Activity Opportunities and Changing Travel Patterns: A case of Developing Nations

Varun Varghese| Under the supervision of Prof. Arnab Jana
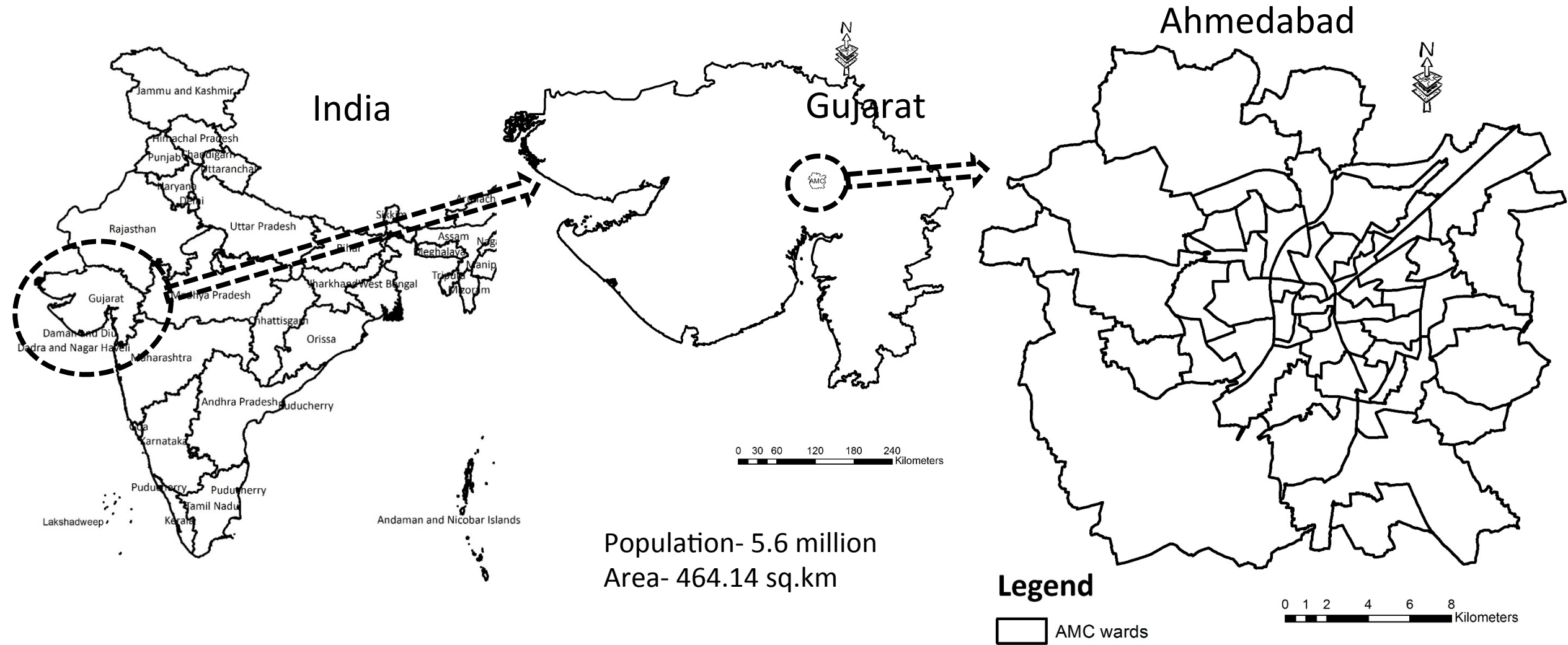
