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CONCEPTS ANALYSIS OF PASSENGER ROAD TRANSPORT: CONCEPT, ESTIMATION AND DIAGNOSIS

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ABSTRACT:

This present paper analyzes the concept of Passenger Road Transport cost and different ways to express it Different components of Passenger Road Transport cost have been discussed. The estimation and analysis of total and unit Passenger Road Transport costs have been traced out. Finally, this chapter discusses the empirical results of trends obtained through linear, quadratic, and exponential models.

INTRODUCTION

The Concept of Passenger Road Transport Cost

The cost of Passenger Road Transport is of crucial importance to the transport planners, economists, and policymakers. It provides the empirical basis for understanding the financial characteristics of a Passenger Road Transport system and its organization. There are two important aspects of cost analysis in Passenger Road Transport. First, it describes the different ways in which the cost is defined and measured, the different types to study the cost component-wise, and reviews various ways to analyze transport cost in order to throw light on the relationship between inputs and output in Passenger Road Transport. Secondly, it discusses the Passenger Road Transport cost function to study the variation of costs with the level of output.

The cost analysis can serve a variety of purposes in Passenger Road Transport Planning. It is frequently used in securing information concerning the financial status of Passenger Road Transport undertaking. Cost analysis can be a powerful aid for achieving the aims regarding the best use of the scarce resources available, full resources implication of any proposed new scheme etc.

The cost structure of any Passenger Road Transport undertaking is a key factor affecting the efficiency of its operation. That is why the concerned management has become cost conscious. Cost control leads to optimum utilization of resources and increases the efficiency in service which is ultimately beneficial to the public. For this, the cost structure of Passenger Road Transport should be studied.

Cost analysis in respect of Passenger Road Transport also plays an important role regarding the regulation of price, rate of depreciation, and public decision. It is cost analysis which is important in dealing with the optimum input combination and setting the optimum plant size.

The several different ways to express and measure Passenger Road Transport cost, each with its own particular meaning and utility, are explained below—

1. Money and Real Cost—Passenger Road Transport inputs *e.g.*, traffic staff, non-traffic staff, number of buses, material, equipment, fuel, building etc, may be expressed in terms of money cost (also known as factor cost), and real cost (also known as resource cost). Evidently, in money cost inputs are measured in their monetary value while in real cost, the inputs are expressed in physical units.

2. Capital and Recurrent Cost—Capital costs (also known as non-recurring costs) include the purchase of durable assets such as land, building, buses, equipment etc. which are expected to yield benefits over a longer period. Current or recurrent or recurring costs include consumable goods and services such as salary of traffic and non-traffic staff, fuel, tubes and tyres, taxes, interest, depreciation etc. which bring immediate or short run benefit and have to be regularly renewed.

3. Total and Unit Cost—Total costs of Passenger Road Transport are the sum of current and capital costs. Unit costs measure the costs of per unit of Passenger Road Transport output. There are two different ways of measuring unit cost. If total cost is divided by the total unit of Passenger Road Transport output, this gives the average cost per unit of output. The additional cost attributing to one extra unit of Passenger Road Transport output is known as the marginal cost.

The units in the unit costs of Passenger Road Transport refer to the no. of passengers carried or seat kms or passenger kms or effective kms depending on the measure of Passenger Road Transport output considered, for the purpose. The unit costs based on different measures of Passenger Road Transport output may serve different purposes. The unit costs based on the no. of passengers carried may be helpful m deciding the pricing policies and determining the fare rates. Similarly, the unit costs based on the effective kms may be helpful in deciding the device of cost control and cost reduction. Also, the unit costs based on the seat kms can be helpful in dealing with the problem of capacity utilization. In Passenger Road Transport economics, sometime revenue in real term is also used as measure of output and thus unit costs based on this measure of Passenger Road Transport output may be helpful while proposing the revenue in the formulation of Passenger Road Transport budgets.

Evidently, there may be five alternative concepts of unit cost of Passenger Road Transport. These are—

(a) Cost per seat km.

(b) Cost per passenger km.

(c) Cost per effective km.

(d) Cost per passenger carried.

(e) Cost per unit of real revenue.

4. Cost at Current and Constant Prices—When costs are expressed at current prices, these are known as cost at current prices. If costs are expressed at the base year prices these are known as the cost at constant prices[1].

5. Opportunity Cost—All the Passenger Road Transport resources or inputs have alternative uses. Since resources are limited, this means that alternative opportunities for using these resources must be sacrificed or forgone. This is known as opportunity cost.

Components of Passenger Road Transport Cost

The total cost of Passenger Road Transport can be classified as visible costs and invisible costs (opportunity costs). The visible costs are those costs which can easily be measured. The visible costs can further be classified as recurring costs and non-recurring costs.

Recurring Cost

Recurring costs are variable costs. These are also known as current costs. These costs relate with the levels of Passenger Road Transport output. Recurring costs include the following items of expenditure.

1. Cost of Personnel—Cost of personnel is the payment made in terms of salaries and allowances. This cost consists of the payment to the traffic staff, workshop and maintenance staff, other staff and the payments made for provident fund, welfare, and super-annotation etc.

