DETERMINANTS OF REGIONAL TRAFFIC GENERATION AMONG ACTIVITY DEVELOPMENT CATEGORIES - SOME EMPIRICAL RESULTS
6.0.0 Introduction

In chapter III, models related to regional transport planning analysis were theoretically discussed. In this chapter, empirical analysis is undertaken with a view to establish a cross-sectional relationship between the total zonal (passenger and freight) traffic generated and various disaggregated activity development categories for the study year 1991 in Bharuch region as shown in table 5.9.1. of chapter V.

For this purpose the statistical regression models already discussed in chapter III section 3.2.0 are most appropriate to use while category analysis in the same chapter section 3.3.0 cannot be adopted because of its limitations.

Consequently, this chapter has been designed so as to confirm the earlier hypothesis (section 1.1.0) as stated by Mitchell and Rapkin that traffic generation is a function of various land use development patterns in the areas under study.

For this reason, a statistical regression was employed as a tool for the analysis of relationship between the variables which we are predominately concerned with. Our dependent variable in this model is either number of zonal passenger traffic (PT) or freight (FT) traffic generations in all the eleven zones of Bharuch region. On the other hand, the Independent variables are, landuse in terms of Area Under Agriculture (AUA), Production Input (PI), Marketable Surplus (MS), Household (HD), Population (POP), Employment (EMPL), Number of Bus Frequency (BF), Number of Truck Frequency (TF), Number of Villages (VLG), Trade and Commerce (TC), Other Services (OS), Transport Storage and Communication (TSC) and Service Manufacturing Industries (SMI). These variables are thirteen in number.

All these data are collected from Bharuch District Census Handbook, Passenger Traffic Frequency from Gujarat State Road Transport Corporation Bharuch division and Freight Traffic Frequency collected through traffic and O-D count at Octroi points within and outside Bharuch zones. In this manner we have an observation matrix of size 11 x 9 where data on 11 zones are supposed to be represented in each column standing for the variables as
shown in the chapter V Table 5.9.1. Largely, in all the Bharuch study zones we are concerned with a cross-sectional analysis for the study year 1991 as already mentioned above.

Generally, as per our hypothesis as mentioned earlier we expect a cross-sectional relationship between zonal traffic generated (Passenger (PT) or Freight (FT)) and the various activities development in all zones of Bharuch regional economy.

Hence our model involves cross-sectional regression analysis for the study year. In this context, the relationship between cross-sectional development activity categories associated with total (zonal) number of traffic generation in Bharuch region have been first estimated by fitting two variables regression models, secondly multiple regression analysis is undertaken in order to identify those factors which determine transport generation in Bharuch region zonewise in developing economies. However, in our analysis of results, it was found that some geographical location factors are of no special importance in determining transport generation and they reflect high degree of multicollinearity which had permitted us to apply a step-wise regression technique thereafter, as shown in table 6.1.4 of this study. In the models we have taken both the dependent and independent variables in natural logarithmic (Ln) form as below:

Model I: \( \ln TG = \alpha + \beta_1 \ln HD + U \)  --- (all other independent variables one by one)

Model II: \( \ln TG = \alpha + \beta_1 \ln HD + \beta_2 \ln POP + \ldots + \beta_9 \ln X_a + U \)

In the above functional models (I) and (II), slope coefficients \( \beta_1 \ldots \beta_9 \) measure a linear statistical relationship associated with a cross-sectional activity development \( \ln X_1 \ldots \ln X_9 \) (independent variables) on a number of zonal traffic generated in terms of passenger and freight traffic rates in the study year 1991. Finally, we have also presented the correlation matrices of our independent variables in order to understand their interrelationship as shown in tables 6.1.5 and 6.2.5.
First, we have estimated a two variable Model 1 as mentioned above and then fitted double
natural logarithmic (Ln), equations for disaggregated activity categories one by one as indicated
in table 6.1.1 below with the corresponding statistical values of student's statistics $R^2$, $R^2$, $F$ values and the regression coefficients.

**6.1.0: The Relationship between Zonal Number of Passenger Traffic
Generated in Disaggregated Activity Development Categories**

By fitting the double natural logarithmic (Ln) relationship as mentioned earlier (Section
6.0.0) to the cross-sectional data (11 x 9) matrix of disaggregated activity development
categories for the study year 1991, and having taken these activities as independent variables
and passenger traffic generated as depending variable, we obtained the following results
as shown in Table (6.1.1) below by examining the relationship one after another.

1. **Household (HD)**
   \[
   \text{LnPTG} = -0.01693 + 1.08485 \text{Ln(HD)}
   \]
   \[
   \text{(-0.012)} \quad (3.236) *
   \]
   \[
   R^2 = 0.53781 \quad \text{F}(1,9) = 10.4726
   \]
   * Significant at 5% level.

   The above regression result indicates that number of households in Bharuch region has
   positive and significant (at 5% level) influence on the passenger traffic generated zonewise.
The $R^2$ accordingly is significant which indicates that independent variable explains 53
percent variation in passenger traffic generated zonewise. $F$-value is also significant which
indicates positive relationship between the variables for the whole result. Our conclusion
from this result implies that zonal number of household has positive influence on the
determination of passenger traffic generated in Bharuch regional economy.

2. **Population (POP)**
   \[
   \text{LnPTG} = -0.60955 + 1.04915 \text{Ln(Pop)}
   \]
   \[
   \text{(-0.359)} \quad (3.128) *
   \]
   \[
   R^2 = 0.52406 \quad \text{F}(1,9) = 9.91002
   \]
   * Significant at 5% level.
The above result shows that zonal number of population in Bharuch region is also significant and have positive influence on the passenger traffic generated zonewise as indicated by the statistical t-value attached to it. The $R^2$ is also significant meaning that zonal number of population explains 52 percent of variation in passenger traffic generated in Bharuch region. Besides that, the F-value statistics is significance of overall regression. This imply that zonal number of population has positive influence for the determination of passenger traffic generated in Bharuch region.

(3) Employment

$$\ln PTG = -0.42168 + 1.10287 \ln \text{Emp}.$$  

\[ (-0.234) \text{ (2.866)*} \]

$R^2 = 0.47724 \quad R = 0.41915 \quad F(1,9) = 8.21621$

* Significant at 5% level.

The above regression results supports the fact that the relationship of zonal number of employment on passenger traffic generated is significant and positive as shown by the Student’s t-values attached to it. The slope coefficient signifies that for this study year (1991), zonal employment has positive influence on the determination of passenger traffic generated and attraction zonewise. $R^2$ is significant which shows that number of zonal employment is an important influence and explains 47 percent of variations in passenger traffic generated zonewise. Thus employment activity has positively influenced passenger traffic generation in Bharuch regional economy.

