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Analysis of Cyclical Sensitivity in Traditional and New Sectors: the Case of Lithuanian Economy

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In this article, different sectors of the Lithuanian economy during 2000–2010 are analysed, as well as theoretical aspects of issues in sector classification. Sectors are classified by the author into groups of high value-added, medium value-added and low value-added; by OECD into high-technology industries, medium-high technology industries, medium-low technology industries and low technology industries. Furthermore, all sectors are labelled either modern or traditional.
Intentions to restructure national economy with priorities in high-technology, knowledge-intensive and high value-added sectors call for formation of a new national specialization. It is important to thoroughly analyse possible effects and influences of these processes to the national economy and welfare of society.
With current interconnections of economies and processes of globalization, it is very important to evaluate sensitivity of different sectors (of different technological intensity and value-added) to general fluctuations of economy. Small open economies, such as Lithuania, are especially susceptible to this problem.
Although this problem may seem to be narrow at first glance, it is in fact quite complex and has not been sufficiently studied in scientific literature. Available research of separate segments is inconclusive due to rapid changes in circumstances, interconnections between segments and contradictions between technological intensity and creation of value-added. In this article, a correlation and regression analysis of fluctuations in gross value-added and GDP of different sectors of Lithuanian economy during 2000–2010 is presented. Although no concrete conclusions were reached, important tendencies were revealed and a basis for further research was established. Some proposed goals are as follows: evaluation of relevance of factors of production to value-added, fluctuations of value-added in markets for services and products, and evaluation of impact of economic policy to cyclicity of different sectors.

Keywords: *High, Low, Medium Value-Added Sectors; High, Medium, Low Technology Sectors; Traditional Sectors, New (Modern) Sectors, Restructuring, Fluctuations Of Economy.*

Introduction

As we examine and compare economies, we must separate traditional (mature) sectors from new (modern) sectors. The latter were formed recently via increasing labor specialization, growth of marginal costs in traditional sectors and replacement of resources, while the former are inherited from the past and use labor-intensive production methods (Zeira & Zoabi, 2011). In all future economic development scenarios of the Republic of Lithuania, the main goal is to improve the position of Lithuanian economic players in the global value chain by restructuring country's economy with the primary focus on high-technology, knowledge-intensive and high value-added sectors. Development of these sectors is considered the most important factor in increasing Lithuania's competitiveness: "Lithuanian industry does not have as much high technologies as developed countries. The significance of low value-added industries in Lithuania is obvious, nevertheless, production with relatively high value-added is important for export development in the future. When considering the results of restructuring the industry, the most common approach is to evaluate the degree of export specialization in the country and changes in export volumes" (Saboniene, 2009). To achieve the desired attractiveness and competitiveness, "Lithuania must undergo certain challenges: focus on high value activities/functions, add services to manufacturing and other high-value sectors, in addition to empowering the traditional sectors" (Lithuania's FDI promotion strategy, 2009; National long term development strategy, 2002). Some authors argue that different kinds of innovations, especially those related to strengthening human resources are a special determinant to competiveness and economic growth (Adekola & Korsakiene, 2008; Ginevicius & Gineviciene 2009). These changes essentially mean the country must develop a new specialization, which gives rise to a sensitive and complicated problem, which can only be dealt with after a thorough analysis, including consideration of effects on job-creation, job-replacement and consequences of cyclical movements. Research on the impact of economic structure on growth has revealed that sectors where specialization is significant appear to decrease in size. Furthermore, impact of high-specialization sectors on overall economic growth can be unpredictable and policies aiming to alter specialization of the national economy can be risky and difficult to implement effectively (Dalum *et al.*, 1999).