2. Cost of Material—Cost of material includes the expenditure on fuel (diesel), lubricant, auto-spare parts, tyre and tubes, batteries, other stores, and reconditioning of accessories and buses.

3. Taxes—The tax component of cost includes the motor vehicle tax, passenger tax, other tees on vehicles, and miscellaneous taxes.

4. Interest—This component of cost includes the interest paid to central and state governments and interest on borrowings.

5. Depreciation—The depreciation component of cost includes the depreciation on vehicles and other assets.

1. Whenever analysts took all the annual transportation cost for a series of years, they must determine whether these are expressed in current prices or constant prices. Thus, analysis must convert the costs for each year into constant prices. This is best done by applying a deflator that shows how much prices for Passenger Road Transportation inputs have increased per year. This study uses real costs of Passenger Road Transport considers 1981-82 as the base year.

6. Other Cost—This cost includes the expenditure incurred by transport corporation on items Bee contingency, temporary work, departmental vehicle repairs, maintenance of other assets etc.

The study of recurring costs through light on such aspects like—

(a) A locative efficiency of resources

(b) Economies of scale

(c) The financial effects of changes in organization pricing policies etc.

(d) Efficiency in Passenger Road Transport, and

(e) Productivity of Passenger Road Transport.

Non-recurring Cost[2]

The non-recurring costs are the fixed costs or the capital costs. These costs do not relate with the level of Passenger Road Transport output. Non-recurring costs include the following items—

(a) Purchase of land and building for setting up the depot, bus stand etc, or the cost of construction of buildings,

(b) Purchase of furniture and durable equipment,

(c) Purchase of buses,

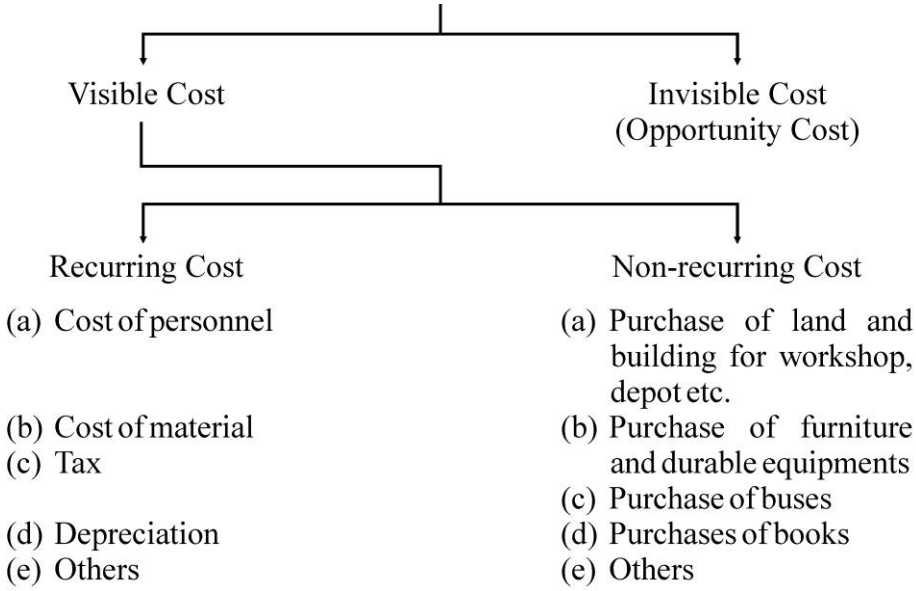
(d) Purchase of books, if any, and

(e) Others.

The components of Passenger Road Transport cost have been outlined in the following diagram.

2. This study does not consider the capital cost of Passenger Road Transport due to computational problems.

Components of Passenger Road Transport Cost



REVIEW OF LITERATURE ON PASSENGER ROAD TRANSPORT COST

The studies relating to the Passenger Road Transport cost vary in objectives 2nd on methodological ground in estimation of unit and total costs. Most of the studies relating to the Passenger Road Transport cost (See Chapter IV; Review on Passenger Road Transport cost function) have their specific purpose. The main purpose of all these studies behind the estimation of the total and unit costs has been the estimation of cost functions only. These studies do not analyze the Passenger Road Transport cost component-wise.

The present study analyzes the Passenger Road Transport cost component wise. The present study also analyzes the Passenger Road Transport cost by estimating the trends in various forms.

ESTIMATION AND ANALYSIS OF PASSENGER ROAD TRANSPORT COST (I): TOTAL AND UNIT COSTS

The total and unit costs have been estimated and the results have been analyzed aider the following way. Data about total and unit Passenger Road Transport costs have been presented in Appendices AG-1 and AG-2.

Estimation of Total and Unit Cost

To calculate the total Passenger Road Transport cost, all the costs incurred on the recurring items have been summed up. The total costs component-wise have also been calculated.

