Cities with Suburbs: Evidence from India

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Abstract

For a country like India that contains a large number of Urban Agglomerations (UAs), suburbanisation has drawn little attention of the literature. I focus on this sparsely studied issue in this work. I calculate population, household and employment density gradients for India's UAs, using Mills' two-point technique. Next, I estimate population, household and employment gradient regressions. I find that the size of UA and lagged value of the population gradient explain population suburbanisation, as we would expect. I find evidence from the employment suburbanisation equation that it is the jobs that follow people, and not *vice-versa*, consistent with what has been found in the literature. In the employment sub-sector regressions, I find that the skills of the labor force are the most important factor explaining suburbanisation of manufacturing, transport, communications and trade/commerce jobs in India's urban areas. I conclude with policy implications.

JEL Classification Code: R11, R12, R23, O18

Key Words: India, Suburbanisation, Density Gradient, Mills' two-point technique, Population gradient, Employment gradient, Household gradient, Gradient regressions, Exponential density function

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Introduction and Motivation

The suburbanisation of metropolitan areas in countries such as the United States and Canada has drawn a lot of attention of the researchers (Mills and Price, 1984; Mills, 1992; Margo, 1992; Mieszkowski and Mills, 1993; Small and Song, 1994, to cite a few examples). For developing countries, and a large country like India that contains a large number of urban agglomerations (UAs), suburbanisation has drawn very little attention, primarily due to lack of data. In this study, I focus on this sparsely studied issue.

Suburbanisation seems imminent in India's UAs. The demand for real estate is rising as incomes are rising, and the middle class is steadily expanding. Further, demand for land and real estate is increasing due to the booming information technology (IT) and BPO (Business Process Outsourcing), and retail services sectors.[1] India caters to slightly over 60 percent of the $1.8 billion offshore BPO market. Taking the average space requirement of 100 square feet per person, it is estimated that the additional space needs of employees would be 100 million square feet over the next five years (*Economic Times* report, 25 July, 2004). The space requirement follows from the additional 1.54 million IT professionals that would be employed over the next five years. This indicates that India needs to add 20 million square feet of space each year, much greater than the commercial real estate space that is developed currently.

According to Jones Lang La Salle's third Corporate Real Estate Impact Survey, India and China will receive the strongest net demand for new space over the next year.[2] A different Jones Lang LaSalle report for India suggests the emergence of key trends in investor preferences, the most important being the diminished importance of location, and preference for non-CBD space. This has resulted in the release of space in the CBD areas as IT firms shift to peripheral areas in campus-style developments. Other reports (for instance, the *Economic Times Property Markets Survey*) also confirm the continued trend of firms to shift to the suburbs. Second, continually lowering interest rates on home loans have increased demand for new built houses at the periphery.

Partly as a result of demand for space, real estate prices have increased everywhere in the country. Further, there is a huge disparity in the rental and capital values of real estate between the central business district (CBD) and suburbs of most cities. Office rentals in the CBD of Mumbai[3] range from INR (Indian Rupees) 75-110 per square foot per month compared to INR 70-85 in suburbs such as Bandra/Kurla. In terms of capital values, the differences between central city and the suburbs are even more. In the National Capital Region, for instance, CBD prime area costs INR 8,213 per square foot whereas the Gurgaon prime area, capital value is only INR 3,664 per square foot! When we take residential land, the story is quite similar. *See* Tables 1 and 2. So it has become relocation time for many firms and households across the country. Based on these data, it is quite plausible to believe that suburbanisation is imminent.

This observation is the basis for understanding any population and employment suburbanisation that have definitely taken place in the urban areas of the country, similar to phenomena occurring in the other countries. Currently we are in darkness with respect to these phenomena in India's urban areas.

II. Objectives

In this study, I examine the following:

- While the number of Urban Agglomerations (UAs) in India grew from 275 to 375 over 1991-2001, what is the extent of population, household and employment suburbanisation?[4] While Mills' two-point method has been widely applied to cities in several countries, in this study, I calculate population, household, and employment density gradients for all Indian UAs for which the data are available, using

1981 and 1991 census data, the most recent available.[5] India, being a large country, shows some variations across regions as well.

- What explains population, household, and employment suburbanisation in India's UAs?

The answers to these questions could be quite important. The extent of suburbanisation, and their determinants have implications for governmental policy variables such as unemployment rate, universal literacy programmes, and their impacts. Better understanding of policy impacts enables better formulation and planning of optimal city growth.

a. Review of Literature

Literature dealing with suburbanisation in large and developed countries such as the United States and Canada is vast. (McDonald, 1989) provides a survey of the literature on density functions. A more recent literature review on studies of gradients is in (Anas, Arnott and Small, 1998) and (Glaeser and Kahn, 2001). Suburbanisation studies relating to Canadian urban areas are in (Bunting, Filion and Priston, 2002) and (Walks, 2004).

Broadly, one stream of literature on traditional urban models relies on the natural evolution theory and takes into account the impact of income and population on the density gradient. Standard urban economic theory shows that increases in income and population have the effect of increasing suburbanisation. The literature dealing with the natural evolution theory of suburbanisation shows that income growth in a metropolitan area leads to decreases in the gradient (Margo, 1992; Thurston and Yezer, 1994). The theory suggests that as new housing is built at the periphery of cities, high income groups who prefer larger amounts of housing settle there. Another factor that supports the natural evolution theory is that over time, increases in real income make expensive modes of transportation like the automobile more affordable. Second, larger metropolitan areas are more suburbanised than smaller ones (Mills and Price, 1984; Mieszkowski and Mills, 1993). Suburbanisation is known to occur in large metro areas because of retail services and lower land costs in the suburbs. That is, as the metro area becomes larger, households prefer to move to the suburbs to make use of shopping malls and consume greater amounts of housing than what would be available in the CBD.

A second class of explanations of suburbanisation in the literature stem from the Tiebout model that relates suburbanisation to central city problems such as high taxes, poor educational attainment, racial tensions, and poor quality of public services. This literature relies on "flight from blight" and argues that central city problems are the cause of the increasing suburbanisation observed in the United States. (Mills and Price, 1984) made an attempt to look at the "flight from blight" hypothesis. Their empirical finding was that the set of measures representing central city problems – crime, educational attainment and taxes – however adds nothing to our understanding of population and employment suburbanisation.

As Mieszkowski, and Mills (1993) point out, even if the effect of "flight from blight" is relatively small, it could have considerable effect on the margin because the measurement of gradients is on an exponential scale rather than a linear one. Thus it is an important factor affecting suburbanisation and is a key factor to whether it is considered a manageable phenomenon or a problem.

Jordan, Ross, and Usowski (1998), measure and analyse differences in rates of suburbanisation during the 1980s among U.S. metropolitan areas, that fit a monocentric urban model. Glaeser and Kahn (2001), study the decentralisation of employment in American cities. They find that employment is highly decentralised in American cities, as may be seen in their finding that less than 16 percent of total employment was located within a 3-mile radius of the city center. They also find evidence that decentralisation is more common in manufacturing employment than they are in services.

Sridhar and Sridhar (2003), study the impact of telecommuting, made possible by technology, on suburbanisation, using data for U.S. metropolitan areas. They use the population and household density gradients as measures of suburbanisation. For telecommuting indicators, they use data from Survey of Income Program and Participation (SIPP). They find support for the natural evolution theory of suburbanisation. They find that large cities (those with large populations) are likely to be more suburbanised than their smaller counterparts, when we control for the influence of central city fiscal and socio-demographic characteristics. Further, they find that telecommuting contributes to centralisation, not suburbanisation, of metro areas, and conclude that technology could be a complement, not a substitute for face-to-face interaction, consistent with Gasper and Glaeser (1989).

I concur with the literature and assume that the natural evolution and fiscal-social problem approaches are both important in explaining suburbanisation in the Indian context as well.[6] Unlike in the USA, UAs in India have a loose description, and the Directorates of Census enjoy a high degree of discretion in designating an area as a UA. There are several instances where outgrowths, shown as parts of UAs, have political and speculative overtones. This is a caveat to be noted so that the phenomenon of UAs is not mistaken as a purely demographic-cum-economic occurrence.

Mills and Tan (1980), compare density functions for developed and developing countries. They find that the negative exponential density function is a good description of data from vastly different countries. They note that while urban decentralisation is a continuously occurring phenomenon in the developed as well as developing countries, central city densities are extremely high in large urban areas of developing countries when compared to the developed countries. They find average density gradients for 12 Indian cities to be 0.652 for 1960 (summarised in their Table 19), quite high when compared to that for cities in Brazil (0.17, for 1960) Japan (0.46 for 1965), and 0.34 (for Mexico), and 0.20 (for USA) for 1960. Only the Korean average density gradient (for 12 cities) was higher than (being 0.70 for 1960) that for India. Quite rightly as they point out, any modest income increases in the developing countries certainly induce people to move out. And, there is an intense conflict between suburban development and rural land uses. They point out that more research should be done on the determinants of land use patterns in developing and developed countries.

