CHAPTER – IV

IMPACT OF CITY SIZE ON CITY GROWTH

In the preceding chapter the salient features of growth pattern of India’s cities over the 1991-2001 period were described and discussed. The analysis revealed a great diversity in the growth pattern of Indian cities. In this pattern, some very fast growing cities with growth rate of 7 percent per year and above were found to co-exist with many stagnating and declining cities. Moreover, cities also varied greatly in terms of size; on the one hand we have some very large cities with population of 10 lakhs and above, on the other a large number of very small cities with population of 5000 or less. This great variation in the size and growth rate of cities makes it interesting as well as necessary to investigate the factors responsible for the growth of cities, i.e., to find out why cities grow at different rates. Out of a large number of factors that may be responsible for the difference in growth rate of cities, the size of the city appears to be one of the most important. Moreover, many other factors affecting city growth rate may also be related to its size. It is also worth mentioning that in the existing empirical literature on determinants of city growth a number of studies on western countries have examined this city size and city growth rate relationship and got the interesting but puzzling result that city growth is independent of city size. It is a puzzling result because common perception suggests that bigger cities must be growing faster than smaller cities, that is why they are big. It will, therefore, be useful to probe whether or not the nature of city size and city growth rate relationship in India is the same as reported in the developed countries. So in this chapter the main focus is to analyse and explore the impact of city size on city growth rate in India on the basis of data for 1991-2001 period. The main issue explored will be; whether bigger cities grow faster than the smaller ones or vice versa. In this chapter we will analyse the impact of city size on city growth rate by taking city size as the only explanatory factor, but subsequently in chapter six
the impact of city size on city growth will be analyzed in a multi-factor context along with other possible determinants of city growth rate.

The present chapter is divided into four sections: In Section one the theoretical aspect of city size and city growth rate relationship in terms of agglomeration economies and diseconomies is discussed. In section two a brief summary of existing empirical evidence on the city size and city growth rate relationship is presented. In section three, the impact of city size on city growth rate at all India level is analyzed by using simple regression analysis. In section four, the impact of city size on city growth in 16 major states of the country is analysed separately for each state. The main conclusions regarding impact of city size on city growth rate in India emerging from our analysis are presented at the end.

I. ECONOMIES AND DISECONOMIES OF CITY SIZE

A city is a geographic area of human settlement within which residents share employment opportunities and sets of economic relations. It is a spatial clustering of producers, service providers, workers and consumers. The dense concentration of firms and people in the city results in lower transport costs for goods, people, ideas etc. that are generally put under the broad label of agglomeration economies. These agglomeration economies act as the main driving force for growth of city population and expansion in its size. It has been observed that agglomeration economies are positively related to city size i.e. as city size becomes bigger it generates greater agglomeration economies. This is so because many economic activities carried out in the cities display increasing returns to scale; and also many more activities are added, that were not earlier performed in the city, as the city size and size of its market becomes bigger. Hence, agglomeration economies in cities arise both from size of the city as well as from the diversity of economic activities carried out in it. However, many negative effects and externalities are also generated due to this increasing concentration of production and people at a small space in the city as the city size
The negative effects of city size expansion result from increasing pollution, longer commuting time to work place, congestion, crime and many other social problems. All these negative effects of city size expansion can be categorized under the common heading ‘congestion costs’. The relationship between city size and city growth rate, therefore, depends on the complex interaction and balance of these agglomeration benefits, and congestion costs of growing size of the city. These agglomeration economies and congestion costs of city size expansion are discussed briefly hereafter.

(i) **Agglomeration Economies**

The agglomeration economies are the benefits and the cost reductions resulting from the clustering and concentration of firms and people in a city. These are economies of proximity of a large number of firms and people concentrated in the city. The agglomeration economies depend both on the size of the city as well as on the diversity of economic activities carried out in it. These economies arise from scale economies in production and consumption and reduction in transport costs of goods and people, and generation of ideas due to clustering and dense concentration of firms and people in the city. These are described in some detail hereafter.

(a) **Scale Economies in Production**

The bigger size of the market of a big city results in the production of various goods being carried out in large size plants, and hence result in economies of scale in production. This in turn leads to lowering the average cost of production of the concerned commodity. The fall in average cost of production occurs mainly because of fixed cost of operating a plant being spread over a larger output. These scale economies within the firm are the historical rationale for the existence of cities in the very first place and also of growth of cities over time.
(b) Scale Economies in Consumption

Due to the large size of the market of the big city many public goods such as parks, sports stadium, etc are provided at a much lower average cost per person, as the huge fixed cost involved in creating these public facilities is shared by large number of consumers.3

(c) Economies from sharing of inputs in production:

In a big city producers are able to share according to need (at a relatively low cost) many services such as repair facilities, accounting services, legal services, advertising facilities etc. In such cities specialized repair facilities, specialized workers in accounting, law, advertising and other technical fields are available and can be shared by firms located there. This reduces the cost of doing business by these firms.4

(d) Economies of sharing in consumption

In a big city consumers are also able to share according to their requirement (at a relatively low cost) many facilities like restaurants, theaters, educational institutions, medical facilities and many other cultural products. The pooled demand, of a large number of residents of a big city, not only makes the production of many of these cultural products economically viable, but also lowers the per unit price of using these products by different consumers.5

(e) Reduction in Transaction cost in Production

The big city size results in increased economic efficiency in production owing to reductions in transaction costs. The transaction costs are costs incurred in trading goods and services. In a big city there is a greater possibility of proper matching between skills of workers and the jobs they perform, as a much bigger variety of jobs are available in such cities. Moreover, the bigger size of city also reduces the search costs of workers with differentiated skills and of employers with differentiated demand for it. This better matching of skills and jobs not only increases labour productivity, but also enables workers to earn a higher return on
their human capital. Due to higher return on human capital to a worker in a big city, the stock of human capital in big cities also goes up and is much bigger than smaller cities.6