This study considers the four measures of Passenger Road Transport output. So, while estimating the unit Passenger Road Transport cost, four different measures of it have been used in this study. These are,

$$UCSK_i = \frac{TC_i}{SK_i} \quad ...(3.1)$$

$$UCPK_i = \frac{TC_i}{PK_i} \quad ...(3.2)$$

$$UCEK_i = \frac{TC_i}{EK_i} \quad ...(3.3)$$

$$UCPC_i = \frac{TC_i}{PC_i} \quad ...(3.4)$$

In the above expressions, *UCSK*, *UCPK*, *UCEK*, and *UCPC* are the unit Passenger Road Transport costs regarding seat kms, passenger kms, effective kms, and no. of passengers carried respectively. *TC* is the total Passenger Road Transport cost. *SK*, *PK*, *EK*, and *PC* are seat kms, passenger kms, effective kms, and no. of passengers carried respectively, *i* shows the years considered in the study *i.e.*, *i* = l 979-80 to 1993-94. The total and unit Passenger Road Transport costs have been estimated for both developed and developing states separately.

ANALYSIS OF RESULTS

The results regarding total and unit Passenger Road Transport costs have been analyzed in the following way.

1. Analysis of Total Passenger Road Transport Cost—Tables 3.1 and 3.2 analyzes the total Passenger Road Transport cost and its various components in developed and developing states respectively.

Table.1: Total Passenger Road Transport Cost and its Components: Developed States (Rs. in lakhs)

Year	Components of Passenger Road Transport Cost					
	Personal Cost	Material Cost	Tax	Depreciation	Miss & Other Costs	Total Cost
1979-80	3685.34 (34.20)	2441.58 (22.66)	2258.20 (20.96)	1433.88 (13.31)	556.12 (5.16)	10775.58
1980-81	4898.45 (31.08)	5872.35 (37.26)	2252.39 (14.29)	1700.65 (10.79)	544.44 (3.45)	15759.57
1981-82	6041.28 (31.47)	7236.07 (37.70)	2666.19 (13.89)	1921.11 (10.00)	686.24 (3.57)	19196.16
1982-83	6171.03 (33.84)	6929.76 (37.99)	2067.92 (11.34)	1757.24 (9.63)	707.95 (3.88)	18238.44
1983-84	6586.38 (3231)	7889.33 (38.70)	2754.64 (13.51)	1837.89 (9.02)	708.24 (3.47)	20384.12
1984-85	6846.90 (35.05)	6534.99 (33.45)	2586.33 (14.62)	1898.22 (9.72)	856.73 (4.39)	19534.41
1985-86	7887.81 (35.55)	7268.24 (32.76)	3141.72 (14.16)	2169.61 (9.78)	1220.73 (5.50)	22185.86

1986-87	8718.45 (36.05)	7597.34 (31.42)	3436.58 (14.21)	2474.87 (10.23)	1353.46 (5.60)	24182.81
1987-88	8918.41 (35.81)	7720.05 (30.99)	3523.17 (14.15)	2862.82 (11.49)	1350.80 (5.42)	24906.56
1988-89	10040.29 (36.63)	8409.71 (30.68)	3790.97 (13.83)	2952.12 (10.77)	1829.15 (6.67)	27410.51
1989-90	11563.32 (38.47)	8552.07 (28.45)	3931.15 (13.08)	3153.00 (10.49)	2820.38 (9.38)	30056.09
1990-91	11397.05 (37.11)	9015.31 (29.35)	4046.46 (13.18)	3535.49 (11.51)	2777.84 (9.04)	30711.59
1991-92	11957.61 (36.20)	9948.44 (31.05)	3987.80 (12.45)	4066.46 (12.69)	2542.46 (7.94)	32038.54
1992-93	12455.17 (38.57)	10672.14 (33.05)	3928.66 (12.17)	3034.44 (9.40)	2396.07 (7.42)	32292.85
1993-94	13477.02 (39.80)	10635.48 (31.41)	4810.42 (14.20)	2960.36 (8.74)	2675.16 (7.90)	33865.45
Mean	8343.39*	7781.52*	3296.84*	2517.21*	1535.05*	24102.57*
Std. Dev.	2768.76*	2048.63*	803.41*	772.49*	886.12*	6866.78*
Coff. Var.	18.40	26.33	24.52	30.69	57.73	28.49

Note: The values in parentheses are the percentage of the corresponding cost component from the total cost

The total of all the values of the parentheses corresponding to a particular year should be 100.00, but it has not been obtained so because of the rounding off the % values.

*–Shows that the values of mean and std. dev. are significantly different (at 5% level of significance) from the corresponding values in developing states.

In developed states, the total Passenger Road Transport cost ranges between Rs. 10775.58 and 33865.45 lakhs where its average is Rs. 24102.57 lakh and the coff. var. is 28.49 percent. Among the components of cost, the proportion of personnel cost m the total cost is more than that of other components. The proportion of miscellaneous and others component is the least in the total cost.