Due to data constraints, however, suburbanisation in the context of developing countries, that too a large country like India that has a large number of UAs, is sparse. Only one study by the Census of India (Jain, 1993) studies the emerging trend in the suburbanisation of India over 1971-81. The study does not analyse suburbanisation as much as it analyses changes in the composition of standard urban areas. It also does not perform any more systematic analyses than calculating trends. Further, in Indian UAs, the process of mergers of suburbs with cities has just begun for better and integrated metropolitan governance. For instance, Delhi cantonment and Mahipalpur were not part of the city in

1981, but they were made respectively merged with the then DMC (now called MCD), in 1991. South Suburban, Garden Reach and Jadavpur municipalities were merged with Calcutta Municipal Council in 1991. Such mergers have just begun, and it is not clear, whether a systematic body of literature has developed regarding this phenomenon as yet.

Suburbanisation is quite important to address in India's context since it could have implications for the large number of retail and BPO firms that are much starved for adequate space in the CBD of many Indian cities.

b. Measurement of Suburbanisation

Suburbanisation is the process where the percentage of population living in the suburbs rises. In the standard urban model, employment is concentrated in the CBD and the locational choice of households is modeled solely on access to the employment centre.[7]

In urban economic theory, the gradient is used as a measure of population suburbanisation. There are several criteria that are needed for an appropriate measure of suburbanisation (Mills, 1992). I use the gradient as a measure of suburbanisation because it has several advantages. The first is that the gradient approach is relatively simple. As (Mieszkowski and Mills, 1993) point out, the exponential density function is a reduced form equation of a simple and robust model of metropolitan spatial organisation (*see* also Brueckner, 1987).

The gradient shows how population density (number of persons per square mile) changes with distance from the CBD. Suburbanisation is the process that occurs when the absolute value of the gradient falls.

There are two ways of measuring the gradient. We can either *estimate* it, or *calculate* it using Mills' two-point gradient technique. Data that are required to *estimate* density gradients pertain to population (household or employment) density (per square kilometre) for census tracts (wards) and their distances from the city centre. The gradient is the coefficient in a regression of density (for census tracts) on distance from the city centre, as in the following negative exponential form of the equation:

$$D(r) = D_0 e^{-br} \quad [1]$$

Where D (r) is the relevant density r kms. from the centre, e is the base of the natural logarithm, and b (the gradient) and D_0 are constants estimated from the data, if the data are available at such a disaggregated level (usually census-tract level). In this approach, as may be clear, this regression is required for every city.

As should be clear, estimation of gradients is a very data intensive process requiring population density and land area data at a very disaggregate level (usually census tract or block group or ward). Mills (1972) demonstrated, through his two-point gradient technique, that from data on just two points in the city, CBD and metro area, we can *calculate* rather than estimate the gradient.

c. Theory

As Brueckner (1987) points out, standard models of population distribution provide the theoretical rationale for the exponential population density function. From the theoretical exponential density function in equation [1], the ratio of L_C to L is derived as given below:[8]

$$\frac{L_c}{L} = \frac{1 - e^{-bR_c} - bR_c e^{-bR_c}}{1 - e^{-bR} - bR\, e^{-bR}} \qquad [2]$$

Given data on L_C, R_C, L, and R, we may calculate the gradient b in [2] for all Indian UAs. Respectively, L_C and R_C refer to population (households or employment) and land area in the inner cities (usually called the central business district in U.S. cities) of UAs in the country. L and R respectively refer to population, (households or employment) and land area of UAs.

I calculate population, household, and employment density gradients for Indian UAs for 1981 and 1991, using expressions derived above. In the next step, I estimate the population, household, and employment density gradients and explain what determines suburbanisation in the Indian context.

Data required for estimation of density gradients is quite intensive. It requires data at the census tract level or at the block group level. In India's census, though data on *population* are readily available at the census tract, even at the ward level, detailed data on *land area* are not available in a centralised fashion, requiring one to go to each of the 375 UAs to obtain the land area data, by census ward! And, there are hundreds of such census wards in each city. This means that it is extremely difficult to obtain population density and land area data at such a disaggregated level for the 375 UAs of the country, making it a near-impossible proposition to estimate density gradients for India's UAs.

Using Mills' two-point technique, and using the standard exponential density function, I derive the ratio of central city population to total UA. Using this equation [2] (that does not have a closed form solution), I calculate population, household, and employment density gradients for India's UAs. Further, using these gradients, I estimate and explain population, household, and employment suburbanisation for India's UAs for 1991.

III. Methodology, Model and Data Sources

First, I obtain data on the land area, population, households, and employment, along with other socio-demographic characteristics for the various components of all UAs in the country for 1981 and 1991 respectively from the 1981 and 1991 Census of India, General Population Tables A-4. I then aggregate various components of UAs separately for the central city and the UA. In order to arrive at R_C and R (land areas of central city and UA respectively), I make the assumption that UAs are circular.[9] This assumption is quite realistic as India's UAs have what are called as ring roads and outer ring roads, similar to the outer loop in the U.S. metropolitan areas, reinforcing the circular nature of these agglomerations. Based on these data, I calculate R_C and R,[10] L_C and L (population of central city and UA respectively) for 1981 and 1991, H_C and H (households in central city and UA respectively), and E_C and E (employment in central city and UA respectively), for 1991. Further, I calculate employment density gradients for several sub-sectors including mining and construction, manufacturing, trade and commerce, communications, and other services, all for 1991.

I calculate the population, household, employment, and various sub-sector gradients[11] for 1981 and 1991 for Indian UAs[12] for which the gradient was calculable.[13]

In the next step, I perform regressions of the population, household, total employment and the various sub-sector gradients by ordinary least squares. I estimate these density gradients as in the standard literature. The following models are used:

$$b_{ij}^* = f_i(y_j) + \xi_{ij} \quad [3]$$

As in previous literature, b_{ij}^* is the equilibrium value of the gradient b for i (population or employment) and UA j. It is assumed that the actual gradient (observed) eventually adjusts to the equilibrium value of the gradient, b* with a lag. y_j is the vector of explanatory variables. As always, ξ_{ij} is the random error term.

The empirical versions of the estimated population (and household) and employment density gradient functions respectively are:

$$b_{Pj} = \alpha_0 + \alpha_{PPOP} POP + \alpha_{PY} Y_j + \alpha_{PJS} JS_j + \alpha_{PN} N_j + \alpha_{PUN} UN_j + \alpha_{PSCST} SCST_j + \alpha_{PLIT} LIT_j + \alpha_{PLAG} PLAG_j \quad [4];$$

and

$$b_{Ej} = \beta_0 + \beta_{EPOP} POP_j + \beta_{EN} N_j + \alpha_{EW} W_j + \beta_{ELF} LF_j + \beta_{ESCST} SCST_j + \beta_{ELIT} LIT_j + \beta_{LF} LF_j + \beta_{EPLAG} PLAG_j \quad [5]$$

where,
b_{Pj} and b_{Ej} = Population (or household) and employment density gradients in UA j;

POP_j = Population of UA j (scaled and divided by 10,000);

Y_j = Annual household income in UA j;
W_j = Wage cost (workers' emoluments as proportion of value of output) in the state in which UA j is located;
JS_j = Proportion jobs suburbanised in UA j;
N_j = Number of local governments in UA j in 1981;
LF_j = Labor force as proportion of population in UA j;

UN_j = Ratio of unemployment rate in the central city to that in the suburbs in UA j;
$SCST_j$ = Ratio of minorities (scheduled castes and/or scheduled tribes[14]) as proportion of total population in central city to that in suburbs, in UA j;
LIT_j = Ratio of literacy rate as a proportion of population above 6 in central city to that in suburbs, in UA j;
$PLAG_j$ = Lagged value of population gradient (for 1981).

As in the standard literature, the population variable is included to test for the natural evolution effect on suburbanisation. It is well-known that larger metropolitan areas are more suburbanised than smaller ones (Mills and Price, 1984; Mieszkowski and Mills, 1993). Suburbanisation is known to occur in large metro areas because of retail services and lower land costs in the suburbs. That is, as the metro area becomes larger, households prefer to move to the suburbs to make use of shopping malls and consume greater amounts of housing than what would be available in the CBD.

