

## The Forecasting of the Seaport Performance Impact on Country's Economics in the Baltic Sea East Coast Region

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### Abstract

The paper scientific relevance is based on the way of understanding of seaport economics impact on state economics competition and competitive advantages of nations by M. Porter and modern tendencies of macroeconomics and geopolitical issues by P. Krugman and the measurement of economic performance and social progress by K. Aiginger. Forecasting of the impact of the seaport performance on Estonia, Latvia and Lithuania economics is based on the links of the port performance and country's macro economical indicators. To achieve the positive impact of the port performance on the country's economics, port conception must be adapting to modern market conditions and needs of the countries. According to the empirical findings it can be highlighted competitive advantages of the country.

**KEY WORDS:** *port performance, country's economics advantages*

### 1. Introduction

All economic sectors must be developed to achieve durable economic growth of the European Union (EU) and its member states. The European Commission's *Blue Growth* and *Blue Economy* initiatives stress the importance of maritime logistics, shipping, seaport sectors. As integral parts of the global logistics chain seaports provide multimodal transport services, combine the interests of domestic seaport service providers, international trade market participants, the maritime transport sector and users of port services. So it is important to analyze the impact of seaport economics at the national, international and regional level. Topics of increasing national and sectoral competitiveness and distinguishing competitive advantages are relevant in scientific discourse. Commonly competitiveness is related to international trade development, the country's productivity and ability to offer attractive infrastructure based on a dynamic cost advantage over other market players. However this study argues that the state's competitiveness is determined by the competitiveness of different economic actors. In many maritime states the growth of the maritime economy is faster than the overall economic growth, so it's important to assess the efficiency of the seaport economy and analyze its impact on the state's competitive advantage in the global market taking into account the need for an overall assessment of seaport performance, and linking port activity, economic and geopolitical factors. Research on seaport economics is underdeveloped by the state's scholars. Research models of foreign scholars are difficult to apply to domestic analysis due to scale effect as research often focuses on the problematics of global-scale seaports or specialized ports. Research on maritime trade, port economics is limited by its focus on a port, state, region; it does not cover the global logistics chain, a part of which ports are, even though in many cases ports are deemed as a multiplier for economic growth in a country or region. Analysis of the competitiveness of specific seaports does not provide its links to the state's or region's competitiveness. Integrated research on international trade (90% of which is conducted by sea in EU), which includes international and strategic marketing that are important for promoting international competitiveness, is relevant from the international competitiveness standpoint.

Scientific problem: what are the theoretical assumptions of the analysis of the impact of port economics on the country's competitive advantage, and how to assess the impact of port economics on the country's competitive advantage. The research object is the impact of port economics on the competitive advantage of the national economy. The aims of the research are (1) to define the link between the competitive advantage of the country's economy and the port's economy, based on the concepts of state competitiveness; (2) to assess the impact of port economy on the economies of the states of the EU Eastern Baltic Sea region. Research methods are analysis of scientific literature, statistical and financial analysis, pair correlation and multi-criteria regression analysis. The paper assess the impact of port economy on the country's competitive advantage by outlining the areas of the country's economy that are directly related to port economy and forecasting the impact of the key productivity indicators on the country's economy.

### 2. Link Between Port Economy and National Economy in Terms of Competitive Advantage

In many public policy statements the development of state competitiveness is associated with the benefits of economic growth, export promotion, productivity gains, and a degree of protectionism. The currently prevailing perception is that competitiveness is a macroeconomic category, which can be defined as productivity; as a share of the country's exports in the global market; as wealth creation [1, 2, 3]. Competitiveness as productivity measures it as the level of productivity of a geographical location that sustains its residents [1, 4]. The basic concept of competitiveness is the difference in productivity defined as the location's ability to create value with the available factors of production,

