CHAPTER - 4

Determinants of Municipal Tax Revenue and Expenditure

Introduction

A study of determinants of revenue and expenditure of ULBs forms the centre-stage of the urban welfare. Unfortunately, in the present scenario of urban crisis, it has received little attention. The aim of the present chapter is to review briefly some of the empirical studies on the determinants of municipal revenues and expenditure of ULBs in Punjab. In fact, the studies analysing the determinant are confined only to public expenditure and a very few have attempted to analyse the determination of public revenue. An attempt has been made here to estimate the determinants of municipal revenues as well.

Empirical Studies

The determinant analysis made its appearance in the early 1950’s. Solomon Fabricant¹ (1952) conducted a pioneering study for United States. He examined the factors influencing the inter-state variation in States and local government expenditure by using multiple regression analysis. He found that State and local government expenditure was explained by three variables, viz., per capita income, population density and percentage of people living in urban areas. In his multiple regression equation, these three variables could explain 72 per cent variation in total expenditure. These
three variables have appeared in one form or the other as possible determinants of public expenditure in almost all subsequent studies. Some later studies incorporated other variables also besides these three. Harvey E. Brazer\(^2\) (1959) in his study included population density, median family income, inter-government revenues, population growth rate and manufacturing trade and services employed as the main variables. Sacks and Harris\(^3\) (1964), Bahl\(^4\) (1968) and Osman\(^5\) (1968) advocated the inter-governmental transfers/transfers as one of the important factors in explaining the variation in State and local expenditure. Hansen\(^6\) (1965) in his study on Belgium concentrated only on urban governments rather than on aggregate of total State and local governments and separated the current expenditure from capital expenditure. Adams\(^7\) (1968) in his study incorporated other factors which reflect socio-economic environment, income and wealth, physical environment, institutional factors, individual characteristics etc. Bahl\(^8\) (1969) examined the determinants of metropolitan expenditure and the inter-city differences in per capita expenditure. The explanatory variables included demographic variables, income and wealth and capacity to finance variables. Michas\(^9\) (1969) conducted a study relating to Canada and the result showed income to be the most important determinant for all expenditures. Pryer\(^10\) (1968) conducted a study of public expenditure in communist and capitalist countries. He considered economic system, the level of economic development and other variables which included
conditioning factors as broad determinants of expenditure. He analyzed the time series of 14 countries with 1950-62 data.

In the Indian context, the determinant analysis by and large followed Fabricant’s model, with some modifications in the specification of independent variables. Mukerji11 (1965) made a reference to the suitability of Fabricant’s model. A pioneering attempt was made by Atul Sharma et al. (1974). The study relates to the ULBs of the State of Gujarat and the main purpose of the study was to examine whether the same set of variables as the one found satisfactory in the developed countries is equally relevant as determinants of expenditures in a developing country like India. They found structural differences in municipal finance because of differences in the economic structure of the area. Nageswar Rao and Rama Rao13 (1977) made a study with reference to the State of Karnataka. They adopted a multiple regression model preceded by correlation analysis. They conducted a cross-sectional study of 17 major municipalities for 1971. In their study, the determinants of total public expenditures, expenditure on public health, sanitation and conservancy and expenditure on public works, were considered. The factors hypothesized to influence the public expenditure were classified as demographic, economic and physical.

However, the scope of the present work is much broader. Besides estimating the determinants of municipal expenditure, an attempt has been made to study the determinants of municipal revenue as well. The study
relates to all the ULBs in Punjab. The study is based on times series data of ULBs relating to two time periods i.e., Period-I (1970-71 to 1990-91) with 1981-82 as base and Period-II (1991-92 to 2005-06) with 1993-94 as base. Multiple regression analysis has been used as analytical technique. The revenue and expenditure are treated as dependent variables, which have been considered in aggregate and by important functional categories. In case of tax revenues, total tax revenue and revenue from property tax and octroi have been considered. Aggregate expenditure and other categories of expenditure such as Public Safety, Public Health and Public Works, have been considered separately. The dependent variables are measured in absolute and in per capita terms.

Selection of Variables

The inclusion of explanatory variables has been governed by theoretical and empirical considerations. For determinants of tax revenue we have taken urban income, urban population, work force, literate persons and number of urban (industrial) workers. In case of property tax and octroi, two additional variables, viz., number of residential houses and number of octroi posts have been considered for the two taxes respectively. For studying expenditure, we have taken total municipal tax revenue, loans and grants to ULBs, urban income, urban population density, urban areas etc. For different functional categories, other appropriate variables have been used.
In fact, the chosen independent variables represent fiscal, demographic and socio-economic characteristics. Due to lack of information on variables such as property value, household income etc., we have taken into consideration other possible explanatory variables. To account for the demographic factors, different population variables have been considered. Rao (1979) in a study of four Indian States has quantified the effects of political factors as well. In political factors he has considered the influence of ideological leanings of political parties in power and the impact of political stability. But since the municipal politics has not drawn much attention in Punjab, the influence of political factors has not been considered.

