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IMPACT OF LAND USE REGULATIONS ON SUBURBANISATION: EVIDENCE FROM INDIA'S CITIES

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IMPACT OF LAND USE REGULATIONS ON SUBURBANISATION: EVIDENCE FROM INDIA'S CITIES[1]

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Abstract

India is characterised by strong land use controls, but their impacts have drawn little attention. I study the impact of the restrictive land use controls such as floor area ratio, and urban land ceiling on population and employment suburbanisation in India's urban areas. Using standard econometric techniques, I find that population suburbanises in response to relaxation of FAR norms in the suburbs. However, land use regulations do not have any impact on employment suburbanisation.

Introduction

The suburbanisation of metropolitan areas in countries such as the United States and Canada has drawn a lot of attention from the researchers (Mills and Price, 1984; Mills, 1992; Margo, 1992; Mieszkowski and Mills, 1993; Small and Song, 1994). For a large developing country, and a highly planned, socialist economy like India that contains a large number of urban agglomerations (UAs), and is characterised by strong land use controls, suburbanisation has drawn very little attention, primarily due to lack of detailed spatial data thus far. However, we do observe that population suburbanisation has been historically continually occurring in India's UAs. India's decennial censuses indicate that while on average, 21 percent of Indian UAs' population was suburban in 1991, over the

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period 1981-91, there was a certain 3 percent increase in the average proportion of population living in the suburbs of UAs.[ii]

In this paper, I study the impact of land use control and regulation on India's suburbanisation, something that has been studied very little by past literature, in the context of developing countries. Answering this question presents a few critical implications for making land and housing more affordable in India's cities and determining their optimal growth.

Research: Objectives and Scope

Given the importance of land use regulations in the context of a planned and socialist economy like India, I make an attempt in this paper, to understand their impact on suburbanisation. I answer the question: What is the impact of land use regulations on suburbanisation in India's Urban Agglomerations (UAs)? I focus on two aspects of land use regulations – floor area ratio (FAR) or Floor Size Index (FAR) restrictions, and urban land ceiling. The following section summarises the literature briefly so the contribution of this work may be assessed.

Relevant Literature

Thus far, only a few papers (Bertaud and Malpezzi (2003), Jain (1993), Sridhar (2004) and Sridhar (2007)) focus on suburbanisation in developing countries. Bertaud and Malpezzi (2003) study the spatial distribution of population in 48 cities of the world, of which a few cities from India are included.[iii] Jain (1993) studies the emerging trend in the suburbanisation of India over 1971-81, but does not analyse suburbanisation as much as the composition of Standard Urban Areas. It also does not perform any more systematic analyses other than calculating trends or dealing with their impacts.

Sridhar (2004) and Sridhar (2007) examine the extent of population and employment suburbanisation in India's UAs and attempt to explain for the first time, the determinants of population suburbanisation in India's context as being dependent on market driven factors such as income, population and a host of blight-related factors. Sridhar (2007) also

examines in detail a major Indian city, Bangalore's suburbanisation and finds that it indeed has suburbanized during the 1991-2001 period. It, however, fails to account for the extraordinary role played by land use regulations in India's cities. Only Bertaud and Malpezzi (2003) discuss the impact of extremely repressive land use regulations which caused the density gradients in cities of planned economies such as South Korea, Russia and South Africa to be virtually flat, i.e., invariant with respect to changes in distance from the city center. Apart from this, the literature dealing with land use regulations and their impact on urban form is quite limited.

Overall, one stream of literature on traditional urban models relies on a market-based model (which Mieszkowski and Mills, 1993 call as natural evolution theory) of the evolution of urban spatial structure, in the absence of land use controls. This market-based approach takes into account the impact of rising incomes, transportation technology, and population, on the density gradient. This theory postulates that as new housing is built at the periphery of cities, high income groups, who prefer larger amounts of housing, settle there. Further, increases in real income make expensive modes of transportation like the automobile more affordable. Finally, suburbanisation occurs in large metro areas because of retail services and lower land costs in the suburbs.

A second theory proposed by the literature is that poor central city living conditions such as high tax rates, poor quality of public services, crime, density, congestion, pollution, lack of free space, and high unemployment persuade people to live farther away from the central city. This explanation of suburbanisation has been referred to as the flight from blight hypothesis. Mills and Price (1984) examine the flight from blight hypothesis and find it does not explain the postwar suburbanisation of the United States.

A fundamental question to ask is whether India's urban areas are likely to evolve following the competitive market model applicable in the U.S. (natural evolution as well as flight from blight hypotheses), or

whether India's institutional framework leads to a different evolution since there exist stronger land use controls.

It is likely that with continued economic reforms, India's UAs are likely to evolve as in the competitive model of the U.S. However, as of now, given the importance of land use regulations, it is necessary to assess their impact on suburbanisation of India's cities. Sridhar (2004) and Sridhar (2007) make the first couple of attempts to study and explain the suburbanisation of India's cities, but are unable to factor in the extraordinary role played by land use controls and their impacts.

This paper is thus an attempt to fill this void in the literature by examining the impacts of land use regulations such as floor area ratio and urban land ceiling on suburbanisation in India's UAs. The next section elaborates on the various land use controls in place in India's cities and their impacts.

Land Use Controls and Regulation in India's Cities

The objective of land use controls everywhere is to ensure orderly and planned development of cities and public services. The severity of such controls is determined by local socio-economic, technical and environmental conditions. While land use regulations are meant to prevent undesirable impacts at the local neighborhood level, they often impact the overall shape of a city and the overall efficiency of land use in a negative way, usually ignored by urban policies (Bertaud (2002)).

Two aspects of land use in India's cities – floor area ratio, which is an indicator of the capital-land ratio allowed in each city, and urban land ceiling, are described below.

Urban Land Ceiling

The Urban Land (Ceiling and Regulation) Act (ULCRA) of 1976, was originally enacted in India with socialist objectives. This law stipulated that individuals or firms cannot hold vacant land beyond a certain size (which varies across metro areas). If they do, they have to declare and sell the extra land to the government for what is considered quite low

price by market standards. The law was adopted by several states,[iv] and was used by local urban authorities in these states to build an adequate stock of urban land for 'public interest' purposes such as road widening, development of open spaces and other 'public' facilities. There is little empirical evidence to show as to whether or not the land so 'taken' was actually used by the government for genuine 'public' purposes. This law artificially restricted the supply of urban land, bid up its price, and encouraged corruption (see Joshi and Little, 1991).