Table.2: Total Passenger Road Transport Cost and its Components: Developing States
(Rs. in lakhs)

Year	**Components of Passenger Road Transport Cost**					
	Personal Cost	**Material Cost**	**Tax**	**Depreciation**	**Miss & Other Costs**	**Total Cost**
1979-80	1214.62 (52.64)	505.39 (21.90)	157.06 (6.81)	106.57 (4.62)	123.10 (5.33)	2307.46
1980-81	1201.52 (29.952)	1776.25 (44.23)	216.77 (5.40)	420.18 (10.46)	143.84 (3.58)	4016.18
1981-82	1293.05 (31.24)	1793.42 (43.33)	195.06 (4.71)	421.63 (10.19)	80.88 (1.95)	4138.61
1982-83	1397.00 (32.50)	1807.26 (42.04)	161.62 (3.76)	447.20 (10.40)	94.60 (2.20)	529852
1983-84	1447.10 (32.63)	1465.87 (33.05)	116.88 (2.64)	360.49 (8.13)	859.47 (19.38)	4334.89

1984-85	1582.91 (33.02)	1329.40 (27.73)	104.81 (2.19)	420.09 (8.39)	1231.26 (25.69)	4793.38
1985-86	1557.34 (31.94)	1586.80 (32.55)	129.64 (2.66)	361.44 (7.41)	1083.00 (22.21)	4875.59
1986-87	1620.47 (31.57)	1728.00 (33.67)	175.05 (3.41)	548.67 (10.69)	891.96 (17.38)	5132.23
1987-88	2072.97 (37.62)	1886.26 (34.23)	164.36 (2.98)	814.28 (14.78)	276.42 (5.02)	5510.44
1988-89	2406.31 (37.80)	2159.69 (33.92)	161.21 (2.53)	935.76 (14.70)	308.25 (484)	6366.18
1989-90	2550.87 (39.66)	2220.18 (34.52)	153.16 (2.38)	862.74 (13.41)	355.51 (5.53)	6431.65
1990-91	2827.00 (41.49)	2338.19 (34.32)	181.89 (2.67)	796.12 (11.68)	450.85 (6.62)	6813.27
1991-92	2796.43 (41.96)	2346.17 (35.20)	148.08 (2.22)	939.37 (9.59)	677.90 (10.17)	6665.08
1992-93	2950.75 (43.07)	2382.93 (34.79)	151.94 (2.22)	633.35 (9.25)	713.34 (10.41)	6850.27
1993-94	2907.41 (44.00)	2414.93 (36.55)	138.13 (2.09)	551.49 (8.35)	813.84 (12.32)	6607.04
Mean	1988.38*	1849.38*	157.04*	553.43*	540.28*	5282.72*
Std. Dev.	679.01*	510.12*	22.81*	227.67*	380.58*	1333.39*
Coff. Var.	34.15	27.58	18.35	41.14	70.44	25.24

Note: The values in parentheses are the percentage of the corresponding cost component from the total cost

The total of all the values of the parentheses corresponding to a particular year should be 100.00, but it has not been obtained so because of the rounding off the % values.

*–Shows that the values of mean and std. dev. are significantly different (at 5% level of significance) from the corresponding values in

In case of the developing states (Table.2), the total Passenger Road Transport cost ranges from Rs. 2307.46 to 6850.27 lakhs where its average and coff. var. are Rs 1333.39 lakh and 25.24 percent respectively. In case of developing states also, iie proportion of personnel cost in the total cost is more (except the years 1980-81 ID 1983-84) while the proportion of tax in the total cost is the least.

Comparatively the levels of the total cost and its various components are higher in developed states than the developing states. The mean and std. dev. of the total cost and its components in the developed states are significantly different from the mean and std. dev. of total cost and its components in developing states. The data of total cost are more consistent having less coefficient of variation in developing states. Similarly, the data of the components of total cost are also more consistent in the developed states (except tax).

2. Analysis of Unit Passenger Road Transport Cost—Table.3 analyzes the unit Passenger Road Transport cost corresponding to the four different measures of the Passenger Road Transport output in case of both developed and developing states. The unit cost regarding seat kms (UCSK), passenger kms (UCPK), effective kms (UCEK), and no. of passengers carried (UCPC) in developed states range between Rs. 0.05 and 0.08, Rs. 0.06 and 0.10, Rs. 2.43 and 3 90, and Rs. 1.31 and 2.14

respectively. The fluctuating trends can be observed for all the unit costs. The average of UCSK, UCPK, UCEK, and UCPC are Rs. 0.06, 0.08, 3.36, and 1.74 respectively in the developed states.

Table.3: Unit Passenger Road Transport Cost
(Rs. in lakhs)

Year	Developed States				Developing States			
	UCSK	UCPK	UCEK	UCPC	UCSK	UCPK	UCEK	UCPC
1979-80	0.05	0.06	2.43	1.31	0.03	0.04	1.56	1.41
1980-81	0.07	0.08	3.30	1.84	0.05	0.07	2.58	2.39
1981-82	0.07	0.10	3.82	2.14	0.05	0.07	2.78	2.68
1982-83	0.07	0.09	3.54	1.95	0.06	0.08	3.05	3.19
1983-84	0.08	0.10	3.90	2.05	0.06	0.08	2.94	3.28
1984-85	0.07	0.09	3.52	1.83	0.06	0.09	3.03	3.69
1985-86	0.07	0.09	3.55	1.85	0.06	0.08	2.92	3.39
1986-87	0.07	0.08	3.50	1.81	0.06	0.08	2.92	3.32
1987-88	0.06	0.08	3.20	1.65	0.05	0.08	2.75	3.51
1988-89	0.06	0.08	3.24	1.66	0.05	0.08	2.92	3.95
1989-90	0.06	0.08	3.29	1.64	0.05	0.08	2.77	3.82
1990-91	0.06	0.08	3.44	1.58	0.06	0.08	3.03	4.11
1991-92	0.06	0.08	3.31	1.59	0.05	0.07	2.84	4.01
1992-93	0.06	0.08	3.16	1.55	0.05	0.08	2.96	4.60
1993-94	0.06	0.08	3.17	1.59	0.05	0.07	2.75	4.67
Mean	0.06	0.08	3.36	1.74	0.05	0.08	2.79	3.47
Std. Dev.	0.01	0.01	0.36	0.22	0.01	0.01	0.36	0.85
Coff. Var.	16.67	12.5	10.12	12.64	20.00	12.5	12.90	24.50