based on different country development levels and the difference in long-term growth rates [5]. Despite the prevailing opinion that competitiveness is a macroeconomic category, M. Porter (1990) argues that state competitiveness can also be described in terms of a microeconomic concept. The definition of a country's competitiveness as promoting structural change at the aggregate level to achieve productivity is debatable [6]. P. Krugman (1994) also did not recognize this concept calling it trivial because the country is not a single economic entity, but is made up of many competing actors. Recent research and documents shaping the EU competitiveness strategy analyze competitiveness as a complex economic phenomenon with meta-economic (global), macro- (national), meso- (regional, branch) and micro- (enterprise) levels [7]. The World Economic Forum (WEF) relies on Porter's theory of state competitiveness as the totality of institutions, policies, and factors that determine productivity. Competitiveness as an export market share is related to the geographic location that determines the nature of competition: if competition between firms is a microeconomic category, competition between firms in different countries is related to the competitiveness of the country. This implies improving the infrastructure or business environment. International trade, as measured by import and export indicators, enables companies to reap the relative advantages of each country in terms of division of labor and specialization, contributing to the economic growth and prosperity of all countries. The location gives the country a competitive advantage, yet it is seen as a specific factor of competitiveness and called a "less modern circumstance" [8, p. 115]. Unlike other strategy factors the content of the location factor does not change over time, but this does not mean that the impact on strategic goals and their realization is also constant, i.e. the location can be both an advantage and a disadvantage in the circumstances.

The concept of competitiveness is constantly supplemented by relevant insights from scientific debates: the concept, which was originally restricted to national economies, is increasingly used at other levels of geography, particularly in sub-national regions [9]; it is considered whether GDP per capita is an appropriate measure of a country's standard of living and whether its primary economic objective must be based on productivity [10]. WEF's conception of competitiveness as productivity is criticised for its uncertainty, neglect of the consequences of competition, and its narrow approach to productivity as an indicator of competitiveness, and argue that competitiveness defines at what extent companies can compete in a particular region [11]. Critical factors of competitiveness are those that also determine the level of productivity in a region compared to others. A region is a geographical location in which economic operators operate, so the definition uses the term companies in the region. The definition identifies the source of competitiveness as the critical determinants of regional competitiveness, which determine the region's productivity. It is thus recognized that economic entities are key factors for competitiveness. By this the concept of the country's competitiveness establishes a link between the macro- and the microeconomic levels and define the concept of a country's competitiveness by a combination of elements such as company, region and productivity, shaped by national institutions and policies (1).

$$\text{Competitiveness} = f(\text{company}; \text{region}; \text{productivity}; \text{institutions}; \text{policies}) \quad (1)$$

If the productivity of a port activity is expressed in the volume of freight flow resulting from the port's connection with maritime and land transport systems, changes in the flow of cargo or port activity affect the national economy, especially in the hinterland. The impact of the port economy on the state economy can be significant [12], Fig.1.

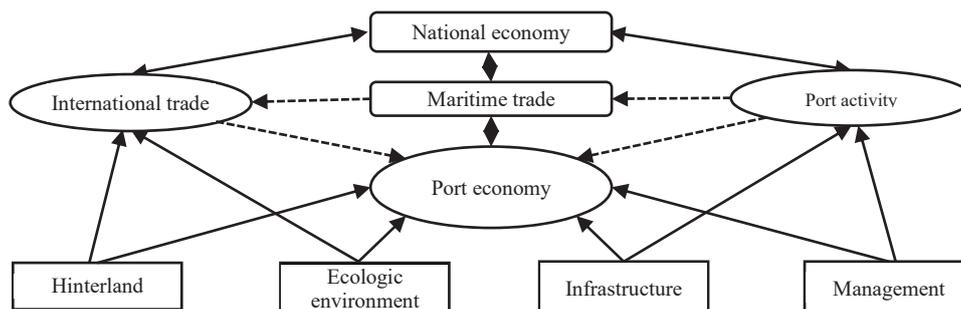


Fig. 1 Link between port economy and national economy [12]

At the macro- and megalconomic levels ports act as economic links between countries to ensure optimal movement of goods, persons and information, and facilitate international trade (Fig. 1). Based on the extent to which port economy is consistent with national and global economic trends, the country's competitive advantage makes port activities a strategic commercial policy instrument at national level. Given that a ports is a part of the logistics chain it is important to consider the port infrastructure as the ability to integrate various modes of transport. The impact of transport infrastructure on the national economy is equated with the impact of the transport sector itself on national productivity.