26th September, 2015| Early Bird Session| 14th Behavior Modeling Workshop in Transportation Networks |The University of Tokyo
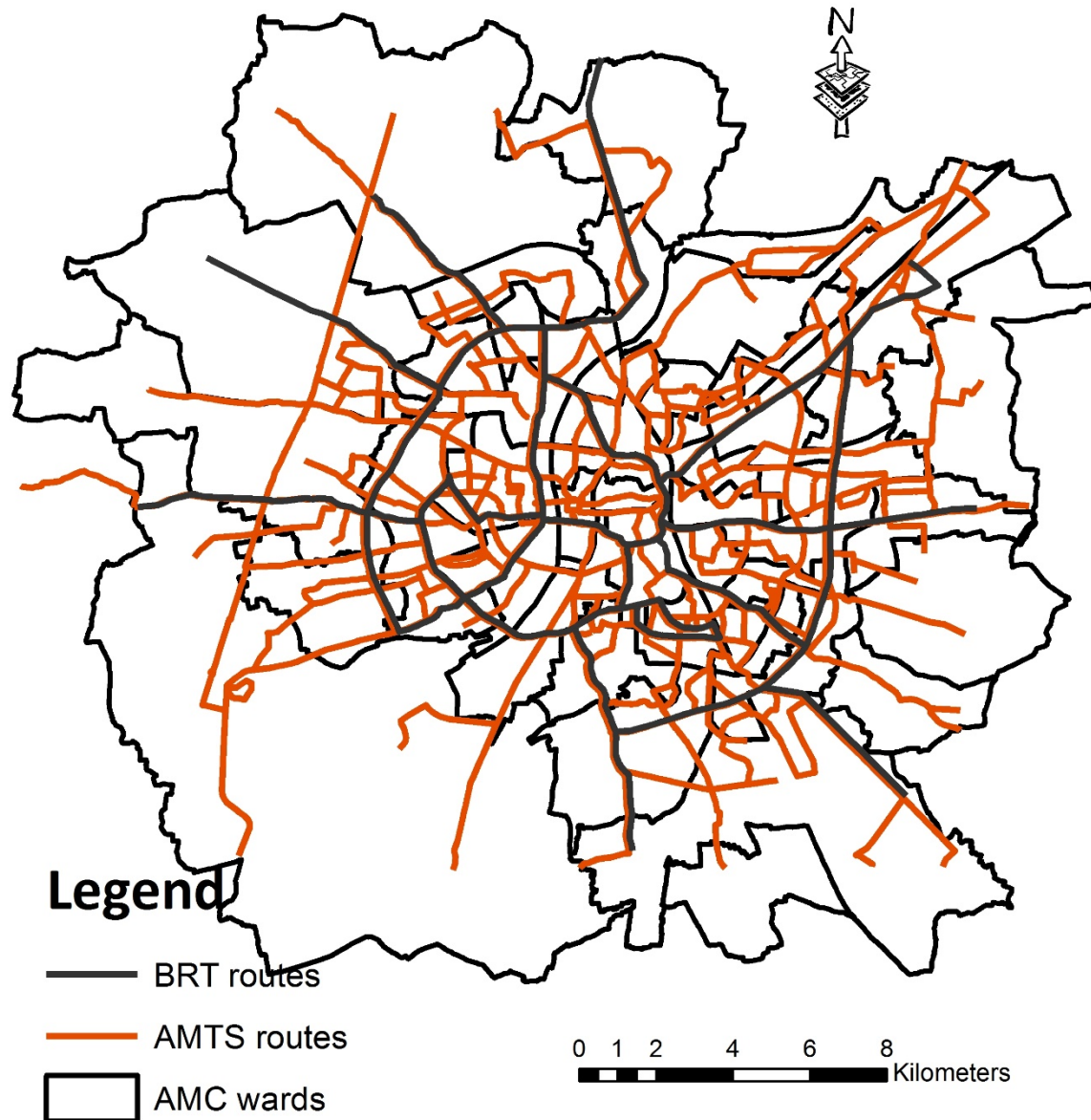
Contents

