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Review Article

Passenger Road Transport Output Analysis : Concept, Measurement and Econometric Analysis

Dr. Rais Ahmad
Associate Professor Economics
Ramabai Ambedkar Govt. Degree College Gajraula, Amroha

Abstract

The growth of financial services in India has largely been led by the banks, changing in banking services makes the great changes in the economy of India. By digitalisation of banking system, the banking services are more easy to use for customers and there is no need to queue in banks for the basic banking services, the customer can use banking services from anywhere. With the help of digital banking the more customers are able to use banking services and this creates the remainder growth in the Indian economy. The banks provide digital banking services through mobile, internet banking, credit cards, debit cards, UPI, NEFT, IMPS etc. The study focuses on the growth of digital banking from last 5 years and also tells about the different type of digital transactions

Keywords- *digital banking, digital payments, card payments, online banking*

Introduction

The analysis of Passenger Road Transport output is the subject matter of this chapter. The concept of Passenger Road Transport output has been discussed along with the different measures used for it. The Passenger Road Transport output has been estimated and the results have been analyzed through the estimated trends, production functions and efficiency and scale effects. The production functions have been estimated in additive and multiplicative forms to study the impact of factors affecting the Passenger Road Transport output.

The Concept of Output in Passenger Road Transport

Output is one of the key elements of a Passenger Road Transport system. In economics, creation of utility in goods and services is known as output. But in the literature of the economics of transport, the output may be seen as the services rendered by Passenger Road Transport system to the society. Through the services of Passenger Road Transport, people go from one place to another to get their work done and thus the Passenger Road Transport system plays the productive role,

Measurement of Passenger Road Transport Output

Planners,, economists, researchers, and policy makers are not with the same approach towards the measurement of Passenger Road Transport output. Different measures have been used for it.

Measures of Passenger Road Transport output may be seen as the (i) supply-side measures, and (ii) the demand-side measures. Supply-side measures of Passenger Road Transport output are with the passenger carrying capacity of the Passenger Road Transport undertakings. In this sense the researchers use the seat kms as the measure of Passenger Road Transport output. Seat kms is the measure of passenger carrying capacity of a Passenger Road Transport undertaking which means the total number of kms travelled by seating passengers.

The demand-side measures of Passenger Road Transport output are related with the demand of Passenger Road Transport service to be consumed by the passengers. Three different demand-side measures of Passenger Road Transport output are frequently used by researchers.[1] These are given below—

1. **Passenger Kms**—Passenger kms is a measure of Passenger Road Transport output and used as an explanatory variable in the cost function.

2. **Effective Kms**—Effective kms has been used as an explanatory variable in the cost function. It is also a measure of Passenger Road Transport output.

3. **No. of Passengers Carried**—No. of passengers carried has been considered as a measure of Passenger Road Transport output and has been used as an explanatory variable in the cost function.

Determinants of Passenger Road Transport Output and Input-Output Relationship

The Passenger Road Transport output is different between as well as within the Passenger Road Transport undertakings. This differentiality in Passenger Road Transport output is due to the difference in availability of determinants of it which can be termed as inputs in the production process.

According to the traditional theory of production function, inputs of labour and capital account the determinants of Passenger Road Transport output. Fuel may also be considered in this sphere. But this simple description of inputs could explain little. So more factors affecting the Passenger Road Transport output are needed to be incorporated in the input specification process. One should specify the Passenger Road Transport inputs while using these in the output analysis so that the deterministicness of the estimation models can be said to the rational.

With the entrance of economists in the area of Passenger Road Transport, the relationship estimated between inputs and output became known as Passenger Road-Transport production function. This relationship in the new approach can be seen and analyzed in the form of the simple input-output analysis.

Production function is a mapping of any input vector ($X : X_1, X_2, ..., X_n$) for a

[1]. Some studies have also considered the real revenue earned by Passenger Road Transport undertaking as the measure of demand-side Passenger Road Transport output. The concept of real revenue has been analysed in Ch. VI.

unique non-negative real number (Q)-the maximum output that can be produced using that input vector. It is a powerful tool since it provides a basic for describing efficient production.

The applications of production function approach to the Passenger Road Transport service have enabled the government, planners, and policy-makers to judge and evaluate the role of various inputs. This approach may be very helpful while designing the future Passenger Road Transport projects with some required and desired modifications, managing the input demand and supply, planning the Passenger Road Transport system in the country, and in many other areas relating to Passenger Road Transport industry.

Passenger Road Transport production function can be estimated in a variety of forms, although most frequently used forms is linear and logarithmic models. Linear models imply independence of the various inputs and constant marginal products, while logarithmic models allow declining marginal products but constrain the form of interaction of variables. The functional forms of Cobb-Douglas models, transcendental (translog) models and generalized production function models are very difficult to translate for Passenger Road Transport service.

Thus, the crux is that one should cautiously specify the Passenger Road Transport inputs while using these in the output analysis so that the determi-nisticness of the estimation models can be rational. The proper input specifi-cation is positively correlated with the efficiency in Passenger Road Transport output as economic efficiency is the mirror to reflect the sightedness of the input specification processes[2].

Review of Literature on Passenger Road Transport Output

Studies relating to the measurement of specification of Passenger Road Transport output and its inputs and the estimation of Passenger Road Transport production function are limited. Researchers kept their attention mostly in the sphere of Passenger Road Transport cost and ignored the Passenger Road Transport output. This output has been used only for the purpose of the estimation of cost functions. Koshal and Koshal (1989) [3] have analyzed the Passenger Road Transport output through estimating the Passenger Road Transport production function in which labour and capital have been used as the inputs and bus kms as the measure of Passenger Road Transport output. They considered 25 Passenger Road Transport undertakings for two years namely 1980-81 and 1985-86. They derived the conclusion that state road transport industry enjoys economies of scale. This study does not consider the fuel as an input in the production process. In the same way, there might be many other determinants of Passenger Road Transport output.

Some studies analyzed the Passenger Road Transport output through estimating the factor productivity that is the productivity

2. On the basis of input-output relationship the efficiency in production may be classified as economic efficiency and technical efficiency. Economic efficiency refers to the correct choice of input-mix, given the prices of inputs. Technical efficiency refers to the maximization of output for a given set of inputs.

3. Koshal and Koshal (1989): "Economies of Scale of State Road Transport Industry in India", International Journal of Transport Economics, June, Vol. XVI, No. 2, 166-173.

of labour, capital, fuel etc. These studies mainly include Gollop and Jorgenson (1980), Berechman (1983), Moshe Kim (1985), and Agarwal (1987) [4] . These studies analyzed the Passenger Road Transport productivity for labour, capital, and fuel. The productivity shares have been calculated for labour, capital, and fuel and then these shares have been added to get the measure of total factor productivity.The study "Technological Change and Scale Economies in Urban Transportation" has been conducted by Andnkopoulos, J. Loizidis and K. P. Prodromidis (1992) with the objective to develop productivity indices and identify their sources[5]. Capital, labour, energy, and time have been considered as explanatory variables while total no. of passengers carried have been used for the measure of Passenger Road Transport output. It is a time series data based study in which loglinear functional forms have been used.Kofi Obeng (1990) [6] studied the sources of output change in urban bus transport system selecting 74 transit systems, for the period 1979 to 1985. Here the pooled data have been used. Labour, capital fuel, time, and some background variables have been considered as the determinants of Passenger Road Transport output while vehicle miles and passengers miles have been used as the measure of Passenger Road Transport output. This study also tried to decompose the change in transit output among the various considered determinants of Passenger Road Transport output.The other studies conducted in the same way may be Bamum and Gilesson (1979), Pucher (1983), Anderson (1983), Cervero (1984), O'Donnell (1985a and 1985b), Obeng (1987) [7] .In all the above studies the

[4]. K. M. Gollop, and D. W. Jorgenson (1980), "United States Productivity Growth by Industry 1947-1973". In J. W. Kendrick and B. N. Vaccara (eds), *New development in Productivity Measurement and Analysis*, N.B.E.R, University of Chicago Press.

J. Brechman (1983), "Cost Structure of the Intercity Bus industry", *Journal of Transport Economics and Policy*. January, 7-24.

Moshe Kim (1985), "Total Factor Productivity in Bus Transport", *Journal of Transport Economics and Policy*, May, Vol. 19, No. 2, 173-182.

M. D. Agarwal (1987), Efficiency of Public Enterprises. Prateeksha Publication, Jaipur.

[5]. A. A. Andrikopoulos, J. Loizidies, K. P. Prodromidis (1992), "The Technological Change and Scale Economies in Urban Transportation", *International Journal of Transport Economics*, June, Vol. XIX, No. 2. 127-148.

[6]. Kofi Obeng (1990), "The Sources of Output Change in Urban Bus Transit System", *International Journal of Transport Economics*, June, Vol. XVII, No. 2, 163-185.

[7]. D. T. Bamum, and J. Gileason (1979), *Measuring the Influence of Transportation Administration*, Washington D. C.

J. Pucher, A. Marksted, J. Hirchman (1983), "Impact of Subsidies on Costs of Urban Public Transport", *Journal of Transport Economics and Policy*, May, Vol. 17, No. 2, 155-176.

S. C. Anderson (1983), "The Effect of Government Ownership and Subsidy on Performance Evidence From the Bus Transit Industry". Transportation Research (A), May, Vol. 17, No. 3, 191-220.

Cervero, Robert. (1984), "Cost and Performance Impact of Transit Subsidy Programmes", *Transportation Research* (A), Vol. ISA, No. 516, 407-413.

K. J, Button, and K. J. O'Donneil (1985a), "An Examination of the Cost Structures Associated with Providing Urban Bus Services in Britain", Southern, *Journal of Political Economy*, Feb., Vol. 32, No. 1, 67-81.

K. J. Button, and K. J. O'Donneil (1985b), "The Cost of the Urban Bus Provision in Great Britain". *Transportation Planning and Technology*, Vol. 10, No. 4, 293-303.

Obeng, Kofi (1987), "Classification of Bus Transit Policy Variables", *Transportation Planning and Technology*, Vol. II, 257-272.

Passenger Road Transport output has been considered in the framework of traditional production function theory. Thus, considering only the labour, capital, fuel, and time as the determinants of Passenger Road Transport output. These studies do not consider the other determinants of Passenger Road Transport output which might play their significant role in influencing the levels of Passenger Road Transport output.