### 3. Research Methodology

Based on M Porter (1990) and European Commission's competitiveness measurement report [7] that define competitiveness as productivity, the state's welfare is determined by the ability of its companies to achieve high

productivity and to increase it, so when determining state competitiveness it is relevant to identify factors that increase productivity. This concept of competitiveness can be expressed as the logical multiplication of potential, advantage and position (2) [8].

$$\text{Competitiveness} = \text{Competitive potential} \wedge \text{Competitive advantage} \wedge \text{Competitive position} \quad (2)$$

At the macroeconomic level the efficiency of port economy and the differences between ports of other countries are critical factors that can affect state competitiveness and provide business prospects [13]. The research model is based on the following logic: efficient and productive port activities shape the port economy, which can be called the country's competitive potential and creates the precondition for the country to gain a competitive advantage in the areas related to the potential productivity (Fig. 2).

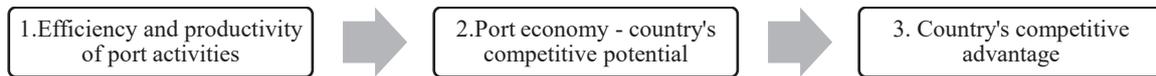


Fig. 2 Link between port (economic) competitiveness and national competitive advantage

This study distinguishes three sets of assessment indicators for assessing the performance of the main seaports in Estonia, Latvia and Lithuania: physical, productivity and operational efficiency. This is in line with the recognized methodology of the traditional UNCTAD (1976) port research methodology [14]. Seaports can be compared in terms of volume of sea cargo, and this indicator measures the productivity of the port and the overall transport sector, as well as the impact of the port economy on the country's competitive advantage. The following indicators that characterize port economy are analyzed – (a) port performance indicators: volume of cargo transported by sea transport to/from the port – total volume and by main cargo types according to the International Maritime Organization breakdown and other cargo not elsewhere classified; and (b) indicators of the interface between the port and hinterland: total inland freight traffic; other goods not included elsewhere; the volume and turnover of goods transported by road; volume and turnover of rail freight, and the country's macroeconomic indicators (GDP and exports).

In order to distinguish the impact of the Lithuanian, Latvian and Estonian ports' economy on the countries' competitive advantage by applying the correlation method, the following elements are determined and analyzed: the main indicator of port economy, cargo carried by sea, and the indicator justifying the intermodality and operations outside the port area, that is the link between volume and turnover of other transport modes and macroeconomic indicators of the country. The impact of the port economy on a country's competitive advantage is evaluated using a multi-criteria regression analysis. The selected models meet the regression analysis application conditions: data are normal, variances are equal, sample sizes are the same. This study analyzes data samples of periods 2008-2015 or 2008-2017, each consisting of 8-10 elements. Formula (3) defines the model for assessing the impact of the port economy on the national economy and competitive advantage: after calculating the values of partial criteria, summing up the product of the regressor, the values of the criteria and their significance, the dependent variable - the indicator of the national economy, which can be a competitive advantage, is calculated as value of  $Y_j$ .

$$Y_j = a + \sum_{i=1}^n (b_i \cdot x_i) + \varepsilon \quad (3)$$

where  $Y_j$  – modeled indicator of the country's economy;  $a$  – free member;  $x_i$  – independent country economic indicator, regressor: macro-environment, business environment, microeconomics, whose impact is being assessed;  $b_i$  – weighting or significance coefficient of a country's economic indicator, degree of influence determined by a set of indicators and its relation to port economy;  $i$  – the number of the economic indicator and the relevant significance coefficient;  $j$  – indicator number;  $\varepsilon$  – residuals.

