

Cordula Welte-Bardtholdt

University of Gdańsk

The effects of transport service quality on the financial condition of companies – a methodology proposal

Transport companies, which, even if privately owned, often operate in markets and in an environment determined by the principles of the functioning of the public sector. On the one hand, they are inclined to maximize the effectiveness of their functioning, including financial efficiency. On the other hand, they are obliged, usually under longterm contracts, to provide services of an appropriate quality and, consequently, to contribute to passenger satisfaction. The aim of the article is to identify the planes of potential correlation, including the negative correlation between financial efficiency and the quality of provided transport services. Measures for both categories are identified. However, due to the fact that within both categories there are measures that are potentially internally correlated, it becomes necessary to use factor analysis to isolate key latent variables and, consequently, to avoid collinearity. For such identified variables, it is advisable to perform canonical analysis to identify correlation groups. Ultimately, this should allow for the construction of a universal model for the analysis of longterm relationships between financial and qualitative performance of transport companies, especially in a panel approach.

Keywords: transport companies, factor analysis, financial analysis

JEL classification: R4, L9, G3, M4

Introduction

Public transport companies, by their nature, must pursue a complex set of objectives related to, on the one hand, ensuring high quality, which contributes to passenger satisfaction with the services received, and, on the other hand, the need to maintain an appropriate financial condition, in particular the profitability of the economic activity of the company. It is commonly accepted that activities aimed at increasing the quality of services and, consequently, passenger satisfaction are cost-intensive and, consequently, deteriorate the financial position of enterprises [Anderson, 2005]. However, it is justified to verify the exact direction and strength of this relationship, also with a breakdown into individual service quality assessment criteria. Nevertheless, due to the high complexity of the problem, classical

statistical and econometric methods are not adequate to such a research problem [Kicova, Kramarova, 2013]. Consequently, the aim of the article is to propose a methodology based on factor analysis and canonical analysis that could be used to determine the strength of the impact in question.

1. Passenger satisfaction in public transport

From an economic point of view, a rational behaviour is one aimed at maximizing the satisfaction of the decision-maker. In practice, however, consumers decide according to the principle of limited rationality, i.e. they strive to achieve a satisfactory result, not an optimal one [Szmelter, Suchanek, 2021].

The preferences of consumers of public transport companies should be of interest to those who sell these services [Hansson et al., 2019]. This is an area where enterprises can look for a competitive advantage over other economic entities that operate in the same scope.

The most common mobility preferences indicated by the passengers include [Brożyna, 2018]:

- travel time,
- comfort,
- cost,
- safety.

Del Castillo and Benitez, in their article devoted to the methodology of modeling and identifying passenger satisfaction in public transport, proposed the division of criteria influencing passenger satisfaction into blocks (Table 1).

Table 1. Criteria for assessing the satisfaction of passengers using collective public transport

Block	Detailed criteria
Convenience of connections	<ol style="list-style-type: none"> 1. Convenience of connections between lines of the same operator 2. Convenience of connections between lines of different operators 3. Differentiation of lines
Accessibility	<ol style="list-style-type: none"> 4. Accessibility of the communication network (number of stops) 5. Facilities for the disabled 6. The adequacy of the location of the most used bus stops
Information	<ol style="list-style-type: none"> 7. Availability of information 8. Availability of timetables and line plans 9. Precision of information 10. Information screens at depots and stops 11. Information screens in buses 12. Information on price lists and season tickets

Block	Detailed criteria
Reliability	13. Punctuality 14. Frequency 15. Travel time 16. Reliability 17. Service downtime
Frequency of use	18. The kindness of the drivers 19. Friendliness of service
Comfort	20. Technical condition of vehicles 21. Cleanliness of vehicles 22. Convenience of vehicles 23. Vehicle lighting 24. Temperature in the means of communication 25. Number of passengers 26. Driver skills 27. Construction of stops (weather conditions) 28. Technical condition and cleanliness of the stops 29. Lighting of the stops 30. Appropriate marking of vehicles and stops
Safety	31. Technical safety of vehicles 32. Safety in vehicles 33. Safety at stops
Environmental effect	34. Noise 35. Impact on road traffic flow

Source: Own elaboration based on: [Del Castillo, Benitez, 2012].

The above list presents an exhaustive set of criteria for assessing the level of transport services, and allows for a comprehensive assessment of passenger satisfaction.

2. Companies' financial results

The financial result is one of the most important categories used to assess the effectiveness of business entities. It is the financial dimension of the results achieved by the enterprise in a specific unit of time [Łach, 2020]. Simply put, the financial result is the effect of subtracting costs from revenues.

The financial result in Polish conditions is determined in two ways, which is reflected in the possibility of preparing the profit and loss account in two variants, namely: comparative and calculation-based [Seredyński, Szaruga, 2015].

