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A Study of the Relationship between Lithuanian International Migration Flows and Transport Sector Performance Indicators

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Abstract: Migration, emigration and immigration are processes directly related to transport and have a significant impact on the performance of this field. On the other hand, extensive movement of people inevitably relates to issues of sustainability, their assurance, etc. Migrants settle in large cities where public transport is well developed. Migrants usually commute by means other than driving their own cars (choosing public transport, walking, cycling or car sharing). Many researchers in the USA (*United States of America)* have linked this to migrants' choice of a place of residence, which are well served by public transport, as they mainly travel for work. However, with passing time and improving living standards, the need for immigrants to not only use public transport, but to also own their own, becomes similar to that of the locals. This also increases the need for the analysis of sustainable transport issues. The correlation and regression analyses used in the article and the application of the ALM (automatic linear modelling) modelling led to the following results: a significant positive correlation was found between emigration and passenger carriage by all modes of transport | Maritime transport, and a significant negative correlation was found between emigration and passenger carriage by all modes of transport | Rail transport, suggesting that these indicators have a mutually significant relationship with one another. The conducted regression analysis and applied modelling showed that the regression model was insignificant and therefore cannot be used. However, the results suggest that the relationship between immigration and transport indicators can be used as a direction for further research.

Keywords: migration; emigration; immigration; transport sector; transport sector indicators

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1. Introduction

The number of migrants as a proportion of the world's population has been remarkably stable, fluctuating at around 3% over the past 60 years [1]. Thus, a very small share of the world's population migrates. One reason for that is the fact that migration is very expensive. Large episodes of migration to rich countries, primarily reflecting the search for better economic opportunities, are nothing new in the history, having taken place even when transport costs were much higher than today. Migrants to emerging markets and developing countries account for a mere 2% of the population, with refugees accounting for the bulk of the rest. In recent years, migration has been at the forefront of political discourse in many developed countries. Opinion surveys show that the majority of residents of major destination countries (e.g., Germany, the UK (United Kingdom) and the USA) have a positive approach to immigration [2]. However, locals also have misconceptions and concerns about migration. There is a common misconception that the number of immigrants is twice as high as it actually is [3]. Concerns include increased competition for jobs in certain segments of the local labour market, higher demand for public services, potential strains on public finances and perceived threats to local cultural identity and social cohesion [4].

Migration mainly takes place in broadly defined regions of the world, such as Europe and Central Asia, where it is less constrained by the larger geographical and cultural barriers that characterise migration between continents.

Beine et al. state that migration is a choice people make based on the costs and benefits of staying at home versus moving to another country [5]. Fuchs et. al. define migration as a permanent change in a person's usual place of residence [6]. Migration forecasting is an important prerequisite for projecting population or planning in the areas that depend on the future number and structure of the population, such as economics, epidemiology, social security or infrastructure. Migration processes have a significant impact on the economy of countries, and when assessing the fact that these flows are created in areas with well-developed local urban transport, it is important to assess how the movement of these flows contributes to the development of transport-generated gross domestic product indicators. Since migration is the most volatile of all demographic components, modelling it is very difficult, although scientific articles analyse it from different perspectives [7–15]. In addition, scientists mainly assess the impact of migration on the economy and analyze which types of transport are used and for what reasons, but there is a lack of assessment of how human migration (which is also linked to emigration) and immigration influence the indicators of specific sectors (e.g., transport) of countries. From this point of view, the novelty of our article is distinguished.

It is also important to note that with increasing migration flows, sustainable development of the country's economy and transport sector must be ensured.

The aim of the article is to assess how migration, emigration and immigration affect indicators of the transport sector of a specific country.

Structure of the article: the Methods and Methodology section presents an analysis of sources of literature on the topic, justifying the problematic nature of the issue and also providing a justification for the selected research methods. The Results and Discussion section analyses the results obtained in the case of Lithuania.

2. Materials and Methods

2.1. Literature Review

The impact of international migration has been thoroughly studied by many researchers. Much of this analysis has been carried out in the context of the economic and social impact of migrants on both host and origin countries. Two specific features have been highlighted in the analysis of the impact of emigrant flows on travel by air: (1) the main impact of liberal air transport policies in facilitating emigrants' visits at home; and (2) the sensitivity of the ratio of passengers to gross domestic product (GDP). The findings of this study show that, say, in Lebanon, the fluctuations and strength of the relationship between the traffic level and GDP are neither consistent nor stable. Moreover, it was observed that the economic support of emigrants to Lebanon through cash inflows reduces the sensitivity of the relationship between passenger traffic and GDP in times of war and peace. The results should be considered as trend indicators to encourage policy makers to consider the best use of these human and financial flows [16].

There are many reasons behind international migration. Many people migrate for economic reasons, whereas others seek a more favourable social, educational, security or political environment. There is no doubt that transport, and air transport and communication services in particular, facilitate migration and help migrants to maintain close relations with their home country [17,18].

Emigrants play a significant role in the socio-economic development of both their home countries and the countries where they settle. A number of studies on the economic impact of international migration have shown how migrants contribute to the economic development of their countries of origin through investment projects, remittances and the transfer of knowledge and skills [19–21].

Global migration is expected to increase with the widening of demographic and economic disparities between developed and developing countries. As a result, international migration to industrialised countries has steadily increased, and the share of migrants in the population of industrialised countries has almost doubled in 30 years.

Obviously, migration has major economic and political consequences for both countries of origin and host countries [22–25]. Remittances made by migrants are considered an important instrument of economic development in many labour-exporting countries, a significant share of which are moving into the transport sector. As a result, transport and its development have also affected migration patterns. Technological and institutional changes in air transport seem to have an impact on a longer movement of the workforce, just like steam ships and railways that appeared in the 19th century [26] For example, the developments in air transport technology and approaches to its regulation have reduced the cost of mobility in certain markets, thus facilitating migration and family connections.

Some authors say that the distance travelled and migrants' income should be considered as key factors in determining the role of transport in transporting migrants. Today, migration mainly takes place over relatively short distances and between countries with close borders. The world's two largest single migration corridors are from Mexico to the USA and from Bangladesh to India. Due to their geographical proximity, these two crossings are mainly served by land transport [27].

Movement between developing and higher-income countries may offer more opportunities for migration mobility through air transport, which is the fastest way to connect communities. Migration routes between countries that share borders are more dependent on land transport.

The largest international migration route without sharing borders is between Turkey and Germany. The movement of Turkish nationals to Western Europe started after the end of the Second World War and increased dramatically in the early 1960s. This migration was mainly due to workforce shortages and the high salaries offered in most Western European countries at that time [28].

Air transport continued to be the most preferred mode of transport for tourists arriving to Turkey, especially for tourists travelling from Western and Eastern Europe, such as Germany, the United Kingdom and France. Migrants prefer low-cost transport when travelling between their host and home country [29].

Studies conducted by Tsang and Charlene found that migrants' travel behaviour differs from that of locals: (1) migrants settle in large cities where public transport is easily accessible; (2) migrants usually commute by means other than driving own cars (including public transport, walking, cycling or car sharing); (3) migrants are more likely to commute to and from work but less likely to travel; etc. [30]

However, the travelling of migrants has different impacts on the society, as migrants incur costs when using the transport network, but they tend to drive and travel less, so their per capita impact is lower than that of an average citizen of the country. On the other hand, the use of cars by both migrants and citizens in general costs a lot to the society, whereas using public transport makes a positive contribution.