#### 4. Impact of port economy on the national economy of the EU Eastern Baltic Sea region countries

Handling of cargoes such as liquid cargo ( $r=0,7; t=2,597 > t_{Sj}=2,447; p<0,05$ ) and goods carried in non-self-propelled vehicles and/or semi-trailers ( $r=0,7; t=2,597 > t_{Sj}=2,447; p<0,05$ ) have the biggest impact on the Tallinn Seaport handling rate. The flows of goods handled by rail and road transport systems have a negative impact on sea port loading figures: increasing road freight traffic may reduce this type of freight handling by ferry ( $r=-0,793; t=3,186 > t_{Sj}=2,447; p<0,05$ ); large containerized cargo flows by rail negatively impact the handling of large containers at seaport ( $r=-0,843; t=3,834 > t_{Sj}=2,447; p<0,05$ ). A statistically significant and relevant model is the model of the impact of the maritime economy on Estonia's GDP (4).

$$Y(X112, X113, X114, X115+X116) = -0,12322667 \cdot X112 - 0,20914326 \cdot X113 + 7,539043018 \cdot X114 + 0,280029324 \cdot (X115+X116) + 3651,900483 \quad (4)$$

where  $X112$  – volume of liquid cargo;  $X113$  – bulk cargo;  $X114$  – large containers;  $X115+X116$  – ro-ro cargo.

The graphical representation of the model presented in Fig. 3.

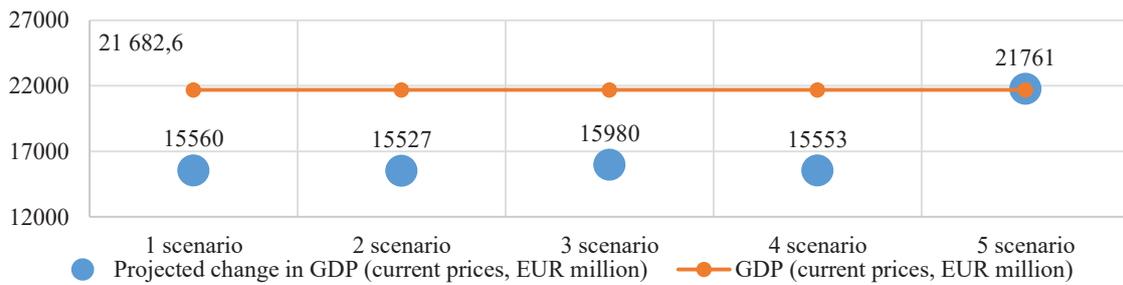


Fig. 3 Model of the impact of port economy on Estonian GDP

Based on the regression model Y, the effect of cargo volume change on GDP is estimated following the 2008-2016 freight volume trend (Fig. 3): decrease of liquid cargo volume (thou. t.) by 5,1% (1 scenario) and decrease of bulk cargo volume (thou. t.) by 4,9% (2 scenario) negatively affects the country's GDP, the impact of the increase of large container volumes (thou. t.) by 3,8% (scenario 3) is strong, positive and statistically relevant (t statistical relevance  $p=0,0004<0,05$ ); the impact of the increase of ro-ro cargo volume by 6,5% (4 scenario) is weak, yet positive. Taking into account the change and trend in cargo volume and the geopolitical, economic and port reform context of the Estonian port, the potential impact on GDP is predicted by changing the size of the cargo volume change (5 scenario) based on change in volume of all types of cargo, given the current trends: a 37% increase in bulk containers and ro-ro cargo volume, 40% decrease in liquid cargo volume, 30% decrease in bulk cargo volume are likely to increase the GDP by about 0,4%.

When analyzing the cargo flows of the Latvian maritime transport sector, the activity of the maritime transport sector is found to be dependent on the handling of bulk cargo ( $r=0,985$ ;  $t=14,107>t_{Sij}=2,447$ ;  $p<0,05$ ). This is due to the increase in the volume of chemical fertilizers produced in Belarus and exported to other markets due to competition from bulk cargo handling on the eastern coast of the Baltic Sea due to Latvia's foreign trade policy. Cargo carried by self-propelled vehicles ( $r=0,925$ ;  $t=5,973>t_{Sij}=2,447$ ;  $p<0,05$ ) and large container flows ( $r=0,852$ ;  $t=3,983>t_{Sij}=2,447$ ;  $p<0,05$ ) are statistically significant for the Latvian maritime transport sector. A weaker link exists between the flows of goods handled in the maritime transport system and those carried by non-self-propelled vehicles ( $r=0,716$ ;  $t=2,509>t_{Sij}=2,447$ ;  $p<0,05$ ). Bulk cargo handling at Latvian seaports is more closely related to bulk cargo flows by rail ( $r=0,794$ ;  $t=3,197>t_{Sij}=2,447$ ;  $p<0,05$ ) and this interface is statistically significant. A statistically significant ( $r=0,878$ ;  $t=4,492>t_{Sij}=2,447$ ;  $p<0,05$ ) impact of the seaport economy on exports model (5) has been made.

