Journal of Security and Sustainability Issues *www.lka.lt/index.php/lt/217049/*
ISSN 2029-7017/ISSN 2029-7025 online
2012 Volume 2(2): 69–78
http://dx.doi.org/10.9770/jssi.2012.2.2(7)

THE INVESTIGATION OF LITHUANIAN GROWTH AND INDUSTRY EXPORT DEPENDENCE ON ENERGETIC RESOURCES

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Received 30 August 2012; accepted 15 October 2012

Abstract. Economic growth and country's industry dependence on the assessment of energetic resources arise as comprehensive approach. The increase in global energy prices, significant dependence on imported energy and increase in energy consumption might result international competitiveness of the country and pose constrains towards sustainable development. Restructuring of the economies from energy intensive industries towards more technologically advanced products and services might lead to higher value added per unit of product, and energy saving sectors with lower energy consumption per unit of output. In order to sustain international competitiveness of exporting sectors, it is necessary to diminish gradually intensity of expensive energy resources. The problem of this study related to the scientific discussion concerning relationships among the intensity of energetic resources' use, economic growth and export. The analysis of the theoretical and empirical studies of the effects of energy on the economic growth and export showed that energetic resources precede and predict the economic growth and export, however, the question concerning the direction of causality remains open, since unobserved variables may drive both developments. This paper analyzes the case of Lithuania. The authors investigate economic growth and industry sectors' export dependence on energetic resources.

Keywords: Economic growth, export, energetic resources, industry sectors, energy dependency.

Reference to this paper should be made as follows: Smaliukienė, R.; Dudzevičiūtė, G.; Adekola, F.A.; Aktan, B. 2012. The investigation of Lithuanian industry export dependence on energetic resources, *Journal of Security and Sustainability Issues* 2(2): 69–78.
http://dx.doi.org/10.9770/jssi.2012.2.2(7)

JEL Classifications: L60, L62, L65, L67, Q4, Q43**.**

1. Introduction

Growing demand for energy in the world is closely related to economic development. Increasing prices of energy resources and a big dependence of countries on the import of energy raise doubts whether a secure energy supply will be ensured in the future and whether countries will be able to remain competitive in international markets. This is especially relevant to Lithuania. After the closure of the nuclear power plant, Lithuania's energy dependence increased from 48,9 percent in 2009 to 79,5 percent in 2010-2011 (Statistics Lithuania 2012). The trends of the past decade reflect a significant increase of the prices of fossil fuel. This phenomenon was caused by the limitations of the main energy resources, i.e. natural gas and oil. The interest in energy consumption and economic growth grew in the seventies, and the relevance of those topics is taking on an even greater meaning due to the growing prices of energy resources and the increasing dependence of the countries on

their import. The energy sector cannot be separated from the national or international economic development and competitiveness. Energy is closely related to all economic activities. The accessibility of energy resources is essential in order to foster economic development. All economic sectors, including residential homes, commercial, transport, tertiary and agricultural sectors, depend on energy resources. Job availability, industrial productivity, urban and rural development, and all the main economic activities are strongly affected by energy consumption. The main parameters and variables, affecting energy supply and demand, are an integral part of the national economic policy (Vera, Langlois 2007; Munim *et al.* 2010).

In scientific literature, the energy sector is analyzed from different theoretical aspects. Opinions and studies of Lithuanian and foreign authors are compared and analyzed in order to determine the energy impact on the country's economic state. Scientists discuss the causality between economic growth and energy consumption – the question whether this correlation exists and what is its nature has been raised. Some of them claim that economic growth is driven by energy consumption (Narayan, Smyth 2008; Munim *et al.* 2010) while others believe that it is vice versa (Linden 2002). Also in research literature are presented that show that among the mentioned variables either there is no causality, or there is a reciprocal relationship. The markets of petroleum products, electricity, gas and other energy resources significantly affect the production, the volume, the rate of growth and the quality of goods and services. According to Jankauskas (2008), the country's level of development can be shown by what energy resources it uses and how. The use of wood and other biofuels, as major energy resources, in underdeveloped African and Asian countries is given as an example. Rapidly developing countries such as China, not paying attention to environmental pollution, are actively increasing energy consumption while developed countries are mainly focusing on the efficient use of energy and the reduction of its impact on the environment. As Kleinpeter notes (1996), looking not only from the energy consumer's position, but also from the energy supplier's one, energy must be accessible in the right place at the right time and in the right form. Energy resources can be primary and secondary, and the latter ones are divided into non-renewable (coal, oil, natural gas, peat, and nuclear fuel) and renewable (hydropower, wind, solar, tidal energy).

