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Passenger potential and the operating result of the public transport organization

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Abstract: *This study analyzes the type and direction of the impact of external factors on the operating results of the public transport organization operations. The multivariate regression model using the hierarchical method was applied in the study, which was utilized to indicate which of the factors and in what way affect the operating results of the investigated public transport organizations. Several variables from the NTD database on passenger transport were selected for the analysis, considering a type of organizations providing services of direct transport (transit company) or services contracted with a third party (private operator). In terms of external factors, the ones directly related to providing transport services and being on the side of passengers were identified and selected. In turn, the operating result was defined as the difference between revenues from fares and operating costs. The ultimate model included four factors that adequately include the explanatory variable and determine passenger potential. The empirical results indicate that the organizations that suffer losses simultaneously serve a significant part of the passenger transport market. At the same time, the operating result in public transport is significantly determined by passenger kilometers, the number of passengers, the population of the urbanized area, and average travel cost. These are the major factors in predicting the operating result in public transport. The vast majority of the surveyed public transport organizations recorded a loss proportional to the market share. Therefore, a decline in the level of individual factors determining passenger potential reduces the level of potential revenues from fares, and this, in turn, increases the loss. Therefore, when planning the operations of public transport, it is crucial to pay attention to primarily the factors determining the demand for this type of service.*

Keywords: operating financial results, public transport, passenger transport, public budget

JEL: R4, R5

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Introduction

An important role in the development of public transport is played by creating an effective system of public transport contributing to a sustainable improvement in the quality of life of society on a local, regional, and national level (Stjernborg & Mattisson, 2016; Buzási et al., 2015; Chen & Hisham Hashima, 2016). Hence, the extent of public transport is not limited only to cities but to entire urbanized areas (over 50% of the world population live in urbanized areas) (World Urbanization Prospects, 2019). This system is shaped, among others, based on economic solutions and social expectations. Therefore, the shape of the public transport network is the result of the impact of many needs and the possibilities of their implementation, while these processes occur in parallel and affect transport services (Pavol et al., 2018).

Public transport satisfies certain transport needs, using various branches and means of transport available in the specific geographical area. Well-targeted investments and the accessibility of infrastructure encourage the use of public transport and simultaneously contribute to an improvement in the economic condition of the served areas and transport organizers (Basso & Silva, 2014). A. Ardila-Gomez and A. Ortegon-Sanchez (2016) claim that public transport is of crucial importance for economic development and an improvement in the quality of life of citizens by providing access to places and activities for work, and education, services, or leisure. Moreover, O. Oliinyk et al. (2021) claim that providing high quality and inexpensive public transport system requires striving for a financial balance, which means that revenues must be sufficient to cover new infrastructure investments while financing the maintenance and exploitation of the existing assets and services.

At the same time, revenues from ticket fares very often do not cover the marginal cost of providing the service (Holmgren, 2014). This is particularly beneficial for passengers who need transport in a specific area. The positive operating result of the public transport organization operations is determined by fixed and variable costs, the tariff setting policy, or competition from private vehicles, especially in sparsely populated areas (Hörcher &Tirachini, 2021). Therefore, further research focuses on the identification and assessment of factors relating to the demand for public transport services, influencing the level of revenues and operating costs in the order of significance of their impact. It is assumed that isolating some significant factors in predicting the level of the operating result will increase the impact of the public transport organization on the level of the generated profit or reduce its loss.

1. Literature review

Public collective transport has been losing popularity for years. Travelers less and less often choose this mode of transport to move in urban and non-urban areas, despite the growing population of global economies. The most important function of public collective transport is to provide a transport service to a group of people. This function determines the efficiency of the transport system in relation to the achievement of public objectives (Yankevich, 2019). The second very important function is to stimulate the development of a certain area by developing the supply of transport services and accessibility to places. An effectively operating and developed public transport system should meet the challenges of constantly increasing availability in time and the space of transport services, the need to develop intermodal transport as well as challenges of reducing transport costs (Setamanit, 2019). The implementation of individual challenges results from specific conditions. They, among others, refer to the quality of infrastructure, efficient organization of processes, and relevant resources (Martinez &Viegas, 2017).

