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The Impact of Economic Sustainability in the Transport Sector on GDP of Neighbouring Countries: Following the Example of the Baltic States

Galina Ševčenko-Kozlovska and Kristina Čižiūnienė *

General Jonas Žemaitis Military Academy of Lithuania, LT-10322 Vilnius, Lithuania; galina.sevcenko@lka.lt
* Correspondence: kristina.ciziuniene@lka.lt

Abstract: Transport is very important for the economy and the society because good transport infrastructure helps to improve the mobility of citizens and the traffic of goods, thus ensuring economic sustainability. Background: The European Union (hereinafter—EU) plans to maintain support for the development of transport infrastructure in individual member states. Lithuania's role as a transit country in the EU's transport network is of great importance; therefore, efficient transport services and appropriate infrastructure can not only support the domestic market and economic and social growth of the country, but also promote positive economic, social, and political processes in other countries and ensure EU's strategic defence movement channels. Methods: The study was conducted using econometric methods, including correlation analysis and a regression model, to assess the selected parameters of the transport sector of Lithuania as a transit country and their impact on the real gross domestic product (hereinafter—RGDP) of the selected Baltic states (Latvia and Estonia). Results: The study identified a combination of key factors in the Lithuanian transport sector that affect differences in the level of real GDP per capita. Conclusions: The findings revealed differences in the context of relation between RGDP per capita in the three Baltic states and indicators of the Lithuanian transport sector.

Keywords: transport sector; freight flows; transport infrastructure; GDP; Baltic States

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1. Introduction

The logistics sector accounts for a significant share of gross domestic product (hereinafter—GDP), and each country is focusing on it, investing in roads, railways, ports, airports, border crossings, public logistics centres, urban logistics, and intelligent infrastructure [1].

One of the aims of the European Union's (hereinafter—EU) transport policy is to achieve that at least 50 percent of freight is carried by rail and water, for more than 300 kilometres by 2040. Countries implementing this policy are in the process of establishing public logistics centres in most strategically suitable locations of the country [1]. This is to ensure the sustainable development of transport.

Sustainable development is understood as development that meets the needs of current generations and does not harm the ability of future generations to meet their own needs. The issues of measuring the sustainable development of the economy are most widely discussed in collective scientific publications [2–13]. Although the scientific literature on the sustainable development of the economy has been widely discussed, it should be noted that there is a lack of more extensive research to assess the validity of the measurement parameters of this development, especially in the transport sector.

It must be in mind that the development of European integration, in the context of modern globalization, is leading to the transformation of European society, through the development of sustainable economic, social, cultural, technological, and environmental processes, as well as the provision of safe living conditions. Sustainable development is often associated with a sustainable transport system, due to the well-known impact of transport on the environment and society. Scientific studies [1,2,5,7,14,15] have analyzed the transport sector from different perspectives, in the context of sustainable development indicators, including positive economic, social, and political impacts, as well as the promotion of negative environmental processes.

Interest in the Baltic states, in the field of sustainable development, has originated from different perspectives. One of them is the transit function for trade with Russia and non-European Union countries (CIS).

Therefore, Kabashkin says that efforts should be taken to create more integrated and sustainable transport, warehousing, and communication links in the Baltic Sea Region (BSR). One of these efforts includes the development of logistics centres (LCs) and their and networks, which will continue to have an impact on improving communication links, spatial planning practices and methods, the development of the logistics chain, and promotion of sustainable modes of transport. These factors will reflect logistics processes in both major gateway cities and remote areas of the BSR [14].

On the other hand, such positioning allows us to assess the impact of countries on the economies of their neighbours.

Therefore, Kabashkin believes that [14] establishing a region as a key component in global logistics networks requires creating a vision on how to strategically position the region, in the context of common global logistics networks.

According to Kabashkin [14], the model of development of specific sectors in the European Union (EU) transport system is rather unbalanced, due to the following factors. First of all, the level of involvement of different countries in the transport industry differs. Secondly, this is mainly due to the model of distribution of EU's financial envelopes. Currently, one of the main priorities of EU's transport policy is the development of trans-European networks (with the possibility of extending them beyond the EU's borders), creation of global transport corridors in cooperation with other countries, development of a sustainable transport system, and economy.

The Baltic region stands out for its economically favourable geographical location in the Eurasian transport system, which connects Russia to the largest markets in Central and Eastern Europe, as well as to the Baltic and the CIS countries.

External circumstances provide the Baltic states with a unique opportunity to fulfil their mission—to be an important connecting element between the two main economic unions within the framework of the transcontinental logistics chain.

Globalization and the intense need to integrate transport systems on the Eurasian continent, including China's transport and logistics systems, pose new challenges that need to be addressed and require innovation strategies to be implemented within the interdependent international continental logistics chain.

In this case, Lithuania becomes a gateway connecting Europe and Asia to other continents. It is also noteworthy that Lithuania is positioned as a transit country, through which even two international corridors, with branches, pass. The study sought to elucidate the relationship between general transport indicators and the country's RGDP. The choice of indicators was determined by the indicators describing the development of the transport sector selected by the Department of Statistics of Lithuania (as well as the number of people injured and killed in road traffic accidents, etc.), which are collected in accordance with EU and national legislation. The values of the countries' economic (RGDP) indicators were taken from the EUROSTAT database.

One of these corridors is quite accident-prone, due to the incomplete infrastructure; therefore, we have included road accidents in our research criteria. This criterion can be considered as exceptionally new, as it has not been considered in this context in previous scientific articles.

The aim of this research is to determine how economic and the selected indicators of the transport sector of the transit country (Lithuania) impact the RGDP of its neighbouring Baltic states (Latvia and Estonia).

An analysis of the above scientific literature has revealed that the impact of the transport sector on GDP is mostly assessed through passenger flows, while freight flows are rarely analyzed by such methods—or the emerging elements of the transport sector and their impact on GDP are assessed. The novelty of this study is the new approach and the distinguished evaluation criteria that allow for the impact of the transport sector on a sustainable economy to be seen from a different angle.

The structure of this article consists of: Introduction (Section 1), Section 2 (which contains an overview of the scientific literature and a description of the choice of methodology), Section 3 (which consists of the presentation and analysis of the results obtained), and, finally, Section 4 (conclusions of the article with the intended directions of further research).

2. Methods and Methodology

The transport sector is very important for the country's economic growth—transport and its services play an important role from the very import of raw materials throughout the entire production process, ending with distribution to the end consumer; so, transportation costs are included in the cost of goods and services. In the context of globalization, a well-developed transport system ensures that the country's maximum potential is exploited. Logistics solutions must not only ensure the movement of goods and services, but also offer the most cost-effective options for that. Thus, the impact of the transport sector on the change in the country's gross domestic product is definitely significant. However, do general development indicators of the transport sector as a separate area of economy determine changes in the country's economic growth indicators and affect RGDP of the countries? These and other issues will be examined further, following this logical sequence: (1) analysis of scientific literature sources to assess the impact of the transport sector and its elements on GDP; (2) identification of Lithuania as a research object; (3) selection of the methodology and its justification.

2.1. Literature Review

Transport is a typical law of economic development. With the deepening of reforms and adjustment of the economic and industrial structure, transport volumes contributed to GDP growth to certain degrees [15].

Numerous studies reveal the same trends between transport volume and GDP [16–18]. Improving transportation can therefore improve productivity and reduce product costs [19]. Maparu and Mazumder investigate causal link between economic development, vehicle development, and urbanization development. Although different empirical methods yield conflicting results, they prove that the reciprocal promotion of different modes of transport and economic development does exist [20].

Development of the transport industry, as the main and leading factor in the country's economic and social development, determines the development trends of the economy and reflects cyclical changes in the country's economy. Freight carriage, as the backbone of the transport industry, is closely related to GDP growth [21].

In recent years, the transport infrastructure of the Baltic states has been growing steadily, along with economic and social development, freight capacity, and freight volumes, and the relation between freight transport and social economy has become ever closer. As different stages of development of freight transport correspond to different stages of economic development, this is of great practical importance for analysing the relation between the economy and transport [22]. In recent years, many domestic and foreign researchers have studied the relationship between transport and economic development, but most of these studies are qualitative [23], while some quantitative research is limited to short-term dynamic assessment [24]. There is a lack of research on the long-term equilibrium state and integrated transport system [25].

Therefore, it is important to note that there are internal and external factors in the transport system [21]:

1. Internal factors of the system include the level of technology and equipment of different modes of transport (road, rail, civil aviation, waterborne transport, size of pipelines, and new investments in fixed assets), output of the different modes of transport (transport capacity and volume, transport prices, and transport services level), and other factors [26].
2. External factors are the level of economic and social development of a country, economic structure, structure of its industry, environment of its population, its policy framework, and factors of public interest [27]. With rapid development of the economy, the demand for freight has been growing, which suggests that freight and GDP are closely related.

Therefore, this article aims to assess how the researchers' approach to key parameters of the transport sector, such as freight flows, elements of transport infrastructure, and their impact on GDP, have changed.