Paper presents a research problem that is related to the continuing scientific debate over the establishment of interaction between energy and economic growth and competitiveness which is caused by export. *Research aim* is related to the identification of interdependencies among energy indicators, economic growth and competitiveness which is caused by export. The main research method applied is correlation analysis.

2. Energy and export in the context of economic growth: empirical studies review

2.1. The interdependence of energy consumption and economic growth

Economic growth in scientific literature is defined as an increase of the volume of manufactured goods and provided services over a certain period of time or an ongoing development of the country's productive potential, which is defined by the growth of the real gross domestic product (GDP) (Snieška *et al.* 2005; Jakutis *et al.* 2007). GDP is one of the key statistical indicators to describe the development of the national economy and is widely used for international comparisons and economic analysis. On the basis of its level, its changes or other ratios, various economic and political decisions are made (Konstantinavičiūtė *et al.* 2010). According to Onsel *et al.* (2008), the country's wealth foundation is expressed by GDP per capita. Bobinaite *et al.* (2011) hold the same opinion saying that GDP is the most widely-spread global indicator which is used to determine the country's economic level of development. On the basis of the scientists' considerations, GDP in this paper will be used as a synonym for economic growth.

In the context of economic growth, energy resources play an important role. Scientists are intensely debating on the subject of energy consumption and economic growth. According to Sun (2001), it was attempted to prove the strong correlation between energy consumption and economic growth already in the sixties. Bobinaitė *et al.* (2011) claims that the interest in this topic increased after 1978 when Kraft published an article which examined the causality between the U.S. energy consumption and gross national income in years 1947-1974. Scientists found that energy consumption determines gross national income. Once this relationship had been found, the responsibility of those individuals who make decisions in the implementation of energy and environmental policy increased.

Recently published studies on the correlation between economic growth and energy consumption were carried out in two ways – some researchers (Amador 2011; Cheng-Lang *et al*. 2010; Bobinaitė *et al*. 2011, Tvaronavičienė 2012) examine the relationship between separate energy resources and economic growth, others (Lee, Chang 2005 and 2008; Narayan, Smyth 2008; Gallastegui *et al.* 2011, Chen *et al*. 2012) analyse the correlation between a total energy consumption and economic growth; however, a general conclusion has not been drawn as to whether there are causal relationships, and if they exist – what they are like. Chen *et al*. (2012) on the basis of the studies report the following results: There is a correlation between GDP and energy consumption; there is no correlation between GDP and energy consumption.

The amount of energy consumption is a consequence of economic growth. GDP of developing countries highly correlates with primary energy consumption per capita (Chow *et al.* 2003). In 2005 and 2008 studies Lee and Chang say that GDP is dependent on the consumption of oil, gas and electricity. Summarizing the authors claim that energy consumption is the engine of economic growth. Ather authors (Amador 2011; Munim *et al.* 2010) are of the same opinion naming the amount of energy consumed as one of the factors of economic growth. If energy consumption determines the rate of economic growth, it means that the lower energy consumption is, the slower the country's economic growth is. According to Sorrelli (2009), the effect of this causal relationship is a paradox – in various countries around the world energy saving policy that is being implemented can slow down the rate of economic growth.