In case of developing states, *UCSK*, *UCPK*, *UCEK*, and *UCPC* range from Rs. 0.03 to 0.06, from Rs. 0.04 to 0.09, from Rs. 1.56 to 3.05, and from Rs. 1.41 to 4.67 respectively. The average of all the four types of unit costs are Rs. 0.05, 0.08, 2.79, and 3.47 respectively Here also the fluctuating trends are being reported by *UCSK*, *UCPK*, *UCEK*, and *UCPC*.

On comparing the data of different types of unit cost between developed and developing states, it can be observed that the data of *UCSK*, *UCEK*, and *UCPC* are more consistent in case of the developed states. The difference of mean and std. dev. regarding all the four types of unit costs have been tested but no significant differences have been noticed between the mean and std. dev. of both types of states.

ESTIMATION AND ANALYSIS OF PASSENGER ROAD TRANSPORT COST (II): TRENDS ANALYSIS

The trends in linear, quadratic and exponential forms have been estimated for the total Passenger Road Transport cost, personnel cost, material cost, and the cost excluding interest and depreciation. The trends have also been estimated for per staff payment and unit costs regarding seat kms, passenger kms, effective kms, and the no. of passengers carried. The estimation procedure and the result have been discussed as below—

Estimation of Trends

To estimate the various trends regarding total and unit costs, the following functional forms have been tested and estimated through the Ordinary Least Squares[3].

$$Y = \beta + \beta_1 t \quad ...(3.5)$$

$$Y = \beta_0 + \beta_1 + \beta_2 t^2 \quad ...(3.6)$$

In $$Y = \beta_0 + \beta_1 t \quad ...(3.7)$$

where, *Y*-the Passenger Road Transport cost, In *Y*-natural logarithm of *Y*, and *t* is the time. β_0, β_1, and β_2 are the coefficients to be estimated. Equation (3.5) is the linear function in which β_1 represents the regression coefficient. Equation (3.6) is the quadratic function, and equation (3.7) is the exponential function in which β_1 measures the constant relative change in *Y* for a given absolute change in *t*[4]. Such a model is known as the constant growth model.

ANALYSIS OF RESULTS

Results regarding the estimated trends have been analyzed as below—

1. Trends of the Total Cost and its Related Concepts—Tables 3.4 to 3.8 show the estimated trends for total Passenger Road Transport cost, total personnel cost, total material cost, total cost excluding interest and depreciation, and the per staff payment respectively. These trends can also be studied in Figures 3.1 and 3.2 in case of developed and developing states respectively. Each table shows the estimated trends for both developed and developing states.

Table.4: Estimated Trends of Total Cost

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	12033.37* (16.70)	11170.51* (9.40)	9.51* (170.27)	3009.47* (13.22)	2455.02* (7.40)	8.06* (114.30)
β_1	1508.65* (19.04)	1813.19* (5.31)	0.07* (11.01)	284.16* (11.35)	479.84* (5.03)	0.06* (7.64)
β_2		–19.03 (0.92)			–12.33** (2.11)	
R^2	0.9654*	0.9677*	0.9031*	0.9083*	0.9331*	0.8179*
R^2	0.9627*	0.9623*	0.8956*	0.993*	0.9219*	0.8039*
F	362.58	179.47	121.15	128.77	83.68	58.39
D–W	1.5155	1.5417	1.1378	1.3177	1.5240	1.2587

3. See (a) Damoder N. Gujrati (1988): *Basic Econometrics*, 2nd Edition McGraw–Hill Book Company; (a) Johnston, J. (1985): *Econometric Methods*, McGraw–Hill Book Company; (c) G.M.K. Madneni (1989: *Introduction to Econometrics*, 5th Edition, Oxford and I.B.H., New Delhi.
4. Using differential calculus, it can be shown that $\beta_1 = d(lny)/dt = (1/y)\,(dy/dt) = (dy/y)\,(1/dt)$. Sec. D. Gujrati (1988): *Basic Econometrics*, McGraw–Hill Book Company.

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

In Table.4, all the estimated coefficients of all the fitted models are highly statistically significant at 1 percent level. In all the models, the measure of the explanatory power *i.e.*, R^2 or $\overline{R}^2$ is also statistically significant as shown by the values of *F*-statistic. It is also clear that the estimated values of the regression coefficients in all the three fitted models are higher in case of developed states than developing states.