**List of Dependent Variables Used in Multiple Regression**

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<td>Description of variables</td>
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<td>Urban Population in ‘000</td>
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<td>Number of Households per Lakh of Population</td>
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<td>Per Capita Urban Income</td>
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<td>Per Capita Tax Revenue</td>
<td>PTR</td>
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<td>Per Capita Loans and Grants</td>
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List of Independent Variables Used in Multiple Regression
Regression Models and Results

The following regression equations were formed and estimated for our analysis;

**Tax Revenue Equation**

\[
TTR = \beta_0 + \beta_1 U1 + \beta_2 UP + \beta_3 LP + U
\]

\[
PTR = \beta_0 + \beta_1 PUI + \beta_2 PUP + \beta_3 PLP + U
\]

**Property Tax Equation**

\[
TRP = \beta_0 + \beta_1 U1 + \beta_2 UP + \beta_3 NH + U
\]

\[
PRP = \beta_0 + \beta_1 PUI + \beta_2 PUP + \beta_3 NH + \beta_4 PUW + U
\]

**Equation of Revenue from Octroi**

\[
TRO = \beta_0 + \beta_1 U1 + \beta_2 UW + \beta_3 OP + U
\]

\[
PRO = \beta_0 + \beta_1 PUI + \beta_2 PUW + \beta_3 OP + U
\]

**Equation of total Municipal Expenditure**

\[
TME = \beta_0 + \beta_1 TR + \beta_2 LG + \beta_3 UI + U
\]

\[
PME = \beta_0 + \beta_1 PTR + \beta_2 PLG + \beta_3 PUI + U
\]

**Equation of Expenditure on Public Safety**

\[
TEPS = \beta_0 + \beta_1 TR + \beta_2 LG + U
\]

\[
PEPS = \beta_0 + \beta_1 PTR + \beta_2 PLG + U
\]

**Equation of Expenditure on Public Health and Conservancy**
$$TEPHC = \beta_0 + \beta_1 \text{TR} + \beta_2 \text{LG} + \text{U}$$

$$PEPHC = \beta_0 + \beta_1 \text{PTR} + \beta_2 \text{PLG} + \text{U}$$

**Equation of Expenditure on Public Works**

$$TEPW = \beta_0 + \beta_1 \text{TR} + \beta_2 \text{LG} + \beta_3 \text{UA} + \text{U}$$

$$PEPW = \beta_0 + \beta_1 \text{PTR} + \beta_2 \text{PLG} + \beta_3 \text{UA} + \text{U}$$

The regression equations/models were specified by including explanatory variables based on theoretical and empirical considerations. Various empirical studies such as Mukerji (1965), Atul Sharma (1974), Nageswar Rao and Rama Rao (1977) and Lily (1984) have included these variables in their regression analysis. In fact, the chosen independent variables represent fiscal, demographic and socio-economic characteristics. The fiscal variables included were state income from urban sector, municipal tax revenue and municipal loans and grants. The socio-economic and demographic variables were literate population, urban workers, urban area, urban population, number of households and number of octroi posts.

In tax revenue equation, tax revenue is dependent upon state income from urban sector, urban population and literate population. As income from urban area increases, a positive impact on tax revenue is expected because tax revenue constitutes a major component of municipal income. A rise in urban population means more population can be brought under tax net and hence a positive impact is hypothesised. The presence of more literate
persons among the population implies better tax compliance and hence a positive impact on tax revenue is assumed. In per capita tax revenue equation, all the independent variables of tax revenue equation are expressed in per capita terms.

In property tax equation, total revenue from property tax is made dependent upon state income from urban sector, urban population and number of households. As income increases, the annual rateable or rental value of the property located in urban areas increases. As property tax is based on this value, a positive impact is expected. As urban population rises, more and more people come to acquire property which will have a positive effect on property tax. As the number of households in urban areas increase, their property comes within the ambit of the property tax. Therefore, a positive impact is hypothesised. In per capita revenue from property tax equation, apart from the above independent variables expressed in per capita terms, an additional variable, namely percentage of urban workers in labour force, has been included. The rationale of including this variable is that the more the urban workers in the labour force, the more urban property they will tend to acquire and hence their liability to pay property tax will increase. A positive relationship is thus expected.

