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EFFECTIVENESS OF STATE TRANSPORT UNDERTAKINGS IN SELECTED STATES OF INDIA: USING THE DEA APPROACH

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ABSTRACT

The purpose of this study is to examine the efficiency of public road transport in selected Indian states and furthermore, the study also provides an overview of the working status of state transport undertakings. Presently, there are around 62 state transport undertakings in India to cater to the requirements related topublic transport. For extracting the efficiency of public road transport, the secondary data have been collected for ten states for the year 2018-19 and these are being seen as homogeneous units where publictransport usage is high. Focusing on the public transport of these states, a complete analysis has been donethrough the Data Envelopment Analysis (DEA) technique with three specific inputs such as fleet size (FS),total staff (TS), fuel consumption (FC), and one basic output is bus utilization (BU). The study also highlights probable weaknesses and strengths of states' public transport. The Charness, Cooper, and Rhodes (CCR) and Banker, Chames, and Cooper (BCC) models of DEA have been employed to evaluate the overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE). Scale efficiency is calculated with OTE and PTE scores which simply describe the size efficiency of decision- making units (DMUs). The Efficiency score of public transport in selected states revealed that during the year 2018-19, these states worked efficiently around 91 percent. Here input input-oriented model has beenapplied that's why for making them efficient, inputs need to be reduced by 9 percent. Based on the efficiency score ranks are also assigned to the states.

JEL Classification: L62, L91, L98, R14, R40

Key Words: Technical efficiency, state transport undertakings, decision making units, data envelopmentanalysis

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I. Introduction

India is a developing country since many decade efforts are being made for the growth and development of the Indian economy (Jha, 2008). Even after continuity in efforts the economy has not yet reached at itsoptimal level. There are some important components of human development which are not only for the benefit of people but also very imperative for development purpose. Transport is one of the most importantcomponents among them. If the economy of any country is to be motivated to move fast, then it is important to fulfill its transport needs. Appropriate transport services like road, railways, airways and water transport are decisive to the development of a well planned economy. If there is shortage in the basicneeds which related to transport, it not only makes the living conditions difficult but also participation in any modern economy seems like to be very (Aneja & Sehrawat, 2022a). Due to lack of adequate transport, the cost of production and distribution increases, because of which the economy is unable to perform at its potential level. The transport sector has tried to make an important contribution to growth and development of the country's economy. Time to time there has been a lot of development in this area. Transport can be simply defined as a process by which people and goods can be moved from one place to another. If we talk about the transport sector in the early 19th century, it has been seen that this sector is not much growing, after the industrial revolution came a lot of changes in this sector and it was developed with new technologies. In the race of development with modernization and urbanization taking place, theneed for a well-developed transport sector has emerged because of many reasons like increased distance between home and work, trade, tourism etc. (Padam & Singh, 2011). Many economists are of the view that in order to increase economic growth, it is necessary to have a good physical connectivity in urban and rural areas. It has been strengthened by working on the transport sector in India so that it can meet thetransport related needs with ease. In India, Road transport is being used more after railways, so for the last few decades it has been noticed that there is a lot of focus on road transport (S. K. Singh, 2014). India's transport sector will become the leading transport sector all over the world. According to the report of ministry of road transport and highway in the year 2016-17, the transport sector had a 4.8 percent share inthe country's GVA (Gross Value Addition) for which only road transport accounting 3.12 percent, the railway addition was 0.77 and 0.12 percent accounted for air transport.

The main focus of this paper is on public road transport, public transport is very important for the societythrough public transport people of all classes can fulfill their transport related needs. The public transport is important not only because of the accessibility, but also due to increasing traffic congestion and pollution. In India there are around 62 state transport undertakings to meet the requirement related to public transport. This sector in India has grown rapidly in the last few decades but still it is far below itsoptimum level.

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Following the introductory part, the paper has been classified into four sections. The second section of paper consists of existing literature review, research gap and objectives of the paper. In third section, all the aspects related to the methodology have been discussed and following the results and discussion have been mentioned in forth section. It has been ended with writing of conclusion of the paper.