After economic reforms began, this law was repealed with effect from January 11, 1999 through an ordinance. While most of the states have now repealed the act, the law continues to be in force in a handful of states.[v] The effect of this law in urban areas of the country and in states where they exist, must have been to artificially restrict the supply of land within an UA's jurisdiction and also to spatially spread them out much more than they would otherwise, something that is testable.

Floor Area Ratio

Building regulations have existed in cities across the world since the period of Greek city states. These regulations were intended to prevent haphazard development, safeguard the interests of neighbors and avert congestion and chaos around human settlements. However, as Bertaud (2002) points out, urban policy in India continues to be guided by and in fact, reduced to the naïve principle of 'reducing central city congestion.'

Floor area ratio is the most readily available measure of the capital-land ratio. The monocentric urban model predicts that floor area ratios fall with distance from the central business district. The reason is that low commuting costs for sites near the city centre lead to high land values, which in turn lead to high floor area ratios. This is quite a contrast to what we observe in India's cities, with increasing FAR toward the city's periphery where the land values are relatively lower.

In India's cities, the FAR determines the total built up space that a plot is allowed to hold, subject to the following, according to the Town and Country Planning Organization (TCPO, 1999):

Land availability and requirements;

Household densities and dwelling sizes; and

Availability of parking.

Having noted this, a draconian land use control in place in India's cities refers to extremely low maximum FAR (which is only 1.33 in Mumbai's central business district) in the centre of cities.[vi] In most large cities around the world, the FAR varies from 5 to 15 in the Central Business District (CBD) to about 0.5, or below, in the suburbs (Bertaud, 2004).[vii] In most large cities of the world, as technology and infrastructure improve, the FAR (FAR) in the city center tends to increase.[viii] In general, the severity of regulation usually varies in inverse proportion with city size (the low FAR in Mumbai would be an exception), a hypothesis that is testable.

One could argue that existing infrastructure in developing countries is insufficient and so higher densities (presumably brought about by a higher FAR) cannot be absorbed, which appears to be the basis of TCPO's (1999) stated guidelines. However, usually with an increase in the FAR, the population or employment density tends to actually decrease; While this might seem counterintuitive, it happens because an increase in FAR is associated with an increase in floor space per person or per job (where the increase in FAR is for commercial or industrial purposes). So more floor space is built on the same unit of land, but people and enterprises consume more of it, so population and/or employment density tends to decrease. Of course, whether density would increase or decrease following an increase in FAR depends on the FAR-elasticity of demand for built area. If there is a more than proportionate increase in built area in response to an increase in the FAR, then population and/or employment density increases. The infrastructure will have to be redesigned and rebuilt in the areas where a large FAR increase is projected. If the actual increase in floor area consumption were to be less than that in the FAR regulation, density decreases.

Most cities of the world have a policy to increase FAR with time. This progressive increase in FAR has two purposes, as Bertaud (2004) points out; first, it allows households and firms to consume more floor space as their incomes increase without having to move to new areas in the suburbs; and second, an increase in FAR contributes to a decrease in the city spatial expansion (suburbanisation), and transport costs. In addition, in most cities, planners practically always establish the regulated FAR at a higher level than the FAR of existing buildings. This practice encourages the redevelopment of obsolete buildings.

Without higher FAR, real estate projects are also usually not financially feasible. Because of low FARs, a few buildings also get renovated and the city is left with a lot of redundant space (see endnote 8 for evidence of this in Mumbai). With very low FARs, the city expands unnecessarily and also in a few suburbs where higher FARs are allowed. This leads to financial infeasibility of public transport originating from these areas.

The extraordinarily low FAR in Mumbai and other Indian cities has also led to an artificial increase in rents per square foot and land prices which have unfavorably impacted the urban poor who have had to consume lower floor area space (some of the lowest in the world, see Bertaud (2004)), because they cannot compete with the increased consumption of more affluent households. The poor are, therefore, progressively pushed out of formal housing into slums or footpath dwellings. The evidence presented by Bertaud (2004) is that households in Mumbai consume an average of only 2.9 square meters of floor space per person, which is one of the lowest residential floor areas per person anywhere in the world (Bertaud, 2004), and more than half of Mumbai's population lives in slums. Bertaud (2004) emphatically argues that an increase in FAR within the municipal limits in Mumbai would enable doubling of the total floor space area over 10 years (as was done in Shanghai).[ix]

Higher FARs are often permitted in the suburbs of India's cities, as in the case of Chennai (where a maximum of 4.25 is allowed in some areas, according to its current master plan). But they are usually maintained at a low level in the central city, which is considered poor public economics. This is because plots of land, which are fully serviced but are not fully used, impose a cost on the community (Bertaud, 2002).

In fact, Bertaud and Brueckner (2003) compute that, in Bangalore, consumer loss from FAR restrictions represent 3-6 percent of household consumption! Savage and Dasgupta (2006) find that in Bangalore, the one way commute time to work increased from about 24 minutes in 1991 to 40 minutes in 2001. Further, the extraordinarily low FARs in India's cities have also contributed to its violations.[x]

Thus there are strong reasons to believe why restrictive land use regulation contributes much more to density pattern, homelessness and suburban expansions than market forces in India's cities. Having noted the importance of land use regulations, I make an attempt to study the impact of such regulations on suburbanisation in India's urban areas.

The next section summarizes succinctly the theory of suburbanization, followed by models and data analysis.

Suburbanisation: Theory

Broadly, suburbanisation is the process where the percentage of population living in the suburbs rises. In the literature, the density gradient is used as a standard measure of population and employment suburbanisation. The gradient shows how population or employment density (number of persons living or working per square mile or kilometre) changes with distance from a central point in the city (in a monocentric urban model), usually the CBD. In a more narrow sense, b-suburbanisation is the process that occurs when the absolute value of the gradient falls, and the city's density gradient flattens out. As in the standard theory, gradients can be estimated or calculated.