I include annual household income in the population and household suburbanisation equations to test for the natural evolution theory of suburbanisation. That is, whether to study if richer UAs are any more suburbanised than poorer ones, since their households can afford the automobile that makes living farther away more plausible. The annual household income data are taken from the National Council of Applied Economic Research (NCAER, 2002) publication *India Market Demographics Report 2002.* These data are such that within every state, the estimated distribution of households by income groups, are provided for all town groups classified by population.[15]

As explained earlier, a second class of explanations of suburbanisation in the literature stem from the Tiebout model that relates suburbanisation to central city problems. This literature relies on “flight from blight” and argues that central city problems are the cause of the increasing suburbanisation observed in the United States. The various ratio variables included in the population and employment density gradient equations – ratio of SCST proportion in the central city to that in suburbs (SCST), ratio of literacy rate in central city to that in suburbs, and finally, ratio of unemployment rate – are meant to test the flight from central city blight hypothesis.[16]

The number of local governments in the UA is indicative of competition prevalent with respect to the provision of public services. This variable (N_j) has been included to test for the Tiebout effect for both population as well as firms. (Jordan, Ross, and Usowski, 1992) include this in their model of suburbanisation. Note that the current number of local governments in the UA could be endogenous. Because of this, the number of local governments in the UA in 1981 was used, note that while 1991 number of governments is endogenous, the number of local governments in 1981 would be exogenous to the model.

The proportion of jobs suburbanised is included in the population gradient equation to test whether people follow jobs, as this is a question that remains unresolved in the literature (*see* Partridge and Rickman, 2003, for some recent evidence). In the various employment gradient equations, lagged value of the population gradient has been included to test for the 'jobs follow people' hypothesis.[17] There is another reason for including the lagged value of the population gradient in both equations, as (Mills and Price, 1984) point out. It is included to test whether the actual value of b adjusts to its equilibrium value with a lag. While the extent of employment suburbanisation is crucial for households, population suburbanisation is important for firms for availability of skills.

The proportion of population in the labour force speaks for the work ethic of the population. The CBD of many UAs in India (for instance, Jamshedpur is built around Tata Iron and Steel) are built around specific industries or firms. Labour force as a proportion of population in these UAs would be high. If this proportion were spatially concentrated (very likely, since such towns have large campus style developments), there would be some impact on employment suburbanisation. This implies that the employment history of a city could be important, and hence needs to be accounted for when studying employment suburbanisation.[18] The proportion of population in the labor force is calculated as the total number of full-time workers plus workers looking for work as a proportion of population for every UA.

For wage cost data, I use data on the total emoluments as a proportion of the total value of output for Indian states, published in the *Annual Survey of Industries,* for 2001-02, by India's Central Statistical Organisation, of the Ministry of Statistics and Programme Implementation, Government of India.

All other data for variables used in all the estimations are from the (Census of India, 1981) and (Census of India, 1991).

As should be clear, the population (household) and employment gradient equations [4] and [5] are both identified.

IV. Findings from Data

When we study the proportion of population that is suburbanised (21.33 percent), the average Indian UA is not any more suburbanised in 1991 than it was in 1981 (20.67 percent). Table 3 shows this.

On average, slightly higher proportion (22.02 percent) of households and employment (21.76 percent) is suburbanised than is population (21.33 percent). We expect households to be more suburbanised than population because household decisions to locate are much more dependent on characteristics such as discrepancy between central city and suburban literacy levels. Table 4 shows suburbanisation of the 21 UAs in the country with million plus population (including the four metropolitan areas) during 1991. While the suburbanisation of population, households and jobs is not different across the million-plus UAs, note that the proportion of population, households and jobs suburbanised are systematically lower in the 21 million-plus UAs (Table 4), when compared to the sample including all UAs for 1991. Table 5 summarises this data for the four metropolitan areas. This table shows that the population, households or jobs suburban for the metro areas is much higher than they are for all UAs or for the UAs with million plus population, quite consistent with what we expect. When we look at the trend of population suburban over 1981-91 (Table 6) for the metro areas, Madras is more suburbanised in 1991 than in 1981. Delhi has remained more or less the same over this decade whereas Calcutta actually had less of its population suburban by 1991.[19]

Table 7 summarises the population, household and employment density gradients for India's UAs, and for the metro areas. Although not apparent from the proportion suburban data (Table 3), when we examine the gradients, on average, India's UAs have certainly suburbanised over the decade as may be seen in the declining value of the density gradient. This is consistent with what is observed in cities in other countries, where density gradients have been declining in general (*see* Mills and Tan, 1980). The density gradients for Indian UAs, however, are larger compared to that for developed countries. For instance, the average density gradient reported by (Jordan, Ross, and Usowski, 1998) for 77 US metropolitan areas for 1990 is 0.16, whereas the gradients for Indian UAs (Table 7) are much higher (average is 0.47). As Papageorgiou and Pines (1989) point out, we expect higher central densities and larger density gradients in countries of higher overall population densities because of the rising opportunity cost of land. (Mills and Tan, 1980) summarise gradients for 12 Indian cities. When I compare them with those I find in this study, gradients for 6 cities are comparable.[20] Table 8 compares the gradients summarised by (Mills and Tan, 1980) and the gradients calculated in this study for the six comparable urban areas.[21] Of these six cities (Poona, Madras, Jamshedpur, Hyderabad, Bangalore, Bombay), I find Bangalore, Hyderabad and Pune suburbanised in the intervening period from 1961-91. The others in fact presumably centralised over the period, a finding that is not unusual.

As one would expect, the metropolitan areas are more suburbanised (lower absolute value of the gradient) in 1991 than when all the UAs are taken into account. Further, on average, population suburbanisation over 1981-91 in the metro areas has been at a much greater pace than in all the UAs, again consistent with our expectation (Table 7).[22]

Surprisingly, household and employment density gradients are not very different from each other for the UAs and the metros (Table 7). In general, when we take only 1991, and examine population, household and employment density gradients, households are the most suburbanised as we would expect, as presumably they would be in need of more land and housing. India had 340 UAs in 1991 for which all data on central city land area and population, and metro land area and population were available. But gradients were calculable only for a sub-sample, this is reported in Table 7. The most suburbanised UA in the country in 1991 was the Belgaum UA in the south Indian state of Karnataka that had only 8 percent of its population in suburbs.[23] The most centralised UA is Singur UA in the eastern Indian state of West Bengal that had 13 percent of its population suburban in 1991. The one with the lowest value of the household density gradient in 1991 is Arcot

UA located in another south Indian state Tamilnadu. This is, interestingly, the UA that had the lowest value of the population gradient in 1981 as well (its population gradient for 1991 was unfortunately not calculable). When we study the employment density gradient for 1991, the UA that is the most suburbanised is Alapuzzha UA in another south Indian state, Kerala, that had 16 percent of its employment suburban in 1991. The most centralised in terms of employment density is Alipurduar UA in the east Indian state, West Bengal.

The observation that most of the UAs that are the most suburbanised are located in south Indian states suggests that density in the UAs of these states declines very slowly as one moves away from the CBD. This suggests that these UAs are all spatially quite well covered in terms of density of population. That is, it is difficult to come across vast stretches of UAs that have low densities in states of the southern region. To examine this further, Table 9 summarises the population, household and employment gradients by region. Table 9 shows that the northern region's population is more suburbanised than their eastern, southern, or western counterparts in 1991, although UAs in the southern region were much more suburbanised than those in all the other regions in 1981. In terms of household and total employment suburbanisation, UAs in the northern and southern regions are much more suburbanised than their counterparts in the eastern and western regions that continue to be more centralised.

Table 10 summarises employment gradients for various employment sub-sectors. In general, gradients were calculable for a larger number of UAs in the case of manufacturing, but for much less number of UAs in the other sectors. This is partly because of the concentration of employment in manufacturing, and much smaller employment in other sectors, in most of the UAs. Table 10 shows that on average, mining and manufacturing employment are much more decentralised compared to services (transport communications, trade and commerce, and other services), consistent with what (Glaeser and Kahn, 2001) find in American metro areas. The finding is intuitive for India as much as for other countries because mines and manufacturing jobs are most likely located much away from the CBD than the other jobs. The most centralised sector in terms of employment is trade and commerce services, easy to imagine since these are mostly office (white or blue-collar) jobs. The manufacturing density gradient is flattest (most suburbanised) in Kanhangad UA in the south Indian state Kerala, with the most centralised manufacturing employment in a UA in Gujarat (Dohad), a west Indian state. So in general, employment and population in UAs in the southern region are more decentralised compared to the eastern or western regions of the country, something that has got to do with their GDP growth as much as suburban growth. All states in the southern region have higher per capita GDP compared with their eastern and some northern counterparts.

With a view to distinguish between different kinds of UAs, I have reported gradients for the following categories:

- UAs which have high densities at the core and low at the periphery;
- UAs with medium or low densities at the core and comparable densities or higher densities at the periphery; and
- UAs with unrelated densities at the core and periphery.