An analysis of the types of transport used by immigrants revealed that the increasing use of public transport by migrants is multifaceted. This can be explained by the fact that migrants choose to live in areas which offer good access to public transport services and a lower level of accessibility by cars [30].

To assess whether this conclusion would apply in, say, the United Kingdom (UK), it should be noted that language barriers have been prominent in a number of studies in this country [31–33]. However, these studies have focused on lower income and less educated subgroups of migrants, who usually come from the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia or Slovenia, and thus are less likely to fit in the situation of skilled individuals [30].

The analysis of walking and cycling revealed that differences in behavioural patterns between migrants and locals diminish with increasing length of stay, whereas the higher propensity to ride a bike decreases rapidly.

The car sharing option was also found to be appealing to migrants, though their interest in it used to be less intense before, due to the limited availability of resources.

Researchers noted that the respondents had a long-term goal of owning their own car, which reflects their opinion that migrants are "agile and evolving".

Previous studies have shown that migrants' travelling habits have become increasingly more similar to those of locals. However, recently arrived migrants (regardless of their nationality) are less likely to use cars and more likely to use buses, the subway/light rail and to walk or cycle.

In summary, it can be concluded that researchers mainly [4,31,34] look at the impact of migration on the economy, analysing the modes of transport migrants use and the reasons behind their choice; however, there is a lack of research on how human migration, which is also linked to emigration and immigration, affects performance of specific sectors (e.g., transport) of different countries.

2.2. Correlation-Regression Analysis of Indicators Reflecting International Migration Flows in Lithuania and Performance Indicators of the Country's Transport Sector

Representative secondary data for the period from 2000 to 2020 were selected in order to comprehensively investigate the relationship between Lithuania's international migration indicators, including immigration, emigration, net international migration and the main indicators describing the performance of the Lithuanian transport sector. An empirical study was carried out using the available data, and linear regression models were created on the basis of 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 uncover important details related to indicators describing the transport sector and international migration flows in Lithuania. The main objective of this study was to answer the following questions:

- Which indicators of the transport sector have an impact on Lithuania's immigration indicator?
- What are the main indicators of the Lithuanian transport sector that affect the emigration rate?
- What are the main indicators of the Lithuanian transport sector that affect the net international migration rate?

To answer these questions, a statistical analysis was carried out using IBM SPSS 27v software. Additionally, the chosen automated linear modelling method was valuable in identifying the main components that are most important for the transport sector in Lithuania. The collected characteristics of the dataset and the automatic linear modelling method described are presented in Section 3.1.

Data used

Representative secondary data for the 2000–2020 period were used in the study. The values of all variables were taken from databases of the EU Statistical Office (hereinafter–EUROSTAT) [35] and the Lithuanian Department of Statistics (hereinafter–SD) [36]. This allowed conducting a comparative analysis of the data of the areas of Lithuania being researched and their normalisation and acceptability.

Our study showed that the transport sector indicators provided by EUROSTAT were not detailed enough: some indicators were included every two years; indicators of some countries are only available from 2004–2006, etc. Many indicators that define international migration have only been available since 2009.

Indicators of the Lithuanian transport sector taken from the Lithuanian Department of Statistics were also not detailed enough. Here, data from the 2000–2020 period dominate.

One Baltic country, namely, Lithuania, was selected for the empirical study of the relationship between the main indicators of international migration flows and the Lithuanian transport sector. An analysis of the relationship between transport and the international migration flows of three countries (Lithuania, Latvia and Estonia) was planned in the initial study, but, due to a partial lack of the necessary data of Estonia and Latvia, a decision was made to stick to the Lithuanian context and the available data.

In the context of recent developments in Europe, and in the face of a conflict between the Russian Federation and Ukraine, the issue of international migration has become particularly relevant in assessing the impact of these processes on various economic areas of countries. Therefore, we believe that the study of a relationship between the processes of movement of people and the operational processes of the transport sector is of great interest and relevance, especially in the assessment of future trends and the anticipation of future prospects.

Data description

The variables chosen for this study presented below are based on information from Eurostat [35] and the Lithuanian Department of Statistics [36].

Based on a critical analysis of scientific literature and insights from the previously conducted studies, in order to ensure the quality of the study, the indicators necessary for the study were selected taking into account the available indicators of the Lithuanian transport sector, their quality (data for all indicators were taken from reliable databases: EUROSTAT and Lithuanian Department of Statistics) and the period (2000–2020). We believe that the period of data analysis covering 20 years is representative enough and will allow us to make reliable insights.

When selecting indicators describing the performance of the Lithuanian transport sector, it was important to have logically based relations between them at the theoretical level and indicators of international migration flows in Lithuania. One indicator reflecting the country's economic situation—the real gross domestic product—has been integrated into the set of indicators reflecting the performance of the transport sector. Real GDP (RGDP) is the sum of all final goods and services produced over a certain period of time (usually a year), calculated at base year (comparative) prices. The inclusion of RGDP in the set of independent indicators of the study is considered to allow for a broader analysis of a change in transport sector indicators in the context of the overall national economy.

Taking all these facts into account, seventeen indicators were selected to obtain an econometric model: the country's real gross domestic product (RGDP) and sixteen indicators from all the general indicators in the Lithuanian transport sector database (Table 1). The following selected indicators are independent variables in the study.

Three main indicators of international migration flows in Lithuania were selected: immigrants, emigrants and net international migration indicator (Table 2). All data have been taken from the LSD, as this is the only database where data for all indicators were available for the 2000–2020 period. The following selected indicators are dependent variables in the study:

Brief explanations/descriptions of the indicators used in the study are presented below.

X1—real gross domestic product (GDP) per capita [SDG_08_10]. One of the main indicators of a country's level of economic development. This indicator is calculated as the ratio of real GDP to the average population in a given year. GDP measures the value of the total final output of goods and services produced by an economy over a certain period of time. This indicator is an independent variable in the study.

X2—passenger carriage by all modes of transport | All modes of transport: the movement of passengers between two destinations (the place of embarkation and disembarkation) by means of all modes of transport (buses, shuttles and trolleybuses going on regular, special and chartered trips on local (urban and suburban), long-distance and international routes). This indicator is an independent variable in the study.

X3—Passenger turnover by all modes of transport | Thousand passenger km: an indicator of the volume of passenger transport (buses and trolleybuses), expressed in passenger kilometres, obtained by summing up the distances travelled by all passengers. This indicator is an independent variable in the study.

X4—Passenger carriage by all modes of transport | Rail transport: an indicator which shows the movement of passengers from the place of embarkation to the place of disembarkation by rail vehicles. This indicator is an independent variable in the study.

Table 1. Independent indicators used in the study.