Population (household or employment) density (per square mile or kilometre) for census tracts (wards) and distances of the tracts (wards) from the city centre are data required to estimate density gradients. Given the estimation of gradients is a very data intensive process requiring population, household or employment density and land area data at a very disaggregate level (usually census tract, block or ward), (Mills, 1972) demonstrated through the two-point method, that from data on just four points in the city, central city land area, metropolitan land area, central city population, and metropolitan area population, one can calculate rather than estimate it. The two point method for a large city would not be very effective in capturing the complexity of the process of "degenerated peripheralisation", which is manifest in many cases. While it is well-known that using ward-level data on densities and their distances from the city center and analysis of their characteristics would give better insights into the dynamics of city growth, due to non-availability of such detailed intra-city data on land area in most cities, I use the gradients for India's UAs calculated using the two-point method. Details of the two point method are fairly standard.

The next section describes the model, methodology and data sources of the work.

Data Sources, Model, and Methodology

I was able to calculate gradients for 150 India's major UAs, using the two-point gradient method, utilizing data on land area and population of the central city (municipal corporation limits) and the UA from the Census. I gathered primary data on land use regulations for several UAs for which gradients were calculated. I explain the calculated gradients as a function of various market-based, and regulatory factors. While the explanation of India's suburbanisation as being dependent on various natural evolution and flight from blight factors has been made by Sridhar (2007), this paper focuses on land use regulations.

Data on Land Use Regulations

I obtained data on regulations pertaining to the maximum FAR allowed in cities. These primary data were obtained by calling several cities for which density gradients were calculated. For this purpose, a database was built of more than 100 cities in the country with their town planning contacts, with the help of the Internet and assistance of the MoUD. A detailed letter requesting the maximum permissible FAR for various land uses (specifically residential, industrial and commercial uses) was sent to each city for this purpose. In most instances, cities and/or development authorities sent information summarizing the maximum permissible FAR by land use for their city. In instances where cities or development authorities sent me the entire copy of their building bye-laws and master plan along with relevant documents, I had to review the entire set to come up with the three maximum permissible FAR numbers for the various land uses in those cities.

Based on this work, three sets of FAR information were generated for every UA – the maximum permissible FAR for residential uses, the maximum permissible FAR allowed for commercial and industrial purposes. While the maximum residential FAR impacts population and household suburbanisation, the maximum permitted non-residential FAR (for commercial and industrial uses) can be expected to impact suburbanisation of jobs.

Based on my discussions with the town planning departments in various cities, the FAR depends on individual site dimensions, land use (residential, commercial or industrial) for which the area is zoned, and the degree of the zone's development. The FAR in most Indian cities is determined by a variety of factors including economic characteristics described above, those specified by the TCPO (1999) and ecological factors (such as whether or not city is prone to earthquakes, looseness of the soil (which impacts building safety).

The maximum FAR throws light on the extent of restrictions on land use. The higher the maximum permissible FAR in a city, the lower is the restriction, as discussed earlier.

Other relevant land use regulations regarding which data were obtained was ULCRA. As discussed earlier, ULCRA, by restricting the supply of land, causes excessive spatial expansion of the city (and should lead to a lower absolute value of the density gradient). Urban land laws being a state subject, the status of ULCRA in India's cities is determined by state-level legislation. Data on the status of ULCRA (whether repealed or not) in all the Indian states and union territories was obtained from the MoUD.

Models

Based on the data obtained from this research, I estimated several models of density gradients (representing suburbanisation) applicable to cities in India, using the equation below.[xi]

$$b_j^* = f_i(y_j) + \xi_j \qquad (1)$$

As in previous literature, b_j^* in (1) is the equilibrium value of the population (household or employment) density gradient b for 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 including market-based factors and those indicating land use regulations. As always, ξ_j is the random error term.

The empirical versions of the population and employment density gradient functions to be estimated are as shown in equations (2) and (3). The expected relationships of the variables with the population and employment density gradients are summarized, along with variable descriptions and data sources in Table 1.

$$b_j = \alpha_0 + \alpha_{PPOP} POP_j + \alpha_{PY} Y_j + \alpha_{PJS} JS_j + \alpha_{PN} N_j + \alpha_{PUN} UN_j + \alpha_{PSCST} SCST_j + \alpha_{PLIT} LIT_j + \alpha_{PLAG} PLAG_j + \alpha_{PFAR} PFAR_j + \alpha_{PULCA} PULCA_j + u_j \qquad (2)$$

$$b_{Ej} = \beta_0 + \beta_{EPOP} POP_j + \beta_{EN} N_j + \alpha_{EW} W_j + \beta_{ELF} LF_j + \beta_{ESCST} SCST_j + \beta_{ELIT} LIT_j + \beta_{EPLAG} PLAG_j + \beta_{EPS} PS_j + \beta_{EFAR} EFAR_j + \beta_{EULCA} EULCA_j + e_j \qquad (3)$$

Table 1: Variable Descriptions, Expected Relationships with Density Gradients, and Data Sources

Vari-able Name	Variable Description	Expected relationship with population/ household density gradient	Expected relationship with employment density gradient	Rationale	Data source
POP_j	Population of UA j	Negative	Negative	Market based	Census of India Primary Census Abstract (PCA)
Y_j	Annual household income in UA j	Negative	NA	Market based	National Council of Applied Economic Research
W_j	Wage costs in UA j	NA	Negative	Market based	Central Statistical Organization Annual Survey of Industries
JS_j	Proportion jobs suburbanized in UA j	Positive	NA	People follow jobs	Census of India PCA
PS_j	Proportion population suburbanized in UA j	NA	Positive	Jobs follow people	Census of India PCA
LF_j	Labor force as a % of population in UA j	NA	Positive	Employment history of a city	Census of India PCA
N_j	Number of local governments in UA j in 1981	Negative	Negative	Tiebout hypothesis	Census of India PCA
UN_j	Ratio of unemployment rate in the central cityto that in the suburbs in UA j	Negative	NA	Flight from central city blight	Census of India PCA
$SCST_j$	Ratio of scheduled castes and/or scheduled tribes[xii] (SC/ST) as proportion of total population in central city to that in suburbs, in UA j	Negative	Negative	Flight from central city blight	Census of India PCA
LIT_j	Ratio of literacy rate, as a proportion of population above 6 years of age, in central city to that in suburbs, in UA j	Positive	Positive	Flight from central city blight	Census of India PCA
$PLAG_j$	Lagged value of population gradient (for 1981) for UA j	Positive	Positive	Convergence	Census of India PCA
$PFAR_j$ or $EFAR_j$	Maximum FAR/FAR allowed in city/UA j for residential or commercial/industrial purposes	Positive	Positive	Restrictive land use regulation	Individual cities
$PULCA_j$ or $EULCA_j$	Dummy=1 if ULCRA is not repealed in the state in which city/UA j is located, 0 if repealed	Negative (if dummy=1 for ULCRA's continued existence in state)	Negative	Restrictive land use regulation	MoUD

Sources: Theory, Standard literature, and Author's analysis.