The above studies differ in considering the measures of Passenger Road Transport output and thus they lack the unanimity about the measure of Passenger Road Transport output.

Estimation and Analysis of Passenger Road Transport Output (I): Trend Analysis Approach

To study the growth of measures of Passenger Road Transport output and related concepts considered in this study, trend analysis has been adopted. Data for all the four measures of Passenger Road Transport output have been shown in Appendices AG-1 and AG-2.

Estimation of Trends

Trends have been estimated for seat kms, passenger kms, effective kms, and no. of passengers carried; the various measures of Passenger Road Transport output considered in this study; and the related concepts of vehicle productivity (or capital productivity) and man power productivity. The trends have been estimated in linear, quadratic, and exponential forms. The estimation technique used is the Ordinary Least Squares. The three models used can be presented as below[8]—

$$Y=\beta_0+\beta_1 t \qquad ...(5.1)$$

$$Y=\beta_0+\beta_1+\beta_2 t^2 \qquad ...(5.2)$$

$$\text{In } Y=\beta_0+\beta_1 t \qquad ...(5.3)$$

where, Y-the Passenger Road Transport output, Iny-natural logarithm of Y, and *t* is the time. β_0, β_1 and β_2 are the coefficients to be estimated. Equation (5.1) is the linear function in which fix represents the regression coefficient. Equation (5.2) is the quadratic function, and equation (5.3) is the exponential function in which β_1 measures the constant relative change in Y for a given absolute change in *t*. Such a model is known as the constant growth model.Above three models have been estimated in case of both developed and developing states.

Analysis of Results

The results of the estimated trends of Passenger Road Transport output have been presented in Tables .1 to 5.6. Trends have also been shown in Figures 5.1 and 5.2 for developed and developing states respectively.

(a) Trends of Seat Kms

The estimated trends of seat kms have been shown in Table .1 for both developed and developing states.It is clear that in all the fitted models in case of both developed and developing states, time affects the seat

[8]. See (a) Damodar N. Gujrati (1988), *Basic Econometrics*, 2nd Edition McGraw-Hill Book Company, (b) J. Johnston (1985), *Econometric Methods*, McGraw-Hill Company (c) G.M.K. Madnani (1989) : Introduction to Econometrics^ 5th Edition, Oxford and I.B.H., New Delhi.

kms significantly. All the coefficients are positive showing the monotonically increasing nature of Passenger Road Transport output. In case of developed states, the values of all the estimated coefficients are statistically significant and show that the impact of time on Passenger Road Transport output in case of developed states is larger than that in case of developing states. The constant growth rates of seat kms are 7 and 5 percent in case of developed and developing states respectively.

Table 1 : Estimated Trends of Seat Kms

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	164661.78* (12.35)	190233.98* (9.17)	12,21* (355.81)	61881.75* (15.43)	67435.70* (40.43)	11.10* (274.87)
β_1	2660.88* (18.18)	17635.40* (2.96)	0.07* (19.25)	4693.66* (10.64)	2733.44** (1.45)	0.05* (10.68)
β_2		564.09** (1.56)			122.51 (1.07)	
R^2	0.9622*	0.9685*	0.9661*	0.8970*	0.9061*	0.8977*
$\overline{R}^2$	0.9593*	0.9633*	0.9635*	0.8891*	0.8904*	0.8898*
F	330.64	184.57	370.41	113.27	57.86	114.08
D–W	0.5386	0.6137	0.5532	0.5942	0.6433	0.6200

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.

The explanatory power of all the fitted models in case of developed states is more than that in case of developing states. The best fit is being shown by the quadratic models where about 97 and 91 percent variations in seat krns are being explained in case of developed and developing states respectively. It is also clear that the exponential model in case of developed states and the quadratic model in case of developing states show the better fit. The very high values of F-statistics show that the values of R^2 or $\overline{R}^2$ are highly significant statistically at more than 1 percent level. The values of D-W statistic show the evidence of the presence of positive autocorrelation.

(b) Trends of Passenger Kms

The results of the estimated trends of passenger kms have been shown in Table .2 where about all the estimated regression coefficients are highly significant with positive sign showing that time affects passenger kms positively in case of both developed and developing states.

Table 2 : Estimated Trends of Passenger Kms

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	135295.49* (12.74)	140605.50* (7.80)	11.98* (308.65)	46440.46* (15.86)	53734.20* (12.70)	10.80* (250.80)

β_1	19292.95* (16.51)	17418.83* (3.36)	0.07* (16.21)	2844.15* (8.83)	269.89 (0.22)	0.04* (8.59)
β_2		117.13 (0.37)			160.89** (2.18)	
R^2	0.9545*	0.9550*	0.9529*	0.8517*	0.8975*	0.8501*
$\overline{R}^2$	0.9510*	0.9475*	0.9493*	0.8461*	0.8804*	0.8386*
F	272.65	127.36	262.89	77.97	52.54	73.72
D–W	0.7008	0.7061	0.5492	0.7289	0.9826	0.7037

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

In case of developed states the passenger kms have shown the significant constant growth rate of 7 percent while this growth rate is 4 percent in case of developing states. It is also clear that the impact of time in passenger kms is more in case of developed states than developing states.About 96 and 90 percent variations in passenger kms are being explained by quadratic models in case of developed and developing states respectively. In case of developed states, the linear model shows the best fit by explaining about more than 95 percent variation in passenger kms but in case of developing states the quadratic model reports the best fit where it explains about 88 percent variation. The values of the function coefficient or the adjusted function coefficient are highly significant at more than 1 percent level as shown by the values of F-test There is presence of positive autocorrelation in case of all the fitted models, as shown by the values of D-W test.

(c) Trends of Effective Kms

Table .3 reports the results of estimated trends of Passenger Road Transport output, the effective kms. It can be seen that except β_1 and β_2 in quadratic model in case of developing states, all the intercept as well as slope coefficients are statistically significant at more than 1 percent level showing the significant impact of changes in time on the effective kms. It can also be seen that the role of time in affecting the effective kms is higher in case of developed states than developing states. The constant growth rates of effective kms are 7 and 4 percent in case of developed and developing states respectively. The positive sign of all the coefficients shows the monotonically increasing nature of the Passenger Road Transport output.It is also clear that all the fitted models explain the variation in effective kms highly significantly. In case of both developed and developing states the quadratic model shows the best fit. It can be seen by the values of the D-W test that there is presence of positive auto-correlation in all the fitted models.

Table 3 : Estimated Trends of Effective Kms

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential

β_0	3376.54* (15.37)	3959.70* (12.82)	8.30* (307.54)	1240.27* (17.79)	1343.77* (11.91)	7.18* (192.44)
β_1	479.48* (19.85)	273.66* (3.08)	0.07* (22.87)	80.70* (10.52)	44.17 (1.36)	0.04* (10.46)
β_2		12.86* (2.38)			2.28 (1.16)	
R^2	0.9681*	0.9783*	0.9757*	0.8950*	0.9055*	0.8937*
$\bar{R}^2$	0.9656*	0.9747*	0.9739*	0.8869*	0.8898*	0.8856*
F	393.87	270.68	522.85	11075	57.49	109.32
D–W	0.5789	0.7708	0.6353	0.5758	0.6245	0.5921

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

(d) Trends of No. of Passengers Carried

Trends have also been estimated for the no. of passengers carried which is one of the measures of Passenger Road Transport output. The results have been shown in Table .4. Table shows that in case of developing states none of the slop coefficients is statistically significant which shows that time does not affect the no. of passengers carried. In this case the coefficients of determination are insignificant. The reverse is the situation in case of developed states where time affects no. of passengers carried significantly as shown by the significant coefficients in all the fitted three models. Also, the positive sign of all the estimated parameters shows that the no. of passengers carried increased monotonically with time. The values of R^2 are highly significant and the best fit is being shown by the exponential model in which about 98 percent variation in no. of passengers carried is explained. The estimated values of D-W statistic show the evidence of the presence of positive autocorrelation.

Table 4 : Estimated Trends of No. of Passengers Carried

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	5573.15* (11.30)	6821.65* (9.63)	8.89* (299.55)	1503.61* (20.41)	1565.85* (12.67)	7.31* (148.66)
β_1	1075.56* (11.30)	634.92* (3.12)	0.08* (23.99)	3.16 (0.39)	-18.80 (0.53)	2.25 (0.42)
β_2		27.53* (2.23)			1.37 (0.64)	
R^2	0.9680*	0.9773"	0.9779"	0.0116	0.0437	0.0131
$\bar{R}^2$	0.9655*	0.9736*	0.9762*	0.0000[a]	0.0000[a]	0.0000[a]
F	393.06	258.73	575.66	0.15	0.27	0.17
D–W	0.3555	0.4709	0.4356	0.5808	0.6093	0.5855

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.
a-The value of $\bar{R}^2$ comes out to be negative, so treated as zero.

(e) Trends of Vehicle Productivity

Trends have also been estimated for the vehicle productivity or the productivity of capital. The results have been shown in Table .5.

Table 5 : Estimated Trends of Vehicle Productivity

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	87090.39* (54.67)	84888.23* (32.69)	11.38* (692.04)	62705.11* (18.08)	67014.80* (11.74)	11.06* (236.58)
β_1	1588.21* (9.07)	2365.44* (3.17)	0.02* (8.89)	1954.35* (5.12)	433.28 (0.26)	0.03* (4.87)
β_2		–48.58 (1.07)			95.07 (0.95)	
R^2	0.8634*	0.8753*	0.8587*	0.6687*	0.6921*	0.6458*
$\overline{R}^2$	0.8529*	0.8545*	0.8478*	0.6433*	0.6407*	0.6185*
F	82.17	42.12	79.01	26.24	13.84	23.70
D–W	0.5428	0.6224	0.5359	0.5727	0.5931	0.5526

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.

In case of developed states, all the estimated coefficients are statistically significant. In quadratic model, 62 is negatively insignificant. In general, it can be observed that the vehicle productivity showed increasing trends.

According to the exponential model, the vehicle productivity has increased by 2 percent constantly per annum. It is also clear that all the fitted models explain the variation in vehicle productivity significantly.

As the explanatory power is concerned, the quadratic model reports the better results by explaining more than 85 percent variation.

In case of developing states, all the coefficients (except β_1 and β_2 in the quadratic model) are statistically significant at more than 1 percent level. All the positive coefficients show the increasing trends of vehicle productivity.