The application of principles of logistics in public transport allows for continuous optimization of transport processes understood as the participation of operators and structural objects in the process of providing all transport services (Sałek, 2021; Poliak et al., 2018). The logistic approach during the development of the technical infrastructure of passenger transport consists primarily of the shortest possible connections between the main locations where passenger flows are generated (Xu et al., 2013; Chen et al., 2018). The logistic approach to management by means of passenger flows requires the combination of separate elements of the transport process in a way that will be able to provide transport services at the highest possible quality level at the lowest possible costs (Konecny et al., 2018). The proper management of this system is difficult and requires extensive knowledge of factors that have a significant impact on the most efficient implementation of the transport process and optimization of related costs (Boschman & Kwan, 2008; Vakula & Raviteja, 2017). On the other hand, understated fares, and public budget support help to reduce various external costs related to environmental pollution and the risk of accidents (Litman, 2022; Bayar et al., 2020). The financing of activities of public transport primarily needs to be dealt with by public local government budgets (Poliak et al., 2017; Trippner-Hrabi & Podgórniak-Krzykacz, 2018; Androniceanu et al., 2022).

There are many factors that affect the choice of means of public transport by potential passengers. They include, among others, availability, environmental aspects, infrastructure, or demographics of a specific area (Ryley et al., 2014; Mishchuk et al., 2019). The choice of the public means of transport is fairly stable in big cities, in particular, due to the growing daily mobility of inhabitants (Szołtysek, 2009; Pawlasova, 2015; Shen et al., 2016). In medium and small towns and villages, this positive trend is generally not present. This is mainly due to the often lower comfort of travel compared to passenger cars or the unpunctuality of public transport. There are also problems with safety and proneness to numerous disruptions in the smoothness of the transport process (Xylia & Silveira, 2017; Matei &Luca, 2022). All of this creates not a sufficiently positive image of collective public transport in society (Delbosc & Currie, 2011). Therefore, it is important to effectively encourage the use of public transport services in urban areas. Moreover, according to K. Janovská et al. (2021), there is a need in the public sector to change the approach to the effectiveness and financial management in the public sector, including public transport to ensure maximum efficiency of services provided with the proper use of public funds.

The appropriate level of ticket fares in public transport and the number of passengers using this type of transport should at least reduce the final losses incurred by public transport organizers. Any additional financial resources generated, in turn, boost the development of cities and urban areas served by public transport. G.G Noja et al. (2021) indicated there is a strong positive relationship between public expenditure and economic and social development.

2. Research methodology

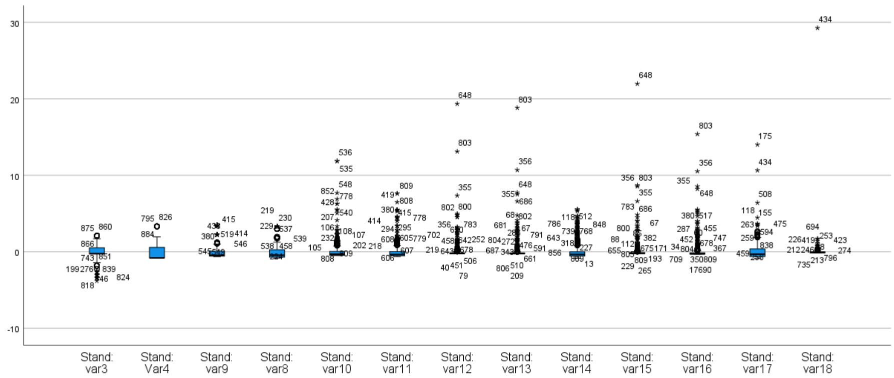
2.1 Data source

There are many definitions of the operating result in the literature. For the purposes of the research and on the basis of the available data, in this study, it is the difference between revenues from ticket fares and operating costs. Hence, it will relate to direct revenues and expenses from passenger services in both rail and road transport. The set of data used in the research came from the National Transit Database (NTD) and included current annual data on public transport broken down by the mode and type of service (NTD Data, 2020, https://www.transit.dot.gov/). All the reported data include:

- Directly Operated (DO) – the service provided directly by the transit company
- Purchased Transportation (PT) – the service contracted with a third party, usually a private operator.

The database included public means of both rail and road transport. All the analyzed data are quantitative. The preliminary database contained 2246 lines from which the entities inactive in the last analyzed year (which did not provide data) were removed. Subsequently, the lines with missing data were also removed. After cleaning the database, 884 lines remained for further analysis. In order to remove outliers, the boxplot of the standardized values of all the variables was generated (Figure 1).

Figure 1. The boxplot of all the standardized observations



According to the generated boxplot, which was the summary of the selected standardized variables, one may identify single observations, e.g., 648, 803, 434 etc., which should be excluded from the further study. In total, nine observations, which significantly stood out from the other data, were excluded. Finally, the analysis included 875 observations. The general characteristics of the research sample broken down by the structure of the surveyed public transport organizations are presented in Table 1.

