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Relationships between road transport indicators and expenditure of visitors in the context of European countries' tourism competitiveness

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Abstract

Research background: Transport represents a dynamic element in the tourism system. In recent decades, transport has been a subject of research mainly from the point of view of the sustainability of the economic systems and the environmental aspects.

Purpose of the article: This study aimed to quantify the relationships between the selected indicators of road transport development and the expenditure of tourism visitors in the selected European countries in the context of the development of their competitiveness.
Methods: The road transport indicators were applied in the research trajectories: density of road (DNST), hare of road infrastructure investment (SH INF), share of motorways (SH MWY), and indicators of visitor expenditure for business (BTS), leisure (LTS), domestic (DTS) and foreign (VEFS) tourism. In the first phase of the analyses, the countries of the European part of the OECD (N = 27; period of 2010–2018) were divided into two clusters based on the development index (HDI) and the innovation index (GII) through the cluster analysis. The two groups were created – more and less developed countries. The results of the analysis of differences declare that there are differences between these groups in the DNST, SH INF, BTS, LTS, and DTS indicators. The correlation and regression analysis methods were applied to quantify the relationships between the variables.
Findings & value added: The difference between the groups of the countries was also shown in the relationships between the road transport development indicators and visitor spending. In more developed countries, the relationship between the traffic indicators on BTS and DTS was significant. In less developed countries, significant relationships were identified with LST and VEFS. This finding underscores regional disparities and cautions against assuming that what policy guidelines from developed countries will be effective in less developed ones. Therefore, when designing improvement policies, it is vital to consider countries in terms of their level of development.

Introduction

The transport infrastructure and the services provided within it represent a part of the daily life of the country's inhabitants. From a macroeconomic point of view, it affects the economic growth of the countries, thus increasing their competitiveness and prosperity. From a sectoral point of view, the transport infrastructure significantly affects employment growth, the inflow of foreign investments, the development of tourism, and regional development within individual economies. Regarding this aspect, it also significantly influences eliminating regional and national disparities. The importance of transport infrastructure is emphasised to a much greater extent by the processes of globalisation and demographic aging. Therefore, efforts for its permanent development are visible in the countries' policies.

The continuous development of transport and transport infrastructure is a necessary condition for the development of every country. This also requires a change in the planning processes, setting up and implementing progressive and economically effective development activities that would be linked to the current possibilities of the countries' economies (Demirkol, 2022). The development of transport and transport infrastructure itself requires the creation of strategic concepts, the use of which would lead to

the creation of sustainable transport systems that support the economic growth and competitiveness of countries. Many countries have long-term strategic plans for the development of transport for different periods that determine the effective direction of the development of their transport sectors. In many cases, their use strongly depends on the resources of the European Union. The scholarly research conducted by Miłek (2022) validates these concepts and expands upon the subject within the contextual framework of the suitability of adopting a regional perspective toward infrastructure. In the realm of strategizing the advancement of transportation infrastructure, it is incumbent upon European authorities to conscientiously consider the regional configuration of nations.

Transport and transport infrastructure is essential for tourism, as it enables the movement of tourists from their place of origin to their destination (Pimonenko *et al*., 2021; Chebli *et al*., 2021). At the same time, it also allows a targeted dispersion of tourists to the different territories and thus supports regional development within the countries. For this reason, it is essential to set policies and strategies that will be aimed at the development of transport and transport infrastructure in relation to the several sectors, while it is important to examine their economic and social interconnectedness within these connections (Kozicka *et al*., 2019; Feriyanto *et al*., 2019; Sandoz, 2021).

Each country has its geographical specifics, historical, economic, and political development, natural conditions, and demographic development (Bernardelli *et al*., 2021; Kunuroglu & Önder, 2022; Němečková & Hayat, 2022; Benassi *et al*., 2022; Impedovo, 2022). For this reason, it is essential to investigate the significant trajectories within which it is possible to reveal new links and determinants of the impact of transport on the economy of the countries, as well as the relationships between transport and its infrastructure along with the other economic parameters (Androniceanu, 2016; Košč *et al*., 2021; Bartoš *et al*., 2021, 2022). The constant investigation of these relations and economic trajectories within them will support the development of models, concepts, and methodologies necessary for the creation of transport development strategies that will contribute to an increase of the competitiveness of not only regions, but also countries and the elimination of economic and social differences between them.

The vast majority of the conducted research studies examine only the aggregated characteristics, such as the individual types of transport, the complex sectors, and the aggregated expenses that prevent the discovery of

the other determinants of transport infrastructure and their causal links to the socio-economic and economic dimensions. A detailed investigation of the impact of the individual indicators of transport infrastructure concerning the individual types of tourist expenditures, which would form a platform for the creation of active policies for the development of tourism and the competitiveness of the countries, is absent.

This was also the motivation for implementing our research, which aimed to quantify the relationships between the selected indicators of road transport development and the expenditure of visitors to the tourism industry in the selected European countries in the context of developing their competitiveness.