- Pubic transport crowding (A case of Ahmedabad city)
    - Measuring crowding
    - Public perception of crowding
    - Cost of crowding
- Activity-travel behavior in Mumbai
    - Introduction
    - Research gaps
    - Research objectives
    - Preliminary findings for Mumbai
    - Ongoing work
- Regional travel behavior (A case of inter-regional trips in India)
    - Destination choice
    - Mode choice

Pubic transport crowding (A case of Ahmedabad city)

India

Gujarat

Ahmedabad

Population- 5.6 million
Area- 464.14 sq.km

Legend

AMC wards

Public transport systems and crowding

Legend

— BRT routes
— AMTS routes
□ AMC wards

0 1 2   4   6   8 Kilometers

Objective measures of crowding

Country	Benchmark (standing pax/m^2)	Source
Europe	4	(UITP 2009)
Australia	4	(Diec et al. 2010)
USA	5	(TRB 2006)
China	8	(AQSIQ 2004)

Average count- 4.31 standing pax/m2 (4.54 for AMTS, 3.62 for BRTS)
Higher during morning peak
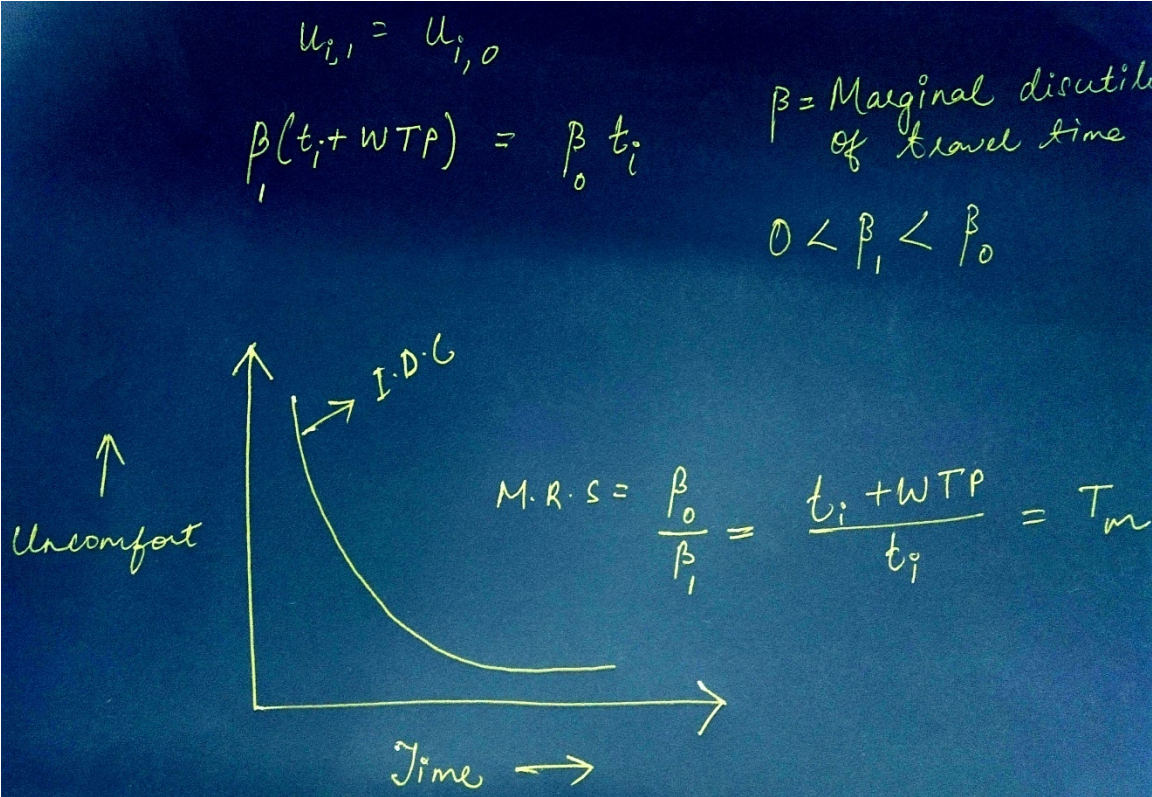Crowding peak – 8.32 standing pax/m2

