However, taking a closer look at the ratio of the workforce which has tertiary education, Lithuania has a significant

comparative advantage over the other CEECs, with a percentage of not less than 34.2% which makes it a regional leader in this regard.

Skilled labor is one of the characteristics of the core and Lithuania fulfills this condition. However, poor remuneration had been causing a brain-drain and many highly qualified workers emigrated to the United Kingdom and Ireland where the financial rewards are more attractive. (Adamczyk, 2009). Emigration is a serious problem for the economic development of Lithuania as highly skilled labor flees abroad, while the Lithuanian government has been paying for their education. On the other hand, the scarcity of skilled workers has driven up the wages for highly qualified vacancies, making it less attractive to emigrate. Paradoxically, during the recent years the Lithuanian government has been issuing working permits for Belarusian and Ukrainian immigrants in order to fulfill the vacancies, which require highly qualified personnel (OECD, 2008).

Another indicator showing Lithuania's changing position in a global hierarchy is per capita GDP. According to the CIA World Factbook, Lithuania ranked 150 in 1993 (the first year data was available for Lithuania). In only two years, Lithuania's position on this indicator rose to 82. The most recent data available (2005) show Lithuania to be in 59th position. Therefore, using per capita GDP as an indicator, Lithuania is rising in a global economic hierarchy.

Other signs of the country rising in the CPH are shown in its economy expanding beyond its borders with more companies investing in neighboring countries and becoming involved with regional trade networks (Mockaitis et al., 2005 and 2007). Also, Lithuania's political economy is increasingly tied to the European Union. For example, Lithuania is straining to meet the EU's strict Maastricht criteria in order to introduce the Euro (Pranulis et al., 2008). Although still a part of the semi-periphery, the country is engaging in such "core" types of industries as biotechnology, which further suggests upward mobility.

Biotechnology may potentially be a similar "disruptive" technology, with Lithuania being at the confluence of a number of favorable factors.

The theoretical discussion of business clusters can be applied to biotechnology, where it is a regional leader. According to the Lithuanian Biotechnology Association, the biotechnology sector in Lithuania has been growing by about 22% yearly for the past five years. Two such companies, Fermentas and Sicor Biotech were sold in 2007 for more than 28 million Euros (Innovations Report, 2008).

An explanation of why foreign companies invest in biotechnology in Lithuania is due to the relative "natural monopoly" status that this industry had enjoyed in Lithuania since the fall of the Soviet Union. In 1975, the biotechnology firm Fermentas was a part of the former Institute of Applied Enzymology, which was a Soviet funded genetic research laboratory. After Lithuania's independence, the firm began to operate independently, and began expanding operations globally, with joint ventures in Germany, Canada, and the United States. Thus, unlike other places where labor is relatively inexpensive, such as Mexico, Lithuania had such relevant factors as an educated workforce or the already built factories and researchers.

For these reasons, we also argue that there is strong aspect of business clustering present in Lithuania (Porter, 1990). Biotechnology firms are clustered about Vilnius, and have ties with business and research centers at Vilnius University. Therefore, there was momentum in the development of the Lithuanian biotechnology sector that other regions did not have. Building on this momentum the Vilnius city municipality and two major universities (Vilnius University and Vilnius Gediminas technical university) are building a major research park, the Saulėtekio slėnis (Sunrise Valley). On the hand, a relevant question is why American pharmaceutical companies, such as Eli Lilly, have opened factories in much more expensive Denmark. One explanation may be because business clusters were already present in that country, while Lithuania's was still being privatized.

Another positive development of the biotechnology industry in Lithuania is related to immigration and the "brain drain" phenomenon. As an example, seventeen advanced Lithuanian experts who had previously emigrated have decided to return to the Vilnius Institute of Biotechnology. Dr. Daumantas Matulis from the Institute of Biotechnology, has stated that, "The growing importance of life sciences and biotechnology in Lithuania is being recognized with ScanBalt Forum 2008 to take place in Vilnius. This is a chance to promote Lithuania as an attractive place to work, live and invest. We intend to further strengthen our position as a strong player within life sciences and biotechnology in the Baltic Sea Region" (Innovations Report, 2008). More generally, the rate of Lithuanians migrating abroad appears to be reducing, perhaps due to increasing opportunities domestically (Gruzevskis, 2007).

