Volume-1 | Issue-3 | December-2018 | ISSN - 2617-4413 (Print) | ISSN - 2617-717X (Online)) |

East African Scholars Multidisciplinary Bulletin
(An Open Access, International, Indexed, Peer-Reviewed Journal)
A Publication of East African Scholars Publisher, Kenya
www.easpublisher.com

Economics

Original Research Article

Measuring Performance of the Freight Rail Transport Companies in the Slovak Republic

Jaroslav Mazanec
University of Zilina, the Faculty of Operation and Economics of Transport and Communications, Department of Economics, Univerzitna 8215/1, 010 26 Zilina

*Corresponding Author
Jaroslav Mazanec
Article History
Received: 12.11.2018 | Accepted: 20.11.2018 | Published: 30.12.2018
DOI: 10.36349/easmb.2018.v01i03.002

Abstract: The objective of article is to assess the financial performance of Slovak enterprises based on Data Envelopment Analysis (DEA). The sample consists of 28 Slovak companies which operate in the rail freight sector. We use relevant key indicators which describe specific area of rail freight transport in the Slovak Republic. These indicators are calculated based financial statements from financial database Finstat. The results show that majority of transport companies are not efficient.
Keywords: Data Envelopment Analysis, Effectiveness, Financial performance, Performance, Rail Transport, Transport Company.
JEL Classification: L25

INTRODUCTION

(Catalano *et al*., 2018) claim that railway systems are part of the social and economic system around the world. (Bougna & Crozet 2016) note that rail transport faces multiple changes due to poor productivity. (European Parliament 2018) created a single railway area. The aim of common transport policy is to encourage competition by harmonizing technical, administrative and safety rules. It is essential for interoperability of national rail systems. The purpose is to allow the usage of different rail systems in the member states and transition among national networks. In addition, (European Parliament 2018) stresses that competition was allowed in domestic and international freight transport from 1 January 2007. European Railway Agency (ERA) was established in Lille and Valencinnes (France) for improve interoperability. (Dolinayova, Camaj & Kanis 2017) explain that rail transport problems are associated with low flexibility compared to road transport, inadequate product portfolios, construction of logistical centres without the railway network connection.

(McKinnon 2015) claims that freight transport is considered a viable and vital activity for economic growth. However, he stresses that the situation in several developing countries is unfavourable because freight transport studies are very rare, especially at the macro level. It is needed to improve the performance of the rail transport system at all levels. Performance is defined in different ways, for instance, traffic intensity, modal split, market diversity, operational efficiency, service quality and environmental impact. In addition, (McKinnon 2015) notes that the various parameters of rail freight are influenced by government interventions. Key parameters of freight transport include spatial structure of the supply chain, freight model split, vehicle routing, vehicle use, exposure to congestion, fuel efficiency and Co_2 energy intensity. On the other hand, national governments focus on land-use planning, infrastructure investments, support for alternative models, modal shift grants, modal shift schemes, truck-driving schemes, transport prices, support to improve design vehicles, release of vehicle weight regulations, etc.

Ministry of Transport and Construction of the (Slovak Republic 2016) states that rail transport is the second most important transport in terms of transported goods volume in the Slovak Republic. In addition, we point out that in the period the transport of goods (in thousands of tonnes) volume increase of transported goods from more than 32 thousand to almost 43 thousand, increase of 31.73%. This situation is the identical for national rail transport. It should be stressed that in 2014 the volume of transported goods by national rail transport represented less than 5 000 thousand tons, which is 3.63 times less than in 1995. However, in 2015 we found increase in the goods volume by more than 21%. According to the structure

of total volume of transported goods in thousand tonnes in international rail transport represents more than 80% of the total goods volume, while in 2016 the goods volume represented almost 90%. It follows that financial condition is relatively highly dependent on international rail transport. The structure of international rail transport is evenly divided into imports (39%), exports (30%) and transit (31%) in 2016, followed by a year-on-year increase compared to the previous import period (15.63%), exports (65%) and transit (54.01%). (Dolinayova, Camaj & Kanis 2017) claim that the competitiveness of Slovak freight and passenger transport is different, because number of freight rail companies is several times higher than passenger rail companies. (Luz, dos Reis & de Macedo 2016) claim that rail transport is an alternative to increase competitiveness in the supply chain, especially for low-priced products.