(4) Trade and Commerce (T&C)

$$\ln PTG = 2.59649 + 0.64957 \ln \text{T&C}$$  

\[ (5.260) \text{ (4.362)*} \]

$R^2 = 0.67883 \quad R = 0.64315 \quad F(1,9) = 19.02269$

* Significance at 5% level.
The regression results presented above indicate that zonal number of trade and commerce has significant and positive influence on passenger traffic generated as shown by Student’s t-values attached to the regression coefficient. The elasticity of passenger traffic generated with respect to the rate of (T&C) is 0.649. The $R^2$ is significant indicating that the statistical relationship percentage of T&C explains 67 percent of the percentage influence on passenger traffic generated and attracted. While F-value is also statistically significant at 5% level indicated at a degree of freedom. From the same analysis, we conclude that the zonal number of trade and commerce in Bharuch region is significant and have positive influence on the determination of passenger traffic generated and attracted zonewise.

(5) Transportation Storage and Communication (TSC)

$$\ln PTG = 3.40700 + 0.45433 \ln TSC$$

$$R^2 = 0.62256 \quad F = 0.51438 \ F(1,9) = 14.805$$

* Significance at 5% level

The above result supports the fact that zonal number of TSC has significant and positive influence on the determination of passenger traffic generated and attracted zonewise. This is indicated by the Student’s t-value attached to it and F value for overall regression. $R^2$ is indicating that number of zonal TSC explains 62 percent variations in passenger traffic generated.

(6) Other Services

$$\ln PTG = 2.10219 + 0.75538 \ln OS$$

$$R^2 = 0.56294 \quad F = 0.51438 \ F(1,9) = 11.59204$$

* Significant at 5% level
The regression results above support the fact that the zonal number of other service is statistically significant and positive influence on the determination of passenger traffic generation zonewise in Bharuch region. The $R^2$ is significant meaning that in the statistical relationship percentage of OS explains 56 percent of the percentage influence on passenger traffic generated and attracted. Besides, F-value is also statistically significant at 5% level of significance with 9 degrees of freedom. We conclude that the relationship between zonal number of other services and passenger traffic generation is positive and significant in Bharuch regional economy.

(7) Service Manufacturing Industries

$$\text{LnPTG} = 3.08036 + 0.46204 \text{LnSMI}$$

$$(4.604) \quad (2.490)^*$$

$$R^2 = 0.40781 \quad R = 0.34201 \quad F(1,9) = 6.19784$$

* Significant at 5% level

This result supports the hypothesis that zonal number of service manufacturing industries is statistically significant at 5% level and have positive influence on passenger traffic generation in Bharuch region. This is indicated by the above critical level of Student’s t-value attached to SMI. However, $R^2$ is low meaning that the statistical relationship of SMI explains only 40 percent variation in passenger traffic generated and attracted zonewise. F-value however, is significant at 5% level of significance with a degrees of freedom which shows that the relationship between the two variables is significant.

(8) Bus Service Frequency

$$\text{LnPTG} = 3.0089 + 0.47374 \text{LnBSF}$$

$$(6.067) \quad (3.511)^*$$

$$R^2 = 0.57802 \quad R = 0.53114 \quad F(1,9) = 12.32816$$

* Significant at 5% level.
The above result shows that zonal number of bus service frequency is statistically significant and have positive relationship on the determination of passenger traffic generation in Bharuch region. The $R^2$ is also high which indicates that the percentage of BSF explains 57 percent variations in traffic generation and attraction zonewise. Besides, F-value is significant at 5% level with 9 degrees of freedom.

(9) Number of Villages

$$\ln PTG = 5.04031 + 0.1565 \ln VLGs$$

(5.098) (-0.312)

$R^2 = 0.01069 \quad R = -0.0992 \quad F(1,9) = 0.09722$

The above equation indicates that the influence of zonal number of villages is insignificant and is actually negative on passenger traffic generation in Bharuch region. $R^2$ is statistically insignificant and zonal number of villages explains only 01 percent on passenger traffic generation and attraction zonewise.

Finally, the previous and above analysis has revealed that certain activity development categories have high rate of influence on the determination of passenger traffic generation and attraction, while some other categories are lagging behind namely zonal number of service manufacturing industries and number of villages.

Comparing the above regression results it may be stated that in explaining passenger traffic generation in Bharuch region the zonal number of employment category has shown the highest rate of influence of 110 percent, followed by the zonal number of household which is determined at a rate of 108 percent, then population by 104 percent, the other services by 75.5 percent, trade and commerce 64.9 percent, bus service frequency by 47.4 percent, service manufacturing industries 46.2 percent, transport storage and communication 45.4 percent and finally number of villages at a rate of -15 percent.
Table 6.1.1:

Model I: The Relationship between Zonal Number of Passenger Traffic Generation and Attraction in Disaggregated Activity Development Categories

<table>
<thead>
<tr>
<th>Regression Equation Form</th>
<th>a</th>
<th>b</th>
<th>R²</th>
<th>R-squared</th>
<th>F(1,9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LnPTG OR A = a*LnHD+Ua</td>
<td>-0.01693</td>
<td>1.08485</td>
<td>0.53781</td>
<td>0.48646</td>
<td>10.47260</td>
</tr>
<tr>
<td></td>
<td>(-0.012)</td>
<td>(3.236)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. LnPTG OR A = a*LnPOP+Ua</td>
<td>-0.60955</td>
<td>1.04915</td>
<td>0.52406</td>
<td>0.47118</td>
<td>9.91002</td>
</tr>
<tr>
<td></td>
<td>(-0.359)</td>
<td>(3.128)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. LnPTG OR A = a*LnTNP+Ua</td>
<td>-0.42168</td>
<td>1.10287</td>
<td>0.47724</td>
<td>0.41915</td>
<td>8.21697</td>
</tr>
<tr>
<td></td>
<td>(-0.234)</td>
<td>(2.866)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. LnPTG OR A = a*LnTSC+Ua</td>
<td>2.59649</td>
<td>0.64954</td>
<td>0.67883</td>
<td>0.64315</td>
<td>19.02269</td>
</tr>
<tr>
<td></td>
<td>(5.260)</td>
<td>(4.362)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. LnPTG OR A = a+bsLn¥LGS+Ua</td>
<td>3.40700</td>
<td>0.45433</td>
<td>0.62265</td>
<td>0.58062</td>
<td>14.805</td>
</tr>
<tr>
<td></td>
<td>(9.724)</td>
<td>(3.853)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. LnPTG OR A = a+bsLn¥LGS+Ua</td>
<td>2.10219</td>
<td>0.75538</td>
<td>0.56294</td>
<td>0.51438</td>
<td>11.59204</td>
</tr>
<tr>
<td></td>
<td>(2.709)</td>
<td>(3.405)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. LnPTG OR A = a+bsLn¥LGS+Ua</td>
<td>3.08036</td>
<td>0.46204</td>
<td>0.40781</td>
<td>0.34201</td>
<td>6.19784</td>
</tr>
<tr>
<td></td>
<td>(4.604)</td>
<td>(2.490)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. LnPTG OR A = a+bsLn¥LGS+Ua</td>
<td>3.0089</td>
<td>0.47374</td>
<td>0.57802</td>
<td>0.53114</td>
<td>12.32816</td>
</tr>
<tr>
<td></td>
<td>(6.067)</td>
<td>(3.511)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. LnPTG OR A = a+bsLn¥LGS+Ua</td>
<td>5.04031</td>
<td>-0.15655</td>
<td>0.01069</td>
<td>-0.09924</td>
<td>0.09722</td>
</tr>
<tr>
<td></td>
<td>(5.098)</td>
<td>(-0.312)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5 percent level
Our analysis has also indicated that the disaggregated activity development categories zonewise in Bharuch region supports the earlier hypothesis that zonal traffic rate is a function of activity development pattern or alternatively landuse development pattern is a determinant of zonal traffic generation or attraction. However, in the coming pages we shall further examine this hypothesis by including more than one independent variables in the model. In the same analysis we will attempt a combined model II as indicated earlier in Section 6.0.0 of this chapter.