No	Indicator	Unit of Measure	Source	Comments
X1	Real GDP per capita	Chain linked volumes (2010), euro per capita	EUROSTAT	Sustainable Development indicator code [SDG_08_10]
X2	Passenger carriage by all modes of transport | All modes of transport	thousands	Lithuanian Department of Statistics (LSD)	
X3	Passenger turnover by all modes of transport	thousand passenger km	LSD	
X4	Passenger carriage by all modes of transport | Rail transport	thousands	LSD	
X5	Passenger carriage by all modes of transport | Road transport	thousands	LSD	
X6	Passenger carriage by all modes of transport | Buses	thousands	LSD	
X7	Passenger carriage by all modes of transport | Trolleybuses	thousands	LSD	
X8	Passenger carriage by all modes of transport | Water transport	thousands	LSD	
X9	Passenger carriage by all modes of transport | Maritime transport	thousands	LSD	
X10	Passenger carriage by all modes of transport | Inland waterway transport	thousands	LSD	
X11	Passenger carriage by all modes of transport | Air transport	thousands	LSD	
X12	Freight carriage by all modes of transport | All modes of transport	thousand tonnes	LSD	
X13	Freight turnover by all modes of transport | All modes of transport	thousand tkm 1	LSD	
X14	Turnover of crude oil and petroleum products | Total by type of freight transport (crude oil and petroleum).	thousand tkm	LSD	
X15	Number of persons injured and killed in road traffic accidents | (Republic of Lithuania/injured)	persons	LSD	
X16	Number of persons injured and killed in road traffic accidents | (Republic of Lithuania/killed).	persons	LSD	
X17	Road traffic accidents where people were injured	number	LSD	

Table 2. Dependent indicators used in the study.

No	Indicator	Unit of Measure	Source	Comments
1	Immigrants	persons	LSD	
2	Emigrants	persons	LSD	
3	Net international migration indicators	1000 residents	LSD	

X5—Passenger carriage by all modes of transport | Thousand, road transport-carriage by buses, shuttles and trolleybuses going on regular, special and chartered trips on local (urban and suburban), long-distance and international routes. This indicator is an independent variable in the study.

X6—Passenger carriage by all modes of transport | Thousand, buses: an indicator showing the movement of passengers from the place of embarkation to the place of disembarkation by bus. This indicator is an independent variable in the study.

X7—Passenger carriage by all modes of transport | Thousand, trolleybuses: an indicator showing the movement of passengers from the place of embarkation to the place of disembarkation by trolleybuses. This indicator is an independent variable in the study.

X8—Passenger carriage by all modes of transport | Thousand, water transport: an indicator showing the movement of passengers from the place of embarkation to the place

of disembarkation by means of water transport. This indicator is an independent variable in the study.

X9—Passenger carriage by all modes of transport | Thousand, maritime transport: an indicator showing the movement of passengers from the place of embarkation to the place of disembarkation by means of maritime transport. This indicator is an independent variable in the study.

X10—Passenger carriage by all modes of transport | Thousand, inland waterway transport: an indicator showing the movement of passengers from the place of embarkation to the place of disembarkation by means of inland waterway transport. This indicator is an independent variable in the study.

X11—Passenger carriage by all modes of transport | Thousand, air transport: an indicator showing the movement of passengers from the place of embarkation to the place of disembarkation by means of air transport. This indicator is an independent variable in the study.

X12—Freight carriage by all modes of transport | Thousand tonnes: movement of freight between two locations (the place of loading and the place of unloading) by all modes of transport. This indicator is an independent variable in the study.

X13—Freight turnover by all modes of transport | Thousand tkm: all modes of transport are the quantity of carried freight in tonnes multiplied by the distance travelled (in kilometres). For rail transport, only the distance travelled within the national territory is taken into account. In maritime transport, the freight turnover is not calculated because most of the freight is transported between foreign ports. This indicator is an independent variable in the study.

X14—Turnover of crude oil and petroleum products | Thousand tkm (total by type of freight transport (Crude oil and petroleum)): an indicator showing any transport of crude oil or liquid petroleum products within the territory of the country by pipeline. This indicator is an independent variable in the study.

X15—Number of persons injured and killed in road traffic accidents | Persons (Republic of Lithuania/injured): persons who have sustained bodily injuries in a road traffic accident, as diagnosed by a health care institution where victims were taken (referred for help) or by a forensic expert. This indicator is an independent variable in the study.

X16—Number of persons injured and killed in road traffic accidents | Persons (Republic of Lithuania/killed): persons who died as a result of injuries sustained in a road traffic accident, either at the scene of the accident or within 30 days after a road traffic accident. This indicator is an independent variable in the study.

X17—Road traffic accidents where people were injured | Number: the number of road accidents, in a public or private territory, in which people were killed or injured, or at least one vehicle, load, road, its structures or any other property at the scene was damaged in the course of movement of a vehicle. This indicator is an independent variable in the study.

Y1—Immigrants | Persons: the number of people who have arrived to the country planning to reside at the new place of residence permanently or for 12 months at the least. This may include a foreigner with a temporary residence permit for one year or more. This indicator is a dependent variable in the study.

Y2—Emigrants | Persons: the number of persons who have moved to another country and intend to reside at the new place of residence permanently or for 12 months at the least. This indicator is a dependent variable in the study.

Y3—net international migration indicator | 1000 residents: this indicator is a dependent variable in the study.

Data simulation method using automatic linear modelling

A regression analysis is widely used as a powerful statistical technique allowing to analyse the relationship between two or more variables under consideration [37]. Moreover, a regression analysis is a reliable statistical method for identifying which independent variables affect the dependent variable [38]. Regression analysis can be used to describe the dependence of the mean values of the cause variable on the values of the cause variable

and to predict the values of the cause variable [39]. In regression analysis, all predictions are quantitative, always dealing with the problem of how the numerical values of one variable depend on the numerical values of another variable [40]. The process of running a regression allows confidently identifying the most important regressors and the regressors which can be discarded and determining how they affect each other [41].

Traditionally, before any linear modelling can be carried out, data must be managed and prepared for use. Typically, linear regression modelling can be done using a statistical package, which can apply linear models and calculate different model suitability statistics [42]. Nevertheless, a typical linear modelling analysis has some limitations, for example: it cannot automatically identify and handle exceptional cases; a gradual method cannot perform regression on all possible subsets; and the existing criteria are assessments of significance which typically have I/II type errors.

Given the limitations of the traditional regression procedure, a decision was made to use the automatic linear modelling procedure, which has been included in the IBM SPSS 27v package for linear modelling and speeds up the process of data analysis through several automatic mechanisms [43–46].

The statistical analysis was carried out by automatic linear modelling procedure using immigrants, emigrants, the net migration indicator as the target variable and the performance indicators of the Lithuanian transport sector in order to show statistically significant relationships between the indicators being analysed. Standard automatic data preparation and a confidence level of 0.95 were used. Subsequently, a forward gradual model selection technique was chosen [38] and Akaike's Information Criterion Corrected (AICC) was used in the case of regressors to be introduced and discarded [42,47]. The key information created using different configurations of models of the modelling procedure is summarised in the following section.

Study results and discussion

As previously mentioned, this study mainly focused on the relationship between Lithuania's international migration flows and indicators of the Lithuanian transport sector. The study was carried out in three directions:

1. Assessing the relationship between the number of immigrants (hereafter: immigration) and the performance indicators of the Lithuanian transport sector.
2. Assessing the relationship between the number of emigrants (hereafter: emigration) and the performance indicators of the Lithuanian transport sector.
3. Assessing the relationship between the net international migration (hereinafter: NIM) and the performance indicators of the Lithuanian transport sector.

To simplify the description of the study, abbreviated definitions have been used, calling the indicator for the number of immigrants: the immigration indicator, the indicator for the number of emigrants: the emigration indicator, and the indicator for net international migration: NIM.

The study was carried out using IBM SPSS 27v software. The study results focus on the variability of the selected indicators for Lithuania in the 2000–2020 period and are presented in Sections 3.1–3.3.