Rationale for Models, Data Sources and Expectations regarding Variables

As in the standard literature, the population and income variables are included in the population and household suburbanisation equations to test the effect of market-based factors. It is well-known from the literature and casual observation that larger metropolitan areas are more suburbanized than smaller ones. Data on population and land area (both of which are needed for calculation of density gradients) are from the Census Primary Census Abstract (PCA).

Annual household income is included in the population and household suburbanisation equations to study if richer UAs are any more suburbanized than poorer ones, since their households can afford the automobile that makes living farther away from the central city more plausible. Data on annual household income are from the National Council of Applied Economic Research (NCAER).[xiii]

The ratio variables in the population, household and employment density gradient equations – ratio of proportion of SC/ST in the central city to their proportion in suburbs, ratio of literacy rate in central city to the literacy rate in suburbs, and finally, ratio of unemployment rate — are meant to test the flight from central city blight hypothesis.[xiv] The ratio of unemployment rate in the central city to that in the suburbs is taken as an indicator of central city blight. The unemployment rate was computed as the ratio of marginal workers in the Census (PCA) to those in the labor force (main plus marginal workers).[xv] This rate was computed separately for the central city and other parts of the UA, and the ratio was taken of the central city to suburban unemployment rate.

The other ratio variables – ratio of literacy rate in the central city to that in the suburbs, and the ratio of SC/ST in the central city to that in the suburbs were computed from the Census PCA.

The number of local governments in the UA is an indicator of competition in the provision of public services. Because the current (1991)

number of local governments in the UA could be endogenous with population/household suburbanisation, the number of local governments in the UA in 1981 (from the Census) was used as an instrument/exogenous measure of competition in public services.

The 1991 proportion of jobs suburbanized in the UA (also from the Census PCA, employment data were not available for UAs for any year other than 1991) is included as a regressor in the population and household gradient equations to test whether 'people follow jobs,' as this is a question that remains unresolved in the literature (see Partridge and Rickman, 2003, for some evidence). While the extent of jobs suburbanized is crucial for household location decisions, population suburbanisation is important for firms, since it indicates the availability of skills.[xvi] I include in the employment gradient equation, the proportion of population suburbanized to test whether jobs follow people.

The reason for including the lagged value of the population gradient in all equations, calculated from the Census, is to test whether the actual value of b adjusts to its equilibrium value with a lag, as (Mills and Price, 1984) point out.

The proportion of population in the labor force speaks for the work culture of the population. This implies that the employment history of a city could be important, and hence needs to be accounted for when studying employment suburbanisation. The ratio of population in the labor force was calculated as the total number of full-time workers plus workers looking for work (marginal workers), from the Census, as a proportion of population for every UA.

For measuring wage costs which are expected to impact suburbanisation of jobs, I used data on total worker emoluments as a proportion of the total value of output for Indian states (in which the UAs are located), from the Annual Survey of Industries for 2001-02, published by the Central Statistical Organization (http://mospi.gov.in/mospi_asi.htm, Table 2.1).

For purposes of this work, primary data was collected on land use regulations—the maximum permissible FAR for various land uses, for more than 100 UAs in the country from their city planning departments or development authorities. Data on ULCRA status was obtained from the MoUD for all states containing the UAs, as discussed earlier. The expected impacts of these variables on the extent of suburbanisation are clear. Since floor area ratio defines the capital-land ratio, it determines the built space; when it is low, it causes excessive horizontal city growth and suburbanisation. Hence its expected impact on the population, household and employment density gradients is positive.

It could well be the case that more crucial factors which determine the past suburbanization of population explain employment suburbanization. These could be lagged values of factors such as land use policies and other exogenous factors determining the past suburbanization of population in the city (see equation 2). Since such historical data are not available, an explanation of employment suburbanization is confined to what is practical.

It should be noted that the population (household) and employment gradient equations (2) and (3) are econometrically identified. While household income determines population suburbanisation, wage costs explain suburbanisation of employment. The local unemployment rate determines population suburbanisation (assuming information regarding jobs), but not so for employment suburbanisation. Further, the size of the labor force is an important factor affecting suburbanisation of employment, but not that of population. The proportion of jobs suburbanized is a potential determinant of the extent of population suburbanisation, whereas it is the extent of population suburbanisation that would be important for firms in their locational decisions. Finally, residential FAR determines population or household suburbanisation whereas FAR for commercial and industrial purposes, determines suburbanisation of jobs.

Controlling for other factors, this research throws light on the extraordinary role of land use regulations in the growth and suburbanization of India's cities. It has clear implications for such regulation in India's cities, which, if addressed, would make city growth optimal and housing more affordable. The next section describes the intriguing findings from the research.

Impact of Land Use Controls on Population and Household Suburbanisation

I estimated equations (2) and (3), along with several regressions of the dependence of employment sub-sectors including manufacturing, transport & communications, and trade & commerce on relevant factors including land use regulations. Tables 2-7 summarize these results.

Table 2 summarizes the population suburbanisation regression as a function of market-based factors, those indicating flight from blight, and land use regulation controls such as residential FAR, and the existence or otherwise of land ceiling (represented by ULCRA). The regression results in Table 2 show that land use controls such as FAR, demographic characteristics such as the ratio of SC/ST in the central city when compared to that in the suburbs and the lagged value of the population gradient are the most significant in explaining population suburbanisation in India's cities.

The ratio of SC/ST in the central city to that in the suburbs has a negative impact on the extent of suburbanisation. This means that the higher the ratio of SC/ST in the central city as compared to that in the suburbs, greater would be the extent of population suburbanisation, reflecting flight from this community. As expected, the lagged value of the population gradient has a positive and highly significant impact on the population gradient. That is, the greater the extent of a city's population suburbanisation in the past, the greater the extent of population suburbanisation in the present as well, and vice-versa. This implies that a city's historical evolution, and spatial patterns of work and home continue

to dominate its current spatial structures, a fact that is well borne out by the case of Kolkata (see Chakravorty (2000)).