Chen *et al.* (2012) presented research results showing the existing reciprocal relationship between economic growth and energy consumption. In this case, the economies of developing countries grow if energy consumption increases, but in the developed economies – this relationship is not found. In countries with developed economies, energy consumption does not promote economic growth, but while those economies are growing – the increase in energy consumption cannot be avoided. Thus the increase in energy consumption leads to economic growth, and the more it grows, the more energy is consumed. Jafari *et al.* (2012) notes that in the reserrch literature there are studies the results of which show that between the mentioned variables no causal relationships exist.

2.2. The interdependence between export and economic growth

The country's economic level of development, the potential of economic growth, productivity, and competitiveness is characterized by various indicators (Dudzevičiūtė 2012). In Lithuania's long-term strategy of economic development by 2015 it is said that the actual competitiveness among industries is best reflected by the share of exported production in the context of the whole country's economy as well as by productivity and operating costs. According to Meilienė and Snieška (2010), in scientific literature the country's international competitiveness is often identified with export. Competitiveness of exports is related to the country's ability to compete in the export markets as well as to ensure economic growth and employment. The export results, their changes reveal the abilities of domestic companies to compete in global economy. Dragomir *et al.* (2010) in the study came to a conclusion that in order to create a well-developed competitive and globalized economic environment, the export sector should be developed. Authors Johnson and Noguera (2011) hold the same opinion saying that in order to be competitive, countries need to increase the share of exported production. The close relationship between competitiveness and export is affected by the fact that exports are one of the main components of GDP growth (Sadorsky 2012). In scientific articles the results of the research show that a statistically significant relationship between economic growth and exports exists (Li, Chen and Wang 2010; Temiz, Gokmen 2010; Tekin 2012), but there is no consensus on the strength of the relationship and its nature. Sadorsky (2012) identifies to way interdependency: country's export volumes affect the country's economic growth; country's economic growth affects the country's export volumes. Jordaan and Eita (2007) in their research presented a hypothesis that economic growth affects export; however, the results of it showed the opposite – export is the driving force of economic growth. There are even a number of theoretical explanations as to why economic growth depends on export. Export growth can increase the demand of a country's production, which leads to an increase of economic activity. Also export development requires highly skilled and specialized workforce which in turn promotes the development of better work habits, higher specialization, economies of scale and productivity. Another argument that buttress export as a growth factor is increased ex-

port volumes which provide the country with foreign currency and, thus, simplify the cooperation between countries, facilitate imports as well as provide favorable conditions for foreign financial capital rising.

Analyzing a large range of countries, results that favor various approaches are obtained. Firs of all there is a difference between the dynamics for developed and developing countries. Besedeš and Prusa (2011) and Tekin (2012) analyzed countries with poorly developed economies. The results showed that there is no relationship between export and economic growth in two countries whereas there is a relationship in the other two. The research also revealed that export volumes affect GDP growth in a half of the analyzed countries; whereas in the other half, GDP growth affects export volumes. The authors concluded that countries where economic growth depends on export volumes have a lot of primary energy resources. Countries where economic growth affects export volumes are rather the exporters of industrial production and services.

The study of Sadorsky (2012) also finds the arguments in support of the existence of this relationship. In the long-term economic growth depends on capital and labor increases as well as on technological improvements, thereby increasing productivity. Such economic growth requires higher skills and technology which can create favorable conditions for export.

2.3. The interdependence between the intensity of energy consumption and export

The interaction between energy consumption and export is different and it depends on the country's level of development, economic state, technology that is used. In countries where economies are rapidly developing, energy consumption exceeds the world's average energy consumption. The opposite situation occurs in countries with developed economies. In the first case, small efficiency of energy consumption is observed, and in the second case – low export specialization. Zheng *et al.* (2011) claim that the intensity of energy consumption depends on the novelty of the technology. In low-tech countries there is no significant correlation between export and energy consumption, while in medium and high-tech countries export volumes and energy consumption interact closely (Narayan and Smyth 2008, 2009; Amador 2011; Li 2010; Bruneckienė, Paltanavičienė 2012). Large export volumes and a lack of investment in technology increase the intensity of energy consumption, but the export of high-tech goods plays an important role in reducing the intensity of the total world's energy consumption.