The subsequent segment is dedicated to an elaborate exposition of the theoretical underpinnings pertaining to the current research endeavor. Subsequently, a comprehensive account of the methodological protocols is provided, predominantly employing panel regression analysis on datasets sourced from European Union nations with varying degrees of economic development. The results section encapsulates the procedures undertaken and provides a concise overview of the steps taken to attain the principal objective of this research study. The subsequent sections delve deeper into the results, fostering discussions and exploring the implications in greater detail.

Literature review

Transport represents a dynamic element in the tourism system. In recent decades, transport has been a subject of research mainly from the point of view of the sustainability of the economic systems and the environmental aspects. Some research teams examine the sustainability of transport from the point of view of its form (Kiel *et al*., 2014; Kovács & Kot, 2016; Poliak *et al*., 2021). However, in recent years, the research teams also observe the impact of the transport cost on the development of other sectors (Kelić *et al*., 2020; Srovnalíková *et al*., 2020).

In addition to the income level, the demand for tourism is also influenced by the price of the journey, the competitiveness of the destination, the exchange rates, the primary transport costs, and so forth. According to Sigala *et al.* (2002), Litman (2013), and other authors, the assumption expresses that if the transport prices fall enough, people will have a higher

tendency to travel. These assumptions are also influenced by the economic and political development of the countries, the globalisation aspects, and the risks related to them.

Effective management of tourism and transport requires policies and measures beyond the economic instruments (Oyunchimeg *et al*., 2022; Androniceanu & Tvaronavičienė, 2019). Betta *et al*. (2021) investigated the impact of the road transport emissions related to tourism in Italy for the years 2015 to 2019 and emphasise the need to create policies implementable in the international environment of the European Union member countries for the sustainability of transport systems. The development of transport infrastructure in the countries is also significantly influenced by the structural aspects of the economy. The tourism sector has a growing share in most macroeconomic aggregates, such as gross domestic product, production, employment, import, government revenue, and so forth (Shpak *et al*., 2022; Feriyanto *et al*., 2019). The economic impact of expeditions on tourism is also heavily discussed in the professional sphere, with their importance in improving structural imbalances in the economy. Downward and Lumsdon (2004) emphasise that understanding the determinants of daily visitor expenditure is needed to implement effective planning processes in many tourist destinations. According to their analyses, the amount of expenditure varies depending on the size of the group and the duration of the daily visit, which is essential information, especially for planners, who can influence the change in visit traffic in individual areas. Işik *et al.* (2017) investigated the dynamic causalities between economic growth, financial development, international trade, and tourism expenditure on CO_2 emissions in Greece.

The proficient governance of tourism and transport necessitates formulating policies that transcend mere economic instruments. It is imperative to underscore the significance of enacting internationally applicable policies to effectively tackle the issue of road transport emissions associated with tourism. Additionally, this highlights the pivotal role played by tourism expenditure in ameliorating economic disparities. Gaining a comprehensive understanding of the factors influencing visitor expenditure is of utmost importance, particularly when it comes to the strategic planning of tourist destinations, even within environmental considerations.

Through the study, Ferri (2004) points out that the investigation of the regional effects of new roads on tourism is also of great importance. The results of his analysis show that the influence of the highway infrastructure

on tourism depends on the origin of the tourism, the province of destination, and the section of the motorway in question.

Many institutions and research teams look for optimal competitiveness indicators in the travel and tourism industry. Celata (2007) examined transport accessibility as one of the main attributes of tourism development in the peripheral areas. The author analyses how transport accessibility can represent a constraint of tourism development in the peripheral areas. It points to the fact that tourism is historically connected to the development of the transport system and the reduction of economic distances.

The regional economic impacts of tourism were also investigated by Zhang *et al.* (2007), who employed the Danish interregional general equilibrium model (LINE). In their study, the authors examined the differences between the direct and derived effects size. The study was applied to the Danish regions that are divided into urban and rural ones. The authors appeal to the importance of perceiving the differences between the absolute and relative impacts of tourism on the regional economy and its competitiveness. Aguiló *et al.* (2012) examined the different strategies in tourism policy to reduce the number of tourists using private motor transport and to promote public, group, or charter transport in the destinations. According to the authors, it is important to create adequate transport policies based on alternative ways of thinking through analyzing tourist demand.

Dwyer and Kim (2003) draw attention to the fact that examining the competitiveness of a destination is methodologically more complex than the competitiveness of the countries, and therefore, it is necessary to carry out conceptual and empirical research in this area. The local transport efficiency and quality indicators represent a significant part of their destination competitiveness models. The preference for the type of road transport among tourists depends not only on the destination and the type of tourism (business, leisure, domestic, and foreign) but also on the profile of the tourists. Similarly, Profillidis and Botzoris (2013) investigated whether and to what extent the different categories of transport infrastructure (roads, railways, airports, ports) contribute to the economic development of the country and increase employment.