(f) Reduction in Transaction Costs in Consumption

The transaction costs for consumers are also lower in big cities. In these cities ‘shopping districts’ for particular products emerge by the clustering of shops selling a single product in a particular location of the city. This considerably reduces the search costs for consumers as they can compare the quality and price of the good offered by different sellers without spending much time, effort and money on traveling; almost all the shops selling that product being located in the same shopping area. Even out of town shoppers are attracted to the city where many sellers of a particular product are clustered in a single location, because of the same reason of reduction in transaction costs.7

(g) Statistical Economies in production And Consumption

Some economies and cost reductions arise in a big city from the operation of the law of large numbers operating in the fluctuations in the fate of micro production units. The fluctuations in labour hired by different individual producers are imperfectly correlated with one another. So out of the large number of firms operating in a big city, some firms are firing workers, while at the same time some other firms are hiring workers. The workers fired by the former are able to find jobs in the latter that are hiring at that very time. Consequently unemployment rate is lower in bigger cities and employment is more stable. Similarly, fluctuations in sales of output are uncorrelated across individual buyers; when some buyers are buying less, some others are buying more at that very time. So firms need to carry smaller amount of inventory of goods to meet demand and that results in lower cost of selling the products.8
(h) Economies of Innovation

The rate at which innovations are made is significantly higher in bigger cities as compared to smaller cities. Innovation is the commercial application of an already known invention or idea. In bigger cities there is a greater possibility of innovations from knowledge spillovers as a result of clustering of producers of various products in close proximity to each other. The workers in one industry/trade are in a better position to borrow, learn and adapt ideas, practices and techniques being used by workers in some other industry/trade located in the neighborhood. This diversity of industry and economic activities clustered in a big city, therefore, act as a fertile ground for innovations in production and trade practices.9

(i) Economies in use of infrastructure:

In bigger cities the unit cost of providing and using big infrastructural assets such as airports, high-tech laboratories, universities and even roads becomes lower by the spreading of fixed costs of these infrastructural assets over a larger number of users. The financing of the building of these infrastructures also becomes easier as the fixed costs can be spread over a larger number of tax payers in a big city. The unit cost of using these infrastructures to individual users is, therefore, lower in bigger cities.10

(ii) Congestion Costs

The growth of city population and its expanding size eventually also generate many negative effects and negative externalities that are explained briefly hereafter.

(a) Increase in Commuting time and Transportation costs

As the city population grows and the city size expands commuting time to work place increases. In big cities like Delhi and Mumbai an hour or more of commuting time to work for an average person is quite normal. This happens not only due to longer distance of commutes, but also due to slowing down of traffic
speed owing to over-crowding and frequent jams. This not only increases the direct financial cost (bus fare, car petrol etc) of commuting to the work place, but also indirectly increases the opportunity cost of time lost in commuting.\textsuperscript{11}

(b) Higher cost of living

The cost of living also rises as the city size increases. In bigger cities the price of almost every article of human use and consumption is higher as compared to small cities due to the various costs imposed by city size. The most dominant factor that pushes up the cost of living in bigger cities is the rent of residential dwellings. Moreover, the rents of commercial premises and shops also being higher in bigger cities leads to higher unit prices of articles sold by traders in these cities compared to the smaller towns.\textsuperscript{12}

(c) Pollution costs

The degree of pollution is also higher in bigger cities compared to smaller ones. Pollution is the damage to environment caused by concentration of production and people in a small space. In bigger cities air becomes highly polluted due to high density of population and the smoke resulting from high density of vehicles. The noise level is also significantly higher in bigger cities than in smaller towns. Similarly, water supply also becomes polluted in bigger cities. It is generally recognized that the extent of pollution is positively correlated with city size. The increasing pollution imposes financial as well as real costs on people living in big cities in terms of higher medical bills and other associated costs and deterioration in the quality of life.\textsuperscript{13}

(d) Crime

The big cities are intrinsically more anonymous and have very weak social groups and community networks. Life in big cities enhances social tension and delinquency. This makes maintaining civil peace harder and policing more costly in bigger cities. It is a well recognized empirical fact that crime rates and city size are positively correlated. The bigger cities virtually become centres of crime.
because criminals also benefit from various agglomeration economies. It is also believed that returns to crime are higher in bigger cities due to scale economies in stolen goods and a greater availability of potential victims. Moreover, the greater concentration of female headed households and single working females in big cities is another vital factor that results in higher crime rates in bigger cities. Moreover, bigger cities also attract a large number of poor individuals who are more likely to be prone towards criminal activity due to lack of means for survival.14

(e) Higher cost of Municipal services

The per capita cost of providing various municipal services is also supposed to be positively related with city size. In part this is because of the efforts of local government to counter some of the negative effects of the big size of the city. In bigger cities local governments spend more on sewer treatment, prevention of air pollution and prevention of water pollution from reaching intolerable levels and this increases the per unit cost of municipal services. Moreover the production of many public utilities may have reached the optimal scale, (the lowest average cost point), but the city still goes on expanding and therefore production of these goods and services occurs on the rising portion of the average cost curve. This results in diminishing returns and increasing costs in provision of such public utilities in big cities.15

So, as the city size expands two opposing forces get generated. On one hand, the various scale and agglomeration economies tend to accelerate the expansion of city population and size, while on the other hand, various congesting forces act as breaks on the expansion of city size. The observed size of the city, therefore, is the result of a complex interaction and balance of these two forces that attract and distract firms, people, and consumers to a city.