Table 1. Characteristics of organizations providing public transport services

Public transport organization	Market share	Share in the number of	Share in passenger kilometers	Operating result [$ million]
City, County or Local Government Unit or Department of	40.6	30.93	21.87	-4060
Independent Public Agency or Authority of Transit Service	52.6	63.60	72.19	-11135
MPO, COG or Other Planning	2.4	0.25	1.23	-24
Other Publicly Owned or Privately Chartered Corporation	0.3	1.61	1.33	-125
Private Provider Reporting on Behalf of a Public Entity	0.7	0.05	0.20	-11
Private-For-Profit Corporation	0.2	0.04	0.26	0.5
Private-Non-Profit Corporation	1.0	0.07	0.05	-17
State Government Unit or Department of Transportation	1.1	0.94	1.32	-169
Subsidiary Unit of a Transit Agency, Reporting Separately	0.3	1.85	1.36	-372
University	0.7	0.66	0.18	2

When analyzing the results of public organizations in detail, it is observed that losses are suffered by the organizations that simultaneously have the largest share in serving the public transport market. In turn, profit is generated in the organizations with a smaller range. The organizations that generated a profit receive more revenue from passenger fares in relation to operating costs incurred. In the case of the other organizations, the number of passenger kilometers and the number of passengers ought to translate into an increase in the level of fares as well as more efficient management of expenses related to variable and fixed costs of the maintenance and use of transport infrastructure.

2.2 Research method

In order to identify and select important factors influencing the operating result of public transport organizations, the multivariate regression model was used. Multiple regression is an extension of simple regression with one predictor and allows for verifying in what way several explanatory variables explain the dependent variable. This method makes it possible to determine the extent to which all the predictors together explain the variance of the results of the dependent variable. Moreover, it provides information on the relationship of each independent variable with the dependent variable. The general equation for multivariate regression (1) has the form (Alexopoulos, 2010):

$$Y_i = b_0 + b_1 * x_1 + b_2 * x_2 + \ldots + b_i * x_i \qquad (1)$$

In this equation, Y_i denotes the predicted value of the explained variable when considering the specific value of the first predictor X_1, the second predictor X_2; b_0 denotes the intersection of the regression plane with the axis Y, i.e., the predicted value of the dependent variable, when both predictors equal 0. B_1 and b_2 are the regression coefficients informing on how fast the value of the dependent variable changes along with an increase in the predictor by one unit.

In order to consider the strength of individual relationships of the independent variables (hereinafter called predictors), selected for the study with the dependent variable, the hierarchical regression model was used to increase the accuracy of prediction. Due to such a regression analysis, it is possible to obtain information on whether adding another predictor significantly improved the fit of the model, i.e., whether an increase in R^2 is significant. When adding another variable to the model, the value of the R^2 statistics always increases, therefore, it is worth verifying if the change is significant. In this way, individual factors, which, according to the r-Pearson testing, have the strongest links with the phenomenon considered, were successively introduced into the model.

3. Results

3.1 Defining the model components

In order to check in what way external factors influence the level of the operating result (profit or loss), the following set of final variables considered in the study was defined.

The dependent variable Y – the value of the variable of the operating result (Var19) calculated as the difference in revenues from fares and operating costs of the public transport organization in individual populated areas of the country.

The independent variables Xi, i.e., predictors, i.e.:

1. Population of the urbanized area (Var9) is expressed as the number of inhabitants living in the geographical space, mainly in the urban area.
2. Population of the area served by the organization (Var11) expressed as the number of inhabitants living in the geographical space, served by one of the public transport organizations.

3. Passenger kilometers (Var12) expressed as the number of passenger kilometers performed by means of passenger transport throughout the year.
4. Average Cost per Trip (Var17) expressed in dollars as the ratio of total operating costs to the number of unrelated passenger journeys.
5. Square kilometers of the urbanized area (Var8) is expressed as the number of kilometers of the surface of the urbanized area.
6. Square kilometers of the urbanized area served by one of the public transport organizations (Var10) is expressed as the number of kilometers of the surface of the urbanized area served by one of the public transport organizations.
7. Average Trip Length (Var14) is expressed as the ratio of passenger kilometers to the number of unrelated passenger journeys.

All the data are quantitative. Both the predictors and the dependent variable are expressed on a continuous quantitative scale.

3.2 Testing the theoretical assumptions

The condition for applying multivariate regression is the lack of strong correlation between the individual predictors (Krzyśko & Waszak, 2013). For this purpose, the preliminary study of the correlation with the Pearson test was carried out. Both the significance of the relationship between single variables and the strength of the relationship is included in Table 2.