6.1.2 Combined Model

Model II: \( \ln PTG = -2.1055 \times 5.332 \ln HD + 2.8289 \ln POP + \\
\quad (-3.780) (-4.222)^* (3.780)^* \\
\quad 3.21319 \ln EMP + 1.67116 \ln TSC + 0.2929 \ln TSC \\
\quad (5.625)^* (11.214)^* (7.270)^* \\
\quad - 1.31007 \ln DS - 0.02603 \ln SMI - 0.8276 \ln BSF \\
\quad (-17.317)^* (-0.489) (-9.878)^* \\
\quad + 0.5375 \ln VLGS \\
\quad (21.835)^* \\
R^2 = 0.999 \quad R^2 = 0.998 \quad F(1,9) = 902.819

* Significant at 5% level

In the above multiple regression result it is evident that among the independent variables, zonal number of population, employment, trade and commerce, transport storage communication and zonal number of villages are significant and have positive and statistically significant influence over the determination of passenger traffic generation in Bharuch region zonewise. While the other variables namely zonal number of household, other services and bus service frequency are highly significant but exert negative influence in determination of passenger traffic rates. Service manufacturing industries coefficient has negative sign and is insignificant. The high values of \( R^2 \), \( R^2 \) and F-test suggest significant effect of the independent variables taken together.
This analysis reveals that when more independent variables are included together in the regression analysis we have a meaningful influence in determining the zonal rate of passenger traffic generation or attraction. This result also supports the earlier alternative hypothesis by Mitchell and Rapkin that traffic generation or attraction is a function of various land-use development categories over space in Bharuch region zonewise.

The multiple regression analysis results discussed above is supported by a step-wise regression exercise in order to enable us to judge the effect of the inclusion of additional variables zonewise.

6.1.3 Step-wise Regression Analysis

The step-wise regression model is often resorted into in order to decide on the “best” explanatory variables zonewise in Bharuch region which determine the rate of passenger traffic generation. We have however, proceeded by introducing the independent variables one by one which is known as step-wise regression modelling. The functional forms of our regression models and results are given in table 6.1.4. Thus we directly report our results for the cross-sectional relationship influence on determining the rate of passenger traffic generation in this study.

Step I: LnPTG = -0.01693 + 1.0845 LnHD
\((-0.012) (3.236)^*\)

\(R^2 = 0.53781 \quad R = 0.48646 \quad F(1,9) = 10.4726\)

* Significance at 5% level.

The above equation indicates that zonal number of household has positive influence as a determinant of passenger traffic generation zonewise in Bharuch region. While \(R^2\) and \(F\)-test values are significant and reveals 53 percent influence of zonewise rate of generation.

Step II: LnPTG = 5.84089 + 10.6265 LnHD - 9.354 LnPOP
\((1.029) (1.188) (-1.068)\)

\(R^2 = 0.5954 \quad R = 0.4943 \quad F(1,9) = 5.887\)
The above result suggests that zonal number of household has the positive effect on determination of passenger traffic generation which is not the case for our second explanatory variable of population rate and this is supported by b and t values of household coefficient in the above equation, while $R^2$ is significant and shows explanation of 59 percent of variation in the rate of passenger traffic generation. By incorporating the second variable (Population) however, the significance of HD is adversely affected. This shift in the significance and the absence of significant influence of both HD and pop shows the presence of multicollinearity.

Step III: $\ln PTG = 7.36630 + 12.77407 \ln HD - 9.9830 \ln POP$

\[
\begin{align*}
(1.209) & \quad (1.344) & \quad (-1.111) \\
-1.65326 \ln EMP & \\
\quad (-0.817)
\end{align*}
\]

$R^2 = 0.6307 \quad F(1,9) = 3.9846$

Step III of our regression analysis shows that zonal number of household is positively correlated with the rate of passenger traffic generation. While in the case of population and employment rates are insignificant with negative signs. $R^2$ is moderately high and significant along with F-test values.

Step IV: $\ln PTG = 4.56248 + 3.10234 \ln HD - 3.49145 \ln POP$

\[
\begin{align*}
(0.696) & \quad (0.239) & \quad (-0.325) \\
+0.46629 \ln EMP + 0.6649 \ln TSC & \\
\quad (0.166) & \quad (1.078)
\end{align*}
\]

$R^2 = 0.6907 \quad F(1,9) = 3.34889$

This result, shows that zonal number of trade and commerce, household and employment rates has influential determination of passenger traffic during the period under our consideration which indicated by the positive values of b coefficient although the t-values are not significant. $R^2$ shows that 69 percent rate in zonewise passenger traffic generation on both the above four included independent variables.
Step V: $\ln PTG = 4.54806 + 3.56234 \ln HD - 3.6615 \ln POP$
\[\begin{align*}
& (0.636) \quad (0.248) \quad (-0.312) \\
& + 0.47714 \ln EMP + 0.29326 \ln TC \\
& (0.427) \quad (0.094) \\
& + 0.09435 \ln TSE \\
& (0.211)
\end{align*}\]
$R^2 = 0.6934 \quad \overline{R} = 0.3869 \quad F(1,9) = 3.3489$

The result above suggests that among the five introduced independent variables, zonal number of household, employment, trade and commerce, and transport storage communication they, have positive statistical relationship on the determination of the rate of passenger traffic generation. While population is insignificant with negative signs. The five variables combined together explain 69 percent in zonal passenger traffic generation as indicated by $R^2$ values.

Step VI: $\ln PTG = -0.86264 - 3.14836 \ln HD +$
\[\begin{align*}
& (-0.088) \quad (-0.187) \\
& (3.26292 \ln POP + 1.03972 \ln EMP + \\
& (0.223) \quad (0.780) \\
& 0.78575 \ln TC + 0.22728 \ln TSE - \\
& (0.237) \quad (0.466) \\
& 1.43299 \ln OS \\
& (-0.838)
\end{align*}\]
$R^2 = 0.73915 \quad \overline{R} = 0.3964 \quad F(1,9) = 1.89$

The regression result above shows that zonal number of population, employment, trade and commerce and transport storage communication are insignificant and positively influenced the determination of passenger traffic generation zonewise in Bharuch region. On the other hand zonal number of household and other services are significant with negative signs. $R^2$ value shows that these variables accounts for 73 percent rate in passenger traffic generation.
Step VII: LnPTG = 4.80575 + 8.5007 LnHD - 3.98787

\[
\begin{align*}
(0.451) & \quad (0.445) & \quad (-0.258) \\
LnPOP & \quad - 2.34629 & \quad LnEMP + 0.36777 \\
(0.560) & \quad & \quad 90.261) \\
LnTC & \quad - 0.12898 & \quad Lntsc - 1.1005 Lnos \\
(-0.229) & \quad (-0.659) \\
- 0.78112 & \quad LnSMI \\
(-1.150) \\
\end{align*}
\]

\[R^2 = 0.8189 \quad \bar{R}^2 = 0.3964 \quad F(1,9) = 1.938\]

The above result indicates that only two explanatory variables namely zonal number of trade and commerce and household are positively correlated on the determination of zonal passenger traffic generation in Bharuch region. While the other variables such as zonal number of population, employment, transport storage communication, other services and service manufacturing industries are insignificant with negative signs. However, this insignificant of some of the independent variables as well as the high values of \(R^2\) and F-test do suggest the existence of multicollinearity among the independent variables.

