https://doi.org/10.55343/CogSust.16

Social and Economic Analysis of the EU Road Freight Transport Fleet

Adrienn Boldizsár
Dept. of Transport Technology and Economics,
Budapest University of Technology and Economics,
Budapest, Hungary
boldizsar.adrienn@edu.bme.hu

Ferenc Mészáros
Dept. of Transport Technology and Economics
Budapest University of Technology and Economics
Budapest, Hungary
meszaros.ferenc@kjk.bme.hu

Erika Török
Dept. of Computer Science,
John von Neumann University,
Kecskemét, Hungary
torok.erika@gamf.uni-neumann.hu

Abstract

An analysis of economic and social indicators provides a good overview of the situation of a country or region in terms of a service or an industry. These indicators can help determine development, even in a community such as the European Union, to establish rankings and take appropriate strategic decisions at the transport policy level. This study aims to analyse road freight transport's economic and social impact. The analysis of economic and social indicators for freight transport in logistics is presented. The trends in vehicle population change in the EU countries were examined, and the relationship between road freight transport and population development in the countries under study was analysed from an economic point of view. The aim was to explore the effects of transport policy measures taken in the region over the last ten years on freight transport, both economically and socially. The study found no correlation between social and freight transport indicators in the EU Member States. Whereas, there is a correlation in the economic dimension, which may raise further questions, for example, when looking in more detail at the situation of a country within the Community.

Keywords
European Union, vehicle fleet, mileage, HDI, GDP

1 Introduction

The relationship between economic growth and transport is a popular key research topic, but it also has many untapped areas. To ensure continued economic growth, it is essential to answer the question of the contribution of each financial sector to development. In addition to the economic impact, it is essential to explore exactly what the environmental impact of freight transport is and what opportunities we have for creating sustainable transport, including transport directly linked to freight transport. An important step is to map and model the present and past situation and draw conclusions. At the same time, it is essential to note that convergence always has a crucial third area, the social impact, although this is not given much attention in logistics, including freight transport. With this in mind, Figure 1 illustrates this study's defined and delimited field.

https://doi.org/10.55343/CogSust.16

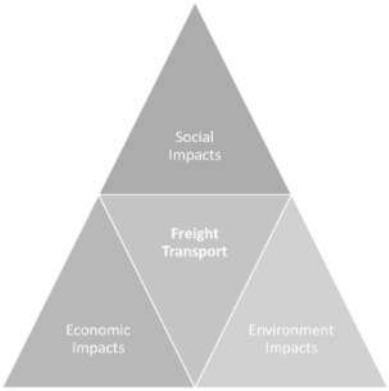

Figure 1. The research framework

The present study examined four factors to investigate the relationship between fleet size and mileage in the EU road freight transport sector by analysing the GDP (Gross Domestic Product) and HDI (Human Development Index) indicators. By examining these indicators, the extent to which each area interacts with the other was calculated, thus confirming or refuting the transport policy aspirations of the region in economic and social terms.

The HDI (Human Development Index) measures the social and economic dimensions of a country's overall performance. The HDI indicator is calculated based on life expectancy at birth in a given country, educational attainment (level of schooling: number of years of regular schooling and average number of years of education) and standard of living (gross national income per capita). The indicator has been used by the United Nations Development Programme (UNDP) to measure well-being since 1993, and the results are published annually in the Human Development Report (HDR) (UNDP, 2020). The indicators, which also provide a picture of the social situation, explain development by factors other than GDP (KSH, 2008). Figure 2 shows a map of the Human Development Index of the world's countries.

