

Regional accessibility as a criterion for sustainable mobility: A study in the National Capital Region of Delhi

*Sumeeta Srinivasan
Peter Rogers*

*Environmental Systems, DEAS
Harvard University*

Outline

- 1. Context of the NCR**
- 2. Land use change model**
- 3. Travel demand in the NCR**
- 4. Accessibility in the NCR**
 - Defining Accessibility**
 - Mapping Accessibility**
- 5. Planning implications**

The National Capital Region (NCR)

The objective of NCR :

“deflect urban population and hazardous industries from Delhi to surrounding areas and achieving a more balanced and harmonized development in the entire region through selective dispersion and relocation of economic activities”

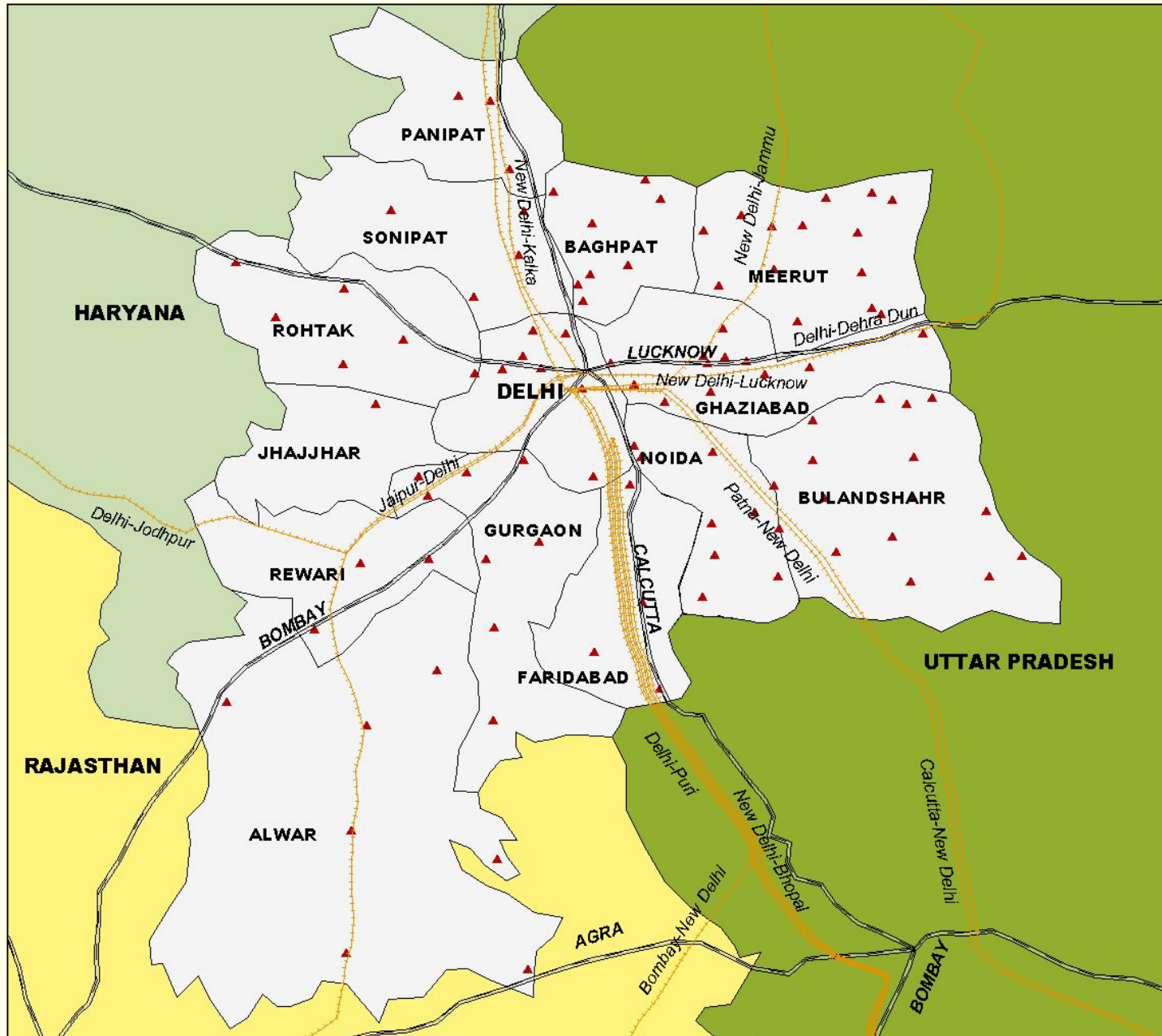
(NCR Planning Board Act, 1985)