In the equation for revenue from octroi, total revenue from octroi depends upon the state income from urban sector, number of urban workers and number of octroi posts in the urban areas. An increase in the income from
urban sector implies an increase in people’s income and hence their purchasing power. A positive impact on revenue from octroi is hypothesised because the demand for goods and services will increase and hence more and more goods and services will start entering into urban areas. The larger the urban workers, the more will be their demand for goods and services, implying a positive effect on octroi collections as more of goods and services would start flowing into urban areas. Similarly, the more the octroi posts, the larger would be their capacity to tax goods and services. A positive impact is assumed.

In the equation for total municipal expenditure, total municipal expenditure is made dependent upon municipal tax revenue, municipal loans and grants and state income from urban sector. As municipal tax revenue increases, the income of the ULBs rises as tax revenue constitutes a sizeable proportion of municipal income. With a rise in municipal income, more municipal expenditure can be incurred, and hence a positive impact is hypothesised. Municipal loans and grants add to the municipal income. A positive impact on municipal expenditure is expected. A rise in state income from urban sector implies a rise in municipal income as it constitutes a major component of urban income. A positive impact on total municipal expenditure is assumed. In equation of per capita municipal expenditure, all the independent variables have been expressed in per capita terms.
In the equation for expenditure on public safety, total expenditure on public safety depends upon municipal tax revenue and municipal loans and grants. Both these variables exert positive influence on municipal expenditure. Hence a positive impact on expenditure on public safety is hypothesised. In the equation of per capita expenditure on public safety, the independent variables are expressed in per capita terms.

In the equation of expenditure on public health and conservancy, total expenditure on public health and conservancy is dependent upon municipal tax revenue and municipal loans and grants. Their positive impact on municipal expenditure has already been discussed above. In the equation of per capita expenditure, the independent variables are expressed in per capita terms.

Finally, in the equation of expenditure on public works, total expenditure on public works is dependent upon municipal tax revenue, municipal loans and grants and urban area. The positive impact of municipal tax revenue and municipal loans and grants has already been discussed. As regards the variable urban area, as urban areas of ULBs increase, more expenditure on public works such as roads, buildings, establishments, etc. has to be incurred. Hence a positive influence is hypothesised. In the equation of per capita expenditure on public works, all the independent variables are expressed in per capita terms.
The above regression equations were estimated using multiple linear regression technique for determinant analysis for the two time periods, i.e., Period I(1970-71 to 1990-91) and Period II(1991-92 to 2005-06). The number of observations for Period I and Period II were 21 and 15 respectively. The data pertaining to the variables were taken from the various issues of the statistical abstract of Punjab. For estimation of equations, ordinary least squares method (OLS) has been used. The estimated equations are given below along with the value of $R^2$.

**Tax Revenue Equation in Period –I**

\[
\begin{align*}
TTR &= 108166.38 + 0.014*UI+77.776UP-79.443LP \\
&\quad \text{\(R^2 = 0.84\)}
\end{align*}
\]

\[
\begin{align*}
(5.713) &\quad (1.242) &\quad (-1.013)
\end{align*}
\]

\[
\begin{align*}
PTR &= 208.138+0.002*PUI+5.542PUP-6.690PLP \\
&\quad \text{\(R^2 = 0.73\)}
\end{align*}
\]

\[
\begin{align*}
(6.141) &\quad (1.023) &\quad (-1.36)
\end{align*}
\]

**Tax Revenue Equation in Period –II**

\[
\begin{align*}
TTR &= 811497.79 + 0.008UI+8.686UP+6.231LP \\
&\quad \text{\(R^2 = 0.78\)}
\end{align*}
\]

\[
\begin{align*}
(1.799) &\quad (0.113) &\quad (0.021)
\end{align*}
\]

\[
\begin{align*}
PTR &= 356.176+0.009PUI-3.243PLP \\
&\quad \text{\(R^2 = 0.27\)}
\end{align*}
\]

\[
\begin{align*}
(1.601) &\quad (-0.467)
\end{align*}
\]

Figures in parenthesis are t-values.

*shows significance at 1 per cent level.
From the estimated equation for the municipal tax revenue it may be observed that urban income is found to be statistically significant both for total tax revenue and per capita tax revenue in Period-I. The regression coefficient of urban income reveals that an increase of Re 1 results in an increase of Re .014 in total tax revenue and Re .002 per capita tax revenue. In Period-II, the coefficient of urban income, though positive, is statistically insignificant. The variable urban population, which has been chosen to measure the scale effect, is not statistically significant in both the periods. In case of literate population, regression coefficient shows a negative sign in both the periods (but it is statistically insignificant). It shows that increase in literacy rate has not resulted in any increase in tax revenue.