2.1.1. Analysis of Factors That Affect Freight Traffic and Their Impact on GDP

Every freight development process is closely related to a stage of economic development of the country.

Results of the research, conducted by Junwook, show that gross domestic product is the key factor of freight traffic between two countries, which indicates that the real revenue of trade partners is the driving force behind the bilateral freight traffic between countries [28]. However, it is important to bear in mind that the impact of bilateral exchange rates and transport costs on the level of industry and goods differs.

Freight demand is a highly volatile process, depending on the economic and industrial structure, while accurate forecasting of freight demand is the basis for transport planning. The research has shown that the growth of the economic aggregate is the main reason for the increase in the value of transport, and the change in the total consumption ratio is the main reason for the increase in freight traffic [29].

Previously, researchers thought that there is a linear relationship between freight transport demand and GDP [30–32]. However, the nature of the industry has a different impact on freight carriage intensity [33]. Alises and Vassallo [34] determined that the economic elasticity of freight carriage has been gradually declining. However, Zhang et al. [35] believe that economic factors still are the main factors that affect freight traffic. Wang et al. [36] believe that freight volumes are affected by macroeconomics, industrial structure, and supply capacity. Sun et al. [37] states that the distribution of resources and population, as well as investments in non-current assets, are the main factors that affect rail freight traffic. Moreover, supply chain management strategies, such as inventory management strategies [38–41] and replenishment strategies [42], will also have an impact on freight volumes.

Many research models have been developed, including the creation and application of transport market share models [43], transport supply chain models [44], transport supply chain models [45], and multiple regression models [46]. However, accurately predicting the growth of freight volumes is difficult in application of such methods, due to the complexity of the economic system, political–legal environment, and rapid development of the service economy.

For example, the American economist, Leontief, offered the input–output (IO) analysis method in 1925. The input–output model can analyze and investigate the quantitative dependence between the freight sector and other sectors of the economy of a country [47,48]. The IO model captures the nature of cross-industrial interactions, has relatively low data requirements, and is easy to implement [49]. Based on the expression of the effects of the cross-sectoral multiplier, the IO model allows us to describe the effects of shocks (in the economic system) on the transport system, from both the theoretical and practical perspectives [29].

Many researchers have analysed the factors that affect freight demand, but their approaches differed in essence:

1. Khan et al. [50] analysed rail freight demand in Pakistan. The research revealed that GDP and freight are the two most important drivers of demand for rail freight.
2. Wang et al. [51] analysed the relationship between freight demand and economic development. They believe that the overall development of the Chinese economy has been dissociated from the development of freight transport, while the intensity of transport has been declining.
3. Patil and Sahu [52] used regression and time series models to estimate cargo demand at Mumbai ports. This research found that GDP and crude oil extraction are the key factors that affect freight transport.
4. Alises and Vassallo [53] studied the impact of economic growth, industrial structure, and road transport intensity on the demand for freight carriage by rail. The results show that, in general, the growth in aggregate demand for road transport has mainly been driven by economic activity.
5. Wijeweera et al. [54] examined the impact of freight prices, international trade, and business cycles on the demand for rail freight in Australia. Their conducted research found that fluctuations in the freight carriage and Australian dollar exchange rates were the main factors affecting freight carriage by rail in Australia.
6. Short et al. [55] examined the relationship between Swedish economic activity and freight carriage traffic. The research found that in the short to medium term, changes in imports and exports led to significant fluctuations in freight demand; in the long-run, freight demand and GDP have been linked, and there are no signs of dissociation.
7. Robert et al. [56] identified and assessed freight demand factors. Their research revealed that the main factors were population, economic activity, fuel prices, the environment, and the policy, with the most commonly used indicators of economic activity being GDP and GDP per capita.
8. Wang et al. [57] offered a hierarchical model. The model shows that the demand for truck loads can be estimated, in terms of truck traffic, population, number of companies, and revenue.
9. Agnolucci and Bonilla [58] conducted a study on the relation between freight volume and GDP in the United Kingdom, from 1956 to 2003. Their study showed that the process of dissociation of freight volumes and GDP has become faster, and the price and revenue elasticity has also dropped to 18%.
10. Fite et al. [59] conducted a regression analysis of 107 indices related to freight transport volumes and considered the construction materials and equipment producer price index of construction materials and equipment (PCPI-CM&E) to be the most important parameter.

Many researchers have also used a variety of methods and models to predict freight volumes at the national level, including Daugherty [60], Picard and Nguyen [61], Mazzarino [62], and Regan and Garrido [63]. There are several measurement standards for freight transport, with tonnes, tonne-kilometers, and transport costs (transport costs or prices paid for transport services) being the most popular ones. The accuracy of forecasting of freight volumes depends on the classification and aggregation of data and the assessed model [64]. The most important factors affecting freight demand are consumer demand, production structure, and the trade method [65,66]. Castro-Neto et al. [67] used an online support vector regression algorithm to be able to accurately predict road traffic. Chen [68] developed a comprehensive transport network, organically combining several modes of transport, and improved the prediction accuracy of the model for choosing a trip. Ahn et al. [69] combined the Bayesian classifier and the vector regression to forecast highway traffic demand, forecasting and analysing the Korean highway freight traffic. Garrido and Mahmassani [70] developed a multinomial probit (MNP) model that predicts freight traffic, based on changes in transport time and space. Pompigna and Mauro [71] used economic data of Italy from 2000 to 2014 as a basis, using a macro input–output method for freight demand and for analysing the forecasted volume of freight in Italy in 2027.

Transport has always been and remains one of the main drivers of economic development in any country, including Lithuania. It is also widely acknowledged that transport will play a crucial role in economic development in the future, especially in a transit region such as the Baltic states. On the other hand, the growth of transport, especially road transport, has had a significant impact on congestion, safety, and pollution. The challenge for transport decision-makers is, therefore, to find the key to sustainable transport development and to reduce adverse effects of transport, in order to ensure that the transport sector remains the driving force of the economy [72]. However, transport infrastructure is becoming an important element in the implementation of this aspect.

2.1.2. Transport Infrastructure and Its Impact on the Economy

The functioning of a modern economy is inseparable from a well-developed and well-functioning transport infrastructure.

Transport infrastructure is an important driving force for integrating regional resources and promoting economic development [73] and sustainability. Empirical studies analysed the degree of its impact on the economic growth of transport sector infrastructure using the 1952–2006 time series data, such as the Chuanfeng Han causal link, in the transport infrastructure and economic growth. The results revealed that transport infrastructure has a significant stimulating impact on economic growth and that the contribution of highways to economic growth is significantly higher than that of rail transport infrastructure [74]. However, the impact of transport infrastructure on regional economic growth may be overestimated, due to the lack of spatial spill-over effects.

Based on provincial group data from 1990–2010, Wang studied the impact of transport infrastructure on economic growth using the federal model, and the results showed that transport infrastructure had a positive side effect on economic growth [75].

Zhang [76] conducted an empirical analysis of the spatial impact of transport infrastructure using the method of research of China's interprovincial data of 1993–2009 and spatial econometrics. The results showed that the impact of non-local transport infrastructure on local economic growth was mainly a positive spatial spill-over effect, but there was also evidence of negative spatial spill-over [77]. Based on new economic growth and new economic geography, taking into consideration the spatial impact of transport infrastructure and multidimensional factors that affect economic growth, Li [77] determined, based on empirical analysis, that new economic growth factors play a significant positive role in promoting the regional economic growth. Therefore, new variables in economic geography are important drivers of economic growth [77].

According to Nenavath [78], infrastructure has had a positive impact on economic growth in India in the long-run. In addition, the Granger causality test revealed a one-way link between transport infrastructure and economic development. For example, the Indian government has been recommended to focus more on the development of transport infrastructure, with a view of achieving better economic development [78].

The spatial correlation between transport infrastructure and the economy can be analysed, while the results show that there is a spatial autocorrelation between them. The paper examines the spatial model of transport infrastructure and economic growth in Dublin, while the results show that transport infrastructure has a spatial side effect on economic growth and that the economic growth has a spatial side-over effect [79].

Thus, in any case, transport infrastructure can be linked to its impact on economic sustainability.

2.1.3. Characteristics of Lithuania as a Transit Country

Lithuania is located in the center of the Baltic Sea region between the markets of the Western and Eastern Europe and is known as a country of transit and logistics services. Two international transport corridors and their branches, namely the IXB and IXD branches of the transport corridor IX (in the East-West direction) and Transport Corridor I and its branch IA (in the North-South direction), cross the territory of the country (Figure 1). All this makes Lithuania an important link in the global logistics chain, as serving East-West and North-South trade flows, making maximum use of different modes of transport and their efficient interaction [1].