The correlation between export and energy consumption is interpreted differently by scientists. The results of Bojnec and Papler (2011) research show that there is a positive correlation between export and energy consumption. According to Sadorsky (2012), export development provokes the demand of the production factors: capital, labor and energy. Various types of machinery and machines to load and transport cargo to the sea ports, airports or other cargo unloading terminals are used to export production. In these terminals, cargo is unloaded, reloaded and prepared for the shipment to foreign countries. Machinery and machines that depend on energy resources are used not only to send production, but are also used to produce and transport it. Zheng *et al.* (2011) argue that export growth increases energy intensity in the entire industry. Grebliauskas and Ramanauskas (2007) think that only industries that use high technology can increase export volume. The energy-intensive sectors are crucial factors shaping the country's economic growth. These sectors (chemical and petrochemical sectors; iron, steel and cement products), whose large part of the production is exported, accounted for even 69 percent of the EU's total industrial energy consumption. On the basis of these insights and facts, it can be concluded that a significant decrease in energy consumption in the industrial sector may reflect a decrease in the production of exports which would lead to a decrease in export volumes as well as to recession. In this case, Sadorsky's (2012) observation is perceptive saying that various country's saving programs can impede not only the development of industry but also of export at the same time disrupting the country's economy. A correlation between energy consumption and export volumes can be found in the research. In this case, energy volumes are important interpreting export fluctuations while export is an important factor when analyzing energy demand. Thus these factors complement each other and there is a strong dependence between them. There is also a possibility for a neutral correlation between energy consumption and export volumes. In this case, the correlation between energy and export is so small that is not statistically significant.

3. Research methodology

The research was guided by the prevailing theories in scientific literature (Lee, Chang 2005 and 2008; Narayan, Smyth 2008; Munim *et al.*, 2010; Tekin 2012; Konya 2006; Sadorsky 2012) on the basis of which two hypotheses were formulated: 1) *there is a direct correlation between energy consumption and economic growth*, 2) *there is a direct correlation between energy consumption and export*. Additionally, interdependencies of industry export and change of energy prices are investigated. In order to confirm or reject the hypotheses, the correlation analysis, which was carried out. Lithuanian statistics were used to determine the correlation

4. Examination of energy consumption

The statistics of GDP of particular years, the annual energy consumption (in tons of oil equivalent) and export is used for analysis. The period of 2003-2010 is under examination (Fig. 1).