Property Tax Equation in Period –I

\[
\begin{align*}
TRP &= 203035.30 + 0.001UI + 55.074UP + 13.380NH - 187.400UW, \quad R^2 = 0.79 \\
&\quad (3.620) \quad (1.217) \quad (0.878) \quad (-0.951) \\
PRP &= -327.658 + 0.100UI - 5.523PUP + 16.434PUW, \quad R^2 = 0.53 \\
&\quad (3.800) \quad (-0.963) \quad (1.006)
\end{align*}
\]

Property Tax Equation in Period –II

\[
\begin{align*}
TRP &= 2119973.2 + 0.001UI - 90.380UP - 327.227NH + 786.213UW, \quad R^2 = 0.79 \\
&\quad (2.419) \quad (-2.254) \quad (-2.191) \quad (2.394) \\
PRP &= -33.002 + 0.001PUI + 1.539PUW, \quad R^2 = 0.38 \\
&\quad (1.572) \quad (0.408)
\end{align*}
\]
Figures in parenthesis are t-values.

*shows significance at 1 per cent level.

From the estimated equation for revenue from property tax, urban income is found to be statistically significant both at total and per capita levels in Period-I. With one per cent increase in urban income, revenue from property tax increases by .001 per cent and with one per cent increase in per capita income, per capita revenue from the tax increases by .1 per cent. In Period-II, urban income is statistically significant at total level while it is statistically insignificant at per capita level. The coefficient of urban population has turned out to be positive at the total level while it is negative at per capita level, although in both cases the coefficients are statistically insignificant. The regression coefficient of number of houses per lakh of population shows a positive (though insignificant) sign in period-I, its shows a negative sign in Period-II. It may be due to tax exemptions for new housing units, exemptions for houses up to 250 sq. yards and tax arrears etc. the regression coefficient for urban workers shows a negative sign at total level, whereas at per capita level sign is positive (but statistically insignificant). In Period-II, the regression coefficient of urban workers shows positive sign at both the levels, and it is significant at total level but insignificant at per capita level. The regression equation explains 79 per cent and 53 per cent of the variations in total tax revenue from property tax. In
Period-II the regression equation explains 79 per cent and 38 per cent of the variations respectively.

**Equation of Revenue from Octroi in Period-I**

\[
\begin{align*}
TRO &= 1214021.146 + 0.010 \times UI + 2839.194 \times UW - 251947.379 \times OP, \quad R^2 = 0.915 \\
&\quad (6.402) \quad (2.204) \quad (-2.129) \\
PRO &= -290.986 + 0.001 \times PUI + 10.575 \times PUW - 0.562 \times OP \\
&\quad (6.060) \quad (2.481) \quad (-1.271)
\end{align*}
\]

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

**Equation of Revenue from Octroi in Period-II**

\[
\begin{align*}
TRO &= 1895644.250 + 0.009 \times UI - 63240.543 \times OP, \quad R^2 = 0.770 \\
&\quad (3.866) \quad (-0.761) \\
PRO &= 371.354 + 0.012 \times PUI - 15.400 \times OP, \quad R^2 = 0.543 \\
&\quad (3.218) \quad (-1.458)
\end{align*}
\]

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

The results of the estimated equation of revenue from octroi show that State’s urban income has emerged as the main determinant of the revenue from octroi. The estimated regression coefficient of the variable was found to be statistically highly significant both at the total and per capita levels in the two periods. In Period-I, with one per cent change in urban income, total
revenue from octroi increases by .010 per cent while with one per cent increase in per capita income, the increase in per capita revenue from octroi is .001 per cent. In Period-II, with one per cent change in urban income, total revenue from octroi increases by .009 per cent and with one per cent increase in per capita urban income, the increase in per capita revenue from octroi increases by .012 per cent. The regression coefficient of the variable urban workers was found to be positive and significant in Period-I at both the total and per capita levels. However, in Period-II, this variable was insignificant and was excluded. The estimated regression coefficients of the variable number of octroi posts were found to be negative in two time periods and at both the levels. The negative value of the coefficients of number of octroi posts per lakh of population shows that number of octroi posts has not resulted in an increase in revenue. There has not been much increase in the number of octroi posts in the state. Also, due to irrationalities of octroi schedules, tax evasion and institutionalized corruption in the system, the revenue from the source has not increased with the increase in the number of octroi posts. The regression equations explained 91 % and 77 % of the variations in total and per capita revenue from octroi respectively in Period-I. This variation was found to be 81% and 54% respectively in Period-II.

**Equation of Total Municipal Expenditure in Period-I**
The results of regression equation for total municipal expenditure show that in Period-I State income from urban sector affect the level of municipal expenditure both at total and per capita levels. The variable loans and grants has been included to take into account inter-governmental flow of funds. The regression coefficient for LG is positive and significant in Period –I at both the levels. However, the coefficient of tax revenue is positive but not significant for total as well as per capita expenditure.