The severity of land use regulations such as FAR has a negative and significant impact on population suburbanisation, while its expected impact is positive. This means that more liberal and higher FARs cause the city to be more suburbanized (with a lower absolute value of the gradient).

Given the pattern of land use regulation in India, the actual negative impact we find here is plausible. Most city-level land use policy in India is directed at the simple (often naïve) principle of reducing congestion in the central city (also see Bertaud 2000), with the result that in actual practice higher FARs are allowed only in peripheral areas of the city. This means that higher floor consumption is encouraged in the suburbs, which is presumably the reason why we observe increased suburbanisation with higher FARs in the population suburbanisation regression. These results indeed imply that allowing higher FARs do encourage higher floor area consumption and attract population. So, if higher FARs were allowed in the city center, population would be attracted there. The spatial clustering of population in the city centre (supported by infrastructure) would ensure smaller and more compact cities, instead of the greatly suburbanized cities we observe. The model in Table 2 explains more than 50 percent of population suburbanisation.

Table 2: Impact of Land Use Regulations on Population Suburbanisation
Dependent Variable: Population Density Gradient

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	0.5539**	0.2807	1.9737	
Population (in thousands)	0.0000	0.0000	-0.6657	869.04
Income (in thousands)	-0.0040	0.0028	-1.4326	63.88
Proportion jobs suburbanized	-0.1176	0.1275	-0.9224	0.30
Number of local governments, 1981	0.0026	0.0038	0.6803	6.60
Ratio of unemployment rate in central city to that in suburbs	0.0031	0.0079	0.3951	1.58
Ratio of literacy rate in central city to that in suburbs	0.1639	0.1702	0.9631	1.03
Ratio of SC/STs in central city to that in suburbs	-0.1340*	0.0752	-1.7825	0.81
Lagged (1981) value of population gradient	0.5705***	0.0966	5.9032	0.47
Maximum permissible residential FAR	-0.0745**	0.0349	-2.1355	2.34
ULCRA (1=Yes; 0=No)	0.0521	0.0475	1.0969	0.40

Sources: Census of India PCA, Primary data from cities and states, and National Council of Applied Economic Research (NCAER) and Author's computations and analyses.

General notes: Number of observations=68.
R^2 =0.57
Adjusted R^2 =0.50
Dependent variable mean=0.44

*Statistically significant at 10 percent level
** Statistically significant at 5 percent level
***Statistically significant at 1 percent level

Table 3 summarizes the household suburbanisation regression as dependent on land use controls along with other characteristics. As Sridhar (2007) points out, the urban model is as much, indeed, more applicable to households than to population. This is because the unemployment rate, literacy rate, tax rate and public services affect household locational decisions more than that of individuals. Hence it is appropriate to estimate a model of household suburbanisation.

The findings from the household suburbanisation regression are similar to what they are for population suburbanisation, with the residential FAR continuing to exert a negative and significant impact on household suburbanisation as well. Thus we find robust impacts of the FARs on population and household suburbanisation, as one would expect, given the extraordinary role land use controls play in India.

Table 3: Impact of Land Use Regulations on Household Suburbanisation

Dependent Variable: Household Density Gradient

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	0.3242	0.2574	1.2595	
Population (in thousands)	0.0000	0.0000	-0.6439	869.04
Income (in thousands)	-0.0026	0.0026	-1.0241	63.88
Proportion jobs suburbanized	-0.0766	0.1169	-0.6553	0.30
Number of local governments, 1981	0.0021	0.0035	0.6029	6.60
Ratio of unemployment rate in central city to that in suburbs	0.0034	0.0072	0.4725	1.58
Ratio of literacy rate in central city to that in suburbs	0.2389	0.1561	1.5307	1.03
Ratio of SC/STs in central city to that in suburbs	-0.1203*	0.0689	-1.7449	0.81
Lagged (1981) value of population gradient	0.5431***	0.0886	6.1272	0.47
Maximum permissible residential FAR	-0.0589*	0.0320	-1.8409	2.34
ULCRA (1=Yes; 0=No)	0.0264	0.0435	0.6071	0.40

Sources: Census of India PCA, Primary data from cities and states, and National Council of Applied Economic Research (NCAER) and Author's computations and analyses.

General notes: Number of observations=68
R^2 =0.57
Adjusted R^2 =0.50
Dependent variable mean=0.41

*Statistically significant at 10 percent level

***Statistically significant at 1 percent level

The variable representing urban land ceiling (ULCRA) is not significant in either regression. This implies that stipulated legal ceilings on urban land, while restricting its supply, are not significant enough to impact population or household suburbanisation, or broadly, city growth.

One possible explanation for the suburbanisation of population and households is that regulation of land use is more relaxed in the periphery of cities, with the result that migrant population finds it less difficult to reside there. Further, a large number of cities in India have recently adopted a policy of 'sanitization through eviction' of the poor from the central cities. Given it is difficult to generate data on cities' programs of slum relocation for use in various models proposed in this paper, I rely on qualitative reasoning and anecdotal evidence. For instance, the zeal of the political elite to turn Bangalore into a Singapore has resulted in extensive evictions and demolitions of settlements, especially small business clusters in productive urban locations (Benjamin 2001). The demolished land is reallocated by master planning to higher income interest groups, including corporations. Similarly in Delhi, Chatterjimitra (1992) finds that the government has utterly "subverted the objectives of supplying land for low income housing" by allowing it to be poached by the middle classes - the development authority has targeted nearly half million squatters for eviction or "voluntary relocation."

Such relocation of the poor and of slums outside of the central city can be one possible explanation of the population and/or household suburbanisation we observe here. However, it should be remembered that slum evictions and beautification of central cities are relatively recent phenomena, whereas the dependent variable data are from 1991. The 2001 Census data on land area had not yet been released for UAs at the time when the work for this paper was completed.

Impact of Land Use Regulation on Suburbanisation of India's Employment

Tables 4-7 summarize the impact of various land use controls and other characteristics on the extent of employment suburbanisation in India's UAs.