Step VIII: LnPTG = 4.01520 + 14.4018 LnHD - 3.0776

\[
\begin{align*}
(0.540) & \quad (1.057) \\
LnPOP & \quad - 7.9081 & \quad LnEMP - 1.0922LnTC \\
(-1.978) & \quad (-0.898) \\
- 0.3693 & \quad LnTSC - 1.26721 LnOS - \\
(-0.901) & \quad (-1.084) \\
0.9672 & \quad LnSMI + 0.8938 LnBSF \\
(-2.003) & \quad (2.040) \\
\end{align*}
\]

\[R^2 = 0.9412 \quad \bar{R}^2 = 0.706 \quad F(1,8) = 4.0003\]
In case of Step VIII our regression result suggests that among the independent variables only one explanatory variable namely zonal number of bus service frequency is highly significant and it has positive statistical relationship on the determination of zonal passenger traffic generation in Bharuch region. Zonal number of service manufacturing industries is significant despite of its co-efficient negative signs. Also zonal number of household is insignificant but positively correlated. Other explanatory variables such as zonal population, employment, trade and commerce, transport storage communication and other services show negative signs and are not significant. The high values of R², R² and F-test indicate significant effects of some of the independent variables. In other words, the insignificance of some of these variables zonewise as well as the high values of R² and R² do reveal the existence of multicollinearity among the independent variables.

5.1.4.: Conclusion

In the previous analysis model I (6.1.1) reveals a cross-sectional relationship in determination of zonal passenger traffic generation with respect to zonal activity development categories in Bharuch region zonewise. In the same, we have observed and established that zonal number of Household, Population, Employment, Trade and Commerce, Transport Storage Communication, other services, service manufacturing industries and Bus Service frequency are highly significant and they have positive relationship on determination of passenger traffic generation zonewise. While coefficients of zonal number of villages show negative signs and is not significance.

Model II (6.1.2) of this study indicates that when more zonal independent variables are included together in the regression analysis, they have a meaningful influence in determining zonal rate of passenger traffic generation zonewise. This results supports the earlier alternative hypothesis by Mitchell and Raphin that various kinds of traffic generation in Bharuch region is a function of regional economic development. In this model the insignificance of some of the independent variables reveals a sure sign for the presence of multicollinearity among these variables zonewise in Bharuch region.
Table 6.1.4
Relationship between zonal passenger traffic and various disaggregated activity development

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b1</th>
<th>b2</th>
<th>b3</th>
<th>b4</th>
<th>b5</th>
<th>b6</th>
<th>b7</th>
<th>b8</th>
<th>R²</th>
<th>R²*</th>
<th>F(1,8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Term</td>
<td>-0.01693</td>
<td>1.0848</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>0.5372</td>
<td>0.4862</td>
<td>10.4726</td>
</tr>
<tr>
<td>Household Employment</td>
<td>5.84089</td>
<td>10.6265</td>
<td>-9.3544</td>
<td>(1.029)</td>
<td>(-0.068)</td>
<td>(1.188)</td>
<td>(-0.817)</td>
<td>(1.029)</td>
<td>(-0.817)</td>
<td>0.5954</td>
<td>0.4943</td>
<td>5.8973</td>
</tr>
<tr>
<td>Trade &amp; Commerce</td>
<td>7.36630</td>
<td>12.7774</td>
<td>-9.9831</td>
<td>-1.6533</td>
<td>(1.209)</td>
<td>(1.344)</td>
<td>(-0.817)</td>
<td>(1.029)</td>
<td>(-0.817)</td>
<td>0.6307</td>
<td>0.4724</td>
<td>3.98465</td>
</tr>
<tr>
<td>Trans-Port Storage</td>
<td>4.56248</td>
<td>3.10234</td>
<td>-3.4915</td>
<td>0.4663</td>
<td>0.6649</td>
<td>(0.696)</td>
<td>(0.239)</td>
<td>(0.166)</td>
<td>(1.078)</td>
<td>0.6907</td>
<td>0.484</td>
<td>3.34889</td>
</tr>
<tr>
<td>Communication</td>
<td>4.54811</td>
<td>3.5624</td>
<td>-3.6616</td>
<td>0.47714</td>
<td>0.28926</td>
<td>0.09435</td>
<td>(0.636)</td>
<td>(0.248)</td>
<td>(0.11)</td>
<td>0.6934</td>
<td>0.3867</td>
<td>2.7613</td>
</tr>
<tr>
<td>Mfg. Industries</td>
<td>5.84089</td>
<td>10.6265</td>
<td>-9.3544</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>-0.3554</td>
<td>0.5372</td>
<td>0.4862</td>
<td>10.4726</td>
</tr>
<tr>
<td>Service Sector</td>
<td>7.36630</td>
<td>12.7774</td>
<td>-9.9831</td>
<td>-1.6533</td>
<td>(1.209)</td>
<td>(1.344)</td>
<td>(-0.817)</td>
<td>(1.029)</td>
<td>(-0.817)</td>
<td>0.6307</td>
<td>0.4724</td>
<td>3.98465</td>
</tr>
<tr>
<td>Bus Service Frequency</td>
<td>4.56248</td>
<td>3.10234</td>
<td>-3.4915</td>
<td>0.4663</td>
<td>0.6649</td>
<td>(0.696)</td>
<td>(0.239)</td>
<td>(0.166)</td>
<td>(1.078)</td>
<td>0.6907</td>
<td>0.484</td>
<td>3.34889</td>
</tr>
<tr>
<td>Step III: LnPTG = 1+blLnHD+b2LnPOP+b3LnEMP+b4LnTC+U</td>
<td>-0.8662</td>
<td>-3.148</td>
<td>3.26292</td>
<td>1.03972</td>
<td>0.78575</td>
<td>0.22728</td>
<td>-1.43299</td>
<td>(0.696)</td>
<td>(0.187)</td>
<td>0.73915</td>
<td>0.3478</td>
<td>1.88906</td>
</tr>
<tr>
<td>Step IV: LnPTG = 1+blLnHD+b2LnPOP+b3LnEMP+b4LnTC+b5LnTS+b6LnOS+b7LnSHI+U</td>
<td>4.80571</td>
<td>8.5007</td>
<td>-3.9879</td>
<td>-2.346</td>
<td>0.36777</td>
<td>-0.12898</td>
<td>-1.10053</td>
<td>(0.451)</td>
<td>(0.445)</td>
<td>0.8189</td>
<td>0.3964</td>
<td>1.93818</td>
</tr>
<tr>
<td>Step V: LnPTG = 1+blLnHD+b2LnPOP+b3LnEMP+b4LnTC+b5LnTS+b6LnOS+b7LnSMI+b8LnBSF</td>
<td>4.0152</td>
<td>14.4018</td>
<td>-3.0776</td>
<td>-7.0081</td>
<td>-1.0218</td>
<td>0.3934</td>
<td>-1.26721</td>
<td>(0.540)</td>
<td>(1.057)</td>
<td>0.9412</td>
<td>0.706</td>
<td>4.0029</td>
</tr>
</tbody>
</table>
6.2.0: The Relationship Between Zonal Freight Traffic Generation and Various Disaggregated Activity Development Categories

In the last sections 6.1.0, 6.1.2 and 6.1.3 of this chapter we have modelled and examined a cross-sectional relationship in the determination of zonal passenger traffic generation with respect to different disaggregated activity development patterns in Bharuch region.