The constant growth rate of vehicle productivity has been estimated as 3 percent in case of developing states. Also, all the fitted models explain the variation in vehicle productivity significantly.

The best fit is shown by the linear model which explains more than 64 percent variation.

The values of D-W statistic show the evidence of the presence of positive autocorrelation.

(f) Trends of Man Power Productivity

The trends of man power productivity have been estimated and the results are shown in Table .6.

Table 6 : Estimated Trends of Man Power Productivity

Parameters	Developed States			Developing States		
	Linear	Quadratic	Exponential	Linear	Quadratic	Exponential
β_0	9535.55* (37.89)	9830.35* (23.65)	9.17* (410.70)	8651.17* (25.28)	8871.31* (15.34)	9.07* (254.09)
β_1	238.64* (8.62)	134.59 (1.13)	0.02* (8.47)	143.35* (3.81)	65.65 (0.40)	0.01* (3.76)
β_2		6.50 (0.90)			4.86 (0.48)	
R^2	0.8512*	0.8605*	0.8467*	0.5274*	0.5363*	0.5210*
$\overline{R}^2$	0.8397*	0.8372.	0.8349*	0.4910*	0.4590*	0.4841*
F	74.34	37.00	71.79	14.51	6.94	14.14
D–W	1.2555	1.2918	1.2675	0.8202	O.S220	0.8113

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level

Table shows that the slope coefficients in the quadratic model in case of both developed and developing states are positively insignificant but all the estimated parameters in linear and exponential models are significant at more than 1 percent level in case of both types of states. It can be observed that the man power productivity in Passenger Road Transport service increased monotonically with time. According to the exponential model, the constant growth rates of man power productivity are 2 and 1 percent in case of developed and developing states respectively. It is also clear that the man power productivity in Passenger Road Transport service is more in case of developed states.

As the explanatory power is concerned, all the fitted models explain the variation in man power productivity significantly at 1 percent level. The linear models show the best fit in case of both types of states. There is presence of positive autocorrelation in case of all the fitted models, as shown by the values of D-W test.

Estimation and Analysis of Passenger Road Transport Output (lI): Production Function Approach

The Passenger Road Transport output has also been analyzed by estimating the Passenger Road Transport production functions. The technique of Ordinary Least Squares has been used for the estimation.

Estimation of Production Functions[9]

These production functions have been defined in many different ways in order to evaluate the effect of different variables on the Passenger Road Transport output. Two approaches have been used which are as below—

(a)Traditional Production Function Approach

[9]. For the Analysis of the theory of production function, see Joan Robinson (1955); "The Production Function", *Economic Journal*. 61-71 and R. W. Shephard (1953): Cost and Production Functions. Princeton University Press.

In case of Passenger Road Transport service, the theory of traditional production function allows to consider the labour, capital, and fuel as the inputs. Here, the expression can be written as below—

Q = *f* (L, K, F) ...(5.4)

where Q-the measure of Passenger Road Transport output, L-labour, K-capital, and F-fuel.

On the incorporation of T, for time, the above equation (5.4) can be written as below—

Q = *f* (L, K, F, T) ...(5.5)

The production function expressed in equations (5.4) and (5.5) have been fitted in both additive and multiplicative forms in case of both developed and developing states. The natural logarithm has been used in the multiplicative models. To study the impact of economic development on Passenger Road Transport output, dummy variable, D, has been used D = l, for developed states and D = 0 for developing states. For this purpose, the models of equations (5.4) and (5.5) in the multiplicative form have been used.As this study considers for different measures of Passenger Road Transport output, so all the above models have been fitted by considering each measure of Passenger Road Transport output separately.

(b) Determinants of Passenger Road Transport Output Approach

The traditional theory of production function ignores many variables which affect the Passenger Road Transport output. The incorporation of these variables as explanatory variables in the Passenger Road Transport production function may improve the explanatory power of the fitted models. Thus by considering these variables, the production functions now may be defined as below—

Model I : SK = *f* (TS, T, HSD, TBR, RI, SBR)

Model II : SK = *f* (TS, CER, SBR, RO, PSP, UCSK) ...(5.6)

Model III : SK = *f* (IS, ATO, SBR, MPP, EPB, UCSK)

Model IV : PK = *f* (TS, T, HSD, TBR, RI, SBR, RO)

Model V : PK = *f* (TBR, RI, SBR, MPP, UCPK, UCPC) ...(5.7)

Model VI : PK = *f* CTS, CER, RCE, ATO, SBR, PSP)

Model VII : EK = *f* (TS, T, HSD, ATK, TBR, RI, SBR)

Model VIII : EK = *f* (HSD, CER, SBR, MPP, UCEK, UCPC)

Model IX : EK = *f* (ITS, RCE, SBR, RO, PSP, EPB)

Model X : PC = *f* (TS, T;HSD, ATK, TBR, RI, SBR)

Model XI : PC = *f* (TTS, CER, ATO, SBR, MPP, PSP, UCPC) ...(5.9)

Model XII : PC = *f* (TS, RCE, FU, SBR, RO, EPB)

In the above expressions; SK-seat kms, PK-passenger kms, EK-effective kms, PC-no, of passengers carried, TS-number of total staff TTS-total number of traffic staff, T-time, HSD-HSD consumed kilolitre, ATK-average tyre kms., CER-capital employed real, RCE-return on capital employed, TBR-total number of buses on the road, FU-fleet utilization, RI-regularity index, ATO-actual trips operated, SBR-staff-bus ratio, RO-number of routes operated, MPP-man power productivity, PSP- per staff payment, EPB-earning per bus, UCSK-unit cost per seat km, UCPK-unit cost per passenger km, UCEK-unit cost per effective km, and UCPC-unit cost per passenger carried.All the above models have been fitted in both additive and multiplicative (with natural log) forms in case of both developed and developing states. The technique of estimation used is the Ordinary Least Squares.[10]

Variables Used in the Production Functions

Variables used in the Passenger Road Transport production functions have been analyzed as below—

1. **Passenger Road Transport Output—**The dependent variable in all the fitted models is the Passenger Road Transport output which may be regarded as an index of overall productivity. The different measures of Passenger Road Transport output used are seat kms (SK); passenger kms (PK), effective kms (EK), and no. of passengers carried (PC).

2. **Total Staff and Total Traffic Staff (TS and TTS)—**These two variables have been used separately as the explanatory variables and considered as crucial inputs in the passenger Road Transport production process. The TS and TTS both represent the labour input and have been expected to be positively correlated with the Passenger Road Transport output.

3. **Staff-Bus Ratio (SBR)—**In the Passenger Road Transport production function, SBR can be regarded as technology index and acts as proxy for labour-capital ratio. If the coefficient of SBR is positive it would show a rise in the productivity of the staff. The negative coefficient of SBR shows a fall in the efficiency of the staff. Evidently, SBR. affects the Passenger Road Transport output via productivity of the staff. The expected algebraic sign of SBR is positive.

4. **Unit Cost (UCSK, UCPK, UCEK, and UCPC)—**It is expected that unit cost is positively correlated with Passenger Road Transport output. Incorporating unit cost as an explanatory variable in the Passenger Road Transport production function enables the inclusion of the infrastructural facilities in the Passenger Road Transport undertaking. Thus, the unit cost may be considered a quality index.

5. **Per Staff Payment (PSP)—**PSP has been considered as a proxy for staff quality. It is generally accepted that work experiences increase the quality of staff. PSP increases with the work experience. So, this permits for testing the hypothesis that Passenger Road Transport output is the positive function of PSP

6. **Time (T)—**Time, the trend variable, also affects the Passenger Road Transport output, it is assumed to be positively correlated with the output.

7. **BSD Consumed (HSD)—**HSD is treated as an input in the traditional theory of production function. It is positively correlated with Passenger Road Transport output.

8. **Average Tyre Kilometres (ATK)—**ATK can be considered as an input in the Passenger Road Transport production process. It is an efficiency index regarding the tyre input. More

[10]. To study the method of Ordinary Least Squares, see J. Johnston (1985): Econometric Methods. McGrow-Hill Book Company and Damodar N. Gujrati (1988): Basic Econometrics, 2nd Edition, McGraw-Hill Book Company.

the average tyre kms higher the level of Passenger Road Transport output.

9. **Capital Employed Real (CER)—** CER represents the capital input and supposed to be positively correlated with Passenger Road Transport output It is considered as an explanatory variable.

10. **Return on Capital Employed (RCE)—**RCE may be regarded as a productivity index of the capital in the Passenger Road Transport undertaking. This is also supposed to be positively correlated with output and included as an explanatory variable.

11. **Total Number of Buses on the Road (TBR)—**TBR has also been considered as a proxy for capital input and supposed to be positively correlated with Passenger Road Transport output. TBR plays the role of an explanatory variable in the production function.

12. **Fleet Utilization (FU)—**FU has been considered as an explanatory variable in the production function and supposed to be positively correlated with Passenger Road Transport output. It may be seen as the efficiency index of utilizing the fleet by the Passenger Road Transport undertaking.

13. **Regularity Index (RI)—**The RI is also a variable affecting the Passenger Road Transport output. It is assumed that RI is positively correlated with output. In Passenger Road Transport service, the RI may be regarded as an index of the managerial efficiency.

14. **Actual Trips Operated (ATO)—** ATO is an explanatory variable because it affects the Passenger Road Transport output. More the trips more the value of the measure of Passenger Road Transport output. So, ATO is assumed to be positively correlated with the output.

15. **Number of Routes Operated (RO)—** In the estimated models of Passenger Road Transport production functions, the RO has been considered as a positively correlated explanatory variable. This variable may be regarded as the proxy for route nationalization.

16. **Man Power Productivity (MPP)—** MPP has been considered as an explanatory variable in the estimated Passenger Road Transport production function. MPP is the index of the productiveness of the labour input which is positively correlated with the output.

17. **Earning per Bus (EPB)—**EPB has also been considered as an explanatory variable and assumed that it is positively correlated with Passenger Road Transport output. The EPB may be considered as an index of the productiveness of capital input.

Analysis of Results

Tables .7 to 5.18 present the estimates of Passenger Road Transport production functions.

(a) Inter-relationship between Variables

By using the coefficient of determination (R) the relationship between Passenger Road Transport output and explanatory variables can be examined. It is necessary for explaining the variations in Passenger Road Transport output with the help of explanatory variables. The R s with respect to various measures of Passenger Road Transport output has been shown in Table .7. Correlation matrices have been presented in Appendices AG-3 and AG-4.