$$Y(X112, X113, X114, X115, X116, X117) = 0,011147638 \cdot X112 + 0,329792643 \cdot X113 + 1,102171161 \cdot X114 + 9,589200032 \cdot X115 + 15,42309427 \cdot X116 + 0,224633594 \cdot X117 + 929,1147905 \quad (5)$$

where: X112 – volume of liquid cargo; X113 – bulk cargo; X114 – large containers; X115 – ro-ro (self-propelled vehicles) cargo; X116 – ro-ro (non-self-propelled vehicles) cargo; X117 – other uncategorized cargo.

The graphical representation of the model presented in Fig. 4.

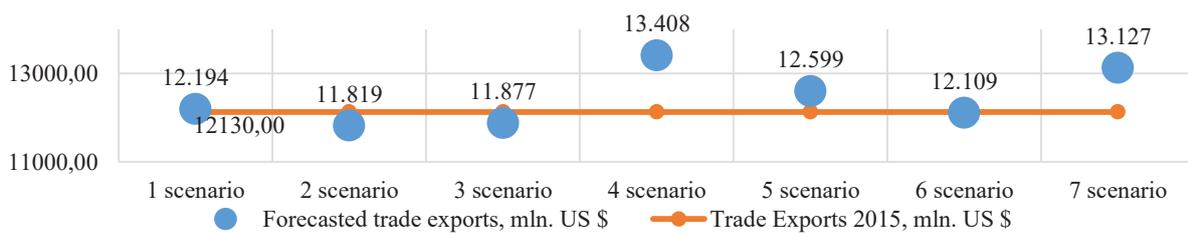


Fig. 4 Model of the impact of port economy on Latvian export trade

Based on the developed regression model Y, the effect of cargo volume change on Latvian trade exports is estimated based on the cargo volume trend of 2008-2016 (Fig. 4): the reduction of liquid cargo volume (thou. t.) by 0,7% (1 scenario) would increase trade export by 0,5%; increase of bulk cargo volume (thou. t.) by 3,6% (2 scenario) has a weak negative impact to trade export (reduces it by 3%) – this is related to bulk cargo processing technology, environmental costs and low added value; increase of large container cargo volume (thou. t.) by 7,4% (3 scenario) would reduce trade export by 1%, such cargo volume impact is increasing due to the increase of cargo volumes, reducing trade export due to significant investments in container handling equipment and container transshipment operations; the increase of ro-ro (self-propelled vehicles) volumes by 6,1% (4 scenario) increases trade export by 11%, the impact of such type of cargo is strong; increase of ro-ro (non-self-propelled vehicles) by 7,9% (5 scenario) would increase export by 4%, the impact of this type of cargo is greatest, the type of cargo implements the principle of intermodality of unaccompanied transport, therefore the handling of this cargo in ports and increase of its volume is positively evaluated in terms of sustainable development, environmental protection; the reduction of uncategorized other cargo volumes by 11,1% (6 scenario) does not impact trade export; 7 scenario related to a combination of average changes and trends in the volume of cargo carried by sea (reduction of liquid cargo volume by 2%, increase of bulk

cargo volume by 2%, increase of large container cargo volume by 8%, increase of ro-ro (self-propelled vehicles) volumes by 5%, increase of ro-ro (non-self-propelled vehicles) volumes by 10%, reduction of uncatagorized other cargo volumes by 2%) have a strong impact on trade export by increasing it by 8%.