II. IMPACT OF CITY SIZE ON CITY GROWTH: SUMMARY OF EXISTING EMPIRICAL EVIDENCE

A perusal of the available empirical literature on city growth clearly indicates that only a few studies have directly probed the impact of city size on
city growth rate. But in most of the other studies on city growth also this relationship is implicit and gets indirectly examined. For instance, in several studies on the nature of city size distribution i.e. whether it follows the Zipf’s law or the rank–size rule, the question of city size-city growth rate relationship is implicit. In the present section we shall present only a brief summary of the conclusions of studies that have directly examined the city size-city growth rate relationship. This will provide the necessary background and foundation for the analysis and interpretation of our own results on impact of city size of city growth rate in India during 1991-2001 period.

Jan Eeckhout in a recent study has analyzed the relationship between city size and city growth rate for the complete set of cities of U.S.A. using 2000 census data. It emerged clearly from his study that for the entire set of American cities no significant impact of size of the city on growth rate of the city is observed. The coefficient of the city size variable was statistically not significant in the many variations in the regression model tried by him. Thus on the basis of these results he concludes that in the United States during the terminal year of 20th century city growth rate is independent of the population size of city i.e. bigger and smaller cities grow at similar rates on the average.

Another recent study on Zipf’s Law, by Yannis M. Ioannides and Henry G. Overman on U.S. data also confirmed that city growth rate is independent of city size i.e., the growth rate of city does not depend on the initial population size of the city.

In another similar study by R. Bradley and J.S. Gans the growth of Australian cities was analyzed using data for 1981-1999 period. In their study regression results clearly revealed that initial population size of cities is negatively related with growth rate of city. Thus, implying that in Australia during this period bigger cities grew at a significantly lower rate than the smaller cities. According to the authors this negative impact of city size on city growth rate implies that congestion effects of city growth out weighed the agglomeration
effects in Australian cities during this period. They further suggested that this negative relation between city size and city growth rate may also be the result of neo-classical type of factor productivity convergence among cities.

J. Eaton and Zvi Eckstein\(^{19}\) analysed the growth of cities in France and Japan and examined the relationship between city size and city growth rate. Their results suggested that growth of cities was independent of the initial size of the city, both in France as well as in Japan.

Bostic et. al.\(^{20}\) while investigating growth of productivity and production factors (particularly labour) in United States in the late 19\(^{\text{th}}\) century found that growth of labour force in cities was positively correlated with initial size of the city. Maybe in the late 19\(^{\text{th}}\) century agglomeration economies of city growth outweighed the congestion costs.

K. T. Rosen and M. Resnick in their study\(^{21}\) examined the size distribution and growth of cities using a sample of 44 developed and developing countries. They mainly probed for the Pareto and primacy measures of size distribution of cities, but as a by product also examined the relationship between city size and city growth rate. Their results indicate that in most of the 44 countries that were examined, large cities were growing faster than the smaller cities. Their study, thus, indicates a positive impact of city size on city growth rate.

In a study by J.G. Williamson and J.A. Swanson\(^{22}\) on the growth of cities in north-eastern United States, it was found that city growth rate was not related to initial size of cities during the second half of nineteenth century in United States. They also found that growth of cities was not related to the industrial composition of the labour force of cities in United States during this period.

Thus on the basis of recent empirical evidence one can say that city growth rate seems to be independent of city size. Although, some studies have also indicated both a positive as well as a negative relationship between city size and city growth rate, but most of the recent studies indicate that the two are not related. The most recent and comprehensive study on this issue is by Jan
Eeckhout. This study clearly reveals the independence of growth rate of cities from the initial size of the city in the latest (2000) census data of United States of America. On the basis of review of the existing empirical evidence on this issue, this author has asserted that independence of city growth rate from city size is an established empirical regularity. This implies that the growth process of cities is proportionate i.e. larger cities on an average do not grow faster or slower than smaller cities. In the light of the above evidence we shall now probe the impact of city size on city growth rate in India on the basis of the set of Indian cities for which data for the period 1991-2001 are available.

III. RELATIONSHIP BETWEEN CITY SIZE AND CITY GROWTH IN INDIA.

In the present section the relationship between size of city and growth rate of city in India is analyzed using census data for 1991 and 2001. The main objective is to investigate whether growth rate of cities is independent of the population size of cities in India, as seems to be the pattern in developed countries.

It has been shown in the previous chapter that cities in India during the 1991-2001 period, grew at very varied rates; some growing at rate higher than 5 percent per year, some not growing at all and some even declining. So, this is a quite appropriate data set to test the relationship of city size with city growth in the Indian context.

The relationship of city size with city growth in India is analyzed in a number of ways. To begin with, the growth rate of cities is compared by dividing all the cities on the basis of size in two groups and three groups. Next, the six-fold census of India city size classification is used, by adding a separate class of metropolitan cities, to compare the growth rate of cities in order to uncover the relationship between city size and city growth. Finally, regression analysis is used to analyze the impact of city size on city growth, by taking city size as the independent variable and city growth rate as the dependent variable. Further, the
regression analysis of city size city growth relationship is carried out not only at the all India level, but also separately for each of the 16 major states of India.