In the developed states, the linear model shows that on average the total cost increases by Rs. 1508.65 lakh per year while in developing states it increases by Rs. 284.16 lakh per year. The 97 percent variation in total cost in case of developing states is being explained. According to the quadratic model, in both types of states the positive values of β_1 and negative values of β_2 show that initially the total cost increases but at the higher years the total cost starts decreasing. The exponential model shows that the total cost significantly increases by 7 and 6 percent annually in developed and developing states respectively.

On measuring the explanatory power of the fitted models, the linear model in case of developed states and the quadratic model in case of developing states shows the better fit. It is also clear that in all the fitted models the fit can be seen well in case of developed states. The values of D–W statistic show the evidence of the presence of positive autocorrelation.

Table.5: Estimated Trends of Total Personnel Cost

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	3402.32' (15.45)	3440.48* (9.17)	8.35* (177.78)	815.37* (8.20)	1036.29* (6.94)	6.94* (161.92)
β_1	660.41* (27.27)	646.95* (5.99)	0.08* (15.88)	146.63* (13.41)	68.65 (1.60)	0.08* (15.91)
β_2		0.84 (0.13)			4.87** (1.87)	
R^2	0.9828*	0.9829*	0.9510*	0.9326*	0.9478*	0.9512*
R^2	0.9815*	0.9800*	0.9472*	0.9274*	0.9391*	0.9474*
F	743.84	343.79	252.03	179.91	108.92	253.16
D–W	1.6151	1.6200	0.9158	0.6648	0.8592	0.8718

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

Above table shows the estimated trends of total personnel cost. It can be seen that all the estimated coefficients in all the fitted models, both for developed and developing states, are statistically significant at 1 percent level. Similarly, the estimated values of R^2 or

$\overline{R}^2$ are also highly significant as tested by applying the *F*-ratio. The linear model shows that on an average the total personnel cost increase by Rs. 660.41 bkh and Rs. 146.63 lakh per year in developed and developing states respectively. The personnel cost not affected by the time (*i.e.*, intercept) is also highly significant in all cases. In the quadratic model of both developed and developing states, the values of β_1 and β_2 are positive showing that the personnel cost increases monotonically with time. The exponential model shows that the constant growth rate of the personnel cost is same *i.e.*, 8 percent both in developed and developing states.

The values of R^2 in all the fitted models for both developed and developing states are significant. As the goodness of fit is concerned, the linear model in case of developed states while the exponential model in case of developing states show the better fit. On the basis of the comparison, the quadratic model in developed states while the exponential model in developing states show the better fit. There is presence of positive autocorrelation in case of all the fitted models as shown by the values of D-W test.

Table.6: Estimated Trends of Total Material Cost

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	4517.25* (8.60)	4132.90* (4.67)	8.42* (68.44)	1103.17* (6.66)	1052.84* (3.74)	6.97* (45.21)
β_1	408.03" (7.07)	543.69** (2-14)	0.06* (4.58)	93.28* (5.12)	111.04 (1.37)	0.06* (3.68)
β_2		–8.48 (0.55)			–1.11 (0.23)	
R^2	0.7934*	0.7985*	0.6171*	0.6687*	0.6701*	05104
R^2	0.7775*	0.7649*	0.5876*	0.6432*	0.6151*	0.4727*
F	49.93	23.77	20.95	26.24	12.19	13.55
D–W	1.2267	1.2095	1.1680	1.4270	1.4124	1.4923

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

Table.6 reports the estimated trends of the total material cost. All the coefficients in the fitted linear, quadratic, and exponential models in both developed and developing states are statistically significant. According to the linear specification, the material cost increases by Rs. 408.03 lakh per year in developed states and Rs. 93.28 lakh per year in developing states. The material cost component which is not affected by the time factor is Rs. 4517.25 lakh and 1103.17 lakh in developed and developing states respectively. In the linear model, about 79 and 67 percent of the total variation in the material cost is explained in case of developed and developing states respectively.

In case of quadratic model, the values of β_2 are negative and the values of β_1 are positive in both types of states which show that there is inverted *U*-shaped material cost trend curve. In the

developed states about 80 percent and in developing states about 67 percent variations are being explained as shown by the values of R^2.

The constant rate of increase of material cost is same (6 percent) in both types of states as shown by the exponential model. This model also shows that about 62 and 51 percent of total variation in the material cost is being explained in developed and developing states respectively.

Comparatively, the goodness of fit in all the fitted models is better in case of developed states. Similarly, all the three fitted models show the better fit for the developed states. It can be seen by the values of the D-W test that there is presence of positive autocorrelation in all the fitted models.

According to Table.7, the total cost excluding interest and depreciation significantly increases by Rs. 1295.12 and 238.52 lakhs per year in developed and developing states respectively.

On the basis of fitted quadratic model, it can be observed that the total cost excluding interest and depreciation is an inverted U-shaped function in both types of states. About 96 and 95 percent variations are explained in case of developed and developing states respectively. In this model, the values of intercept are statistically significant.