Such old Europe economies as Germany are juggernauts, compared to nimble Lithuania. The country has a very highly educated population, and competitive universities that produce bright graduates. Thus, all things equal, per capita, Lithuania needs fewer innovators to make potentially large changes in its much smaller economy, which unlike EU-15 countries, is still in a condition of flux. Given such evidence, we find that our hypothesis of business clusters being a cause of the success of biotechnology in Lithuania to be supported.

Another advantage for Lithuania in terms of innovation is the attractiveness in the previous regard to foreign direct investment. Although Lithuania may lack the capital of "old Europe," it has a skilled and educated workforce, and low labor costs. This makes it an attractive place for foreign firms that want to also "out innovate" the competition. Why build a factory in the traditionally more expensive EU-15, than in the less expensive business climate of such new member countries at Lithuania?

The current economic crisis can in a sense be seen in a positive light for tiny Lithuania. While the economy is under stress, Lithuanian firms can continue to innovate. However, when the global economy does improve - which, with time, it will - it will take a far smaller "push" to restore Lithuania's economy to a strong position, compared to much larger EU-15 countries. Although premature to draw any conclusions, there are glimmers of hope. For example, the IMF's Robert Zoellick stated on March 22 2009 that, weighted down by large, sluggish economies, the global economic recovery is expected in 2010, at which point major economies will break even. However, developing nations'

economies such as Lithuania's are expected to expand by up to 4.5% (World Bank, 2008).

Lithuania has certain real advantages compared to larger economies in terms of innovation. First, Lithuania's industries are still in a relatively nascent stage. Twenty years after the collapse of the Soviet Union, its industries are specializing and adapting to a global marketplace faster than the industries of such "old Europe" countries as Germany. This is a case of the so-called "second place advantage," where a newly opened economy can learn from the mistakes and consequently "out innovate" them, since they have no new infrastructure to need to replace. Regionally, the European Commission states that biotechnology will be a very important part of Europe's economy in the coming decades. Although information about the biotechnology sector in Europe is incomplete, Ernst and Young (Ernst & Young, 2000; 2001) find that the Lithuanian biotechnology market is one of the largest in the region. 99% of biotechnology products are exported to 86 countries. In 2006, the biotechnology industry had sales in excess of 90 million Euros. Among former Communist countries, Lithuania follows only Hungary in sales volume. The Lithuanian government is wisely to investing in this up and coming sector by increasing biotechnology research funding during the last five years (Innovations Report, 2008).

The case of Russia: A sleeping giant

After the collapse of the Soviet Union, many former USSR republics as well as Russia had to go through painful transformation from globally isolated command economy to the globally-integrated economy ruled by market forces. Each independent state was left alone face to face with a new reality and had to find its own ways to achieve it. Such small country as Lithuania was able to transform rapidly showing good achievements in the main economical, political and social indicators. In Russia this transformation was not so rapid. It gradually privatized the main industries (exceptions: energy and defense related sectors). In terms of world –system analysis, Russia's position is ambiguous – it has certain features of core and periphery states. Looking at Russian economy sector-wise, there is domination of service sector (59.1%), followed by industrial sector accounting to 36.8% of total GDP output. Share of agricultural sector is only 4% (The World Factbook, 2010). Russia is slowly integrating into global trade with its main export commodities – petroleum and petroleum products, natural gas, metals, wood and wood products, chemicals, and a wide variety of civilian and military manufactures. Still mineral and wood products dominate in Russian export composition accounting to 66% and 16% respectively. Unfortunately, civilian and military products constitute relatively small proportion of Russia's exports. This, in fact, does not allow classifying Russia as a core state. So far, Russia is placed among peripheral states (Chase-Dunn, Kawano, and Brewer, 2000).

Russian labor force is in a good position to participate in developing a modern economy, however the problem here is that Soviet economy placed great emphasis on non-service sector and future labor force was trained accordingly. Even among the highly skilled labor force Soviet educational

system skewed training towards the sciences, mathematics and engineering, giving little attention to education in management and entrepreneurship.