(i) **Comparison of Growth Rates of cities of different size**

To begin with we compared the growth rates of cities of different size by dividing all the Indian cities into two size classes: (i) cities with population higher than the median city, (ii) cities with population less than the median city. The data set of Indian cities used for computing and comparing growth rates consist of 2673 cities on which required information both for 1991 and 2001 was available. The results of this comparison are presented in table 4.1. A perusal of the table reveals that the mean of growth rate of cities with population above the median city is 2.13 percent per year compared to the mean growth rate of 2.08 percent per year for cities with population below the median city. It is clearly evident that the mean growth rate of these two sub-sets of cities does not differ much despite the big difference in their mean population size. It may be noted (from table 4.1) that the mean size of population of cities ‘above the median city’ is 1.35 lakh, whereas the mean size of population of cites ‘below the median city’ is only 12.75 thousand. In spite the mean size of the above median city cities being more than ten times the mean size of the below median city cities their growth rates differ only marginally i.e. by 0.05 percent Further, it may be seen that even the coefficient of variation of growth rates of cities in these two subsets does not differ markedly. The above exercise was carried out again by dividing all the cities on the bases of size into the following three subsets by arranging all cities in ascending order of population size.

(i) Smallest one-third cities,
(ii) Middle one-third cities.
(iii) Upper one-third cities
### Table 4.1

Comparison of Growth Rate of cities: Below Median versus Above Median City Size

<table>
<thead>
<tr>
<th>City Size Group/Definition</th>
<th>No. of observations</th>
<th>Population Range (000)</th>
<th>City Size (Mean population) (000)</th>
<th>City growth Rate (1991-2001) (Mean)</th>
<th>City growth Rate (S.D)</th>
<th>City growth Rate (C.V.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above Median Cities</td>
<td>1336</td>
<td>21.0 to 1259.6</td>
<td>134.94</td>
<td>2.13%</td>
<td>2.26</td>
<td>94.25%</td>
</tr>
<tr>
<td>Below Median Cities</td>
<td>1337</td>
<td>0.3 to 21.0</td>
<td>12.57</td>
<td>2.08%</td>
<td>1.95</td>
<td>106.67%</td>
</tr>
</tbody>
</table>

**Notes:**
1. Above Median cities means in 1991 population of the city was above the median city size, and below median cities means city size was smaller than median city size.
2. S.D. is standard deviation, and C.V. is coefficient variation.
Table 4.2

Comparison of Growth Rate of cities: Smallest, Middle, and Largest cities

<table>
<thead>
<tr>
<th>City Size Groups Definition</th>
<th>Number of observations</th>
<th>Population Range (000)</th>
<th>City Size (Mean Population) (000)</th>
<th>City Growth Rate (Mean)</th>
<th>City Growth Rate (S.D.)</th>
<th>City Growth Rate (C.V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallest one-third cities</td>
<td>891</td>
<td>0.3 to 15.0</td>
<td>9.95</td>
<td>2.12%</td>
<td>2.09</td>
<td>101.44%</td>
</tr>
<tr>
<td>Middle one-third cities</td>
<td>891</td>
<td>15.0 to 32.6</td>
<td>21.83</td>
<td>2.07%</td>
<td>1.65</td>
<td>12.46%</td>
</tr>
<tr>
<td>Upper one-third cities</td>
<td>891</td>
<td>32.6 to 1259.6</td>
<td>189.41</td>
<td>2.11%</td>
<td>2.52</td>
<td>83.73%</td>
</tr>
</tbody>
</table>

Notes: 1. Smallest is the smallest one third, largest is the largest one third, and so on when all cites arranged in ascending order of population size in 1991.

2. S.D. is standard deviation, and C.V. is coefficient variation.
The mean growth rates of these three sub-sets of cities were calculated and compared and that comparison is presented in table 4.2. It may be observed from this table that even in this comparison no marked difference is seen in the mean growth rate of the three subsets of cities. The lowest mean growth rate (2.07 percent per year) is recorded by the middle one-third cities and the highest (2.12 percent per year) by the smallest one-third cities; and the difference between these two growth rates (.05 percent) is very small. The difference between the lowest and the highest growth rates (0.05 percent per year) looks negligible in comparison to the very big difference in the mean population size of cities in these three subsets. It is worth mentioning that the mean population size of the upper one-third of cities (1.89 lakhs) is nineteen times the mean population size of smallest one third of cities (9.95 thousand); but the growth rates of these two classes of cities differs only by 0.01 percent. It may also be noted that though mean growth rates among these three sub-set of cities do not differ markedly, the coefficient of variation of growth rates does show a marked difference.

The coefficient of variation ranges from the very low 12.46 percent in the middle one third of cities to the high 101.44 percent in the smallest one third of cities. This suggests that cities in the middle of the city size distribution differ only slightly from one another in their growth rates; but the cities in the lower and upper tails of the city size distribution differ considerable from one another in their growth rates. Notwithstanding the above fact we can still say that even this tripartite division of cities on the basis of size does not reveal any relationship between city size and city growth in India.\textsuperscript{23}

Further, we used the census classification of Indian cities into six size classes to analyze city size city growth relationship. The census classification was, however, modified by creating a seventh class of very big cities having population of 10 lakh and above we have called these very big cities ‘Metropolitan cities’ just to distinguish these from other big cities.\textsuperscript{24} This modified version of census of India city size classes can be seen in column three of table 4.3. The mean growth rate of cities, along with other related statistics were computed and compared. The
### Table-4.3