II. Literature review

The review of literature is given to identifying the research gap and useful for framing the objectives. Transport is one of the important components of human development. It acts as an intermediary of all sectors in an economy. All sectors are directly or indirectly related with transport. Considering the important of all these, the trend of doing research in this area is also increasing. Public transport of states is fulfilling social objective, there are some eminent persons who have done a good research on state road transport undertakings like.

Several authors (Agarwal et al., 2010; Aneja & Sehrawat, 2022b; Balenzentis, A., & Balenzentis, 2011; Bishnoi, N. K., 2007; Hooda D S and Nitisha Sehrawat, 2021; Padam & Singh, 2011; Sharifian et al., 2017) focused on increasing urban population and its demand for transport. The situation of transport in large cites deteriorating due to pollution, wastage of energy, road congestion, high accident rate. (S. K. Singh, 2016) explained the transport in urban areas and reveals some important facts. In India's urban transport sector some challenges have emerged which impede economic growth. (Sanjay Kumar Singh & Venkatesh, 2004) provided a general overview of transport sector in India. Transit Cooperative Research Program (TCRP) report (2003) suggested that it is necessary to follow the structured process for the perfect performance measurement system. Transport sector facing many problems which are creates hurdles in its growth and development like casualty, timeliness, skills, human resources, good governance, pricing and funding. (Sanjay Kumar Singh & Venkatesh, 2004) focused on technical characteristics and efficiency of STUs and captured that the relative efficiency scores of DMUs concluded that STUs of small size and medium size is more efficient than the comparison to large size. Indian public transportation system is not able to provide all these services to their passengers. Public Transport had designed in traditional ways to fulfill the need of poorer section, who cannot afford ride in personal vehicles.

The situation of transport in large cites deteriorating due to pollution, wastage of energy, road congestion, high accident rate. Seeing the population growth in most Indian cities, the urban transport infrastructure thus needs to be expanded manifold over the next few years, if the gap in the demand and supply has to be abolished (Padam & Singh, 2011). (Kumar, S. S., & Vankatesh, 2004) explained that for running any public organization government policies plays an important role.

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III. Objectives of the paper

The key objective of this paper is to examine the technical efficient state and rank all the states in the data set by using DEA during 2018-19. In addition, the paper tries to explore the required improvements in theinputs and outputs for the inefficient units.

IV. Research methodology

The DEA approach has been adopted to measure the technical efficiency of states public transport. Keeping in view the objectives of the paper, secondary data have been collected from various sources like annual reports, statistical abstract and CIRT etc. To understand concerned methodology of current paper it has been designed as follows:

Sample Size: The present paper considers ten states for measuring the efficiency of their public road transport. All those states which have been selected for this study have their own State Transport Undertakings (STUs). The state transport undertakings define the undertakings which provide road transport services.

Table 1: Selected states for measurement the efficiency of public road transport

Sr. No	States	Performed STUs
1	Andhra Pradesh (S1)	1
2	Gujarat (S2)	1
3	Karnataka (S3)	4
4	Kerala (S4)	1
5	Maharashtra (S5)	6
6	Rajasthan (S6)	1
7	Tamil Nadu (S7)	8
8	Telangana (S8)	1
9	UP (S9)	1
10	Delhi (10)	1

Source: CIRT report 2018- 19

As per various reports of ministry of road transport and highways and CIRT the above selected states andtheir undertakings represents that in these states large number of people depending on public transport fortheir basic needs of transport. The above table indicated that Andhra Pradesh, Gujarat, Kerala, Rajasthan,Telangana, UP and Delhi are the states where one major transport unit fulfill the requirement of public transport. In Maharashtra 6 performing units has been taken, these are as: Maharashtra SRTC, BEST Undertaking, Navi Mumbai MT, Pune Mahamandal, Thane MT and Kalyan Dombivali MT.