Gutiérrez and Miravet (2016) investigated the profiles of tourists. They found that tourists who arrived by plane used public transport less often. According to the authors, the decision-making algorithms when choosing types of personal transport for tourists in a given location are influenced by many factors subject to subsequent investigation. In this context, Miravet *et*

al. (2021) draw attention to the importance of solving the sustainable balance of the destinations that are influenced by the daily activities associated with the arrival of tourists. The results of their study show that the tailor-made strategies.

Usmani *et al*. (2021) declared in their study that tourist expenditure positively impacts economic growth, but tourist arrivals do not significantly affect economic growth. The direction of causality shows that tourist expenditure has bidirectional causality with economic growth. The study has several implications supporting the construction of the regulatory frameworks and the tariff structures supporting quality transport infrastructure for tourists. These tools can support the development of policies aimed at improving the sustainability and competitiveness of the destinations and the countries. The authors recommend examining and identifying which socio-demographic factors and trip characteristics condition the tourist's willingness to pay. The influence of transport infrastructure on the economic growth of the country was studied on an expert level through several approaches, with one of the three most applied approaches being the analysis of benefits and returns (CBA). Nevertheless, the estimates of the direction and the magnitude of the economic impacts of the transport infrastructure are significantly different according to the other macroeconomic models, and thus, it is difficult to capture the various causal mechanisms connecting the transport infrastructure and the economy (Betta *et al*., 2021; Kot & Kozicka, 2018). For this reason, it is crucial to investigate the transport-to-economy relations and their impact on the various sectors and to support the development of the methodological platforms.

Research methods

The study aimed to quantify the relationships between the selected indicators of road transport development and the expenditure of tourism visitors in the selected European countries of the Organization for Economic Co-operation and Development in the context of developing their competitiveness. Consequently, the analysis encompassed a selection of countries: Austria — AUT, Belgium — BEL, Switzerland — CHE, Czech Republic — CZE, Germany — DEU, Denmark — DNK, Spain — SPN, Estonia — EST, Finland — FIN, France — FRA, United Kingdom — GBR, Greece — GRC, Hungary — HUN, Iceland — ISL, Ireland — IRL, Italy — ITA, Lithuania —

LTU, Luxembourg — LUX, Latvia — LVA, Netherlands — NDL, Norway — NOR, Poland — POL, Portugal — POR, Slovakia — SVK, Slovenia — SVN, Sweden — SWE.

The analytical processes were carried out with the aim of a classification of the selected countries into the most homogeneous clusters according to their development characteristics and, successively, an evaluation of the relationships between the development of road transport and the expenditure of visitors to the tourism industry, as well as a consideration of the differences between the countries in the individual clusters in the investigated dimensions.

Several databases were examined for analytical data processing. The Human Development Index (HDI) was obtained from the Human Development Reports (2021) database. The Global Innovation Index (GII) was obtained from the final reports of Cornell University, INSEAD, and WIPO (2021). The traffic indicators and the purchasing power parity indicator were obtained from the Organization for Economic Cooperation and Development (2021) database, and the tourism visitor expenditure indicators were obtained from the World Travel & Tourism Council (2020) database. The indicators were applied for the period 2010 to 2018. The GII indicators were obtained from the reports available with an inevitable delay. The year 2010 is selected as a beginning based on a possible data distortion due to the 2009 financial crisis. The year 2018 is the end of the examination as the most recent published data from an area of transport in the Organization for Economic Co-operation and Development database is suitable for this year.

The WTTC database contains the data on the expenditure of tourism visitors (TS) in gross values (billions in USD). We employed the data converted to a per capita value for analytical purposes. The data on populations (POPULATION) in the individual countries are obtained from the databases of the Organization for Economic Cooperation and Development (2021). Subsequently, these values were adjusted by purchasing power parity (PPP) from the same database, while the average Organisation for Economic Cooperation and Development purchasing power parity value is 1. The following equation expresses the mathematical definition.

$$TS_i = \frac{\frac{TS_i \times 1{,}000{,}000{,}000}{POPULATION_i}}{\frac{PPP_i}{100}} \tag{1}$$

Table 1 provides a description of the data that entered the subsequent analytical processes.

Several methods are employed to achieve the aim of the study. The silhouette method is applied to estimate the appropriate number of clusters when applying the cluster analysis. The cluster analysis is carried out by the Partitioning Around Medoids (PAM) method employing the Manhattan distance (Kassambara, 2017). The analysis of the differences in the indicators of transport development and the expenditure of tourism visitors between the clusters was carried out through the Wilcoxon signed-rank test.

The correlation analysis applying Pearson's r coefficient was employed to roughly estimate the relationship between the traffic indicators and visitor spending.