Comparison of Growth Rate of Cities: Census City Size Classes

<table>
<thead>
<tr>
<th>City size class</th>
<th>Number of observations</th>
<th>Population Range (000)</th>
<th>City Size in 1991 (Mean population (000))</th>
<th>City Growth Rate (1991-2001) (Mean)</th>
<th>City Growth Rate (S.D.)</th>
<th>City Growth Rate (C.V.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>70</td>
<td>Less than 5000</td>
<td>3.57</td>
<td>3.01%</td>
<td>2.78</td>
<td>92.36%</td>
</tr>
<tr>
<td>5</td>
<td>352</td>
<td>5000 to 9999</td>
<td>7.78</td>
<td>2.09%</td>
<td>1.91</td>
<td>91.48%</td>
</tr>
<tr>
<td>4</td>
<td>857</td>
<td>10, 000 to 19, 999</td>
<td>14.74</td>
<td>2.02%</td>
<td>1.87</td>
<td>92.53%</td>
</tr>
<tr>
<td>3</td>
<td>796</td>
<td>20, 000 to 49, 999</td>
<td>30.71</td>
<td>2.04%</td>
<td>1.83</td>
<td>89.71%</td>
</tr>
<tr>
<td>2</td>
<td>318</td>
<td>50, 000 to 99, 999</td>
<td>68.28</td>
<td>2.03%</td>
<td>3.06</td>
<td>150.79%</td>
</tr>
<tr>
<td>1</td>
<td>257</td>
<td>1 Lakh to 9, 99, 999</td>
<td>251.07</td>
<td>2.34%</td>
<td>2.32</td>
<td>98.97%</td>
</tr>
<tr>
<td>0</td>
<td>23</td>
<td>10 Lakh and above</td>
<td>3086.83</td>
<td>3.03%</td>
<td>1.15</td>
<td>38.09%</td>
</tr>
</tbody>
</table>

**Note:** S.D. is standard deviation, and C.V. is coefficient variation.
details of this comparison are presented in table 4.3. It may be noted that between size-class two (50,000 to 99,999) to size class five (5000 to 9999) the mean of city growth rates differs very little. However the mean growth rate of the cities in the smallest size class (less than 5000) and the mean growth rate of the largest size class cities (10 lakh and above) are clearly higher than the mean growth rates of cities in size classes two to five. Even the mean growth rate of cities in size class one (1 lakh to 9,99,999) is slightly higher than the mean growth rate of cities in size class two to five. Hence, this division of all Indian cities into seven size classes (the smallest less than 5000, the largest 10 lakh and above) does suggest some sort of relationship between city-size and city growth rate in India, which remained hidden in the earlier division of cities into two or three size classes. The comparison of mean growth rates of cities of the seven size classes presented in table 4.3 clearly shows that cities at the lower end (less than 5000) and the upper end (10 lakh and above population) of the city size distribution grew faster than cities in the middle of the size distribution. It may be seen that cities of population less than 5000 grew at a mean rate of 3.01 percent per year and cities of 10 lakh and above population grew at a mean rate of 3.03 percent per year, whereas cities in the middle of the city size distribution grew at a mean rate of about 2 percent per year. It may also be pointed out that the variation around the mean growth rate was very low in the Metropolitan cities class (coefficient of variation = 38.09 percent), and very high in city size class two (coefficient of variation = 150.79 percent). In the other five city size classes the coefficient of variation of growth rates did not differ markedly.

This visible difference in the mean growth rate of cities at the two ends of the city size distribution from cities in the middle was further probed to find out whether the difference is statistically significant. For this purpose the standard difference in means test was used. The difference in means test was carried out with help of a simple dummy variable regression model given below.25
\[ Y = a_0 + (a_1 - a_0)D_1 \]  
\[ Y = b_0 + (b_1 - b_0)D_2 \]  
\[ Y = a_0 + (a_1 - a_0)D_1 + (a_2 - a_0)D_2 \]  
\[ Y = c_0 + (c_1 - c_0)D_3 \]

Where \( Y \), is the dependent variable i.e. the growth rate of cities. 

\( D_1 \) is a dummy variable which takes value ‘1’ for cities with population less than 5000 and ‘0’ for all other cities.

\( D_2 \) is a dummy variable which takes value ‘1’ for cities with population 10 lakh and above and ‘0’ for all other cities.

\( D_3 \) is a dummy variable which takes value ‘1’ for cities with population less than 5000 and ‘0’ of cities with population 10 lakh and above in a subset of cities that includes only these two types of cities.

The result of this difference of means test with the help of dummy variables regression model are presented in table 4.4. The regression coefficient of dummy variable \( D_1 \) gives the difference between mean growth rate of cities with population 5000 or less and all the other cities. The mean growth rate of the smallest size class cities was 0.938 percent higher than the mean growth rate of all the other cities, and this difference is statistically significant at 5% level for a two-tailed test. Thus we can say that cities in the smallest size class (population less than 5000) grew at a significantly higher rate then all the other cities taken together. The coefficient of dummy variable \( D_2 \) in equation (2) indicates the difference in mean growth rate of metropolitan cities, (the largest size class of cities), and all the other cities taken together. It is observed from this equation that the metropolitan cities, on the average, grew at 0.939 percent higher annual growth rate compared to all the other cities. Further, the t-value attached to this coefficient indicates that this difference in the growth rates of metropolitan cities and non-metropolitan cities is statistically significant at 1 percent level for a two-tailed test. Hence we may say that during the 1991-2001 period metropolitan
Table-4.4

Differences is growth Rate of Cities: Regression Results
Dependant variable: Growth Rate of cities