3. Results and Discussion

3.1. Relationship between Immigration and Transport Sector Performance Indicators

The study started with preliminary estimates. Descriptive statistics was used to identify trends in the number of immigrants in Lithuania in 2000–2020 (dependent variable, Y). This 20-year period was chosen because of the availability of all the necessary data. In addition, sixteen transport sector variables and one indicator reflecting the country's economy, the RGDP, were distinguished and included in the study as independent variables.

A preliminary analysis showed that (variable Y) ranged from 1510 to 43,096 individuals, with a mean of that period being 15,347.8571. Thus, the number of immigrants from 2000 to 2014 constantly increased (from 1510 to 24,294 persons). Another jump in

emigration is observed from 2018 to 2020 (from 28,914 to 43,096 persons). For many years, the majority of immigrants (on average about 82%) were returning Lithuanians. The rest are citizens of the European Union (EU) (3%) and non-EU citizens (15%). Since 2017, this trend began to change. In 2020, the share of returning Lithuanians was 48 percent, the share of EU citizens decreased to 2 percent and the share of non-EU citizens was 50 percent. Most foreigners came from Ukraine and Belarus (about 38 percent of the total number of immigrants).

It can be assumed that, since 2000, Lithuania has strengthened its economy by implementing the vision of an independent democratic country striving for EU integration, freedoms and a safe life.

Table 3 shows the results of the descriptive statistical analysis of the dependent variable (Y) along with the seventeen independent variables.

Table 3. The results of a descriptive analysis of the dataset collected for immigration and the Lithuanian transport sector.

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Y	21	1510.00	43,096.00	15,347.8571	11,868.02386	0.999	0.501	0.316	0.972
X1	21	5230.00	14,050.00	9781.4286	2686.04968	−0.057	0.501	−0.894	0.972
X2	21	235,928.00	477,126.00	408,900.0952	49,564.23648	−2.012	0.501	7.070	0.972
X3	21	2,366,613.00	6,381,049.00	4,688,822.0000	841,481.96300	−0.656	0.501	1.965	0.972
X4	21	3342.00	8852.00	5518.7143	1398.38611	0.834	0.501	0.015	0.972
X5	21	229,729.00	468,305.00	400,514.4286	48,799.71927	−2.029	0.501	7.196	0.972
X6	21	182,371.00	321,451.00	283,141.2857	31,400.61255	−1.685	0.501	4.357	0.972
X7	21	47,358.00	165,665.00	117,373.1905	31,418.32863	−0.249	0.501	−0.403	0.972
X8	21	1364.00	2949.00	2268.5714	382.13971	−0.873	0.501	1.511	0.972
X9	21	58.00	366.00	235.9048	104.76779	−0.480	0.501	−1.132	0.972
X10	21	1300.00	2890.00	2032.7143	361.76762	0.030	0.501	1.137	0.972
X11	21	97.00	1161.00	598.6190	231.39284	0.178	0.501	0.858	0.972
X12	21	105,845.60	178,390.30	132,680.5810	19,959.80521	1.147	0.501	0.855	0.972
X13	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
X14	21	209,342.00	5,084,778.00	1,744,537.2381	1,866,047.52181	0.927	0.501	−1.025	0.972
X15	21	3193.00	8467.00	5368.3333	1947.99082	0.452	0.501	−1.676	0.972
X16	21	173.00	773.00	439.3810	239.81544	0.322	0.501	−1.807	0.972
X17	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 number of immigrants (Y) and seventeen Lithuanian transport sector indicators, it is important to discuss and compare the Lithuanian immigration indicator against the other selected indicators used in this study.

Table 3 shows that the average number of immigrants is 15,347.8571. Since 2000, immigration has varied from 1510 to 43,096 persons.

A country's economy cannot function properly without a well-developed, properly functioning transport infrastructure and its components: passenger and freight carriage/turnover by all modes of transport, etc., as well as the analysis of a change in the RGDP indicator, which reflects the economy.

The RGDP (X1) has ranged from €5230.00 to €14,050.00 per capita, with an average of €9781.4286 in 2000–2020. It is noticeable that during the considered period there was a growth of RGDP, small fluctuations of which were observed only in 2008–2011 (from 10,130 to 9820 euros per inhabitant of the country), and from 2012, continuous growth of RGDP is recorded again. This shows that the political and economic decisions made by the country's leadership were correct, as a result of which the successful integration of Lithuania into the EU space took place and is ongoing, as well as the development of sustainable economic international relations that ensure the development of the country's business entities and the well-being of the population.

Passenger carriage by all modes of transport (X2) has varied from 235,928.00 to 477,126.00 thousand passenger kilometres over the 21 years under review; passenger

turnover by all modes of transport (X3) varied from 23,666,613 to 6,381,049 thousand passenger kilometres (with the average being 4,688,822). It should be noted that the indicators reflecting passenger carriage by different modes of transport: rail transport (X4); road transport (X5); buses (X6); and trolleybuses (X7) show a downward trend over the 21-year period under consideration. These changes can be assumed to be directly linked to a decline in the country's population and an increase in its own vehicle fleet. It should not be forgotten that for a long time the mentioned types of transport were physically and morally obsolete, and the business could not invest more in updating the existing fleet of vehicles without state aid. This undoubtedly had an impact on the residents' choice of whether to use public transport or, if possible, to invest in their own vehicle. We would also like to emphasize the European trends that are becoming popular in the country—sustainable, environmentally friendly solutions for movement (increasing number of cyclists, electric scooters and other alternative means of movement)—which also reduce the indicators of passenger transport by traditional means of transport.

However, the analysis of passenger carriage by water transport (X8), maritime transport (X9) and inland waterway transport (X10) revealed an upward trend (Table 3). These changes can be linked to higher investments in maritime and inland waterway infrastructure. It can also be assumed that with the strengthening of the country's economic indicators and the improvement of living conditions, more and more residents can afford to travel by water transport, as a result of which the services offered by businesses in this area also increase.

Freight carriage by all modes of transport (X12) varied from 105,845.60 to 178,390.30 thousand tonnes. It can be noted that in the period from 2008 to 2009 there was a significant decrease in the values of freight transportation (134,773.9 to 105,845.6 thousand tons), which can be related to the Russian crisis and its impact on the Lithuanian economy, but a quick reorientation to other markets made it possible to quickly restore freight transport indicators and ensure their growth, thus improving the country's gross domestic product.

Cargo turnover by all modes of transport (X13) changed from 20,149,249.00 to 71,374,829.00 thousand tkm over 21 years, and these remarkable results are the consequence of economic, political and social decisions made by Lithuanian governments.

A change in several other indicators should also be mentioned–the number of persons injured and killed in road traffic accidents (injured (X15)) decreased from 8467 to 3193 during the period under consideration, and the number of persons injured and killed in road traffic accidents (killed (X16)) also showed a steady downward trend, from 773 (in 2005) to 173. This can be attributed to large investments in road transport infrastructure and road safety.

Moreover, the relationship between immigration (Y) and the seventeen indicators of the Lithuanian transport sector was assessed. A descriptive analysis showed that some of the variables had an unusual distribution (see Table 3). Therefore, statistical rules were followed to calculate Spearman's correlation coefficients between the variables that represent the Lithuanian case. Table 4 illustrates the results of the correlation analysis.

There is a significant positive correlation between immigration and the following indicators:

- Freight turnover by all modes of transport (Y and X13, $r = 0.\ 971$, $p < 0.01$).
- RGDP (Y and X1, $r = 0.\ 958$, $p < 0.01$);
- Passenger carriage by all modes of transport | Maritime transport (Y and X9, $r = 0.848$, $p < 0.01$);
- Passenger carriage by all modes of transport (Y and X12, $r = 0.612$, $p < 0.01$).