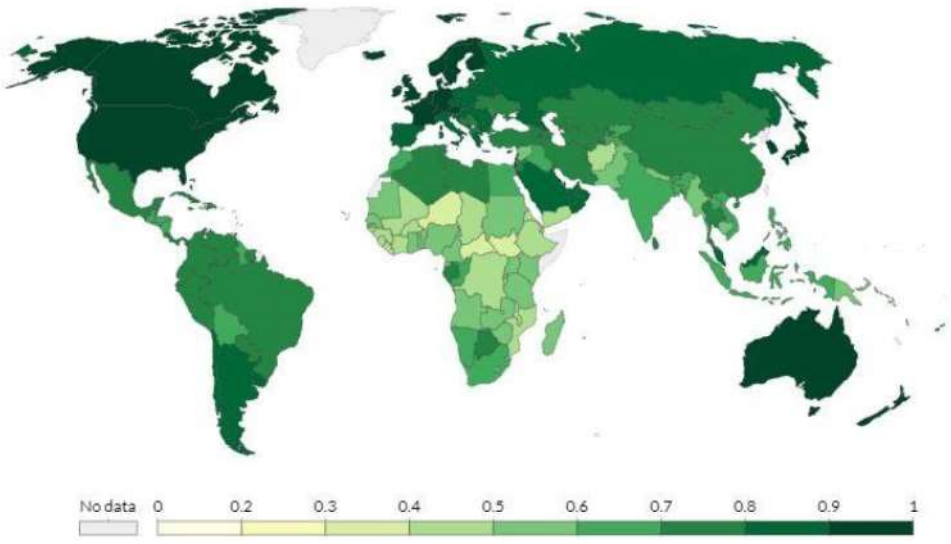

Figure 2. The World Human Development Index 2017 (Our World in Data)

Figure 2 shows that most of Europe is highly developed, while those lagging slightly behind, such as Hungary, have a high HDI. The HDI, as outlined above, can be used to draw several conclusions, for example, on the impact of other indicators. Figure 3 shows the HDI values for Europe. The map shows that almost all the countries in Europe belong to the very highly developed countries.

https://doi.org/10.55343/CogSust.16

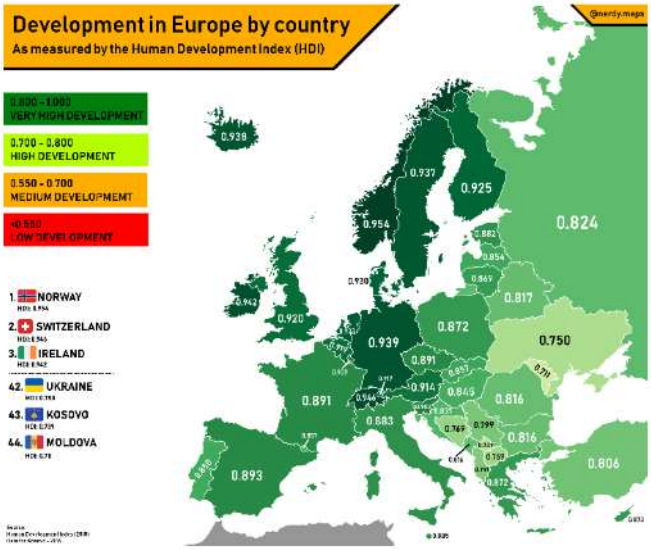

Figure 3. Human Development Index in Europe (Reddit)

Some studies have tried to get a picture by comparing HDI and other indices and indicators, using it to examine recent findings such as the Water Poverty Index (WPI) (Ladi et al., 2021), the prediction of municipal elections (Yero et al., 2021), sustainability in the area of freight transport (Kumar & Anbanandam, 2019), or the impact of the Covid 19 epidemic (Liu et al., 2020). These indicators are most useful strategically to help decision-makers set the right direction. A study carried out in 2015 already analysed the impact of logistics performance on social development. The result shows a strong relationship between the LPI (Logistics Performance Index) and the HDI, which substantiates that in the EU, the LPI strongly influences social development; logistics performance is higher in countries where social development is more advanced (Bîzoi et al., 2015).

According to preliminary estimates from the International Transport Forum (ITF) 2019 data, global GDP or a nation's gross domestic product, grew by 2.9% between 2018 and 2019, rising slower than in the previous year. GDP grew by 1.7% in most advanced economies, while in emerging and developing economies, it rose by 3.7%, slightly less than in previous years. Airfreight tonne-kilometres fell by 3.2% in 2019 due to global trade tensions. In Russia, rail freight transport is stagnant, up just 0.2%, even with a 6.3% decline in the United States. The EU is down 1.9% in this area. It is estimated that tonne-kilometres of road freight transport continued to grow by 1% in the EU and 6.3% in Russia (ITF, 2019).