Russia is also trying to tie up politically with other countries. For example, it is one of the initiators of cooperative coalition of BRICS countries (Brazil, Russia, India, China and South Africa). Rather than allying to economically advanced countries, Russia has gone into coalition of countries which are currently (by and large) on a similar stage of development. Based on remarkable growth rates of these countries it is expected that in future (approx. in 2050) these countries will become the main contributors to world's economic growth. BRICS countries aim at multilateral cooperation in nuclear energy, aircraft engineering, space exploration, bio- and nanotechnology and other spheres. Therefore, undertaking these types of activities which are specific to core states, BRICS countries aim at rising in a core-periphery hierarchy all together.

Together with nanotechnology, biotechnology is one of the pillars of innovational economy. According to Kondratieff's theory of business cycle and Schumpeter's innovation theory, together with computer technology, genetic engineering, multimedia (including global intellectual information systems) and ecologically clean energetics, biotechnology and nanotechnology are considered to be laid down as trunk innovations which will form the core of a new 6th technological order (Akayev, 2009). Together with pharmaceutics, biotechnology sector has become one of the most attractive sectors for investors amongst leading sectors of the world economy. The first place belongs to gas and oil sector, second – banking sector and the third one – biotech. As an example, in European Union the turnover of bio-economy was 1.5 trillion euro in 2008 where 10% of total workforce was employed (Sychiov, 2009). USA, European Union, China, India, Japan, Brazil and many other countries view biotechnology as a key sector for the development of their economies and transforming them into so-called "bio-based economies", i.e. economies based on biology and industrial biotechnology. In order to successfully develop this sector, necessary legislative framework has been created, corresponding national programs have been adopted, and so on – all these measures have created necessary economic preferences for the development of biotechnology sector in these countries.

In Russia biotechnology sector is considered as a priority sector. This fact was confirmed in the Concept of long-term socio-economic development in Russian Federation till 2020. Both the Russian government and private industry have recognized the need to improve the legal and economic environment for the biotechnology industry. So, on one hand, biotech is given much attention – it has been always mentioned as key sector which is able to ensure innovational future of Russia. Also Biotechnology sector is considered a top priority in Russia's economic modernization plan. But at the same time it looks like Russian biotech is marked as priority sector only as a result of world tendency. In reality till now biotech in Russia remains in the state of stagnation. Moreover, with passage of time Russian biotechnologies are becoming more and more uncompetitive. During the last several years Russian biotechnologies were bypassed by many other competitors, not only such as India, China, but also Poland, Czech Republic and the Baltic states as well. Let's have a closer look at prevailing situation in Russian biotech today.

Russian biotech: current situation

The global bio-industry was estimated to be worth more than $2 trillion in 2010. According to the Organisation for Economic Cooperation and Development, in 2030, biotechnology will be used to produce up to 35% of chemicals, up to 80% of pharmaceuticals, and 50% of agricultural products. Many western and Asian countries long back realized the importance of development of biotech sector in their economies and substantial resources are being forwarded into it.

Unfortunately, today Russia is very far from being a leader in biotechnology. The state of development of biotech sector in Russia today places it on the 70th place only among other countries of the world (The strategy 2008). The share of Russia in world volume of biotechnology products is measurably small accounting to 0.2% in 2010 (as compared to 5% twenty-five years back) with a heavy emphasis on pharmaceutical products. In other areas such as "green, grey and white biotech" , the results are even more modest. Just to compare, the US share of biotech is 42%, European Union – 22%, China – 10%, India – 2% (The strategy 2008).

The situation in Russia is worsened by constantly increasing demand on biotech products from the domestic consumers. As a result, Russia is very much dependent on imports of such important biotech products as drugs and feed additives. As a result, over two-thirds of the Russian biotechnology market is occupied by imported products. So far the "sister"-sector - nanotechnology receive much more attention in Russia than biotechnology.

Russian biotech: historical trends

But the situation was not always like this. Traditions of Russian fundamental and applied life science go back to the last third of the 19th century (the reign of "tsar-liberator" Alexander II). Basic scientific schools in organic chemistry and life sciences appeared in St. Petersburg, Moscow, Kazan, Kiev and Warsaw. Since those times Russian bioscience and biotechnology has experienced rises and falls together with the whole country (Rabinovich, 2007).