LITERATURE REVIEW

(Lavy, Garcia, Scinto & Dixit 2014) emphasizes that key performance indicators (KPIs) are significant performance approach. In addition, they explain that the selection of relevant KPIs is important in relation to the planned objectives. Performance assessment can be enhanced by simulations that create multiple scenarios to future. Later, (Marchetti & Wanke 2016) assesses the efficiency of Brazilian rail concessionaires by data envelopment analysis (DEA) between 2010 and 2014. In addition, authors test the significance of exogenous factors for the concessionaire performance through bootstrap trucated regression. These factors include main type of cargo, track gauge, type of rail operation and secondary data from National Land Transport Agency. The results show that the Brazilian railroad has a surplus of wagons in 2017.

(Bougna & Crozet 2016) analyses rail transport through various statistical methods. First, authors applied a stocastic distance function that assesses productive effectiveness and changes through multiple outputs in the rail sector. In general, this method is less used in studies comparing the rail transport performance. Moreover, they analysed the overall productivity factor for European rail transport. The results show that the average productivity increased year on year. Then, they test how liberalization of rail transport has an impact on productive efficiency. (Bougna & Crozet 2016) found that tender improves productive efficiency, but free entry has a different impact. In other words, competition and liberalization do not affect efficiency in rail transport. (Lukinskiy, Pimonenko, Paajanen & Shulzhenko 2013) compare the operational efficiency of logistics centres based on key performance indicators in the Rail Baltic Growth Corridor (RBGC) Russia project. (Lukinskiy, Pimonenko, Paajanen & Shulzhenko 2013) argue that modern approaches that evaluate key logistics indicators are limited by benchmarking methods. Similarly, (Oum, Waters & Yu 1999) quantify productivity and efficiency in rail transport.

Performance measurement is quite common in the rail sector. (Sharma *et al*., 2016) demonstrate that benchmarking activities are important in assessing efficiency in rail systems because identify weaknesses and strengths. (Han & Hayashi 2008) measure the effectiveness of Chinese public transport through DAE. On the other hand, (Bill 2013) analyses performance in several European countries. However, (Huang *et al*., 2018) evaluate performance based on the TOPSIS method.

(Kliestik & Zvarikova 2013; Farrell 1957) claim that DEA is a multi-criteria method that serves to measure and compare effectiveness within a group of homogeneous units. It is linear programming method, which was initially used to measure the effectiveness of non-profit organizations. The origin of DEA method is related to (Debreu1951; Koopmans 1951; Shepard 1951; Farrell 1957). (Furthermore, Charnes, Cooper and Rhodes 1978) created the CCR DEA model, named after the author's initials. (Jablonsky 2011) states that this model maximizes the effectiveness rate expressed by the weighted output and weighted inputs ratio, provided that the efficiency level of all other units under consideration is less than or equal to 1. In our case, we applied an output-oriented DEA model witch Constant returns to scale (CRS) and variable returns to scale (VRS).

In general, the output variables have maximizing character. It means that greater number of outputs with unchanged inputs causes higher effectiveness. However, the input variables are characterized by a minimizing character. That means that smaller number of inputs with an unchanged amount of output leads to higher effectiveness. The effectiveness itself ranges from 0 to 1, respectively from 0 to 100 %. The DEA model is based on a set of permissible options, which consists of all effective decision units (DMUs). The advantages of DEA are that they compare the effectiveness within the analysed group, input and output quantities can be in different units of measure. On the other hand, the disadvantage is the sensitivity to the number of units under consideration in relation to the number of variables in the given model (Banker, *et al*., 1989) claim that number of DMUs should be three times higher than number of input variables.

METHODOLOGY

The aim of this article is to evaluate the performance of Slovak enterprises in the rail freight sector (SK NACE 49 200) using the non-parametric method DEA. To evaluate the performance of transport

companies, we use relevant indicators, such as NCUASS (non-current assets/ total assets), CUASS (current assets/ total assets), DEBRAT (debt/ total assets), CASLIQ (cash liquidity), ADDSAL (added value/ sales volume) and ASSTUR (assets turnover). These data are obtained from the Finstat database. The sample consists of 28 transport companies. Table 1 shows the input data for the performance calculation of transport companies using DEA in 2016.