In different timeframes, some medium value-added and high value-added sectors have demonstrated growth rates below the national average, which suggests traditional segments of economies are necessary to ensure sustainable growth. In this paper, competitiveness is defined as a real comparative advantage with "possibility for citizens to enjoy a high standard of living, not the ability of a country to sell more abroad than it buys from abroad" (Krugman, 2001). Lithuania is a small open economy as the standard openness ratio (ratio of imports and exports to GDP) was 1,22 (88,1/72,4 b LTL) in 2005; 1,28(106,4/83,2b LTL) in 2006; 1,21(120,0/99,2 b LTL in 2007; 1,31 (146,7/112,1 b LTL) in 2008; 1,10 (101,4/91,9 b LTL) in 2009; 1,38 (131,0 /95,1 b LTL) in 2010 and has increased to 1,57 (166,9 /106,0 b LTL) in 2011. It follows that the economy is highly sensitive to all effects and influences of either global or regional economic fluctuations, especially in times of crisis or recession. It can be assumed that an increase in dependence on foreign trade during 2010–2011 can be mostly attributed to shrinkage of domestic market (which mostly consists of sales of traditional, everyday use products) and declining manufacturing sectors which account for most of national employment. Countries specialize by exploiting their comparative advantages arising from differences in technology, innovativeness and differences in processes of value-added (Bernatonyte & Normantiene, 2009). Another important concept is that strong international trade links can result in more correlated business cycles across countries - "as trade flows could also induce increased specialization of production resulting in changes in the nature of business cycle correlations" (Kose *et al.*, 2003). It is impossible to avoid economic fluctuations (Aizenman & Pinto, 2005; Stock & Watson, 1993; Zarnovitch, 1992). Furthermore, occurrence and magnitude of economic fluctuations are becoming increasingly dramatic under the influence of globalization, resulting in negative material and social effects to welfare of society. According to Otrok (2000), welfare cost of business cycles is not zero, as modifications of subject preferences can lead to costs associated with consumption volatility. The results of international financial and economic integration are sometimes controversial and therefore it is necessary to analyse assumptions of economic restructuring which is supposed to lead to a specialized national economy. Economic goals and methods of action must be balanced in accordance with all relevant aspects, including economic stability and peculiarities of fluctuations in different value-added sectors.

The object of the paper is the creation of value -added in separate sectors of economy and classification of sectors with regards to value-added.

The aim/objective of the paper is to evaluate the sensitivity of different value-added production and services sectors to economic fluctuations.

Research methods are logical and comparative analysis of scientific literature and statistical data, correlation analysis and linear regression analysis.

Problems with Classification of Sectors by Value-Added and Technological Intensity

Structural adjustments of economic systems towards high value-added, high technological intensity, high knowledge intensity and innovative manufacturing and services are frequently discussed in literature. In particular, internalization of technology is examined in terms of how technology influences country's trade specialization and how technological specialization influences stability, concentration and convergence. Some conclusions are offered: success of advanced industrial countries is based on specialization in profitable, high value-added activities; incomes of acting subjects in the world economy are mostly influenced by whether and how they can find a niche in high value-added segments and international value chain (Kilvits, 2012; Yang *et al.*, 2010). It is claimed that perspectives of economic development "are getting more heavily dependent on the ability to initiate, disseminate and implement innovations in all spheres of life". Activation of innovations is considered to be a significant challenge associated with social and economic development (Davies, 2004; Melnikas, 2008; Snieska, 2008).

Some authors measure the competitiveness of territories (regions) by innovations and intensity of knowledge outsourcing processes (Snieska & Draksaite, 2007). It is thought that it is very important to widely analyze the nature of modern technologies and the role of technology-based economy in in terms of different social and political aspects of countries (Ghazinoory & Ghazinouri, 2009). Prescott (1986) stated that economic fluctuations are optimal responses to uncertainty regarding the rate of technological change. The average rate of technological change varies much both over time and across national economies, so attention should be focused not on fluctuations in output of economies, but on determinants of the average rate of technological advancement.