Starting with 1860s, Russia saw series of discoveries and breakthroughs in the biotechnology by such prominent scientists as A.M. Butlerov, K.A. Timiryazev, V.I. Palladin, I.I. Mechnikov, S.N. Winogradskii and many others. The reign of Alexander III and Nikolay II was marked by the persecutions of many Russian scientists because many of them protested against arbitrariness of the Russian autocratic monarchy. In 1911, 130 leading scientists left Moscow University as a protest measure. Many talented scientists left Russia during 1920-1930 as a result of collisions of the civil war.

Paradoxically, but despite harsh events of 1914-1924, during following 10-15 years Russian life science experienced a period of blossoming basically as a result of increased support of Bolshevik's government. Many western visitor stated perfect conditions for bioscience research in that period of Soviet history. As R.B. Harvey (Cambridge University, England) wrote in his review entitled "Plant physiology in Russia": "One gets the impression of a thoroughly

conscious and helpful government support for fundamental research throughout Russia. The lack of organization of the work in plant physiology and geography in our own Bureau of Plant Industry is certainly in strong contrast with the fine conditions given by the Bolsheviki for these phases of research". Even the future Nobel laureate H.J. Muller (USA) shifted to the USSR and worked at Moscow Institute of Genetics as a senior researcher. Up to 1937 the development of biotechnology was impressive.

However, during 1937-1948 national genetics was almost completely destroyed. Russian scientific elite faced anti-genetic campaign which was headed by Stalin's protégé T. Lysenko. This resulted in a terrible loss of the national genetic elite in the names of N.I. Vavlov, N.K. Koltsov, A. Levitsky, S.S. Chetverikov and many other talented scientists. "Some of them died in jails, others were refused an opportunity to work in science and banished" (Rabinovich, 2007).

The WWII put before the national bioscience vital tasks of extreme urgency for survival of the country. The wood hydrolysis industry established by Sharkov in 1942 saved thousands of lives (the production of bakers yeast by acidic saccharification of woody materials) during the Leningrad's blockade. Almost at the same time the first Soviet penicillin was produced by Z.V. Ermolyeva (a founder of Soviet antibiotic science) and as a result hundreds of thousands of people were saved in the hospitals.

And again post-war Stalin's repressions in bioscience were extended. Many outstanding scientists were sent to Stalin's GULAG camps as "foreign spies" or "wreckers" (Rabinovich, 2007). Many of them never could come back. Those who could, for them the opportunity to work in science appeared only in the post-Khrushchev days when last restrictions on genetic research and education was fully abolished.

Again, the period during Cold War was marked by rapid growth of Russian bioscience and biotechnology very much supported by the Soviet government in their attempt "to catch up and overtake the USA" (Rabinovich, 2007). As a result, a self-sufficient model of national biotech industry was created in Russia. It contributed 5% to the total world biotech market. During this very period of 1970-80s the first bio-clusters appeared on the Russian territory.

Jury Ovchinnikov was the one who brought about formation of first bio-clusters. Russian leading academic institutions were brought together with industrial potential of the country. The main biotech potential was concentrated in Moscow, St. Petersburg, Novosibirsk, Tomsk, also in Kirov, Sverdlovsk and Nizhny Novgorod regions. In these regions there were created strong institutional and educational centers as well as factories. Some of these facilities exist even today.

After some time as "perestroika" started, biotechnology sector was forgotten and ignored for a very long time in Russia. The period of Yeltsin's structural reforms and privatization of national biotech industry (1991- 1998) has led to almost complete collapse of state support of national science, emigration of talented scientists abroad ("brain-drain"), replacement of the domestic biotech by import counterparts resulting in 4-10 times decrease in production of bio-products in Russia.

Biotech in Russia: type-wise

"Red" biotech

Considering biotech sector development in Russia sector-wise, "red" biotechnology is mostly developed in Russia nowadays sharing about 60%. It is also the most capital intensive division of biotech sector. But still only 5% of the domestically produced intermediary bio-products are used in the production of final products. The remaining part is covered by imports. Currently several bio-pharmaceutical projects are being realized mostly in Moscow region ("Biokad", Bioprocess, Himrar) and Volgograd (Generium) - all they are basically intended to produce biotech generics in order to substitute import counterparts.