Here, also, we fit a double logarithmic regression model to the data matrix (11 x 9) of different activity development patterns for the study year 1991. Having taken these activities as independent variables and zonal number of freight traffic generation as depending variable we obtained the results as shown in table 6.1.1. Here, we report our empirical regression results one after another as follow:

(1) Area Under Agriculture (AUA)
\[
\ln FTG = 2.78706 + 0.54586 \ln AVA \\
(2.228) \quad (1.875)
\]
\[R^2 = 0.28083 \quad R_5 = 0.20092 \quad F(1,9) = 3.51442\]

The above result suggest that the relationship between zonal area under agriculture and zonal freight traffic generation is moderately significant (at 10% level) and positive as shown by the student's 't' value attached to it. The slope coefficient of this result signifies that for the study year 1991, zonal area under agriculture in Bharuch region has positive influence on the determination of freight traffic generated zonewise. \(R^2\) is insignificant which explains only 28 percent of the percentage influence on zonal freight traffic generation. Besides, that, \(F\)-value is not statistically significant. This result imply that zonal area under agriculture has moderate influence on the determination of freight traffic generation zonewise in Bharuch region.

(2) Production Inputs (PI)
\[
\ln FTG = 59228.9 + 6.97638 \ln PI \\
(0.336) \quad (0.794)
\]
\[R^2 = 0.06549 \quad R_5 = -0.03835 \quad F(1,9) = 0.63070\]

179
This result indicates that zonal number of production input in Bharuch region is statistically insignificant and have positive influence on the determination of freight traffic generation and attraction zonewise. \( R^2 \) and F-values are also statistically insignificant. This result therefore, could not support the earlier hypothesis in the study region.

(3) Marketable Surplus (MS)

\[
\ln FTG = 3.50884 + 0.32564 \ln MS \\
(2.515) \quad (1.162)
\]

\[
R^2 = 0.13049 \quad R = 0.03388 \quad F(1,9) = 1.3506
\]

The above regression result show that zonal number of marketable surplus is statistically insignificant with positive influence on the determination of freight traffic generation zonewise in Bharuch region. \( R^2 \) is also statistically insignificant indicating that zonal number of marketable surplus explains only 13 percent of the percentage influence on freight traffic generation zonewise.

(4) Population (POP)

\[
\ln FTG = -0.21490 + 1.04870 \ln POP \\
(-0.121) \quad (3.003)^* 
\]

\[
R^2 = 0.50048 \quad R = 0.44498 \quad F(1,9) = 9.017
\]

* Significant at 5% level

The regression result presented above supports the fact that zonal population in Bharuch region is statistically significant and have positive influence on the determination of freight generation and attraction zonewise. \( R^2 \) is also significant meaning that zonewise population explains 50 percent of the percentage influence on the determination of freight transport generated and attracted in Bharuch region. Beside that, F-value is statistically significant which indicates positive relationship between the variables for the whole result. This result implies that zonewise number of population in Bharuch region has a high bearing on the determination of freight transport generation and attraction.
(5) **Trade and Commerce (T&C)**

\[ \ln FTG = 2.9622 + 0.6576 \ln T&C \]

(5.745) (4.228)*

\[ R^2 = 0.665 \quad R = 0.6279 \quad F(1,9) = 17.87^* \]

* Significant at 5% level.

The above result supports the fact that zonal number of trade and commerce in Bharuch region is highly significant and have positive relationship on the determination of freight transport generation and attraction zonewise. Below that, \( R^2 \) is statistically significant which indicates that zonal number of trade and commerce explains 66 percent of the percentage influence on the determination of freight traffic generation zonewise. Beside that, F-value is also significant meaning that there is a positive relationship between the variables. Thus, zonal number of trade and commerce has highly influenced the determination of the rate of freight traffic generation during the study 1991 in Bharuch region. This result also supports the hypothesis by Mitchell and Rapkin.

(6) **Transportation Storage and Communication (TSC)**

\[ \ln FTG = 3.80299 - 0.45309 \ln TS&C \]

(10.204) (3.612)*

\[ R^2 = 0.5918 \quad R = 0.5465 \quad F(1,9) = 13.048 \]

* Significance at 5% level.

The regression result presented above supports the fact that zonal transport storage and communication is significant and positive influence on the determination of zonal freight traffic rates in Bharuch region. \( R^2 \) is significant which reveals that zonal transport storage and communication explains 59 percent of the percentage influence on the determination of freight rates zonewise. Beside that, F-value is statistically significant indicating that there is a positive relationship between the variables of the whole result. Therefore, we can state that zonal transport storage and communication has highly influenced the determination of freight traffic in Bharuch region zonewise.
(7) Other Services (OS)

\[ \ln(FTG) = 2.3498 + 0.78655 \ln(OS) \]

\[ (2.625) \quad (3.113)^* \]

\[ R^2 = 0.51840 \quad R = 0.46489 \quad F(1,9) = 9.688 \]

* Significance at 5% level.

The above result reveals that zonal number of other services in Bharuch region is significant and has a positive relationship on the determination of freight traffic rates zonewise in the study year 1991. \( R^2 \) is statistically significant which indicates that zonal number of other services explains 51 percent of the percentage influence on the determination of freight traffic rates zonewise.

Besides that, F-value is significant which means that there is a significant positive relationship between the variables of the whole result.