Table 4: Impact of Land Use Regulations on Employment Suburbanisation

Dependent Variable: Employment Density Gradient

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	0.2429	0.2524	0.9623	
Population (in thousands)	-0.0001**	0.0000	-2.1372	865.32
Number of local governments, 1981	0.0060	0.0038	1.5710	6.60
Worker emoluments as a proportion of value of output for state	1.7022	2.1510	0.7914	0.06
Proportion in labor force	-0.3128	0.6001	-0.5213	0.30
Ratio of literacy rate in central city to that in suburbs	0.1034	0.1779	0.5810	1.02
Ratio of SC/STs in central city to that in suburbs	-0.0675	0.0714	-0.9452	0.81
Lagged (1981) value of population gradient	0.4876***	0.1038	4.6967	0.48
Proportion population suburbanized	-0.2771**	0.1342	-2.0655	0.30
Maximum permissible non-residential FAR	0.0005	0.0438	0.0113	2.55
ULCRA (1=Yes; 0=No)	-0.0198	0.0664	-0.2983	0.38

Sources: Census of India PCA, Primary data from cities and states, and Annual Survey of Industries of the Central Statistical Organization, Author's computations and analyses.

General notes:

Number of observations=68
R^2 =0.48
Adjusted R^2 =0.38
Dependent variable mean=0.43

** Statistically significant at 5 percent level
***Statistically significant at 1 percent level

The factors that affect the suburbanisation of employment in India's cities are the size of a city (urban agglomeration) as measured by its population, the extent of past suburbanisation (as indicated by lagged value of the population gradient) and proportion of population suburbanized. Specifically, the larger the city, the more suburbanized is its total employment. This is to be expected since in the centre of large cities, the costs of doing business (such as real estate) are likely to be higher, hence employment tends to be suburbanized. While the suburbanisation of jobs is dependent on the historical suburbanisation of population, it is certainly dependent on the extent of current population suburbanisation. That is, the greater the proportion of population in the city that has currently suburbanized, the greater is the extent of employment suburbanisation. This shows that jobs follow people for the various skills they have to offer. Recall that the proportion of jobs suburbanized in a UA did not have a significant impact on population or household suburbanisation (Tables 2 and 3). Given the observation that migrant population finds it less difficult to reside in the periphery of cities due to relaxed land use regulations there, their presence becomes a source of labor for the construction and other activity that takes place in the suburbs.

While ULCRA does not have the expected impact on population, household or employment suburbanisation, we find the maximum permissible FAR for non-residential uses does not have the expected impact on employment suburbanisation in the way the residential FAR consistently impacts population and household suburbanisation.

I estimated the impact of land use controls on all sub-sectors of employment, following Mills (1984) and Sridhar (2007). These regressions for manufacturing, transport & communications, and trade & commerce employment density gradients are summarized in Tables 5-7.

Table 5: Impact of Land Use Regulations on Manufacturing Employment Suburbanisation

Dependent Variable: Manufacturing Employment Density Gradient

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	0.2635	0.3763	0.7001	
Population (in thousands)	-0.0001	0.0000	-1.6433	1,018.89
Number of local governments, 1981	0.0048	0.0046	1.0611	7.32
Worker emoluments as a proportion of value of output for state	-2.5077	2.6564	-0.9440	0.06
Proportion in labor force	-0.1677	0.9014	-0.1860	0.30
Ratio of literacy rate in central city to that in suburbs	0.0814	0.2327	0.3500	1.03
Ratio of SC/STs in central city to that in suburbs	-0.0483	0.1142	-0.4227	0.75
Lagged (1981) value of population gradient	0.4131***	0.1274	3.2422	0.47
Proportion population suburbanized	-0.1528	0.1637	-0.9330	0.28
Maximum permissible non-residential FAR	0.0639	0.0553	1.1558	2.52
ULCRA (1=Yes; 0=No)	0.0095	0.0806	0.1174	0.35

Sources: Census of India PCA, Primary data from cities and states, and Annual Survey of Industries of the Central Statistical Organization, Author's computations and analyses.

General notes:

Number of observations=57
R^2 =0.37
Adjusted R^2 =0.23
Dependent variable mean=0.41

***Statistically significant at 1 percent level

In none of the sub-sector regressions are land use controls significant in determining suburbanisation of jobs. In the manufacturing sub-sector regression, it is only the lagged value of the population gradient that is significant in determining its suburbanisation (Table 5). Specifically, the positive impact of this variable implies that the higher the extent of population centralization in the past, higher is the extent of centralization of manufacturing employment in the present, and vice-versa. This is consistent with past literature on the subject and shows that manufacturing jobs follow people for a variety of skills.

When we study the impact of various land use controls and other characteristics on the suburbanisation of employment in transport and communications, we find that land use regulation such as FAR and urban land ceiling does not have any impact (Table 6).

Table 6: Impact of Land Use Regulations on Transport & Communications Employment Suburbanisation

Dependent Variable: Transport & Communications Employment

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	-0.1272	0.3904	-0.3257	
Population (in thousands)	-0.0001	0.0000	-1.5351	1,014.31
Number of local governments, 1981	0.0044	0.0046	0.9549	7.33
Worker emoluments as a proportion of value of output for state	-1.9292	2.8359	-0.6803	0.05
Proportion in labor force	0.0901	0.9455	0.0953	0.30
Ratio of literacy rate in central city to that in suburbs	0.5066*	0.2609	1.9416	1.01
Ratio of SC/STs in central city to that in suburbs	0.0042	0.1107	0.0381	0.80
Lagged (1981) value of population gradient	0.4220***	0.1357	3.1092	0.46
Proportion population suburbanized	-0.0009	0.1862	-0.0047	0.28
Maximum permissible non-residential FAR	0.0094	0.0558	0.1687	2.48
ULCRA (1=Yes; 0=No)	-0.0370	0.0812	-0.4553	0.31

Sources: Census of India PCA, Primary data from cities and states, and Annual Survey of Industries of the Central Statistical Organization, Author's computations and analyses.