In contrast, in Period-II, the State’s urban income has no significant impact on municipal expenditure at both total as well as per capita levels.
The tax revenue has a significant impact on municipal expenditure at both the levels. However, the regression coefficient of the variable loans and grants in this period is negative at both the levels.

**Equation of Expenditure on Public Safety in Period – I**

\[
TPS = 45435.097 + 0.049TTR - 0.022LG \quad R^2 = 0.150
\]

\[
(1.777) \quad (-0.534)
\]

\[
PPS = 15.829 + 0.019TTR - 0.037PLG \quad R^2 = 0.031
\]

\[
(0.490) \quad (-0.681)
\]

**Equation of Expenditure on Public Safety in Period – II**

\[
TPS = -10208.339 + 0.148*TTR-0.087LG \quad R^2 = 0.672
\]

\[
(4.762) \quad (-1.828)
\]

\[
PPS = 8.246 + 0.116PTR-0.043PLG \quad R^2 = 0.338
\]

\[
(2.286) \quad (-0.150)
\]

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

The results of estimated equation of expenditure on public safety for period –I show that none of the regression coefficient is statistically significant and \( R^2 \) is very low. The regression coefficient of loans and grants is not only insignificant statistically but is also negative. The situation is exactly the same at per capita level. This implies that tax revenue and
loans and grants do not affect the expenditure on public safety. In Period-II, the total expenditure on public safety was determined by tax revenue and the regression coefficient was found to be statistically significant at 1 per cent level whereas the regression coefficient of loans and grants was negative as well as statistically insignificant. The results at per capita level show that per capita expenditure on public safety was determined by per capita tax revenue while the regression coefficient of per capita loans and grants was negative and statistically insignificant. The value of R was found to be low. Other variables like urban area and urban population were included in the equations but the regression coefficients were not found to be statistically significant and hence were not retained in the final equations.

**Equation of Expenditure on Public Health and Conservancy in Period-I**

\[
\begin{align*}
\text{TEPHC} &= 9841.761 + 0.578\times \text{TTR} + 0.389\times \text{LG} \\
&= 9841.761 + 0.578\times \text{TTR} + 0.389\times \text{LG} \\
R^2 &= 0.72 \\
\end{align*}
\]

(5.199) (2.343)

\[
\begin{align*}
\text{PEPHC} &= 13.836 + 0.453\times \text{PTR} + 0.419\times \text{PLG} \\
&= 13.836 + 0.453\times \text{PTR} + 0.419\times \text{PLG} \\
R^2 &= 0.58 \\
\end{align*}
\]

(3.754) (2.472)

**Equation of Expenditure on Public Health and Conservancy in Period-II**

\[
\begin{align*}
\text{TEPHC} &= 378323.83 + 0.479\times \text{TTR} - 0.235\times \text{LG} \\
&= 378323.83 + 0.479\times \text{TTR} - 0.235\times \text{LG} \\
R^2 &= 0.73 \\
\end{align*}
\]

(6.217) (-1.826)

\[
\begin{align*}
\text{PEPHC} &= 60.820 + 0.549\times \text{PTR} - 1.015\times \text{PLG} \\
&= 60.820 + 0.549\times \text{PTR} - 1.015\times \text{PLG} \\
R^2 &= 0.60 \\
\end{align*}
\]

(4.274) (-1.394)
In case of public health and conservancy, the estimated equation shows that the estimated coefficient both for tax revenue and loans and grants are statistically significant with positive signs at both the levels in Period-I. Both the variables explained 72% variation in total expenditure on public health and conservancy. In Period-II, the regression coefficients of total revenue and per capita total revenue were found to be statistically significant. The regression coefficients of loan and grants at both the levels were negative and statistically insignificant. The regression equations explained 73% and 60% variations in the dependent variable at total and per capita levels respectively.

**Equation of Expenditure on Public Works in Period – I**

\[
\text{TEPW} = -45226.805 + 0.189 \text{TTR} - 0.036 \text{LG} + 108.481 \text{UA} \\
R^2 = 0.82
\]

(2.483) (-0.629) (1.808)

\[
\text{PEPW} = -6.160 + 0.176 \ast \text{PTR} - 0.045 \text{PLG} + 0.023 \text{UA} \\
R^2 = 0.73
\]

(3.182) (-0.743) (2.475)

**Equation of Expenditure on Public Works in Period – II**

\[
\text{TEPW} = -86104.074 + 0.376 \ast \text{TTR} - 0.204 \text{LG} + 0.354 \text{UA} \\
R^2 = 0.72
\]