<table>
<thead>
<tr>
<th>Eqn. No.</th>
<th>Number of observations</th>
<th>Intercept</th>
<th>Regression coefficient of $D_1$</th>
<th>Regression coefficient of $D_2$</th>
<th>Regression coefficient of $D_3$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2673</td>
<td>2.092</td>
<td>0.938$^b$ (2.119)</td>
<td>-</td>
<td>-</td>
<td>0.045</td>
</tr>
<tr>
<td>2</td>
<td>2673</td>
<td>2.076</td>
<td>-</td>
<td>0.939$^a$ (3.674)</td>
<td>-</td>
<td>0.071</td>
</tr>
<tr>
<td>3</td>
<td>2673</td>
<td>2.067</td>
<td>0.963$^b$ (2.181)</td>
<td>0.947$^a$ (3.709)</td>
<td>-</td>
<td>0.084</td>
</tr>
<tr>
<td>4</td>
<td>93</td>
<td>3.030</td>
<td>-</td>
<td>-</td>
<td>-0.016 (0.026)</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Note:
1. $D_1$ takes value 1 for cities with population less than 5000 and 0 for others.
2. $D_2$ takes value 1 for cities with population 10 lakh and above and 0 for others.
3. $D_3$ takes value 1 for cities with population less than 5000 and 0 for with population 10 lakh and above in a set that includes only these two types of cities.
4. Figures in brackets are $t$-values; $a$ and $b$ indicate respectively significant at 1 percent and 5 percent level for a two tailed test.
cities, ‘on the average’ grew at a significantly higher rate than the non-metropolitan cities. We next tested the difference in the mean growth rates of these two types of cities, (smallest and the largest i.e. metropolitan), from the rest of the cities i.e. from cities in the middle of the city size distribution. The results of this exercise are shown in equation (3) of table 4.4. It may be observed that the coefficient of both the dummy variables, (D₁ for smallest cities and D₂ for the largest metropolitan cities), have positive signs and are statistically significant at 5 percent and 1 percent levels respectively. Thus, results given in equation (3) confirm the earlier results of models in equation (1) and equation (2), that the smallest size class cities (population less than 5000) and the largest size class cities (population 10 lakh and more) grew at a significantly higher rate compared to the cities in the middle of city size distribution, during the 1991-2001 period. We further investigated whether or not the significantly faster growing two groups of cities (the smallest and the largest) differed significantly from each other in their mean growth rates. The results of this exercise are presented in equation (4) of table 4.4. It may be noted that the regression coefficient of dummy variable D₃ (created for this purpose) is very small (0.016) and is not statistically significant even at 10 percent level. In fact the t-value attached to the coefficient of dummy variable D₃ is almost negligible. On the basis of this result one may say that the mean growth rate of the smallest cities (population less than 5000) and the largest cities (population 10 lakh and above) did not differ significantly during the period 1991-2001. To sum up we may say that the results presented in table 4.4 suggest that the smallest size class cities and the largest size class metropolitan cities grew at a significantly higher rate than cities in the middle of the city size distribution, but between the growth rate of cities at the two tail ends of the city-size distribution no-significant difference is observed.

(ii) Regression Analysis of City Size City growth Relationship

The relationship between city size and city growth was further explored with the help of regression analysis. To begin with, a scatter plot of city size city growth relationship was prepared. This scatter plot is displayed in fig. 1.²⁶ Even a
cursory observation of the scatter plot suggests that no clear positive or negative relationship exists between city size and city growth rate; nor does it indicate clearly any non-linear type of relationship between city size and city growth. In view of the above, we employed simple linear and log linear regression models to test for the city size city growth relationship. To be more specific the following two regression equations were estimated:

\[ Y = a + bx + e \quad - (1) \]
\[ y = \alpha + \beta (\log x) + E \quad - (2) \]

Where \( y \) is city growth rate over 1991-2001 period, and

\( x \) is city size in terms of population of the city in 1991, \( e \) and \( E \) are the usual error terms.

The results of this regression exercise are presented in table 4.5. It may be observed that in equation (1) the regression coefficient of city size is not only very small, but also not statistically significant even at 10 percent level. This result indicates that during the 1991-2001 period there was no significant linear relationship between city size and city growth rate. In equation (1) the city size variable (independent variable) is used in its natural form i.e. population of each town in thousands in 1991. This form of the independent variable assumes that a 1000 increase in city population has the same impact on city growth rate irrespective of the level of city size e.g. an increase in the city population form ten lakh to ten lakh one thousand has the same impact as increase in city size from one lakh to one lakh one thousand. This presumption may be untenable because increase in city size may have a different impact on city growth rate at different levels of city size. This weakness in regression model of equation (1) is corrected in equation (2) where the independent variable is entered in the form of log of city size i.e. Log of city population in 1991.
Figure-1
City Growth Rate City Size Relationship: Scatter Diagram

City Growth Rate

Log City Size
Impact of City size on City Growth: Regression Results  
Dependent variable: City Growth Rate  
Independent variable: City size (Population in 1991)

<table>
<thead>
<tr>
<th>Description of Estimated Coefficient</th>
<th>Equation Number</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form of Independent Variable</td>
<td></td>
<td>City Size</td>
<td>Log City Size</td>
</tr>
<tr>
<td>Intercept</td>
<td></td>
<td>2.089</td>
<td>1.993</td>
</tr>
<tr>
<td>Regression coefficient</td>
<td></td>
<td>0.0001</td>
<td>0.033</td>
</tr>
<tr>
<td>t- value</td>
<td></td>
<td>1.569</td>
<td>0.879</td>
</tr>
<tr>
<td>R-Square</td>
<td></td>
<td>0.030</td>
<td>0.017</td>
</tr>
<tr>
<td>Number of observations</td>
<td></td>
<td>2673</td>
<td>2673</td>
</tr>
</tbody>
</table>
This semi log form model assumes that a 1 percent increase in city size has the same impact on city growth rate, irrespective of the level of city size. But even in this form the coefficient of city size variable remains very small and is not statistically significant even at 10 percent level. On the basis of the results presented in table 4.5, it may not be wrong to conclude that during the 1991-2001 period no significant linear relationship between city size and city growth rate was observable in India. This result is quite in line with the results reported in some recent studies on the relationship between city size city growth rates in the developed countries. So like the developed countries in India also growth rate of cities seems to be independent of their size. However, this conclusion has to be qualified somewhat on account of the results reported in the previous section which indicate that cities at both the tail ends of the city size distribution (the smallest cities and the largest metropolitan cities) grew at a significantly faster rate than cities in the middle of city size distribution. More complex non-linear regression models may help to discover some relationship between city size and city growth that may have remained hidden from the linear models, but such an exercise is not be attempted here and is attempted in chapter six where multiple regression analysis of factors influencing city growth is taken up.