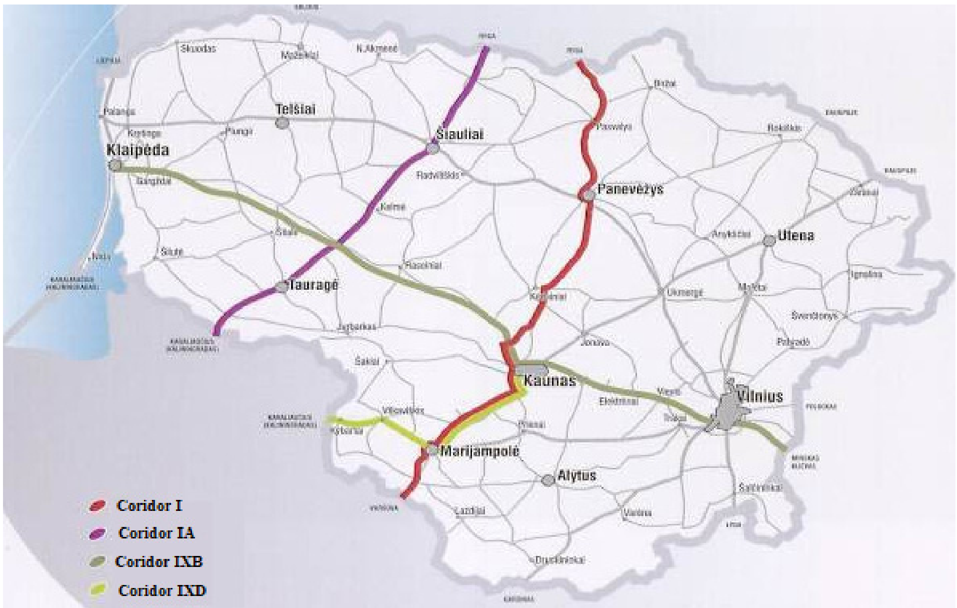

Figure 1. International corridors crossing the territory of Lithuania.

Lithuania has a very convenient geographical location offering easy access to markets of the European Union (EU) and the Commonwealth of Independent States (CIS) that have 750 million consumers. It plays an important role as a transit country in the East-West transport corridor (including the Scandinavian-Adriatic transport corridor) and has developed a well-functioning intermodal transport system [80].

The port of Klaipėda is the northernmost ice-free port on the eastern shore of the Baltic Sea and a bridge connecting the CIS, Asia, the EU, and other markets. It is a shortest distance, in terms of time, that can be reached by train from China and acts as a trampoline for Chinese companies, reaching the EU and neighbouring markets [80].

Lithuania offers an interoperable transport network of two gauges—the Russian standard gauge (1520 mm) and the European standard gauge (1435 mm) which allows reloading containers coming from the East on "Russian" gauge on "European" gauge and carrying further to Europe on new international railways Rail Baltica and a unique 30-min experience with simplified administrative cargo documentation procedures when crossing EU-CIS border [80]. This allows Lithuania to have strong positions as a transit country.

Benefits of Lithuania's transport and logistics infrastructure already made Lithuania a cargo transit gateway for Chinese business investing in infrastructure projects in Belarus. The Klaipėda Seaport already is a trampoline for Chinese business to the Baltic Sea region and CIS countries. Taking the plans for further deepening the channel and building an outer port into account, the port will also end up among the most competitive EU ports.

The Baltic states Estonia, Latvia, and Lithuania, as well as Poland, are located along strategic trade corridors of Europe, forming the EU's eastern border with Russia and other CIS countries. EU membership has led to a rapid economic growth of the Baltic states and Poland as a result of eliminated trade barriers and lower transaction costs. A large influx of EU grants was focused on the development and improvement of transport infrastructure [81].

2.2. Methodology

Correlation analysis is not typical for transport research. Several studies have been performed using this analysis method, however, most of them focused on passenger transport and correlations on the behavior of customers in this mode of transport. The aim of this research was to answer the question of whether there is any relationship between transport efficiency and investment in infrastructure in these countries; if so, is there a link between the selected countries and where this correlation occurs?

The three Baltic states—Lithuania, Latvia, and Estonia—were selected for the empirical study of the relationship between the RGRP and the main indicators of the Lithuanian transport sector. These countries have similar economic, social, ecological, cultural, and political conditions. The political, economic, and social areas of these countries have very close links. Ecological issues, European Union standards, and other challenges of climate change are highly relevant for all the countries being analysed. Therefore, they are interesting in analysing interrelationship between the countries' real GDP per capita and the Lithuanian transport sector indicators, assessing trends and forecasting prospects.

Research Questions, the Data and the Methodology Used

Representative secondary data for the 2000–2020 period were selected, in order to comprehensively analyse the relationship between the real GDP per capita of the three Baltic states Lithuania, Latvia and Estonia and the main indicators describing the Lithuania's transport sector. The real GDP per capita has been chosen because it is an indicator adjusted for inflation and reflects the country's level of economic development. This indicator shows that the lower the RGDP per capita is, the more economically poor the country's economy, as well as the more people living in the country that there are. An empirical study was conducted based on the available data and the linear regression models developed using preliminary descriptive statistics.

This study was directly related to both the search for answers and the collection of unique and useful information that can help to identify, compare, and reveal important details related to the change of indicators of the Lithuanian transport sector and the relationship with the country's real GDP per capita. The main purpose of this study was to answer the following questions:

- What indicators of the transport sector affect Lithuania's real gross domestic product per capita (the abbreviation RGDP will further be used referring to RGDP per capita)?
- What are the main indicators of the Lithuanian transport sector that affect Latvia's real gross domestic product per capita?

What are the main indicators of the Lithuanian transport sector that affect Estonia's real gross domestic product per capita?

In order to answer these questions, a statistical analysis was conducted using the IBM SPSS 27v software [82]. Moreover, the chosen automatic linear modelling technique was valuable in identifying the key components important in the change in RGDP in the three Baltic states.

Data used. Representative secondary data for the 2000–2020 period were used in the study. The values of all variables were taken from the databases of the EU's statistical office (hereinafter—Eurostat) and the Lithuanian Department of Statistics (hereinafter—LSD), which allowed conducting a comparative analysis of the data from the countries being analysed.

Our study showed that the transport sector indicators of the countries provided by Eurostat were not comprehensive enough, as some of them were included every two years; while indicators for some countries were only available from 2004–2006, etc.

The indicators of the Lithuanian transport sector obtained from the Lithuanian Department of Statistics were not detailed enough either. The period from 2000 till 2020 dominated in the data, and it turned out that some indicators were cumulative (i.e., data for 2001 were also included in the data for 2000).

Description of data. The variables selected for this study and presented in the text below were based on information from Eurostat [83] and Statistics Lithuania [84].

Based on the critical analysis of the scientific literature and the insights of previous research, in order to ensure the quality of the study, indicators required for the study were selected taking into account the available indicators of the Lithuanian transport sector, their quality and submission period.

When selecting indicators of the Lithuanian transport sector, it was important to ensure logically justified links between indicators and the country's real GDP per capita at the theoretical level. Taking all these facts into account, eleven of all general indicators available in the Lithuanian transport sector database were selected to obtain the econometric model (Table 1). In the study, these selected indicators are independent variables.

Table 1. Selected study indicators.

Code	Indicator	Unit of Measure	Source	Comments
Y	Real GDP per capita	Chain linked volumes (2010), euro per capita	EUROSTAT	Sustainable development indicator code [SDG_08_10]
X1	Carriage of freight by all modes of transport ǀ	thousand tonnes	Statistics Lithuania (LSD)	
X2	Freight turnover by all modes of transport ǀ (all modes of transport)	thousand tkm	LSD	
X3	Change in road length per year ǀ (road length (all roads))	km	LSD	
X4	Change in road length per year ǀ (length of paved roads (all roads))	km	LSD	
X5	Change in railway length per year ǀ (main roads)	km	LSD	
X6	Change in the length of inland waterways per year ǀ (inland waterways)	km	LSD	
X7	Transportation of crude oil and oil products ǀ (total by mode of transport (crude oil and oil products))	thousand tonnes	LSD	
X8	Turnover of crude oil and oil products ǀ (total by mode of transport (crude oil and oil products))	thousand tkm	LSD	
X9	Number of people injured and killed in road accidents (Republic of Lithuania/injured)	people	LSD	
X10	Number of people injured and killed in road accidents (Republic of Lithuania/killed)	people	LSD	
X11	Road accidents involving human injuries	pcs.	LSD	

The more detailed description of the indicators, which was taken from the methodology and meta-descriptions of the specific mode of transport, completely reproduces the title of the indicator, so a more detailed description was not included in the article (e.g., X1—carriage of goods by all modes of transport. Description: Movement of goods between two places (places of embarkation/loading and disembarkation/unloading) using all modes of transport).

It should be noted that Lithuania is positioned as a transit country through which as many as 2 international corridors with branches pass, and one of these corridors is quite accident-prone due to the incomplete infrastructure, therefore we have included road accidents in our research criteria. This criterion can be considered to be exceptionally new, as previous criteria have not been considered in this context in previous scientific articles.

Data modelling method using automatic linear modelling (hereinafter—ALM)**.** Regression analysis has widely been used as a powerful statistical method to examine the relationship between two or more variables being analysed. Moreover, regression analysis is a reliable statistical method for identifying, which independent variables affect a dependent variable [85]. The regression process allows for us to specifically indicate the most important regressors, regressors to be rejected, and mutual interaction of these regressors.