(6.198) (-2.196) (1.386)
\[ \text{PEPW} = -89.780 + 0.316 \text{PTTR} + 0.193 \text{PLG} + 0.055 \text{UA} \quad R^2 = 0.63 \]

(2.735)  (0.313)  (1.297)

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

The estimated equations of expenditure on public works in Period-I show that tax revenue plays a significant role at both the levels. The regression coefficients of loans and grants show negative signs and are statistically insignificant. The estimated regression coefficient of urban area shows a positive sign at both the levels but is statistically insignificant. This is because there has not been much change in the urban area in the State. Due to the limited resources available with the ULBs, with increased area, expenditures decreases. With an increase in urban boundaries the ULBs need heavy initial capital investments. Most of the services under public works are capital intensive in nature which needs more resources. But due to the limited resources, the ULBs have to curtail expenditure.

In Period-II again, tax revenue emerged as the main determinant of expenditure on public works at both the levels. The regression coefficients of loans and grants and urban area were found to be statistically insignificant at both the levels. The regression equations explained 72% and 63%
variations in expenditure on public works at total and per capita levels respectively.

**Regression Models and Results Using Dummy Variable**

In order to test the differences in the regression coefficients in two time periods, we have used the time dummies. With the introduction of a dummy variable to each equation of the above model, the two time periods were clubbed together and the entire period from 1970-71 to 2005-06 was considered as one set of observations for the purposes of analysis. The number of observations thus became 36. The introduced dummy variable was such that it assumed the value 0 in the period from 1970-71 to 1990-91 and the value 1 in the period from 1991-92 to 2005-06. The following regression equations were formed and estimated for our analysis. These regression equations are exactly the same as estimated earlier except that a dummy variable was added to each one of them. The regression equations are:

**Tax Revenue Equation**

\[ TTR = \beta_0 + \beta_1 U + \beta_2 UP + \beta_3 LP + \beta_4 D + U \]

\[ PTR = \beta_0 + \beta_1 PUI + \beta_2 PUP + \beta_3 PLP + \beta_4 D + U \]

**Property Tax Equation**

\[ TRP = \beta_0 + \beta_1 UI + \beta_2 UP + \beta_3 NH + \beta_4 D + U \]

\[ PRP = \beta_0 + \beta_1 PUI + \beta_2 PUP + \beta_3 NH + \beta_4 PUW + \beta_5 D + U \]
Equation of Revenue from Octroi

\[ TRO = \beta_0 + \beta_1 UI + \beta_2 UW + \beta_3 OP + \beta_4 D + U \]
\[ PRO = \beta_0 + \beta_1 PUI + \beta_2 PUW + \beta_3 OP + \beta_4 D + U \]

Equation of total Municipal Expenditure

\[ TME = \beta_0 + \beta_1 TTR + \beta_2 LG + \beta_3 UI + \beta_4 D + U \]
\[ PME = \beta_0 + \beta_1 PTR + \beta_2 PLG + \beta_3 PUI + \beta_4 D + U \]

Equation of Expenditure on Public Safety

\[ TEPS = \beta_0 + \beta_1 TTR + \beta_2 LG + \beta_3 D + U \]
\[ PEPS = \beta_0 + \beta_1 PTR + \beta_2 PLG + \beta_3 D + U \]

Equation of Expenditure on Public Health and Conservancy

\[ TEPHC = \beta_0 + \beta_1 TTR + \beta_2 LG + \beta_3 D + U \]
\[ PEPHC = \beta_0 + \beta_1 PTR + \beta_2 PLG + \beta_3 D + U \]

Equation of Expenditure on Public Works

\[ TEPW = \beta_0 + \beta_1 TTR + \beta_2 LG + \beta_3 UA + \beta_4 D + U \]
\[ PEPW = \beta_0 + \beta_1 PTR + \beta_2 PLG + \beta_3 UA + \beta_4 D + U \]

The above regression equations were estimated using multiple regression technique for the period from 1970-71 to 2005-06 for 36 observations using dummy variables. For estimation of regression equations, ordinary least squares (OLS) method has been used. The estimated regression equations are given below along with the value of \( R^2 \).
Tax Revenue Equation

\[ TTR = 34983.295 + 0.008*UI + 10.4*UP + 43.234*LP + 642500.82*D \]
\[
(3.689) \quad (0.252) \quad (0.338) \quad (0.967), \quad R^2=0.964
\]

\[ PTR=-193.322+0.002P*UI-3.571P*UP+5.099P*LP+345.366\times D \]
\[
(2.591) \quad (-0.360) \quad (0.832) \quad (7.305), \quad R^2=0.924
\]

Figures in parenthesis are t-values.