General notes:
Number of observations=55
R^2 =0.36
Adjusted R^2 =0.21
Dependent variable mean=0.49

*Statistically significant at 10 percent level

***Statistically significant at 1 percent level

Table 7 summarizes the impact of various land use controls along with other characteristics on the suburbanisation of trade and commerce jobs. First, size of the city determines suburbanisation of trade and commerce jobs. This is reasonable to expect because of the higher costs of doing business in the centre of larger cities, as discussed earlier. Further, the number of local governments in the UA has a positive and significant impact on suburbanisation of trade and commerce jobs. This implies that the greater the extent of competition in public service delivery (indicated by the number of local governments in the UA), the more centralized the UA is. While we would have expected the number of local governments to have a negative impact on suburbanisation of jobs (i.e., greater competition in public service delivery encourages suburbanisation), the positive impact we find could be due to the fact that in most Indian UAs, the local government in the central city is the most dominant provider of public services, and hence trade and commerce jobs tend to be concentrated there. One reason for the responsiveness of trade & commerce and other services (hotels, motels and restaurants) to public services is that they tend to be quite heavily dependent on municipal services such as water supply and sewerage. In the case of manufacturing firms, indeed, many of them build their own water and sewerage treatment plants, and hence may not be as dependent on public services offered by cities.

Table 7: Impact of Land Use Regulations on Trade & Commerce Employment Suburbanisation

Dependent Variable: Trade & Commerce Employment Density Gradient

Variable	Coeff.	Std.Err.	t-ratio	Variable mean
Constant	0.5857	0.4205	1.3931	
Population (in thousands)	-0.0001**	0.0000	-1.9971	1,205.61
Number of local governments, 1981	0.0074*	0.0043	1.7275	8.13
Worker emoluments as a proportion of value of output for state	-5.5709*	3.1079	-1.7925	0.06
Proportion in labor force	0.3623	0.9021	0.4016	0.29
Ratio of literacy rate in central city to that in suburbs	0.2346	0.2579	0.9098	1.02
Ratio of SC/STs in central city to that in suburbs	-0.1301	0.1098	-1.1849	0.81
Lagged (1981) value of population gradient	0.3759***	0.1414	2.6581	0.40
Proportion population suburbanized	0.0681	0.1876	0.3629	0.31
Maximum permissible non-residential FAR	-0.0597	0.0510	-1.1694	2.50
ULCRA (1=Yes; 0=No)	-0.0679	0.0810	-0.8389	0.33

Sources: Census of India PCA, Primary data from cities and states, and Annual Survey of Industries of the Central Statistical Organization, Author's computations and analyses.

General notes:

Number of observations=45
R^2 =0.43
Adjusted R^2 =0.27
Dependent variable mean=0.49

*Statistically significant at 10 percent level

***Statistically significant at 1 percent level

Wage costs have a negative and significant impact on the suburbanisation of trade and commerce jobs. This means that whenever worker emoluments as a proportion of the value of output in the state in which the UA is located increase, trade and commerce jobs tend to suburbanise. This result makes sense in the context of UAs that are located in multi-state areas (Delhi for example is in a tri-state area consisting of Delhi, Uttar Pradesh and Haryana; Delhi's suburbs are in the other states, for instance, Gurgaon in Haryana, NOIDA in Uttar Pradesh). Suburbanisation in such instances would imply that the firm would just move away to a different state in its suburbs, where such wage costs would be lower.

The next section discusses these findings and their policy implications, highlighting areas of future research.

Discussion and Policy Implications

This research discusses an important controversy regarding city growth—whether it should be horizontal or vertical. The findings here suggest that cities should go for vertical rather than horizontal growth in the interests of efficiency.

When we take the results from all regressions, they imply that land use regulations are significant in determining the pattern of population and household suburbanisation (or horizontal growth) in India's context. Thus the extraordinary role played by them cannot be ignored. This is an important result because India was a planned and regulated economy for a long time and this was assumed to be conducive for the poor and the vulnerable. The findings here, that population may be attracted to a relaxation of FAR norms are quite important. They imply that, in order to make better use of existing infrastructure (water supply, sewerage, roads) in the centre of India's cities, city governments should consider increasing the FAR there so that more households can be accommodated in the city centre. This way excessive city growth and urban sprawl can be contained, commuting reduced, floor area consumption increased and housing made more affordable.

The results here also imply that land use regulations do not directly impact suburbanisation of jobs. Factors such as size of city, literacy rate and the city's historical evolution and pattern of population suburbanisation impact employment suburbanisation in India's cities. However, given the findings that jobs follow people, and land use regulations impact the spatial pattern of population distribution, firms would follow them. Hence in an indirect sense, land use controls impact the spatial distribution of jobs.

Finally, state-level land use regulations such as ULCRA do not affect the suburbanisation of jobs, population, or of households.

Areas of Future Research

There are no concluding remarks for this work, as it is the beginning of a new research agenda on land use regulations for India's cities. Therefore I rather highlight the areas of work that future research should focus upon, as my set of concluding remarks.

Future research in this area should focus on the exogenous determinants of the FAR. The monocentric urban model predicts that floor area ratios within a city depend on distance from the city center, steadily declining toward the edge of the city. This is a testable hypothesis for India's cities. To enable researchers to do this, every city has to make an attempt to map out its FARs by census ward and by land use zone. This would greatly improve the transparency of land transactions regarding which there is currently a lot of debate in India, in the context of Special Economic Zones (SEZs). Given that the work here does not throw light on the 'optimal' value of the FAR for a city, the database would also generate a debate on the 'right' value based on the stakeholders' (developers, public, city, economic and environmental) views.

Second, based on my informal discussions (not systematic work), an incidental finding has been that FARs across cities depend on a variety of exogenous characteristics such as soil conditions, environmental conditions

(for instance, the seismic zone) and other natural topographical factors, in addition to factors such as population density, dwelling sizes and availability of parking space. This is also testable.

Further investigation into possible causes of intra and inter-city variations in FARs would throw more light on factors contributing to the low FAR in India's cities, and help in formulating more liberal and better policies to city growth. In a demand-supply framework, the demand for floor space is based on price and income characteristics, and the supply of floor space is determined by land use regulations, which are in turn determined by a variety of other factors discussed above. Thus, given their welfare implications, more research is needed to determine the equilibrium floor area prices and floor spaces actually consumed, especially so in India's context.

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End Notes

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[ii] While suburbanisation is certain to have started in the 1990s and continued into 2001 as well, we do not have the data to confirm the suburbanisation trends for 2001 since the 2001 census land area data on UAs have not yet been released.

[iii] While city and UA boundaries are not the same, for purposes of simplicity, here, I take the liberty of using these terms interchangeably.