Traditionally, data must be sorted and ready for use before any linear modelling. Typically, linear regression modelling can be performed using a statistical package that can fit linear models and calculate different model conformity statistics [82]. Nevertheless, a typical linear modelling analysis has some limitations, such as being powerless to automatically detect and handle exceptional cases, when a gradual method cannot perform regression on all possible subsets, while the existing criteria assessments of materiality with typical Type I/II errors.

In light of limitations of the traditional regression procedure, a decision was made to use an automated linear modelling procedure included in the IBM SPSS 27v package for linear modelling, speeding up the data analysis process through several automated mechanisms.

ALM refers to a data mining approaches like Regression Trees, which utilizes a machine learning approach to find the best predictive model using the available data [86]. ALM is considered a relatively a new method, introduced in SPSS software (version 19 and up), enabling researchers to select the best subset automatically especially when there are a large number of variables [87]. In ALM, the predictor variables are automatically transformed in order to provide an improved data fit, and SPSS uses rescaling of time and other measurement values, outlier trimming, category merging and other methods for the purpose [87–89].

Statistical analysis was conducted by way of development of the automatic linear model using the RGDP as a target variable and indicators of the Lithuanian transport sector in order to find out statistically significant relations between the indicators being analysed. Standard automatic data preparation and a 0.95 confidence level were used, subsequently choosing a step-by-step model selection technique procedure [85] and Akaike's information criterion corrected (AICC) for the introduction or removal of regressors [82]. The summary of the main information created using model configurations of the automatic linear modelling procedure is presented in the following Section.

3. Research Results and Discussion

As previously mentioned, the main focus of this study was to analyse the relationship between RGDP and indicators of the Lithuanian transport sector. The research was performed using the IBM SPSS 27v software, and the research results focused on the variability of RGDP in 2000–2020 in the three Baltic states: Lithuania, Latvia, and Estonia. The results are presented in Sections 3.1–3.3 below.

3.1. Relation between RGDP and Indicators in the Transport Sector: Lithuania's Case

The research was started with preliminary calculations. The collected descriptive statistics helped to see the trends of the real gross domestic product per capita in Lithuania in 2000–2020 (dependent variable, Y). The 20-year period was chosen due to the availability of all the necessary data. Moreover, eleven variables in the transport sector were distinguished and included in the study as independent variables.

Preliminary analysis showed that the (variable Y) ranged from EUR 5230.00 to EUR 14,050.00, with an average for that period being EUR 9781.4286. Table 2 shows the descriptive results of the statistical analysis of the dependent variable (Y), together with eleven independent variables.

Table 2. Results of a descriptive analysis of the dataset collected for the Lithuanian case study.

Descriptive Statistics									
Code	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Y	21	5230.00	14,050.00	9781.4286	2686.04968	−0.057	0.501	−0.894	0.972
X1	21	105,845.60	178,390.30	132,680.5810	19,959.80521	1.147	0.501	0.855	0.972
X2	21	20,149,249.00	71,374,829.00	39,307,555.2857	14,291,203.21690	1.030	0.501	0.555	0.972
X3	21	−486.00	1745.00	488.6190	593.67765	0.125	0.501	−0.373	0.972
X4	21	−808.00	992.00	196.3810	484.34879	−0.312	0.501	0.166	0.972
X5	21	−245.10	147.00	−11.6476	66.50451	−1.722	0.501	9.060	0.972
X6	21	−16.00	37.00	3.0000	10.92703	1.551	0.501	4.235	0.972
X7	21	9373.10	35,626.60	18,330.7571	7744.82728	1.009	0.501	−0.405	0.972
X8	21	209,342.00	5,084,778.00	1,744,537.2381	1,866,047.52181	0.927	0.501	−1.025	0.972
X9	21	3193.00	8467.00	5368.3333	1947.99082	0.452	0.501	−1.676	0.972
X10	21	173.00	773.00	439.3810	239.81544	0.322	0.501	−1.807	0.972
X11	21	2817.00	6772.00	4458.2381	1506.02875	0.416	0.501	−1.769	0.972
Valid N (listwise)	21								

Given that this study focused on the relationship between the RGDP (Y) and eleven Lithuanian transport indicators, discussing and comparing the RGDP and selected indicators is important.

Table 2 shows that the average RGDP is EUR 9781.43 and changed from EUR 5230 to EUR 14,050 per capita, since 2000.

The functioning of the country's economy is not possible without a change in the developed and well-functioning transport infrastructure and its components—change in freight turnover, length of roads, rail length, etc. Freight transport by all modes of transport (X1) ranged from 105,845.60 to 178,390.30, and in 2000–2020, it changed by an average of 132,680.6 thousand tons; freight turnover by all modes of transport (X2) during the 21 years under review changed from 20,149,249 to 71,374,829 thousand tkm; a change in the length of roads (all roads (X3)) changed from 486 to 1745 km during the analysed period (average—488.6190); the length of railways during the (X5) ranged from 245.10 to 147 km. Such great results are a consequence of economic, political, and social decisions of the Lithuanian government. A change in several other indicators should also be mentioned, including a change in the number of people injured and killed in road accidents (injured (X9)) decreased from 8467 to 3193 persons during the analysed period, and the number of people injured and killed in road accidents (killed X10)—from 773 (in 2005) to 173. This can be attributed to significant investments in road transport infrastructure and road safety.

Moreover, a relationship between RGDP (Y) and the eleven Lithuanian transport sector indicators was assessed. Descriptive analysis showed that some of the study variables were not normally distributed (see Table 2). Therefore, statistical rules were used to calculate Spearman's correlation coefficients between the variables that represent the Lithuanian case. Table 3 presents the results of the correlation analysis.

Table 3. Spearman's correlation (Lithuanian case).

			Correlations											
	Code		**Y**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**
Spearman's rho	Y	Correlation Coefficient	1.000	0.606 **	0.990 **	−0.516 *	−0.487 *	0.688 **	−0.575 **	−0.865 **	−0.903 **	−0.831 **	−0.862 **	−0.848 **
		Sig. (two-tailed)		0.004	0.000	0.017	0.025	0.001	0.006	0.000	0.000	0.000	0.000	0.000
	X1	Correlation Coefficient	0.606 **	1.000	0.648 **	−0.402	−0.149	0.088	−0.394	−0.387	−0.439 *	−0.242	−0.284	−0.270
		Sig. (two-tailed)	0.004		0.001	0.071	0.518	0.703	0.077	0.083	0.047	0.291	0.211	0.236
	X2	Correlation Coefficient	0.990 **	0.648 **	1.000	−0.499 *	−0.464 *	0.642 **	−0.554 **	−0.826 **	−0.864 **	−0.810 **	−0.831 **	−0.820 **
		Sig. (two-tailed)	0.000	0.001		0.021	0.034	0.002	0.009	0.000	0.000	0.000	0.000	0.000
	X3	Correlation Coefficient	−0.516 *	−0.402	−0.499 *	1.000	0.379	−0.494 *	0.296	0.570 **	0.550 **	0.274	0.348	0.307
		Sig. (two-tailed)	0.017	0.071	0.021		0.090	0.023	0.193	0.007	0.010	0.230	0.123	0.175
	X4	Correlation Coefficient	−0.487 *	−0.149	−0.464 *	0.379	1.000	−0.476 *	0.305	0.374	0.406	0.471 *	0.479 *	0.469 *
		Sig. (2–tailed)	0.025	0.518	0.034	0.090		0.029	0.179	0.095	0.067	0.031	0.028	0.032
	X5	Correlation Coefficient	0.688 **	0.088	0.642 **	−0.494 *	−0.476 *	1.000	−0.576 **	−0.723 **	−0.692 **	−0.571 **	−0.590 **	−0.606 **
		Sig. (two-tailed)	0.001	0.703	0.002	0.023	0.029		0.006	0.000	0.001	0.007	0.005	0.004
	X6	Correlation Coefficient	−0.575 **	−0.394	−0.554 **	0.296	0.305	−0.576 **	1.000	0.394	0.457*	0.306	0.332	0.357
		Sig. (two-tailed)	0.006	0.077	0.009	0.193	0.179	0.006		0.077	0.037	0.178	0.141	0.112
	X7	Correlation Coefficient	−0.865 **	−0.387	−0.826 **	0.570 **	0.374	−0.723 **	0.394	1.000	0.960 **	0.773 **	0.804 **	0.783 **
		Sig. (two-tailed)	0.000	0.083	0.000	0.007	0.095	0.000	0.077		0.000	0.000	0.000	0.000
	X8	Correlation Coefficient	−0.903 **	−0.439*	−0.864 **	0.550 **	0.406	−0.692 **	0.457*	0.960 **	1.000	0.831 **	0.874 **	0.846 **
		Sig. (two-tailed)	0.000	0.047	0.000	0.010	0.067	0.001	0.037	0.000		0.000	0.000	0.000
	X9	Correlation Coefficient	−0.831 **	−0.242	−0.810 **	0.274	0.471*	−0.571 **	0.306	0.773 **	0.831 **	1.000	0.964 **	0.992 **
		Sig. (two-tailed)	0.000	0.291	0.000	0.230	0.031	0.007	0.178	0.000	0.000		0.000	0.000
	X10	Correlation Coefficient	−0.862 **	−0.284	−0.831 **	0.348	0.479*	−0.590 **	0.332	0.804 **	0.874 **	0.964 **	1.000	0.976 **
		Sig. (two-tailed)	0.000	0.211	0.000	0.123	0.028	0.005	0.141	0.000	0.000	0.000		0.000
	X11	Correlation Coefficient	−0.848 **	−0.270	−0.820 **	0.307	0.469 *	−0.606 **	0.357	0.783 **	0.846 **	0.992 **	0.976 **	1.000
		Sig. (two-tailed)	0.000	0.236	0.000	0.175	0.032	0.004	0.112	0.000	0.000	0.000	0.000	

Note: Spearman's r correlation is significant at the * $p < 0.05$ or ** $p < 0.01$ level (two-tailed test).