Subsequently, the regression analysis was carried out that consisted of two steps. The assumptions for selecting suitable methods were verified in the first step, and the regression analysis was carried out in the subsequent step. The selection of the appropriate regression models was supported by the Breusch-Pagan test that verified the variability of the residuals homoscedasticity and, thus, an occurrence of heteroscedasticity, then the F test that verified the significance of the sample structure in the dimension of the countries (ID) and the individual years. The Hausman test helped decide whether to choose the fixed or random effects regression models (Wooldridge, 2010). The panel regression models enriched with robust estimators in a case of significant heteroscedasticity were applied. The Arellano estimator (Arellano, 1987) was selected for the fixed effects model, and the White 2 estimator (Wooldridge, 2010) for the random effects model.

The endogeneity problem was solved through the application of the regression models supplemented with the instrumental variables, while the fixed effects model involved a standard addition of an instrumental variable (Croissant & Millo, 2019) and the Amemiya and MaCurdy instrumental method (Amemiya & MaCurdy, 1986). All the analytical processes were processed in the R software environment (R Core Team, 2020).

Results and discussion

Several results were obtained by applying the methods based on the stated methodological procedures. In the first stage of the analytical processes, cluster analysis was carried out, aiming to divide the selected countries into relatively homogeneous groups according to the characteristics of their development and innovative activities. Subsequently, a basic descriptive analysis was carried out. This part also applied the test of differences between the clusters representing the individual countries. The next part of the discussed results is devoted to the regression analysis models that verified the relationships between the road transport development indicators and the tourism visitor expenditures.

Before an application of the cluster analysis itself, a median value was calculated on the raw input data (HDI, GII), where the values for the appropriate years of the given country were included in this calculation. The values for the individual countries were subsequently standardised from 0 to 1, where 0 represents the lowest and 1 is the highest value in the given selection. This data was successively applied to estimate the number of clusters where the silhouette method was applied and, thus, recommended the two clusters. Figure 1 shows the structure of the given countries in terms of HDI and GII. Cluster 1 represents the countries with higher outputs in HDI and GII, so they are more developed than those in Cluster 2.

The countries with a darker shading possess a better position regarding development and innovation. The placement of the countries in the clusters is not random, and the role of geographical position is clear. Switzerland, Sweden, the Netherlands, and the United Kingdom belong to the countries with the best output. The second cluster consists of the two groups. Greece, Poland, Slovakia, Latvia, and Hungary are located among the countries with a lower output included in the second cluster. It is possible to look at these countries as the ones with a lower output, but a suitable view also admits a specific potential of these countries in the sense of beta convergence, for instance. Thus, these countries with lower output will grow faster than the ones with higher output. The division of the countries into clusters is vital for the following processes in that all the subsequent analytical processes are organised according to the mentioned clusters to point out the deviations of the countries caused by development.

Table 2 contains the outputs of the bivariate correlation of Pearson's r between road transport and visitor expenditure indicators. Our ambition

was to identify the differences in significance and even the direction of the relationship between the individual clusters. In the DNST variable, the difference was manifested only in the significance of the DTS variable (r: Cl 1 = -0.437†, Cl 2 = -0.176*) and the VEFS variable (r: Cl 1 = -0.093, Cl 2 = -0.344†). The most significant differences between the clusters were shown in the SH INF indicator, where a difference can be identified in relation to the expenditure variable of each visitor. In the case of the SH INF and DTS relationship, it is even a difference in direction (r: Cl 1 = 0.429†, Cl 2 = -0.326†). A significant difference in the direction of the relations was also manifested in the SH MWY indicator in an association with BTS (r: Cl 1 = -0.607†, Cl 2 = 0.300***) and DTS (r: Cl 1 = -0.353†, Cl 2 = 0.250 **). Based on the aforementioned rough estimate of the relationships, it can be assumed that there is a particular difference between the individual clusters in the relationship between traffic and visitor spending in the tourism industry.

Table 3 contains the outputs of central tendency and the tests of differences of the mentioned indicators between the clusters. It visualises the results of the descriptive analysis with an identification of the countries and the clusters. The values highlighted in bold represent the five highest values for the given indicator; the five lowest values are highlighted with a double underline. The last rows of the table show the mean values in the individual clusters and the test of differences (Wilcoxon W) between them, in which it is clear that a significant difference at the α level of less than 0.05 was not manifested in the SH MWY (W = 7499*) and VEFS (W = 13501) from.

Within the regression analysis applied, the four multivariate regression models were constructed. Their difference lies in the dependent variable represented by visitor spending in tourism — BTS, LTS, DTS, VEFS. The models were named according to these variables — mBTS, mLTS, mDTS, and mVEFS. The independent variables that appeared were identified as the same in each model, representing the transport indicators (DNST, SH INF, SH MWY).

In the process of achieving the study's goal, we proceeded as follows. In the first part, the fundamental outputs of the specifics of the regression models are discussed, on the basis of which the particular regression model was selected. This is followed by a presentation of the models themselves and an evaluation of the endogeneity of these models.