(8) Service Manufacturing Industries (SMI)

\[ \ln(FTG) = 2.99731 + 0.6104 \ln(SMI) \]

\[ (7.181) \quad (5.144) \]

\[ R^2 = 0.7462 \quad R = 0.718 \quad F(1,9) = 26.462 \]

* Significant at 5% level

The above result indicates that zonal number of service manufacturing industries' coefficient is highly significant and it has positive relationships on the determination of freight traffic generation and attraction zonewise in Bharuch region. Here \( R^2 \) is also high which means that zonal service manufacturing industries explains 74 percent of the percentage influence of the determination of freight transport generation zonewise. Besides, F-value is statistically highly significant which reveals a positive relationship between the variables of the whole result. This result imply that zonal service manufacturing industries has the highest bearing on determination of freight transport generation or attracted in Bharuch region zonewise.
The above regression results support the fact that zonal truck service frequency in Bharuch region is highly significant with a positive relationship on the determination of the rate of freight transport generated and attracted zone-wise during the study year. Below that $R^2$ is highly significant meaning that zonal truck frequency explaining 98 percent of the percentage influence on the determination of freight transport generation zonewise. Besides, F-value is also highly significant which reveals a positive relationship between variables of the whole result. In this result, we conclude that zonal number of truck frequency has also the highest bearing on the determination of freight transport in Bharuch region zonewise.
Table 6.2.1: Model I

Relationship Between Total Zonal Freight Traffic Generation on Activity Categories

Regression Equation Form       Estimation of

<table>
<thead>
<tr>
<th>Equation</th>
<th>a</th>
<th>b</th>
<th>r²</th>
<th>r⁻²</th>
<th>F(1,9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LnFTG OR A = a + b₁LnAU₂ + U₁</td>
<td>2.78706</td>
<td>0.54586</td>
<td>0.28083</td>
<td>0.20092</td>
<td>3.51442</td>
</tr>
<tr>
<td></td>
<td>(2.228)</td>
<td>(1.875)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. LnFTG OR A = a + b₂LnPI₂ + U₂</td>
<td>59228.908</td>
<td>6.97638</td>
<td>0.06549</td>
<td>-0.03835</td>
<td>0.63070</td>
</tr>
<tr>
<td></td>
<td>(0.336)</td>
<td>(0.794)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. LnFG OR A = A + b₃LnMS₃ + U₃</td>
<td>3.50884</td>
<td>0.32564</td>
<td>0.13049</td>
<td>0.03388</td>
<td>1.35065</td>
</tr>
<tr>
<td></td>
<td>(2.515)</td>
<td>(1.162)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. LnFTG OR A = 1 + b₄LnPOP₄ + U₄</td>
<td>-0.21490</td>
<td>1.04870</td>
<td>0.50048</td>
<td>0.44498</td>
<td>9.01725</td>
</tr>
<tr>
<td></td>
<td>(-0.121)</td>
<td>(3.003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. LnFTG OR A = a + b₅LnNo.Cult.₅ + U₅</td>
<td>6.73032</td>
<td>-0.39144</td>
<td>0.05982</td>
<td>-0.04465</td>
<td>0.57261</td>
</tr>
<tr>
<td></td>
<td>(3.171)</td>
<td>(-0.757)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. LnFTG OR A = 1 + b₆LnTC₆ + U₆</td>
<td>2.96222</td>
<td>0.65766</td>
<td>0.66511</td>
<td>0.62790</td>
<td>17.87436</td>
</tr>
<tr>
<td></td>
<td>(5.745)</td>
<td>(4.228)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. LnFTG OR A = a + b₇LnTSC₇ + U₇</td>
<td>3.80299</td>
<td>0.45309</td>
<td>0.59180</td>
<td>0.54645</td>
<td>13.04814</td>
</tr>
<tr>
<td></td>
<td>(10.204)</td>
<td>(3.612)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. LnFTG OR A = a + b₈LnOS₈ + U₈</td>
<td>2.34984</td>
<td>0.78655</td>
<td>0.51840</td>
<td>0.46489</td>
<td>9.68775</td>
</tr>
<tr>
<td></td>
<td>(2.625)</td>
<td>(3.113)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. LnFTG OR A = a + b₉LnSMI₉ + U₉</td>
<td>2.99731</td>
<td>0.61040</td>
<td>0.74620</td>
<td>0.71801</td>
<td>26.46165</td>
</tr>
<tr>
<td></td>
<td>(7.181)</td>
<td>(5.144)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. LnFTG OR A = 1 + b₁₀LnNo.TKSF₁₀ + U₁₀</td>
<td>1.94017</td>
<td>1.04945</td>
<td>0.98930</td>
<td>0.98811</td>
<td>832.38445</td>
</tr>
<tr>
<td></td>
<td>(17.481)</td>
<td>(28.851)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5% level
6.2.2 Multiple Regression Model

Model 11: \( \text{LnFTG} = 1.7116 + 8.8449 \text{LnAUG} + 0.0925 \text{LnPl} \)

\[
\begin{align*}
(6.116) & \quad (0.160) & \quad (2.200)^* \\
0.0945 \text{LnMS} + 0.01565 \text{LnPOP} + 0.1231 \text{LnTC} \\
(-3.578)^* & \quad (0.146) & \quad (1.504) \\
0.212 \text{LnTSC} + 1.2897 \text{LNOS} + 0.06897 \text{LnSMJ} + \\
(-5.450)^* & \quad (0.026) & \quad (2.463)^* \\
1.15269 \text{LnTKSF} \\
(49.77)^* \\
R^2 = 0.99995 \quad R_z = 0.9995 \quad F(1,9) = 2202.69
\end{align*}
\]

* Significance at 5% level.

This result supports the fact that among the zonal independent variables, truck frequency, service manufacturing industries and production inputs are highly significant and they have positive relationship on the determination of freight transport generation of attracted during the study year. While zonal number of marketable surplus and transport storage communication are also significant with negative signs. The other variables namely zonal area under agriculture, population, trade and commerce, and other services are insignificant and have positive influence. The high values of \( R^2, R_z^2 \) and F-test reveals significant effect of some of the independent variables. And the insignificant of some of these variables zonewise indicates the existence of multicollinearity among the independent variables.

In this analysis therefore, we conclude that when more independent variables are included together in the regression model they have a meaningful relationship in the determination of zonal rate of freight transport generation or attraction in Bharuch region. This result also supports the earlier hypothesis by Michael and Rapkin. It is also true that freight transport generation on attractive have a function of economic development in Bharuch region.
6.2.3. Step-wise Regression Analysis

Step I: LnFTG = 2.7872 + 0.5458 LnAUA
(2.222) (1.875)
R² = 0.281  R² = 0.2009  F(1,8) = 3.5144

The above equation indicates that zonal area under agriculture in Bharuch region has positive influence on the determination of freight transport generation zonewise and moderates significant. Below that, R² is statistically insignificant meaning that zonal area under agriculture explains only 28 percent of the percentage influence of the rate of freight generation during the study year 1991. Beside, F-test value is also significant which indicates that there is positive relationship between the variables of the whole result. This result imply that zonal area under agriculture moderately supports the relationship influence on the determination of freight traffic generation in Bharuch region.

Step II: LnFTG = 4.57345 - 0.87687 LnAUA + 1.08182 LnPI
(1.599) (-0.763) (1.251)
R² = 0.19311  R² = -0.00861  F(91,8) = 0.95732

In case of Step II the regression result suggest that among the independent variables, none of these variables namely zonal area under agriculture and production input have significance effect on the determination of freight traffic generation zonewise in Bharuch region as shown by the regression parameters.

Step III: LnFTG = 3.57839 - 0.8888 LnAUA + 1.00713 LnPI +
(1.164) (-1.151) (1.651)
0.2749 LnMS
(0.935)
R² = 0.28269  R² = -0.0247  F(1,8) = 0.9196
In case of Step III of our regression equation along with zonal area under agriculture and production inputs, we inserted marketable surplus as another independent factor. And the result shows that none of the independent variables could be individually significant or influential on the determination of freight traffic generation in Bharuch region during the study 1991. However, $R^2$ shows that 28 percent influence on determination of freight transport generation could be attributed to the included zonal marketable surplus zonewise.