Some scientists claim that smaller countries display a higher level of specialization compared to big countries, and therefore smaller countries need to reach some minimal dimension in R&D and production to specialize in specific sectors (Amendola *et al.*, 1992). Amendola finds that over long periods of time the persistency of technological specialization tends to fade away because of the emergence of new technological inventions and new industries. Under the assumption that more technology-intensive sectors and firms use resources more efficiently, offer higher rewards to the employees and employers, are more dynamic and often introduce spill over effects to other sectors, it is agreed that construction of a complete classification in terms of technology intensity is complicated. The main difficulties in classification are as follows: how to rank direct intensity (production of technology) and indirect intensity (use of technology) as well as how to avoid a degree of arbitrariness in choosing the discern points between the classes of different technology levels (Hatzichronoglou, 1997). It must also be evaluated how spill overs (as situations in which other's strategies affect one's own optimal strategy) and strategic improvements create other important macroeconomic effects (Diebold & Rudebusch, 1996; Posner, 1961). Recently, firms and even whole industries were observed to be experimenting with novel business models based on harnessing collective creativity through open innovation. The apparent success of some of these experiments

challenges prevailing views of strategy (Chesbrough & Appleyard, 2007).

Some studies suggest classification of industrial sectors on the parameters of market concentration, share of factors of production in value–added, intensity of R&D, skilled-labour intensity and the number of patents (Davies & Lyons, 1996; OECD, 1996). Organization for Economic Cooperation and Development (OECD) (1996) proposed a classification of industrial sectors (excluding services) into four groups according to technological (R&D) intensity: high-technology industries (HT), medium-high technology industries (MHT), medium-low technology industries (MLT), low-technology industries (LT) (ISIC Rev.3 Technology intensity definition, 2011). Although this classification is used for evaluating economic structure and formation of strategies (including Lithuania), it has some flaws and is unable to foresee all economic aspects. Today, all branches contain segments of high-technology production and products, effective marketing channels, well-known brands, etc. Due to globalization, subjects in low-technology branch earn a significant number of subcontractors in high-technology branch (Kilvits, 2012).

On the basis of OECD classification and methodology, (Grimpe & Sofka, 2008) analysed absorptive capacity of high- and low-technology sectors to assimilate external knowledge, concluding that medium-low technology and low technology industries hold a great importance in value-added production and employment in economies, so it is important to analyse innovation activity of these sectors and how it differs from technology sourcing activities in high-technology industries.

Bassal (2008) distinguishes growth sectors (information technology, telecommunications: optic wire and cable, telephone manufactures, telecom companies) and value sectors (consumer staples: food, beverage, cosmetic companies, etc.; energy: drilling, energy firms, exploration and production; financials; capital goods: aerospace, railroad, defence, heavy equipment manufacturers; basic materials industries: chemical, paper, steel manufacturers and utilities). In this study, this classification is not further examined nor applied. The assumption that R&D is procyclical, but responds asymmetrically to demand shocks was of crucial importance to initiate this study because it was applicable to economy of Lithuania during the period 2006–2008 (Min, 2011).

Sensitivity Analysis of Different Sectors to Economic Fluctuations

Few studies appear to consider the issue of high and low value-added sectors and high- and low- technology sectors sensitivity to economic fluctuations. In part, this is because the concept of high or low value-added sector can be interpreted differently in different markets and timeframes. Additional confusion is brought in by the concept of high or low technology sector, as both processes are changing in time and interconnected. Economy is too complex to be summarized with statistics, but nevertheless it is essential to look for connections, directions of influence and trends. Dynamics of value-added in the economy of Republic of Lithuania in general and separate sectors as well are researched in a study of 2000–2010, where phases of economic cycle are shown according to one macroeconomic aggregate - real GDP (Figure 1).

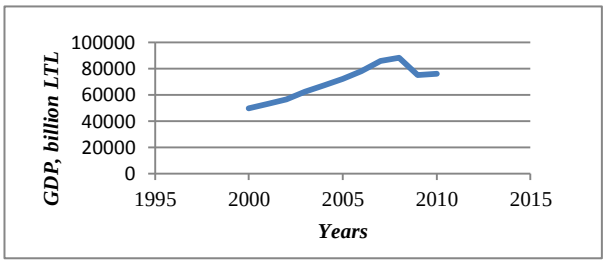

Figure 1. Lithuania GDP dynamics during 2000–2010

Two methods were considered when choosing a basis for sector classification: measurement of value-added percent (how much of industry's final shipment value is added during processing) and added value per employee in each sector (except wholesale and retail trade, real estate activities, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management and remediation activities, administrative and support service activities).