Table 2. Correlations between the variables considered

Correlation

		Operating result	Population of an urbanized area	Passenger kilometers	Average Cost per Trip	Square kilometers of an urbanized area	'Square kilometers of an urbanized area	Population of the area served by the agency	Unlinked Passenger Trips	Average trip length
Operating result (Var19)	Pearson's coefficient	--								
Population of an urbanized ares (Var9)	Pearson's coefficient	-,277**	--							
	Significance (two-tailed)	,000								
Passenger kilometers (Var12)	Pearson's coefficient	-,827**	,284**	--						
	Significance (two-tailed)	,000	,000							
Average Cost per Trip (Var17)	Pearson's coefficient	,133**	-,036	-,190**	--					
	Significance (two-tailed)	,000	,293	,000						
Square kilometers of an urbanized area (Var8)	Pearson's coefficient	-,295**	,835**	,297**	,020	--				
	Significance (two-tailed)	,000	,000	,000	,545					
Square kilometers of the area served by the agency (Var10)	Pearson's coefficient	-,071	,065	,088**	-,010	,112**	--			
	Significance (two-tailed)	,037	,055	,009	,763	,001				
Population of the area served by the agency (Var11)	Pearson's coefficient	-,399**	,533**	,436**	-,039	,504**	,379**	--		
	Significance (two-tailed)	,000	,000	,000	,246	,000	,000			
Unlinked Passenger Trips (Var13)	Pearson's coefficient	-,846**	,213**	,839**	-,213**	,217**	,017	,269**	--	
	Significance (two-tailed)	,000	,000	,000	,000	,000	,619	,000		
Average trip length (Var14)	Pearson's coefficient	,100**	,004	,051	-,036	,023	,253**	,216**	-,122**	--
	Significance (two-tailed)	,003	,917	,129	,293	,498	,000	,000	,000	

Based on the analysis of the correlation between the individual independent variables, i.e., predictors, strong correlations were indicated for the variables, i.e.: Square kilometers of an urbanized area (Var8); Square kilometers of an urbanized area served by the agency (Var10) and Population of the area by the agency (Var11), for which r > 0.4. The strong mutual relationship between these variables excludes them from further study. At the same time, the predictor Average Trip Length (Var14) is very weakly correlated with the dependent variable, therefore, it was also removed from the further analysis. All the other analyzed predictors, i.e.: Var9, Var12, Var13, and Var17 are significantly correlated with the dependent variable Y (Operating results – Var19) and weakly with each other, which fulfills the conditions for conducting the process of the multivariate regression analysis.

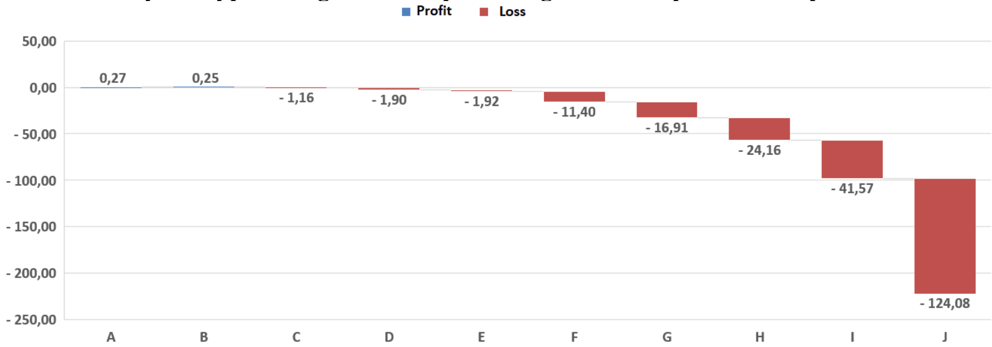
The results of the multivariate regression analysis carried out using the input method began with the summary of the average value of the individual variables (Table 3).

Table 3. Average values of the variables studied

Variables	Average value
Passenger kilometers	20.46 million km
Unlinked Passenger Trips	2.21 million passengers
Population of an urbanized area	1.88 million people
Average Cost per Trip	28 $/trip
Operating result	$-18.14 million

The obtained information indicates that the average number of kilometers performed by passengers in the analyzed period amounted to over 20 million. More than 2 million passengers used public transport at that time, and the average level of the population was 1.88 million people. The average unit travel costs amounted to $28. The average financial result was $18 million on average, and it was negative. This means that a significant proportion of organizations that deal with providing collective public transport suffer a financial loss. In total, these are ten different organizations, among which on average only two organizations record operating profits, i.e.: University (A) and Private-For-Profit Corporation (B). For the other organizations, i.e.: MPO, COG or Other Planning Agency (C); Private Provider Reporting on Behalf of a Public Entity (D); Private-Non-Profit Corporation (E); City, County or Local Government Unit or Department of Transportation (F); State Government Unit or Department of Transportation (G); Independent Public Agency or Authority of Transit Service (H); Other Publicly-Owned or Privately Chartered Corporation (I) and Subsidiary Unit of a Transit Agency, Reporting Separately (J), it is a loss. The graphical presentation of the operating result for organizations providing public transport services is illustrated in Figure 2.