The following are the different layers of the company's financial result:

- sales result,
- operational result,
- gross financial result,
- gross financial result.

Regardless of the level at which we consider the obtained result, it may take the form of profit (a positive financial result) or loss (a negative financial result).

The result on sales is the one that distinguishes between two variants of determining the financial result. In the comparative variant, operating costs are recognized by type groups, namely [Siewierska et al., 2011]:

- depreciation,
- use of materials and energy,
- external services,
- taxes and duties,
- salaries,
- insurance and benefits,
- other costs.

The above approach to determining operating costs causes the violation of one of the main accounting principles, i.e. the principle of matching costs and revenues. This is due to the fact that not all costs that occurred in the reporting period can be assigned corresponding revenues in the same period. For this reason, in the comparative variant, there is an item of changes in the state of products, correcting the differences – it can take both a positive and negative value. In the calculation variant, on the other hand, the following are distinguished within costs: the cost of manufacturing the products sold and the value of goods and materials sold. Therefore, there is no need to make any adjustments. In this way, the gross result on sales is generated, which should be deducted by two categories of costs: sales costs and general and administrative costs. The use of this procedure leads to a sales result. Regardless of the variant used to determine the result on sales, its value should be the same.

In terms of determining the remaining levels of the financial result, there are no differences between the comparative and calculation variant of profit and loss.

The operating result is generated by including other operating activities in the calculation of revenues and costs. It is an activity that includes events not related to the core business of the enterprise. This includes events such as sale of fixed assets, costs or revenues related to created or released provisions or the effects of write-downs.

The gross result is created after taking into account financial revenues and costs. Financial activities include various types of interest, results from the sale of financial assets, dividends or shares in profits.

From January 2016, in determining the financial result of entities other than those referred to by the Accounting Act: banks, insurance companies, reinsurance companies and credit unions, no extraordinary gains and losses are distinguished. If such events occur in the course of the company's operations, they are included in other operating activities. Due to this change, enterprises do not distinguish separately the result from economic activity [Kaczmarczyk, 2021].

The net financial result is created by reducing the generated profit (if any) by the income tax due to the state. Taxable profit cannot, however, be directly equated with gross profit. The gross profit shown in the profit and loss account is calculated on the basis of the balance sheet law. The tax base is determined on the basis of the provisions of the tax law by deducting from the tax income those costs that qualify as tax deductible costs. It should be additionally noted that enterprises have the right to reduce the tax base by settling losses achieved in previous years.

3. The concept of the economic effectiveness of the companies

The principle of rational management has two dimensions: maximizing the effects with given inputs or minimizing the inputs serving the achievement of the assumed goal. Both dimensions of the above principle lead to the optimal use of the available resources, and the degree of achievement of the assumed goal compared to the expenditure incurred for this purpose is determined by the measure of management efficiency [Eklof et al., 1999].

Tools helpful in assessing the financial aspect of management efficiency are provided by the financial analysis, with particular emphasis on the ratio analysis.

The analysis of the company's liquidity is aimed at assessing its ability to pay its liabilities on time. The liquidity of economic entities is assessed using three basic indicators [Rashid, 2018]:

- current ratio,
- quick ratio,
- cash ratio.

The current liquidity of an economic entity is understood as the ratio of current assets to current liabilities. The optimal value of the indicator should be at the level of 1.2–2.0. It tells whether the company has enough current assets to cover its short-term liabilities. Quick liquidity narrows the current ratio indicator and does not include inventories. The exclusion of inventories is due to the fact that it is the least liquid current asset and it may take time for the enterprise to convert it into cash. The cash liquidity of the enterprise is calculated by including only the cash resources of the enterprise in the numerator. This indicator shows what part of its liabilities the company is able to repay immediately.

Rotation analysis is also called performance analysis. The study of this area allows for the assessment of the effectiveness with which the enterprise manages its assets. This area includes indicators such as [Lin, Lin, 2021]:

- assets turnover ratio,
- inventory turnover ratio,
- receivables turnover ratio.

The asset turnover ratio is calculated by relating sales revenues to total assets. It informs about the amount of revenues generated by the unit of assets. This ratio can be modified by taking into account only the fixed or current assets. The inventory turnover ratio is calculated as the ratio of sales revenue to the average inventory, while the receivables turnover ratio is the ratio of sales revenue to the average amount of receivables. Both indicators indicate the effectiveness of the management of the selected asset and should be of optimal size, adequate to the type of business.

In assessing the financial condition of the company, it is also important to analyze the debt. It allows to determine the degree of indebtedness of the enterprise and to assess whether the structure of financing sources is not too risky.

The basic indicators calculated in this respect are [Baraja, Yosya, 2019]:

- general debt ratio,
- equity debt ratio,
- tangible fixed assets debt ratio.