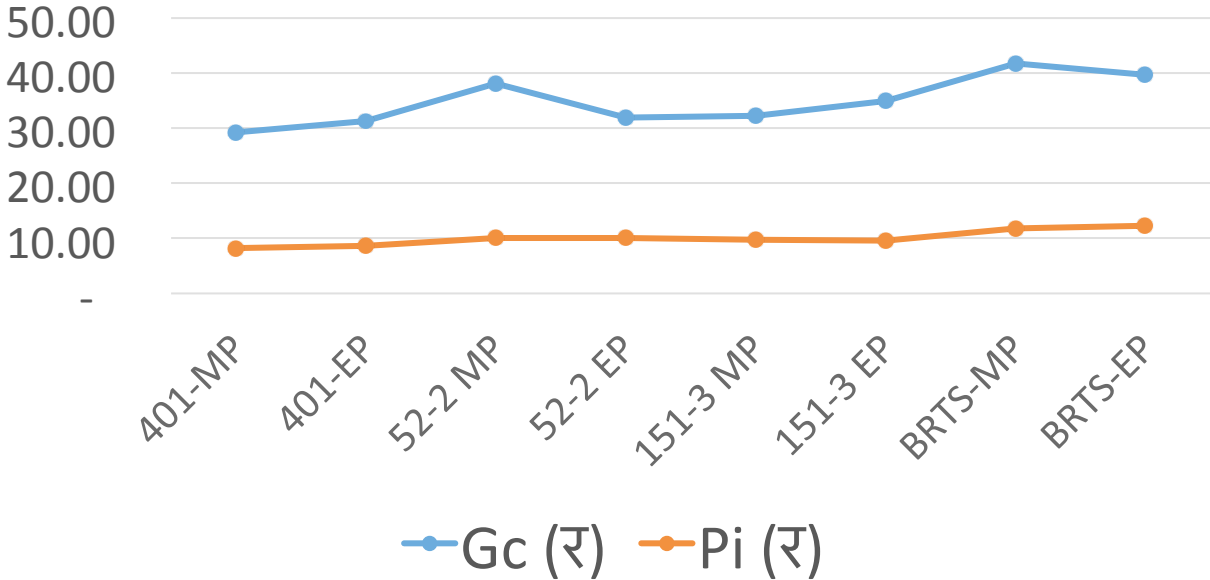# Subjective measures of crowding

- Average increase of 18.49 %
- Some routes as high as 48%
- Perception dependent on time of day, no. of choices, type of service, personal characteristics

Generalized cost

Adapted from Haywood and Koning (2013)

$Generalized\ Cost\ (comfort) = p_i + wt_i\, T_m$

Generalized cost vs Out of pocket cost

Gc (₹)   Pi (₹)

Cost of crowding

GC-AMTS (₹)

40.00							
30.00							
20.00							
10.00							
-							
1.52	1.00	1.10	1.20	1.30	1.40	1.50	1.60

— GC-AMTS (₹)

GC-BRTS (₹)

50.00							
40.00							
30.00							
20.00							
10.00							
-							
1.32	1.00	1.10	1.20	1.30	1.40	1.50	1.60