Figure 2. The average level of the operating result broken down by the type of organization providing collective public transport



3.3 Modelling predictions for the operating result

According to the assumption of the hierarchical regression (like Radkiewicz & Zieliński, 2010), the variables will be introduced into the model in the selected order, according to the strength of the relationship with the dependent variable. Therefore, the order of introducing the variables into the model is the following: i.e.: Var13 for r=0.846; Var12 for r= 0.827; Var9 for r =0.277 and Var17 for r= 0.133. Table 4 summarizes the independent variables selected for the analysis with the order of their introduction to the model broken down by the impact on the dependent variable. In the case of the hierarchical analysis with four predictors, the summary of the four models will be obtained (Table 4).

Table 4. The variables introduced into the model

Model	Variables introduced	Method
1	Passenger kilometers (Var12)	Introduction
2	Unlinked Passenger Trips (Var13)	Introduction
3	Population of an urbanized area (Var9)	Introduction
4	Average Cost per Trip (Var17)	Introduction

The results in Table 5 indicate that the first of them is the same as in the case of simple regression. In turn, each subsequent one shows whether adding another predictor significantly improved the accuracy of prediction. Therefore, the most relevant part of the analysis is the results for step 4, in which the total impact of all the predictors on the dependent variable is analyzed.

Table 5. The model – the summary step by step

Model	R	R^2	Cor. R^2	Change statistics				
				R-square change	F of the change	df1	df2	Change F significance
1	0.846	0.716	0.715	0.716	23.88	1	875	<.001
2	0.873	0.762	0.761	0.046	16.68	1	874	<.001
3	0.875	0.765	0.765	0.003	12.52	1	873	<.001
4	0.876	0.768	0.767	0.003	10.27	1	872	.001

The first value R= 0.846 corresponds to the strength of the correlation with one predictor, in turn, the other Rs inform the strength of the multiple correlations and describe the degree of the linear relationship between two variables – the dependent variable and the other, which is the linear combination of the predictors calculated according to the formula (2) (Bedyńska & Brzezicka, 2007):

$$R = \sqrt{M + \beta_1 r_{x1} + \beta_2 r_{x2} + \cdots + \beta_k r_{xk}} \qquad (2)$$

where β stands for standardized regression coefficients

r – coefficients of the correlation of the predictor with the dependent variable.

The value of the corrected R^2 in the second step was 0.761 and it means an increase in R^2 by 0.046, i.e., by 6%. Adding the second predictor significantly improved the prediction, since the value of the F test (2.874) = 16.68; p <0.001. The value of the F test (3.873) = 12.52; p <0.001 means that adding the third predictor was statistically significant. Also, adding the fourth predictor significantly improved the prediction of the model, since F (4.872) = 10.27; p <0,001. The R^2 value, close to one, means a good fit to the model, due to which it is possible to explain the variability of the phenomenon at the level of at least 70%.

Table 6. The analysis of variance

Model		Sum of squares	df	Mean square	F	Significance
1	Regression	138.000	1	138.00	22.881	<.001
	Residual	55.000	875	9.900		
	Total	194.000	876			
2	Regression	147.000	2	739.000	23.215	<.001
	Residual	46.000	874	5.100		
	Total	194.000	876			
3	Regression	148.000	3	495.000	24.283	<.001
	Residual	45.000	873	5.600		

Model		Sum of squares	df	Mean square	F	Significance
	Total	194.000	876			
4	Regression	149.000	4	372.000	23.097	<.001
	Residual	45.000	872	5.400		
	Total	194.000	876			

Based on Table 6, it is possible to observe that the model with four predictors explains more variance than the model with one predictor. The value of the F statistics for the model is F (4.875) = 23.097; p < 0.001. This means that the model significantly explains the variability of the operating results of organizations dealing with collective public transport. To verify the predicted values of the regression coefficients for both predictors, the values of the coefficients in Table 7 should be read.