Analyzing the structure of Lithuanian sea freight traffic in terms of the causal relationships between the types of cargo forming the cargo structure, it was found that the size of the flow of ro-ro cargo (self-propelled vehicles) ( $r=0,92$ ;  $t=5,647 > t_{Sij}=2,447$ ;  $p<0,05$ ) and bulk cargo flows ( $r=0,91$ ;  $t=5,339 > t_{Sij}=2,447$ ;  $p<0,05$ ) have the greatest impact on factors of port activities. There is a tendency for a stronger causal link between seaports and road freight transport flows ( $r=0,72$ ;  $t=2,545 > t_{Sij}=2,447$ ;  $p<0,05$ ), the relationship between rail freight flow and seaport performance is weaker and not statistically significant ( $r=0,61$ ;  $t=2,001 < t_{Sij}=2,447$ ;  $p<0,05$ ). Thus, the cargo flows through the territory of Lithuania, some of which are serviced in the seaport, are dependent on the cargo flows carried by road transport, which have a direct impact on the performance indicators of the seaport in handling bulk cargo flows by road transport ( $r=0,88$ ;  $t=4,582 > t_{Sij}=2,447$ ;  $p<0,05$ ) and large container cargo ( $r=0,91$ ;  $t=5,434 > t_{Sij}=2,447$ ;  $p<0,05$ ). A statistically significant model of the impact of the seaport economy on Lithuanian trade exports has been developed (6).

$$Y(X112, X113, X114, X115, X116, X117) = 0,11215308 \cdot X112 + 4,49344796 \cdot X113 - 7,5552782 \cdot X114 - 31,096511 \cdot X115 + 25,2087999 \cdot X116 + 2,69531351 \cdot X117 - 9488,4902 \quad (6)$$

Where:  $X112$  – volume of liquid cargo;  $X113$  – bulk cargo;  $X114$  – large container cargo;  $X115$  – ro-ro (self-propelled vehicles) cargo;  $X116$  – ro-ro (non self-propelling vehicles) cargo;  $X117$  – other uncatagorized cargo.

The graphical representation of the model presented in Fig. 5.