IV. STATE WISE ANALYSIS OF CITY SIZE - CITY GROWTH RELATIONSHIP

All the cities of India were taken as a single set in the above regression analysis. We further probed the city size-city growth relationship separately for each of the 16 major states of India. It is widely accepted that the states of India differ from one another quite markedly in terms of resource endowments, language, culture, history, economy etc. and are virtually separate politico economic entities. Moreover, the history and pattern of urban development in different regions of India differs considerably due to the time and pattern of different regions coming under the British rule. Thus, the relationship between city size and city growth rate may differ from state to state. So it was examined
separately for each of the 16 major states of India. The earlier mentioned two regression models, linear and semi-log, were used for this purpose. Two broad patterns of city size-city growth rate relationship emerged from the regression results on these 16 states. In the following eight states, a positive relationship was indicated between city size and city growth rate, though it was not always statistically significant: Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu. The regression results on these eight states are reported in table 4.6. It may be observed that in five out of these eight states the regression coefficient of city size is not only positive but also statistically significant at different levels of confidence. In the state of Orissa, both the regression models revealed a positive and significant relationship. Similarly in the case of Haryana a positive significant relationship between city size and city growth rate is revealed by both the models, though significant only at 10 percent level. It is worth mentioning that in states of Karnataka, Madhya Pradesh and Maharashtra a positive significant relationship at 1 percent level emerges when semi-log model is used; but no significant relationship is indicated when the simple linear model is used. In Andhra Pradesh, Gujarat and Tamil Nadu a positive relationship between city size and city growth rate is indicated, but is not statistically significant even at 10 percent level; though t-values are greater than one in all the three cases.

On the other hand, in the case of the rest of the eight states, the coefficient of city size variable was either negative or very small and the attached 't-value' was not significant even at 10 percent level. These states are: Assam, Bihar, Himachal Pradesh, Kerala, Punjab, Rajasthan, Uttar Pradesh, West Bengal (table 4.7). This means that in the case of these eight states the coefficient of city size variable was not significantly different from zero. Thus, one may conclude that like the all India result, city size did not have any significant impact on city growth rate in these eight states during 1991-2001 period. The comparison of these 2 groups of states, one showing a positive relationship between city size and city growth rate, the other suggesting no significant relationship between the
### Table 4.6

**Impact of City Size on City Growth: State Wise Regression Results-1**

Dependent Variable: City Growth Rate

<table>
<thead>
<tr>
<th>State</th>
<th>Independent Variable</th>
<th>Intercept</th>
<th>Regression Coefficient</th>
<th>t-Value</th>
<th>R</th>
<th>No. of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>City size</td>
<td>1.672</td>
<td>0.0001</td>
<td>0.843</td>
<td>0.07</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>0.879</td>
<td>0.205</td>
<td>1.545</td>
<td>0.13</td>
<td>131</td>
</tr>
<tr>
<td>Gujarat</td>
<td>City size</td>
<td>1.684</td>
<td>0.001</td>
<td>1.235</td>
<td>0.10</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>0.345</td>
<td>0.414</td>
<td>1.593</td>
<td>0.13</td>
<td>151</td>
</tr>
<tr>
<td>Haryana</td>
<td>City size</td>
<td>2.900</td>
<td>0.005</td>
<td>1.723</td>
<td>0.20</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>1.814</td>
<td>0.418</td>
<td>1.704</td>
<td>0.19</td>
<td>73</td>
</tr>
<tr>
<td>Karnataka</td>
<td>City size</td>
<td>2.127</td>
<td>0.0001</td>
<td>1.094</td>
<td>0.08</td>
<td>192</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>1.185</td>
<td>0.290</td>
<td>3.042</td>
<td>0.22</td>
<td>192</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>City size</td>
<td>2.150</td>
<td>0.0001</td>
<td>0.166</td>
<td>0.10</td>
<td>286</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>1.394</td>
<td>0.261</td>
<td>2.983</td>
<td>0.17</td>
<td>286</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>City size</td>
<td>2.272</td>
<td>0.0001</td>
<td>0.736</td>
<td>0.04</td>
<td>230</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>1.061</td>
<td>0.353</td>
<td>2.764</td>
<td>0.18</td>
<td>230</td>
</tr>
<tr>
<td>Orissa</td>
<td>City size</td>
<td>1.508</td>
<td>0.004</td>
<td>1.821</td>
<td>0.19</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>0.092</td>
<td>0.509</td>
<td>3.179</td>
<td>0.32</td>
<td>89</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>City size</td>
<td>0.848</td>
<td>0.0001</td>
<td>0.181</td>
<td>0.98</td>
<td>206</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>0.301</td>
<td>0.167</td>
<td>1.398</td>
<td>0.09</td>
<td>206</td>
</tr>
</tbody>
</table>

**Note:** a and c indicate respectively significant at 1 percent and 10 percent level for a two tailed test.
### TABLE 4.7