The most significant research results published concerning the vehicle fleet are mainly connected to emissions, environmental challenges (Krause et al., 2020), and road safety (Pauer et al., 2019). In this context, the establishment of logistics networks and distribution systems, both from an ecological, economical and an efficient point of view, and their analysis using statistical tools (Bac & Erdem, 2021), as well as spatial statistical studies (Szabó & Sipos, 2020), are essential aspects. The fourth and last indicator chosen to characterise road freight transport is mileage, which is an excellent indicator of the performance of the EU Member States involved in road freight transport and the haulier's situation (Nowak et al., 2019).

Following a literature review and the presentation of the research framework, a general analysis of the EU vehicle fleet is presented in Sections 3 and 4, followed by a linear regression analysis of each value and the results. Section 5 concludes with a summary of the significance of the research findings.

https://doi.org/10.55343/CogSust.16

2. Methodology

This study aims to explore the possible relationships between HDI, GDP, vehicle fleet, and mileage at the macro level across the European Union Member States from 2018 (Figure 4).

Figure 4. Research parameters for freight transport

To this end, the vehicle fleets of the Member States were examined and analysed for each category, such as small, medium and heavy vehicles, to provide an overview of the current situation. 24 Member States participated in the analysis, partly due to geographical features (e.g. island countries) or lack of data. The collected data were analysed with descriptive statistical tools, from which a comprehensive picture of the data set can be obtained immediately. A linear regression analysis was then carried out on the values presented above to see if and to what extent there is a relationship between the values.

3. Freight transport vehicle fleet in the European Union

The European Union has a significant road freight transport performance, with almost 75% of the total volume of goods transported by road. Consequently, it is essential to look at the vehicle fleets in different countries to see what trends currently dominate the market. The vehicles involved in road freight transport can be divided into three categories according to their transport capacity: small, medium and heavy goods. The GVWR (Gross Vehicle Weight Rating) determines which category a vehicle can be placed in and how much load it can safely carry. The GVWR also defines eight subcategories (ACEA Report, 2021). Figure 5 shows the number of small trucks in the European Union between 2015 and 2019.

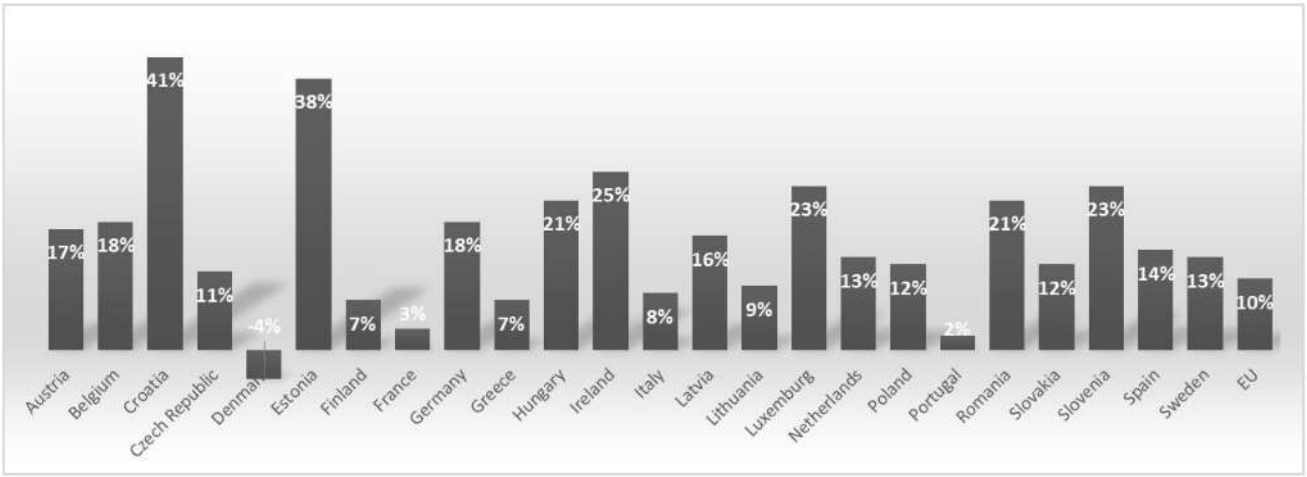

Figure 5. Change in the number of vans between 2015 and 2019 (Own editing)