The overall debt ratio is the ratio of liabilities to the company's assets. Thus, it shows what part of the property is financed from external sources. Equity debt is counted as the ratio of external capital to equity, which allows to determine the amount of external capital that is attributable to the monetary unit of equity. The tangible fixed assets debt ratio is calculated as the ratio of the company's tangible fixed assets to its long-term liabilities.

In addition, the long-term debt ratio is also important, reflecting the ratio of long-term liabilities to the company's equity.

The assessment of the company's profitability allows for the determination of the ability to generate financial results by various economic categories. The basic measures of profitability are [Madushanka, Jathurika, 2018]:

- return on sales,
- return on assets,
- return on equity.

The above ratios are calculated by referring the financial result to individual categories (sales revenues, total assets, equity). Depending on the purpose of the analysis, the denominator may include the net financial result, but also the result on sales or gross financial result. If the achieved result takes the form of profit, profitability ratios are obtained, if losses – deficit ratios.

Profitability ratios do not have specific values that they should achieve, but in the case of enterprises whose purpose is to maximize their own market value, expressed, *inter alia*, by generating profit, these should be profitability ratios. It is also important to compare the results achieved with the competitive companies and with own results from previous periods. The trend in profitability indicators should be increasing.

4. The use of factor analysis and canonical analysis in studying the relationship between quality of service and financial condition of enterprises

It is possible to identify and study the relationships between complex aggregates, such as the quality of services and the financial condition of enterprises, with the use of various statistical tools. Classically, to determine the direction and strength of the relationship between phenomena, correlation analysis is used, and then to determine precise measures of impact, linear regression analysis or multiple regression analysis. However, these methods are based, as a rule, on a number of assumptions that are difficult to meet in this problem: the presence of one explained variable, the lack of collinearity of the variables, the measurement of variables on ratio scales or the normal distribution of the variables.

Consequently, to describe the relationship between the analysed characteristics of transport companies, the use of a sequence of two adequate research methods was adopted: factor analysis and canonical analysis.

As a rule, factor analysis is used to reduce the number of variables and to detect structure in relationships between variables. Therefore, it can be used to reduce dimensions, which plays a significant role in the research problem in question, due to the multitude of parameters reflecting both the quality of services provided and the financial condition of the enterprise [Quader, Abdullah, 2020]. An important condition for the verification of statistical hypotheses is the lack of collinearity of the predictors, because by introducing strongly correlated explanatory variables into the model, its predictive power is lowered, due the construction of OLS estimator. If there is a high correlation between a pair of explanatory variables, it can be concluded that they are redundant. It becomes possible to combine such two variables into one factor – variable scatter plots are created and then principal components analysis is performed, which leads to the generation of a new variable, which is a linear combination of the previous variables. It is possible to perform an analogous procedure for more than two collinear variables, using rotation that maximizes the variance of the output variable space.

Within the analyzed problem, both in the case of the quality of services and the financial condition, there is a suspicion of the presence of redundant variables within individual blocks. In the case of passenger satisfaction criteria, it becomes advisable to carry out the Cattell scree test inside the blocks due to the desire to simplify the data collection procedure itself [Shrestha, 2021]. In the case of the financial condition of the enterprise, it is advisable to select variables that have a similar direction and the return of model values. As a rule, liquidity ratios have specific benchmark levels, but due to their financial nature, it is possible to initially reject them when examining the company's financial condition. This leaves three groups of factors determining the financial condition: turnover, profitability and debt, within which three basic indicators for which the multicollinearity is suspected were identified. Consequently, at the pre-test stage, it is advisable to repeat the study of redundant variables for financial indicators, using the Cattell test, similarly to the satisfaction indicators or using the Guttman–Kaiser eigenvalue criterion [Rojas-Valverde et al., 2020]. Conducting a factor analysis should lead to obtaining a reduced number of independent variables in both categories (Table 2).

Table 2. Independent variables for financial position and service quality after factor analysis

Financial position	Service quality
1. Asset turnover ratio	1. Differentiation of lines
2. Return of sales	2. Accessibility of the communication network
3. Return on equity	3. Information screens at depots and stops
4. Overall debt ratio	4. Travel time
	5. Reliability
	6. Technical condition of vehicles
	7. Convenience of vehicles
	8. Number of passengers
	9. Driver skills
	10. Technical condition and cleanliness of the stops
	11. Technical safety of vehicles
	12. Safety in vehicles
	13. Impact on road traffic flow

Source: Own elaboration.