The National Capital Region (NCR)

- Delhi (5% area, 39% popn)
- Noida (Gautam Buddha Nagar), Ghaziabad, Meerut, Bahadurgarh, Baghpat in UP (36% area, 28% popn)
- Alwar (15% area, 9% popn) in Rajasthan and
- Gurgaon, Faridabad, Panipat, Rohtak, Jhajjhar, Rewari and Sonipat in Haryana (44% area, 24% popn).

Total area: 30,242 Sq km Population: 32,798,662
(2001 Census)

The National Capital Region (NCR)



Land use change in the NCR

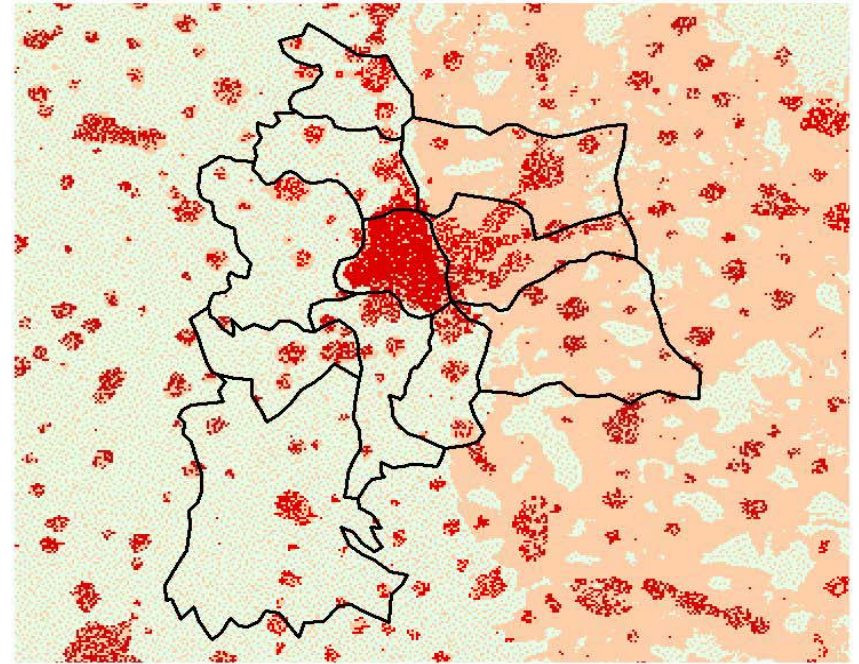
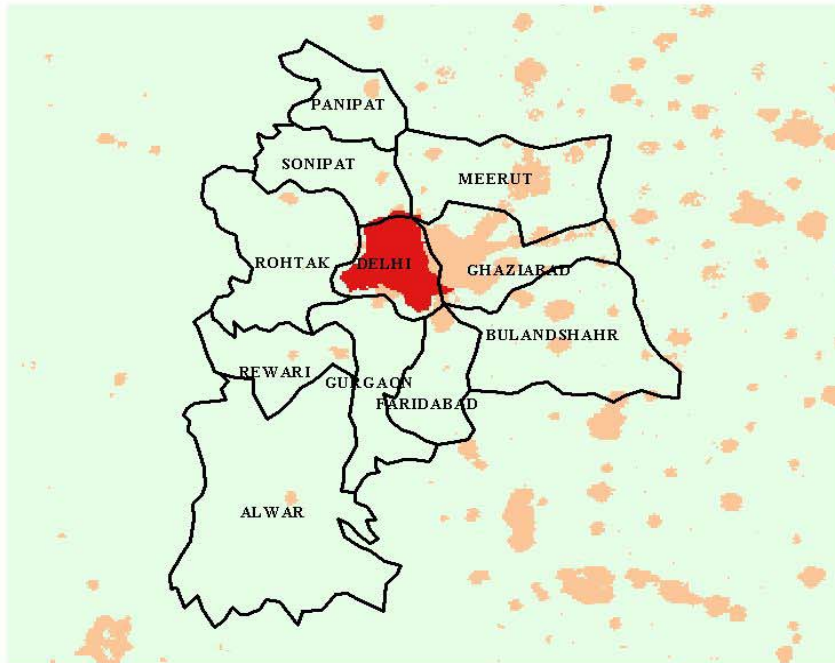
Urbanization was modeled based on density:

1. rural (< 1000 persons per sq km)
2. suburban (1000-5000 persons per sq km)
3. urban (> 5000 persons per sq km)

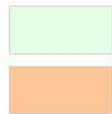
[Cellular Automaton/ Markovian model is used to model land use change

Its advantage: needs relatively little data to estimate]

Land use change model results



Population density



Rural (<math>< 1000</math> per sq km)

Suburban (1000-5000 per sq km)



Urban (> 5000 per sq km)

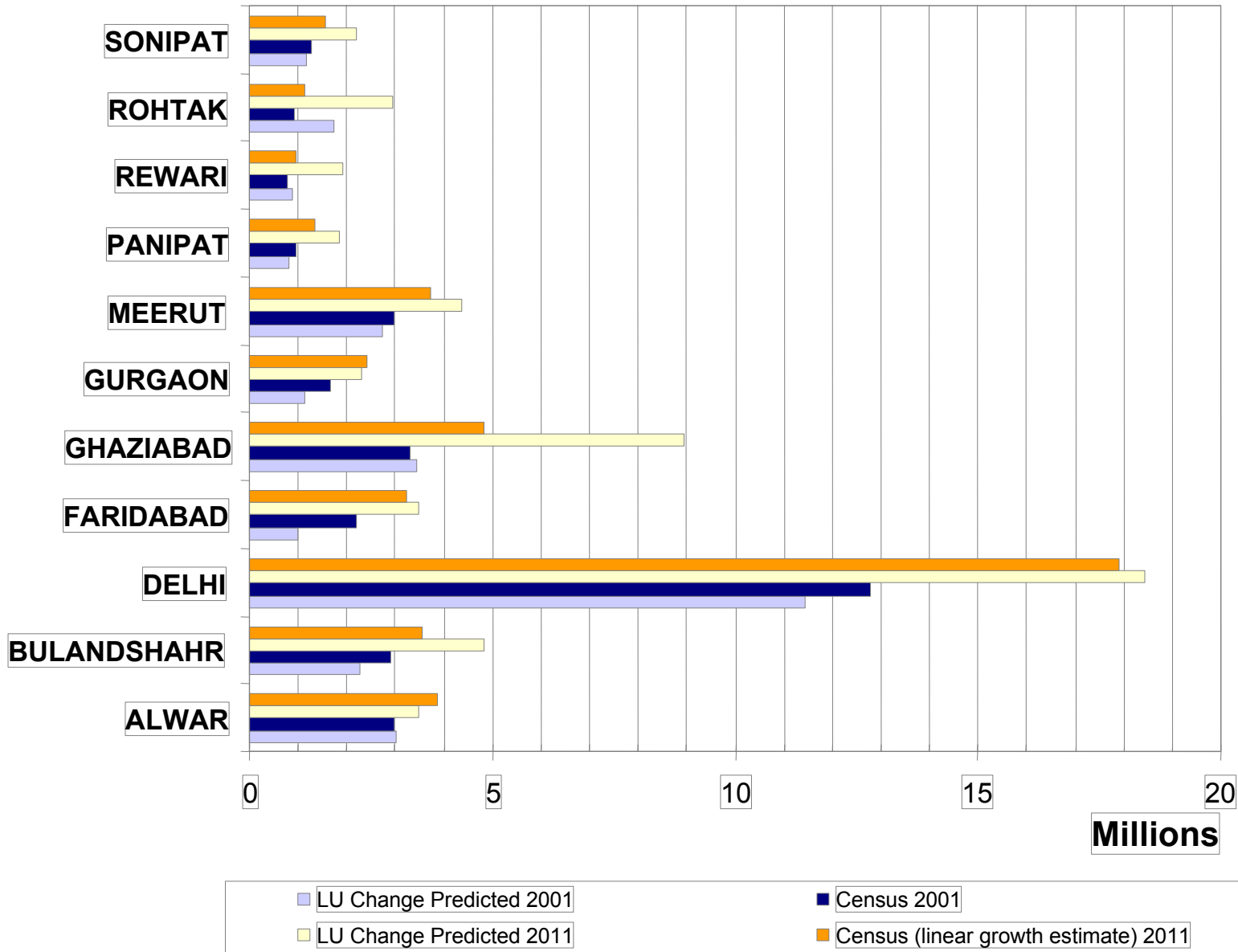


Population density



30 0 30 Kilometers

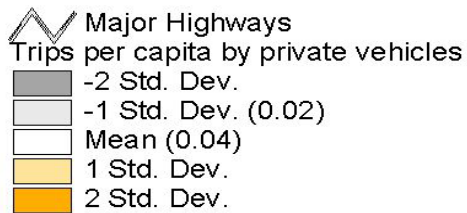
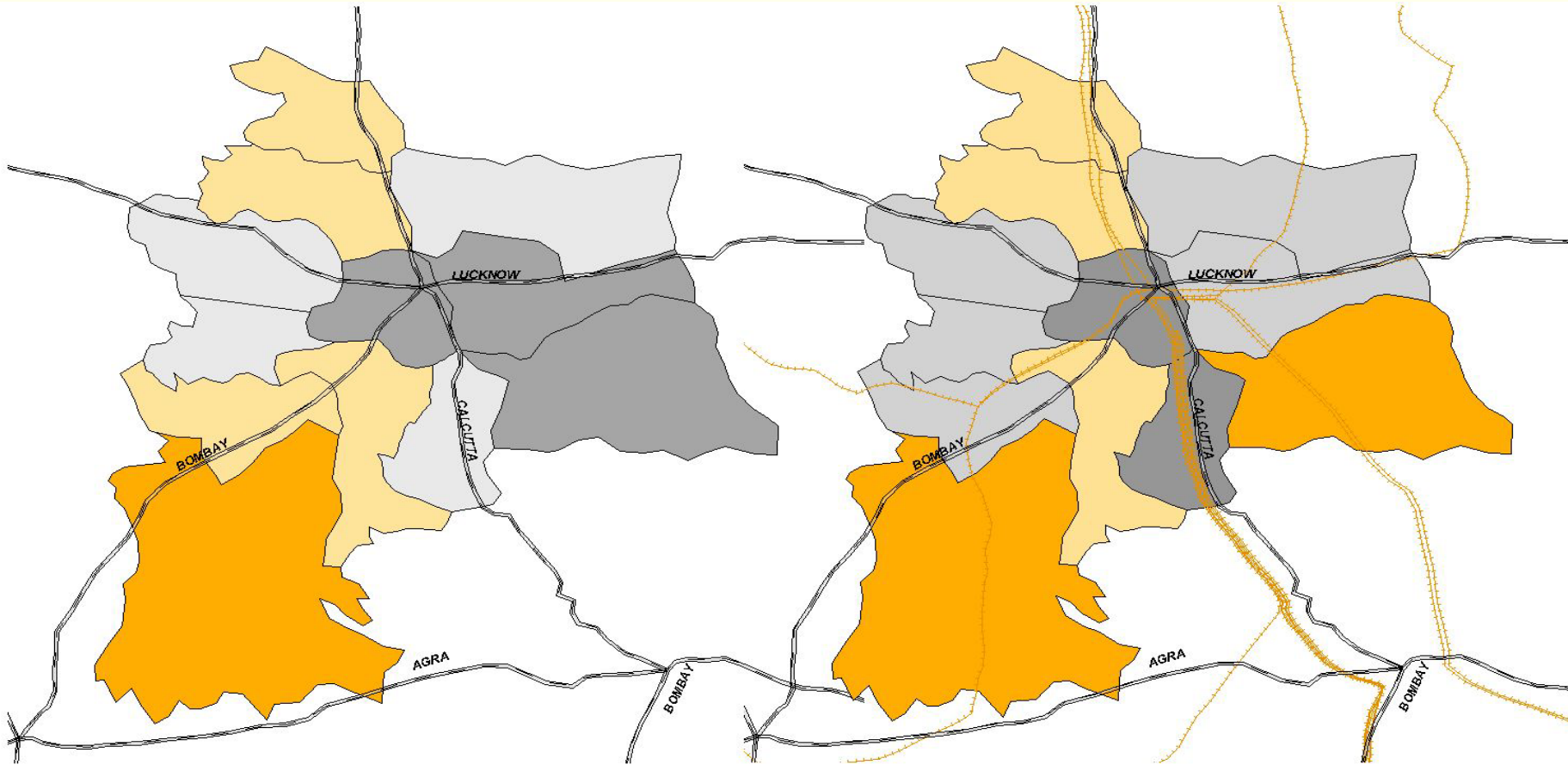
Comparing predictions