In the near future 10 factories for the generics production are planned to be built in Russia. The common value of this project is estimated to be 10.8 billion rubles. (Strategy of development of pharmaceutical industry before 2020). Therefore, Russian "red" biotech has a potential for growth against the background of overall sluggish development of this sector. And this potential can be realized through the increased domestic production of bio-generics as import substitute and also through the realization of local scientific potential in this sphere.

"White" biotech

This direction includes bio-chemical products, bio-fuels and products of food biotechnology. Unfortunately, Russia here also does not have anything significant to present in the global market. In Russia the samples of bio-based polymers are missing today, whereas, Russian scientific potential do allow conducting this type of research (at least in the development of biodegradable polymers) provided adequate and well-timed financial support.

Another perspective direction is hydrolysis industry. During Soviet times the domestic demand for many primary chemical components was completely met by domestic production. Today this type of production needs to be revived with the help of the specialists from rest of the world taking into account the newest achievements in this sphere. So there is a need for Russia to successfully collaborate with other competent scientific institutions.

In the light of increasing concerns about ensuring energy security, decreasing dependence on imported energy sources and concerns about deteriorating environmental situation, the production of bio-fuels gradually increase all over the world. But again in Russia bio-fuels are not produced on industrial basis. There is only one project which is being realized in Tyumen region (Biotechnology corporation) where the bio-fuel production from biomass is planned. Perhaps, this can be partially explained by availability of huge amounts of oil and gas resources in Russia which are being actively exploited. And the energy situation is not as critical as in the case of many European countries including Lithuania. Also it can be a reason that Russia prefers to invest money into exploration of new places where oil and gas can be excavated rather than concentrating on development of alternative energy sources.

There are two more reasons why the development of Russian bio-fuel production is very sluggish:

- Insufficient government support
- Low prices on traditional fuel in Russia makes production of bio-fuels unprofitable

As a result, there is a risk that Russia's disregard of the wave of technological change in energy production will face later on decreasing demand on traditional sources of fuels – oil and petrochemicals – Russia's main export articles.

As far as food biotechnologies are concerned, the enzyme production in Russia today constitutes only 15% of the level of 1990 year. The market share of Russian producers of enzymes is only 20% and they are mostly used in production of cattle feed. Food product producers prefer imported enzymes for their production. Major enzyme producers are located in Moscow region, Kirov region (Vostok), Novosibirsk region (Sibbiofarm). The common problem of these producers is high depreciation rate of fixed assets and old technologies.

The situation in Russia's market for food supplements is relatively favorable. About 8 000 names of food supplements are officially registered in Russia today, out of which 60% are locally produced by local companies. There are about 900 food supplement producing companies registered in Russia. The biggest companies are concentrated in Altai (Evalar) and Moscow regions (Diod, Fora-Farm). But the majority of these producers serve the low-price segment of the market for food supplements and their domestic share accounts only for 30% of the total market.

"Green" biotech

Growing genetically modified crops in Russia is not legislatively forbidden. However, it is strictly regulated by the state ecological expertise. Regulations governing the state environmental assessment of genetically modified crops have not been taken, so in practice it is not carried out. Thus, currently growing genetically modified crops on an industrial scale in the Russian Federation is not conducted.

Thought Russia has introduced the European norm regarding genetically modified organisms which must not differ on the properties of their traditional counterparts, to be recognized as safe for human health and be permitted for sale without any restrictions. Currently, the Russian Federation passed a full cycle of all necessary studies and approved for use in food 15 lines of genetically modified crops.

Some analytics believe that this very governmental interference into cultivation and processing of genetically modified crops creates competitive disadvantages for the import of agricultural products and also holds back the development of "green" biotechnology and agriculture in Russia. But to my opinion, this type of activity as production of genetically modified crops cannot be left unchecked taking into account possible adverse effects on human body such products may have.

To date, the only project is announced which will be associated with the

development of transgenic forest. It is a Russian-Swedish joint venture company "Baikal-Nordic" that plans to implement a project worth 1.5 billion rubles in the Buryat Republic to 2012. The project involves creating a nursery with a genetically modified species.