Such a distinction between the different kinds of UAs helps us to better appreciate the policy implications, instead of treating all of them as homogenous entities.

Tables 11-14 report population, employment, household and various sub-sector gradients for UAs classified by the ratio of population density in the CBD when compared to that in suburbs. Tables 15-18 report the various gradients for UAs classified by the similar employment density ratio. For these classifications, four categories are used:

- UAs for which CBD population (or employment) density is less than that for the suburbs (Tables 11 and 15);
- UAs for which CBD population (or employment) density is more, specifically 1-5 times more than that for the suburbs (Tables 12 and 16);
- UAs for which CBD population (or employment) density is 5-10 times more than that for the suburbs (Tables 13 and 17);
- UAs for which CBD population (or employment) density is more than 10 times than that for the suburbs.

Figures 1-8 show the distribution of UAs classified by the ratio of the relevant (population, household, or employment sub-sector) density in the CBD to that in the suburbs.

When we examine the population gradient, the gradient progressively keeps getting bigger whenever the CBD population density is higher compared to that in the suburbs (Tables 11-14). For instance, on average, the population gradient is only 0.44 for UAs with population density in CBD 1-5 times greater than that in the suburbs (Table 12), but it is 0.81 for UAs that have population density in their CBD greater than 10 times than that in their suburbs. This is what we would expect, since the higher the CBD population density, the more centralised would UAs be. A similar story holds good for household and employment gradients as well, when UAs are classified by ratio of population density. That is, households and employment in UAs with population density in CBD lower than that in the suburbs, are also suburbanised. As example, on average, the employment gradient in UAs with population density in CBD lower than that in suburbs is only 0.05 compared with an average of 0.78 in UAs where population density in CBD is also several times higher than that in suburbs. This is true in the case of all other employment sub-sector density gradients, with the exception of mining. This reinforces the notion that jobs follow people.

Conversely, Tables 15-19 confirm that UAs, whose CBD employment density is lower than that in the suburbs, are more suburbanised in terms of their population. Similar is the case with household suburbanisation. Households are more suburbanised where the employment density is also higher in the suburbs when compared to the CBD. A similar story holds good for all other employment sub-sector gradients. Employment in the various sub-sectors is more suburbanised where total employment is suburbanised and vice-versa.

V. Explaining India's Suburbanisation

I present the results from the estimation of population, household and employment (total and for certain sub-sectors) suburbanisation in Tables 11-13. The equations are estimated by ordinary least squares. First, note that the population and employment equations are adequately identified.

The size of the UA (indicated by population) and the lagged value of the population gradient (for 1981) significantly affect population suburbanisation (Table 19). Specifically, larger UAs are more suburbanised than smaller ones, as is clear from the negative sign on the variable. As metro areas grow bigger, people move farther out to make use of more land. The lagged value of the population gradient adds significantly to the model's explanatory power. The lagged population gradient is positive and significant, implying that UAs are likely to continue their historical suburbanisation trends. Consistent with what (Mills and Price, 1984) find, much of the explanatory power of the models comes from lagged values of the population gradient.

In the household suburbanisation equation, in fact, it is only the lagged value of population gradient that is significant. This implies that the gradual convergence towards the equilibrium value of the gradient is indeed significant. By and large, it is also because of the lagged population gradient that the sample size is a little smaller than otherwise. However, without this variable, the explanatory power of all models is rather poor (0.07 or so) so I refrain from reporting those results. Overall, the explanatory power of the model is slightly better for the household suburbanisation than for population suburbanisation. This shows that the standard urban model is as much a model about households rather than merely population.

To examine the impact of automobiles on suburbanisation, I separately estimate population and household suburbanisation equations with the number of motor vehicles per 1,000 population included along with variables in equation [4], since this data is available only for 21 of the UAs.[24] Even here it is the lagged population gradient that is significant in explaining population as well as household suburbanisation. In addition to this, another finding of interest in this estimation is that when controlled for the motor vehicles per 1,000 population, the literacy rate ratio has a negative impact on the gradient. This implies that when ownership of the automobile is controlled for, population and households locate in the suburbs even when the literacy rate there is low relative to the central city! Another big difference is that when the motor vehicles per 1000 population is added to the equations, the explanatory power increases to 0.83 (value of adjusted R-squared for population suburbanisation equation and 0.80 for household suburbanisation). Part of this is attributable to the fact that these estimations make use of only 15 observations and the model provides a good fit for the small sample.

Apart from this, there could be little in the motor vehicles variable itself that explained suburbanisation, since it is not significant.

When we estimate employment suburbanisation, it is the lagged value of the population gradient, that explains a substantial part of employment suburbanisation in India's UAs (Table 20). This shows that jobs follow people, but not the other way (recall that jobs suburbanised did not have a significant impact on population or household suburbanisation, Table 19). This is consistent with the findings of (Mills and Price, 1984) in American cities. This implies it is not the *current* population or size of the UA that impacts employment suburbanisation, but it is the pool of labour force that is pre-existing. When the lagged value of the population gradient is included, the model explains 31 percent of employment suburbanisation.

When I estimate manufacturing employment density gradients, some interesting new results emerge. Table 20 shows that the size of UA, wage costs, literacy rate ratio of central city when compared to that in suburbs, and lagged value of the population gradient are important and significant in explaining manufacturing suburbanisation. This implies the following:

- Manufacturing jobs follow people with specific skills for which literacy rate is only a proxy.
- Manufacturing moves away from high-wage areas.[25]
- Manufacturing activity requires large amount of land and has to locate away from high density areas such as the CBD, and they could be polluting in nature as well.

All these explanations are consistent with what we know about cities that have large manufacturing bases.

Finally, I estimate suburbanisation of communications jobs and trade & commerce service jobs (Table 21). When we take the former, the factors that explain manufacturing suburbanisation also explain suburbanisation of communication jobs, with the exception of wage costs that are not important for communications. In the case of communications, large UAs are more suburbanised than are smaller UAs. These jobs follow people again, as may be evident in the continued significance of the lagged population gradient. As with manufacturing jobs, if the ratio of literacy rate in the central city is high relative to that in suburbs, these jobs are centralised, if not, they are suburbanised. This again reinforces the importance of a variety of skills for these jobs as well, of which literacy rate is just one measure.

Finally, the suburbanisation of trade and commerce jobs follows a similar pattern as with manufacturing jobs. That is, larger UAs are more suburbanised in their trade and commerce employment. Further, they follow people as well (lagged value of population gradient), and follow people with certain skills (at the minimum, the literacy rate). So if there are more literates in the suburbs, these jobs are suburbanised, and *vice-versa*. The wage costs are as important in determining the location of trade and commerce jobs, as with manufacturing jobs. The higher the wage costs, more likely that trade and commerce jobs move away.

VI. Discussion and Implications

When we take all results together, we find that larger UAs are in general more suburbanised. Population gradients converge gradually to their equilibrium value, as rightly pointed out by (Mills and Price, 1984). This is evident in the robustness of the lagged population gradient in the population and household gradient equations. Further, jobs follow people as may be seen in all the employment (total as well as sub-sector) gradient equations. Various jobs closely follow people for the skills they have to offer of which literacy rate is only one indicator. Manufacturing and trade/commerce jobs are sensitive to wage costs as well. This indicates that 'right to work' laws may have to take precedence over minimum wage laws.

In the Indian context, these results are quite important. This is because a number of business process outsourcing (BPO) firms are looking to make use of labour force with 'employable' skills. Thus policies to attract population flows with certain skills may be more successful than specific policies or incentives to attract these firms. This result is quite important in the light of competition among states for various kinds of firms. This implies that state and local governments are better off focusing on improving skills of their population with universal literacy and vocational training programmes. For instance, call centre firms look only for training in English speaking, and whether potential employees have a neutral English speaking accent.

Recently, BPO firms in India classified various cities in India based on how much training of labor force is needed in every city category. *See* Table 22, which has been reproduced from India's leading business newspaper, *The Economic Times* (October 5, 2004), for purposes of illustrating how important skills are in this booming industry in India. This is just an example of the specific skills communications firms require.

It may be asked that if companies are making their judgments regarding talent pool availability, is this research relevant. The research here shows that over and above BPO and call centre firms, traditional firms such as transport, communications, manufacturing, trade and commerce firms are also sensitive to availability of workforce with specific skills. Probably nothing new as well. The research and the database developed in this paper can be a useful warehouse of information for all these firms regarding where the population has suburbanised, and where they have not. Further, urban local governments in UAs where literacy rates are low can gear up to improve their public services so that they are able to attract and retain skilled labour force.