Table-1: Input sample for measuring effectiveness based on DEA

DMU	NCUASS	CUAASS	DEBRAT	CASLIQ	ADDSAL	ASSTUR
DMU1	0,84	0,16	0,67	0,00	0,41	0,78
DMU2	0,68	0,31	0,94	0,03	0,24	1,76
DMU3	0,67	0,32	0,65	0,08	0,27	1,46
DMU4	0,30	0,70	0,67	0,12	0,68	11,48
DMU5	0,00	0,96	0,23	2,98	0,11	1,69
DMU6	0,01	1,00	0,97	0,02	0,02	3,54
DMU7	0,43	0,57	0,81	0,08	0,25	2,91
DMU8	0,59	0,41	0,78	0,10	0,18	1,36
DMU9	0,01	0,84	0,88	0,30	0,09	5,21
DMU10	0,97	0,03	0,82	0,05	0,93	0,09
DMU11	0,00	0,89	0,96	0,02	0,11	2,29
DMU12	0,01	0,94	0,82	0,00	0,28	4,51
DMU13	0,00	1,00	0,09	1,11	0,04	1,80
DMU14	0,39	0,60	0,55	2,34	0,38	1,32
DMU15	0,69	0,30	0,95	0,05	0,34	1,31
DMU16	0,04	0,96	0,59	0,22	0,08	2,87
DMU17	0,07	0,93	0,51	1,51	0,01	1,96
DMU18	0,69	0,30	0,08	2,32	0,70	0,40
DMU19	0,00	1,00	0,71	0,75	0,08	3,88
DMU20	0,07	0,93	0,77	0,22	0,18	2,43
DMU21	0,03	0,97	0,72	0,01	0,45	0,92
DMU22	0,84	0,16	0,84	0,02	0,82	0,99
DMU23	0,72	0,28	0,95	0,04	0,03	1,06
DMU24	0,21	0,79	0,25	1,52	1,08	1,49
DMU25	0,30	0,70	0,67	0,00	0,68	0,04
DMU26	0,14	0,86	0,41	0,93	0,11	2,37
DMU27	0,36	0,64	0,79	0,61	0,21	1,67
DMU28	0,00	1,00	0,63	0,74	0,04	4,05

Source: author based on Finstat (2018)

RESULTS

According to Finstat (2018), the most important rail freight transport company are Cargo Slovakia (45.38%), Budamar Logistics (27.53%), Railtrans International (9.07%) based on the sales volume. We find that Railway Company Cargo Slovakia has dominant position in freight rail transport. In 2016 these three transport companies have earned more than 82% of all revenues in railway transport sector. Even though in the sector more than 30 enterprises do business. However, these companies have low market share below 3%. However, we measure effectiveness for 28 transport companies. It is associated to respect conditions for applying non-parametric DEA method.

Table-2 shows the results of descriptive statistics in the rail freight sector. We find that doing business in railway sector is capital intensive. However, average DMU achieve NCUASS at 32%. On the other hand, results show that among companies are extreme difference, because range is from 0 to 97%. Next, average company achieve CUAASS at 66%. On the other hand, we find that transport companies don't mainly use equity, because average DEBRAT is 67%. Moreover, we focus on CASLIQ, ADDSAL and ASSTUR. The results show that average CASLIQ achieve 0.58. It means that transport companies in railway sector have problem with settling short-term liabilities. Table 2 demonstrates the detailed results of NCUAS, CUAASS, DEBRAT, CASLIQ, ADDSAL and ASSTUR in terms of descriptive statistics.

Table 2 : Descriptive statistics

	NCUASS	CUAASS	DEBRAT	CASLIQ	ADDSAL	ASSTUR
Mean	0,32	0,66	0,67	0,58	0,31	2,34
Standard Error	0,06	0,06	0,05	0,16	0,06	0,42
Median	0,26	0,74	0,72	0,11	0,22	1,73
Mode	0,00	0,70	0,67		0,68	
Standard Deviation	0,33	0,32	0,26	0,83	0,30	2,21
Range	0,97	0,97	0,89	2,98	1,07	11,44
Minimum	0,00	0,03	0,08	0,00	0,01	0,04
Maximum	0,97	1,00	0,97	2,98	1,08	11,48
Count	28,00	28,00	28,00	28,00	28,00	28,00

Source: author based on Finstat (2018)

Table-3 shows that only two DMUs are efficient based on CRS DEA with output orientation, namely DMU5 and DMU24. Based on the results of CRS DEA, we recommend DMU1 to improve CASLIQ, ADDSAL and TURASS. DMU1 has low cash liquidity. It means that company have problem with insolvency. The results show that DMU1 must improve CASLIQ from 0.00 to 0.44. Moreover, DMU must increase ADDSAL and ASSTUR, specifically ADDSAL is needed to increase from 0.41 to 0.85 and company must rise ASSTUR from 0.78 to 1.58. From complex perspective DMU1 must improve all output variable at the original input level. The DMU2 must fundamentally change the input and output variables. The results demonstrate that company must decrease NCUASS from 0.68 to 0.52 (almost 23%). In addition, DMU2 must change capital structure. CRS DEA recommends decreasing DEBRAT from 0.94 to 0.61 (more than 30%). These important changes have positive impact on increasing of CASLIQ from 0.03 to 0.09 (more then 3-times), increasing of ADDSAL from 0.24 to 0.67 and increasing of ASSTUR from 1.76 to 4.98 (almost 3-times). Other results are interpreted in the same way.