Step IV: \[ \ln FI_{G} = 1.72862 - 1.22496 \ln AUA + 0.8001 \ln PI + \]
\[ (0.672) (-1.317) (1.143) \]
\[ -9.986 \ln M + 1.11515 \ln POP \]
\[ (-0.038) (2.265)* \]
\[ R^2 = 0.6134 \quad R^* = 0.35563 \quad F(1,8) = 2.37975 \]
* Significance at 5% level.

In the above Step IV, our regression result shows that among the independent variables, only zonal population has influenced determination of freight transport generation during the study period under consideration which is indicated by the positive value of student-t test and significant at 5% level. While zonal production input coefficient has positive influence and insignificant. Other variables namely zonal area under agriculture, and marketable surplus are insignificant with negative signs. The $R^2$ value explains that this variables have 61 percent influence on the determination of freight transport generation zonewise. Besides, F-Value shows moderate statistical significant which imply that the independent variables have moderate influence on determining freight transport generation for the whole result.

Step V: \[ \ln FTG = 8.56174 + 0.4348 \ln AUA - 0.92257 \ln PI \]
\[ (3.006) (0.526) (-1.249) \]
\[ + 0.60709 \ln MS - 2.03143 \ln POP + 1.76295 \ln TC \]
\[ (2.244) (-1.839) (2.186) \]
\[ R^2 = 0.86073 \quad R^* = 0.72146 \quad F(1,8) = 6.180 \]
* Significant at 5% level
Step V of our regression analysis shows that zonal marketable surplus, trade and commerce are both influential in determining freight traffic generation. While zonal area under agriculture is insignificant with positive influence. Other variables, production input and population are insignificant with negative signs. Below that, R^2 value shows that zonal freight traffic generation is influenced by 86 percent of influence in the five factors jointly.

Step VI: \[ \ln FTG = 8.4448 + 0.29977 \ln AUA - 0.92792 \ln PI + 0.5444 \ln MS - 1.70791 \ln POP + 1.4473 \ln TC + 0.1576 \ln TSC \]
\[ \text{R}^2 = 0.86182 \quad \text{R} = 0.65456 \quad \text{F}(1,8) = 4.15806 \]

The above result shows that none of our independent variables is significant or influential in determining freight traffic generation in Bharuch region. However, zonal area under agriculture, marketable surplus, trade and commerce and transport storage communication have some positive influence. Thus, the insignificant of the independent variables as well as high values of R^2, R^-2 and F-test suggest the existence of multicollinearity among the independent variables.

Step VII: \[ \ln FTG = 9.82508 + 0.46069 \ln AUA - 1.13277 \ln PI + 0.5573 \ln MS - 2.3270 \ln POP + 1.28029 \ln TC + 0.13956 \ln TSC + 0.70013 \ln OS \]
\[ \text{R}^2 = 0.87352 \quad \text{R} = 0.57841 \quad \text{F}(1,8) = 2.9599 \]

188
Step VII of our regression analysis shows that none of the independent variables is significant or influential in determining freight traffic generation in Bharuch region zonewise. However, the zonal area under agriculture, marketable surplus, trade and commerce transport storage communication and other services have some positive influence. The insignificance of these variables as well as high values of $R^2$ and F-test depicts the existence of multicollinearity among the independent variables zonewise.

Step VIII: \[ \text{LnFTG} = -3.75999 - 0.06605 \text{LnAUA} + 0.02193 \text{LnPI} \]

\[ (-19.309) \quad (-2.208) \quad (0.852) \]

\[ - 0.0340 \text{LnMS} + 0.16774 \text{LnPOP} - 0.0497 \]

\[ (-2.560) \quad (2.545) \quad (-1.025) \]

\[ \text{LnTC} + 0.03079 \text{LnTSC} - 0.0909 \text{LnOS} + \]

\[ (1.454) \quad (-3.001) \]

\[ 12.4141 \text{LnSMI} \]

\[ (80.311) \]

\[ R^2 = 0.99996 \quad R^2 = 0.9998 \quad F(1,8) = 6376.27 \]

* Significance at 5% level.

This result indicates that among the independent variables, zonal service manufacturing industries and population are both highly significant and they have positive relationship or influence in determining the rate of freight transport generation during the study year 1991 in Bharuch region. While zonal number of production input and transport storage communication are insignificant and positively correlated. Other variables namely, area under agriculture, marketable surplus and other services are significant with negative signs. The $R^2$ values explains that this variables included together have 99 percent of the percentage influence in determining zonal freight traffic generation.

However, the insignificance of some of these variables as well as high values of $R^2$, $R^2$ and F-test depicts a clear sign of the presence of interrelationship among the independent variables.
Table 6.2.4: Stepwise Regression Results Between Zonal Freight Traffic Generation and Various Activity Categories Zonewise.

Stepwise regression model form:

\[
\begin{align*}
\ln TC + 0.5
\end{align*}
\]

<table>
<thead>
<tr>
<th>Step</th>
<th>Regression Model</th>
<th>Coefficients</th>
<th>Standard Errors</th>
<th>t-values</th>
<th>F-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>( \ln Y(ZFTG) = 1 + b_1 \ln AUA + U_1 )</td>
<td>2.7876</td>
<td>(2.228)</td>
<td>1.251</td>
<td>3.186</td>
</tr>
<tr>
<td>II.</td>
<td>( \ln Y(ZFTG) = A + b_1 \ln AUA + b_2 LnP_1 + U_2 )</td>
<td>4.54345</td>
<td>(1.599)</td>
<td>0.935</td>
<td>0.038</td>
</tr>
<tr>
<td>III.</td>
<td>( \ln Y(ZFTG) = A + b_1 \ln AUA + b_2 LnP_1 + b_3 \ln MS + U_3 )</td>
<td>3.5739</td>
<td>(1.164)</td>
<td>0.935</td>
<td>0.038</td>
</tr>
<tr>
<td>IV.</td>
<td>( \ln Y(ZFTG) = A + b_1 \ln AUA + b_2 LnP_1 + b_3 \ln MS + b_4 \ln POP + U_4 )</td>
<td>1.72852</td>
<td>(0.672)</td>
<td>-0.986</td>
<td>1.151</td>
</tr>
<tr>
<td>V.</td>
<td>( \ln Y(ZFTG) = a + b_1 \ln AUA + b_2 LnP_1 + b_3 \ln MS + b_4 \ln POP + b_5 \ln TC + U_5 )</td>
<td>8.56174</td>
<td>(3.00)</td>
<td>0.60709</td>
<td>-2.3143</td>
</tr>
</tbody>
</table>