VII. Concluding Remarks

This study has examined population, household and employment suburbanisation in India's UAs, a topic that has received comparatively less attention in the literature. The findings of interest are that population, household and employment suburbanisation has certainly taken place in India's UAs. Persons have suburbanised as urban agglomerations have naturally evolved, and persons as well as households suburbanise, consistent with historical trends. Employment suburbanises in response to availability of labour force with specific skills one measure of which is the literacy rate. In addition, manufacturing and trade/commerce jobs are sensitive to wage costs.

The logical question to ask is: does increasing suburbanisation of urban agglomerations imply that individual UAs can suburbanise forever? As (Mills and Tan, 1980) note, there is an intense conflict between suburban development and rural land uses in the context of developing countries. It is likely that suburbanisation in the Indian context implies conversion of a large number of rural areas into urban areas (increase in the number of UAs phenomenon, for instance, over 1991-2001, there has been an increase in the number of UAs from 275 to 375 in India). If this trend continues, India is more likely to have a more *extensive* rather than *intensive* urbanisation phenomenon. That is, more number of cities rather than more growth of existing cities. That way, suburbanisation means that the rural hinterlands of the country would benefit from urbanisation, public services and overall growth.

Table 1: Office Rentals and Capital Values in Selected Metro Areas

Metro Area	CBD Rental (INR/Sqft/ Month)	Suburb Rental (INR/Sqft/ Month)	CBD Capital Value (INR/Sqft)	Suburban Capital Value (INR/Sqft)
NCR	20	37	8,213	3,664
Mumbai	75-110	70-85	10,000-12,000	6,000-7,000
Bangalore	42	26	4,000	2,700
Average	**52**	**47**	**7738**	**4288**

Source: Compiled from *Economic Times Realty Bites*, December 28, 2003.

Table 2: Residential Rentals and Capital Values in Selected Metro Areas

Metro Area	CBD Rental (INR/Month)	Suburb Rental (INR/Month)	CBD Capital Value (INR/Sqft)	Suburban Capital Value (INR/Sqft)
NCR	100,000-175,000	25,000-35,000	7,000-10,000	2,400-3,200
Mumbai	60,000-125,000	45,000-100,000	7,000-15,000	6,500-10,000
Bangalore	40,000-100,000	25,000-80,000	2,200-3,800	1,800-2,600
Average	**100000**	**51667**	**7500**	**4417**

Source: Compiled from *Economic Times Realty Bites*, December 28, 2003.

Table 3: Suburbanisation of Population, Households, and Jobs in India, 1981 and 1991

	% 81 pop suburban	% 91 Pop suburban	% HH suburban	% Emp Suburban
Average	0.2067	0.2133	0.2202	0.2176
Maximum	0.9252	0.9231	0.9356	0.9285
Minimum	0.0018	0.0005	0.0012	0.0012
Std.Dev	0.2008	0.2014	0.2041	0.2011
Observations	233	374	374	374

Table 4: Population, Household, and Employment Suburbanisation in India's Million-Plus UAs, 1991

Variable	Mean	Std.Dev.	Minimum	Maximum
% Population suburban	0.1826	0.1622	0.0086	0.6008
% Households suburban	0.1893	0.1660	0.0103	0.6023
% Jobs suburban	0.1836	0.1604	0.0098	0.5681

Number of observations=21

Table 5: Population, Household, and Employment Suburbanisation in India's (4) Metropolitan Areas, 1991

Variable	Mean	Std.Dev.	Minimum	Maximum
% Population suburban	0.3031	0.2122	0.1082	0.6008
% Households suburban	0.3087	0.2112	0.1069	0.6023
% Jobs suburban	0.2899	0.2011	0.0993	0.5681

Table 6: Population Suburbanisation in India's Metropolitan Areas during 1981-91

	% Pop suburban, 1981	% Pop suburban, 1991
Delhi	0.10	0.11
Kolkata	0.64	0.60
Mumbai	NA*	0.21
Chennai	0.24	0.29

*Not available. Mumbai was not a UA in 1981, so separate central city and suburban data are not applicable.

Table 7: Summary of Population, Household, and Employment Density Gradients

	Population density gradients		% Change	HH density gradient	Employ-ment density gradient
	1981	**1991**	**1981-91**	**1991**	**1991**
Average, all	0.4933	0.4669	-5.35%	0.4533	0.4621
Maximum	0.9910	0.9983	0.74%	0.9879	0.9871
Minimum	0.0102	0.0072	-29.41%	0.0049	0.0194
Std.Dev	0.2649	0.2697	1.79%	0.2624	0.2601
Observations	94	154	77	161	160
Average, metros	0.2467	0.1963	-20.44%	0.2306	0.2578
Max, metros	0.3475	0.2995	-13.81%	0.2933	0.3473
Min, metros	0.1870	0.1244	-33.48%	0.1693	0.1818
Std.dev, metros	0.0878	0.0745	-15.08%	0.0629	0.0794

Table 8: Comparison of Density Gradients

Urban Area	Density gradient, Mills & Tan [6], for 1961	Density gradient calculated in this study for 1991
Bombay	0.102	0.194
Madras	0.235	0.299
Bangalore	0.528	0.380
Hyderabad	0.324	0.303
Pune	1.072	0.234
Jamshedpur	0.232	0.274

Table 9: Population, Household, and Employment Density Gradients by Region

Region	Population density gradients		HH density gradient	Employment density gradient
	1981	**1991**	**1991**	**1991**
Average, Southern region*	0.4569	0.4583	0.4121	0.4266
Average, Eastern region**	0.5225	0.4587	0.4834	0.4833
Average, Northern region***	0.5075	0.4140	0.4036	0.4239
Average, Western region****	0.5008	0.5493	0.5361	0.5004

*Karnataka, Kerala, Andhra Pradesh, Tamilnadu, Pondicherry
**Orissa, West Bengal, Bihar, Manipur, Meghalaya, Assam
***Delhi, Haryana, Uttar Pradesh, Chandigarh, Madhya Pradesh, Himachal Pradesh
****Maharashtra, Goa, Rajasthan, Gujarat

Table 10: Density Gradients for Employment Sub-sectors

	Mean	Std.Dev.	Minimum	Maximum	Obser-vations
Mining & quarrying	0.4568	0.2593	0.0020	0.9708	81
Manufacturing (household and non-household industry) and Construction	0.4590	0.2839	0.0191	0.9971	151
Transport, storage and communications	0.4965	0.2621	0.0109	0.9777	126
Trade and commerce services	0.5080	0.2587	0.0403	0.9996	111
Other services	0.4613	0.2652	0.0024	0.9337	136

Table 11: Gradients for UAs with CBD Population Density less than that in Suburbs

	Mean	Std.Dev.	Minimum	Maximum	Obser-vations
Population gradient	NA	NA	NA	NA	0
Household gradient	0.02	0.02	0.00	0.06	4
Employment gradient	0.05	0.03	0.03	0.07	2
Mining gradient	0.39	0.27	0.02	0.79	9
Manufacturing gradient	0.32	0.28	0.03	0.76	12
Communications gradient	0.28	0.16	0.10	0.49	7
Trade & commerce gradient	0.44	0.28	0.08	0.87	14
Other services gradient	0.38	0.20	0.07	0.73	12
Population gradient, 1981	0.36	0.36	0.01	0.85	7

Table 12: Gradients for UAs with Population Density in CBD 1-5 times more than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.44	0.26	0.01	1.00	138
Household gradient	0.44	0.25	0.01	0.99	140
Employment gradient	0.44	0.25	0.02	0.99	139
Mining gradient	0.46	0.24	0.01	0.97	54
Manufacturing gradient	0.43	0.27	0.02	0.99	118
Communications gradient	0.48	0.26	0.01	0.98	103
Trade & commerce gradient	28.89	264.76	0.04	2470.00	87
Other services gradient	0.44	0.26	0.00	0.92	101
Population gradient, 1981	0.48	0.25	0.01	0.99	77

Table 13: Gradients for UAs with Population Density in CBD 5-10 times more than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.64	0.25	0.30	0.97	12
Household gradient	0.60	0.24	0.27	0.96	13
Employment gradient	0.64	0.22	0.28	0.93	15
Mining gradient	0.43	0.35	0.00	0.93	10
Manufacturing gradient	0.64	0.26	0.21	1.00	16
Communications gradient	0.61	0.23	0.33	0.96	10
Trade & commerce gradient	0.54	0.19	0.38	0.90	6
Other services gradient	0.58	0.29	0.03	0.93	19
Population gradient, 1981	0.70	0.24	0.35	0.96	8