As shown in Figure 4, the number of light commercial vehicles increased between 2015 and 2019 in most EU Member States, with only Denmark showing a 4% decrease. Croatia (41%) and Estonia (38%) have exceptionally high figures. Ireland follows them with 25%, then Luxembourg and Slovenia with 23%. Hungary had 388,718 light commercial vehicles in 2015, which rose to 470,454 in 2019 after a 21% increase. Overall, there is a 15–25% increase between countries. France is very far behind with 3%, Greece with 7%, Italy with 8% and Portugal with only 2%. On average, the European Union saw a 10%

https://doi.org/10.55343/CogSust.16

increase. France has the highest number of vans of all the countries listed, with around 6 million. Figure 6 illustrates the growth of medium and heavy goods vehicles in the European Union in 2019.

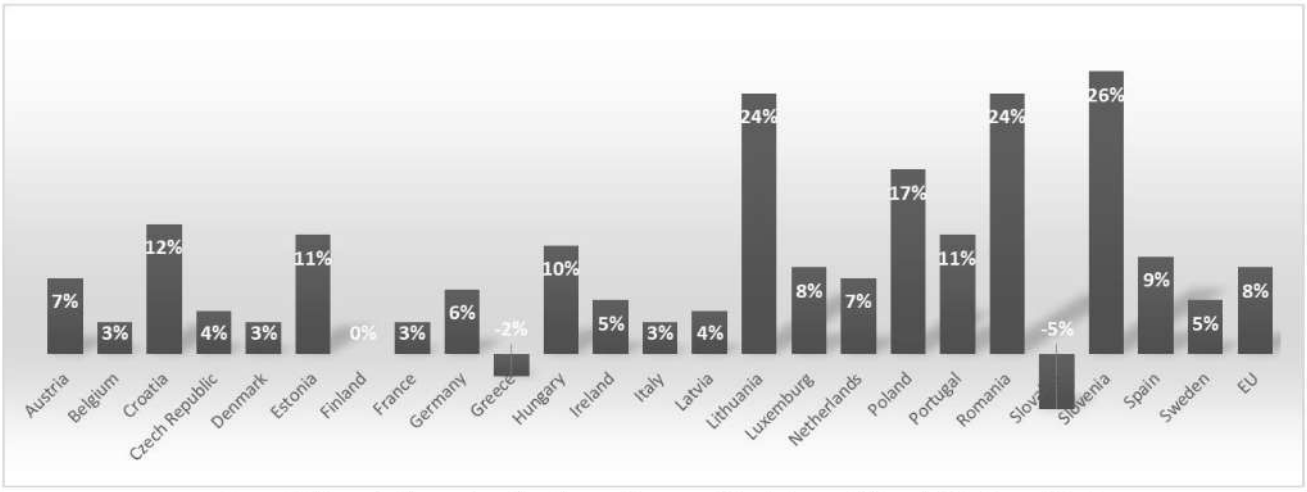

Figure 6. Change in the number of medium and heavy vehicles between 2015 and 2019 (Own editing)

In contrast to light commercial vehicles, the number of medium and heavy goods vehicles increased less in the EU. Greece saw a 2% decrease, Slovakia a 5 % decrease, and Finland stagnated. In Belgium, Denmark, France, Italy, Latvia and Denmark, a slight increase in numbers was witnessed. Slovenia had the highest growth with 26%, followed by Romania and Lithuania with 24% and Poland with 17%. For the EU, there was an 8% average increase between 2015 and 2019. The figure is 10% in Hungary, with 96,109 medium and heavy goods vehicles in 2019, compared to 87,666 in 2015.

A descriptive statistical method was used to analyse further the small, medium and heavy goods vehicles involved in freight transport. The results are presented in Table 1. The table shows that the number of elements analysed is 24 instead of 27 Member States because no such data were available for Malta, Cyprus, and Bulgaria. Consequently, further analyses were carried out for 24 Member States with 2019 data.

Table 1. Descriptive statistical results (Own editing)

	Vans	Medium and heavy vehicle
Average	1171290 pcs	259553 pcs
Standard error	320028.17	69270.62
Standard deviation	1567811.43	339355.33
Median	527772.5	95625
Mode	-	-
Minimum	38547 pcs	12300 pcs
Maximum	6029070 pcs	1150493 pcs
Sum	28110951 pcs	6229282 pcs
Sample number	24	24

The analysis shows significant differences in the number of transport vehicles between the countries studied. The average for vans is nearly 1.2 million units, and for medium and heavy goods vehicles, it is 260,000. In terms of dispersion, there is quite a significant variation in both cases.