Table 7. Estimating the coefficients of the regression model

Model		Non-standardized coefficients		Standardized coefficients	t	p
		B	Stand. error	Beta		
1	(Intercept)	-5613527.414	88884.864		-6.316	<.001
	Var13	5.654	0.120	-0.846	-46.946	<.001
2	(Intercept)	-4284791.038	82021.018		-5.224	<.001
	Var13	-3.438	0.203	-0.514	-16.959	<.001
	Var12	-0.305	0.023	-0.395	-13.026	<.001
3	(Intercept)	-2721121.343	92695.076		-2.936	.003
	Var13	-3.472	0.202	-0.520	-17.221	<.001
	Var12	-0.288	0.024	-0.374	-12.153	<.001
	Var9	-0.967	0.273	-0.061	-3.539	<.001
4	(Intercept)	-15320.880	125005.842		-0.012	.990
	Var13	-3.537	0.202	-0.529	-17.547	<.001
	Var12	-0.290	0.024	-0.376	-12.288	<.001
	Var9	-0.954	0.272	-0.060	-3.510	<.001
	Var17	-9.030	2.478	-0.054	-3.206	.001

To predict the operating results based on the successively introduced independent variables, i.e.: Unlinked Passenger Trips; Passenger kilometers, Population of an urbanized area, and Average Cost per Trip, the hierarchical regression analysis was carried out. These factors relating to the demand side of public transport services constitute a certain type of passenger potential.

The assumed model, considering four predictors (Table 7), significantly better predicts the operating results of public transport organizations, which is indicated by the R^2 change (change = 0.052, i.e., by 7.2% and p <0.001). The model turned out to be a good fit for the F data (4; 872) = 10.27; p <0.001. All the predictors allow for a significant prediction of the dependent variable, whereas Unlinked Passenger Trips (beta = -0.529; p <0.001) is a stronger predictor than Passenger kilometers (beta = -0.376; p <0.001), which, in turn, is a stronger predictor than Population of an urbanized area (beta = -0.060; p < 0.001), and this, in turn, is stronger than Average Cost per Trip (beta = -0.054; p < 0.001). This model (3) can be written as:

$$\mathbf{Y_i} = -15320.880 - 3.537 \text{ Unlinked Passenger Trips} - 0.290 \text{ Passenger kilometers} - 0.954 \text{ Population of an urbanized area} - 9.030 \text{ Average Cost per Trip} \quad (3)$$

The intercept at the level of -15320,880 does not change depending on the change in the predictor, which means that the lack of the impact of the factors considered amounts to lose a generation in public transport organizations at the level of about $15 thousand. This value is significantly different from zero, which is indicated by the t-test result (875) = -6.316; p < 0.001.

4. Research results and discussion

The conducted analysis of the hierarchical multivariate regression made it possible to determine whether the introduced predictors are related to the dependent variable as well as what their strength and direction of this relationship is. The level of the operating results is mostly influenced by Unlinked Passenger Trips, Passenger kilometers, Population of an urbanized area and Average Cost per Trip. These predictors explain the variability of the operating result of public transport organizations in over 76%. Since the vast majority of organizations in the study recorded losses in the last analyzed year, the results should be interpreted in relation to this. At the same time, the relationship between the operating result and the individual predictors is negative. This means that a decline in the number of passengers, the kilometers performed by them or a decrease in the population of the region will increase the level of loss, i.e., the difference in the operating result understood as the difference between revenues from fares and operating costs from transport operations. The loss was recorded in almost all the cases of the considered types of organizations. This means that the decline in the level of the individual external factors named in this study as the passenger potential decreases the level of potential revenues from fares. Therefore, when planning the operations of collective public transport, it is crucial to pay attention primarily to the number of passengers and the number of kilometers performed by them using public transport.

5. Conclusions

Public transport systems are currently operating with different deficits. In addition to fares borne by travelers, all the other operating and maintenance costs are covered mainly by the public sector budget. Managing public transport, due to the population density of the country and the misconception that it is primarily intended for the poorer part of the society increases financial losses. However, the population of the urbanized area, number of passengers, or number of their journeys currently constitute the dominant external factors that affect the operating results of collective public transport entities.

Due to environmental and economic aspects, public transport requires the support and the change in its management so as to involve an increasing number of people from urbanized areas and with the largest population. The losses suffered by the entities providing public transport services can be mitigated by applying incentives to passengers by promoting the benefits of collective transport visible in the environmental protection. Moreover, the policy of tariffs and charges for single and multiple-use tickets also requires modification. An important aspect is also participation in events that require transport services. Furthermore, indicating the factors of the impact of passenger potential on the profitability of transport organizations may be used in further studies to analyze the profitability threshold for passenger journeys in the areas with the specific population.