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In Tamil Nadu, Public Transport units are: State Express Transport Corporation Ltd Tamil Nadu., TN STC (Coimbatore) Ltd., TN STC (Kumbakonam) Ltd., TN STC (Madurai) Ltd., Metro TC (Chennai) Ltd.,TN STC (Salem) Ltd., TN STC (Villupuram) Ltd., TN STC (Tirunelvell) Ltd. Karnataka performed its public transport need with four units- Karnataka SRTC, North Eastern Karnataka RTC, North Western Karnataka RTC, Bangalore Metropolitan TC.

Data base: The secondary data have been collected for measuring the efficiency of public road transport.The data have been taken from Central Institute of Road Transport (CIRT), Association of State Road Transport Undertakings (ASRTU), MoRTH reports and statistical abstracts of different states.

Table 2: Observed data for the year 2018-19

		Inputs			Output
Sr. No	**DMUs**	**FC**	**FS**	**TS**	**BU**
1	S1	5.22	11837	53263	366
2	S2	5.33	7963	40148	449
3	S3	4.75	23058	11648	351
4	S4	4.61	5136	35002	295
5	S5	3.3	24250	145114	224
6	S6	5.03	5295	15280	392
7	S7	5.33	20514	12876	389
8	S8	5.15	10463	50529	345
9	S9	5.23	12080	21069	342
10	S10	3.85	3897	24721	195
Mean		4.78	12449.3	40965	334.8

Source: CIRT Report 2018-19

Model Specification

For the fulfillment of the objectives of this paper, the much popular non parametric Data Envelopment analysis technique has been used. The specialty of this model is that it is applied to the homogeneous units. Considering the growing need of this technique, many models have been developed in this area. Butin current paper basic two models have been used for measuring the efficiency: the CCR and other is BCC model. The CCR model has been used to find out the overall technical efficiency of state public transport and BCC model used for pure technical efficiency of state public transport.

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For evaluate the efficiency –

$$\text{MAX } E_k = \frac{\sum_{n=1}^{a} u_{nj} x_{nj}}{\sum_{m=1}^{b} v_{mj} y_{mj}}$$

Let there are L^{th} set of homogenous DMUs.

DMU_i= (1, 2, 3… jth)

Each DMUs having set of inputs and outputs

Inputs, Xni; (n=1,2,3……a)

Outputs, y_{mi}; (m=1,2,3……b)

u_{nj}; weight given to input,

v_{mj}; weight given to output

The value of E_k lies between zero to unity ($0 \leq E_k \leq 1$); If E_k= 0, DMU considered as inefficient unit, E_K= 1(fully efficient)

Although CCR model is based on constant return to scale and applied for measuring overall technical efficiency and on the other hand BCC model is based on variable return to scale and measuring the pure technical efficiency.

$\phi_a+\phi_b+\phi_c+……..\phi_n=1$

Selection of Inputs and output or Data Envelopment Analysis

As discussed DEA is used when DMUs are Homogeneous, here results have been extracted by selectingten homogeneous units and input and output for these DMUs have taken as under:

Total fleet- Total fleet size means total number of buses operated in the states which indicates its capitalinput.

Total number of staff is showing the labour input of DMUs and fuel consumption has been taking asmaterial input.

Fuel consumption= Total earned kilometer /fuel average

For output, bus utilization (total effective kilometer done by each bus on road per day) has been

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takenfor the assessment of efficiency.

V. Results and Discussion

For measuring the efficiency score here two models of DEA (CCR and BCC) have been employed. With the help of CCR model, the overall technical efficiency score is extracted. This model is based on constant return to scale and describe the total efficiency of input and output. Empirical results of concerned decisionmaking units tells about the physical efficiency of various state transport undertakings. The range of efficiency score is 0 to 1 which simply indicates that the DMUs which having 1 efficiency score they worked efficiently, the inputs are fully employed and there is no need to reduction in inputs. On another hand those DMUs whose efficiency is less than 0, indicates that there must be reduction in inputs to makethem efficient.

