The Influence of Pandemic COVID-19 on the Quality of Public Railway Transport in South Bohemia

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Abstract

The way the pandemic COVID-19 affecting the public railway transport in the South Bohemia currently is a much-debated issue. On both a theoretical and practical level, this paper aims to determine whether the pandemic COVID-19 influenced the quality of public railway transport in South Bohemia between the years 2020 and 2021. The results of the paper provide the unambiguous arguments which could have been foreseen. There is, however, dissatisfaction among individual groups of passengers as well as on the part of the state. The surveys point to the slowly improving state of the quality of public railway transport in the coming years. Statistical and mathematical methods confirm the overall weaker efficiency and stability of passenger transportation. The reason is the psychological and economic aspects due to the COVID-19 pandemic.

Keywords

development, railway transport, decision-making under risk, economics, COVID-19

1 Introduction

The COVID-19 pandemic has affected the whole world. The result was negative effects in the form of a reduction in the total travel capacity. There have been changes in the proportions of modes of transport in most countries around the world. There were restrictions that affected the psychological side of passengers, the economic and political situation (Ciuffini et al., 2023). An easy and quick return is basically unlikely. Public transport is adapting to the new trend of home office and the fear of crowded spaces. This has the greatest impact on the provision of public transport services. In the Great Britain, there is a state of deregulated competitive public transport. A reassessment is needed on how to ensure an efficient and effective transport system. The Great Britain is restoring public confidentiality. The loss of passengers caused the loss of lost profits and the overall operation during the pandemic caused financial problems. The private and public sectors provide at least a basic level of service for key workers in urban economies. On the other hand, home office initially had the effect of reducing the use of private cars (Vickerman, 2021).

With fewer passengers, the transport system would have to increase fares and who should bear the burden. The question is whether the fare increase will be paid by the passengers or part of the fare could fall on the employer. Such a principle of financing public transport is introduced in France (Anciaes et al., 2019; Galvan and Agarwal, 2018).

In Poland, in large cities, state policy deals with the analysis of the traffic behaviour of the population. The analysis deals mainly with detailed psychological factors of passengers. The results of the survey are almost identical to those in the Great Britain (Kaewunruen et al., 2019; Tubis, 2022).

An international online survey on changes in everyday mobility during the pandemic assembled answers to the analysis of the issue of commuting. The surveys were conducted in Austria, Brazil, Bulgaria, Germany, Hungary, Iran, Italy, Japan, Malaysia, Slovakia, Slovenia, Thailand, the Great Britain and the Czech Republic. It was found that working from home office represents up to 60% of the total work performed in the listed countries. Among

people with workplaces where presence is necessary, this percentage does not exceed 30% (Link, 2019; Pregnolato and Dawson, 2018; Shibayama et al., 2021).

Italy (Sicily) has found in its analysis of travel practices that the quality of public transport services gives preference to the use of passenger cars. Local offices cannot directly influence this situation, they can only raise awareness in regional sequences. The quality of services must be improved directly by transport companies without the relevant intervention of local offices. This proves that communication between offices and transport companies is above standard (Basbas et al., 2021; Bagirova et al., 2017; Song and Schnieder, 2019).

In the Netherlands, due to multilevel governance, the whole transport policy situation has not changed or expanded. As a result, the public transport sector has not deteriorated sharply. The political response was rapid and effective. It was controlled mainly by endogenous forces. The Dutch policy agreed on a rescue financial package following a process of detailed consultations between state and non-state participants. The quality of passenger transport services has not changed. A general effective financial support scheme has been established to maintain the quality of transport (Delaplace and Dobruszkes, 2016; Hirschhorn, 2021).