A significant positive correlation was found between RGDP and the following indicators:

- Freight turnover by all modes of transport (Y and X2, $r = 0.99$, $p < 0.01$);
- Change in the length of railways per year (Y and X5, $r = 0.688$, $p < 0.01$);
- Freight carriage by all modes of transport (Y and X1, $r = 0.606$, $p < 0.01$).

Moreover, a significant negative correlation was observed between RGDP and the following:

- Turnover in crude oil and oil products (Y and X8, $r = -0.903$, $p < 0.01$);
- Transportation of crude oil and crude oil products (Y and X7, $r = -0.865$, $p < 0.01$);
- Change in the number of persons injured and killed in road traffic accidents (Y and X10, $r = -0.862$, $p < 0.01$);
- Road traffic accidents where people were injured (Y and X11, $r = -0.848$, $p < 0.01$);
- Number of people injured and killed in road accidents (injured) (Y and X9, $r = -0.831$, $p < 0.01$);
- Change in the length of inland waterways per year (Y and X6, $r = -0.575$, $p < 0.01$).

A statistically significant negative correlation was found between RGDP and 2 indicators in the transport sector:

- Change in road length per year | km (road length (all roads)) (Y and X3, $r = -0.516$, $p < 0.05$); and
- Change in road length per year | km (length of paved roads (all roads)) (Y and X4, $r = -0.487$, $p < 0.05$).

Since all independent indicators have statistically important correlations with the dependent variable, they all were used in further calculations of the automatic linear modelling (ALM).

Results of automatic linear modelling: Lithuanian case. The aim of this section is to establish the relationship between RGDP as a dependent variable (target = Y) and eleven statistically significant indicators for the transport sector that represented independent variables. Therefore, SPSS 27v software was used to conduct the automatic linear modelling (ALM) analysis.

Under the ALM procedure, automated data generation was used in this study, which allowed for avoiding shortcomings in the set of the collected data conducting an internal procedure related to transformation of target and forecasting indicators. ALM and FSR procedures helped to develop a conceptual model in order to explain a change in the Lithuanian RGDP in the 2000–2020 period. The automatic modelling covered eleven variables: X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, and X11.

The final FSR model showed sufficient accuracy, which allowed forecasting RGDP (target = Y), in the case of Lithuania, according to the two transport sector indicators (X2 and X8). Moreover, ALM was used to calculate the coefficient of determination at 0.964, which showed that these two variables accounted for 96.4% ($R2 \times 100 = 96.4\%$) of the change in the target variable, with the remaining indicators accounting for a total of 0.6%. The ALM presents the impact of the two indicators (X2 and X8) in a diagram, which helps to visualize the significance of the predicted indicator, according to the arrangement of the model variables listed from the top to the bottom, in terms of a decrease in the impact—the higher up, the more significant the impact (lower p value).

Accordingly, the ALM presents variables that were included in the model significance assessment that was assessed by conducting the ANOVA (Analysis of variance) analysis. Figure 2 illustrated the impact of the transport sector indicators (X2 and X8) on the goal = Y.

Moreover, the ALM analysis presents the results of the evaluation of the coefficients in the form of a diagram and a table. The graphical illustration of the results first shows the intercept, and then model variables are sorted by effect from the top to the bottom, reducing the importance of prediction. The colour of the connecting lines in the diagram represents the sign and the weight of the coefficient, according to the significance of the coefficient. This information reveals that the intercept and one transport indicator (X2) have a plus sign, while the other transport indicator (X8) is negative (see Figure 2b). Table 4 presents detailed information about the developed FSR model.

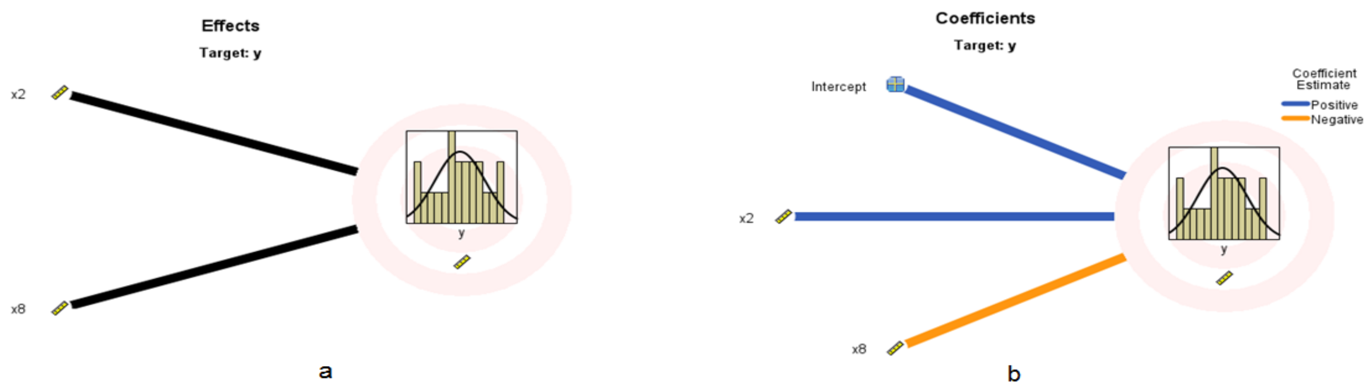

Figure 2. Visual illustration of automatic linear regression results in the case of Lithuania: (**a**) impact of sustainable development indicators (X2 and X8) on RGDP (Y); (**b**) negative and positive estimates of the coefficients calculated for the Lithuanian transport sector indicators (X2 and X8).

Table 4. Automatic linear regression model for the Lithuanian case study.

Coefficients [a]													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
2	(Constant)	5620.257	556.750		10.095	0.000	4450.570	6789.944					
	X2	0.000	0.000	0.692	11.731	0.000	0.000	0.000	0.940	0.940	0.521	0.568	1.762
	X8	−0.001	0.000	−0.378	−6.406	0.000	−0.001	0.000	−0.832	−0.834	−0.285	0.568	1.762

[a] Dependent Variable: y.

The compiled regression model can be expressed in the following equation:

$$Y = 5620 + X_2 \times 0.130 - X_8 \times 0.544, \quad (1)$$

where Y—RGDP; 5620—intercept—constant of the model; X2—freight turnover by all modes of transport; X8—turnover of crude oil and oil products.

3.2. Relation between Latvia's RGDP and Lithuania's Indicators in the Transport Sector

The preliminary analysis showed that RGDP (variable Y) ranged from 5250 to 12,530 per capita in Latvia, while the average of the 2000–2020 period was EUR 9,301.43. Table 5 illustrates these results of the descriptive statistical analysis of the dependent variable (Y) and eleven independent variables.

Moreover, a relationship between Latvian RGDP (Y) and the eleven indicators of the Lithuanian transport sector was assessed.

Spearman's correlation coefficients, which represent the Latvian case, were calculated in order to assess links between variables. Table 6 illustrates the results of the correlation analysis.

Table 5. Descriptive statistics (Latvian case).