*shows significance at 1 per cent level.

From the estimated regression equation for the municipal tax revenue, the regression coefficient of urban income was found to be highly statistically significant. The regression coefficients of other variables, viz. urban population and literate population, though positive, were not statistically significant. The regression coefficient of dummy variable was also not found to be statistically significant. At the per capita level, the estimated regression equation shows per capita urban income as the significant variable because its regression coefficient was significant. Other variables like percentage of urban population and percentage of literate population in total population, failed to influence per capita tax revenue. The regression coefficient of the former was found to be negative. However, the regression coefficient of dummy variable here was found to be statistically significant at 1 per cent level. The regression equations explained about 96 per cent and
92 per cent of the variations in dependent variable at total and per capita levels respectively.

**Property Tax Equation**

\[
TRP = -13315.192 + 0.001 \times UI + 5.622 \times UP + 0.581 \times NH - 41729.455 \times D, \quad R^2 = 0.955
\]

\[(8.539) \quad (1.397) \quad (0.131) \quad (-0.455)\]

\[
PRP = -359.732 + 0.001 \times PUI - 5.487 \times PUP - 0.001 \times NH + 18.033 \times PUW + 24.511 \times D
\]

\[(2.189) \quad (-1.206) \quad (-0.651) \quad (1.833) \quad (1.067)\]

\[R^2 = 0.903\]

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

From the estimated equation for revenue from property tax at total level, urban income was found to be statistically significant at 1 per cent level. Other variables such as urban population and number of households per lakh of population, did not show any statistical impact on the revenue from property tax. The dummy variable was also not found to be statistically significant and its coefficient was found to be negative. In the estimated equation for per capita revenue from property tax, per capita urban income was found to be statistically significant. The variable percentage of urban workers in labour force was not found to influence the dependent variable although the regression coefficient showed a positive sign. The other variables such as percentage of urban population and the number of
households per lakh of population also failed to influence the dependent variable. The regression coefficient of dummy variable was also not found to be statistically significant. The regression equation explained about 90 per cent of the variation in the dependent variable as R was found to be 0.903.

**Equation of Revenue from Octroi**

\[ TRO = -442578.78 + 0.009 \times UI - 667.437 \times UW + 71141.92 \times OP + 184004.96 \times D \]

(6.232) (-1.439) (1.594) (0.868), \( R^2 = 0.972 \)

\[ PRO = -818.172 + 0.001 \times PUI + 32.341 \times PUW - 7.148 \times P + 300.796 \times D, \quad R^2 = 0.922 \]

(2.474) (1.555) (-0.947) (5.789)

Figures in parenthesis are t-values.

* *shows significance at 1 per cent level.

In the estimated equation of total revenue from octroi, the variable urban income was found to determine the revenue from octroi as its regression coefficient was found to be highly significant. The variable number of urban workers failed to influence the dependent variable and the estimated regression coefficient was found to be negative. The variable number of octroi posts per lakh of population was also not found to influence total revenue from octroi although the estimated coefficient of the variable was positive. The dummy variable also failed to exert significant influence on the dependent variable. The explanatory variables together explained about 97 per cent of the variation in the dependent variable. In the estimated equation of per capita revenue from octroi, per capita income was found to
be statistically significant with estimated regression coefficient showing positive sign. The variables, percentage of urban workers and number of octroi posts per lakh of population, were not found to influence the dependent variable. However, the dummy variable exerted a highly significant influence on the dependent variable as its regression coefficient was found to be significant at 1 per cent level. The R was found to be 0.922.

**Equation For Total Municipal Expenditure**

\[
TME = 202859.39 + 1.138*TR - 0.427*LG + 0.001*UI + 163980.76D, \quad R^2 = 0.985
\]

(7.152) (-3.329) (0.915) (0.843)

\[
PME = 3.037 + 0.916*PTR + 0.804*PLG + 0.001*PUI + 125.028D, \quad R^2 = 0.963
\]

(5.901) (2.278) (1.399) (1.963)

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

The results of the regression equation for total municipal expenditure showed that tax revenue had a highly significant impact on total municipal expenditure as its regression coefficient was found to be significant at 1 per cent level. The variable loans and grants had a significant negative impact on total municipal expenditure as the estimated regression coefficient had a negative sign. The variable urban income failed to influence the dependent variable. The dummy variable was also not found to influence the dependent variable although its regression coefficient showed a positive sign. The explanatory variables together explained 98 per cent of the variation in the dependent variable. In the estimated per capita municipal expenditure
equation, per capita tax revenue had a highly significant influence on per capita municipal expenditure. The other statistically significant variable was per capita loans and grants. The other two variables, namely per capita urban income and the dummy variable, failed to influence the dependent variable as their regression coefficients were not found to be statistically significant. The regression equation explained about 96 per cent variation in per capita municipal expenditure.