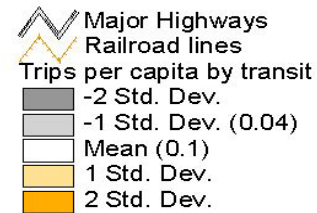
Travel demand in the NCR

- Trip rates assume that:
 - Districts like Gurgaon, Faridabad and Noida become more self contained
 - Districts like Panipat, Sonapat, Ghaziabad, Alwar and Jhajjhar become less agricultural
- Demand (in terms of numbers)
 - The highest demand for inter-district travel by private vehicles is from Ghaziabad (includes Noida)
 - Ghaziabad and Bahadurgarh also generate the highest of inter-district transit (bus) travel
 - Alwar generates a large number of trips by private vehicles
 - Locations in Haryana generate below average levels of inter-district bus travel

Travel demand per capita



Private Vehicles



Transit

Why Accessibility?

- Mobility is often mentioned as a goal for transportation planning
- However, mobility improvements ignore interaction between land use and transportation
- Accessibility takes into account two elements:
 1. the distance between the person or place and their destinations and
 2. utility of various destinations
- Accessibility is, a function of both land use patterns and the performance of transportation systems

Accessibility

Employment accessibility measures can be:

1. Cumulative opportunity and gravity based measures (count the number of opportunities that can be reached within a given travel time, cost or distance)
2. Utility theory based measures (the expected maximum utility from a random utility model of destination choice)
3. Space-time measures (add the time dimension to accessibility estimation)

Accessibility for NCR

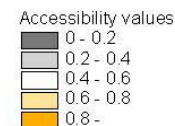
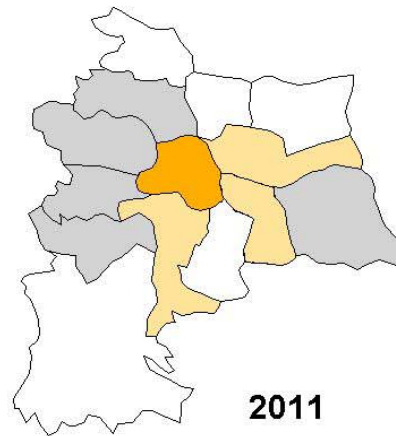
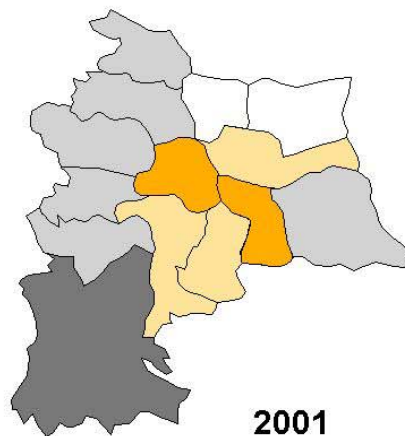
The gravity measure of accessibility weights distance in a less arbitrary fashion than cumulative measures. Here it is:

$$A_i^m = \sum_j (O_j f(C_{ij}^m) / \sum_m D_j^m),$$
$$D_j^m = \sum_k P_k^m f(C_{kj}^m)$$

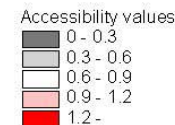
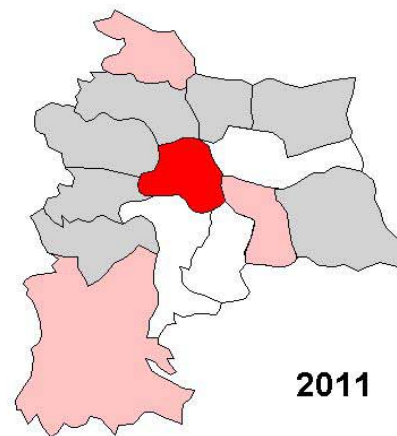
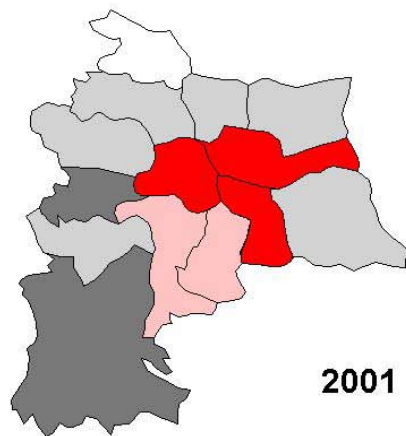
- $f(C_{kj}^m)$ is the demand potential for district j, measured in terms of worker availability
 P_k^m is the number of workers living in district k and traveling by mode m,
 $\sum_m D_j^m$ is the impedance function for traveling from district k to j by mode m, here it is $e^{-\beta d_{kj}}$ where β is a friction factor calibrated empirically
 O_j is the estimated employment for the district j

