INNOVATIONS AND DEVELOPMENT

BALTIC AND ASIAN TIGERS: THE BIOTECHNOLOGY SECTORS OF LITHUANIA AND INDIA AS SOURCES OF INNOVATION AND ECONOMIC GROWTH

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Abstract: This paper explores similarities and differences between the biotechnology sectors of Lithuania and India. In both cases, the biotechnology sectors are major motors of economic growth. In the case of Lithuania, we borrow from Schumpeter's ideas of innovation and Porter's business cluster theory, and argue that Lithuania is "at the right place and the right time" to make it a regional leader in Baltic biotechnology. Although very different, India's biotechnology sector is also rapidly changing and innovating.

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Introduction

The goal of this paper is to compare the development of the Lithuanian and Indian biotechnology sectors. A task of the paper is to provide an overview of the current state of Lithuania in the context of the global economy by focusing on the country's ability to innovate in the field of biotechnology. We use a comparative-historical methodological approach using secondary data to illustrate our points. India is already highly developed, 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 0.831 in the year 2000, increased to 0.862 in 2005, then further increased to 0.869 in 2008, which placed it in the "highly developed" category according to the United Nations ranking system (United Nations 2009). 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). Others (Giedraitis et. al., unpublished paper[1]) have conducted a similar study comparing Lithuania's biotechnology sector to India. To what degree might biotechnology contribute to macroeconomic indicators suggesting national economic growth in both Lithuania and India?

Theoretical framework

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, Giedraitis 2009).

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

[1] This paper is based on an article not yet published that compared Lithuania's Biotechnology sector with the German Bavarian region's biotechnology sector.

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 India's economy can focus on what Ricardo (1817) may have called its comparative advantage in the field.

Schumpeter's (1943) ideas 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 India. 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 2008a; 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 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 (see table). 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.

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.

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, 2008a).

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 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 India: An Asian tiger

India is developing into an open market economy, India has the second largest labor force next to China - that is 478.3 million (2009 est.). In early 1990s many factors accelerated the country's growth. The factors such as economic liberalization, deregulation on industries, privatization on many state owned enterprises and trimming up controls on overseas trade and venture, India's economy is dominated by service sector, the contribution of agriculture is 16.1percent, Industry - 28.6 percent and the service sector contribution is 55.3 percent. India's GDP real growth rate is 8.3 percent, stands in the seventh position comparing to the other countries in the world.

More than half of the labor forces 52%, involved in traditional village farming, modern agriculture, 14% of the labor force drawn in the industrial sector and remaining 34% percentage of them implicated in service sector (CIA The World Factbook 2009). Since independence the literacy rates of India seeing constant augment from 18.33 percent in 1951, to 28.30 percent in 1961, 34.45 percent in 1971, 43.57 percent in 1981, 52.21 percent in 1991, 64.84percent in 2001, and 68 percent in 2007.

According to Worldbank, Edstats finding, the Tertiary education of Indians is on ongoing pace appreciably, between 1983 and 2004. Execution of tertiary education in the age group 25-34 bifolded from 4.4 percent in 1983 to 8.8 percent in 2004. The rate of enrollment increased by 5 percentage, from 7.6 percent to 12.6 percent (a 60 percent increase).

Indian biotech is one of the fastest growing biotech sectors in the world. The main advantages of Indian biotech sector are cost effectiveness, world class R&D facilities, skilled manpower are also acting as the backbone of biotech industry in India. The revenue of the Indian biotech industry is crossed 3 billion US $ in 2009-2010 according to 2010, 8th annual survey conducted by Association of Biotechnology Led Enterprises (ABLE). India ranks among the top 12 nations in the long list of biotech companies (Ernst & young 2004).

Biopharma, BioServices, BioAgri, industrial Biotech and Bioinformatics

The Indian Biopharma market contains the products such as, vaccines, insulin, therapeutic drugs, and diagnostics, this Biopharma market contributed $US 1.96 billion revenue. Secondly the Bioservices segment includes contract research outsourcing and custom manufacturing outsourcing contributed $US 586.4 million. Thirdly, the Bioagri segment revenue is about $US 430.22 million, it showed larger growth rate of 37 percent, comparing to year 2008 - 09. The Industrial biotech segment mostly consists of industrial enzymes and the revenue estimated in this segment is $US 125 million, and finally Bioinformatics contributed $US 51.4 million of the total revenue. (Biospectrum-ABLE 2010 survey).

Regulating bodies of Indian Biotech

DBT (Department of Biotechnology) under the Ministry of Science & technology is the central body establishing a roadmap and making push for producing quality biotech force (man power) and making India more effective and competitive in the biotechnology & life sciences industry. DBT has made significant contribution more than a decade in the growth & development of agriculture, health care, animal sciences, environment & industry. DBT-Department of Biotechnology and MoEF Ministry of Environment and Forest are the leading biotech regulating body in India. Various committees of the above mentioned ministries are also involved in regulation of biotechnology in India. The committees such as

Recombinant DNA Advisory Committee (RDAC), Review Committee on Genetic manipulations (RCGM), Genetic Engineering Approval Committee (GEAC), and State Biosafety Coordination Committee (SBCC), District level Coordination committee (DLCC). These committees involved in the approval process, framing guidelines, and safety procedures.

India's Research and Development ensures the encouragement of various research start ups across a diverse sector of biotechnology such as, Agricultural, Bio fertilizer, plant, animal, aquaculture, Seri biotechnology, medical biotechnology, stem cell research, Nano Biotechnology and biodiesel etc. These lead to development in production of various indigenous biotechnology products. Most of the state governments investing in biotechnology, the leading states are found to be Andhra Pradesh, Karnataka, Himachal Pradesh, Maharashtra & Tamilnadu.

Biotech Parks in India

To encourage the Research and development effectively, as in Lithuania, the Indian government has been investing more in Biotechnology Parks. In turn it develops the skilled manpower for biotechnology and encourages the research and innovation. There are many Biotech parks is functioning all over the country. Parks such as, Golden Jublee Biotechnology park for women, Chennai, Tamilnadu - This Biotech Park was approved under the joint project of the department of biotechnology and Government of Tamilnadu. It is involved in the production of herbal

cosmetics, bio - fertilizers, bio - pesticides, essential oil and spice fortified with herbs.

In summary, Indian Biotech has emerging in the world's Biotech cluster. More Investments, schemes and lots of multinational companies and domestic companies playing the important role in shaping the biotech industry in India.

Conclusion

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

Biotechnology is already contributing greatly to India's economy. Contrariwise, in the case of Lithuania, biotechnology is rapidly expanding in importance, and is seen as a future leading edge sector. Thus, biotechnology is contributing to both economies and at increasing rates.

Foreign investors may be increasingly diversifying their investment to more countries, causing the rate of investment and development in Lithuania to flatten out. Additionally, with the increasing cost of labor in Lithuania, foreign investors may find it more profitable to invest in a country with a less expensive workforce. Low costs are not the only explanation for diversification. Companies may also seek technological success by using local, highly educated talent.

Both Lithuania and India both benefitted greatly from government investment in the biotechnology sector.

Additionally, In both instances we find that the strength of business clusters greatly benefitted to formation of the biotechnology sectors. Unlike India, Lithuania also benefitted from the "inherited" infrastructure from the breakup of the Soviet Union, and the resulting cheap and highly educated labor force.

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