[iv] The states that initially adopted the law were Andhra Pradesh, Haryana, Gujarat, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Tripura, Uttar Pradesh and West Bengal. Subsequently, it was adopted by six more states—Assam, Bihar, Madhya Pradesh, Manipur, Meghalaya and Rajasthan.

[v] These states which continue to have ULCRA are Andhra Pradesh, Himachal Pradesh, Maharashtra, Uttaranchal and West Bengal.

[vi] An FAR or FAR of 1.33 means that only 1.33 square meters of floor area (including those on multiple storeys) can be built per square meter of lot area. An FAR of 2, for instance, allows building an area of floor space equal to twice the area of the plot on which it is built. An FAR of 2 therefore would allow 2000 square meters of floor space to be built on a 1000 square meters plot. If half of the land is built upon, the building would have 4 floors (of 500 square metres each) to fully use the allowed FAR.

[vii] For instance, the southern tip of New York City's Manhattan has an FAR of 15, one of the highest in the world, which is permitted both for residential, commercial and industrial purposes.

[viii] In Mumbai, contrary to international evidence, the regulated FAR has in fact decreased since 1964 when the FAR was fixed at 4.5 in Nariman point while it is now fixed at 1.33. Many buildings predate the

imposition of the recent FAR regulation and therefore have a FAR higher than 1.33. As a consequence, any redevelopment of old buildings would entail a loss of floor space, which, given the high price of floor space in Mumbai, make any redevelopment uneconomical. Bertaud (2004) notes the instance when dilapidated buildings had to be rebuilt by the Bombay Building Repairs and Reconstruction Board, the Mumbai Municipal corporation allowed to increase the floor area ratio from 1.33 to about 3.2 (Phatack, 2003), acknowledging that it was not possible to relocate the tenants in situ without increasing the FAR!

However, there is trading of FAR that is allowed in Mumbai, referred to as the transfer of development rights (TDRs), which the city allowed in exchange for land or public facilities it did not have the resources to buy or build. However this was arbitrary, ad hoc and did not alleviate the negative impacts of a uniformly low FAR. As Bertaud (2004) points out, this was not a way of increasing land use efficiency, but a way of generating additional resources for the local authority.

[ix] Shanghai in 1984, recovering from more than 10 years of Cultural Revolution, had a floor area per person of 3.65 square meters. Shanghai's municipality, at the time, considered that rapidly increasing floor consumption was to be the city's first priority. In 2003, the average floor space consumption in Shanghai was 13.1 square meters per person (Bertaud, 2004). This was achieved in part by drastically increasing the FAR there.

[x] Thanks are due to N.Jayaram for raising this issue. Violation of building bye—laws is highly common in Bangalore and nearly 90 per cent of all buildings in Bangalore represent violations, and this includes most of the apartment buildings. The news item at http://www.deccanherald.com/deccanherald/Nov112005/realty9535220051110.asp (retrieved February 1, 2007) discusses these violations of building bye-laws in Bangalore and points out the low FAR in the city as being one primary reason. Given the low FAR, it is not possible to provide comfortable accommodation, hence the owner violates the building bye—laws to accommodate more floor area, and if possible, to earn rental income, with unauthorised construction and addition of floors.

The housing and urban development department of the Government of Tamilnadu (in government order 400 (http://www.tn.gov.in/gorders/house/hud400-e.htm, retrieved February 1, 2007) accepts building violations as part of routine activity and prescribes penalty or regularization fee for excess built up area constructed in violation of the maximum FAR prescribed in the Development Control Rules. Here also presumably violations are partly attributable to the low FARs permitted.

I also made an attempt to get some systematic empirical evidence of violations of FARs (by land use zone, maximum permissible FAR, and nature of the violations) from the Bangalore *Mahanagara Palike* but I was not successful in getting this information by the deadline that was required to complete this project.

[xi] While ideally, the data set would have consisted of all the 365 UAs in India, I restrict it to those for which all data were available, which is about 150 UAs for 1991 and about 80 UAs for 1981, or 80 UAs for which both the 1981 and 1991 data were applicable.

[xii] 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.

[xiii] 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. The town groups used in the NCAER data 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—up to Indian Rupees (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 varies depending on their population and their state of location. So, all UAs with population above 500,000 in 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.

[xiv] Another possible candidate for indicating relative attractiveness of the central city is the property tax rate by UA (at this point, however, separate data on property tax rate for central city and UA are not available in a centralized manner). The property tax is the only one levied at the local level in India, apart from the octroi on businesses where they exist. Octroi is levied on business activity, being a tax on the entry of goods into a municipal area for consumption or sale. A number of states in the country have recently abolished octroi on businesses, as its cost of collection is high. Further, octroi is distortionary, distorts prices of goods and gives rise to a number of discretionary practices that become breeding ground for corruption.

The ratio of property tax revenue to the taxable value of property would give us a measure of property tax rate. While data on property tax revenue are

available (though not in centralized manner for all cities), data on the assessed value of taxable property is unavailable even for Delhi, let alone in a centralized fashion for all UAs in the country. Most cities in India continue to follow the archaic annual rateable value (ARV) method of property valuation which is quite subjective, when compared to the unit area method, which is more objective and in which property valuation and assessment depend on characteristics of the property. Delhi has taken steps to move towards unit area method only since 2004. This means that the property tax base is subjective and is best not shared with public.

Because of these reasons, 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 taken to be an indicator of the extent of competition in local public service delivery.

[xv] Main workers in the Census of India are defined as those who had worked for the major part of the year preceding the enumeration. These workers are those who were engaged in any economically productive activity for 183 days or six months or more during the year. Marginal workers are defined as those who worked for sometime in the year preceding the enumeration but did not work for a major part of the year. These workers include those who worked for less than 183 days or six months during the year. To be consistent with the census' definition of non-workers, here, all non-workers in the categories (i) those attending to household duties at home; (ii) students; (iii) dependents; (iv) retired persons or renters; (v) beggars; (vi) inmates of institutions; and (vii) other non-workers, were treated as those outside of the labor force for purposes of calculating the unemployment rate.

[xvi] In the Indian context, this is important since BPO, call centres and other IT-enabled services depend quite heavily on the quality of manpower available. I am unable, however, to perform causality tests between jobs suburbanized and population suburbanized because of lack of data on jobs suburbanized for any period other than 1991. Recall that the Granger causality test (or other variants of the test) requires the use of lagged values of the variables in determining causality.