Table 4 mentions the starting points when deciding about the choice of a specific regression model. The residuals homogeneity was verified by the

Breusch-Pagan test (BP), which indicates a potential occurrence of heteroscedasticity when the output is significant. In these cases, robust estimation methods were applied (Random model: White 2 estimator; Within model: Arellano estimator). The outputs of the F test focused on the internal structure of the sample for the structure of the countries (FT ID), fulfilling the significance of the output values in all the cases. On the other hand, for the outputs, where the structure formed by individual years (FT Time) decreased, there was no significant output. According to the abovementioned, the individual effects formed by the separate countries were applied in the models. The Hausman test (HT) recommends a preference for the fixed effects model over the random effects model that occurred only in the two cases in cluster 1. The last column offers the identification of the most appropriate model from the point of view of the previous tests. These models were similarly applied in the estimation of the coefficients.

The main part of the research is offered in Table 5, where the investigated relationships between the development of road transport and the expenditure of visitors in the tourism industry are shown. The results are presented for the individual clusters.

The endogeneity problem is explained by the data in Table 6 through the comparison of the regression models enriched with the instrumental variable and the unadjusted regression models. The role of the instrumental variable was fulfilled by the indicator of innovations in the field of infrastructure (GII INF). To assess the endogeneity problem, the fixed effects model and the random effects model and their variants with the instrumental variables were employed. If the endogeneity were significant, the differences would be manifested mainly in the β coefficients, while these differences would perform specifically as a change of the relationship trajectory. As the results show, some endogeneity is present. In the case of the fixed effects models, the β coefficients not significant in these models were significant in the fixed effects models with the instrumental variables and vice versa. There were no differences in the sign of the relationship (the positive and negative β coefficients). Similar results are also presented for the random effects models. Based on the results presented in the table demonstrating the comparison of the outputs of the individual models, it is possible to reveal a relatively stable estimate of the effects that, to a large extent, can be identified with the results presented in Table 5.

Based on the applied cluster analysis, the two clusters of the European countries within the OECD were constructed. The first cluster with the

more positively evaluated outputs consisted of the countries such as Switzerland, Sweden, the Netherlands, and the United Kingdom. Cluster 2 involved the countries with a lower output of development and innovation. This cluster included the countries such as Greece, Poland, Slovakia, Latvia, and Hungary. The goal of the analysis was also to point out the differences between the groups of the countries, characterised by their level of development. For this reason, the results were compared and evaluated in the countries with higher and lower levels of development.

The results of the descriptive analysis and the analysis of differences pointed to the fact that there is a significant difference in a majority of the selected indicators among the constructed clusters. The difference was manifested in the density of roads, the share of road infrastructure investments, in the expenditure of business, leisure, and domestic tourism, where the first cluster dominated, especially in the expenditure of visitors in the tourism industry. The road infrastructure density indicator found higher values in the first cluster for the share of road infrastructure investments. For the total transport infrastructure, the second cluster dominated.

The results of the correlation analysis that presented the relations between visitor expenditures in the tourism industry and the road transport indicators pointed to the occurrence of significant associations. The positive as well as negative directions of these associations were demonstrated. The existence of the different relations between more and less developed countries was confirmed.

The results from the applied panel regression models pointed to the visible differences in the investigated relationships between the countries with higher and lower levels of development. The countries belonging to the more developed group are represented by the regression model focused on business and domestic tourism expenditures as significant. The countries with a lower level of development report the spending model of leisure and foreign tourism as significant. These results also fully correspond with the studies of the authors Mačiulis *et al*. (2009), Purwanto *et al.* (2017), and Deng (2013).

The differences were also identified in the direction of the individual β coefficients. They were shown in the model of business tourism expenditures, where the group of the less developed countries is represented by a significant positive effect of all three indicators on leisure tourism expenditures. In contrast, the group of the less developed countries shows only one significant effect for the indicator of the share of highways in the

total road infrastructure (this effect was negative). The differences were also evident in the other two models focusing on domestic tourism expenditures in the more developed countries — with a negative sign and, on the contrary, in the countries with lower positive development. The model of foreign tourism expenditures for the countries with a higher level of development does not present any significant β coefficient in contrast to the group of the less developed countries, where the significant positive coefficients were revealed. The assumed relationships were verified by applying several models, including the panel regression models supplemented with the instrumental variables. Comparison of the coefficients between the models ensures a relatively stable estimate of effects. For more developed countries, the indicators showing the density of road infrastructure and the share of highways in the total road infrastructure appeared relatively stable in business tourism expenditures. These results are also confirmed by the results of studies by the authors Işik *et al*. (2017), Zhang *et al.* (2007), and Dwyer and Kim (2003).

The outputs of these models acquired positive coefficients. This means that if there is an increase in the density of road infrastructure in more developed countries, growth in the area of business tourism expenditure is also expected to some extent. This is also confirmed by the studies of the authors Usmani *et al*. (2021), Lakshmanan (2011), and Profillidis and Botzoris (2013). Less developed countries showed certain contradictions in the mentioned relationship between the models with and without the instrumental variables. The impact of road transport development on business tourism expenditures can be considered insignificant in less developed countries. In more developed countries, the most stable effect of road transport development on domestic tourism expenditure was identified in the investment shares of road infrastructure to total infrastructure. This effect takes a negative trajectory. These findings correlate with the results of studies by Işik *et al*. (2017) and Gooroochurn and Sugiyarto (2005).