Accessibility in the NCR 2001-2011

Employment accessibility by bus



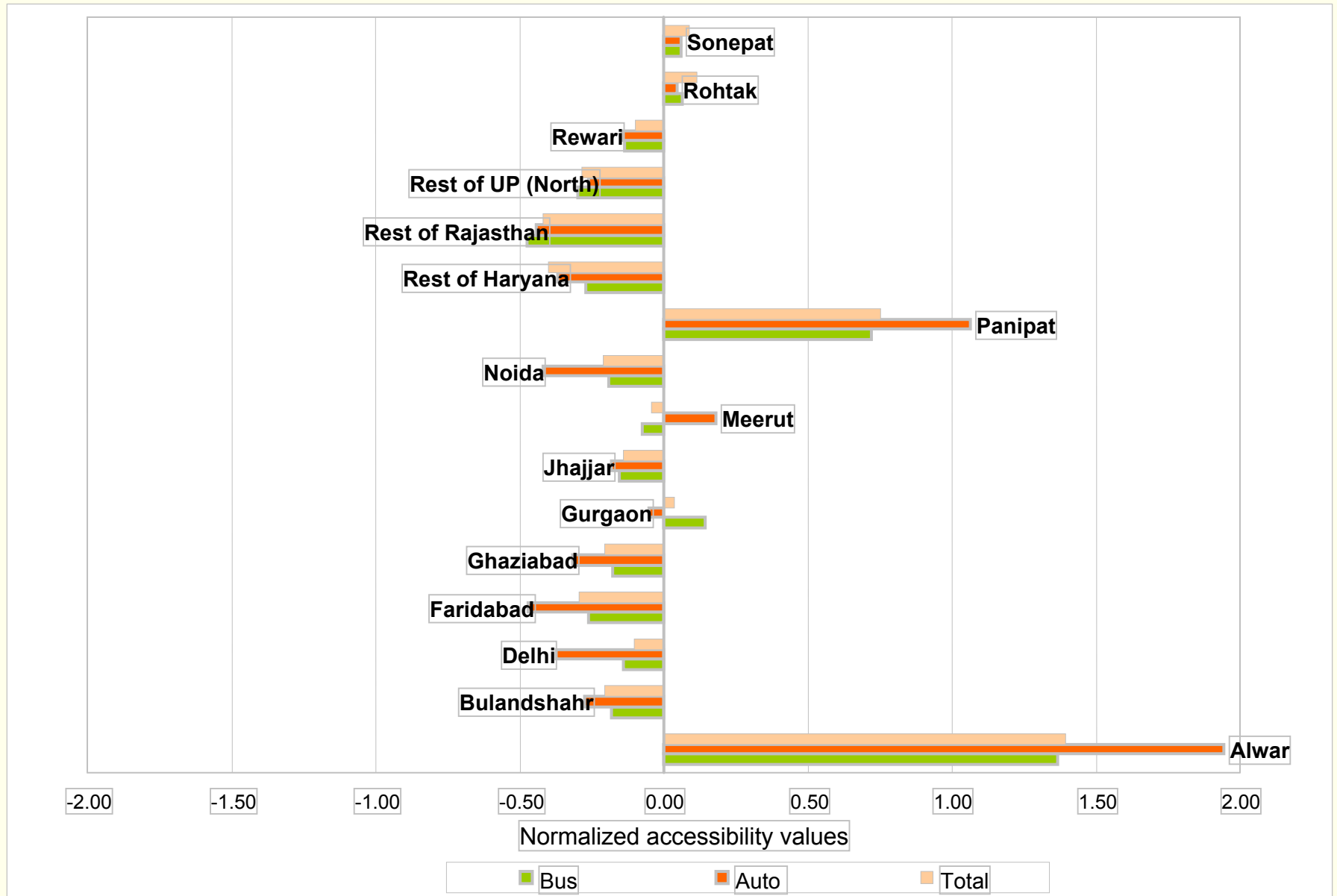
Employment accessibility by private vehicles



20 0 20 40 Kilometers



Accessibility changes in the NCR 2001-2011



Assumptions

- Travel times remain unchanged between 2001 and 2011 (This is reasonable in that no new highways are planned in the region and improvements to existing highways will be overtaken by the growth in travel demands in the region for inter-district travel)
- Employment estimates for the region are optimistic in that they assume that several of the outlying districts create new industrial employment
- All people within a district have same accessibility regardless of income/gender/etc

Implications for NCR

- Accessibility to employment is an indicator of the “supply” of transportation services in the region
- In combination with the demand for trips generated the measures suggest the imbalance of demand and supply for transportation services in the region
- Maps indicate that the growing demand for inter-district travel will not be matched by accessibility trends in the region
- NCRPB studies indicate that employment growth in the region continues to be imbalanced and heavily concentrated in the districts abutting Delhi

Implications for NCR

- NCRPB has suggested a new strategy – Development away from the “counter-magnet towns” in the region to other “counter magnet cities” in other States (Chandigarh in Punjab, Bikaner and Jaipur in Rajasthan, etc)
- Improving accessibility over all districts is crucial for economic development
 - providing impetus to develop more employment opportunities in all districts
 - improvements in the transportation connections between and within the districts

Implications for Planning

- Planning decisions have to be implemented to have any value
- Setting up the connections between the various political and planning authorities in the region is crucial
- Improvements in accessibility will only follow improvements in political coordination