Table 4. Spearman's correlation (relationship between immigration and the Lithuanian transport sector indicators).

			Correlations																
			Y	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**
Spearman's rho	Y	Correlation Coefficient	1.000																	
	X1	Correlation Coefficient	0.958 **	1.000																
	X2	Correlation Coefficient	−0.552 **	−0.671 **	1.000															
	X3	Correlation Coefficient	0.161	0.222	0.230	1.000														
	X4	Correlation Coefficient	−0.609 **	−0.671 **	0.545 *	−0.078	1.000													
	X5	Correlation Coefficient	−0.530 *	−0.653 **	0.999 **	0.239	0.526 *	1.000												
	X6	Correlation Coefficient	0.308	0.227	0.471 *	0.674 **	−0.058	0.495 *	1.000											
	X7	Correlation Coefficient	−0.842 **	−0.897 **	0.838 **	−0.030	0.687 **	0.822 **	−0.030	1.000										
	X8	Correlation Coefficient	0.508 *	0.464 *	0.019	0.405	−0.178	0.036	0.305	−0.231	1.000									
	X9	Correlation Coefficient	0.848 **	0.905 **	−0.604 **	0.205	−0.695 **	−0.584 **	0.331	−0.836 **	0.177	1.000								
	X10	Correlation Coefficient	0.336	0.277	0.161	0.396	−0.030	0.177	0.283	−0.075	0.952 **	−0.043	1.000							
	X11	Correlation Coefficient	0.165	0.288	0.048	0.933 **	−0.279	0.056	0.539 *	−0.136	0.308	0.310	0.262	1.000						
	X12	Correlation Coefficient	0.612 **	0.606 **	−0.178	0.440 *	−0.079	−0.168	0.416	−0.478 *	0.626 **	0.360	0.623 **	0.305	1.000					
	X13	Correlation Coefficient	0.971 **	0.990 **	−0.645 **	0.205	−0.643 **	−0.626 **	0.253	−0.891 **	0.470 *	0.887 **	0.288	0.251	0.648 **	1.000				
	X14	Correlation Coefficient	−0.822 **	−0.903 **	0.703 **	−0.217	0.716 **	0.695 **	−0.043	0.832 **	−0.425	−0.779 **	−0.243	−0.340	−0.439 *	−0.864 **	1.000			
	X15	Correlation Coefficient	−0.771 **	−0.831 **	0.825 **	0.173	0.687 **	0.813 **	0.157	0.856 **	−0.184	−0.770 **	0.017	−0.017	−0.242	−0.810 **	0.831 **	1.000		
	X16	Correlation Coefficient	−0.786 **	−0.862 **	0.849 **	0.116	0.627 **	0.842 **	0.173	0.868 **	−0.264	−0.784 **	−0.048	−0.045	−0.284	−0.831 **	0.874 **	0.964 **	1.000	
	X17	Correlation Coefficient	−0.783 **	−0.848 **	0.842 **	0.168	0.676 **	0.833 **	0.166	0.878 **	−0.196	−0.781 **	0.002	−0.012	−0.270	−0.820 **	0.846 **	0.992**	0.976 **	1.000

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). Listwise N = 21.

As we can see from Table 2, there is high significant positive correlation between immigration and X13; X1; X9 and X12. The highest positive value can be recorded between immigration and Cargo turnover by all types of transport (Y and X13, r = 0.971, $p < 0.01$). This can be explained by the significance and importance of freight turnover for the change in the country's gross domestic product and, accordingly, the values of the improving indicators of the country's economic sectors, as a result of which the country's attractiveness for possible immigration flows increases. Other important indicators with high significance are RBVP (X1), passenger transport by all types of transport, and sea transport (X9). These changes in the values of the indicators can be linked to the improvement of the well-being of the population and the greater number of trips for work and leisure purposes, as a result of which the intensification of immigration flows can be predicted. It is also important to emphasize that there are very strong positive correlations between the above-mentioned independent variables, which means that the problem of multicollinearity can be encountered when constructing regression equations.

A significant positive correlation was found between immigration and passenger carriage by all modes of transport | Water transport (Y and X8, $r = 0.508$, $p < 0.05$)

A significant negative correlation was found between immigration and the following:

- Passenger carriage by all modes of transport | All modes of transport (Y and X2, $r = -0.552$, $p < 0.01$);
- Passenger carriage by all modes of transport | Rail transport (Y and X4, $r = -0.609$, $p < 0.01$);
- Passenger carriage by all modes of transport | Trolleybuses (Y and X7, $r = -0.842$, $p < 0.01$);
- Turnover of crude oil and petroleum products | Total by type of freight transport (crude oil and petroleum) (Y and X14, $r = -0.822$, $p < 0.01$);
- Number of persons injured and killed in road traffic accidents | (Republic of Lithuania/injured) (Y and X15, $r = -0.771$, $p < 0.01$);
- Number of persons injured and killed in road traffic accidents | (Republic of Lithuania/killed) (Y and X16, $r = -0.786$, $p < 0.01$);
- Road traffic accidents where people were injured (Y and X17, $r = -0.783$, $p < 0.01$).

We would like to point out that a very strong negative relationship is established between immigration (Y) and passenger transportation by all types of transport | Trolleybuses (Y and X7, r = −0.842, $p < 0.01$). Next in importance are X14, X16, X15, X17, X4 and X2. Very strong positive correlations are recorded between the mentioned independent indicators (see Table 2).

A statistically significant negative relationship was found between immigration and passenger carriage by all modes of transport | Road transport (Y and X5, $r = -0.530$, $p < 0.05$).

No statistically significant relationships were found between immigration and the following indicators: passenger turnover by all modes of transport (X3, $p > 0.05$); passenger transport by all modes of transport | Buses (X6, $p > 0.05$); passenger transport by all modes of transport | Inland waterways (X10, $p > 0.05$); and passenger transport by all modes of transport | Air transport (X11, $p > 0.05$). These four transport sector indicators were excluded from further analysis. The subsequent automatic linear modelling (ALM) calculations included independent indicators with statistically highly significant correlations with the dependent variable.

Results of automatic linear modelling: the relationship between the indicators of immigration and transport sector performance

This section aims to establish the relationship between immigration as a dependent variable (Target = Y) and the thirteen statistically significant transport sector indicators representing independent variables. SPSS 27v software was used to this end, also conducting an automatic linear modelling (ALM) analysis.

In accordance with the ALM procedure, automatic data preparation was used in this study, which allowed avoiding shortcomings in the set of the collected data and

allowed conducting an internal procedure related to the transformation of the target and the predicting variables.

In order to maximise the predictive capacity of the developed automatic linear model and the forward stepwise regression (FSR), a conceptual model was used substantiating the need to explain the change of Lithuanian immigration for the 2000–2020 period. Automatic modelling included eleven variables: X1, X2, X4, X5, X7, X8, X9, X12, X13, X14, X15, X16 and X17.

The final FSR model showed sufficient accuracy, which means that it can predict immigration (target = Y) flows according to a single transport sector indicator (X13). Moreover, ALM was used to calculate the coefficient of determination at 0.891, which showed that this variable accounts for 89.1% (R2 × 100 = 89.1%) of the change in the target variable, with the remaining variables accounting for a total of 10.9%. Moreover, the ALM presents the effect of a single indicator (X13) in the graph, which helps to visualize the importance of the predictor based on the model variable.