The stated findings can be interpreted in such a way that the capital spent on the development of road transport in the developed countries is not as efficient as the capital spent on the other types of infrastructure (for instance, air transport). In less developed countries, such a trajectory was not confirmed. According to the presented results, the effects of transport development in less developed countries do not possess stable relationships. These findings also correspond with the results of studies by Pulido-

Fernández *et al.* (2019), Mudarra-Fernández *et al*. (2019), and Brida and Scuderi (2013).

When focusing on the impact of road transport development on spending in leisure tourism, in contrast to more developed countries, relatively stable effects formed by all three indicators of transport development were demonstrated in less developed countries. The impacts of road infrastructure development on foreign visitor spending were significant only in less developed countries. In these countries, the effect of road density development can be considered the most stable. A positive direction was identified for this effect, so if there is an increase in road infrastructure, it is possible to expect an increase in spending in the field of foreign tourism. This fact is also confirmed by the results of the studies by Marrocu *et al.* (2015), Thrane (2014), and Kastenholz (2005).

The results of the analyses confirm the differences in the relationships between road transport development indicators and tourism visitor expenditures among the groups of the countries differing in the level of development that encourages the implementation of subsequent research and a reveal of the other determinants affecting these differences. These findings represent a valuable platform for policymakers and strategic plans in the field of transport to increase the competitiveness of the regions and the countries. As Deng (2013) states, the development of a methodological platform will constantly be crucial for investigating the relationships between transport development and economic indicators because the controversial findings of some research studies are the result of the different methods of measurement and the use of incompatible data that is problematic for comparative analyses.

Conclusions

Transport and transport infrastructure is one of the main driving forces in the economic development of any country. The economic growth of the countries and the increase in their competitiveness are also connected with the continuous development of transport and transport systems. The effective development of transport requires the creation of high-quality concepts and strategies for its development. At the same time, it is essential to perceive the aspects of the interconnectedness of transport with many sectors of the country's economy. For this reason, the analyses quantifying the

relationships between the selected indicators of transport development and the economic characteristics are important so that they will enable the creation of the set policies and new policies aimed at developing countries' competitiveness.

This study aimed to quantify the relationships between the selected indicators of road transport development and the expenditure of tourism visitors in the selected European countries in the context of developing their competitiveness. To achieve the goal, the available international databases were applied, and the optimal analytical methods were selected due to the character of the data explored.

The study provides valuable insights for policymakers as well as for creators of strategic plans and development strategies. The two groups of countries were created — more and less developed countries. The results of the analysis declare the fact that there are differences between these groups in the DNST, SH INF, BTS, LTS, and DTS indicators. The outcome of the study also supports the creation of national and international benchmarking indicators and a platform for comparative analyses that would support the development of the competitiveness of tourist destinations, the competitiveness of the tourism industry, and the competitiveness of economies.

In addition to the unquestionable value that the presented research brings, it is imperative to acknowledge several inherent limitations. The major limitation lies in the absence of observations for certain indicators in specific countries. While the extent of missing values may not be substantial, it is crucial to recognize that generalizing the results becomes impracticable for countries where specific indicators lack data. Moreover, caution must be exercised when interpreting the causality of the relationships presented, as addressing the endogeneity problem entirely in economics remains arduous. The current research study solely encompasses countries without a more granular internal structure, disregarding the heterogeneous nature of infrastructure intensity within nations.

Consequently, future research endeavors will explore smaller regional subdivisions beyond the NUTS 2 level. Additionally, forthcoming investigations will prioritize elucidating the relationships between sustainability indicators, circular economies, and the environment.

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Annex

Table 1. Indicators characteristics

ID	Indicator	Description
HDI	Human Development Index	A composite index measuring average achievement in the three basic dimensions of human development – a long and healthy life, knowledge, and a decent standard of living (index 1 to 100 – the higher, the more positive)
GII	Global Innovation Index	It evaluates the innovation ecosystem performance of the economies each year while highlighting the innovation strengths, the weaknesses, and the particular gaps in the innovation metrics. (index 0 to 1 – the higher, the more positive)
DNST	Density of road	km of road per one hundred sq km of land
SH INF	Share of road infrastructure investment in total inland transport infrastructure investment	Percentage (%)
SH MWY	Share of motorways in total road network	Percentage (%)
BTS	Business tourism spending	Spending of business trips of domestic residents and foreign visitors in a country (USD per capita).
LTS	Leisure tourism spending	Spending of domestic residents and foreign visitors on leisure purposes in a country (USD per capita).
DTS	Domestic tourism spending	Spending of domestic residents on business and leisure purposes in a country (USD per capita).
VEFS	Visitor exports – foreign spending	Spending of foreign visitors on business and leisure purposes in a country, including transport spending, but excluding spending on education (USD per capita).