— GC-BRTS (₹)
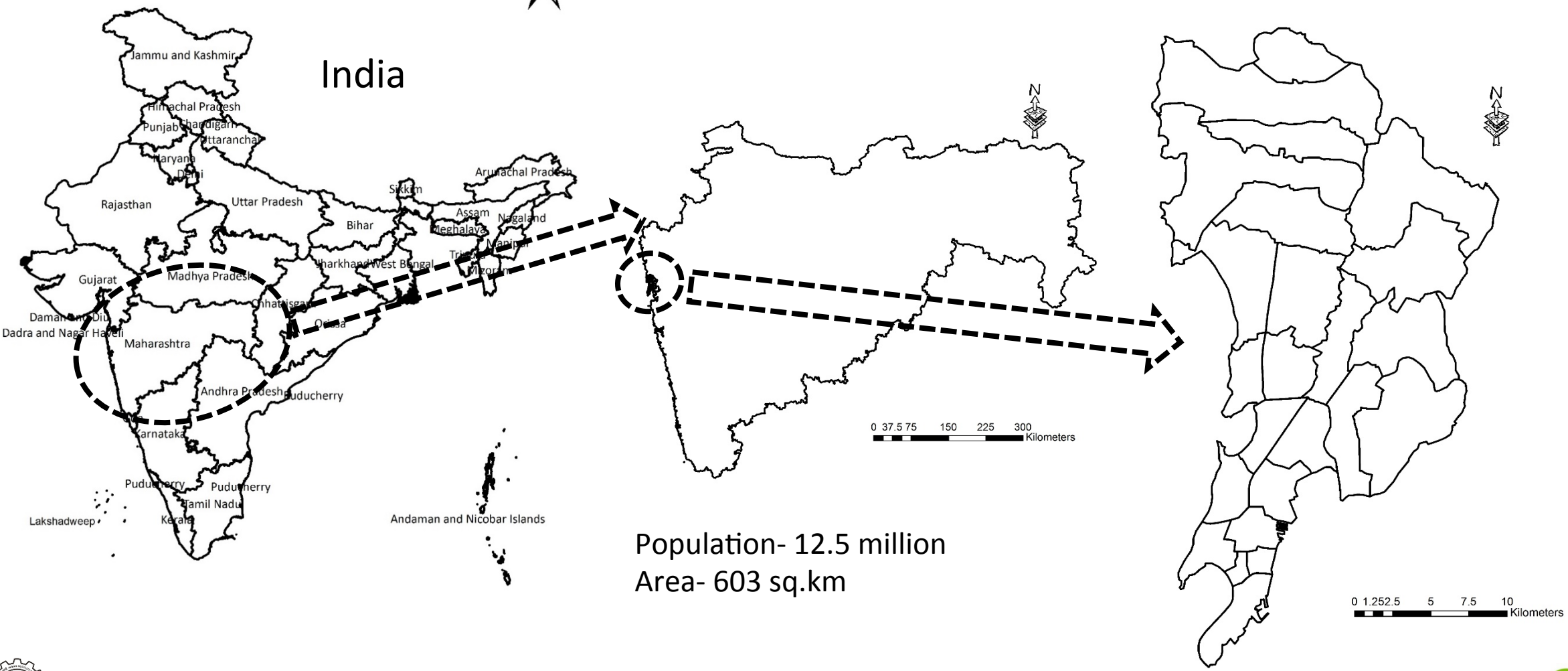
Sketch by: Shubhadeep Sengupta