In a majority of industrialised countries, railway transport is heavily subsidised by public resources at present. Without these subsidies, railway transport would not be able to compete with road transport. Each such use of public sector resources, however, raises questions regarding the acceptability and justification of such resources in comparison to the other public expenditure. Last but not least, the subsidies intended for railway transport (along with many other subsidies) represent an obstacle to the tax reduction. In this paper, we strive to quantify the total volume of passengers transported on passenger trains ordered by the South Bohemia Region on one of the important railway lines, namely the railway line No. 190 Ceske Budejovice – Strakonice.

Principles of territorial development define the spatial planning documentation for the whole region territory while refining and developing the objectives and tasks of the spatial planning in accordance with the territorial development policy. The strategies for achieving these goals are being determined and the planning activities of individual municipalities or towns are being coordinated (Shires et al., 2019).

The essential part of the territorial development is to submit the future plans for the construction of a new railway corridor and restoration of other railway lines which will intersect the chosen regions and have a significant influence on building other partial structures. The economic and political factors directly affect future decision-making and influence the investment matters in the process of creating and establishing the living standard of individual households (Sysyn et al., 2019).

2 Methodology

The goal of this paper is to prove through statistical and mathematical models whether the quality of passenger transport, including the evaluation of the overall efficiency of selected lines on the basis of criteria set by passengers in the South Bohemian Region, has improved between 2020 and 2021. Another goal is to examine what factors affect the overall quality of passengers by railway transport.

The data are available from a survey by Ceske drahy, a. s. for the years 2020 and 2021. The average daily number of passengers carried becomes the basis for statistical analysis. The DEA method is also applied, which evaluates the overall efficiency of the quality of use of selected lines in the South Bohemian region. Based on the passenger survey, the basic criteria for determining the overall efficiency of public rail transport are selected. These are the number of connections on a given route, operating costs per kilometre travelled, transport revenues, the number of passengers carried and the number of kilometres travelled. Line No. 190, which is considered to be the backbone track within regional development and financing by the region, is analysed in more detail statistically.

The goal is to apply a suitable statistic model in order to reject or not to reject the null hypothesis in comparing two mean values against the claim of the alternative hypothesis in the transportation of passengers on the railway line No. 190 from Ceske Budejovice to Strakonice. We chose those transport links which provide basic transport services in low-populated areas. The data make the sample under review. The two selected samples are being statistically analysed:

- average daily number of transported passengers in 2020 and
- average daily number of transported passengers in 2021 during the pandemic COVID-19.

The analysed data have a quantitative character of the data. Within determining the basic theoretical assumptions or estimations, it will be practically confirmed whether the slowly receding pandemic has increased the volume of transported passengers. The results of the paper

show the overall analysis of line No. 190 and the overall efficiency of the use of sub-lines based on the established criteria of passenger evaluation.

The characteristics of the selected lines are as follows:
- line No. 190: Ceske Budejovice – Strakonice,
- line No. 195: Rybnik – Lipno nad Vltavou,
- line No. 196: Ceske Budejovice – Horni Dvoriste,
- line No. 201: Tabor – Razice,
- line No. 220: Ceske Budejovice – Praha,
- line No. 225: Veseli nad Luznici – Havlickuv Brod,
- line No. 226: Veseli nad Luznici – Gmünd (Austria).

Table 1 contains the data being analysed.

Then, the data normality assumption is analysed. Based on the normality results, a suitable application of the statistic method is chosen. We can choose to apply the paired t-test or the Wilcoxon paired test. The overall analysis of the efficiency of selected lines is assessed using the DEA method, and the CCR model while minimizing inputs and maximizing outputs. The data have been evaluated using the R software and software Analysis Frontier to draw up this paper.

3 Results
Statistical and mathematical methods are applied on the basis of the set goals of the paper. The statistical (sample) population can be characterized. Data are characteristic:
- two selections,
- the dependence of selections is confirmed.

The Shapiro-Wilk normality test applied to ascertain the data normality assumption of both investigated samples confirms the null hypothesis against the alternative hypothesis by the p-value greater than 0.05 (5% = alpha). The null hypothesis is determined as follows: the selections meet the data normality assumption. The alternative hypothesis says that the selections do not meet the data normality assumption.