Accordingly, the ALM provides variables that have been included in the model significance assessment that was assessed conducting an ANOVA analysis. The effect of the variable X13, which reflects the freight turnover of all modes of transport, was very high according to the F test (significance of FX13 = 0.839, $p < 0.00$). Figure 1 presents a visualisation of the impact of the transport sector indicators (X13) on the target = Y.

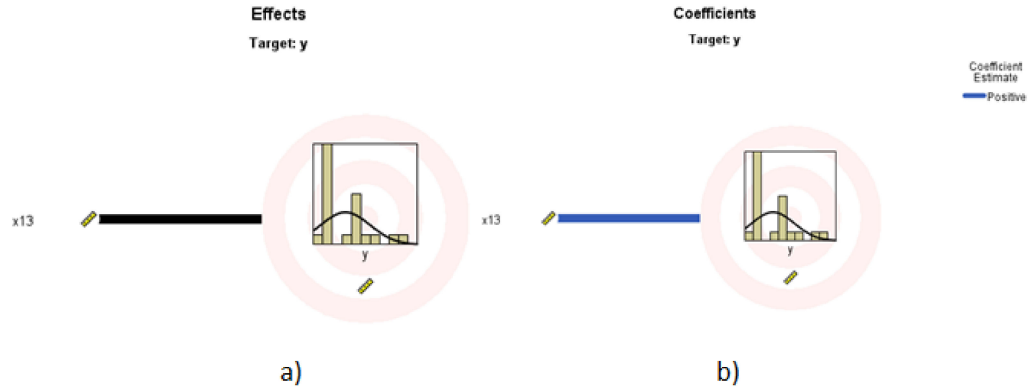

Figure 1. Visual presentation of automatic linear regression results: (**a**) impact of the transport sector indicator (X13) on immigration (Y); and (**b**) the positive coefficient value calculated for the Lithuanian transport sector indicator (X13).

Moreover, the ALM analysis presents the results of the coefficient estimation in the form of a graph and a table. Graphical presentation of results first shows the intercept, and then the variables in the model are sorted by impact from top to bottom, reducing the importance of prediction. In our case, there is one independent variable. Moreover, connecting lines in the graph are presented in colours corresponding to the coefficient sign and weight, according to the significance of the coefficient. This information revealed that the intercept (the constant value) has a negative sign and one transport indicator (X13) has a positive sign. Table 5 presents a detailed information on the developed FSR model.

Table 5. FSR model illustrating the relationship between immigration and transport sector indicators.

Coefficients [a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	−15,467.224	2621.518		−5.900	0.000
	X13	0.001	0.000	0.944	12.473	0.000

a. Dependent Variable: y.

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

$$Y = -15,467.224 + 0.001 \times X13, \quad (1)$$

where Y is immigration; – the intercept is the constant in the model; and X13 is freight turnover by all modes of transport.

3.2. Relationship between Indicators of Emigration and Transport Sector Performance

The study started with preliminary calculations. Descriptive statistics was conducted to find out the trends in the number of emigrants in Lithuania in 2000–2020 (dependent variable, Y). This 20-year period was chosen due to the availability of all the necessary data. Moreover, sixteen transport sector variables and one indicator reflecting the country's economy, the RGDP, were included in this study as independent variables.

The preliminary analysis showed that (variable Y) ranged from 16,719 to 83,157 persons, with a mean of 37,913.8095 for that period. Table 6 below shows the results of the descriptive statistical analysis of the dependent variable (Y) together with the seventeen independent variables.

Table 6. Results of a descriptive analysis of the dataset collected for emigration and the Lithuanian transport sector.

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Y	21	16,719.00	83,157.00	37,913.8095	15,030.57307	1.385	0.501	2.880	0.972
X1	21	5230.00	14,050.00	9781.4286	2686.04968	−0.057	0.501	−0.894	0.972
X2	21	235,927.90	477,126.40	408,900.1048	49,564.27537	−2.012	0.501	7.070	0.972
X3	21	2,366,613.00	6,381,049.00	4,688,822.0000	841,481.96300	−0.656	0.501	1.965	0.972
X4	21	3342.20	8852.10	5518.6952	1398.40372	0.834	0.501	0.016	0.972
X5	21	229,729.40	468,304.50	400,514.4476	48,799.58577	−2.029	0.501	7.196	0.972
X6	21	182,371.10	321,450.90	283,141.2810	31,400.56077	−1.685	0.501	4.357	0.972
X7	21	47,358.30	165,665.00	117,373.1667	31,418.42252	−0.249	0.501	−0.403	0.972
X8	21	1364.10	2948.60	2268.4429	382.00195	−0.872	0.501	1.509	0.972
X9	21	58.40	366.30	235.8190	104.75512	−0.476	0.501	−1.135	0.972
X10	21	1299.90	2890.20	2032.6286	361.85703	0.031	0.501	1.138	0.972
X11	21	96.80	1161.10	598.5381	231.44375	0.179	0.501	0.859	0.972
X12	21	105,845.60	178,390.30	132,680.5810	19,959.80521	1.147	0.501	0.855	0.972
X13	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
X14	21	209,342.00	5,084,778.00	1,744,537.2381	1,866,047.52181	0.927	0.501	−1.025	0.972
X15	21	3193.00	8467.00	5368.3333	1947.99082	0.452	0.501	−1.676	0.972
X16	21	173.00	773.00	439.3810	239.81544	0.322	0.501	−1.807	0.972
X17	21	2817.00	6772.00	4458.2381	1506.02875	0.416	0.501	−1.769	0.972
Valid N (listwise)	21								

The relationship between emigration (Y) and seventeen indicators of the Lithuanian transport sector was also assessed. The descriptive analysis showed that some of the variables had abnormal distribution (see Table 6). Therefore, statistical rules were followed to calculate Spearman's correlation coefficients between the variables that represent the Lithuanian case. Table 7 presents the results of the correlation analysis.

A significant positive correlation was determined between emigration and passenger transport by all modes of transport | Maritime transport (Y and X9, $r = 0.483$, $p < 0.05$).

A significant negative correlation between emigration and passenger transport by all modes | Rail transport was found (Y and X4, $r = -0.509$, $p < 0.05$). There is a strong negative correlation ($r = -0.695$, $p < 0.01$) between indicators (X4; X9).

No statistically significant relationships were found between emigration and the other indicators:

Table 7. Correlation between emigration and selected independent transport sector indicators.