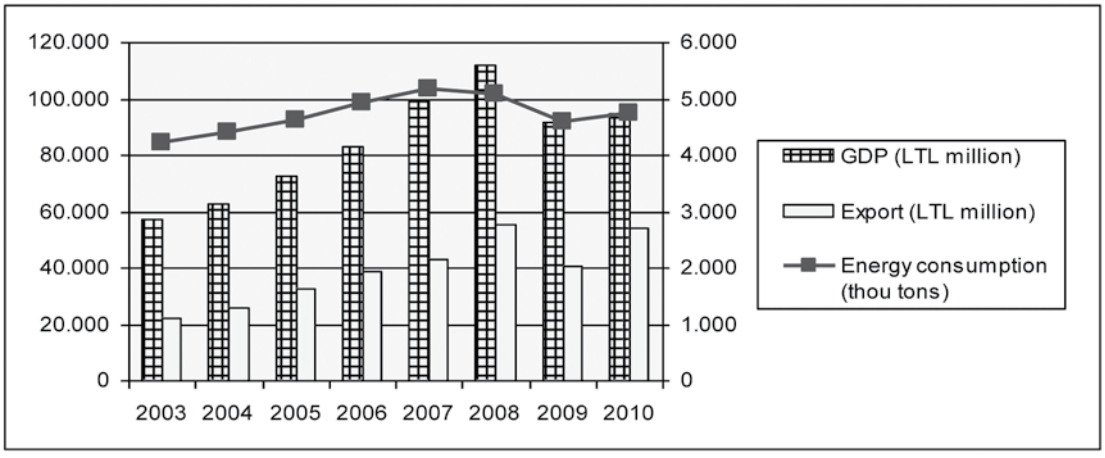

Fig. 1. Lithuania's GDP, export and energy consumption

Source: World Bank, gasbuddy.com

The results of correlation analysis are presented in Table 1.

Table 1. Correlation and their statistical significance

	GDP and Energy Consumption	Export and Energy Consumption
Correlation Coefficient, r	0,86	0,78
Coefficient of Determination, R^2	0,74	0,61

When correlation coefficients are positive, if values of one factor increase, values of another factor also increase. Energy consumption and GDP, energy consumption and export respectively have correlation coefficients of 0.86 and 0.78, respectively. This indicates the presence of a strong correlation. The significance of it is proved or denied by the stochastic dependence, the prerequisite of which, for the correlation to be significant. Both cases satisfy this condition. Coefficient of determination (R^2) indicates that about 70 percent of GDP variance is explained by the dynamics of energy consumption, and about 60 percent Lithuania's export is affected by energy consumption. The research confirmed the two hypotheses saying that there is a direct correlation between energy consumption and GDP and between energy consumption and export; however, energy has rather more influence upon the Lithuania's economic growth than upon competitiveness which is reflected by export. This is confirmed by the coefficients of determination.

The interdependence of dynamics of energy prices and export in separate industries will be examined next.

The research showed that energy consumption has an effect on export volumes. Life shows that energy dependence increases energy prices, and high prices may become a limiting factor for the competitiveness of enterprises. How energy prices affect exporting sectors will be analyzed next. Average prices of energy resources between the years 2003-2011 will be used for the research. The prices of gas and electricity are the prices paid by the companies for the energy consumption, the price of oil – the average world oil price (Fig.2 and Fig.3).

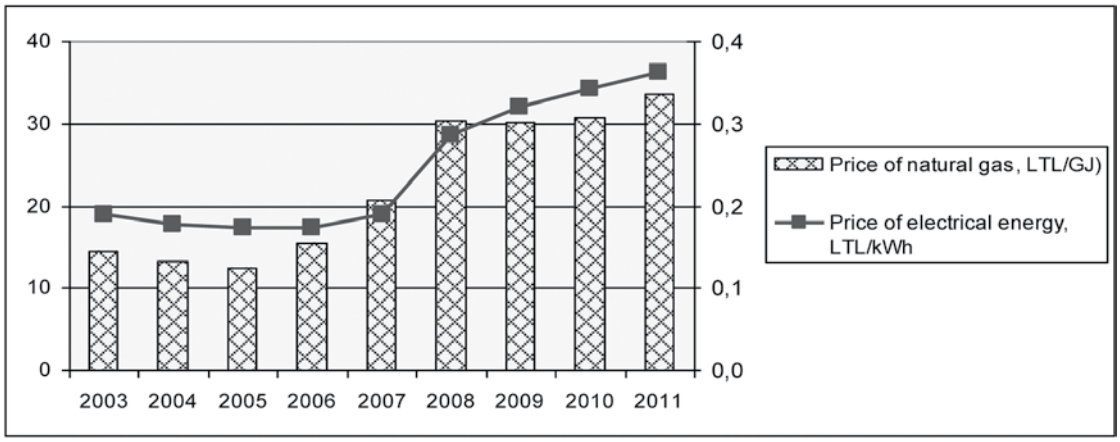

Fig. 2. Prices of natural gas and electricity

Source: World Bank

Three commodity groups were selected for the research that accounted for the largest share of Lithuania's export in 2011: mineral products (25.58 percent), machinery and equipment, including nuclear reactors (10.33 percent), chemical products (9.24 percent) (Fig. 3).