Analysis has shown that in Lithuania's economic sectors, gross value-added (GVA) percent in general production was fluctuating from 27 % in manufacturing of chemicals and chemical products to 75 % in real estate activities and 77 % in manufacturing of basic pharmaceutical products and pharmaceutical preparations during 2000–2010. The percent of gross value-added generated by general production to all economic activity was fluctuating only slightly in the years 2000 to 2010: from a maximum of 53 % in the year 2000 to a minimum of 50 % in 2010. The percent of gross value-added in most manufacturing industries (except the ones mentioned) to general production was at an average of 35 % to 50 %, while in services (except the ones mentioned) it was 53–63 %. A trend of value-added growth in general production was significant in two sectors only: in manufacturing of basic pharmaceutical products and pharmaceutical preparations (from 32 % in the year 2000 to 75 % in the year 2010) and in manufacturing of motor vehicles and other transport equipment from 50 % in year 2000 to 63 % in year 2010. In other sectors, only a marginal increase or a slight decrease was observed.

Under the second evaluation method mentioned above - evaluation of value-added per employee - sectors appear very different. In all types of economic activity in Lithuania, average VA per employee was 48,33 LTL during 2000–2010.

In terms of separate sectors, VA per employee ranged from 16,97 LTL in agriculture, forestry and fishing to 327,9 LTL in telecommunications. Classification of sectors according to average VA per employee index is chosen in order to reflect an accurate rate of change of this index across all sectors under consideration, as well as in separate groups (Tables 1, 2, 3).

Table 1

Classification of sectors and activities by VA per employee in 2000–2010 years: high value-added sectors

High value –added (1,5 times > average 48,33 LTL) sectors	**By OECD**	**VA per empl., LTL**	**Regres. Coef.**	**Corel. Coef.**
Manufacture of chemicals and chemical products (GVA % 31 →27)	MHT	174,1	0,0413	0,879354
Manufacture of pharmaceutical products and pharmaceutical preparations (GVA % 32→75)	HT	120,8	0,0027	0,446706
Information and communication (GVA % 66→61)		137,3	0,0363	0,956936
Telecommunications (GVA % 74→66)		327,9	0,0167	0,898380
Mining and quarrying (GVA % 57→57)		86,25	0,0035	0,768234
Manufacture of motor vehicles and other transport equipment(GVA % 46 →52)	MHT	80,19	0,0111	0,946342
Transporting and storage (GVA % 60→57)		75,68	0,1741	0,915899
Financial and insurance activities (GVA % 58→58)		93,30	0,0632	0,927011
Total average per group		136,94	0,040	0,950293

Table 2

Classification of sectors and activities by VA per employee in 2000–2010 years: medium value-added sectors

Medium value - added (32,22LTL < average 48,33 LTL <72,50 LTL) sectors	**By OECD**	**VA per empl.,LTL**	**Regres. Coef.**	**Corel. Coef.**
Manufacture of food and tobacco products (GVA % 33→33)	LT	55,93	0,0468	0,819896
Manufacture of wood, paper, printing and reproduction of recorded media (GVA % 38→40)	LT	40,74	0,0284	0,989861
Manufacture of rubber and plastic products, other non-metallic products (GVA % 36→39)	MLT	66,25	0,0362	0,960321
Manufacture of basic metals, metal products, except machinery and equipment(GVA % 40→41)	MLT	46,97	0,0232	0,974711
Manufacture of computer, electronic and optical products(GVA % 37→46)	HT	62,88	0,0006	0,104170
Manufacture of electrical equipment (GVA % 43→34)	MHT	49,12	0,0037	0,774663
Manufacture of machinery and equipment n.e.c. (GVA % 43→45)	MHT	53,21	0,0092	0,905783
Manufacture of furniture, other manufacturing, repair of equipment (GVA % 41 →45)	LT	42,92	0,0457	0,949763
Construction(GVA % 49 →53)		44,42	0,2111	0,922262
Publishing activities, video and TV programme production, broadcasting(GVA % 51→48)		61,77	0,0063	0,875778
Computer programming, consultancy and information service activities (GVA % 59 →58)		70,42	0,0134	0,859245
Professional, scientific and technical activities (GVA % 59 →63)		67,14	0,0736	0,952892
Total average per group		55,14	0,040	0,948637