Descriptive Statistics												
Code	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Sta-tistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Y	21	7280.00	5250.00	12,530.00	195,330.00	9301.4286	2155.17351	4,644,772.857	–0.393	0.501	–0.703	0.972
X1	21	72,544.70	105,845.60	178,390.30	2,786,292.20	132,680.5810	19,959.80521	398,393,823.869	1.147	0.501	0.855	0.972
X2	21	51,225,580.00	20,149,249.00	71,374,829.00	825,458,661.00	39,307,555.2857	14,291,203.21690	204,238,489,386,628.400	1.030	0.501	0.555	0.972
X3	21	2231.00	–486.00	1745.00	10,261.00	488.6190	593.67765	352,453.148	0.125	0.501	–0.373	0.972
X4	21	1800.00	–808.00	992.00	4124.00	196.3810	484.34879	234,593.748	–0.312	0.501	0.166	0.972
X5	21	392.10	–245.10	147.00	–244.60	–11.6476	66.50451	4422.850	–1.722	0.501	9.060	0.972
X6	21	53.00	–16.00	37.00	63.00	3.0000	10.92703	119.400	1.551	0.501	4.235	0.972
X7	21	26,253.50	9373.10	35,626.60	384,945.90	18,330.7571	7,744.82728	59,982,349.548	1.009	0.501	–.405	0.972
X8	21	4,875,436.00	209,342.00	5,084,778.00	36,635,282.00	1,744,537.2381	1,866,047.52181	3,482,133,353,670.691	0.927	0.501	–1.025	0.972
X9	21	5274.00	3193.00	8467.00	112,735.00	5368.3333	1947.99082	3,794,668.233	0.452	0.501	–1.676	0.972
X10	21	600.00	173.00	773.00	9227.00	439.3810	239.81544	57,511.448	0.322	0.501	–1.807	0.972
X11	21	3955.00	2817.00	6772.00	93,623.00	4458.2381	1506.02875	2,268,122.590	0.416	0.501	–1.769	0.972
Valid N (listwise)	21											

Table 6. Spearman's correlation (Latvian case).

			Correlations											
	Code		**Y**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**
Spearman's rho	Y	Correlation Coefficient	1.000	0.713 **	0.961 **	–0.538 *	–0.456 *	0.619 **	–0.578 **	–0.831 **	–0.873 **	–0.718 **	–0.757 **	–0.737 **
		Sig. (two-tailed)		0.000	0.000	0.012	0.054	0.003	0.006	0.000	0.000	0.000	0.000	0.000
	X1	Correlation Coefficient	0.713 **	1.000	0.648 **	–0.402	–0.149	0.088	–0.394	–0.387	–0.439*	–0.242	–0.284	–0.270
		Sig. (two-tailed)	0.000		0.001	0.071	0.518	0.703	0.077	0.083	0.047	0.291	0.211	0.236
	X2	Correlation Coefficient	0.961 **	0.648 **	1.000	–0.499 *	–0.464 *	0.642 **	–0.554 **	–0.826 **	–0.864 **	–0.810 **	–0.831 **	–0.820 **
		Sig. (two-tailed)	0.000	0.001		0.021	0.034	0.002	0.009	0.000	0.000	0.000	0.000	0.000
	X3	Correlation Coefficient	–0.538 *	–0.402	–0.499 *	1.000	0.379	–0.494 *	0.296	0.570 **	0.550 **	0.274	0.348	0.307
		Sig. (two-tailed)	0.012	0.071	0.021		0.090	0.023	0.193	0.007	0.010	0.230	0.123	0.175
	X4	Correlation Coefficient	–0.456 *	–0.149	–0.464 *	0.379	1.000	–0.476 *	0.305	0.374	0.406	0.471 *	0.479 *	0.469 *
		Sig. (two-tailed)	0.054	0.518	0.034	0.090		0.029	0.179	0.095	0.067	0.031	0.028	0.032
	X5	Correlation Coefficient	0.619 **	0.088	0.642 **	–0.494 *	–0.476 *	1.000	–0.576 **	–0.723 **	–0.692 **	–0.571 **	–0.590 **	–0.606 **
		Sig. (two-tailed)	0.003	0.703	0.002	0.023	0.029		0.006	0.000	0.001	0.007	0.005	0.004
	X6	Correlation Coefficient	–0.578 **	–0.394	–0.554 **	0.296	0.305	–0.576 **	1.000	0.394	0.457 *	0.306	0.332	0.357
		Sig. (two-tailed)	0.006	0.077	0.009	0.193	0.179	0.006		0.077	0.037	0.178	0.141	0.112
	X7	Correlation Coefficient	–0.831 **	–0.387	–0.826 **	0.570 **	0.374	–0.723 **	0.394	1.000	0.960 **	0.773 **	0.804 **	0.783 **
		Sig. (two-tailed)	0.000	0.083	0.000	0.007	0.095	0.000	0.077		0.000	0.000	0.000	0.000
	X8	Correlation Coefficient	–0.873 **	–0.439 *	–0.864 **	0.550 **	0.406	–0.692 **	0.457*	0.960 **	1.000	0.831 **	0.874 **	0.846 **
		Sig. (two-tailed)	0.000	0.047	0.000	0.010	0.067	0.001	0.037	0.000		0.000	0.000	0.000
	X9	Correlation Coefficient	–0.718 **	–0.242	–0.810 **	0.274	0.471*	–0.571 **	0.306	0.773 **	0.831 **	1.000	0.964 **	0.992 **
		Sig. (two-tailed)	0.000	0.291	0.000	0.230	0.031	0.007	0.178	0.000	0.000		0.000	0.000
	X10	Correlation Coefficient	–0.757 **	–0.284	–0.831 **	0.348	0.479*	–0.590 **	0.332	0.804 **	0.874 **	0.964 **	1.000	0.976 **
		Sig. (two-tailed)	0.000	0.211	0.000	0.123	0.028	0.005	0.141	0.000	0.000	0.000		0.000
	X11	Correlation Coefficient	–0.737 **	–0.270	–0.820 **	0.307	0.469*	–0.606 **	0.357	0.783 **	0.846 **	0.992 **	0.976 **	1.000
		Sig. (two-tailed)	0.000	0.236	0.000	0.175	0.032	0.004	0.112	0.000	0.000	0.000	0.000	

Note: Spearman's r correlation is significant at the * $p < 0.05$ or ** $p < 0.01$ level (two-tailed test).

A significant positive correlation was determined between RGDP and the following indicators:

- Freight turnover by all modes of transport (Y and X2, $r = 0.961$, $p < 0.01$);
- Change in the length of railways per year (Y and X5, $r = 0.619$, $p < 0.01$);
- Freight carriage by all modes of transport (Y and X1, $r = 0.713$, $p < 0.01$).

Moreover, a significant negative correlation was observed between RGDP and the following:

- Turnover in crude oil and oil products (Y and X8, $r = -0.873$, $p < 0.01$);
- Transportation of crude oil and crude oil products (Y and X7, $r = -0.831$, $p < 0.01$);
- Change in the number of persons injured and killed in road traffic accidents (Y and X10, $r = -0.757$, $p < 0.01$);
- Road traffic accidents where people were injured (Y and X11, $r = -0.737$, $p < 0.01$);
- Number of people injured and killed in road accidents (injured) (Y and X9, $r = -0.718$, $p < 0.01$);
- Change in the length of inland waterways per year (Y and X6, $r = -0.578$, $p < 0.01$);
- Change in road length per year | km (road length (all roads)) (Y and X3, $r = -0.538$, $p < 0.05$).

A statistically significant negative correlation was found between RGDP and one transport sector indicator, namely, the change in road length per year | km (length of paved roads (all roads)) (Y and X4, $r = -0.456$, $p < 0.05$).

Since all independent variables have statistically significant and significant correlations In *Proceedings of the* with a dependent variable, they are all used in further automatic linear modelling (ALM) calculations.

Results of the automatic linear modelling: Latvian case. This section aims to determine the relationship between the Latvian RGDP (as a dependent variable) (target = Y) and eleven statistically significant indicators of the Lithuanian transport sector that represented independent variables. SPSS 27v software was used to conduct automatic linear modelling (ALM) analysis. According to the ALM procedure, this study used automated data generation, which allowed us to avoid shortcomings in the set of the collected data and to conduct an internal procedure, related to the transformation of target and predictive indicators. ALM and FSR procedures helped to create a conceptual model to explain a change in the Latvian RGDP in the 2000–2020 period. The automatic modelling covered eleven variables: X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, and X11.

The final FSR model showed sufficient accuracy, which means that it can be used to predict RGDP (target = Y) in the Latvian case, according to two indicators of the transport sector (X7 and X1).

ALM presents the impact of two indicators (X7 and X1) in a graph (Figure 3), which helps to visualize the significance of the predicted indicator, according to the arrangement of the model variables listed from the top to the bottom, in terms of a decrease in the impact—the higher up, the more significant the impact.

The ALM also provides the variables included in the assessment of the model significance, which was assessed in the ANOVA analysis. Figure 3 illustrates the impact of the indicators of the Lithuanian transport sector (X7 and X1) on the Latvian RGDP (Y).

Moreover, the ALM analysis presents results of the evaluation of the coefficients, in the form of a diagram and a table. The graphical illustration of the results first of all shows the intercept, and then the model variables are sorted by effect from top to bottom, reducing the importance of prediction. The colours of the connecting lines in the diagram represent the sign and weight of the coefficient, according to the significance of the coefficient. This information reveals that the intercept and one transport indicator (X1) have a plus sign, while the other transport indicator (X7) is negative (see Figure 3b).

The developed regression model can be expressed in the following equation:

$$\boldsymbol{Y} = 6578 + \boldsymbol{X}_1 \times 47.51 - \boldsymbol{X}_7 \times 195.4, \quad (2)$$

where Y—Latvia's RGDP; 6578—intercept—constant of the model; X1—freight carriage by all modes of transport; X7—transportation of crude oil and oil products.