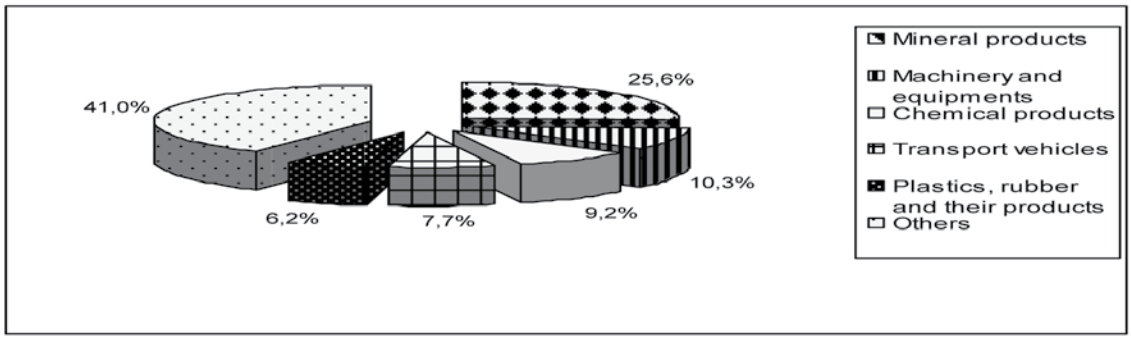

Fig. 3. Export structure by commodity groups in 2011

Source: Statistical Yearbook of Lithuania

The export of mineral products in the past nine years fluctuated. During the years 2003-2006 the export of these products was increasing while in 2007 it decreased significantly. In 2008 it increased more than twice, but in 2009 the export reduced whereas between 2010-2011 a significant rise can be observed (Fig.4).

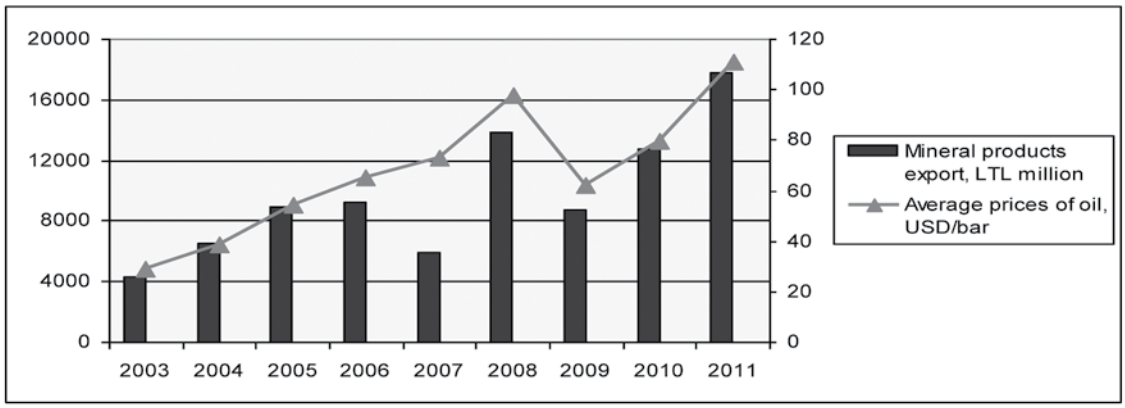

Fig.4. The export of mineral products and average price of oil

Source: Statistical Yearbook of Lithuania, gasbuddy.com

If energy prices increase, the value of mineral exports also increases. After the correlation analysis, the results showed that there is a correlation between the mineral exports and the prices of natural gas, electricity and oil. The strongest correlation of mineral exports can be observed in relation to the average oil prices (correlation coefficient of 0.90) (Table 2). A high correlation coefficient is determined by the fact that the higher the price of oil in the world is, the higher the prices of Lithuania's exports are.