Table 7 : R^2 for Explanatory Variables (SK, PK, EK And PC- Dependent Variable)

Independent Variables	Developed States				Developing States			
	SK	PK	EK	PC	SK	PK	EK	PC
TS	0.9799*	0.9716*	0.9765*	0.9886*	0.9065*	0.8862*	0.9069*	0.0369
ITS			0.9706*	0.9888*			0.9382*	0.0461
HSD	0.9982*	0.9868*	0.9978*	0.9862*	0.9892*	0.9493*	0.9898*	0.1376
ATK			0.2738	0.2605			0.4301**	0.0054
CER	0.8420*	0.8804*	0.8214*	0.8257*	-0.1685	-0.2538	-0.1683	-0.1442
RCE		0.0843	0.0744	0.0806		-0.2224	-0.2129	-0.0111
TBR	0.9888*	0.9690*	0.9938*	0.9890*	0.7164*	0.6616*	0.7130*	-0.0001
FU				0.5021**				-0.0022
RI	-0,6104*	-0.6582*	-0.5767*	-0.6039*	-0.5963*	-0.5516*	-0.5935*	0.0116
ATO	0.8640*	0.8330*		0.8742*	0.3100	0.2716		0.0821
SBR	-0.2197	-0.2210	-0.2068	-0.1969	0.6370*	0,6576*	0.6408*	0.3582**
RO	0.9906*	0.9841*	0.9910*	0.9866*	0.9465*	0.9299*	0.9465*	0.0813
MPP	0.9025*	0.8987*	0.9076*	0.8603*	0.7721*	0.7198*	0.7751*	0.3697**
PSP	0.7341*	0.7276*	0.7432*	0'.7164*	0.9448*	0.8694*	0.9361*	0.0716
EPB	0.4426**		0.4385**	0.4418**	0.8219*		0.8169*	0.0851
UCSK	-0.2403				-0.0052			
UCPK		-0.0813				0.0064		
UCEK			-0.0336				0.0559	
UCPC		-0.2868	-0.2583	-0.2774		0.5417*	0.6213*	-0.0344

Note : *–Significant at 1% level.
**–Significant at 5% level.
(–)Shows the negative direction of correlation.

In case of developed states, the explanatory variables of TS, ITS, HSD, CER, TBR, FU, ATO, RO, MPP, PSP, and EPB have the significant positive correlation with the respective measures of Passenger Road Transport output. Only RI has the significant negative correlation. The maximum variation in SK, PK, and EK is being explained by HSD while TBR explains the maximum variation in PC. From 24 to more than 99 percent, from 8 to 99 percent, from 7 to more than 99 percent, and from 8 to 99 percent are the ranges in which the variations in SK, PK, EK, and PC respectively are being individually explained by the explanatory variables.In case of developing states, SBR and MPP affect the PC significantly. SK, PK, and EK are being significantly explained by TS, ITS, HSD, ATK, TBR, RI, SBR, R0; MPP, PSP, EPB, and UCPC. The variables of TS, TTS, HSD, ATK, ATO, SBR, RO, MPP, PSP, EPB, UCPK, and UCEK have the positive impact on the corresponding measures of Passenger Road Transport output SK is being negatively affected by CER, RI, and UCSK; PK is being negatively affected by CER, RCE and RI; the CER, RCE, and RI affect the EK negatively; and PC is being negatively affected by CER, RCE, TBR, FU, and UCPC. The ranges in which the explanatory variables individually explain the variation in SK, PK, EK, and PC ape 1 to 99 percent 1 to 95 percent, 6 to 99 percent, and less than 1 to 37 percent respectively.

(b) Traditional Production Function Approach

The results of the estimated production functions under traditional production function approach have been analyzed as below—

1. **Additive Model—**Table .8 shows the estimates of Passenger Road Transport production function.

Table 8 : Estimates of Passenger Road Transport Production Function : Additive Model

Inde-pendent Variables	Developed States				Developing States			
	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
β_0	-21519.46* (16.68)	-74600.25 (5.64)	-1649.07 (10.33)	-7360.92 (10.26)	-27721.68 (2.90)	-1946.57 (0.16)	-281.69 (1.77)	2249.54 (6.44)
TS	2.09* (3.19)	3.70* (3-10)	-1.68 (0.12)	0.1S* (2.81)	-0.56 (0.42)	1.46 (0.85)	-7.30 (0.33)	-0.07 (137)
HSD	2.97* (10.31)	3.12* (5.97)	0.04* (6.08)	0.04 (1.45)	3.11* (9.08)	1.59* (3.58)	0.05* (9.40)	0.04* (3.15)
TBR	-15,22 (1.78)	-51.71* (3.34)	0.39 (2.10)	0.52 (0.62)	-0.29 (0.04)	-11.48 (1.05)	-0.03 (0.22)	-0.50 (1.63)
R^2	0.9990*	0.9940*	0.9986*	0.9943*	0.9898*	0.9542*	0.9902*	0.6003
$\overline{R}^2$	0.9988*	0.9924*	0.9982*	0.9927*	0.9866*	0.9417*	0.9875*	0.4913
F	3848.14	612.06	2577.42	638.77	343.95	76.36	370.32	5.51
D–W	2.1460	18433	0.8842	1.6405	1.8950	1.7891	1.8919	0.9976

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

Considering seat kms as the measure of output, labour and fuel affect it significantly. In case of passenger kms as the measure of output all the three inputs affect it significantly. Fuel and capital both affect the effective kms significantly Only labour input affects the no. of passengers carried significantly.

All the fitted four models of Passenger Road Transport production function show that all the inputs considered explain jointly more than 99 percent variation in the Passenger Road Transport output.

The values of F-statistics are very high showing that the values of R2 are highly significant at more than 1 percent level. These are the results in case of developed states.In case of developing states, only fuel affects all the considered measures of Passenger Road Transport output significantly.

Other inputs of labour and capital do not play any significant role in affecting the Passenger Road Transport output. About 99 percent variation in seat kms, 95 percent variation in passengers kms, and 99 percent variation in effective kms are being explained significantly.

According to the fitted model the variation in no. of passengers carried is not being explained significantly by labour, capital, and fuel jointly.

It can be seen that labour is more productive in case of developed states as shown by the higher values of regression coefficients with respect to labour. In case of effective kms, capital and fuel are more productive in developing states than in developed states. It is also clear that the fit is better in case of developed states.

In cases where the values of D-VV are greater than 2 *i.e.* (D-W) > 2S it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation.

Time as the Explanatory Variable

Table .9 shows the estimates of Passenger Road Transport production function where, T has been incorporated as an explanatory variable along with labour, capital, and fuel.

Table 9 : Estimates of Passenger Road Transport Production Function : Additive Model (Incorporation of Time as Explanatory Variable)

Inde-pendent Variables	Developed States				Developing States			
	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
β_0	-95411.33* (5.09)	-26147.05 (0.77)	-673.75** (2.17)	-6478.41* (3.21)	-7808.16 (0.36)	3133.08 (0.11)	13.78 (0.04)	657.44 (1.05)
TS	1.70** (2.51)	2.97** (2.43)	-0.02 (1.47)	**0.17 (2.31)	-1.28 (0.85)	1.28 (0.63)	-0.02 (0.71)	-9.13 (0.21)
T	2149.46 (1.50)	3989.12 (2.43)	80.30* (1.47)	72.66 (2.31)	718.27 (0.85)	183.22 (0.63)	10.66 (0.71)	-57.43** (2.84)
HSD	3.01* (1098)	3.19* (6.44)	0.04* (8.74)	0.04 (1.43)	3.00* (8.38)	1.56* (3.21)	0.05* (8.63)	0.05 (4.69)
TBR	-18.65 (2.22)	-58.08* (2.82)	**0.26 (1.90)	0.40 (0.44)	-3.28 (0.37)	-12.25 (1.01)	-0.07 (0.50)	-0.26 (1.04)
R^2	0.9992*	0.99952*	0.9993*	0.9944*	0.9904*	0.9544*	0.9909*	0.7784*
$\overline{R}^2$	0.9989*	0.9933*	0.9991*	0.9922*	0.9866*	0.9361*	0.9873*	0.6898*
F	3213.13	516.54	3767.38	445.19	258.78	52.26	272.93	8,78
D–W	2.2345	1.8909	1.3824	1.5280	1.7504	1.7345	1.7702	1.5393

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

It can be seen that T significantly affects only the effective kms in case of developed states and the no. of passengers carried in case of developing states. In all other cases the role of T is not significant but all the coefficients have the expected positive sign. In cases where the values of D-W are greater than 2, *i.e.* (D-W) > 2, it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation.

2. **Multiplicative Model—**Tables .10 to 5.13 analyze the results of the estimated Passenger Road Transport production functions.

Table .10 shows that in case of developed states, labour affects all the Passenger Road Transport output, except effective kms, significantly and has the output increasing effect. Capital negatively and significantly affects the seat kms and passenger kms. The fuel has the significant positive effect on all the measures of Passenger Road Transport output. All the models show the highly significant explanatory power as shown by the values of R^2.

Table 10 : Estimates of Passenger Road Transport Production Function : Multiplicative Model

Inde-pendent Variables	Developed States				Developing States			
	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
β_0	-4.72* (6.90)	-7.15* (4.79)	-5.86* (8.48)	-8.99* (6.53)	-2.31* (3.15)	-0.16* (0.13)	-4.86* (7.36)	9.39* (6.25)
TS	0.53* (3.26)	1.13* (3.17)	0.23 (1.38)	0.99* (3.04)	-0.14 (0.50)	0.28 (0.57)	-0.14 (0.54)	-0.78 (1.33)
HSD	1.43* (9.00)	1.84* (5.32)	0.99* (6.22)	0.90* (2.86)	1.40* (8.35)	1.10* (3.80)	1.28* (5.53)	1.11* (3.25)
TBR	-0.61** (2.54)	-1.66* (3.18)	0.03 (0.13)	-0.37 (0.77)	0,04 (0.16)	-0.42 (1.07)	0.01 (0.02)	-0.81 (1.73)
R^2	0.9983*	0.9911*	0.9980*	0.9939*	0.9863*	0.9471*	0.9865*	0.6272
$\overline{R}^2$	0.9978*	0.9887*	0.9974*	0.9923*	0.9826*	0.6326*	0.9828*	0-5256
F	2135.89	409,80	1807.91	599.44	264.63	65.59	268.10	6.1697
λ	1.35	1.31	1.25	1.52	1.30	0.96	1.15	-0.48
D–W	1.9942	1.2927	0.8365	1.8075	1.8778	1.7636	1.8730	0.9466

Note : Values in parentheses are the absolute *t*-ratios. *–Significant at 1% level.
**–Significant at 5% level. l-Shows the function coefficient

In case of developing states, only fuel is the input which affects all the measures of output significantly and has the expected positive sign. Other inputs of labour and capital do not affect any Passenger Road Transport output. The estimated production function considering no. of passengers carried as the measure of output does not show the significant explanatory power. By adding the output elasticities with respect to labour, capital, and fuel the values of function coefficient (λ) have been calculated. It is clear that in all the four measures of Passenger Road Transport output there is the presence of increasing returns to scale in case of developed states. In case of developing states, there is the presence of increasing returns to scale as the seat kms and effective kms are concerned while in case of passenger kms there is the presence of decreasing returns to scale. The value of function coefficient in case of no. of passengers carried is negative showing that the inputs of labour, capital, and fuel negatively affects the Passenger Road

Transport output jointly. It can be seen by the values of the D-W test that there is presence of positive autocorrelation in all the fitted models.