Conclusions

In order to estimate the strength of the impact of qualitative factors on the financial condition of enterprises, it is advisable to use canonical analysis for such

a defined set of independent data. The canonical correlation analysis procedure is an additional procedure for estimating the relationship between the variables that enables the study of the relationship between two sets of variables, as in the problem at hand. It consists in determining the canonical roots that allow to determine the strength and direction of the relationship between individual variables from both sets, which in turn allows for economic control of qualitative parameters in order to ensure the appropriate financial condition of enterprises. When extracting canonical roots, eigenvalues are calculated. They can be interpreted as the proportion of the variance explained by the correlation between the relevant canonical variables. It should be noted that this proportion is calculated in relation to the variance of canonical variables, that is, weighted sum values of two sets of variables; The eigenvalues do not say how much variability is accounted for in any of the sets of variables. The number of eigenvalues is calculated as there are canonical roots, i.e. as many as the minimum number of variables in either of the two sets. In canonical correlation analysis terminology, weighted sums define a root or canonical variable. It can be assumed that canonical variables describe some hidden variables. If for a set of differentiated quality indicators after a previous factor analysis, a weighted sum with high weights for all indicators related to financial condition is obtained, it can be concluded that the relevant canonical variable measures in fact the relationship between condition and quality of services.

The methodology understood in this way allows, according to the authors, to effectively and adequately recognize the strength and direction of the relationship between passenger satisfaction and the financial condition of public transport enterprises. Furthermore, this methodology allows for an adequately comprehensive treatment of the complex issues of both the quality of services and the financial condition of enterprises.

References

- Anderson S., Allen J., Browne M., 2005, *Urban logistics – how can it meet policy makers' sustainability objectives?*, Journal of Transport Geography, no. 1.
- Baraja L., Yosya E.A., 2019, *Analysis the impact of liquidity, profitability, activity and solvency ratio on change in earnings*, Indonesian Management and Accounting Research, no. 1.
- Brożyna E., 2018, *Jakość usług MPK Kraków. Ocena składowych jakościowych najistotniejszych z punktu widzenia pasażera*, Autobusy – Technika, Eksploatacja, Systemy Transportowe, no. 19.
- Del Castillo J.M., Benitez F.G., 2012, *A methodology for modeling and identifying users satisfaction issues in public transport systems based on users surveys*, Procedia Social and Behavioral Sciences, no. 54.
- Eklöf J.A., Hackl P., Westlund A., 1999, *On measuring interactions between customer satisfaction and financial results*, Total Quality Management, no. 10.
- Hansson J., Pettersson F., Svensson H., Wretstrand A., 2019, *Preferences in regional public transport: a literature review*, European Transport Research Review, no. 1.

- Kaczmarczyk A., 2021, *Informacja sprawozdawcza mikrojednostek w aspekcie marginalizacji zasady ostrożności*, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, no. 3.
- Kicová E., Kramářová K., 2013, *Possibilities of using financial analysis in the bus transport companies*, paper presented at the 9th International Scientific Conference on Financial Management of Firms and Financial Institutions, Financial Management of Firms and Financial Institutions, Ostrava, Czech Republic.
- Lin Q., Lin X., 2021, *Cash conversion cycle and aggregate stock returns*, Journal of Financial Markets, no. 52.
- Łach K., 2020, *Efekt dźwigni finansowej a struktura źródeł finansowania przedsiębiorstw w Polsce w latach 2005–2018*, Zeszyty Naukowe SGGW, Polityki Europejskie, Finanse i Marketing, no. 23.
- Madushanka K.H.I., Jathurika M., 2018, *The impact of liquidity ratios on profitability*, International Research Journal of Advanced Engineering and Science, no. 3.
- Quader S.M., Abdullah M.N., 2020, *Constraints to SMEs: A rotated factor analysis approach*, South Asian Studies, no. 2.
- Rashid C.A., 2018, *Efficiency of financial ratios analysis for evaluating companies' liquidity*, International Journal of Social Sciences & Educational Studies, no. 4.
- Rojas-Valverde D., Pino-Ortega J., Gómez-Carmona C.D., Rico-González M., 2020, *A systematic review of methods and criteria standard proposal for the use of principal component analysis in team's sports science*, International Journal of Environmental Research and Public Health, no. 17.
- Seredyński R., Szaruga K., 2015, *Komentarz do ustawy o rachunkowości*, ODDK, Gdańsk.
- Shrestha N., 2021, *Factor analysis as a tool for survey analysis*, American Journal of Applied Mathematics and Statistics, no. 1.
- Siewierska J., Kołosowski M., Ławniczak A., 2011, *Sprawozdanie finansowe według MSSF/MSR i ustawy o rachunkowości. Wycena, prezentacja, ujawnianie*, ODDK, Gdańsk.
- Szmelter-Jarosz A., Suchanek M., 2021, *Mobility patterns of students: Evidence from Tricity area, Poland*, Applied Sciences, no. 2.

C. Welte-Bardtholdt, (✉) c.weltebardtholdt.580@studms.ug.edu.pl
Uniwersytet Gdański, ul. Armii Krajowej 119/121, 81-824 Sopot, Poland