			Correlations																
			Y	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**
Spearman's rho	Y	Correlation Coefficient	1.000																	
	X1	Correlation Coefficient	0.231	1.000																
	X2	Correlation Coefficient	−0.269	−0.671 **	1.000															
	X3	Correlation Coefficient	0.317	0.222	0.230	1.000														
	X4	Correlation Coefficient	−0.509 *	−0.671 **	.545 *	−0.078	1.000													
	X5	Correlation Coefficient	−0.257	−0.653 **	0.999 **	0.239	0.526 *	1.000												
	X6	Correlation Coefficient	0.257	0.227	0.471 *	0.674 **	−0.058	0.495 *	1.000											
	X7	Correlation Coefficient	−0.343	−0.897 **	0.838 **	−0.030	0.687 **	0.822 **	−0.030	1.000										
	X8	Correlation Coefficient	−0.334	0.464 *	0.019	0.405	−0.178	0.036	0.305	−0.231	1.000									
	X9	Correlation Coefficient	0.483 *	0.905 **	−0.604 **	0.205	−0.695 **	−0.584 **	0.331	−0.836 **	0.177	1.000								
	X10	Correlation Coefficient	−0.416	0.277	0.161	0.396	−0.030	0.177	0.283	−0.075	0.952 **	−0.043	1.000							
	X11	Correlation Coefficient	0.425	0.290	0.051	0.934 **	−0.277	0.058	0.544 *	−0.138	0.312	0.312	0.265	1.000						
	X12	Correlation Coefficient	−0.103	0.606 **	−0.178	0.440 *	−0.079	−0.168	0.416	−0.478 *	0.626 **	0.360	0.623 **	0.305	1.000					
	X13	Correlation Coefficient	0.230	0.990 **	−0.645 **	0.205	−0.643 **	−0.626 **	0.253	−0.891 **	0.470 *	0.887 **	0.288	0.252	0.648 **	1.000				
	X14	Correlation Coefficient	−0.171	−0.903 **	0.703 **	−0.217	0.716 **	0.695 **	−0.043	0.832 **	−0.425	−0.779 **	−0.243	−0.342	−0.439 *	−0.864 **	1.000			
	X15	Correlation Coefficient	−0.161	−0.831 **	0.825 **	0.173	0.687 **	0.813 **	0.157	0.856 **	−0.184	−0.770 **	0.017	−0.016	−0.242	−0.810 **	0.831 **	1.000		
	X16	Correlation Coefficient	−0.123	−0.862 **	0.849 **	0.116	0.627 **	0.842 **	0.173	0.868 **	−0.264	−0.784 **	−0.048	−0.047	−0.284	−0.831 **	0.874 **	0.964 **	1.000	
	X17	Correlation Coefficient	−0.147	−0.848 **	0.842 **	0.168	0.676 **	0.833 **	0.166	0.878 **	−0.196	−0.781 **	0.002	−0.011	−0.270	−0.820 **	0.846 **	0.992 **	0.976 **	1.000

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Real GDP per capita (X1, $p > 0.05$); passenger carriage by all modes of transport | All modes of transport (X2, $p > 0.05$); passenger turnover by all modes of transport (X3, $p > 0.05$); passenger carriage by all modes of transport | Road transport (X5, $p > 0.05$); passenger transport by all modes of transport | Buses (X6, $p > 0.05$); passenger transport by all modes of transport | Trolleybuses (X7, $p > 0.05$); passenger transport by all modes of transport | Water transport (X8, $p > 0.05$); passenger transport by all modes of transport | Inland waterway transport (X10, $p > 0.05$); passenger transport by all modes of transport | Oil transport (X11, $p > 0.05$); freight transport by all modes of transport | All modes of transport (X12, $p > 0.05$); freight turnover by all modes of transport | All modes (X13, $p > 0.05$); turnover of crude oil and petroleum products | Total by type of freight transport | Crude oil and petroleum products (X14, $p > 0.05$); number of persons injured and killed in road traffic accidents | Republic of Lithuania/injured (X15, $p > 0.05$); number of persons injured and killed in road traffic accidents | Republic of Lithuania/killed (X16, $p > 0.05$); road traffic accidents where people were injured (X17, $p > 0.05$).

All these fifteen transport sector indicators were excluded from further analysis. Independent indicators that had statistically significant correlations with the dependent variable were included in the subsequent automatic linear modelling (ALM) calculations.

The application of ALM modelling showed that the developed regression model has a very low significance level and therefore cannot be used for reliable prediction and justification of process relationships.

3.3. Relationship between Indicators of Net International Migration (NIM) and Transport Sector Performance

The study has been conducted in the same manner as the previously conducted and presented studies of the relationship between indicators of immigration and emigration and the performance of the Lithuanian transport sector, i.e., starting with preliminary calculations. The descriptive statistics used helped to identify the trends of change in NIM in Lithuania in 2000–2020 (dependent variable, Y). Sixteen transport sector variables and one indicator reflecting the country's economy (the RGDP) were distinguished and included as independent variables in this study.

The preliminary analysis showed that (variable Y) ranged from −25.20 to 7.10 per 1000 inhabitants, whereas the average for that period was −6.7190. Table 8 below shows the results of the descriptive statistical analysis of the dependent variable (Y) together with the seventeen independent variables.

Table 8. Results of the descriptive analysis of the dataset collected for NIM and Lithuanian transport sector indicators.

Descriptive Statistics									
	N Statistic	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
		Statistic	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Y	21	−25.20	7.10	−6.7190	6.84555	−0.422	0.501	2.079	0.972
X1	21	5230.00	14,050.00	9781.4286	2686.04968	−0.057	0.501	−0.894	0.972
X2	21	235,928.00	477,126.00	408,900.0952	49,564.23648	−2.012	0.501	7.070	0.972
X3	21	2,366,613.00	6,381,049.00	4,688,822.0000	841,481.96300	−0.656	0.501	1.965	0.972
X4	21	3342.00	8852.00	5518.7143	1398.38611	0.834	0.501	0.015	0.972
X5	21	229,729.00	468,305.00	400,514.4286	48,799.71927	−2.029	0.501	7.196	0.972
X6	21	182,371.00	321,451.00	283,141.2857	31,400.61255	−1.685	0.501	4.357	0.972
X7	21	47,358.00	165,665.00	117,373.1905	31,418.32863	−0.249	0.501	−0.403	0.972
X8	21	1364.00	2949.00	2268.5714	382.13971	−0.873	0.501	1.511	0.972
X9	21	58.00	366.00	235.9048	104.76779	−0.480	0.501	−1.132	0.972
X10	21	1300.00	2890.00	2032.7143	361.76762	0.030	0.501	1.137	0.972
X11	21	97.00	1161.00	598.6190	231.39284	0.178	0.501	0.858	0.972
X12	21	105,845.60	178,390.30	132,680.5810	19,959.80521	1.147	0.501	0.855	0.972
X13	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
X14	21	209,342.00	5,084,778.00	1,744,537.2381	1,866,047.52181	0.927	0.501	−1.025	0.972
X15	21	3193.00	8467.00	5368.3333	1947.99082	0.452	0.501	−1.676	0.972
X16	21	173.00	773.00	439.3810	239.81544	0.322	0.501	−1.807	0.972
X17	21	2817.00	6772.00	4458.2381	1506.02875	0.416	0.501	−1.769	0.972
Valid N (listwise)	21								

The relationship between NIM (Y) and seventeen indicators of the Lithuanian transport sector was also assessed. The descriptive analysis showed that some of the study variables demonstrated abnormal distribution (see Table 8). Therefore, statistical rules were followed to calculate Spearman's correlation coefficients between the variables that represent the Lithuanian case. Table 9 illustrates the results of the correlation analysis.

A significant positive correlation was found between NIM and freight carriage by all modes of transport | All modes of transport (Y and X12, $r = 0.457$, $p < 0.05$).