Table 2. Correlation of export of mineral products and the prices of energy resources

	Price of Electricity	Price of Natural Gas
Correlation Coefficient	0,80	0,82
Coefficient of Determination, R^2	0,64	0,67

The stochastic dependency confirmed the significance of the correlations. The coefficient of determination showed that 82 percent of mineral exports is explained by the change of oil prices. The price of natural gas and electricity explains 67 percent and 64 percent of the mineral exports, respectively.

Another commodity group being analyzed is machinery and equipment. The export of this group in the period of 2003-2008 was growing consistently; however, it declined during the recession whereas in 2011 it exceeded the pre-recession level (Fig. 5).

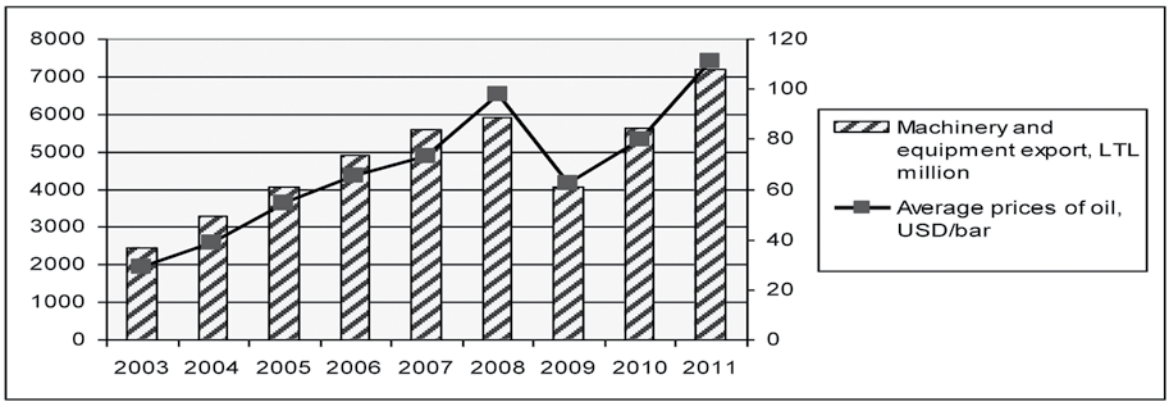

Fig. 5. The export of machinery and equipment and average price of oil

Source: Statistical Yearbook of Lithuania, gasbuddy.com

The fourth hypothesis is presented – *the export of machinery and equipment depends on the prices of natural gas, electricity and oil. The export volumes of such production reduce when energy prices rise*. The correlation coefficient indicates that there is a direct correlation between the export of machinery and equipment and energy prices (Table 3).

Table 3. Correlation of export of machinery and equipment and the prices of energy resources

	Price of Electricity	Price of Natural Gas	Price of Oil
Correlation Coefficient, r	0,72	0,78	0,97
Coefficient of Determination, R^2	0,52	0,61	0,94

A strong relationship exists between the prices of oil and the export of machinery and equipment, they have correlation coefficient of 0.97. The significance of the correlation is confirmed by the stochastic dependence; moreover, there is a significant correlation with the price of natural gas. Coefficient of determination showed that about 94 percent of the machinery and equipment exports is explained by the change of oil prices.

The correlation between the price of energy resources and the export of chemical products is further examined (Fig. 6).