Table 3: Efficiency Score of DMUs

DMUs	OTE	PTE	SE
S1	0.83	0.90	0.92
S2	1.00	1.00	1.00
S3	1.00	1.00	1.00
S4	0.81	0.96	0.84
S5	0.81	1.00	0.81
S6	1.00	1.00	1.00
S7	1.00	1.00	1.00
S8	0.80	0.89	0.89
S9	0.82	0.90	0.92
S10	0.68	1.00	0.68
Mean	0.87	0.97	0.91

Source: Author's own calculation

The table 3 represent the OTE score of S2 (Gujarat), S3 (Karnataka), S6 (Rajasthan), S7 (Tamil Nadu) isone which simply indicates that these are overall technical efficient. The mean value of OTE is 0.87, it means that in 2018-19 the public transport of these state are 87 percent overall technical efficient. When comes to PTE score this is calculated with BCC model. This model showing the picture of managerial efficiency. According to BCC model the results of PTE shows that among these ten DMUs there are 6 DMUs which having one efficiency score and in that a DMUs there is no need to change in its inputs. Theaverage score of all DMUs for this particular yeas is 97 percent showing that there are 3% need to be change in its inputs to become these DMUs fully efficient. The ratio of OTE and PTE scores results SE. Scale efficiency is related

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with the size of DMUs. There are four DMUs which having the appropriate in size. S2, S3, S6 and S7 these decision making units efficient in term of SE and OTE. Average score of scale efficiency is 91% for all the DMUs. The average score of OTE, PTE and SE is around 92%. The mean value of OTE, PTE and SE showing that S1 (Andhra Pradesh), S4 (Kerala), S8 (Telangana) and S9 (UP) these DMUs having below average score. Basically these DMUs units are highly inefficient units in term of overall efficiency, managerial efficient and operation size as compare to other. The above resultsare very handful in increasing the efficiency score of DMUs. The DEA model suggested that on the basisof concerned data there might be some efficient units and some inefficient unit. And according to this model the efficient units are set as benchmark units for inefficient units. So the above table clearly showing that the public transport of Gujarat, Karnataka, Rajasthan and Tamil Nadu can be set as benchmark units for the public transport of inefficient states.

Table 4: Rank of DMUs

Under CCR Model	Rank	Under BCC Model	Rank
Gujarat	1	**Delhi**	1
Karnataka	1	**Tamil Nadu**	1
Rajasthan	1	**Gujarat**	1
Tamil Nadu	1	**Karnataka**	1
Andhra Pradesh	5	**Rajasthan**	1
Uttar Pradesh	6	**Maharashtra**	1
Kerala	7	**Andhra Pradesh**	7
Maharashtra	8	**Andhra Pradesh**	8
Telangana	9	**Uttar Pradesh**	9
Delhi	10	**Telangana**	10

Source: Author's calculation

Ranks are also given with the help of CCR and BCC models. Gujarat, Karnataka, Rajasthan and Tamil Nadu these four states secured rank one in both models. The public transport of these state is performed efficiently. Under BCC model along with above four Maharashtra also secured rank one. From the given ranks under both models, it is observed that in term of OTE score Delhi stands in bottom and in term of PTE Telangana stands in bottom. They secured rank ten lowest among all DMUs.

VI. Conclusion

Through this paper an attempt for analyses the public road transport of some major sates in India, where the public transport is mostly used. Here, DEA technique has been used for analysis the

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efficiency of State Transport undertaking. Along with the efficiency of these states, projection table and ranks also assigned to states according the efficiency. The mean overall technical efficiency of these DMUs is 92 percent which simply indicates that as per efficiency scores these units should reduce their inputs by 8 percent to make them as efficient units. The economic growth of country is directly or indirectly dependent on transport. Public transport of states has an important role in states growth and development. The average of OTE, PTE and SE has been worked out 0.87, 0.97 and 0.91. These scores are based on input oriented models and there is no scope to increase in the level of output, only the efficiency score can be improved by reducing inputs.

The present paper can help the policy maker gets to know how much work should be done on fleet size. In selected states how many new buses should come and how many should be repaired for improving theefficiency. Inputs and outputs can be modified to improve the efficiency scores of state public transport units and the states where public transport units are working efficiently consider them as a benchmark forinefficient units.

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