Time as the Explanatory Variable

Table .11 shows that time has the significant positive effect on all the measures of Passenger Road Transport output as shown by the positive output elasticities with respect to time.In case of developing states, T negatively and significantly affect the no. of passengers carried as shown by the value (-0.03) which is the elasticity of Passenger Road Transport output with respect to time. In cases where the values of D-W are greater than 2, i.e. (D-W) > 2, it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive auto correlation.

Table 11 Estimates of Passenger Road Transport Production Function : Multiplicative Model (Incorporation of Time as Explanatory Variable)

Inde-pendent Variables	Developed States				Developing States			
	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
β_0	-2.20** (2.35)	-2.30 (1.02)	-2.59* (4.67)	-4.33** (2.13)	1.67 (0.61)	3.82 (0.75)	-1,35 (0.54)	-2.08 (0.42)
TS	0.46* (3.71)	0.99* (3.33)	0.13 (1.81)	0.86* (3.24)	-0.37 (1.19)	0.05 (0.09)	-0.34 (1.21)	-0.12 (0.22)
T	0.02* (3.18)	0.03** (2.55)	0.02* (6.97)	0.02** (2.73)	0.01 (1.50)	0.01 (0.81)	0.01 (1.46)	-0.03** (2.38)
HSD	1.52* (12.57)	2.02* (6.94)	1.12* (15.64)	1.08* (4.13)	1.32* (7.86)	1.02* (3.28)	1.21* (8.02)	1.35* (4.44)
TBR	-0.95* (4.57)	-2.31* (4.65)	-0.40* (3.31)	-0.99** (2.23)	-0.09 (038)	-0.55 (1.27)	-0.11 (0.51)	-0.45 (1.07)
R^2	0.9992*	0.9946*	0.9997*	0.9965*	0.9888*	0.9503*	0.9889*	0.7623*
$\overline{R}^2$	0.9988*	0.9925*	0.9995*	0.9951*	0.9844*	0.9304*	0.9844*	0.6672*
F	2927.81	462.35	7233.27	715.36	221.37	47.99	22.43	8.02
D–W	2.6519	1.9512	2.0515	1.7301	1.7045	1.5560	1.7064	1.5568

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

To study the impact of level of economic development on the Passenger Road Transport output, the dummy variable D has been incorporated. Table .12 shows the results.

Table 12 : Estimates of Passenger Road Transport Production Function : Multiplicative Model(Impact of Economic Development on Passenger Road Transport Output)

Independent Variables	Developed States			
	Model I	Model II	Model III	Model IV
β_0	-2.65*	-2.13*	-5.41*	-1.45

	(8.30)	(3.30)	(18.79)	(0.97)
TS	0.11 (0.71)	0.25 (0.83)	0.04 (0.31)	-1.06 (1.49)
HSD	1.27* (12.78)	1.05* (5.25)	1.15* (12.94)	0.61 (1.31)
TBR	-0.06 (0.61)	0.06 (0.31)	0.02 (0.28)	1.63* (3.72)
D	-0.36* (10.58)	-0.16** (2.31)	-0.22* (7.19)	0.89* (5.57)
R^2	0.9990*	0.9964*	0.9992*	0.9913*
$\bar{R}^2$	0.9989*	0.9958*	0.9991*	0.9899
F	6396.03	1738.58	7807.37	713.20
D–W	1.5389	1.1461	1.3253	0.5752

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

Table shows that the output elasticity with respect to D is negative in case of seat kms, passenger kms, and effective kms showing that the economic development inversely and significantly affects the SK, PK, and EK. This elasticity is positively significant as 0.89 in case of no. of passengers carried. There is presence of positive autocorrelation in case of all the fitted models as shown by the values of D-W test.

(c) Determination of Passenger Road Transport Output Approach

To study the impact of variables affecting the Passenger Road Transport output, many variables along with labour, capital, and fuel have been incorporated and then Passenger Road Transport production functions have been estimated. These results have been presented in Tables .13 to 5.17.

Tables .13 and 14 show the results of the additive models while Tables .15 and 5.16 present the results of the multplicative models. Table .17 presents the estimates of Passenger Road Transport production function m which impact of economic development has been studied by incorporating the dummy variable D.

1. **Additive Model**—The results of the additive models (Table .13 in case of developed states and Table .14 in case of developing states) have been analyzed as below—

Table .13 shows that the variables of TS and HSD (Model I); TS, PSP, and UCSK (Model IT) and TS and MPP (Model HI) are the significant variables affecting the seat kms. The variables TS, HSD, MPP, and PSP have the expected positive sign. UCSK, the proxy for infrastructural facilities, negatively affects the seat kms which shows that the basic infrastructural facilities are not being used efficiently. In all the models considering seat kms as the measure of Passenger Road Transport output, the values of R or R are very high showing the highly significant explanatory power.

In case of passenger kms as the measure of Passenger Road Transport output, the variables of HSD (Model IV), TBR and RI (Model V) and TS (Model VT) significantly affect the output. HSD, TS, and TBR have the expected positive sign.

The negative coefficient of RI shows that there is lack of regularity in the bus operation.

Table .13 : Estimates of Passenger Road Transport Production Function : Additive Model (Developed States)

Indepen-dent Variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X	Model XI	Model XII
β_0	-7049.46 (0.04)	94697.71 (0.98))	-355982.74* (5.94)	141557.08 (0.38)	604827.88** (2.05)	-18161.70 (0.15)	-4664.20 (0.90)	-4119.86" (3.46)	-566.44 (0.42)	5849.06 (0.36)	-3591.45 (0.38)	-1320.42 (0.10)
EK												
TS	1.82** (1.89)	5.66* (3.05)	6.93* (28.02)	2.63 (1.22)		4.33* (4.01)	6.26 (0.03)			0.22** (3.31)		0.27** (2.36)
TTS									0.03 (0.94)		0.44* (7.77)	
T	2765.42 (1.70)			629832 (0.94)			116.20** (2.52)			437.44* (3.06)		
HSD	2.56* (4.36)			3.28** (2.40)			0.06** (2.15)	0.05* (17.76)		0.05 (0.55)		
ATK							-0.04 (0.89)			-0.25 (1.47)		
CER		-0.96 (0.75)				3.09 (1.58)		-0.02 (1.67)			-0.13 (1.47)	
RCE						0.50 (1.01)			0.01 (1.35)			1.02 (1.16)
TBR	-11.33 (0.75)			-53.94 (1.68)	34.04* (5.09)		-0.39 (0.50)			–0.88 (0.36)		
FU												312.31 (0.02)
RI	-29615.72 (0.20)			-123628.28 (0.41)	-741055.30* (3.12)		3008.30 (0.86)			-490,1.47 (0.44)		
ATO			-134.65 (0.98)			277.28 (0.67)					-14.76 (0.75)	
SBR	5728.15 (1.06)	-20284.76 (1.72)	-829.53 (0.18)	-1407.20 (0.11)	-727.68 (0.06)	-10387.52 (0.84)	275.18 (0.73)	148.70 (1.59)	49.37 (0.33)	417.93 (0.36)	-413.53 (0.70)	-652.02 (1.15)
RO		18.70 (1.03)		-11.90 (0.38)					1.11* (3.93)			0.83 (0.83)
MRP			33.09* (8.60)		15.84 (1.63)			0.23** (2.58)			0.63 (1.12)	
PSP		8.16** (2.01)				1.88 (0.51)			0.21** (2.22)		0.32 (1.13)	
EPB			-0.09 (1.50)						-0.01* (3.12)			2.83 (0.27)
UCSK		-1481886 .66**	-185933.67 (0.84)									
UCPK					257271.73 (0.21)				-			
UCEK								647.58** (2.13)				
UCPC					-25716.61 (0.45)			-1311.63** (2.46)			-1176.49 (0.84)	
R^2	0.9993*	0.9970*	0.9995*	0.9955*	0.9908*	0.9916*	0.9994*	0.9992*	0.9964*	0.9989*	0.9967*	0.9963*
$\bar{R}^2$	0.9988*	0.9947*	0.9990	0.9909*	0.9839*	0.9852*	0.9989*	0.9986*	0.9937*	0.9979*	0.9934*	0.9935*
F	1960.95	441.26	2414.16	219.50	143.60	156.70	1779.25	1710.92	370.41	928.94	302.14	357.18
D-W	2.2341	2.0820	2.1983	1.7911	1.8597	1.8412	1.7556	1.7754	2.3003	2.3512	2.6993	1.8455

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

*–Significant at 1% level.