Table 1 Primary data

Average daily number of transported passengers on line No. 190	
in 2020	in 2021
443 (Monday)	964 (Monday)
321 (Tuesday)	1390 (Tuesday)
374 (Wednesday)	1885 (Wednesday)
456 (Thursday)	910 (Thursday)
389 (Friday)	840 (Friday)

Source: M. Telecky and K. Papouskova

The result of the Shapiro-Wilk test will provide an answer as to whether the final statistical test will be parametric or non-parametric. A partial analysis of the data normality assumption is given in Table 2.

Based on the results, the null hypothesis is not rejected and is valid. This means that a parametric statistical test (two-sample paired t-test) is applied. This implies that the method of the paired t-test will be applied. The null hypothesis says that the selections being compared have the same mean values. The alternative hypothesis says: that the selections being compared do not have the same mean values. It is clearly visible on the theoretical level that both selections are not identical. The significance level is determined at the 95 % level.

Table 3 proves the rejection of the null hypothesis.

According to the data of line No. 190, it is understandable that the number of transported passengers has increased. However, the determined level of significance is an important factor for a complete analysis by a suitable statistical test.

P is the value amounts to 0.01939. It means that the null hypothesis is rejected, and the alternative hypothesis holds true. The mean values of both selections are not identical. The slowly receding pandemic COVID-19 unambiguously supported the higher use of railway line No. 190 (Ceske Budejovice – Strakonice) by the passengers due to changes in psychological, political, and economic aspects.

The financing of public railway transport was hectic on the part of the transport orderer. The reason was insufficient communication and non-cooperation between public, and private sector carriers and the transport orderer. Transport companies were forced to disrupt several connections during the working days. This has increased the number of passenger cars, including the noticeable negative externalities in passenger car transport.

Table 2 Data normality assumption

Shapiro - Wilk normality test	p-value
data: Number of transported passengers in 2020	0.1875
data: Number of transported passengers in 2021	0.7072

Source: M. Telecky and K. Papouskova

Table 3 Paired t-test

Paired t-test	p-value
data: Average daily number of transported passengers in 2020 and average daily number of transported passengers in 2021	0.01939
mean of the differences	−801.2

Source: M. Telecky and K. Papouskova

After the analysis of individually selected railway lines, the overall efficiency can also be assessed based on selected criteria relevant to passengers. The following Table 4 shows the efficiency of the use of other selected relevant lines in the South Bohemian Region.

Based on the results of the DEA method, the analyzed line No. 190 is effective. This is due to an increase in the number of passengers carried, an increase in revenues and profits per kilometer driven, including the provision of a new vehicle unit. It can be argued that on efficient lines, the quality of services provided has increased in terms of overall efficiency. Effective lines were lines No. 201 and 220 on the contrary, lines No. 195, 196, 225 and 226 were still inefficient in 2021. The reason is the still prevailing car traffic.

The conclusion of the paper deals with possible measures that are implemented in selected countries of the world. It is emphasized what measures have been introduced in the Czech Republic and what measures should be introduced in the near future in order to improve the quality of passenger transport by public rail.

4 Conclusion
The resumption of the use of public railway transport is and will be limited, essentially insufficient, during the pandemic within the overall capacity of the transport system due to growing demand. As a result, car use is increasing. In most European and North American cities, passengers use public transport over shorter distances during a pandemic. Where the risk of infection is still high measures are recommended to encourage the use of private cars (Zunder and Islam, 2018).

In India, the study concluded a possible conclusion to prevent the increase in the use of private vehicles. Measures have been taken in most cities to disable parking on the main streets, reduce fares and improve the overall coverage

of the public transport system. Furthermore, a higher fare discount during rush hour was introduced. These measures should provide a higher quality of passenger transport by public transport (Kamar et al., 2022; Mota et al., 2017).