Table 14: Gradients for UAs with Population Density in CBD >10 times than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.81	0.09	0.70	0.90	4
Household gradient	0.80	0.07	0.70	0.86	4
Employment gradient	0.78	0.07	0.70	0.86	4
Mining gradient	0.56	0.25	0.13	0.83	8
Manufacturing gradient	0.76	0.18	0.53	0.93	5
Communications gradient	0.80	0.08	0.68	0.89	5
Trade & commerce gradient	0.89	0.08	0.84	0.99	3
Other services gradient	0.85	0.05	0.81	0.90	3
Population gradient, 1981	0.56	0.04	0.53	0.59	2

Table 15: Gradients for UAs with CBD Employment Density less than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-Vations**
Population gradient	0.10	0.13	0.01	0.26	3
Household gradient	0.19	0.36	0.01	0.84	5
Employment gradient	NA	NA	NA	NA	NA
Mining gradient	0.30	0.25	0.02	0.63	8
Manufacturing gradient	0.31	0.26	0.03	0.76	14
Communications gradient	0.27	0.15	0.10	0.49	6
Trade & commerce gradient	0.42	0.27	0.08	0.87	14
Other services gradient	0.39	0.20	0.07	0.73	11
Population gradient, 1981	0.37	0.35	0.03	0.85	7

Table 16: Gradients for UAs with Employment Density in CBD 1-5 times more than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.45	0.26	0.03	1.00	136
Household gradient	0.44	0.25	0.00	0.99	141
Employment gradient	0.44	0.26	0.02	0.99	145
Mining gradient	0.47	0.24	0.01	0.97	55
Manufacturing gradient	0.45	0.28	0.02	0.99	118
Communications gradient	0.48	0.26	0.01	0.98	105
Trade & commerce gradient	0.50	0.26	0.04	1.00	87
Other services gradient	0.43	0.26	0.00	0.92	107
Population gradient, 1981	0.49	0.26	0.01	0.99	78

Table 17: Gradients for UAs with Employment Density in CBD 5-10 times more than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.65	0.26	0.30	0.97	12
Household gradient	0.62	0.26	0.27	0.96	12
Employment gradient	0.63	0.25	0.28	0.93	12
Mining gradient	0.48	0.34	0.00	0.93	12
Manufacturing gradient	0.61	0.26	0.21	1.00	15
Communications gradient	0.63	0.23	0.33	0.96	11
Trade & commerce gradient	0.54	0.19	0.38	0.90	6
Other services gradient	0.68	0.22	0.30	0.93	14
Population gradient, 1981	0.69	0.26	0.35	0.96	7

Table 18: Gradients for UAs with Employment Density in CBD >10 times than that in Suburbs

	Mean	**Std.Dev.**	**Minimum**	**Maximum**	**Obser-vations**
Population gradient	0.79	0.09	0.70	0.87	3
Household gradient	0.78	0.07	0.70	0.84	3
Employment gradient	0.77	0.08	0.70	0.86	3
Mining gradient	0.51	0.27	0.13	0.80	6
Manufacturing gradient	0.81	0.15	0.61	0.93	4
Communications gradient	0.83	0.06	0.79	0.89	3
Trade & commerce gradient	0.89	0.08	0.84	0.99	3
Other services gradient	0.85	0.05	0.81	0.90	3
Population gradient, 1981	0.56	0.04	0.53	0.59	2

Table 19: Estimation of Population and Household Density Gradients, 1991

	Population suburbanisation		Household suburbanisation	
Variable	**Coefficient (Standard Error)**	**Mean for relevant sample**	**Coefficient (Standard Error)**	**Mean for relevant sample**
Constant	0.2769 (0.2267)		0.1831 (0.2054)	
Population/10,000	-0.0006 (0.0003)*	80.99	-0.0005 (0.0003)	80.99
Income (in Indian Rupees)	0.0000 (0.00)	63,290.62	0.00 (0.00)	63,290.62
Lagged population gradient	0.5280 (0.0979)***	0.47	0.5252 (0.0886)***	0.47
Proportion jobs suburbanised	-0.1836 (0.1104)	0.29	-0.1087 (0.1000)	0.29
Ratio of unemployment rate in central city to that in suburb	0.0070 (0.0082)	1.51	0.0065 (0.0074)	1.51
Ratio of proportion SC/ST population in the central city to that in suburb	-0.0550 (0.0701)	0.80	-0.0559 (0.0635)	0.80
Number of governments in UA, 1981	0.0058 (0.0039)	6.33	0.0042 (0.0035)	6.33
Literacy rate ratio (central city to suburb)	0.0122 (0.0914)	1.05	0.0098 (0.0828)	1.05
Mean, dependent variable		**0.42**		**0.39**
Adjusted R^2	**0.38**			**0.40**
Number of observations	**76**			**76**
F	**6.67**			**7.12**

* Significant at 10 percent level of significance.
***Significant at 1 percent level of significance.

Table 20: Estimation of Employment and Manufacturing Density Gradients

	Employment suburbanisation		Manufacturing Suburbanisation	
Variable	**Coefficient (Standard Error)**	**Mean for relevant sample**	**Coefficient (Standard Error)**	**Mean for relevant sample**
Constant	0.3578 (0.1934)*		0.3681 (0.2574)	
Population/10,000	-0.0004 (0.0003)	82.20	-0.0005 (0.0003)*	95.34
Wage costs in state (emoluments as % of output)	0.4916 (1.4624)	0.06	-3.4507 (1.7326)*	0.06
Number of governments in UA, 1981	0.0026 (0.0034)	6.45	0.0043 (0.0036)	7.06
Ratio of proportion SC/ST population in the central city to that in suburb	-0.0725 (0.0678)	0.80	-0.0119 (0.0960)	0.75
Literacy rate ratio (central city to suburb)	-0.0165 (0.0901)	1.05	0.1874 (0.0983)*	1.06
Lagged population gradient (1981)	0.4886 (0.1003)***	0.48	0.4636 (0.1136)***	0.47
Proportion population in labour force	-0.3995 (0.5508)	0.30	-0.4987 (0.7701)	0.29
Mean of dependent variable		**0.41**		**0.42**
Adjusted R^2	**0.31**		**0.31**	
Number of observations	**74**		**63**	
F	**5.62**		**4.98**	

* Significant at 10 percent level of significance.
** Significant at 5 percent level of significance
***Significant at 1 percent level of significance.

Table 21: Estimation of Density Gradients, Employment Sub-sectors

	Transport and Communication suburbanisation		**Trade and Commerce Suburbanisation**	
Variable	**Coefficient (Standard Error)**	**Mean for relevant sample**	**Coefficient (Standard Error)**	**Mean for relevant sample**
Constant	-0.0259 (0.2534)		0.2456 (0.2431)	
Population/10,000	-0.0005 (0.0003)*	95.99	-0.0005 (0.0003)*	110.40
Wage costs in state (emoluments as % of output)	-0.9152 (2.1707)	0.05	-5.4337 (1.9031)**	0.06
Number of governments in UA, 1981	0.0035 (0.0039)	7.17	0.0049 (0.0036)	7.74
Ratio of proportion SC/ST population in the central city to that in suburb	0.0145 (0.0946)	0.80	0.0229 (0.0877)	0.80
Literacy rate ratio (central city to suburb)	0.1848 (0.1076)*	1.05	0.2001 (0.0963)**	1.06
Lagged population gradient (1981)	0.4302 (0.1244)***	0.46	0.4640 (0.1290)***	0.41
Proportion population in labor force	0.6684 (0.7498)	0.30	0.5690 (0.7061)	0.29
Mean of dependent variable		**0.50**		**0.51**
Adjusted R^2	**0.27**		**0.38**	
Number of observations	**60**		**51**	
F	**4.16**		**5.37**	

* Significant at 10 percent level of significance.
** Significant at 5 percent level of significance
***Significant at 1 percent level of significance.

Table 22: Search for Talent: Classification of Towns for Locational Decisions

Type	A City	B City	C City
Locations	Delhi, Mumbai, Bangalore, Chennai, Gurgaon, Faridabad, Noida, Pune, Thane Satellites: Hyderabad, Kolkata, Ahmedabad, Baroda, Trichy, Kochi	Chandigarh, Jaipur, Kota, Goa, Nagpur	Meerut, Jodhpur, Bhopal, Patna, Nasik, Guwahati, Vizag, Pondicherry, Coimbatore, Gwalior
Talent pool availability	High	Medium	---
Costs	High	Medium-low	Low
Attrition	Very high (45%-50%)	Less than 15%	Less than 10%
English accent	Very little training required	Training required	High training required

Source: *The Economic Times*, October 5, 2004.