**–Significant at 5% level.

The variables of T and HSD (Model VH); HSD, MPP, UCEK, and UCPC (Model VIII); and RO, PSP, and EPB (Model IX) significantly affect the effective kms. The variables of EPB, PSP, MPP, RO, HSD, and T have the expected positive sign. The very high values of F-statistics show that Model VII, VIII and IX show a very high significant explanatory power at more than 1 percent level as shown by the values of R^2 or $\overline{R}^2$. In case of no. of passengers carried the variables of TS and T (Model X), TTS (Model XI), and TS (Model XII) have the significant impact on the no. of passengers carried. These all explanatory variables have the expected positive sign. The values of R^2 or $\overline{R}^2$ are highly significant explaining more than 99 percent variation in no. of passengers carried. In cases where the values of D-W are greater than 2, *i.e.* (D-W) > 2, it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation. Table .14 shows that the variables of HSD, TS, CER, SBR, PSP, MPP, and UCSK significantly affect the seat kms in the various estimated Models I to HI. All these explanatory variables have the positive effect on the Passenger Road Transport output. In all these concerned models, the values of R are highly significant at more than 1 percent level. In case of passenger kms as the measure of Passenger Road Transport output variables TS, TBR, SBR, and UCPK have the significant impact. The UCPK has negative regression coefficient showing that the basic infrastructural facilities are not being used efficiently. All the R^2 are highly significant.

Table .14 : Estimates of Passenger Road Transport Production Function : Additive Model (Developing States)

Indepen-dent Variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X	Model XI	Model XII
β_0	-7392.69 (.18)	-74081.38* (5.31)	-112993.64* (10.56)	-54788.15 (0.82)	-116491.55* (3.79)	-69128.52 (2.41)	-303.13 (2.56)	-406.70 (1.68)	-1532.79* (3.62)	-988.89 (1.02)	-193.96 (0.62)	-868.30 (0.38)
EK												
TS	-5.36 (0.73)	2.13 (1.49)	5.94* (29.30)	-0.62 (0.22)		3.82** (2.12)	-0.04 (1.54)			-0.04 (0.92)		-0.09 (1.22)
TTS									0.11** (2.01)		0.06 (1.63)	
T	589.32 (0.58)			937.40 (0.69)			3.22 (0.26)			-36.79 (1.59)		
HSD	3.00* (6.42)			0.70 (0.78)			0.05* (8.99)	0.04* (6.71)		0.04* (3.71)		
ATK							0.01** (2.65)			7.52 (1.01)		
CER		1.04** (2.87)				-0.95 (1.35)		-2.51 (0.52)			-0.01 (1.07)	
RCE						0.27 (1.34)			4.34 (1.65)			-3.48 (0.66)
TBR	-1.43 (0.09)			-7.66 (0.36)	24.78** (2.34)		0.04 (0.19)			-0.09 (0.24)		
FU												1008.11

												(0.46)
RI	-6121.84 (0.21)			49161. 76 (105)	24778.51 (0.89)		-207.71 (0.56)			943.49 (1.43)		
ATO			-16.62 (0.07)			54256 (0.76)					14.87** (2.25)	
SBR	396.18 (0.10)	7605.03* (3.82)	-623.00 (0.48)	1458.60 (0.27)	10894.12* (4.63)	5559.97 (1.73)	31.82 (0.62)	2104 (0.73)	176.13** (2.76)	112.22 (0.21)	114.36** (2.06)	247.73** (2.11)
RO		22.18 (0.86)		65.25 (1.21)					0.18 (0.31)			1.29 (1.05)
MRP			00.57* (7.73)		120 (1.43)			0.04 (1.54)			0.06 (0.90)	
PSP		5.41* (5.00)				0.74 (0.40)			0.07** (2.68)		-0.03 (0.59)	
EPB			7.47 (0.23)						-1.20 (0.77)			-2.69 (0.07)
UCSK		-249869 .80** (2.24)	-4335.60 (0.05)									
UCPK					-494241.40* (3.65)							
UCEK								-118.50** (2.39)				
UCPC					7496.26 (1.76)			79.34** (2.15)			-179.22** (2.82)	
R^2	0.9905*	0.99 35"_	0.9979*	0.9630*	0.9797*	0.9532*	0.9955*	0.9965*	0.9873*	0.8782*	0.9286*	0.6185
$\bar{R}^2$	0.9834*	0.9886*	0.9564*	0.9261	0.9645	0.9181"	0.9910*	0.9939*	0.97784'	0.7564*	0.8571*	0.3323
F	133.83	203.13	64316	26.05	64.31	27.16	220.72	378.82	103.57	7.21	12.99	2.16
D-W	1.7501	2.7778	1.7969	1.8754	2.2542	2.4769	2.2304	2.0! 70	3.1051	1.8224	1.9501	1.8004

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

The variables TTS, HSD, ATK, SBR, PSP, UCEK, and UCPC have the significant impact on effective kms, except UPEK. All the variables have the expected positive sign. All the R are statistically highly significant. Considering no. of passengers carried, the variables of HSD, ATO7 SBR, and UCPC affect the Passenger Road Transport output significantly except UCPC. All the variables have the expected positive sign while the negative coefficients of UCPC shows that the basic infrastructural facilities are not being used efficiently. The value of R in Model XII is not significant while this value in rest of the Models X to XI is highly significant.On comparing the results of Tables .13 and 5.14, it can be concluded that in case of seat kms, the variables of TS, HSD, PSP, and MPP are more productive in case of developed states than developing states while CER is more productive in case of developing states. HSD, TBR, TS, and UCPKhave the more productive effect on passenger kms in case of developed states than developing states. In case of effective kms the variables T, HSD, RO, PSP, MPP, EPB, and UCEK have the more productive impact in case of developed states than developing states while ATK and UCPC are more productive in developing states. The variables playing more productive role in developed states are TS, TTS and T than developing states. The ATO, SBR, and UCPC are the variables having more productive effect on no. of passengers carried in case of developing states. In cases where the values of D-W are greater than 2, i.e. (D-W) > 2, it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation.

2. Multiplicative Model—Tables .15 and 5.16 analyze the results of the estimated production functions in case of developed and developing states respectively. The analysis of results is as follows—

Table .15 : Estimates of Passenger Road Transport Production Function :Multiplicative Model (Developed States)

Indepen-dent Variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X	Model XI	Model XII
β_0	-1.26 (0.67)	-2.20** (2.50)	-9.57* (16.82)	-0.94 (0.22)	-2.80 (0.54)	0.63 (0.19)	-2.36 (1.80)	-8.72* (11.21)	2.24 (0.92)	4.22 (1.61)	-6.62 (1.72)	0.25 (0.07)
EK												
TS	0.37** (2.05)	0.88* (4.34)	1.17* (45.57)	1.12** (2.30)		0.95** (2.52)	0.04 (0.29)			0.80* (3.32)		0.38 (0.66)
TTS									0.19 (0.73)		1.05* (6.21)	
T	0.02* (2.97)			0.06** (2.51)			0.01* (5.15)			0.04* (5.42)		
HSD	1.43* (5.31)			3.07* (3.23)			056** (2.45)	0.99* (16.14)		-0.25 (0.32)		
ATK							0.08 (0.62)			0.02 (0.07)		
CER		9.53 (2.21)				0.14 (0.36)		-0.02 (0.94)			-0.12 (1.06)	
RCE						-2.80 (0.02)			5.55 (0.67)			4.66 (0.66)
TBR	-0.81** (2.73)			-3.26* (3.18)	0.82* (3.45)		-0.17 (0.38)			0.09 (0.11)		
FU												-1.03 (1.10)
RI	-0.31 (0.81)			-0.35 (0.39)	-2.59** (2.31)		-0.19 (0.63)			-1.50** (2.25)		
ATO			0.20* (4.49)			0.16 (0.40)					-0.17 (0.64)	
SBR	-0.02 (0.11)	-0.51** (2.22)	-0.18** (0.44)	0.17 (0.30)	0.17 (0.43)	-0.75 (0.37)	-0.13 (4.03)	0.46* (0.90)	-0.22 (1.32)	-0.89 (0.70)	-0.36 (0.70)	-0.35 (0.93)
RO		0.28 (1.27)		0.88 (1.42)					0.99** (2.66)			1.09** (1.98)
MRP			0.99* (12.81)		0.81 (1.49)			0.46* (3.44)			0.30 (0.56)	
PSP		0.33* (3.24)				0.09 (0.27)			0.29 (1.09)		0.56 (1.92)	
EPB			0.12* (3.68)						-0.51 (1.67)			-0.31 (1.22)
UCSK		-0.28* (3.38)	-0.04 (1.69)									
UCPK					-1.57 (0.00)							
UCEK								0.33** (2.57)				
UCPC					-0.08 (0.18)			-0.33** (2.76)			-0.33 (1.48)	
R^2	0.9992*	0.9984*	0.9998*	0.9962*	0.9846*	0.9894*	0.9997*	0.9994*	0.9972*	0.9991*	0.9961*	0 9985*
$\bar{R}^2$	0.9986*	0.9971*	0.9996*	0.9923"	0.9731*	0.9736*	0.9994*	0.9990*	0.9931*	0.9982	0.9921*	0.9962*
F	1693.68	807.42	6657.68	258.41	85.14	62.36	3375.63	2272.10	239.62	1121.07	252.36	441.55
D-W	2.6156	1.8386	3.0755	2.0433	1.4398	2.6150	1.8547	1.4692	2.7235	2.3163	2.5634	1.5883

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

Variables Significantly Affecting the Passenger Road Transport Output

Model	Developed States	Developing States
I.	TS[a], T[a], HSD[a], TBR[b]	HSD[a]
II.	TS[a], SBR[b], PSP[a], UCSK[b]	CER[a], SBR[a], PSP[a]
III.	TS[a], ATO[a], SBR[b], MRP[a], EPB[a]	TS[a], MPP[a]
IV.	TS[a], T[a], HSD[a], TBR[b]	No variables significant
V.	TBR[a], RI[b]	SBR[a], UCPK[B], UCPC[a]
VI.	TS[a]	Case of perfect positive multiple correlation
VII.	T[a], HSD[a]	TS[a], HSD[a], ATK[a]
VIII.	HSD[a], SBR[a], MRP[a], UCEK[a], UCPC[b]	HSD[a], UCEK[B], UCPC[a]
IX.	RO[a]	Case of perfect positive multiple correlation
X.	TS[a], T[a], RI[b]	HSD[a]
XI.	TTS[a]	ATO[a], SBR[a], PSP[b], UCPC[b]
XII.	RO[a]	Case of perfect positive multiple correlation

Note : a-Variables have the positive effect on the Passenger Road Transport output.

b—Variables have the negative effect on the Passenger Road Transport output.

As the results of explanatory power are concerned it can be seen from Tables .15 and 16 that all the values of R^2 are highly significant explaining very high degree of variation in the considered measures of Passenger Road Transport output. In cases where the values of D-W are greater than 2, *i.e.* (D-W) > 2 it can be said that there is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation.