**Equation of Expenditure on Public Safety**

\[
\text{TEPS} = 14308.506 + 0.141*\text{TR} - 0.084\text{LG} - 5310.600\text{D}, \quad R^2=0.916
\]

(7.161) (-2.814) (-0.108)

\[
\text{PEPS} = 8.564 + 0.092*\text{PTR} - 0.048\text{PLG} + 9.849\text{D}, \quad R^2=0.828
\]

(3.076) (-0.628) (1.006)

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

In the estimated equation of expenditure on public safety, tax revenue was found to determine the expenditure on public safety as its regression coefficient was found to be highly significant. The variable loans and grants was found to have a significant negative influence on expenditure on public safety as the estimated regression coefficient was negative. The regression coefficient of dummy variable was found to be negative and was statistically insignificant. The regression equation explained about 91 per cent of the variation in the dependent variable. In regression results of the equation of per capita expenditure on public safety, per capita tax revenue was found to
determine per capita expenditure on public safety as the estimated regression
coefficient was statistically significant at 1 per cent level. Other variables,
namely per capita loans and grants and the dummy variable, failed to
influence per capita expenditure on public safety as their regression
coefficients were statistically insignificant. The explanatory variables
explained about 82 per cent variation in the dependent variable.

Equation of Expenditure on Public Health and Conservancy

$$\text{TEPHC}= 86949.806 + 0.507 \times \text{TR} - 0.146 \times \text{LG} + 262979.454 \times \text{D}, \quad R^2=0.969$$

(9.714) (-1.840) (2.014)

$$\text{PEPHC}= 17.384 + 0.460 \times \text{PTR} + 0.233 \times \text{PLG} + 42.655 \times \text{D}, \quad R^2=0.936$$

(5.417) (1.071) (1.540)

Figures in parenthesis are t-values.

* shows significance at 1 per cent level.

In the estimated equation of expenditure on public health and conservancy,
tax revenue largely determined the expenditure on public health and
conservancy as the regression coefficient was found to be highly significant
statistically. The variable loans and grants failed to influence the dependent
variable and its regression coefficient was negative. The dummy variable
was found to have a positive influence on expenditure on public health and
conservancy. The regression equation explained 96 per cent variation in the
dependent variable. In the estimated equation of per capita expenditure on
public health and conservancy, per capita tax revenue emerged as the sole
determining variable and its regression coefficient was statistically
significant at 1 per cent level. Other variables, namely per capita tax revenue and the dummy variable, failed to exert any influence on the dependent variable. The $R^2$ was found to be about 93 per cent.

**Equation of Expenditure on Public Works**

$$\text{TEPW} = -21027.553 + 0.369\times TR - 0.188\times LG + 14.678\times UA - 72003.186\times D, \quad R^2 = 0.950$$

$t$-values: (7.152) (-3.154) (0.131) (-0.763)

$$\text{PEPW} = -22.712 + 0.317\times PTR - 0.029\times PLG + 0.025\times UA - 13.850\times D, \quad R^2 = 0.913$$

$t$-values: (4.867) (-0.192) (1.440) (-0.732)

Figures in parenthesis are $t$-values.

* shows significance at 1 per cent level.

The estimated regression equation of expenditure on public works shows that tax revenue played a significant role as its estimated regression coefficient was found to be highly significant statistically. The regression coefficient of the variable loans and grants showed a negative sign though it was statistically significant. The regression coefficient of the variable urban area was not found to be statistically significant. This is because there has not been much change in the urban area of the State. The dummy variable also failed to influence the dependent variable and its regression coefficient was found to be negative. The regression equation explained 95 per cent variation in the expenditure on public works. In the estimated regression equation of per capita expenditure on public works, only per capita tax revenue emerged as the variable influencing per capita expenditure on public works as its regression coefficient was found to be statistically
significant at 1 per cent level. None of the other variables could influence the dependent variable. The regression model explained about 91 per cent variation in the dependent variable.

Thus, from the above analysis of different regression equations, it may be inferred that municipal taxes are largely determined by the urban income of the State. Municipal expenditure by other categories is largely determined by municipal tax revenues and loans and grants. It can also be concluded that the level of services provided by the ULBs depends on the availability of resources with the ULBs and is not governed by the demand for public goods and services. Aggregate municipal expenditure in the State is determined by municipal tax revenue, loans and grants and State’s urban income. The introduction of dummy variables to the regression model has not changed the regression coefficients much in the estimated regression equations. However, $R^2$ values have increased in all the estimated regression equations.
Notes and References