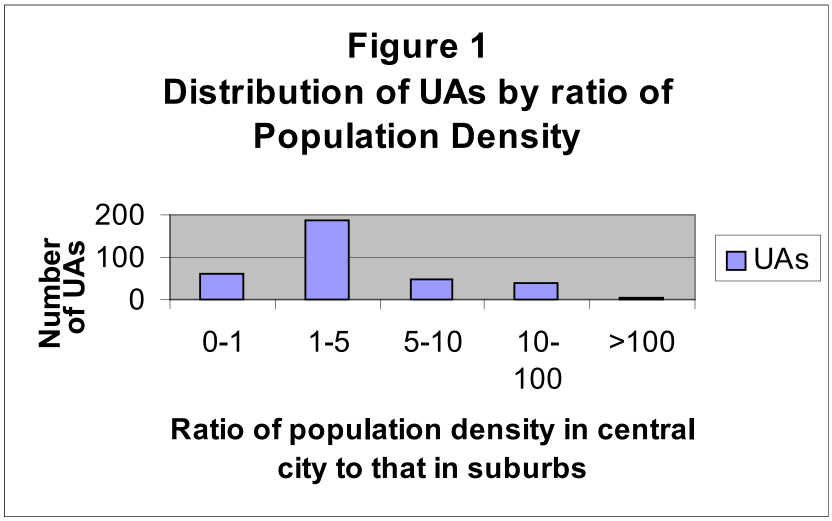


Figure 1
Distribution of UAs by ratio of Population Density
Number of UAs
200
100
0
UAs
0-1
1-5
5-10
10-100
>100
Ratio of population density in central city to that in suburbs

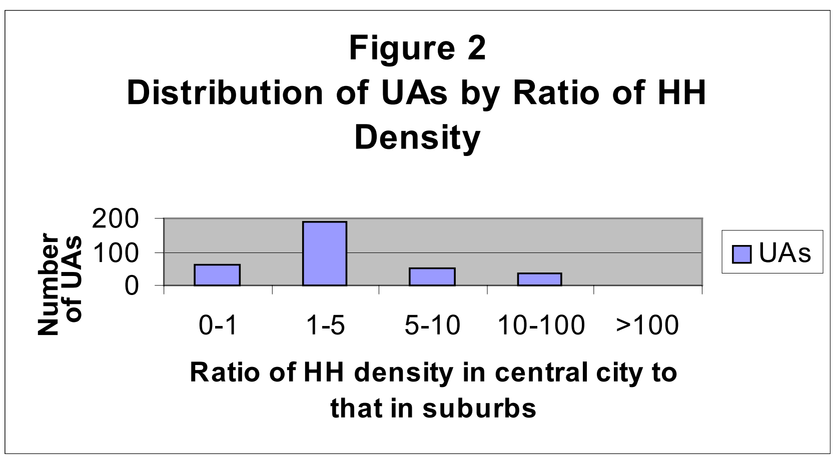


Figure 2
Distribution of UAs by Ratio of HH Density
Number of UAs
200
100
0
UAs
0-1
1-5
5-10
10-100
>100
Ratio of HH density in central city to that in suburbs

Figure 3
Distribution of UAs by Ratio of Employment Density

Figure 4
Distribution of UAs by Ratio of Mining employment density

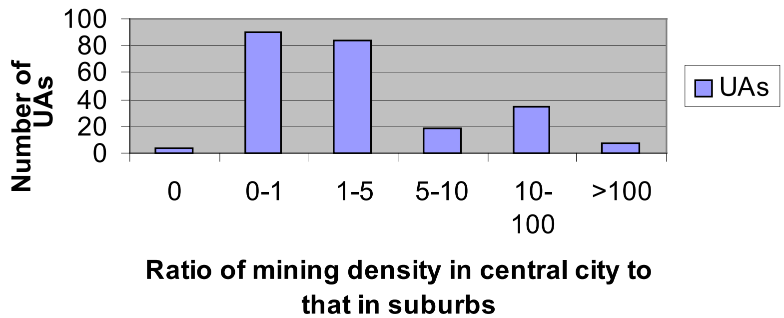


Figure 5
Distribution of UAs by Ratio of Manufacturing Employment Density

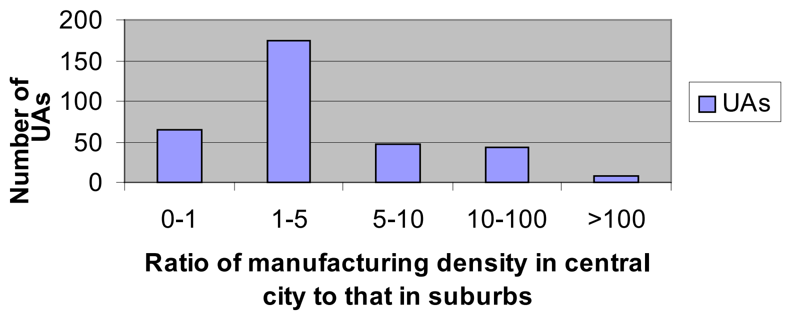
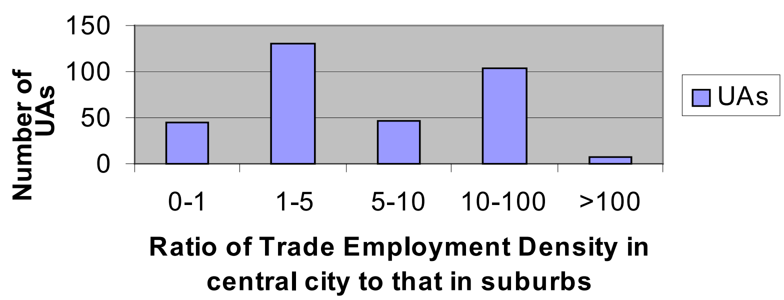


Figure 6
Distribution of UAs by Ratio of Trade Employment Density



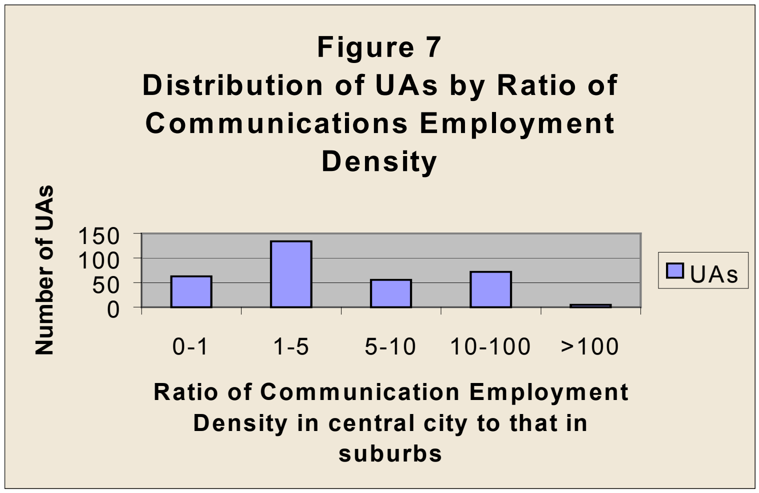


Figure 7
Distribution of UAs by Ratio of Communications Employment Density
Number of UAs
150
100
50
0
0-1
1-5
5-10
10-100
>100
UAs
Ratio of Communication Employment Density in central city to that in suburbs

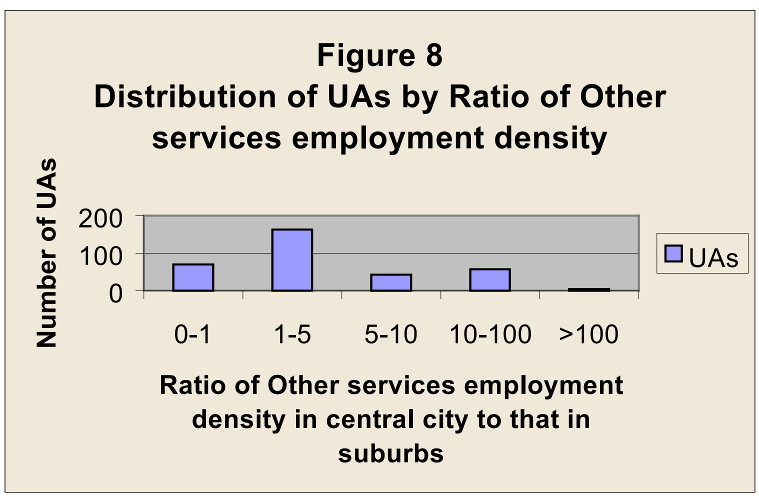


Figure 8
Distribution of UAs by Ratio of Other services employment density
Number of UAs
200
100
0
0-1
1-5
5-10
10-100
>100
UAs
Ratio of Other services employment density in central city to that in suburbs

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Endnotes

1. According to a study by the international property consultant firm CB Richard Ellis, the success of retailing in India depends on three factors: availability of retail space, supply chain parameters, and infrastructure such as highways.