Table .16 : Estimates of Passenger Road Transport Production Function : Multiplicative Model (Developing States)

Indepen-dent Variables	Model I	Model II	Model III	Model IV	Model V	Model VI[a]	Model VII	Model VIII	Model IX[a]	Model X	Model XI	Model XII[a]
β_0	1.81 (0.54)	-0.10 (0.06)	-9.53* (26.90)	8.10 (1.45)	-2.36 (1.03)	2.15	-3.75 (1.57)	-4.11* (4.65)	-1.73	-0.83 (0.17)	-0.73 (0.35)	5.10
EK												
TS	-0.51 (1.30)	0.19 (0.57)	1.09* (25.55)	-0.74 (1.04)			-0.57** (2.15)			0.58 (1.05)		
TTS											0.53 (1.59)	
T	0.01 (1.12)			0.02 (1.28)			5.09 (0.64)			-0.02 (1.27)		
HSD	1.24* (5.72)			0.19 (0.38)			1.24* (8.40)	0.82* (5.92)		1.18* (3.86)		
ATK							0.19* (2.82)			0.22 (1.57)		
CER		0.03** (2.03)				0.66		-6.74 (0.71)			-0.04 (1.55)	
RCE						3.99			7.18			7.34
TBR	0.11 (0.27)			-0.12 (0.17)	0.63 (1.76)		0.14 (0.52)			-0.25 (0.43)		
FU												1.37
RI	-2.45 (0.01)			0.73 (1.45)	0.27 (0.89)		-0.07 (0.399)			0.59 (1.59)		
ATO			-5.28 (0.11)			-1.17					0.42** (2.89)	

SBR	0.27 (0.69)	0.75* (3.62)	-0.04 (0.49)	0.49 (0.76)	1.40* (4.56)	1.68	0.28 (1.07)	0.19 (1.40)	0.32	0.54 (0.99)	0.63** (1.91)	0.53
RO		0.40 (1.44)		1.18 (1.88)					0.51			-0.47
MRP			1.10* (11.59)		0.40 (1.76)			0.27 (1.77)			0.52 (1.40)	
PSP		0.54 (4.82)				0.38			0.47		-0.40** (1.40)	
EPB			0.03 (0.59)						0.06			0.36
UCSK		-0.07 (1.13)	0.01 (0.43)									
UCPK					0.55* (3.12)							
UCEK								-0.27* (3.26)				
UCPC					0.39** (2.05)			0.20* (2.93)			-0 28** (2.76)	
R^2	0.9895*	0.9914*	0.9990*	0.9691*	0.9789	1.0000	0.9950*	0.9967*	1.0000	0.8853*	09167*	1.000
$\bar{R}^2$	0.9816*	0.9849*	0.9982"	0.9381	0.9630*	1.0000	0.9901*	0.9942*	1.0000	0.7705*	0.8333	1.0000
F	125.49	153.55	1273.89	31.31	61.72	undefined	200.69	401.66	undefined	7.71	10.99	undefined
D-W	1.7185	2.7230	2.1173	1.9504	2.0112		2.3189	1.8324		1.9530	1,6042	

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

Impact of Economic Development

Under the determinants of Passenger Road Transport output approach the impact of economic development has also been studied by incorporating the dummy variable D (D = 1, developed states and D = 0, developing states). Here multiplicative models have been used. Results have been shown in Table .17.

Table .17 : Estimates of Passenger Road Transport Production Function : Multiplicative Model (Impact of Economic Development on Passenger Road Transport Output)

Indepen-dent Variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X	Model XI	Model XII
β_0	-2.03 (1.79)	-2.17" (1.99)	-9.55* (36.08)	-0.69 (0.31)	-6.73" (4.99)	-1.71 (1.75)	-6.27* (5.94)	-6,13* (9.75)	-1.69 (1.59)	-17.65* (4.12)	-2.74 (1.54)	-4.21 (0.30)
EK												
TS	0.02 (0.09)	0.59** (2.69)	1.11* (40.86)	0.22 (0.53)		1.12* (6.50)	-0.24 (1.35)			0.45 (0.63)		1.60 (0.85)
TTS									0.25 (1.22)		0.76* (4.98)	
T	2.26 (0.43)			-4.21 (0.45)			1.27 (0.03)			-0.06* (3.39)		
HSD	1.24* (11.32)			0.61** (2.27)			1.21* (1347)	1.17* (23.02)		1.19* (3.26)		
ATK							0.15** (2.69)			0.09 (0.44)		
CER		0.04** (1.96)				0.19 (1.57)		5.38 (0.51)			0.05 (1.33)	
RCE						0.02** (2.30)			0.02** (2.88)			0.04 (1.39)
TBR	-5.63 (0.03)			-0.32 (0.97)	1.04* (8.99)		0.18 (1.28)			0.88 (1.52)		
FU												1.08 (0.43)
RI	-0.04 (0.21)			0.29 (0.85)	-0.21 (0.54)		0.01 (0.08)			0.76 (1.30)		
ATO			-0.09** (2.26)			-0.16 (0.89)					0.52** (2.47)	

SBR	0.01 (0.07)	0.15 (0.95)	-0.09 (0.70)	-0.08 (0.26)	0.73** (2.92)	-0.41 (1.03)	0.09 (0.77)	0.13 (1.41)	-0-06 (0.27)	0.20 (0.39)	0.14 (0.44)	-2.11 (1.50)
RO		0.6** (2.74)		0.86** (2.60)					1.00* (3.68)			-0.19 (0.11)
MRP			1.07* (16.79)		0.80* (3.82)			0.10 (0.85)			-0.09 (0.27)	
PSP		0.27* (3.48)				0.16 (1.21)			0.03 (0.19)		0.22 (1.03)	
EPB			0.06 (1.67)						-0.02 (0.11)			0.12 (0.30)
UCSK		-0.20* (3.79)	8.90 (0.38)									
UCPK					-0.26 (1.61)							
UCEK								-0.03 (0.53)				
UCPC					0.09 (0.69)			-0.02 (0.52)			-0.54* (5.45)	
D	-0.29** (2.56)	-0.67* (3.34)	-0.01 (0.18)	-0.98** (2.86)	0.21 (1.78)	0.16 (0.66)	-0.18 (1.86)	-0.20* (3.64)	-0.95* (3.12)	-0.89** (2.21)	-0.12 (0.40)	0.72 (0.63)
R^2	0.999 1"	0.9983*	0.9998*	0.9974*	0.9961*	0,9981*	0.99951	0.9994*	0.9992"	0.9965*	0.9973*	0.9936*
$\bar{R}^2$	0.9987	0.9973	0.9988	0.9954	0.9948	0.9966	0.9993	0.9952	0.9986	0.9951	0.9963	0.9886
F	3297.77	1820.61	17534.93	1016.57	791.63	654.54	4880.55	5424-99	1625-23	737.64	984.56	199.73
D-W	1.4311	1.7636	1.6238	1.8469	1.0533	3.0902	1.3274	1.5869	2.9734	1.0241	1.6562	1.4716

Note : Values in parentheses are the absolute *t*-ratios.
*–Significant at 1% level.
**–Significant at 5% level.

It is clear that in case of seat kms, the coefficients of D are significant in Models I and II. These coefficients are with negative sign. The coefficient of D in Model IV is negatively significant. In case of effective kms, D negatively and significantly affects the Passenger Road Transport output. According to Model X, D is negatively significant. It can be seen that the coefficients of D which are significant have the negative sign. In cases where the values of D-W are greater than 2, i.e. (D-W) > 2, it can be said that these is some degree of negative autocorrelation but in cases where (D-W) < 2, there is some degree of positive autocorrelation.

Estimation and Analysis of Passenger Road Transport Output (III): Efficiency and Scale Effects

The Passenger Road Transport output significantly differs between the developed and developing states. This difference in Passenger Road Transport output can be analyzed in terms of the efficiency and scale effects.

Estimation of Output Differentials and their Decomposition into Efficiency and Scale Effects

While analyzing the results of the estimated production functions in section 6 above, the fact emerged is that the estimated production functions in case of developed states has been observed significantly different from the estimated production functions in case of developing states. So one can intend to search the causes responsible for this difference. As the causes behind this difference are concerned, these may be called as efficiency and scale effects. The inputs in the production process, considered in this study, may influence the Passenger Road Transport output in two ways. The number of units of inputs used may positively affect the Passenger Road Transport output. Thus, it is the hypothesis in this case that the Passenger Road Transport output can be increased by increasing the unit of inputs. These effects on the Passenger Road Transport output may be termed as the scale effects. Not only the number of unit of inputs used affects the Passenger Road Transport output but the quality of inputs used also affects the Passenger Road Transport output. Thus, more the qualitative inputs more will be the Passenger Road Transport output. These effects can be termed as efficiency effects. In short, the differences in the Passenger Road Transport output between developed and developing states can be said to be emerged due to these efficiency and scale effects. These are the two effects in which the Passenger Road Transport output differentials can be decomposed.

The Decomposition Model

Considering Passenger Road Transport output as the function of labour, capital, and fuel the production function can be written as given in equation (4) which is as below—

$Q = f\,(L, K, F)$ ...(10)

This functional relationship can be into Cob-Douglas form as,

$$Q = \beta_0 \; L^{\beta_1} \; K^{\beta_2} \; F^{\beta_3} \quad ...(11)$$

Taking natural logarithm of both sides,

$\ln Q = \ln \beta_0 + \beta_1 \ln L + \beta_2 \text{In } K + \beta_3 \ln F$

This log linear form can be written for developed and developing states separately by using x for developed states and y for developing states. So,

$\ln Q^x - \ln \beta_0^x + \beta_1^x \ln L^x + \beta_2^x \ln K^x + \beta_3^x \ln F^x$ ...(12)

$\ln Q^y - \ln \beta_0^y + \beta_1^y \ln L^y + \beta_2^y \ln K^y + \beta_3^y \ln F^y$ .....(13)

The subtraction of equation (5.13) from equation (5.12) gives the percentage quantity by which the Passenger Road Transport output in case of developed states is more than that in case of developing states. Thus,

$\ln Q^x - \ln Q^y = \ln \beta_0^x + \beta_1^x \ln L^x + \beta_2^x \ln K^x + \beta_3^x \ln F^x - \ln \beta_0^y + \beta_1^y \ln L^y + \beta_2^y \ln K^y + \beta_3^y \ln F^y$

By adding and subtracting By In L", B2y in Kx, and By In Fx in the above expression and then rearranging the terms following equation is obtained.

