BUSINESS CLUSTERS AND THE POTENTIAL OF THE BIOTECHNOLOGY SECTOR IN LITHUANIA

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Abstract. *What are the unique circumstances that allow innovations in an economy to take hold and mature into productive business sectors? We pose the given question in our discussion of the uncommonly favorable circumstances surrounding the biotechnology sector in Lithuania. The purpose of this paper is to analyze Lithuania's ability to expand its economy during a time of crisis, focusing on its unique ability to innovate in such sectors as biotechnology. Our primary hypothesis is as follows: Lithuanian biotechnology sector is expanding because business clusters have been established. 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 itself a regional leader in biotechnology. We draw upon the world-systems theory to argue that biotechnology is one means whereby Lithuania can rise in the global core-periphery hierarchy.*

Keywords: *Schumpeter, innovation, World-systems analysis, biotechnology, business cluster theory.*

Introduction

This paper aims 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. 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, edu-

cational 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 other Baltic countries, Lithuania rates the highest in terms of this indicator, which is based on such factors as health, family life, political stability, and political freedom (The Economist 2007). To what degree might biotechnology contribute to macroeconomic indicators suggesting national economic growth?

We draw upon a modified form of Kondratiev wave theory, Schumpeter's process of innovation, and Porter's business cluster theory to analyze the potential of Lithuanian biotechnology sector and to test our hypothesis: Lithuanian biotechnology sector is expanding because of the establishment of business clusters.

Theoretical framework

One way to understand Lithuania in the global economy 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 Frank (1978) began to theorize an expanding European economic world-system, 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 countries to rich core countries, or from the global South to the global North (Arrighi 1995, Turchin 2007).

We are not analyzing the question of resource redistribution in an economic sense, but rather are interested in Lithuania's potential for upward mobility in the core-periphery hierarchy (CPH) through such non-material resources as innovation, education, and potential for business cluster formation. While the world-systemic perspective alludes to entrepreneurial labor as a form of capital, it does not emphasize it. We use the world-systemic perspective as a broad theory to situate our empirical work.

One of the structural constants 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 failing to explain 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 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 Lithuania to emphasize the importance of innovation on the 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 change radically stagnant industries or an even an entire economy.

Innovation can be a means to rise in the CPH, while stagnation - a means to fall. Schumpeter suggested that innovation and entrepreneurship act as a sort of engine for economies to expand. Such national institutions as the government and economy must create favorable conditions for an entrepreneur to be able to bring new commodities to the market. In such countries as Lithuania, still undergoing a post-Soviet transition, opportunities abound for new business ideas.

Schumpeter placed great emphasis on the role of Kondratiev waves in explaining the expansion of businesses through innovation. Rather than a condition of stagnation via Walrasian equilibrium, Schumpter noted that innovators can breathe life into an economy through the introduction of new technologies and innovations. For example, Schumpeter noted that the steam engine as perfected by James Watt in the 1760s helped to bring about the Industrial Revolution.

Generalized clusters emerge when human activities are likely to agglomerate to shape urban areas. This phenomenon has traditionally been labeled as 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 are impossible when costumers are geographically dispersed. Specialized clusters emerge when firms in the same or closely related industries establish in the same locations to form what is sometimes called industrial zones. This phenomenon is known as localization economies. The bases of specialized clusters emerge due to 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. 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 un-traded 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. Un-traded interdependencies capture less tangible benefits from geographical clustering. Examples of un-traded 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 in the geographical proximity. This locating together creates benefits in the form of networks of interaction among firms.

Coming up with these theoretical ideas, we made an analysis of the Lithuanian situation for identifying its fit in the world-system hierarchy upon a modified form of Kondratiev wave theory. We analyzed Lithuania's ability to expand its economy during the time of crisis, focusing on its unique ability to innovate in such sectors as biotechnology using the Schumpeter's concept and Porter's business cluster theory.

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 integrated 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 by 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 plas-

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 (http://go.worldbank.org/JVXVANWYY0).[1]

tic products 6.0% (Lithuanian Department of Statistics 2009). Despite the fact that minerals were at the top of 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 in the recent decade the gap between these countries is gradually filled as a result of high economic growth. Lithuania has several characteristics that are typical of 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 that 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.

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 was 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

[1] The World Bank Edstat database did not provide any data on Estonia and the Czech Republic, which are considered as being a "high income country". See: http://go.worldbank.org/JVXVANWYY0.

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).

At the same time, 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).

Why foreign companies invest in biotechnology in Lithuania can be accounted for by 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 educated workforce or the already built factories and researchers.

This is the reason why 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 a 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 one hand, a relevant question arises 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 were still being privatized.

Another positive development of the biotechnology industry in Lithuania is related to immigration and the "brain drain" phenomenoa. As an example, seventeen outstanding Lithuanian experts who had previously emigrated 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 strengthen further 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 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 the cause of the success of biotechnology in Lithuania is 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, and not in the less expensive business climate of such new member state countries as 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 it may be 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 the 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 is only the second after Hungary in sales volume. The Lithuanian government is therefore wise to be investing in the biotechnology sector by increasing biotechnology research funding during the last five years (Innovations Report 2008).

Conclusions

Although Lithuanians economy was growing, the overall rate of economic development in Lithuania compared to other countries is not as rapid. One explanation is that 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.

The goal of this paper was to illustrate the concept of the core-periphery hierarchy in relation to Lithuania's global position with an emphasis on the role of innovation in biotechnology. We found that Lithuania is on a rising trajectory in the hierarchy. Lithuania has many qualities of a semi-peripheral country, and given such booming innovative sectors as biotechnology, it is well-poised to weather the current economic crisis better than other countries.

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