Source: elaborated according to the Human Development Reports (2021), Cornell University, INSEAD and WIPO (2021), Organisation for Economic Co-operation and Development (2021), World Travel & Tourism Council (2020)

Table 2. Output of the relations exploration (Pearson's r) in the cluster division

Dep. Var.	Cl	DNST	Dir.	SH INF	Dir.	SH MWY	Dir.
BTS	1	r = **-0.342†** n = 96	-	r = **0.504†** n = 100	+	r = **-0.607†** n = 94	-
	2	r = **-0.303*** ** n = 98	-	r = -0.143 n = 111	-	r = **0.300*** ** n = 89	+
LTS	1	r = **-0.314*** ** n = 96	-	r = **0.441†** n = 100	+	r = **0.624†** n = 94	+
	2	r = **-0.346†** n = 98	-	r = -0.077 n = 111	-	r = **0.600†** n = 89	+

Table 2. Output of the relations exploration (Pearson's r) in the cluster division

Dep. Var.	Cl	DNST	Dir.	SH INF	Dir.	SH MWY	Dir.
DTS	1	r = **-0.437†** n = 96	-	r = **0.429†** n = 100	+	r = **-0.353†** n = 94	-
	2	r = -0.176* n = 98	-	r = **-0.326†** n = 111	-	r = **0.250**** n = 89	+
VEFS	1	r = -0.093 n = 96	-	r = **0.375†** n = 100	+	r = **0.826†** n = 94	+
	2	r = **-0.344†** n = 98	-	r = 0.180* n = 111	+	r = **0.583†** n = 89	+

Note: * – p-value <0 .1; ** – p-value < 0.05; *** – p-value < 0.01; † – p-value < 0.001.

Table 3. Descriptive statistics of the selected indicators

ID	Cl	DNST		SH INF		SH MWY		BTS		LTS		DTS		VEFS	
		Mean	Med	Mean	Med	Mean	Med	Mean	Med	Mean	Med	Mean	Med	Mean	Med
AUT	**1**	155.16	150.97	19.69	21.55	1.72	1.75	576.9	574.6	**3480.2**	**3474.2**	**2090.6**	2093.8	1966.5	1951.3
BEL	**1**	**510.49**	**510.49**	28.88	28.58	1.14	1.14	427.9	423.9	1213.9	1209.6	742.7	728.2	899.1	968.5
CHE	**1**	**180.96**	**180.99**	52.44	52.84	1.99	1.98	511.4	511.5	2876.9	2870.3	1933.1	1935.8	1455.1	1445.5
CZE	**2**	72.18	72.18	61.91	63.21	1.63	1.39	277.7	258.2	1176.4	1180.7	593.3	578.4	860.8	855.6
DEU	**1**	-	-	68.75	68.61	-	-	615.6	607.3	**2941.2**	**2930.2**	**3065.5**	**3031.2**	491.3	496.1
DNK	**1**	176.66	177.2	52.08	48.72	**2.05**	**2.07**	**927.4**	**940.7**	1483.2	1444.7	1354.4	1331.3	1056.2	1054
ESP	**2**	-	-	58.11	61.87	-	-	368.2	366.8	2748.6	2779.7	1393.8	1377.7	1723	1768.8
EST	**2**	136.64	136.02	**85.52**	**89.24**	0.23	0.24	658.5	681.1	2130.5	2166.6	714.9	699.5	**2074.2**	**2145.9**
FIN	**1**	25.68	25.69	69.78	69.53	1.08	1.13	**788.6**	**781.4**	2047.9	2072.7	2089.1	**2102.8**	747.4	782.3
FRA	**2**	**196.69**	**198.01**	56.6	54.28	1.07	1.07	490.6	484.6	2034.3	2020.4	1694.3	1687.9	830.5	806.1
GBR	**1**	174.22	174.21	41.5	40.83	0.92	0.92	**902**	**872.7**	1901.4	1918.1	**2309.9**	**2367.2**	493.6	504.7
GRC	**2**	-	-	**86.38**	**87.33**	-	-	227.1	221.5	**3222.6**	**3347.8**	1392.4	1395.1	**2057.2**	**2176.7**
HUN	**2**	**226.46**	**225.2**	58.31	66.4	0.83	0.83	136.4	135.9	1188.9	1151.5	391	395.1	934.3	900.6
IRL	**1**	141.23	139.36	-	-	0.94	0.94	618.4	653	1354.8	1330.9	450.9	474.3	1522.3	1514.8
ISL	**1**	-	-	**100**	**100**	-	-	**1768.2**	**1601.6**	**6867.3**	**6901.5**	**2913**	**2943.4**	**5722.5**	**5485**
ITA	**2**	86.4	86.76	48.71	46.56	**2.67**	**2.65**	601.2	579.6	2440.4	2538.5	**2317.2**	**2400.4**	724.3	735.4
LTU	**2**	134.29	134.62	71.19	74.4	0.46	0.47	248.9	255.3	898.2	904.8	484.6	503.5	662.5	671.7
LUX	**1**	124.67	119.3	50.73	52.86	**5.15**	**5.24**	183.2	170.2	**3749.4**	**3850**	696.6	694.8	**3236**	**3324.7**
LVA	**2**	94.16	94.18	73.57	72.1	-	-	278.4	282.8	1357.8	1376.2	682.3	687.3	953.9	911.8
NLD	**1**	**412.5**	**412.32**	62.54	62.54	1.94	1.93	426.1	406.6	1243.2	1240	876.5	869.5	792.8	777.2
NOR	**1**	25.9	25.89	**77.78**	**75.74**	0.49	0.49	576.4	555.2	1769.1	1635.8	1655	1538.5	690.5	652.5
POL	**2**	135.99	136.2	**89.26**	**90.1**	0.34	0.37	171.5	150.1	482.6	481.9	211	209.5	443.1	438.5
PRT	**2**	15.36	15.62	76.4	75.48	**21.17**	**21.41**	522.2	548.1	2806.6	2811.7	1198.3	1253.2	**2130.6**	**2085.2**
SVK	**2**	108.03	114.01	67.47	66.59	0.86	0.85	359.2	341.8	866.6	814.6	626	608.4	599.9	553.3
SVN	**2**	100.25	100.17	48.37	54.23	**3.84**	**3.85**	387.6	374.3	2240.8	2240.2	909.3	906.5	1719.1	1712.9
SWE	**1**	52.86	52.81	57.13	58.15	0.95	0.97	**892.5**	**869**	1867.7	1854.8	1732	1732.8	1028.2	991.1
CL	**1**	169.7	150.97	56.65	55.55	1.65	1.14	708.8	595	2522.8	1973.2	1685.3	1804.1	1546.3	1004.3
CL	**2**	119.1	116.19	67.37	65.45	3.32	0.97	363.7	332.8	1814.9	1976	969.9	749.7	1208.7	907.3
Diff Test CL		**8442*** **		**8949†**		7499*		**9231†**		**11893†**		**10147†**		13501	