8

Activity-travel behavior in Mumbai

India
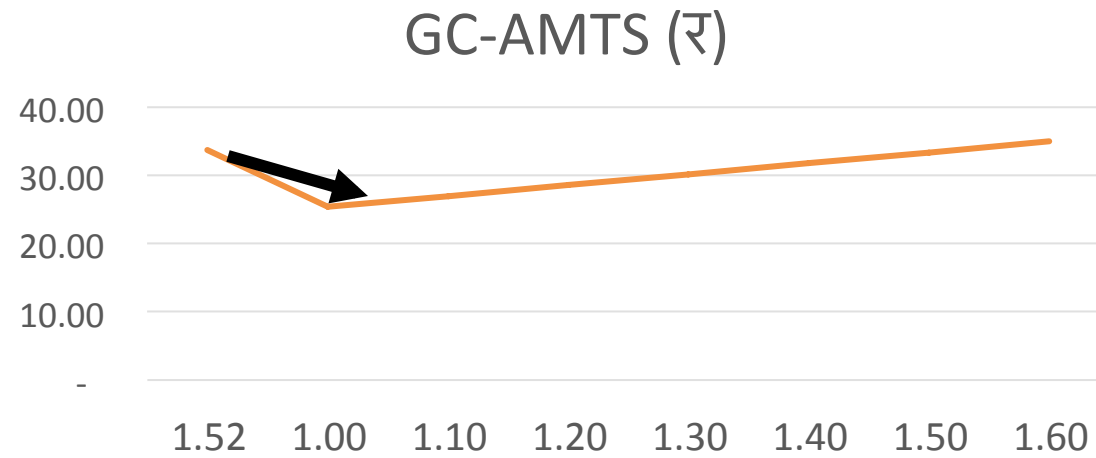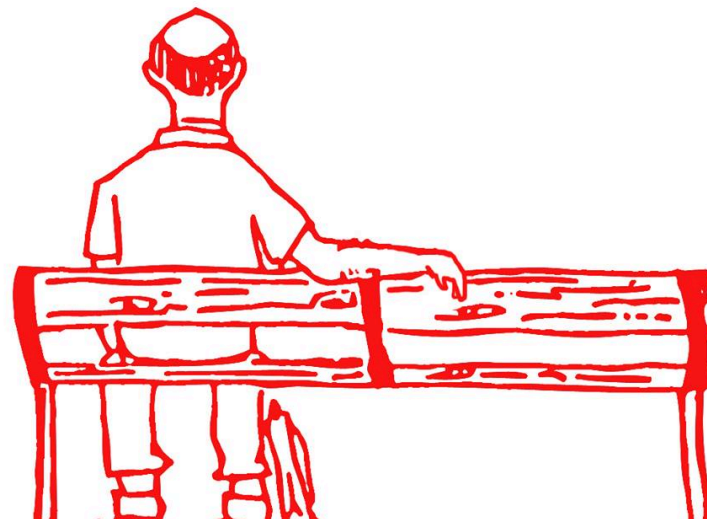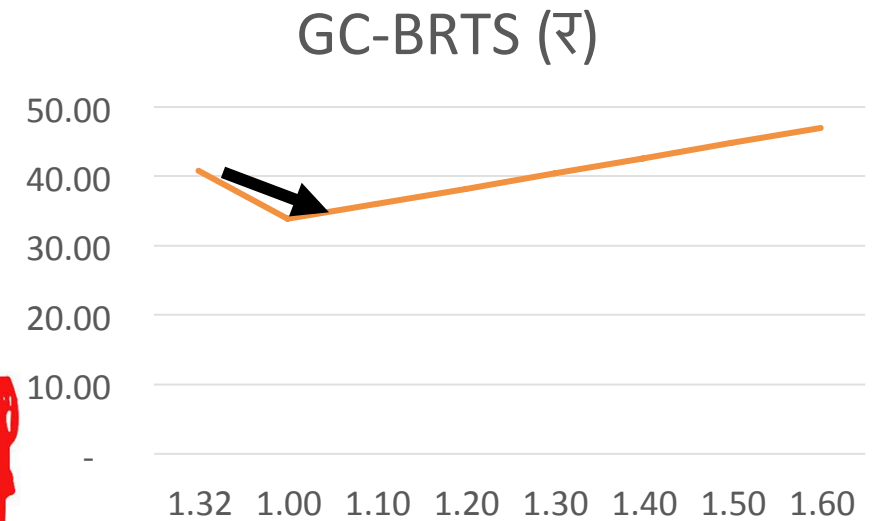
Maharashtra