Table-3 : Results for output orientated DEA model with CRS

		Virtual inputs			Virtual outputs		
DMU	**Eff. score**	**NCUASS**	**CUAASS**	**DEBRAT**	**CASLIQ**	**ADDSAL**	**ASSTUR**
DMU1	2,045217	0,8300	0,1586	0,6659	0,4441	0,8478	1,5859
DMU2	2,828580	0,5241	0,3127	0,6169	0,0907	0,6672	4,9811
DMU3	2,977641	0,6734	0,3222	0,6459	0,4305	0,7996	4,3498
DMU4	0,999999	0,3036	0,6963	0,6727	0,1250	0,6776	11,4811
DMU5	**1,000000**	**0,0014**	**0,9596**	**0,2276**	**2,9804**	**0,1142**	**1,6910**
DMU6	0,000231	0,0059	0,0642	0,0519	0,0286	0,0135	0,2022
DMU7	2,930621	0,4275	0,5670	0,6594	0,2351	0,7433	8,5324
DMU8	4,350342	0,5881	0,4100	0,6265	0,4478	0,7643	5,9034
DMU9	0,000604	0,0060	0,0654	0,0529	0,0284	0,0137	0,2062
DMU10	0,999997	0,9703	0,0270	0,8156	0,0523	0,9254	0,0867
DMU11	0,000024	0,0009	0,0100	0,0080	0,0045	0,0021	0,0313
DMU12	0,000620	0,0131	0,1421	0,1148	0,0628	0,0297	0,4473
DMU13	0,085388	0,0000	0,1139	0,0605	0,0950	0,0067	0,3917
DMU14	1,075735	0,3912	0,5980	0,1691	2,5163	0,4597	1,4229
DMU15	2,553009	0,6933	0,3040	0,7047	0,2563	0,8768	3,3498
DMU16	1,719728	0,0402	0,9586	0,5865	0,6545	0,1506	4,9341
DMU17	1,711821	0,0676	0,9322	0,3061	2,5859	0,2254	3,3528
DMU18	0,999972	0,6948	0,3048	0,0820	2,3210	0,7041	0,4022
DMU19	0,592771	0,0000	0,7585	0,3457	0,6815	0,0496	2,3131
DMU20	0,003787	0,0665	0,7221	0,5833	0,3204	0,1512	2,2736
DMU21	1,000001	0,0299	0,9699	0,7198	0,0053	0,4495	0,9224
DMU22	1,132396	0,8400	0,1600	0,7460	0,2140	0,9248	1,1196
DMU23	4,160262	0,1491	0,2816	0,2621	0,1567	0,2931	4,4271
DMU24	**1,000000**	**0,2086**	**0,7897**	**0,2455**	**1,5208**	**1,0797**	**1,4890**
DMU25	1,567948	0,3036	0,6963	0,3167	1,3409	1,0624	1,3173
DMU26	2,158780	0,1434	0,8566	0,3830	2,0104	0,3460	5,1251
DMU27	2,800686	0,3558	0,6442	0,3366	1,6969	0,5757	4,6637
DMU28	0,693522	0,0000	0,8171	0,4339	0,6819	0,0482	2,8102

Source: author based on Finstat (2018)

CONCLUSION

The disadvantage of DEA method is impossibility to apply variables with negative values. Moreover, we cannot use categorical variables in connection with customer satisfaction assessment, because these indicator is mainly assessed by interval from 1 (good) to 5 (bad). However, the important limitations are unpublished information about employee number and wagon number which foreign authors commonly apply in research studies. The potential research can be focused on comparison of more transport companies in the Slovak Republic in time through Malmquist index or to make an international comparison of transport companies in the Visegrad Group.

Based on the results, we find that many transport companies are not efficient in freight rail transport sector. The reason is associated with strong competition in context with road freight transport. It has impact on low sale revenues, added value and effectiveness. Moreover, results indicate that transport companies with dominant position on the market does not have better effectiveness than others.