\( R^2 \) indicates the proportion of variance explain, \( R^{-2} \) is the adjusted coefficient of determination, and \( F(1, 9) \) is the F-test statistic with 1 and 9 degrees of freedom.
| VI. \( \ln(Y(ZFTG)) = \) & 8.4448 & 0.29977 & 0.92192 & 0.5444 & -1.70791 & 1.4473 & 0.1576 & 0.86182 & 0.65456 & 4.15806 \\
| & \( a + b_1\ln(\text{AUA}) + b_2\ln(\text{PI}) + b_3\ln(\text{HS}) + b_4\ln(\text{POP}) + b_5\ln(\text{TC}) + b_6\ln(\text{TSE}) + b_7\ln(\text{OS}) + b_8\ln(\text{SII}) + b_9\ln(\text{TK}) \) | (2.607) & (0.251) & (-1.127) & (1.174) & (-0.778) & (0.765) & (0.178) & \\
| VII. \( \ln(Y(ZFTG)) = \) & 9.82508 & 0.46069 & -1.13277 & 0.5523 & -2.3270 & 1.28029 & 0.13956 & 0.70003 & 0.87352 & 0.5784 & 2.9599 \\
| & \( a + b_1\ln(\text{AUA}) + b_2\ln(\text{PI}) + b_3\ln(\text{HS}) + b_4\ln(\text{POP}) + b_5\ln(\text{TC}) + b_6\ln(\text{TSE}) + b_7\ln(\text{OS}) \) | (2.215) & (0.340) & (-1.145) & (1.087) & (-0.863) & (0.605) & (0.142) & (0.527) & \\
| VIII. \( \ln(Y(ZFTG)) = \) & -3.75999 & -0.0665 & 0.02193 & -0.0340 & 0.16774 & -0.0497 & 0.03079 & -0.0909 & 12.4141 & 0.99996 & 0.9998 & 6376.2706 \\
| & \( A + b_1\ln(\text{AUA}) + b_2\ln(\text{PI}) + b_3\ln(\text{HS}) + b_4\ln(\text{POP}) + b_5\ln(\text{TC}) + b_6\ln(\text{TSE}) + b_7\ln(\text{OS}) + b_8\ln(\text{SII}) + b_9\ln(\text{TK}) \) | (-19.349) & (-2.208) & (0.852) & (-2.560) & (2.545) & (-1.025) & (1.454) & (-3.001) & (80.311)* & \\
| IX. \( \ln(Y(ZFTG)) = \) & 1.71164 & 8.84498 & 0.0925 & -0.0945 & 0.0165 & -0.2119 & 1.2897 & 0.06897 & 1.15269 & 0.99995 & 0.9995 & 2202.6918 \\
| & \( 1 + b_1\ln(\text{AUA}) + b_2\ln(\text{PI}) + b_3\ln(\text{HS}) + b_4\ln(\text{POP}) + b_5\ln(\text{TC}) + b_6\ln(\text{TSE}) + b_7\ln(\text{OS}) + b_8\ln(\text{SII}) + b_9\ln(\text{TK}) \) | (6.113) & (0.160) & (2.200)* & (-3.578) & (0.146) & (1.504) & (-5.450) & (0.026) & (2.463)* & (49.77) & |
Table 6.2.5
Correlation Matrix of Zonewise Freight Traffic Generation in Activity Development Categories

<table>
<thead>
<tr>
<th></th>
<th>b1</th>
<th>b2</th>
<th>b3</th>
<th>b4</th>
<th>b5</th>
<th>b6</th>
<th>b7</th>
<th>b8</th>
<th>b9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Area under Agriculture (AUA)</td>
<td>1.0000</td>
<td>0.1876</td>
<td>0.3665</td>
<td>0.3612</td>
<td>0.7074*</td>
<td>0.4188</td>
<td>0.8156*</td>
<td>0.1475</td>
<td>0.8636**</td>
</tr>
<tr>
<td>2. Production Input (PI)</td>
<td>0.1876</td>
<td>1.0000</td>
<td>0.8549**</td>
<td>0.1691</td>
<td>0.4758</td>
<td>0.5952</td>
<td>0.4812</td>
<td>0.4344</td>
<td>0.2922</td>
</tr>
<tr>
<td>3. Marketable Surplus (MS)</td>
<td>0.3665</td>
<td>0.8549*</td>
<td>1.0000</td>
<td>0.1913</td>
<td>0.4788</td>
<td>0.6642</td>
<td>0.6176</td>
<td>0.1353</td>
<td>0.5709</td>
</tr>
<tr>
<td>4. Population (POP)</td>
<td>0.3612</td>
<td>0.1691</td>
<td>0.1913</td>
<td>1.0000</td>
<td>0.4976</td>
<td>0.6303</td>
<td>0.2081</td>
<td>0.0140</td>
<td>0.3749</td>
</tr>
<tr>
<td>5. Trade &amp; Commerce (TC)</td>
<td>0.7074*</td>
<td>0.4758</td>
<td>0.4788</td>
<td>0.4976</td>
<td>1.0000</td>
<td>0.7863*</td>
<td>0.8893**</td>
<td>0.5266</td>
<td>0.7205*</td>
</tr>
<tr>
<td>6. Transport Storage &amp; Communication (TSC)</td>
<td>0.4188</td>
<td>0.5952</td>
<td>0.6642</td>
<td>0.6308</td>
<td>0.7863*</td>
<td>1.0000</td>
<td>0.6560</td>
<td>0.4607</td>
<td>0.6110</td>
</tr>
<tr>
<td>7. Other Services</td>
<td>0.8156*</td>
<td>0.4812</td>
<td>0.6176</td>
<td>0.2081</td>
<td>0.8893**</td>
<td>0.6560</td>
<td>1.0000</td>
<td>0.4004</td>
<td>0.8751**</td>
</tr>
<tr>
<td>8. Service Manufacturing Industries (SMI)</td>
<td>0.1475</td>
<td>0.4347</td>
<td>0.1353</td>
<td>0.0140</td>
<td>0.5266</td>
<td>0.4607</td>
<td>0.4004</td>
<td>1.0000</td>
<td>0.0735</td>
</tr>
<tr>
<td>9. Number of Truck Service Frequent (TSF)</td>
<td>0.8636**</td>
<td>0.2922</td>
<td>0.5709</td>
<td>0.3799</td>
<td>0.7205*</td>
<td>0.6110</td>
<td>0.8751**</td>
<td>0.0735</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* Significant at 1% level of significant (one tailed test)
** Significant at 1% level of significant (One tailed test).
6.2.6 Conclusion

Putting all the regression analysis models 6.1.0 and 6.2.0 together one could notice a variation in determining the rate of zonal traffic generation with respect to activity development patterns zonewise in Bharuch region during the study year 1991. The models depict that when more zonal independent variables are included together in the regression analysis, they have a meaningful relationship and influence in determining the rate of traffic generation and attraction. This analysis supports the fact that landuse development pattern in a given region is a function of various kinds of traffic generation or attraction as underlined by Mitchell and Rapkin. And it is also true that the rate of various kinds of traffic generation in Bharuch region is a function of economic development.

In this study, the empirical analysis, already undertaken reveals different experiences in regional transportation development. This analysis leads us to the conclusion that the rate of transport generation or attraction is not determined by zonal activity development categories alone, but there are a number of technological and socio-political factors which shape the nature and patterns of regional transportation development.