Authors Contributions

The author/authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Alexopoulos, E. C. (2010). Introduction to Multivariate Regression Analysis. *Hippokratia 14(1),* 23-8.

Andrei, L., Luca, O. (2022). Towards a sustainable mobility development in Romanian cities. a comparative analysis of the sustainable urban mobility plans at the national level. *Management Research and Practice*, 14(1), March, 30-40.

Androniceanu, A., Georgescu, I., & Kinnunen, J. (2022). Public administration digitalization and corruption in the EU member states. A comparative and correlative research analysis. *Transylvanian Review of Administrative Sciences*, No. 65 E, February, 5-22.

Ardila-Gomez, A., and & Ortegon-Sanchez, A. (2016). Sustainable Urban Transport Financing from the Sidewalk to the Subway. *2016 International Bank for Reconstrucion and Development*.

Attila, B., and Csete, M. (2015). Sustainability indicators in assessing urban transport systems. *Periodica Polytechnica. Transportation Engineering* 43(3), 138-145, doi: 10.3311/PPtr.7825

Bayar, Y., Remeikiene, R., Androniceanu, A., Gaspareniene, L., & Jucevicius, R. (2020). The shadow economy, human development and foreign direct investment inflows. *Journal of Competitiveness*, 12(1), 5-21. Doi: https://doi.org/10.7441/joc.2020.01.01

Basso, L., and Silva, H.S. (2014), Efficiency and substitutability of transit subsidies and other urban transport policies. *American Economic Journal: Economic Policy,* 6(4*)*, 1-33.

Bedyńska, S., and Brzezicka, A. (2007). Statystyczny drogowskaz. Praktyczny poradnik analizy danych w naukach społecznych na przykładach z psychologii, Wydawnictwo Academica, Warszawa.

Berezny, R., and Konecny, V. (2017). The impact of the quality of transport services on passenger demand in the suburban bus transport. *Procedia Engineering,* 192, 40-45, doi: 10.1016/j.proeng.2017.06.007.

Boschman, E. & Kwan, M.P. (2008). Towards socially sustainable urban transportation: Progress and potential. *International Journal of Sustainable Transportation*. 2, 138-157.

Chen, J., Lu Y. & Cui M. (2018). Estimating alighting stops of smart card public transportation passengers based on travel patterns. *Journal of Xi'an University of Architecture & Technology (Natural Science Edition),* 50(1*)*, 23-29, doi:10.15986/j.1006-7930.2018.01.005.

Chen Kwan, S., and Hisham Hashima J. (2016). A review on co-benefits of mass public transportation in climate change mitigation. *Sustainable Cities and Society,* 22, 11-18.

Delbosc, A., and Currie, G. (2011). Transport problems that matter—Social and psychological links to transport disadvantage. *Journal of Transport Geography,* 19*,* 170-178, doi: 10.1016/j.jtrangeo.2010.01.003

Holmgren, J. (2014). A strategy for increased public transport usage—The effects of implementing a welfare maximizing policy. *Research in Transportation Economics,* 48, 221–226, doi.org/10.1016/j.retrec.2014.09.046.

Hörcher, D. & Tirachini A. (2021). A review of public transport economics. *Economics of Transportation,* 25, 1-34, doi.org/10.1016/j.ecotra.2021.100196.

Janovská, K., Vozňáková, I., Orlíková, L. & Tománek P. (2021). The efficiency of providing public services in transport. *Administratie si Management Public,* 37, 60-73, doi: 10.24818/amp/2021.37-04.

Konečny, V., Berežny, R., Kostolna, M. & Saradín P. (2018). Comparative Analysis of the Importance of the Requirements of Passengers and Evaluating the Quality of Air and Bus Transport. *MATEC Web of Conferences,* 236, doi: 10.1051/matecconf/201823602006

Kral, P., Janoskova, K. & Kliestik, T. (2018). Key determinants of the public transport user's satisfaction. *Administratie si Management Public,* 31*,* 36-51, doi: 10.24818/amp/2018.31-03

Krzyśko, M., and Waszak, Ł. (2013). Functional canonical correlation analysis for functional data. *Biometrical Letters,* 50(2), 95-105, doi.org/10.18778/0208-6018.325.12

Maria, X., and Silveira, S. (2017). On the road to fossil-free public transport: The case of Swedish bus fleets. *Energy Policy* 100(1), 397-412, doi: 10.1016/j.enpol. 2016.02.024