Based on the preliminary studies and the literature review, our null hypothesis is that socio-economic development has an evident influence on the extent of freight transport. In the next section, this hypothesis is tested and will be explored to what time freight transport influences the socio-economic development if a relationship can be found.

https://doi.org/10.55343/CogSust.16

4. Regression analysis of the social and economic impact of freight transport

Linear regression was used to examine, among other things, the relationship between the change in a country's population and the characteristics of freight transport, such as fleet size and mileage, and was also prepared for the 24 countries previously analysed. To determine this, the HDI and mileage of the nations, expressed in million tonne-kilometres, were considered, and the relationship between the Human Development Index and the number of transport vehicles (Figures 7/a and b) was checked

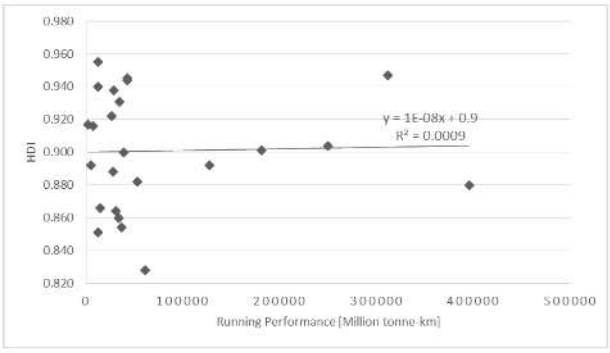

Figure 7/a. Relationship between HDI and Running Performance (Own editing)

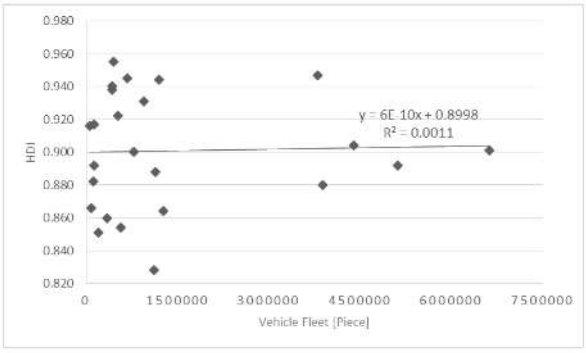

Figure 7/b. Relationship between HDI and Vehicle Fleet (Own editing)

The two graphs show no linear regression relationship for the data series under consideration. The relationship between the number of road freight vehicles and mileage is analysed below. Figure 8 clearly shows that, in this case, a correlation between the two data series can already be detected. R^2 is 0.58, which also supports the previous statement. In the present case, this value is 15.699, which means that a 1% change in the fleet of vehicles leads to a change in mileage of about 16% by 2019.

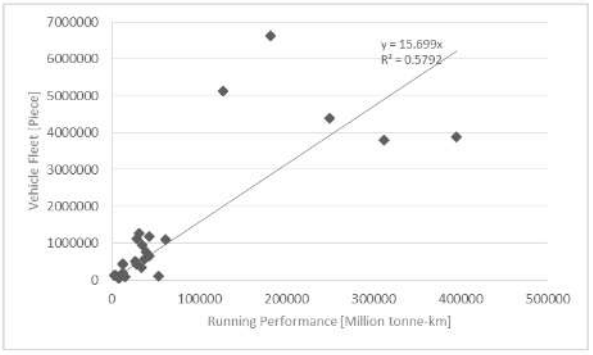

Figure 8. Relationship between number of road freight Vehicle Fleet and Running Performance (Own editing)

Figure 8 shows a direct correlation between the number of road freight vehicles and the mileage of the countries studied. This result indicates that a government, or even a company, can increase its transport performance by increasing the number of its vehicles.