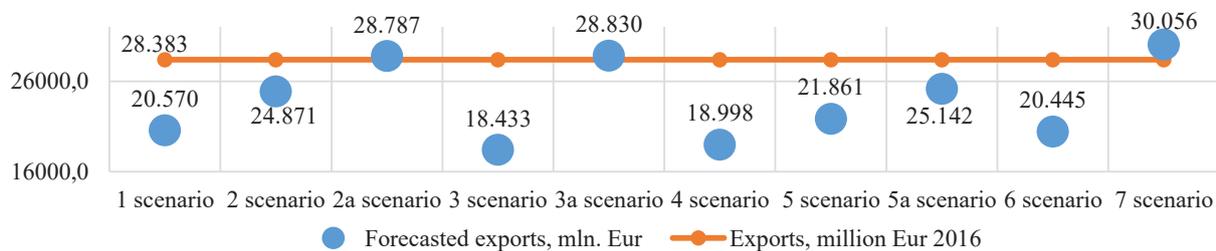


Fig. 5 Model of the impact of port economy on Lithuanian export trade

Considering the significance of the coefficients, the impact of the volume change for bulk cargo, large containers and ro-ro cargo is significant to export. Based on the developed regression model  $Y$ , the effect of cargo volume change on export is estimated based on the freight volume trends in 2008-2016 (Fig. 5): increase of liquid cargo volume (thou. t.) by 2% (1 scenario) weakly, yet negatively impacts exports, which may decrease by 28%, this is in line with the nature of this cargo line – liquid cargo is mainly fertilizers, oil and petroleum products that are in transit or imported; increase of bulk cargo volumes (thou. t.) by 5,8% (2 scenario) reduces the export by 14%, this is related to the cargo structure of Klaipeda port as fertilizers that are imported make up the part of the bulk cargo flow, whereas agricultural products exported; 2a scenario suggests that the increase of bulk cargo volumes (thou. t.) by 11% will have a positive impact on export, if the flow of bulk cargo will be formed from the output of domestic industrial enterprises; the increase of large container cargo volume (thou. t.) by 6,3% (3 scenario): the impact of large container cargo volume is negative, of average strength and statistically significant (t statistical significance  $p=0,04 < 0,05$ ) – it reduces export by 36%, this may be related to the activities of the container distribution center, which has recently focused on the storage of empty containers and the transshipment of containers from ship to ship; the decrease of large container cargo volumes by 25% (3a scenario) would increase export by 0,1%, to achieve this, the port manager needs to seek agreements with the shipping company alliance 2M for flow control of empty and overloaded containers; increase of ro-ro (self-propelled vehicles) cargo volumes by 3% (4 scenario) would decrease export by 34%, the impact of this type of cargo is negative and strong, statistically significant (Student test reliability  $p=0,019 < 0,05$ ), since ro-ro cargoes are usually consumer goods, foodstuffs, the volume of which is influenced by the increasing consumption trend, short sea shipping, etc., thus this type of cargo is imported or in transit; increase of ro-ro (non-self-propelled vehicles) cargo volumes by 4,3% reduces export by 24%, the model's coefficient is the greatest, the impact of this type of cargo is the greatest (Student test reliability  $p=0,017 < 0,05$ ); increase of ro-ro (non-self-propelled vehicles) cargo volumes by 15% (5a scenario) would increase export by 10%, such a probability is realistic as the port of Klaipeda is one of the leading in the region in terms of the volume of ro-ro cargo carried by sea; the reduction of the volume of other uncatagorized cargo by 1,5% (6 scenario) reduces export by 29%, the volume of this type of cargo is decreasing and the effect may be intensified. The impact on export is forecasted by changing the size of cargo volume (7 scenario): increase of liquid cargo volume by 20%, increase of bulk cargo volume by 20%, increase of ro-ro (self-propelled vehicles) by 8%, increase of ro-ro (non-self-propelled vehicles) by 15%, increase of volume of other uncatagorized cargo volumes by 2% would increase the export by 4,4%.

## 5. Conclusions

For the sake of the well-being of the country's population, the current concept of competitiveness is criticized for

its uncertainty. Competitiveness is expressed in terms of productivity, while productivity growth is understood as increasing competitiveness and means more efficient use of resources, which increases the return on investment that in turn determines the overall rate of economic growth. In terms of the concept of competitiveness as a global market share, strategic national entities operating in the international market, such as the transport system of which the seaport is a part, are important for the country's competitive advantage in the global market. According to the neoclassical economic concept of transport infrastructure, the natural and technical parameters of the port influence the economic indicators of the port. The country's potential for competitive advantage can be port economy, as the port infrastructure and its interconnection with transport systems cover the whole country as well as provides interconnections with other countries, it is a route from import/export, the port is adapted for freight and passenger transport, port activities generate economic value related to the country's GDP, port operations are planned and developed.

From the point of view of the port economy, in order to strengthen the competitiveness of the European macro-region on the Eastern Coast of the Baltic Sea, it is important to increase the competitiveness of Estonia, Latvia and Lithuania by taking advantage of geographical location. It is assumed that Estonian maritime and land transport systems are not mutually balanced, are not oriented towards the formation of an integral cargo logistics chain and operate independently. This may be determined by the country's geopolitical situation and strategic decisions on maritime tourism, development of passenger transportation services and short sea shipping in ports by transshipment of cargo by self- and non-self-propelled vehicles. Given the recent trend in cargo specialization in modern world ports and the steadily and rapidly increasing global trend in cargo containerization, it may be assumed that changes in the cargo flow structure of the Tallinn Seaport are in line with these trends and it is likely that in the long term Tallinn Port may become a specialized port in the region. In Latvia international and local freight flows have an integrated use of both rail and road infrastructure, depending on the geographical location of freight flows and their formation. The main cargo flow to the sea port is brought by land transport, which has a strong positive influence on the country's export and business development, therefore it is necessary to improve the road and railway transport infrastructure. Taking into account the prevailing trends of cargo flow import in Riga port and the volume and positive change of bulk cargo flow, it can be stated that Riga port may be a competitive advantage region of Latvia for bulk cargo import and/or transit sector. The activity of the Klaipeda seaport has a positive effect on the national import and export indicators – more than 64% of the import and export flows are influenced by the activities of port, that are related to the road transport system. The Lithuanian maritime transport sector is directly dependent on the flow of bulk cargo and the flow of such cargo by road, whereas the railway infrastructure is underutilized for transporting bulk cargo. Large container cargo flows serviced by road transport are significant for seaport activities.

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