Note: * – p-value <0 .1; *** – p-value < 0.01; † – p-value < 0.00

Table 4. Assumptions of the panel regression models

Model	BP	FT ID	FT Time	HT	Recommended Model
			Cluster 1		
mBTS	0.87	**62.86†**	0.63	**14.88*****	Within
mLTS	**9.03****	**58.26†**	0.39	7.40*	White 2 Random
mDTS	4.31	**64.61†**	0.44	7.23	Random
mVEFS	**8.20****	**41.31†**	0.28	**31.27†**	Arellano Within
			Cluster 2		
mBTS	**10.30****	**123.35†**	0.25	1.8	White 2 Random
mLTS	3.33	**178.81†**	0.33	3.82	Random
mDTS	**23.97†**	**237.98†**	0.25	1.81	White 2 Random
mVEFS	**15.96*****	**242.81†**	0.21	2.63	White 2 Random

Note: * – p-value <0 .1; ** – p-value < 0.05; *** – p-value < 0.01; † – p-value < 0.001.

Table 5. Outcome of the panel regression models

Reg. output	mBTS (SE)	mLTS (SE)	mDTS (SE)	mVEFS (SE)
Cluster 1				
DNST	**6.39***** (2.39)	**-1.73**** (0.87)	**-2.70†** (0.77)	5.72 (7.33)
SH INF	**-4.00***** (1.31)	-3.39 (4.35)	**-10.24†** (2.34)	2.66 (7.26)
SH MWY	**198.87***** (70.49)	101.49 (154.67)	**-145.27**** (58.86)	120.47 (238.84)
Intercept	-	**2482.07†** (445.67)	**2812.52†** (278.93)	-
Observations	78	78	78	78
R2	0.26	0.02	0.21	0.03
Adjusted R2	0.13	-0.02	0.17	-0.15
F Stat	**7.75†**	5.12	**27.69†**	0.61
Cluster 2				
DNST	0.69 (0.61)	**7.44***** (2.73)	1.96 (1.26)	**7.14†** (1.80)
SH INF	**0.99**** (0.43)	**3.22**** (1.43)	**1.58**** (0.73)	**2.59**** (1.06)
SH MWY	7.71 (12.06)	**117.35***** (38.06)	**47.56**** (22.10)	86.09 (55.45)
Intercept	199.95 * (111.85)	80.32 (453.70)	401.01 (335.00)	-264.5 (287.72)
Observations	83	83	83	83
R2	0.08	0.22	0.07	0.25
Adjusted R2	0.05	0.19	0.03	0.22
F Stat	5.88	**19.11†**	4.63	**23.77†**

Note: * – p-value <0 .1; ** – p-value < 0.05; *** – p-value < 0.01; † – p-value < 0.001.

Figure 1. Geographic structure of the EU OECD countries with the division of the clusters