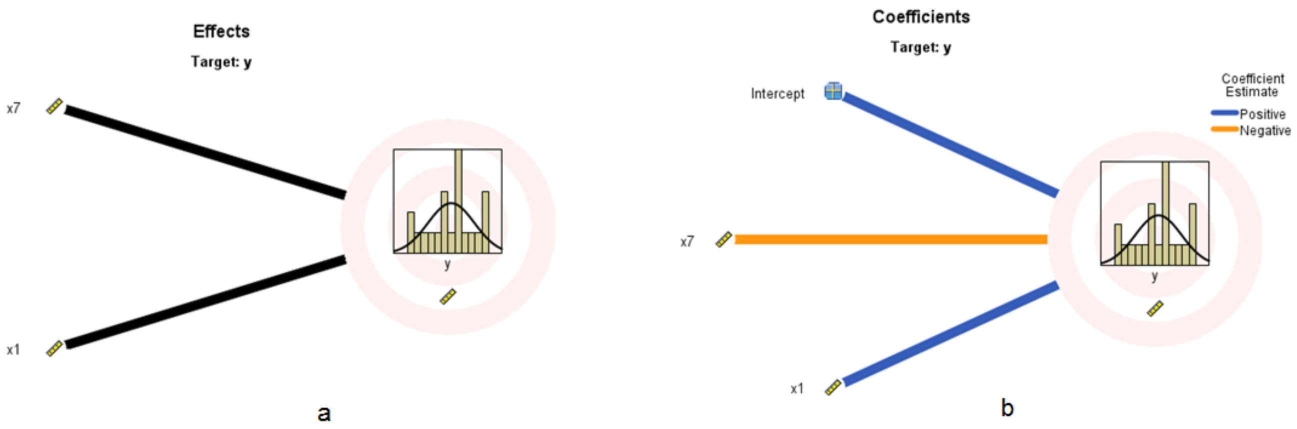

Figure 3. Visual presentation of results of the automatic linear regression in Latvian case: (**a**) impact of the transport sector indicators (X7 and X1) on RGDP (Y); and (**b**) negative and positive estimates of the coefficients calculated for the Lithuanian transport sector indicators (X1 and X7).

3.3. Relation between Estonian RGDP and Lithuania's Indicators in the Transport Sector

The preliminary analysis showed that the RGDP (variable Y) ranged from EUR 7540 to EUR 15,510 per capita, while the average for the 2000–2020 period was EUR 11,953.81. Table 7 presents these results of the descriptive statistical analysis of the dependent variable (Y) and eleven independent variables.

Moreover, a relationship between Estonian RGDP (Y) and the eleven indicators of the Lithuanian transport sector was assessed.

Spearman's correlation coefficients which represent the Estonian case were calculated, in order to assess the links between the variables. Table 8 illustrates the results of the correlation analysis.

A significant positive correlation was observed between RGDP and the following indicators:

- Freight turnover by all modes of transport (Y and X2, $r = 0.961$, $p < 0.01$);
- Change in the length of railways per year (Y and X5, $r = 0.576$, $p < 0.01$);
- Freight carriage by all modes of transport (Y and X1, $r = 0.757$, $p < 0.01$).

Moreover, a significant negative correlation was observed between RGDP and the following:

- Turnover in crude oil and oil products (Y and X8, $r = -0.873$, $p < 0.01$);
- Transportation of crude oil and oil products (Y and X7, $r = -0.792$, $p < 0.01$);
- Change in the number of persons injured and killed in road traffic accidents (Y and X10, $r = -0.726$, $p < 0.01$);
- Road traffic accidents where people were injured (Y and X11, $r = -0.704$, $p < 0.01$);
- Number of people injured and killed in road accidents (injured) (Y and X9, $r = -0.685$, $p < 0.01$);
- Change in the length of inland waterways per year (Y and X6, $r = -0.596$, $p < 0.01$).

A statistically significant negative correlation was found between RGDP and one transport sector indicator:

- Change in road length per year (length of roads (all roads)) (Y and X3, $r = -0.536$, $p < 0.05$).

Table 7. Descriptive statistics (Estonian case).

Descriptive Statistics												
Code	**N**	**Range**	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**	**Skewness**		**Kurtosis**	
	Sta-tistic	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Y	21	7970.00	7540.00	15,510.00	251,030.00	11,953.8095	2283.55529	5,214,624.762	−0.389	0.501	−0.583	0.972
X1	21	72,544.70	105,845.60	178,390.30	2,786,292.20	132,680.5810	19,959.80521	398,393,823.869	1.147	0.501	0.855	0.972
X2	21	51,225,580.00	20,149,249.00	71,374,829.00	825,458,661.00	39,307,555.2857	14,291,203.21690	204,238,489,386,628.400	1.030	0.501	0.555	0.972
X3	21	2231.00	−486.00	1745.00	10,261.00	488.6190	593.67765	352,453.148	0.125	0.501	−0.373	0.972
X4	21	1800.00	−808.00	992.00	4124.00	196.3810	484.34879	234,593.748	−0.312	0.501	0.166	0.972
X5	21	392.10	−245.10	147.00	−244.60	−11.6476	66.50451	4422.850	−1.722	0.501	9.060	0.972
X6	21	53.00	−16.00	37.00	63.00	3.0000	10.92703	119.400	1.551	0.501	4.235	0.972
X7	21	26,253.50	9373.10	35,626.60	384,945.90	18,330.7571	7744.82728	59,982,349.548	1.009	0.501	−0.405	0.972
X8	21	4,875,436.00	209,342.00	5,084,778.00	36,635,282.00	1,744,537.2381	1,866,047.52181	3,482,133,353,670.691	0.927	0.501	−1.025	0.972
X9	21	5274.00	3193.00	8467.00	112,735.00	5368.3333	1947.99082	3,794,668.233	0.452	0.501	−1.676	0.972
X10	21	600.00	173.00	773.00	9227.00	439.3810	239.81544	57,511.448	0.322	0.501	−1.807	0.972
X11	21	3955.00	2817.00	6772.00	93,623.00	4458.2381	1506.02875	2,268,122.590	0.416	0.501	−1.769	0.972
Valid N (listwise)	21											

Table 8. Spearman's correlation (Estonian case).

			Correlations											
	Code		**Y**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**
Spearman's rho	Y	Correlation Coefficient	1.000	0.757 **	0.961 **	–0.536*	–0.414	0.576 **	–0.596 **	–0.791 **	–0.837 **	–0.685 **	–0.726 **	–0.704 **
		Sig. (two-tailed)		0.000	0.000	0.012	0.062	0.006	0.004	0.000	0.000	0.001	0.000	0.000
	X1	Correlation Coefficient	0.757 **	1.000	0.648 **	–0.402	–0.149	0.088	–0.394	–0.387	–0.439*	–0.242	–0.284	–0.270
		Sig. (two-tailed)	0.000		0.001	0.071	0.518	0.703	0.077	0.083	0.047	0.291	0.211	0.236
	X2	Correlation Coefficient	0.961 **	0.648 **	1.000	–0.499*	–0.464*	0.642 **	–0.554 **	–0.826 **	–0.864 **	–0.810 **	–0.831 **	–0.820 **
		Sig. (two-tailed)	0.000	0.001		0.021	0.034	0.002	0.009	0.000	0.000	0.000	0.000	0.000
	C3	Correlation Coefficient	–0.536 *	–0.402	–0.499*	1.000	0.379	–0.494 *	0.296	0.570 **	0.550 **	0.274	0.348	0.307
		Sig. (two-tailed)	0.012	0.071	0.021		0.090	0.023	0.193	0.007	0.010	0.230	0.123	0.175
	X4	Correlation Coefficient	–0.414	–0.149	–0.464 *	0.379	1.000	–0.476 *	0.305	0.374	0.406	0.471 *	0.479 *	0.469 *
		Sig. (two-tailed)	0.062	0.518	0.034	0.090		0.029	0.179	0.095	0.067	0.031	0.028	0.032
	X5	Correlation Coefficient	0.576 **	0.088	0.642 **	–0.494 *	–0.476 *	1.000	–0.576 **	–0.723 **	–0.692 **	–0.571 **	–0.590 **	–0.606 **
		Sig. (two-tailed)	0.006	0.703	0.002	0.023	0.029		0.006	0.000	0.001	0.007	0.005	0.004
	X6	Correlation Coefficient	–0.596 **	–0.394	–0.554 **	0.296	0.305	–0.576 **	1.000	0.394	0.457 *	0.306	0.332	0.357
		Sig. (two-tailed)	0.004	0.077	0.009	0.193	0.179	0.006		0.077	0.037	0.178	0.141	0.112
	X7	Correlation Coefficient	–0.791 **	–0.387	–0.826 **	0.570 **	0.374	–0.723 **	0.394	1.000	0.960 **	0.773 **	0.804 **	0.783 **
		Sig. (two-tailed)	0.000	0.083	0.000	0.007	0.095	0.000	0.077		0.000	0.000	0.000	0.000
	X8	Correlation Coefficient	–0.837 **	–0.439 *	–0.864 **	0.550 **	0.406	–0.692 **	0.457*	0.960 **	1.000	0.831 **	0.874 **	0.846 **
		Sig. (two-tailed)	0.000	0.047	0.000	0.010	0.067	0.001	0.037	0.000		0.000	0.000	0.000
	X9	Correlation Coefficient	–0.685 **	–0.242	–0.810 **	0.274	0.471 *	–0.571 **	0.306	0.773 **	0.831 **	1.000	0.964 **	0.992 **
		Sig. (two-tailed)	0.001	0.291	0.000	0.230	0.031	0.007	0.178	0.000	0.000		0.000	0.000
	X10	Correlation Coefficient	–0.726 **	–0.284	–0.831 **	0.348	0.479 *	–0.590 **	0.332	0.804 **	0.874 **	0.964 **	1.000	0.976 **
		Sig. (two-tailed)	0.000	0.211	0.000	0.123	0.028	0.005	0.141	0.000	0.000	0.000		0.000
	X11	Correlation Coefficient	–0.704 **	–0.270	–0.820 **	0.307	0.469 *	–0.606 **	0.357	0.783 **	0.846 **	0.992 **	0.976 **	1.000
		Sig. (two-tailed)	0.000	0.236	0.000	0.175	0.032	0.004	0.112	0.000	0.000	0.000	0.000	