**Impact of city size on city Growth: State wise regression Results-II**

**Dependent Variable: City growth rate**

<table>
<thead>
<tr>
<th>State</th>
<th>Independent Variable</th>
<th>Intercept</th>
<th>Regression Coefficient</th>
<th>t-Value</th>
<th>$R^2$</th>
<th>No. of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assam</td>
<td>City size</td>
<td>2.660</td>
<td>0.0001</td>
<td>0.125</td>
<td>0.016</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>4.119</td>
<td>-0.483</td>
<td>1.494</td>
<td>0.19</td>
<td>60</td>
</tr>
<tr>
<td>Bihar</td>
<td>City size</td>
<td>2.231</td>
<td>-0.002</td>
<td>1.124</td>
<td>0.09</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>2.340</td>
<td>-0.074</td>
<td>0.246</td>
<td>0.02</td>
<td>149</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>City size</td>
<td>2.649</td>
<td>-0.002</td>
<td>0.109</td>
<td>0.018</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>3.071</td>
<td>-0.254</td>
<td>0.729</td>
<td>0.12</td>
<td>38</td>
</tr>
<tr>
<td>Kerala</td>
<td>City size</td>
<td>1.368</td>
<td>0.0001</td>
<td>0.112</td>
<td>0.016</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>1.141</td>
<td>0.052</td>
<td>0.174</td>
<td>0.03</td>
<td>53</td>
</tr>
<tr>
<td>Punjab</td>
<td>City size</td>
<td>2.457</td>
<td>0.001</td>
<td>0.571</td>
<td>0.05</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>3.028</td>
<td>-0.171</td>
<td>1.095</td>
<td>0.10</td>
<td>121</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>City size</td>
<td>2.221</td>
<td>0.001</td>
<td>0.716</td>
<td>0.05</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>2.347</td>
<td>-0.022</td>
<td>0.103</td>
<td>0.08</td>
<td>166</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>City size</td>
<td>2.459</td>
<td>0.0001</td>
<td>0.181</td>
<td>0.055</td>
<td>629</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>2.382</td>
<td>0.034</td>
<td>0.721</td>
<td>0.003</td>
<td>629</td>
</tr>
<tr>
<td>West Bengal</td>
<td>City size</td>
<td>1.071</td>
<td>0.0000916</td>
<td>0.315</td>
<td>0.03</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Log City Size</td>
<td>0.222</td>
<td>0.230</td>
<td>0.774</td>
<td>0.07</td>
<td>98</td>
</tr>
</tbody>
</table>
two, reveals no clear geographical pattern in their location, nor any definite pattern in their level of development. We observe both north-Indian and south-Indian states, as well as high per capita income and low per capita income states in both the groups. The state wise regression results on city size and city growth relationship presented in tables 4.6 and 4.7, therefore, suggest that in the case of India, this relationship seems to be more complex due to the vast size of the country and the marked socio-economic and cultural diversity and differences in urban history of different regions of India.

On the basis of a combined assessment of the preceding three sets of results, [(i) the tabular comparison of city growth rates among cities of different size classes; (ii) the regression analysis of city size city growth rate relationship at the all-India level; and (iii) the regression analysis of the city size-city growth rate relationship in 16 major states of India], it is difficult to draw any definitive conclusion on city size city growth relationship in India during the 1991-2001 period. The all-India regression results suggest no significant relationship, but the state-wise regression results suggest that there may exist a positive relationship between the two in some regions/states of India. Similarly, the city size group wise comparison of city growth rates suggests that the smallest and the largest cities grew at a significantly faster rate than cities in the middle of the city size distribution. It is possible that the impact of city size on city growth rate in India being more complex, may become clear later (in chapter six), when we analyze the role of city size in city growth along with other factors in a multivariate regression exercise.
NOTES AND REFERENCES


6) The higher labour productivity in big cities compared to the smaller ones is the result of better matching of workers to jobs and greater formation of
human capital. For some evidence for the United States see. L.Sveikauskas, 


18) R. Bradley and J.S. Gans, “Growth in Australian Cities”, *Economic Record*, September 1998, pp.266-78. The negative relationship of city size and city growth found by them is, however, in a multivariate context in which a number of other determinants of city growth rate were also included. Jan Eeckhout, Y.M. Ioannides and H.G. Overman results showing no relationship between the two are from regression models in which city size was the only factor considered.


21) K.T. Rosen and M. Resnick, “The size distribution of cities: An examination of the Pareto Law and Primacy”, *Journal of Urban Economics*, Sept, 1980, pp.165-86. The sample of 44 countries included almost all the developed countries and many developing countries (including India). The authors, on the bases of many linear and non-linear models conclude, “This paper suggests that large cities are growing faster than small cities in most of the countries of our sample”, Page 184.

22) This is one of the few studies on the relationship between city size and city growth during the early and middle nineteenth century. See J.G.

23) The marked difference in the coefficient of variation of these three sub-sets of cities may have significant implications for the relationship between city size and city growth, but we were not able to think up any due to limited training in statistical methods.

24) In the previous chapter also we have described the growth behaviour of metropolitan cities separately and to remain consistent we have retained that category in this chapter also. Moreover, the growth pattern of very big cities may be different and that will help in revealing the possible non-linearity in the city size city growth rate relationship.

25) This procedure gives exactly the same result as the standard difference of means test, but is easier to use. See Damodar Gujarati, *Basic Econometrics*, 1978, Chapter 13, pp.287-93.

26) In this figure we have kept log city size on the X-axis rather than absolute city size, partly following Jan Eeckhout, (op. cit. 2004). In his scatter diagram on American cities he has used both city size and city growth rate in log form; but we have kept growth rate in the natural percent per year terms because of the negative growth rate of many cities of our sample and also because it is intuitively more clear that way.