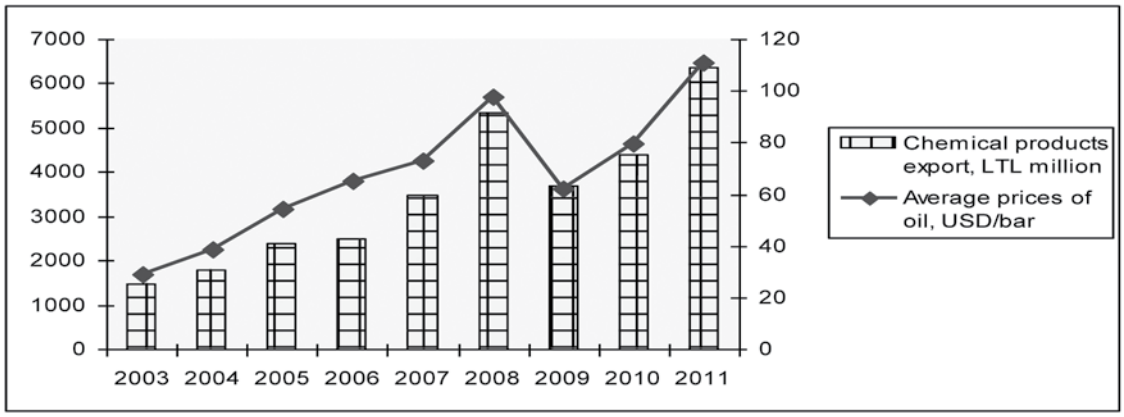

Fig. 6. The export of chemical products and average price of oil

Source: Statistical Yearbook of Lithuania, gasbuddy.com

The export of chemical products depends on the prices of natural gas, electricity and oil, the export volumes of this commodity group decline when energy prices rise. The correlation coefficient indicates the existence of a strong correlation between the export of chemical products and the prices of energy resources (Table 4). A particularly strong correlation exists between the export of chemical products and the prices of natural gas and oil. Coefficient of determination indicates that about 77 percent of chemical exports is determined by the change of oil prices while the price of natural gas affects 74 percent of it. The affect of electricity price on the export of chemical industry is less in comparison with the prices of oil and natural gas.

Table 4. Correlation of chemical exports and the prices of energy resources

	Price of Electricity	**Price of Natural Gas**	**Prices of Oil**
Correlation Coefficient, r	0,86	0,86	0,88
Coefficient of Determination, R^2	0,73	0,74	0,77

This research confirms that there is a direct correlation between the export of chemical products and the prices of energy resources, i.e. if electricity prices raise the export of chemical products increases.

This study confirms the assumption that economic growth is affected by energy consumption. A conducted correlation analysis revealed the existence of a significant correlation between energy prices and export. The research showed that energy prices and export volumes depend on each other. Thus when prices of energy resources increase, export volumes tend to increase as well, which indicates that the country's international competitiveness does not decrease because of rising energy prices.

5. Conclusions

The research results confirms hypothesis that were developed on the literature review. There are interdependency of energy consumption and economic growth, energy consumption and export. Most of the research showed that there is a close correlation among these economic factors, but causality remains an open debate. In any case, knowing the dynamics of one of the factors, the values of the other factor can be predicted with high probability.

In literature review the competitiveness of both the companies and the country is often identified with the ability to compete in the international market. It is considered that the ability of the companies to compete in the open global market is shown best by export. In many cases, there is a statistically significant relationship between economic growth and export, but some research generally denied the existence of it. The researchers conclude that the practices of different countries lead to different results.

The correlation between export and energy is interpreted differently by scientists. Previous research results provide arguments why energy consumption determines export volumes and vice versa. On the basis of these insights, we can conclude that a significant decrease in energy consumption in the industrial sector may reflect a decrease in exports, which would

cause the recession. The researchers argue that there might be a neutral relationship between energy consumption and export volumes.

The research in Lithuania's case confirmed the two hypotheses saying that there is a direct correlation between energy consumption and GDP and between energy consumption and export, but the energy has a greater impact on economic growth in Lithuania than on competitiveness which is reflected by export.

After the correlation analysis in the case of Lithuania, the results showed that there is a direct and significant correlation between the export of mineral products and the prices of natural gas, electricity and oil. The strongest correlation is noticed between the export of mineral products and the average oil prices.

The research showed that an especially strong relationship exists between the oil price and the export of machinery and equipment. About 90 percent of the export of machinery and equipment is explained by the change of oil prices and about 60 percent – by the price of natural gas. The significance of electricity price was denied by this research.

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