Table.7: Estimated Trends of Total Cost Excluding Interest and Depreciation

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
$\square_0$	10350.96* (16.10)	9858.13* (9.11)	9.35* (157.40)	2452.44* (16.52)	2264.31* (9.29)	7.87 (132.93)
$\square_1$	1295.12* (18.32)	1469.06* (4.72)	0.07* (10.35)	238.52* (14.61)	304.92* (4.35)	0.06* (9.05)
$\square_2$		–10.87 (0.58)			–4.15 (0.97)	
R^2	0.9627*	0.9637*	0.8918*	0.9426*	0.9468*	0.8630*
R^2	0.9598*	0.9576*	0.8834*	0.9382*	0.9379*	0.8525*
F	335.48	159.27	107.11	213.42	106.76	81.91
D–W	1.6232	1.6288	1.1654	1.6895	1.7117	1.4515

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

Speaking on the basis of the exponential model, the constant rates of growth of total cost excluding interest and depreciation are 7 and 6 percent for developed and developing states respectively. These growth rates are highly significant at 1 percent level. The explanatory power of the exponential models is about 89 and 86 percent for developed and developing states respectively.

It can also be seen that all the fitted models have the higher degree of explanatory power in developed states than the developing states as shown by the *F*-statistic. The estimated values of D-W statistic show the evidence of the presence of positive autocorrelation.

The estimated trends of the per staff payment have been shown in Table.8.

Table.6: Estimated Trends of Per Staff Payment

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	10078.95* (19.01)	8793.16* (11.36)	9.23* (190.20)	6374.72* (15.65)	6820.60* (10.09)	8.83* (225.53)
β_1	447.66* (7.68)	901.46* (4.05)	0.03* (6.56)	472.70* (10.55)	315.33 (1.62)	0.05* (10.88)
β_2		–28.36** (2.10)			9.84 (0.83)	
R^2	0.8192*	0.8677*	0.7679*	0.8954*	0.9011*	0.9011*
$\bar{R}^2$	0.8053*	0.8456*	0.7500*	0.8873*	0.8846*	0.8935*
F	58.91	39.34	43.00	111.25	54.66	118.46
D–W	1.3015	1.6904	1.0894	1.1611	1.2276	1.2767

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

The above table shows that all the fitted models have their almost all the coefficient highly significant at 1 percent level. According to the linear models, Rs. 448 and 473 are the estimates of average per staff annual payment in developed and developing states respectively. The results of the quadratic models show that per staff payment is being represented by an inverted U-shaped curve in developed states while it shows monotonic insignificant increase in case of developing states. The estimated constant growth rates of per staff payment show that per staff payment has increased annually by 5 percent in the developing states and by 3 percent in the developed states.

The explanatory power of all the fitted models is highly significant. The quadratic model in developed states and the exponential model in developing states show the better fit by explaining about 85 and 89 percent variations respectively. The s of D-W statistic shows the evidence of the presence of positive autocorrelation.

2. Trends of the Unit Costs—Tables 3.9 to 3.12 analyze the estimated trends of unit costs, based on seat passenger kms, effective kms and no. of passengers carried respectively.

Table .9: Estimated Trends of Unit Cost (Seat Kms)

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	0.07* (17.82)	0.06* (10.40)	-2.68* (43.36)	0.05* (11.33)	0.04* (6.46)	-3.03* (31.16)
β_1	-6.07 (1.42)	2.48 (1.48)	-8.43 (1.24)	2.86 (0.54)	5.20* (3.20)	8.86 (0.83)
β_2		–1.93* (1.89)			–3.07* (3.11)	
R^2	0.1335	0.3324	0.1061	0.0256	0.46100**	0.0503
$\bar{R}^2$	0.0668	0.2211	0.0373	0.0000[a]	0.3711**	0.0000[a]
F	2.00	2.99	1.54	0.34	5.13	0.69
D–W	1.0704	1.2382	1.0525	0.9072	1.3335	0.9284

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

a–The value of R^{-2} comes out to be negative, so treated as zero.

According to Table .9, the coefficient in linear model is significantly negative which shows that the unit cost (Seat kms) significantly decreases with time in case of developed states but insignificantly increases in developing states. All the coefficients of the quadratic model in case of developing states are significant at 1 percent level but in case of developed states only the $\square_2$ in quadratic model is negatively significant. The negative constant growth rate of unit cost in case of developed and the positive constant growth rate of unit cost in case of developing states are insignificant.

Only the quadratic model in case of developing states shows the significant explanatory power which explains about 37 percent variation. There is presence of positive autocorrelation in case of all the fitted models, as shows by the values of D-W test.

Table .10 analyzes the results of the estimated trends of unit cost regarding passenger kms.

Table.10: Estimated Trends of Unit Cost (Passenger Kms)

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
$\square_0$	0.09* (15.78)	0.07* (8.96)	-2.47* (36.25)	0.07* (11.49)	0.05* (7.31)	-2.73 (28.21)
$\square_1$	-3.21 (0.54)	3.65** (1.52)	-2.13 (0.28)	8.93** (1.37)	8.51* (4.64)	0.02** (1.51)
$\square_2$		–2.48* (1.70)			–7.76* (4.27)	
R^2	0.0217	0.2121	0.0061	0.1259	0.6528*	0.1484
R^2	0.0000[a]	0.0808	0.0000[a]	0.0586	0.5949*	0.0829
F	0.29	1.62	0.08	1.87	11.28	2.27
D–W	0.9309	1.0203	0.8820	0.9403	1.7590	0.9662

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

a–The value of R^{-2} comes out to be negative, so treated as zero.