"Grey" biotech

Officially, the usage of some bio-destructors was allowed in 1990s in Russia. Such giants as Gazprom and Transneft have authorized in their instructions the use of some bio-destructors (Devoroil, Putidoyl, Oleovorin) in case of emergency response. Russian "grey" biotech is limited to the use of bio-destructors developed earlier (during Soviet days). Though we cannot say that Russia is lagging in the scientific research for bioremediation of oil spills, still the scientific base for creation of bio-products for the destruction of toxic, chemical and petro-chemical waste is relatively week.

Main problems with Russian biotech and recent developments

"Russia is the only huge country where a uniform program of biotech development is lacking. Current state of biotech sector in Russia, absence of long term development strategy and absence of one regulating body - all these are crying anomalies" (Sychiov, 2009). There is no proper coordination and administration of this important sector. There is lack of corresponding laws and regulations which would insure systematic developing of this important sector.

Another problem - lack of financing of research and development institutions, lack of quality and quantity of scientific publications in biotech sphere. Today Russian research and development institutions require timely and adequate financial support.

To correct this, the first attempt to make a uniform national program of biotech development was made in 2005 by Biotechnologists' society. Later on they were initiators of creating the first strategy of biotech development in Russia till 2020. This strategy was officially approved in December 2010. Of course it is far from being perfect, it will need certain revisions and corrections till it will be fully tailored to the changing pattern of biotech development. The future of biotech sector in Russia is closely related with future Russian government. Nowadays it is obvious that without biotech it is not possible to build up a modern effective economy as well as a strong state with bright future. On the other hand, biotech development is not possible without strong governmental will and world support. So far the Russian "tandem" in the faces of V.V Putin and D. A. Medvedev stresses a lot the necessity of biotech development and moreover their government pays attention to the needs of this sector. Hopefully, this pattern will continue and Russia soon will be able to catch up with its competitors and may be it will be able to become one of the leaders.

The popularization of biotech at the federal and regional levels is insufficient. The importance of the biotech development must be realized not only at the top of political hierarchy but at the lower levels of political administration also. This is very important because once it is realized, the development of bio-clusters in regions will be very helpful in developing

biotechnology sector as a whole and also in improving regional standards of living. So far the situation is very sad. As an example, in Irkutsk region (as well as in many other regions of Russia) there are many small towns (called mono-towns) with small populations (about 100,000 people or more) which were built around developing industries called city-forming industries. In my native city Usolye-Sibirskoye (Irkutsk region), as an example, there were 6 city-forming industries established and working well up to "perestroika" time – thermal power plant (TEC-11), Himprom (chemical production factory), mining equipment plant, machine-building plant (Usolmash), salt plant (Solzavod), garment factory (Revtrud). These were the main employers in the city. Privatization reforms of post-Soviet period had destroyed these city-forming industries and as a result the city life was destroyed too. Out of these 6 factories, only 3 are somehow surviving now, offering much less employment opportunities to the local population. And what is even more terrible, as far as "Himfarm" chemical production plant is concerned, it was privatized and re-sold many times. Finally it became a victim of acquisition by its competitors which did not want to compete with Siberian Himfarm's cheaper and better production. The same has happened to other industries too. As a result, the city has become very poor, population decreased from 110 000 to 70 000 people during 1998-2010, criminal situation is terrible in the region and so on. It is very painful to see how bad the situation is there now as I do still remember the days when the city was blossoming. To my opinion, the guilt lies fully with the local governments and administrations of such mono- towns because they are looking for short-term benefits and ignoring badly the opportunities they are losing while selling off the industrial base of their regions and hence their own future. But there are other examples also. For example, in Omsk region, local government long back realized that "Russian bioenergetics begins in Siberia" (Sutyaginsky, 2007) and they are actively trying to modernize existing industrial capacities and also investing into new projects such as "Titan Group" which was established in 1989 and now it is one of the most successful biotech enterprises in Omsk region as well as beyond it, having about 30 importers of their productions all over the world.