In the next step, the economic correlations were analysed. The relationship between the number of transport vehicles and GDP is illustrated in Figures 9/a and b.

https://doi.org/10.55343/CogSust.16

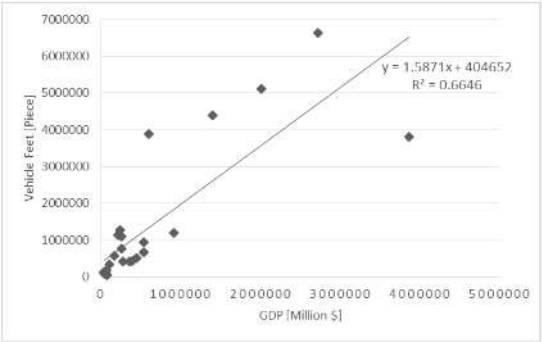

Figure 9/a. Relationship between GDP and the number of transport Vehicles (Own editing)

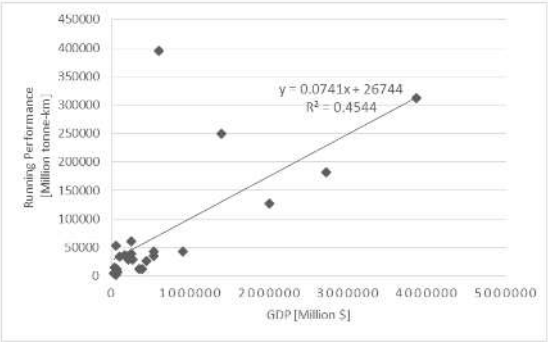

Figure 9/b. Relationship between GDP and Running Performance (Own editing)

The test between GDP and the number of goods vehicles resulted in an R^2 of 0.66, suggesting a weak positive correlation between the values and a significantly higher regression coefficient than the HDI tests. When analysing mileage and GDP, the R^2 value is 0.45, suggesting that there is also a fragile relationship between them. The other values tested are shown in Table 2.

In the analysis of fleet size and mileage, it was assumed that if the former is zero, i.e. if there is no transport vehicle, the mileage is zero. In this case, the axle section is also zero since it starts from the origin. This assumption is not valid for the other tests, so the line does not start from the origin in those cases.

The analysis of heavy goods vehicles shows that, although the Community transport policy is moving in a different direction, there has been a steady increase in the number of road transport vehicles in the EU for almost all Member States and, therefore, for the EU average. Only in very few cases has the number of road transport vehicles decreased in a given country. Consequently, it is assumed that the volumes of goods transported by road have not reduced in the recent period, but rather, as the market has required more transport vehicles, the area continues to grow. The correlations between GDP, HDI, fleet size, and mileage in 2019 have been examined in the economic and social context. Linear regression results ascend from the weakest to the most substantial relationship (Table 2).

Table 2. Results obtained by linear regression calculation

Parameters	R^2	Regression constant	Regression coefficient
Running Performance + HDI	0.0009	0.9000	$1*10^{-8}$
Vehicle Fleet + HDI	0.0011	0.8998	$6*10^{-10}$
Vehicle Fleet + Running Performance	0.5792	0	15.699
Vehicle Fleet + GDP	0.6646	404 652	$2*10^{-6}$
Running Performance + GDP	0.4545	26 744	$7*10^{-8}$

The regression coefficient is small for mileage and HDI and fleet size and HDI, showing no strong correlation between the value pairs. In contrast, the values compared to GDP are much higher, indicating a positive correlation. This yielded a surprising result, given the economic link between each value when calculating the HDI indicator, and it was previously assumed that HDI and each of the goods transport parameters were also related.

5. Conclusion

This article sought to answer the question of the relationship between economic and social indicators in a country and fleet size and mileage. This analysis was carried out for the European Union Member States based on 2019 data. From the data collected, it can be concluded that in most of the countries studied, the number of transport vehicles and the mileage increased, indicating a continuous growth in road freight transport. There is a moderately strong positive relationship between fleet size, mileage and GDP, so it can be said that these values generate each other in the direction of growth. In addition to the economic effect, freight transport performance has been compared with HDI using linear regression. No direct correlation between a country's HDI indicators and road freight transport performance has been found.

https://doi.org/10.55343/CogSust.16

Due to the recent pandemia, another exciting area of research could be how these same values evolved in 2020–21. A limitation of the study is that only one specific base year was examined, so it is impossible to get a fully comprehensive picture. However, the analysis of the fleet size also revealed an increasing trend, which has been present in the past and is likely to continue in the future. It is essential to highlight that current EU transport policy ambitions include the target of zero-emission devices for passenger cars, vans and heavy-duty vehicles by 2050. Consequently, continued monitoring and possible further development of research may be necessary. Overall, the results reflect the situation in the whole European region, highlighting how the Community's transport policy choices can affect the social and economic status.