Note: Spearman's r correlation is significant at the * $p < 0.05$ or ** $p < 0.01$ level (two-tailed test).

Results of the automatic linear modelling: Estonian case. The aim of this section is to establish the relationship between Estonia's RGDP (as a dependent variable) (target = Y) and the eleven statistically significant indicators for the Lithuanian transport sector that represented independent variables. Therefore, SPSS 27v software was used to conduct the automatic linear modelling (ALM) analysis. Under the ALM procedure, automated data generation was used in this study, which allowed for avoiding shortcomings in the set of the collected data conducting an internal procedure related to transformation of target and forecasting indicators. The ALM and FSR procedures helped to develop a conceptual model in order to explain a change in the Lithuanian RGDP in the 2000–2020 period. The automatic modelling covered eleven variables: X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, and X11.

The ALM presents the impact of the three indicators (X2; X7 and X9) in the diagram (Figure 4). The diagram helps to illustrate the predicted indicator by model variables listed from the top to the bottom, in terms of a decrease in the impact—the higher up, the more significant the impact is.

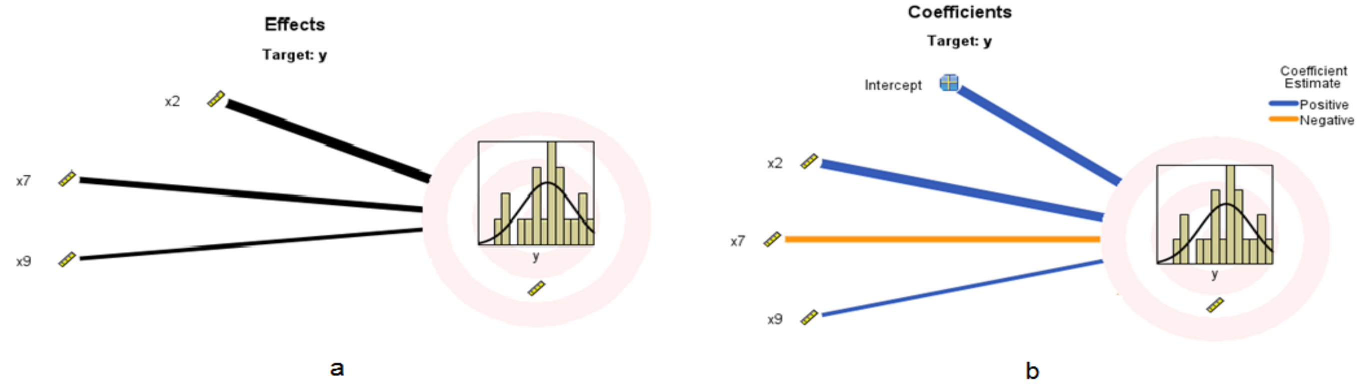

Figure 4. Visual presentation of the results of the automatic linear regression in Estonian case: (**a**) impact of the transport sector indicators (X2, X7, and X9) on Estonia's RGDP (Y); and (**b**) negative and positive estimates of the coefficients calculated for the Lithuanian transport sector indicators (X2, X7, and X9).

Accordingly, the ALM provides variables that are included in the assessment of the significance of the model in conducting the ANOVA analysis. Visualization of the impact of the indicators of the Lithuanian transport sector (X2; X7 and X9) on Estonia's RGDP (Y) is presented in Figure 4.

Moreover, the ALM analysis presents results of the evaluation of the coefficients in the form of a diagram and a table. The graphical illustration of the results first of all shows the intercept, and then the model variables are sorted by effect from top to bottom, reducing the importance of prediction. The colours of the connecting lines in the diagram represents the sign and the weight of the coefficient, according to the significance of the coefficient. This information reveals that the intercept and two Lithuanian transport indicators (X2 and X9) have a plus sign, while one transport indicator (X7) is negative (see Figure 4b).

The developed regression model can be expressed in the following equation:

$$\boldsymbol{Y} = 9197 + \boldsymbol{X}_2 \times 0.107 - \boldsymbol{X}_7 \times 175.7 + \boldsymbol{X}_9 \times 0.330, \quad (3)$$

where Y—Estonia's RGDP; 9197—intercept—constant of the model; X2—freight turnover by all modes of transport; X7—transportation of crude oil and oil products; X9—number of people injured and killed in road accidents (injured).

Transport has always been and will remain one of the main drivers of economic growth. Summarizing the results of the calculations for all three Baltic countries, it can be stated that the increasing indicators of economic prosperity, which are also significantly influenced by the sustainable development of transport, allow for moving towards balanced sustainability.

4. Conclusions

Transport sector is an important component of the economy, which can also be seen as an important tool for ensuring economic development. Lithuania's favourable geographical position and well-developed domestic road network create preconditions not only for ensuring the development of domestic transport infrastructure by maintaining excellent connections within the country, but also for promoting sustainable economic relations with neighbouring countries (Latvia and Estonia) and joining international transport networks.

An efficient transport system renders social and economic benefits, such as employment, access to different markets and investments, while inefficient transport system can result in economic expenses, reduced opportunities, and a lower quality of life.

The study identified a combination of key factors in the Lithuanian transport sector that affect differences in the level of real GDP per capita. The findings revealed differences between RGDP per capita of the three Baltic states and indicators of the Lithuanian transport sector.

In Lithuania, Latvia, and Estonia, a significant positive correlation was found between the RGDP and following indicators: freight turnover by all modes of transport; change in railway length over the year; freight transport by all modes of transport. Additionally, a statistically significant negative correlation was found: in Lithuania (between the RGDP and two indicators of the transport sector) and Latvia and Estonia (between the RGDP and one transport indicator).

Based on the analysis of the results, it was found that the regression models differ both in the intercept-model constants and variables themselves. In this regard, the turnover of cargo, in all modes of transport, coincided in Lithuania and Estonia, while the transportation of crude oil and oil products in Latvia and Estonia coincided. It should also be mentioned that, in the regression equations of Lithuania and Latvia, there were only two variables, while, in Estonia, there were three.

In the context of the study, we see that the change in the development indicators of the transport sector in Lithuania, as a transit country, has a statistically significant relationship, not only with the economic processes in Lithuania, but also with the changes in the RGDP of Latvia and Estonia.

Freight turnover in all modes of transport and turnover of crude oil and oil products in Lithuania were found to be the main factors explaining the dynamics of RGDP per capita of 96%. The results show that both independent variables had different effects on the change in RGDP. With increasing freight turnover, RGDP per capita grew in all modes of transport, while a positive change in the turnover of crude oil and oil products had a negative impact on the change in RGDP.

In Latvia, freight carriage by all modes of transport and carriage of crude oil and oil products accounted for about 94% of RGDP. The results of the study show that the increase in freight carriage, by all modes of transport, has driven RGDP up. In contrast, the carriage of crude oil and oil products reduced RGDP.

The findings of the Estonian case revealed that the turnover of freight carriage by all modes of transport, carriage of crude oil and oil products, and the number of people injured and killed in road accidents affected RGDP. This combination of factors explains approximately 94% of the dynamics of RGDP. The developed regression model shows that freight turnover in all modes of transport, as well as the increase in the number of people injured and killed in road accidents, had a positive impact on RGDP; however, dependence on crude oil and oil products reduced RGDP per capita.

Based on the insights obtained during the study, the authors assume that the change in the indicators of the Lithuanian transport sector during the period from 2000 till 2019 had a significant impact on the value of RGDP per capita of Lithuania, Latvia, and Estonia and contributed to ensuring the development of sustainable economic processes in the Baltic states under consideration.

Further research can focus on forecasting the changes of these indicators in assessing consequences of the COVID-19 pandemic, as well as the impact of policy decisions on, and in relation to, the CIS countries.

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