All the coefficients of the estimated quadratic models in both the cases of developed and developing states are significant. The constant growth rate of unit cost in case of developed states is not significant but this rate is significant at 10 percent level in case of developing states. Only the quadratic model in case of the developing states shows the significant explanatory power where about 59 percent variation is being explained. All the other fitted models have very low insignificant explanatory power. It can be seen by the values of the D-W test that there is presence of positive autocorrelation in all the fitted models.

The result of the estimated trends of unit cost regarding effective kms have been reported in Table.11.

Table .11: Estimated Trends of Unit Cost (Effective Kms)

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	3.40* (17.74)	2.91* (10.64)	1.21* (19.66)	2.50* (13.58)	1.94* (8.12)	0.88* (10.66)
β_1	-5.25 (0.25)	0.17** (2.15)	-1.57 (0.02)	0.04 (1.75)	0.23* (3.39)	0.02** (1.79)
β_2		–0.01** (2.28)			–0.01* (2.96)	
R^2	0.0047	0.3055	0.0001	0.1906	0.5317**	0.1972
R^2	0.0000*	0.1898	0.0000[a]	0.1283	0.4537**	0.1354
F	0.06	2.64	0.01	3.06	6.81	3.19
D–W	0.9330	1.1087	0.9169	0.9101	1.1924	0.9438

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

a–The value of R^{-2} comes out to be negative, so treated as zero.

The above table shows that all the regression coefficients of the fitted quadratic models, both in case of developed and developing states, are significant. The constant growth rate of 2 percent of unit cost in case of developing states is significant at 5 percent level. The rest of the estimated regression coefficients under different models are insignificant (except the intercepts).

The quadratic model in case of developing states explains the variation in unit cost significantly where about 45 percent variation is being explained. All the other fitted models do not explain the variation significantly. The estimated values of D-V statistic show the evidence of the presence of positive autocorrelation.

Table.12 analyzes the estimated trends of unit cost regarding no. of passengers carried.

Table.12: Estimated Trends of Unit Cost (No. of Passengers Carried)

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	1.90* (17.30)	1.66* (9.99)	0.63* (9.62)	2.08* (11.12)	1.68* (5.91)	0.75* (8.48)
β_1	-0.02 (1.71)	0.06 (1.31)	-0.01 (1.48)	0.17* (8.46)	0.31* (3.84)	0.06* (5.85)
β_2		–5.22** (1.79)			–8.74* (1.76)	
R^2	1.1832	0.3560	0.1439	0.8461*	0.8777*	0.7247*
R^2	0.1204	0.2486	0.0780	0.8343*	0.8573*	0.7035*
F	2.92	3.32	2.18	71.48	43.05	34.21
D–W	0.9738	1.0805	0.9545	1.0133	1.1479	0.8565

Note: Values in parentheses are the absolute *t*-ratios.

*–Significant at 1% level.

**–Significant at 5% level.

All the results of all the fitted models in case of developing states are significant at 1 percent level while only the values of intercept of all the fitted models are significant in case of developed states. The significant constant growth rate of unit cost in case of developing states is 6 percent.

In case of developing states, the quadratic model shows the best fit by significantly explaining about 86 percent variation in the unit cost. It is also clear that all the fitted models in case of developed states insignificantly explain very low variation. The values of D-W statistic show the evidence of the presence of positive autocorrelation.

CONCLUSION

Following are the conclusions of this chapter—

1. Analyzing the Passenger Road Transport cost and its related concepts, this chapter has dealt with the estimation and analysis of total and unit Passenger Road Transport costs. Trends have also been estimated for total cost and its components and for unit costs through linear, quadratic, and exponential models.

2. The component of total Passenger Road Transport cost, which has the largest proportion, is the personnel cost, followed by the material cost in developed as well as developing states. The level of total Passenger Road Transport cost and its components are higher in case of developed states than developing states. The total Passenger Road Transport cost in case of developed states is found significantly different from that in case of developing states.

3. The levels of unit Passenger Road Transport cost in the case of seat kms, passenger kms and effective kms have been found higher on an average basis in case of developed states while the unit Passenger Road Transport cost regarding no. of passengers carried has been found more in case of developing states. Fluctuating trends have been observed in the unit cost in case of both types of states.

4. The total real cost showed the monotonically increasing trends in case of developed and developing states. The rate of increase has been found higher in case of developed states. The same trends have also been estimated for each of the component of total Passenger Road Transport cost. The time has been found significant in affecting the total Passenger Road Transport cost and its components at more than 1 percent level.

5. Trends have also been estimated for unit cost regarding each measure of Passenger Road Transport output. The quadratic models showed comparatively better fit. In case of unit cost regarding each measure of Passenger Road Transport output, the quadratic models in case of developing states showed the significant explanatory power. Similarly, for the unit cost regarding no. of passengers carried the linear and exponential models also reported the significant values of R^2.

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