Martinez, L.M., and Viegas, J.M. (2017). Assessing the impacts of deploying a shared self-driving urban mobility system: An agent-based model applied to the city of Lisbon, Portugal. *International Journal of Transportation Science and Technology,* 6*,* 13-27, doi.org/10.1016/j.ijtst.2017.05.005

Mishchuk, H., Samoliuk, N. & Bilan Y. (2019). Measuring social justice in the light of effectiveness of public distributive policy. *Administratie si Management Public,* 32, 63-76, doi: 10.24818/amp/2019.32-05

Noja, G.G., Cristea, M., Thalassinos, E. & Kadłubek, M. (2021). Interlinkages between Government Resources Management, Environmental Support, and Good Public Governance. Advanced Insights from the European Union. *Resources,* 10 (5*),* 41. https:// doi.org/10.3390/resources10050041

NTD Data, https://www.transit.dot.gov/ntd/ntd-data (access: 03.03.2022)

Oliinyk, O., Bilan, Y., Mishchuk, H., Akimov, O. & Vasa, L. (2021). The Impact of migration of highly skilled workers on the country's competitiveness and economic growth. *Montenegrin Journal of Economics,* 17(3), 7-19, doi: 10.14254/1800-5845/2021.17-3.1

Pawlasova, P. (2015). The factors influencing satisfaction with public city transport: A structural equation modeling approach. *Journal of Competitiveness,* 7(4*),* 18-32, doi: 10.7441/joc.2015.04.02

Poliak, M., Hammer, J., Reuter, N. & Poliakova, A. (2018). The impact of the transport route on the cost of the transfer. *2018 XI International Science-Technical Conference Automotive Safety*, 1-6, doi: 10.1109/AUTOSAFE.2018.8373319

Poliak, M., Semanova, S., Mrinikova, M., Kamoackova, L. & Simurkova P. (2017). Financing public transport services from public funds. *Transport Problems* 12(4), 61-72, doi: 10.20858/tp.2017.12.4.6

Radkiewicz, P. & Zieliński, M. (2010). Hierarchical linear models - their advantages and reasons for application. *Psychologia Społeczna,* 14*,* 217-233.

Ryley, T.J., Stanley, P.A., Enoch, M.P., Zanni, A.M. & Quddus M.A. (2014). Investigating the contribution of demand responsive transport to a sustainable local public transport system. *Research in Transportation Economics,* 48*,* 364-372, doi: 10.1016/j.retrec.2014.09.064

Sałek, R. (2021). The Importance of Telematic Information and Logistics Indicators for the Management of the Quality of Transport Services. *Production Engineering Archives,* 27(3), 176-183, doi: 10.30657/pea.2021.27.23

Setamanit, S. (2019). Improving transportation contract management using simulation. *Polish Journal of Management Studies,* 20(2)*,* doi: 10.17512/pjms.2019.20.2.39

Shen, W., Xiao, W. & Wang, X. (2016). Passenger satisfaction evaluation model for Urban rail transit: A structural equation modeling based on partial least squares. *Transport Policy,* 46, 20-31, doi.org/10.1016/j.tranpol.2015.10.006

Stjernborg, V., and Mattisson O. (2016). The Role of Public Transport in Society—A Case Study of General Policy Documents in Sweden. *Sustainability, 8,* 1120, doi:10.3390/su8111120

Szołtysek, J. (2009). Podstawy logistyki miejskiej. Wydanie drugie. Wydawnictwo Akademii Ekonomicznej w Katowicach. Katowice.

Trippner-Hrabi, J., and Podgórniak-Krzykacz A. (2018). Innovations in Local Public Transport-Significance for the Local Community. *European Spatial Research and Policy,* 25(2), 117-135, doi.org/10.18778/1231-1952.25.2.07

Vakula, D., and Raviteja B. (2017). Smart public transport for smart cities. *The 2017 International Conference on Intelligent Sustainable Systems (ICISS),* Palladam, India, 7-8; 805-810.

Xu, W., Deng, C. & Liu, B. (2013). Approach on Public Traffic Passenger Flow Statistics Based on IC Data. *Journal China Journal of Highway and transport,* 26(5), 158-163.

Yankevich, N. (2019). Systematic integrated approach to quantifying preventive diagnostics in a ‘smart’ transport system. *Journal of Industrial Engineering International,* 15, 479-486, doi:10.1007/s40092-019-0306-x

World Urbanization Prospects (2019), 2018 Revision, Department of Economic and Social Affairs, New York. Retrieved from: https://population.un.org/wup/. Accessed on April 29, 2022.