References

ACEA (2021). *ACEA Report, Vehicles in use Europe 2021*. https://www.acea.auto/uploads/publications/report-vehicles-in-use-europe-january-2021.pdf (Downloaded: 11 March 2022)

Bac, U., Erdem, M. (2021). Optimisation of electric vehicle recharge schedule and routing problem with time windows and partial recharge: A comparative study for an urban logistics fleet. *Sustainable Cities and Society*. 70, 102883. DOI: https://doi.org/gphpw2

Bîzoi, G., Bîzoi, A. C., Sipos, G. L., Sipos, C. (2015). The Transport and Logistics Sector's Performance and the Social Development – A Comparison within the European Union. *Studia Universitatis Babeş-Bolyai Oeconomica*. 60(1), 68–81.

IMF International Monetary Fund (2019). *World Economic Outlook Databases*. https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases#sort=%40imfdate%20descending (Downloaded: 2 March 2022)

ITF International Transport Forum (2019). *Key Transport Statistics*. https://www.itf-oecd.org/sites/default/files/docs/key-transport-statistics-2020.pdf (Downloaded: 16 February 2022)

KSH – Hungarian Central Statistical Office (2008). A humán fejlettségi mutató. *Statisztikai Tükör*. 2(85). https://www.ksh.hu/docs/hun/xftp/gyor/jel/jel308042.pdf (Downloaded: 28 February 2022)

Krause, J., Thiel, C., Tsokolis, D., Samaras, Z., Rota, C., Ward, A., Prenninger, P., Coosemans, T., Neugebauer, S., Verhoeve, W. (2020). EU road vehicle energy consumption and CO_2 emissions by 2050 – Expert-based scenarios. *Energy Policy*. 138, 111224. DOI: https://doi.org/gnkg7w

Kumar, A., Anbanandam, R. (2019). Development of social sustainability index for freight transportation system. *Journal of Cleaner Production*. 210, 77–92. DOI: https://doi.org/gjz79b

Ladi, T., Mahmoudpour, A., Sharifi, A. (2021). Assessing impacts of the water poverty index components on the human development index in Iran. *Habitat International*. 113, 102375. DOI: https://doi.org/gkfhjr

Liu, K., He, M., Zhuang, Z., He, D., Li, H. (2020). Unexpected positive correlation between human development index and risk of infections and deaths of COVID-19 in Italy. *One Health*. 10, 100174. DOI: https://doi.org/ghnwqp

Nowak, M., Hewitt, M., Bachour, H. (2019). Mileage bands in freight transportation. *European Journal of Operational Research*. 272(2), 549–564. DOI: https://doi.org/hr9h

Our World in Data (s.a.). *The Human Development Index around the world.* https://ourworldindata.org/human-development-index (Downloaded: 9 March 2022)

Pauer, G., Sipos, T., Török, Á., (2019). Statistical analysis of the effects of disruptive factors of driving in simulated environment. *Transport*. 34(1), 1–8. DOI: https://doi.org/gm4j

Reddit.com website: https://www.reddit.com/r/europe/comments/ee7fr9/european_countries_by_human_development_index/; (Downloaded: 19 May 2022)

Szabó, Zs., Sipos. T. (2020). Térstatisztika a közlekedésben: Spatial statistics in transport. *Műszaki Szemle*. 75, 1–7. https://ojs.emt.ro/index.php/muszakiszemle/article/view/261

UNDP (2020). *Human Development Report. The next frontier – Human development and the Anthropocene* https://hdr.undp.org/content/statistical-update-2018" https://hdr.undp.org/content/statistical-update-2018 , (Downloaded: 22 February 2022)

Yero, E. J. H., Sacco, N. C., Nicoletti, M. C. (2021). Effect of the Municipal Human Development Index on the results of the 2018 Brazilian presidential elections. *Expert Systems with Applications*. 168, 114305. DOI: https://doi.org/hr9j.