One more problem is a lack of stimuli to private business as well as a lack of cooperation between government and business. To improve the coordination between the public and private sectors, the Russian government has launched a national program entitled "Biotechnological development in Russia in 2006-2015". Russia aims at establishing special economic zones for innovative biotechnology, as well as, the creation of biotech parks. There can be several reasons why private investors are not very enthusiastic. Very long bureaucratic procedures, absence of real government support for new companies, imperfect taxation system are just several reasons for that. Foreign investors face the same problems also plus instable past of Russian development t makes them "think twice" before investing into Russian economy.

The problem of brain-drain has become a huge problem after collapse of the Soviet Union. Many talented specialists, educated people went abroad. Now there is need to bring back those specialists if possible. Recently, favorable conditions are being created in order to establish cooperation of Russian and western biotechnologists. Russia is trying to make up professional ties with western and Asian specialists in the sphere of biotechnologies. For example,

India and Russia have signed the Russia-India Biotech Network (RIBN) agreement recently to enhance collaboration in the biotechnology sector. American "Pfizer" recently teamed up with Russian "Petrovax Pharm" to produce its conjugate vaccine against pneumococcal infection in the country. UK based company "Astra Zeneca" has set up a hi-tech science center in St. Petersburg that will use local scientific talents to assist the company's research and development division.

But even thought the situation is quite pessimistic, it does not mean that Russia has no chances to catch up with its competitors in biotech development. These are some factors which will be very instrumental for Russia in this process.

- High educational base and scientific potential
- Relatively cheap energy, fresh water, resources for intensive development of agricultural sector
- Huge geographical territory

All these factors together create for Russia quite favorable conditions for successful development of such direction of biotech as bio-fuels, microbiological synthesis, renewable resources based chemistry and so on. But in order to realize all these possibilities, all existing problems impeding the development of Russian biotech should be solved. "It is our job to change this situation – to create an atmosphere in Russia that will encourage the development of a powerful bio-industry. We have all the potential for it, such as a strong research and educational base with projects and patents meeting international standards" (V.V. Putin).

Conclusion

In this paper we showed the different ways that the biotechnology sectors have been developing in Russia and in Lithuania. Our main findings based on our comparative-historical approach are as follows:

1. In the case of Lithuania, biotechnology is rapidly expanding in importance, and is seen as a future leading edge sector. Its annual growth rates are impressive. As far as Russian biotech is concerned its contribution to the economy is very small (0.2% in 2010) with heavy emphasis on "red" biotech. In other areas such as "green, grey and white biotech" , the results are even more modest.
2. Lithuania has successfully used its heritage from Soviet day in the form of Institute of Applied Enzymology and used as a base for the biotech development. Whereas in Russia, there is a very strong institutional and educational potential, educated labor force, it is not being adequately and timely supported by the Russian government. As a result, Russian biotechnology science is lagging behind as far as the quantity and quality of scientific publications is concerned. Contrary to that, the Lithuanian government keeps on investing in biotech sector by increasing biotechnology research funding during the last five years (Innovations Report, 2008).

3. The "brain drain" problem seems like is being overcome in Lithuania, whereas in Russia a lot is to be dome to solve this problem. Both the countries emphasize the development of research parks in order to attract best specialists and to keep them. Both in Russia and in Lithuania there are plenty of institutions (in Russia even more) where a well qualified labor force is being trained.
4. The success key to the development of biotech in Lithuania lies with its bio-clusters. Russia is developing its bio-clusters on its territory and this process is being inhibited by insufficient popularization of biotechnologies in federal and regional levels, inadequate coordination between upper and lower levels of the government administration and also corruption.
5. Lithuania's biotech sector is attractive for FDIs largely due to its "natural monopoly" status. Also, relatively stable political and economic situation adds to that. Whereas in Russia such favorable platform is just in the process of creation. Though Russian huge market is very attractive for the foreign investors, it will take time to establish macro-economic and political stability in Russia.
6. Also the mere sizes of these two economies do dictate different conditions. It is relatively easier to control and to coordinate the implementation of the biotech development strategy in tiny Lithuania, especially when major bio-cluster are located around the capital. In Russia, there is an urgent need for a uniform strong regulating body and its perfect coordination with regional administrative units in order to implement its strategies with respect to biotech development. Together with huge geographical territory, Russia has cheap energy (unlike Lithuania), fresh water and other resources for intensive development of agricultural sector and "green" biotech.

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