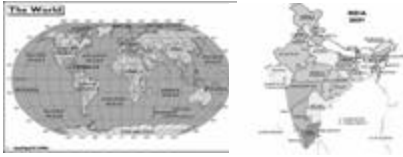


# Cities with Suburbs: Evidence from India



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## Motivation for Research



- ◆ Large and developing country
  - Sparse literature
- ◆ Demand for real estate
  - Steadily rising incomes (Figure 1)
  - Falling home loan interest rates
  - Booming IT sector
    - Space requirements
  - Disparity in real estate prices (Tables 1 and 2)

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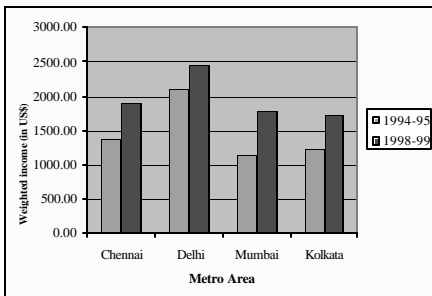
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### Figure 1. Annual Income in India's Metropolitan Areas



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**Table 1. Office Rentals and Capital Values in Selected Metro Areas**

Metro Area	CBD Rental (Sqft/ Month)	Suburb Rental (Sqft/ Month)	CBD Capital Value (Per Sqft)	Suburban Capital Value (Per Sqft)
NCR	\$0.46	\$0.84	\$187.43	\$83.61
Mumbai	\$2.11	\$1.77	\$251.03	\$148.33
Bangalore	\$0.96	\$0.59	\$91.28	\$61.62
<b>Average</b>	<b>\$1.18</b>	<b>\$1.07</b>	<b>\$176.58</b>	<b>\$97.85</b>

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

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**Table 2. Residential Rentals and Capital Values in Selected Metro Areas**

Metro Area	CBD Rental (Per Month)	Suburb Rental (Per Month)	CBD Capital Value (Per Sqft)	Suburban Capital Value (Per Sqft)
NCR	\$3,137.84	\$684.62	\$193.98	\$63.90
Mumbai	\$2,110.91	\$1,654.50	\$251.03	\$188.27
Bangalore	\$1,597.44	\$1,198.08	\$68.46	\$50.21
<b>Average</b>	<b>\$2,282.06</b>	<b>\$1,179.07</b>	<b>\$171.15</b>	<b>\$100.79</b>

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

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## Research Objectives



- ◆ What is the extent of population, household and employment suburbanization that has occurred?
  - Suburbanization
- ◆ What explains population, household and employment suburbanization in India's Urban Agglomerations?
- ◆ Importance of answers

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## Review of Past Literature



- ◆ Natural evolution theory
  - Effect of income and population
- ◆ Tiebout hypothesis
  - Flight from blight (central city conditions)
- ◆ Evidence from the United States
- ◆ Studies of developing countries

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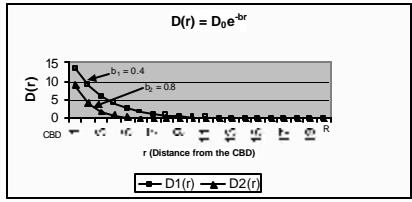
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## Theoretical Framework



- ◆ Monocentric urban model
- ◆ Standard exponential density function
  - Gradient




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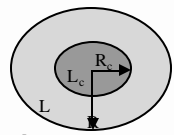
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## Two-Point Gradient Technique



$$L_c = \int_0^{R_c} 2\pi r D(r) dr = \int_0^{R_c} 2\pi r D_0 e^{-br} dr = \frac{2\pi D_0}{b^2} [e^{-bR_c} + bR_c e^{-bR_c} - 1]$$

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

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

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## Methodology and Model



- ◆  $b_i = a_{i0} + \sum_{j=1}^N a_{ij} x_{ij} \quad \forall i \in M$
- ◆  $b_{Pj} = \alpha_0 + \alpha_{\text{PPOP}} \text{POP} + \alpha_{\text{PY}} Y_j + \alpha_{\text{PJS}} \text{JS}_j + \alpha_{\text{PN}} N_j + \alpha_{\text{PUN}} \text{UN}_j + \alpha_{\text{PSCST}} \text{SCST}_j + \alpha_{\text{PLIT}} \text{LIT}_j + \alpha_{\text{PLAG}} \text{PLAG}_j$
- ◆  $b_{Ej} = \beta_0 + \beta_{\text{EPOP}} \text{POP}_j + \beta_{\text{EN}} N_j + \alpha_{\text{EW}} W_j + \beta_{\text{ELF}} \text{LF}_j + \beta_{\text{ESCST}} \text{SCST}_j + \beta_{\text{ELIT}} \text{LIT}_j + \beta_{\text{EPLAG}} \text{PLAG}_j + \beta_{\text{EPSUB}} \text{PSUB}_j$
- ◆ Census of India data
  - Urban Agglomerations

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## Variable Definitions and Data Sources