Table 3

Classification of sectors and activities by VA per employee during 2000–2010: low value-added sectors

Low value-added (1,5 times < average 48,33 LTL) sectors	**By OECD**	**VA per empl.,LTL**	**Regres. Coef.**	**Corel. Coef.**
Agriculture, forestry and fishing (GVA % 50 →35)		16,97	0,0278	0,786666
Manufacture of textiles, wearing apparel, leather and leather products (GVA % 39 →44)	LT	26,42	-0,0067	-0,489470
Accommodation and food service activities (GVA % 63 →66)		30,79	0,0169	0,962027
Total average per group		24,73	0,017	0,798177

High value-added group of sectors consists of industries in which average VA per employee was 1,5 times above the national average during 2000–2010, while low value-added group of sectors consists of industries in which average VA per employee was 1,5 times below the national average during 2000–2010.

Ratio of minimum VA per employee value to maximum VA per employee value in different groups during 2000–2010 was as follows (after elimination of telecommunications sector, which is considered an outlier due to exceptionally high value): 2,3 in high value-added group, 2,29 in medium value-added group, 1,8 in low value-added group.

Ratio between average VA per employee in high value-added group and medium value-added group was 2,5 while the same ratio between low value-added and medium value-added groups was 2,3. It can be assumed that the margin of error in grouping is negligible.

Correlation coefficients between GVA in sectors grouped according to average VA per employee during 2000–2010 and GDP revealed the following relationships (Figure 2).

Figure 2. GVA to GDP correlation by sectors during 2000–2010

1. Relationship between GVA amounts in high value-added and medium value added groups is very strong.
2. Relationship in low value-added group is strong.
3. There exists a faint tendency of decrease in sensitivity to cyclical changes as VA per employee decreases (it must be analyzed in further studies).

4. In all groups there are exceptions with weak, medium and perceptible relationships.

A linear regression analysis of the same values has revealed the following magnitude of influence variation between groups (Figure 3).

Average value of regressive influence is the largest in high and medium value-added groups.

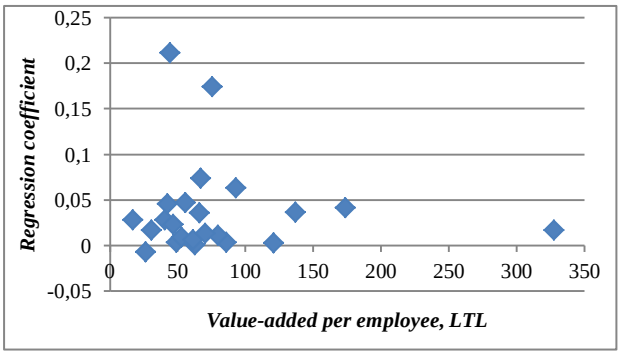

Figure 3. GDP to GVA regression by sectors during 2000–2010

1. Value of regressive influence is smallest in low value-added group.

2. Regressive influence is inverted in a single low value-added industry during 2000–2010 (manufacture of textiles, wearing apparel and leather).

Analysis of the same coefficients in sectors, grouped according to OECD methodology (Table 4) tends to conclude that application of high industrial technologies provides more accurate assumptions for economic stability in the phases of economic cycles. Data also suggests that there is no strong direct relationship between sector's propensity to high technologies and high generation of value-added.