$\ln Q^x - \ln Q^y = [(\ln L^x - \ln L^y)\, \beta_1^y] + [(\ln K^x - \ln K^y)\, \beta_2^y] + [(\ln F^x - \text{In } F^y)\, \beta_3^y] + [(\beta_1^x - \beta_0^y) + (\beta_1^x - \beta_1^y) \ln L^x + (\beta_2^x - \beta_2^y) \ln K^x + (\beta_3^x - \beta_3^y) \ln F^{x.}$ ...(14)

In this equation the 1st three terms in the brackets on the right hand side capture the scale differences due to labour, capital, and fuel respectively while the next values show the efficiency differences due to inherent efficiency due to labour, capital, and fuel respectively.

For simplicity., equation (14) may be expressed as below—

$\ln Q^{x-y} = \ln L^{x-y} \beta_1^{x-y} + \ln K^{x-y} \beta_2^y + \ln L\, F^{x-y} \beta_3^{\,y} + \beta_0^{x-y} + \beta_1^{x-y} - \ln L^x + \beta_2^{x-y} \ln K^x + \beta_3^{x-y} \ln F^x$...(15)

The above model has been applied to decompose the output differentials into efficiency and scale effects. This decomposition technique have been used in case of all the measures of Passenger Road Transport output considered in this study.

Analysis of Results

The estimated decomposition components in forms of efficiency and scale differences have been shown in Table .18.

Table .18 : Production Function Decomposition into Efficiency and Scale Components

Decomposition Components	Q = SK		Q = PK		Q = EK		Q = PC	
	Calculated at Developed Mean $X^* = X^{-x}$ $\beta^* = \beta^y$	Calculated at Developing Mean $X^* = X^{-x}$ $\beta^* = \beta^x$	Calculated at Developed Mean $X^* = X^{-x}$ $\beta^* = \beta^y$	Calculated at Developing Mean $X^* = X^{-x}$ $\beta^* = \beta^x$	Calculated at Developed Mean $X^* = X^{-x}$ $\beta^* = \beta^y$	Calculated at Developing Mean $X^* = X^{-x}$ $\beta^* = \beta^x$	Calculated at Developed Mean $X^* = X^{-x}$ $\beta^* = \beta^y$	Calculated at Developing Mean $X^* = X^{-x}$ $\beta^* = \beta^x$
Efficiency Differences								
Interact (β^{x-y} X*)	-2.41	-2.41	-6.99	-6.99	-1.00	-1.00	18.38	-18.38
Labour (β_1^{x-y} $\overline{TS}$ *)	6.87	5.74	8.72	7.28	3.80	3.17	18.16	15.15
Capital (β_2^{x-y} $\overline{TBR}$ *)	-5.75	-5.06	-10.96	-9.65	0.18	0.16	3.89	3.42
Fuel (β_3^{x-y} $\overline{HSD}$ *)	0.36	0.27	8.85	6.84	-3.47	-2.68	-2.51	-1.94
Total	-0.93	-1.44	-0.38	-2.52	-0.49	-0.35	1.16	1.75
Scale Differences								
Labour ($\overline{TS}^{x-y}$ β_1^*)	-0.24	0.90	0.48	1.92	-0.24	0.39	1.33	1.68
Capital ($\overline{TBR}^{x-y}$ β_2^*)	0.04	-0.65	-0.45	-1.76	0.01	0.03	-0.86	-0.39
Fuel ($\overline{HSD}^{x-y}$ β_3^*)	3.81	3.89	2.99	5.00	3.48	2.69	3.02	2.45
Total	3.61	4.14	3.02	5.16	3.25	3.11	0.83	3.74
Grant Toal (C^{x-y})	2.68	2.68	2.64	2.64	2.76	2.76	1.99	1.99

Note : Results in Table .18 have been calculated from the estimated Passenger Road Transport production function under the "Traditional Theory of Production Function". Regression coefficients used in calculation of efficiency and scale differences have been given in Table .10.

The efficiency and scale differences in case of all the measures of output have been calculated both at developed and developing means separately. It is clear that the difference of the intercepts in cases of all measures of output is negative showing that the inherent efficiency have been seen more in case of developing states. It is also clear that the efficiency component with respect to labour is positive in case of all the measures of Passenger Road Transport output showing that the levels of labour efficiency are higher in case of developed states.

In case of seat kms, the productivity of labour on the basis of efficiency is more in case of developed states by 687 percent. Similarly, this percent in case of passenger kms, effective kms, and no. of passengers carried is 872, 380 and 1816 respectively. In case of fuel, on the basis of efficiency the seat kms are more in developed states by 36 percent and in case of passenger kms by 885 percent. In case of effective kms and no. of passengers carried the efficiency component with respect to fuel is negative showing that fuel efficiency is more productive in developing states. It can also be seen that the capital efficiency is less productive in case of developed states as the both seat kms and passenger kms are concerned while capital efficiency is more productive in case of developing states as the effective kms and no. of passengers carried are concerned. The total efficiency differences are negative in case of seat kms, passenger kms and effective kms showing that the input efficiency is more productive in case of developing states. But as the no. of passengers carried is concerned the input efficiency is more by 116 percent in case of developed states.

Regarding scale differences, it can be seen that the labour is more productive in case of developing states as the seat kms, effective kms, and no. of passengers carried are concerned. But labour is more productive in developed states (48 percent) as the passenger kms is concerned. In case of fuel, all the decomposition components are positive showing that the output is more in case of developed states by 381,299,348, and 302 percent as the seat kms, passenger kms, effective kms, and no. of passengers carried respectively are concerned. In the same way, the capital is more productive in case of developed states as the seats kms and effective kms are concerned but capital is less productive in developed states in case of passenger kms and no. of passengers carried. On the basis of total scale differences, output is more in developed states than developing states by 361, 302, 325, and 83 percent as seat kms, passenger kms, effective kms, and no. of passengers carried respectively are concerned.

Looking at the grand total, it can be observed that the seat kms, passenger kms, effective kms, and no. of passengers carried are more in case of developed states than developing states by 268, 264, 276, and 199 percent respectively.

The above discussion of production function decomposition into efficiency mid scale components is based on the efficiency and scale differences calculated at developed states means of labour, capital and fuel. In the same way, results can also be discussed on the basis of the efficiency and scale differences calculated at developing states means of labour, capital, and fuel. In Table .18, these means have been shown by putting bar on the symbol used for labour (TS), Capital (TOR), fuel (HSD).

Under scale differences; labour, capital, and fuel contributions in case of developed and developing states have been estimated with scale elasticities ($\square_1^*$, $\square_2^*$ and $\square_3$ respectively) in case of developed states and developing states separately.

Conclusion

The conclusions of this chapter are as mentioned below—

1. The measurement of Passenger Road Transport output includes the analysis of the measures of output based on the supply-side i.e. seat kms while passenger kms, effective kms, and no. of passengers carried have been used as the measures of Passenger Road Transport output on the demand-side.

2. Trends have been estimated in linear, quadratic, and exponential forms for all the measures of Passenger Road Transport output. All the fitted models, except in case of developing states and no; of passengers carried as the measure of output, explain the variation in Passenger Road Transport output significantly at more than 1 percent level. All the models show the monotonically increasing trends in all the measures of Passenger Road Transport output. The magnitude of all

the coefficients in all the estimated models are higher in case of developed states than developing states.

3. Trends have also been estimated for vehicle productivity and man power productivity. The increasing significant trends have been observed in vehicle as well as man power productivities. All the models significantly explain the variation in these factor productivities significantly. The levels of factor productivity have been found more in case of developed states than developing states.

4. In case of developed states TS, HSD, CER, TBR, RI, ATO, RO, MPP, PSP, and EPB affect the seat kms significantly. Except RI all these variables have found positively correlated with seat kms. The passenger kms is significantly and positively affected by TS, HSD, CER, TOR, ATO, RO, MPP, and PSP while RI negatively and significantly correlated with TS, TTS, HSD, CER, TBR, RI, RO, MPP, PSP, and EPB. Similarly no, of passengers carried has been observed significantly affected by TS, ITS, HSD, CER, TBR, FU, RI, ATO, RO, MPP, PSP, and EPB.

5. In case of developing states the variable of TS, HSD, TBR, RI, SBR, RO, MPP, PSP, and EPB affect the seat kms significantly. Except RI, all these variables have been found positively correlated with seat kms. The no. of passengers carried has been found significantly affected by SBR and MPP. UCPC, PSP, MPP, RO, SBR, RI, TBR, HSD, and TS affect the passenger kms significantly. Except RI, all these variables have the positive impact on passenger kms. Effective kms have been observed significantly and positively affected by TS, ITS, HSD, ATK, TBR, SBR, RO, MPP, PSP, EPB, and UCPC while RI has the negative impact on effective kms.

6. Passenger Road Transport production functions have been estimated in additive as well as multiplicative forms. All the fitted models explain the variation in Passenger Road Transport output significantly, but in case of developing states the model considering no. of passengers carried as the measure of Passenger Road Transport output does not affect the variation in both additive and multiplicative models. The level of economic development has been observed significant and negatively related with all the considered measures of Passenger Road Transport output.

7. Except the traditional theory of production function, the production functions have also been estimated under the determinants of Passenger Road Transport output approach. In the various fitted models TS, HSD, PSP, ATO, MPP, EPB, TBR, UCEK, RO, and TTS have the positive impact on the Passenger Road Transport output in case of developed states while TBR, UCSK, Rl and UCPC have the negative impact on Passenger Road Transport. In case of developing states HSD, CER, SBR, PSP, TS, MPP, UCPC, ATK, UCEK, and ATO have the positive impact on the Passenger Road Transport output while UCPK, UCEK, and PSP have the negative impact on Passenger Road Transport output Almost all the fitted models on

production functions explain the variation significantly.

8. Production function decomposition into efficiency and scale components show that the efficiency decomposition components have been found negative in case of SK, PK, and EK showing that the developing states are more efficient but in case of no. of passengers carried the efficiency components come out to be positive showing that as measure of Passenger Road Transport output is concerned developed states are more efficient. In case of scale decomposition of components the estimates have been found positive regarding all measures of Passenger Road Transport output which show that the developed states are more productive. It can be seen from the overall decomposition values that the level of Passenger Road Transport output is more in developed states than developing states.

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