ACKNOWLEDGMENT

This contribution was undertaken as parts of the research project VEGA č. 1/0870/16 Application of facility management in managing the transport companies in the Slovak Republic.

REFERENCES

1. Banker, R. D., Charnes, A., Cooper, W. W., Swarts, J., & Thomas, D. (1989). An introduction to data envelopment analysis with some of its models and their uses. *Research in Governmental and Nonprofit Accounting* 5, 125-163.
2. Bill, J. (2013). Measuring European railway efficiency using DEA approach. In H. Vojackova (Ed.), *Mathematical methods in economics 2013* (pp. 43-48). Jihlava: Coll Polytechnics Jihlava.
3. Bougna, E., & Crozet, Y. (2016). Towards a liberalised European rail transport: analysing and modelling the impact of competition on productive efficiency. *Research in Transportation Economics, 59*, 358-367.
4. Catalano, G., Daraio, C., Diana, M., Gregori, M., & Matteucci, G. (2018). Efficiency, effectiveness, and impacts assessment in the rail transport sector: a state-of-the art critical analysis of current research. *International transactions inoperational research, 26*, 5-40.
5. Dolinayova, A., Camaj, J., & Kanis, J. (2017). Charging railway infrastructure models and their impact to competitiveness of railway transport. *Transport Problems, 12*(1), 139-150.
6. European Parliament. (2018). Železnižná doprava. Retrieved 5. 17., 2018, from http://www.europarl.europa.eu/ftu/pdf/sk/FTU_3.4.5.pdf
7. Farrell, M. J. (1957). *The measurement of productive efficiency.* Cambridge: University of Cambridge, Department of Applied Economics.
8. Finstat. (2018). Retrieved 6. 3., 2018, from https://www.finstat.sk/
9. Han, J., & Hayashi, Y. (2008). Perfromance of urban public transport systems in China: Data Envelopment Analysis. In H. P. Lo, S. C. Leung, & S. Tam (Ed.), *Transportation and management science* (pp. 585-593). Hong Kong: Hong Kong Soc Transportation Studes.
10. Huang, W. C., Shuai, B., Sun, Y., Wang, Y., & Antwi, E. (2018). Using entropy-TOPSIS method to evaluate urban rail transit system operation performance: The China case. *Tranportation research part A-policy and practice, 111*, 292-303.
11. Jablonsky, J. (2011). *Programy pro matematicke modelovani.* Praha: Oeconomica.
12. Kliestik, T., & Zvarikova, K. (2013). Performance evaluation of the Slovak equity mutual funds based on the Data Envelopment Analysis. V B. a. International Conference on Information (Editor)., *26*, stránky 410-415.
13. Lavy, S., Garcia, J. A., Scinto, P., & Dixit, M. K. (2014). Key performance indicators for facility performance assessment: simulation of core indicators. *Construction management and economics, 32*(12), 1183-1204.
14. Lukinskiy, V. S., Pimonenko, M. M., Paajanen, M., & Shulzhenko, T. G. (2013). Development of methodoloty and tools for comparative asessment of operational efficiency of KPI-based logistical infrastructure facilities. *Transport and Telecommunication, 14*(3), 223-229.
15. Luz, J., dos Reis, J., & de Macedo, J. (2016). How the Quality of Cargo Railways Transportation Service effects the Competitiveness of Piauí state, Brazil. *Information systems, logistics and suppy chain*, 1-6. Bordeaux: Kedge business school.
16. Marchetti, D., & Wanke, P. (2016). Brazil's rail freight transport: Efficiency analysis using two-stage DEA and cluster-driven public policies. *Socio-Economic Planning Sciences, 59*, 26-42.
17. McKinnon, A. (2015). *Performance measurement in freight transport: Its contribution to the design, implementation and monitoring of public policy.* Retrieved 10. 2, 2018, from https://www.itf-oecd.org/sites/default/files/docs/mckinnon.pdf
18. Ministry of Transport and Construction of the Slovak Republic. (2018). Statisticke udaje. Retrieved 3. 6., 2018, from https://www.mindop.sk/statistiky-15/doprava/statisticke-udaje/vyvoj-v-doprave-sr

19. Oum, T., Waters, W. G., & Yu, C. (1999). A survey of productivity and efficiency measurement in rail transport. *Journal of transport economics and policy*, *33*(1), 9-42.
20. Sharma, M. G., Debnath, R. M., Oloruntoba, R., & Sharma, S. M. (2016). Benchmarking of rail transport service performance through DEA for Indian railways. *International journal of logistics management*, *27*(3), 629-649.