- ◆  $b_{Pj}, b_{Ej}$  = Population (or household) and employment density gradients in UA j;
- ◆ POP<sub>j</sub> = Population of UA j (scaled and divided by 10,000);
- ◆ Y<sub>j</sub> = Annual household income in UA j;
- ◆ W<sub>j</sub> = Wage cost (workers' emoluments as proportion of value of output) in the state in which UA j is located;
- ◆ JS<sub>j</sub> = Proportion jobs suburbanised in UA j;
- ◆ N<sub>j</sub> = Number of local governments in UA j in 1981;
- ◆ LF<sub>j</sub> = Labor force as proportion of population in UA j;
- ◆ UN<sub>j</sub> = Ratio of unemployment rate in the central city to that in the suburbs in UA j;
- ◆ SCST<sub>j</sub> = Ratio of minorities (scheduled castes and/or scheduled tribes) as proportion of total population in central city to that in suburbs, in UA j;
- ◆ LIT<sub>j</sub> = Ratio of literacy rate, which is computed as a proportion of population above 6 years of age, in central city to that in suburbs, in UA j;
- ◆ PLAG<sub>j</sub> = Lagged value of population gradient (for 1981).
- ◆ PSUB<sub>j</sub> = Proportion population suburbanised in UA j;

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## Summary of Population, Household and Employment Density Gradients

	Population density gradients			% Change	HH density gradient	Employment density gradient
	1981	1991	1981-91	1991	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	

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## 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

## Employment Gradients for Sub-sectors

	Mean	Std.Dev.	Minimum	Maximum	Observations
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

## Estimation of Population Density Gradients

Variable	Coefficient (Standard Error)	Mean for relevant sample
Constant	0.2769 (0.2267)	
POP <sub>j</sub>	-0.0006 (0.0003)*	80.99
Y <sub>j</sub>	0.0000 (0.00)	63,290.62
PLAG <sub>j</sub>	0.5280 (0.0979)***	0.47
JS <sub>j</sub>	-0.1836 (0.1104)	0.29
UN <sub>j</sub>	0.0070 (0.0082)	1.51
SCST <sub>j</sub>	-0.0550 (0.0701)	0.80
N <sub>j</sub>	0.0058 (0.0039)	6.33
LIT <sub>j</sub>	0.0122 (0.0914)	1.05
Mean, dependent variable		0.42
Adjusted R <sup>2</sup>	0.38	
Number of observations	76	
F	6.67	

## Estimation of Household Density Gradients

Variable	Coefficient (Standard Error)	Mean for relevant sample
Constant	0.1831 (0.2054)	
POP <sub>j</sub>	-0.0005 (0.0003)	80.99
Y <sub>j</sub>	0.00 (0.00)	63,290.62
PLAG <sub>j</sub>	0.5252 (0.0886)***	0.47
JS <sub>j</sub>	-0.1087 (0.1000)	0.29
UN <sub>j</sub>	0.0065 (0.0074)	1.51
SCST <sub>j</sub>	-0.0559 (0.0635)	0.80
N <sub>j</sub>	0.0042 (0.0035)	6.33
LIT <sub>j</sub>	0.0098 (0.0828)	1.05
<b>Mean, dependent variable</b>		<b>0.39</b>
<b>Adjusted R<sup>2</sup></b>		<b>0.40</b>
<b>Number of observations</b>		<b>76</b>
<b>F</b>		<b>7.12</b>

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## Estimation of Employment Density Gradients

	Coefficient	S.E.	t-ratio	Mean of variable
Constant	0.2985	0.1877	1.5901	
Population/10,000	-0.0007*	0.0003	-2.2945	82.20
Number of governments, 1981	0.0062	0.0036	1.7335	6.45
Wage costs	2.7710	1.6786	1.6507	0.06
Proportion in labor force	0.3189	0.5313	-0.6003	0.30
SC/ST ratio	-0.0451	0.0662	-0.6805	0.80
Literacy rate ratio	-0.0086	0.0868	-0.0991	1.05
Lagged population gradient	0.4192***	0.1005	4.1719	0.48
Proportion population suburbanized	-0.3112*	0.1248	-2.4930	0.30
<b>Mean, Dependent variable</b>	<b>0.41</b>			
<b>Adjusted R<sup>2</sup></b>	<b>0.36</b>			
<b>Number of observations</b>	<b>74</b>			
<b>F</b>	<b>6.08</b>			

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## Estimation of Manufacturing Density Gradients

	Coefficient	S.E.	t-ratio	P-value
Constant	0.3522	0.2567	1.3720	0.1757
Population/10,000	-0.0007*	0.0003	-2.0785	0.0424
Number of governments, 1981	-2.1702	2.0257	-1.0713	0.2888
Wage costs	0.0063	0.0039	1.5971	0.1161
Proportion in labor force	-0.0061	0.0957	0.0641	0.9491
SC/ST ratio	0.1875	0.0979	1.9158	0.0607
Literacy rate ratio	0.4302***	0.1165	3.6939	0.0005
Lagged population gradient	-0.4849	0.7671	-0.6321	0.5300
Proportion population suburbanized	-0.1741	0.1443	-1.2065	0.2329
<b>Mean, Dependent variable</b>	<b>0.42</b>			
<b>Adjusted R<sup>2</sup></b>	<b>0.32</b>			
<b>Number of observations</b>	<b>63</b>			
<b>F</b>	<b>4.58</b>			

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**Search for Talent: Classification of India's Towns  
for Locational Decisions by BPO Firms**

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.

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