2. In a study, Jones Lang LaSalle, India found a strong positive relationship between the market capitalisation of IT companies and their spending on land and building. This is a clear indication of the fact that as companies grow and their market capitalisation increases, their real estate spending also witnesses a directly proportional increase. This is intuitive to believe since Indian companies such as Infosys, WIPRO, Reliance Infocomm and Ranbaxy have used land as a vehicle to park their surplus funds.

3. This refers to erstwhile Bombay, renamed as Mumbai post-1991. Also, note that Madras was renamed Chennai, and Calcutta, as Kolkata. I use the old and new names of the metros interchangeably in the paper.

4. An UA, according to the Census of India (1981), is one with the following characteristics, and reports data separately for the core city (roughly the equivalent of CBD in American metro areas) and outside of the core city:

    a. A city or town with continuous outgrowth(s) the outgrowth being outside the statutory limits but located within the boundaries of the adjoining village or villages; or
    b. Two or more adjoining towns with their outgrowth(s); or
    c. A city with one or more adjoining towns with their outgrowths all of which form a continuous spread.

5. For 2001, the Census of India has not yet released land area data for UAs. Based on my discussions with them, it could take them time ranging from a few months to a year, to release this data.

6. A fundamental question could be whether India's urban areas are likely to evolve following the competitive model applicable in the US, or whether India's institutional framework could lead to a different evolution since there are stronger land use controls. Land use controls such as the Urban Land (Ceiling and Regulation) Act, 1976 existed in India. While this law was used to build an adequate stock of urban land for 'public interest' purposes such as road widening, development of open spaces and other 'public' facilities. This law was repealed with effect from January 11, 1999, the law continues to be in force in a handful of states (Maharashtra and Bihar). Further, rent control in Indian cities has thwarted the effective development of the land market by limiting property owners' incentives to maintain and renovate property.

It is likely that sometime in the near future, real estate in India could be freed of these controls. It is quite plausible to believe that Indian UAs are likely to evolve as in the competitive model of the US. One example is: although land use controls exist, free rural-urban migration is causing migrants to locate at the periphery of cities, and though not immediately, they are gradually annexed into the city limits, increasing the city's geographical boundary and of course its burden of public services. There are however, natural limits to their growth (optimum city size, as we know from general equilibrium models of city growth), and this could be reached much faster in Indian cities due to rent control (restrictions on supply of housing). This does allow the competitive model of individual migration decisions to determine city growth when land use controls exist. In fact a few Indian cities are specifically adopting a *laissez faire* approach to city growth. This somewhat lends support to the idea of using the natural evolution factors and flight from blight factors in the suburbanisation regressions, and variables that indicate the 'jobs follow people' or the 'people follow jobs'.

7. It is easy to conceive cities that have multiple employment centers. However, as long as employment density in the CBD is greater than it is in the suburbs, the monocentric urban model holds good. Also, following the literature (for instance, Small and Song [14]), I use 'monocentric' to mean any distribution which is approximately circular and symmetric around a single centre, not in the more restricted meaning of all employment being in the CBD.

8. Equation [1] is $D(r) = D_0e^{-br}$. Since $2\pi r$ is the circumference of a circle, expressions for L_C and L are derived as follows:

$$L_C = \int_0^{R_C} 2\pi r D(r) dr$$

Substituting for D(r) from [1], we get

$$L_C = \int_0^{R_C} 2\pi r D_0 e^{-br} dr$$

Integrating the expression above yields

$$L_C = \frac{2\pi D_0}{b^2}\,[1 - e^{-bR_c} - bR_c e^{-bR_c}]$$

Similarly for L,

$$L = \int_0^{R} 2\pi r D(r) dr = \int_0^{R} 2\pi r D_0 e^{-br} dr = \frac{2\pi D_0}{b^2}[1 - e^{-bR} - bR\, e^{-bR}]$$

9. The area of a circle is ΠR^2, R (radius of circle) can be solved for.

10. In the case of almost all the states, I called the state census offices to get land area data for UAs, where they were not available, or to verify them with what I had obtained from the 1991 data CD ROM. State governments in India get land area data from their local governmental units and then compile and pass them along to the central Census of India office in New Delhi that disseminates it.

11. The available data for 1981 enable me to calculate only the population gradient for 1981. Data on households and employment by sub-sector were not available separately for central city and rest of central city for the UAs in 1981. For 1991 these data are available and all the gradients reported in the text are calculated.

12. There were 221 UAs in the country in 1981, but their number had grown to 375 in 1991. Note the following caveats, however:

    a. A large number of UAs in the north Indian state of Punjab for 1991 had to be left out due to the lack of disaggregated land area data, bringing the 1991 UA sample to about 340.
    b. There were a large number of UAs in 1981 that were no longer enjoying the UA status in 1991, since they were de-classified. And, obviously enough, a large number of new UAs had developed by 1991. This is to claim that there were only about 80 UAs for which both 1981 and 1991 data were available, and gradients could be calculated and compared. This also explains why the sample for all regressions that include the lagged value of the population gradient is small. But yet, a substantial part of the explanatory power in all models comes from lagged values of the population gradient.

13. The gradients were calculated using Visual Basic. Out of the 340 UAs, gradients were calculable for roughly 150 of them, due to the nature of land area data. For instance, whenever the central city and UA land area data were not very different, the gradient could not be calculated. I changed the tolerance limits to greater levels, even then, some of them were not calculable.

14. Scheduled castes (SC) and scheduled tribes (ST) in India have been traditionally socially repressed, so it is possible to believe that their presence would deter the location of ‘higher-caste’ population and households in a given area.

15. The town groups are: Over 500,000 population; 200,000-500,000 population; 100,000-200,000 population; 50,000-100,000 population; 20,000-50,000 population; and <20,000 population. The annual incomes for 1996-97 are in 1998-99 prices. The income groups used by NCAER are: Upto INR 35,000; 35,001-70,000; 70,001-105,000; 105,001-140,000; Above 140,000. I take the mid-point of income for each of these categories, and calculate a weighted average of household income, where the weights are the estimated number of households in every income category. UAs' income vary depending on their population and their state of location. So all UAs above 500,000 population within any given state would have the same average annual household income. This works well in most cases, not well in some others. But this is the only resort since income data at the city level are not available in any other data source.

16. Another possible candidate for indicating relative attractiveness of the central city is the property tax rate by UA (at this point, it is impossible to think about central city and UA ratios for property tax rate, based on data available). The property tax is the only one levied at the local level in India, apart from the octroi on businesses where they exist. The ratio of the property tax revenue to the taxable value of property would give us a measure of property tax rate. Let alone in a centralised fashion for all 375 UAs in the country, although data on property tax revenue are available (not in centralised manner), data on the assessed value of taxable property is unavailable even for Delhi. This is because most cities in India continue to follow the annual rateable value (ARV) method of property valuation that is very subjective, when compared to the unit area method, which is more objective and makes property valuation and assessment depend on characteristics of the property. Delhi has taken steps to move towards unit area method very recently. This means that the property tax base is subjective and is best not shared with public. A number of states in the country have recently abolished octroi on businesses, as it is distortionary, distorts prices of goods and gives rise to a number of discretionary practices that become breeding ground for corruption, and its high cost of collection.

    Because of these considerations, the tax base of cities in India is much less buoyant than it is in countries such as the United States and tax rates are less likely to be a factor influencing suburbanisation. However, the level of public services could be a factor influencing suburbanisation, and the number of local governments in the UA is indicative of the extent of competition in local public service delivery.

17. In the Indian context, this is important since BPO, call centres and other IT-enabled services depend heavily on the quality of manpower available.

18. As mentioned earlier, employment gradients for 1981 could not be calculated for inclusion owing to lack of such disaggregated data for 1981.

19. Greater Mumbai was not an UA in 1981, so comparable data are not computable.

20. The other 6 cities that Mills and Tan (1980) summarise gradients for 1951 and 1961, are either not UAs any more, or gradients were not calculable for them.

21. Note that gradients summarised by Mills and Tan are estimated, whereas those in this study are calculated.

22. Household and employment density gradients or the proportion of households and employment suburban could not be calculated for 1981 as analogous data were not available. For 2001, the Census of India has not yet released land area data for UAs.

23. A lower value of the gradient is consistent even with a small proportion of population living in the suburbs. Recall t he gradient refers to the *slope* of the density function with respect to distance from the CBD. This implies that in this UA, not only is the proportion suburban small, but also that the UA has a very flat density function, that is, the density is declining very slowly as we move away from its CBD.

24. These estimations were based on only 15 observations.

25. Note that wage costs (as measured by emoluments as percentage of value of output) are not available in a disaggregated fashion for central city and suburbs, but are for the state in which the UA is located.