The financing of public transport in the conditions of the Czech Republic is an insufficient and unresolved chapter. Almost all transport companies do not achieve a positive economic result (profit). The COVID-19 pandemic caused even higher losses. This has resulted in the cancellation of some connections in terms of capacity utilization, a reduction in operating costs and thus a deeper loss. Regional public transport is financed by regional public budgets. Long-distance connections, on the other hand, through the state budget. International direct connections with the capital of the Czech Republic (Prague) were cut off by the neighbouring state of Austria. Even with the cancellation of some connections, the compensation amount for transport companies in the Czech Republic was increased by CZK 5.5 billion. The question is whether this is a sufficient compensatory amount as an auxiliary tool on the part of the state and regions.

Due to the increasing quality of passenger transport, it is necessary to devise a completely new system of financing public transport. An example is France. Every employer participates in the form of taxes for the financing of public transport in the defined region.

Currently, transport companies are raising fares. These results indicate an increase in passenger transport by car. The goal is to reduce this transport by car and promote public transport. Unfortunately, this does not work during the COVID-19 pandemic. Political and economic factors, on the other hand, inadvertently support passenger car transport.

Another issue is the criticism of financing public transport in response to the reduction of the value-added tax rate. The state plans the proposal for the VAT rate reduction from the present 15% to 10%. It is just the taxes imposed on the transportation which become the income for funding the public transport. If the proposal for tax reduction passes, we can expect a negative correlation in the form of funding the public transport and its quality and a slowdown in the growth of the fleet renewal.

It is necessary to realise what criteria form the major part of decision-making under risk and what risks, on the other hand, may arise and deviate from the introduced system of the public transport funding.

At present, the government (Ministry of Transport in cooperation with the Ministry of Finance) introduced a reduction of discounts on the passenger transport.

Table 4 Evaluation of the efficiency of individual lines in the application of the DEA method in 2021

The resulting value of the DEA method when applying the CCR model – minimizing inputs and maximizing outputs		
Line	Score	Effectivity
No. 190	100%	✓
No. 195	75%	✗
No. 196	80%	✗
No. 201	100%	✓
No. 220	100%	✓
No. 225	81%	✗
No. 226	76%	✗

Source: M. Telecky and K. Papouskova

The reason behind are the cuts in public spending and the search for new ways of funding other activities in the public interest. After the introduction of the reduced fares, the expenditures from the state and municipal budgets increased. This might be a benefit for the carriers but another factor must be remembered: The quality of transportation should also increase with the rising compensation amount. If excessive transportation use is expected in certain regions, the quality cannot remain the same. This results in the deterioration of the passengers' psyche and marginalization for many reasons.

The results of the investigation confirm the hypothetical question that public track-based transport unambiguously supports the growth in the volume of passenger transport, especially in the case of pupils, students, and seniors above 65. The method of the introduction of this system is to raise the standard of living for the citizens who maximize the benefit of the transport for the lowest paid (sacrificed) consideration. The question, however, is whether the efficiency of public transportation use has increased. The results are questionable. The goal is to reduce the private motor vehicle transport and to support the public transport to sufficiently reduce traffic congestion in towns/cities. Various groups of interest, however, are strongly disadvantaged. Following the reduced fare introduction, the passengers who are not eligible to use the advantageous discounts offered by the state and have to pay a regular fare are marginalized. This entails high negative impacts on the quality of transport.

The usability of public railway transport, including the provision of quality passenger transport, continues in a gradual trend. This is also proved by the results of the DEA method within the efficiency of selected lines in the South Bohemian Region. The DEA method generally recommends increasing the number of connections, the number of passengers carried, the compensation amount for transport companies and reducing fares for inefficient lines. These factors can be changed through a more effective political and economic situation of the state, by changing the system of financing transport companies. Line No. 195 is the least efficient. The effective lines are No. 190, 201 and 220.

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