However, no statistically significant correlations were found between emigration and other indicators: real GDP per capita (X1, $p > 0.05$); passenger carriage by all modes of transport | All modes of transport (X2, $p > 0.05$); passenger carriage by all modes of transport (X3, $p > 0.05$); passenger carriage by all modes of transport | Rail transport (X4, $p > 0.05$); passenger carriage by all modes of transport | Road transport (X5, $p > 0.05$); passenger carriage by all modes of transport | Buses (X6, $p > 0.05$); passenger transport by all modes of transport | Trolleybuses (X7, $p > 0.05$); passenger transport by all modes of transport | Water transport (X8, $p > 0.05$); passenger transport by all modes of transport | Inland waterway transport (X10, $p > 0.05$); passenger transport by all modes of transport | Air transport (X11, $p > 0.05$); freight turnover by all modes of transport | All modes of transport (X13, $p > 0.05$); turnover of crude oil and petroleum products | Total by type of freight transport | Crude oil and petroleum products (X14, $p > 0.05$); number of persons injured and killed in road traffic accidents | Republic of Lithuania/injured (X15, $p > 0.05$); number of persons injured and killed in road traffic accidents | Republic of Lithuania/killed (X16, $p > 0.05$); road traffic accidents where people were injured (X17, $p > 0.05$). All these 16 transport sector indicators were excluded from further analysis.

The application of ALM modelling showed that the regression model, which includes one transport indicator (X12), has a very low significance level and therefore cannot be used.

Table 9. Correlation between NIM and selected independent transport sector indicators.

			Correlations																
			Y	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**	**X12**	**X13**	**X14**	**X15**	**X16**	**X17**
Spearman's rho	Y	Correlation Coefficient	1.000																	
	X1	Correlation Coefficient	0.374	1.000																
	X2	Correlation Coefficient	−0.356	−0.671 **	1.000															
	X3	Correlation Coefficient	−0.146	0.222	0.230	1.000														
	X4	Correlation Coefficient	0.216	−0.671 **	0.545 *	−0.078	1.000													
	X5	Correlation Coefficient	−0.361	−0.653 **	0.999 **	.239	.526 *	1.000												
	X6	Correlation Coefficient	−0.184	0.227	0.471 *	0.674 **	−0.058	0.495 *	1.000											
	X7	Correlation Coefficient	−0.266	−0.897 **	0.838 **	−0.030	0.687 **	0.822 **	−0.030	1.000										
	X8	Correlation Coefficient	0.312	0.464 *	0.019	0.405	−0.178	0.036	0.305	−0.231	1.000									
	X9	Correlation Coefficient	0.170	0.905 **	−0.604 **	0.205	−0.695 **	−0.584 **	0.331	−0.836 **	0.177	1.000								
	x10	Correlation Coefficient	0.227	0.277	0.161	0.396	−0.030	0.177	0.283	−0.075	0.952 **	−0.043	1.000							
	X11	Correlation Coefficient	−0.238	0.288	0.048	0.933 **	−0.279	0.056	0.539 *	−0.136	0.308	0.310	0.262	1.000						
	X12	Correlation Coefficient	0.457 *	0.606 **	−0.178	0.440 *	−0.079	−0.168	0.416	−0.478 *	0.626 **	0.360	0.623 **	0.305	1.000					
	X13	Correlation Coefficient	0.418	0.990 **	−0.645 **	0.205	−0.643 **	−0.626 **	0.253	−0.891 **	0.470 *	0.887 **	0.288	0.251	0.648 **	1.000				
	X14	Correlation Coefficient	−0.249	−0.903 **	0.703 **	−0.217	0.716 **	0.695 **	−0.043	0.832 **	−0.425	−0.779 **	−0.243	−0.340	−0.439 *	−0.864 **	1.000			
	X15	Correlation Coefficient	−0.291	−0.831 **	0.825 **	0.173	0.687 **	0.813 **	0.157	0.856 **	−0.184	−0.770 **	0.017	−0.017	−0.242	−0.810 **	.831 **	1.000		
	X16	Correlation Coefficient	−0.381	−0.862 **	0.849 **	0.116	0.627 **	0.842 **	0.173	0.868 **	−0.264	−0.784 **	−0.048	−0.045	−0.284	−0.831 **	0.874 **	0.964 **	1.000	
	X17	Correlation Coefficient	−0.295	−0.848 **	0.842 **	0.168	0.676 **	0.833 **	0.166	0.878 **	−0.196	−0.781 **	0.002	−0.012	−0.270	−0.820 **	0.846 **	0.992 **	0.976 **	1.000

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

4. Conclusions

Sustainable development of a country, ensuring a clean, healthy environment and an improving quality of life of population, is a long-term strategic process that provides appropriate conditions for present and future generations, combining the environmental, economic and social objectives of the society, within the limits of acceptable environmental impacts. In the national context, the implementation of these processes is not possible without a sustainable transport development, comprehensive improvement of the condition of the environment, continued economic growth, rapid social progress and balanced management of international migration flows.

The implementation of the sustainable development strategy requires the development of the transport sector to be cost-effective and environmentally friendly and steady economic growth to improve social processes and help to ensure that migration flows are managed in a way that meets the needs of the country, especially by addressing the problems of ensuring the long-term structural and qualification needs of the labour market and contributing to the promotion of the socio-economic development of the country.

The scientific analysis made it possible to identify that migrant flows are concentrated in those areas where the urban public transport infrastructure is best developed, as they do not have the financial means to purchase their own transport. An analysis of the scientific literature was also carried out, which allowed us to identify that those researchers who study the topic of migration often study general economic, social, etc. findings. That which affects the transport sector usually only affects the analysis of the type of transport and the mode of transportation. Considering these facts, the authors of the article present an analysis of the indicators of the transport sector linked to the migration process, which made it possible to reveal the importance and novelty of this topic.

The study results revealed differences in the relationship between the three indicators of international migration in Lithuania (i.e., immigration, emigration and net international migration (NIM)) and the indicators of the Lithuanian transport sector.

Limitations of the study: the study examines the official data of the Lithuanian Department of Statistics on international migration and the transport sector covering the period from 2000 to 2021. In this paper, the causes and consequences of the international migration movement in the EU and Lithuania are not examined in detail but are limited only to the search and explanations of connections with the indicators of the Lithuanian transport sector. Additionally, the study does not examine the factors/processes/decisions promoting (increasing or reducing) the processes of international migration (immigration, emigration and general indicators of net international migration) and their impact on the country's economy as a whole, but instead it aims to examine the connections between international migration processes and the main indicators of the transport sector.

The study found that the main factor in the Lithuanian transport sector that affects the evolution of immigration as an indicator of international migration flows in Lithuania is the turnover of freight by all modes of transport. It was found that in Lithuania, freight turnover by all modes of transport is the main factor, explaining about 89.1% of the dynamics of the immigration indicator. The results show that this independent variable had a positive impact on changes in immigration. The number of immigrants by all modes of transport increased with the increase in freight turnover.

In the context of the correlation analysis, the study of the relationship between emigration and the indicators of Lithuanian transport sectors showed that there is a significant positive correlation between emigration and passenger carriage by all modes of transport | Maritime transport, and a significant negative correlation between emigration and passenger carriage by all modes of transport | Rail transport. Moreover, these indicators were found to have a significant correlation with each other. The conducted regression analysis and the application of ALM modelling showed that the regression model was insignificant and therefore cannot be used.

The analysis of the relationship between the NIM and the Lithuanian transport sector indicators revealed that there was no significant relationship; the regression model is insignificant and cannot reliably explain the relationship between the indicators.

The conducted study (in the context of immigration, emigration, net international migration indicators and the determination of the relationship between the Lithuanian transport sector and the RGDP) allows concluding that for better and more reliable results, the set of the selected transport indicators can be revised and supplemented to strengthen regression models.

Therefore, the relationship between immigration and transport sector indicators, as well as the impact of emigration, immigration and migration on the transport sector indicators of neighboring countries, can be seen as promising areas for further research.

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