The same analysis of statistical data of traditional Lithuanian sectors (agriculture, forestry and fishing, manufacture of textiles, apparel, leather, food, wood, furniture and construction) has shown that the change of VA in these sectors is closely related to economic fluctuations - correlation coefficient between GDP and VA during 2000–2010 is 0,966365, regression coefficient – 0,058. With the exception of construction sector (its regression coefficient is unusually high among sectors in question), average regression influence coefficient of traditional sectors is 0,028 - the same as that of low technology sectors.

Table 4

Relationship of GDP and GVA in Lithuanian industries classified by technology intensity

Groups of industries by OECD	Correl.coef.	Regres.coef.
High-technology industries	0,4079470	0,001
Medium-high technology industries	0,9424986	0,016
Medium-low technology industries	0,9728272	0,029
Low-technology industries	0,9422785	0,028

According to Krugman, "the usual reason value-added per worker is high in some industries is that other inputs, such as capital or skill, are high there as well. Since the economy has limited supplies of capital and skill, encouraging industries that use those scarce resources intensively may well lower instead of raise per capita income". Therefore, more reliable assessment could be made if structure and changes of creation of value-added were further analyzed.

In conclusion, a thorough long-term analysis of the structure and sensitivity of value-added to economic fluctuations, levels of value-added created in industry and services sectors is needed in order to prepare for reliable construction of economic future. Structural analysis is important because value-added is a reward for all production factors, including labour, capital and entrepreneurship. There are some directions for future research. After evaluating differences of VA creation between production and services sectors, it would be important to measure and validate an optimal ratio of production to services that would be beneficial to the welfare of society. It is also important to determine optimal depth of country's specialization. Finally, impact of implemented economic policy to cyclicity of different sectors should be evaluated.

Conclusions

- Economic scenarios of countries which aim to restructure national economy with priorities towards high technology, knowledge–intensive and high value-added sectors, are likely to improve the position of these sectors in the global value chain.
- Analysis of scientific literature has shown that technological changes and changes in technological intensity are the determining factors of country's economic growth. However, without further analysis regarding impact of specialization adjustment to economic growth this conclusion can be unpredictable and the policies that aim to change the specialization patterns of the economy can be risky. Moreover, over long periods, the persistence of technological specialization tends to fade away because of the emergence of new technological findings and new industries.
- Peculiarities of fluctuations in different value-added sectors, their mutual relationship and relationship to national economy fluctuations must be considered.
- Analysis of fluctuations in Lithuanian economic sectors with respect to gross value-added ratio to general production during 2000–2010 has shown that gross value-added percent of all economic activity in general production during 2000–2010 was fluctuating slightly. A trend of value-added growth with respect to general production was strong in only two sectors, while only a slight ratio increase or even a decrease was observed in other sectors.
- Correlation analysis revealed a following relationship variety in groups of sectors with different VA per employee: relationship of value-added with GDP in high value-added and medium value-added groups is very strong; in low value-added group - strong. There exists a faint tendency of decrease of sensitivity to cyclical changes as AV per employee increases, which must be examined in further studies.
- A regression analysis has revealed the following magnitude of influence on GDP among groups of sectors

with different VA per employee: average value of regressive influence is largest in high and medium added value groups and smallest in low value-added group.

- Analysis of correlation and regression coefficients in industry sectors, based on grouping already established in OECD methodology, tends to conclude that application of high industrial technologies provides more accurate assumptions for economic stability in the phases of economic cycles. Data also suggests that there is no strong direct relationship between sector's propensity to high technologies and generation of high value-added.
- The same analysis of the correlation and regression coefficients in traditional Lithuanian sectors (agriculture, forestry and fishing, manufacture of textiles, apparel, leather, food, wood, furniture and construction) has shown that the change of VA in these sectors is closely related to economic fluctuations.
- Correlation and linear regression analyses of separate national economy sector groups have been conducted regarding fluctuations of gross value-added and fluctuations of GDP during 2000–2010. Although clear conclusions were not observed, some trends were revealed, highlighting the necessity of further research to evaluate the share of factors of production in value-added, fluctuations of value-added creation in industry versus services, and to measure the impact of implemented economic policies to cyclicity in different sectors.

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