Mumbai

Population- 12.5 million
Area- 603 sq.km

Activity-travel behavior in Mumbai- An Introduction

Time

Space

Activity time- Maintenance
Travel- Maintenance

Activity time- Leisure

Travel- Leisure

Activity time- Mandatory

Travel- Mandatory

Home

Work- Mandatory

Social connection- Leisure

Cinema- Leisure

Shopping- Maintenance

Adapted from time-space prism developed by Hagerstrand (1970)
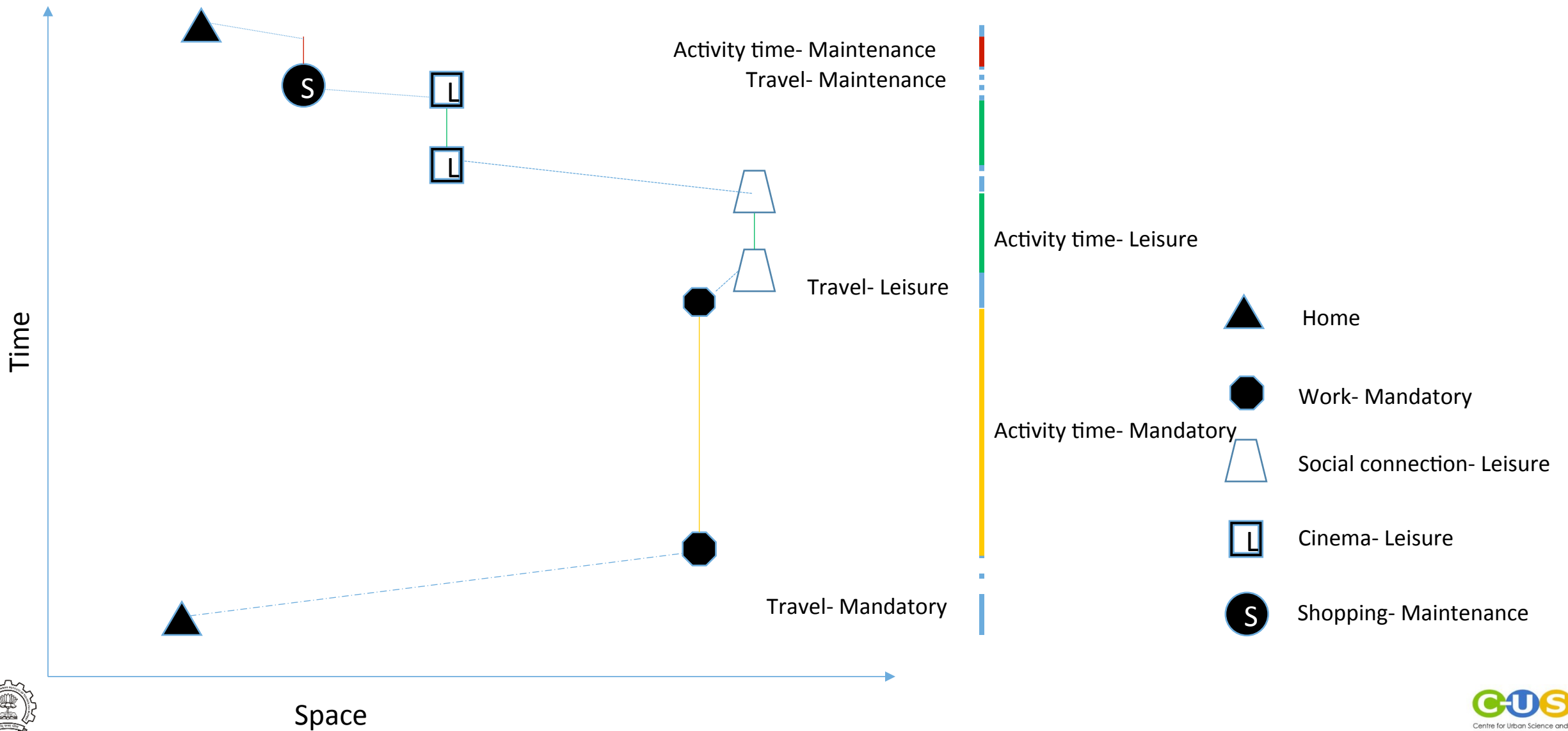
Travelling patterns in Mumbai: Descriptives

Income wise distribution of activity purposes

Legend: Work, Shopping, School, Social visit, Entertainment, Health, Personal, Return to home, Other

Categories: <5k, 5k-7.5k, 7.5k-10k, 10k-20k, >20k

Data source- Baker et. al (2005)
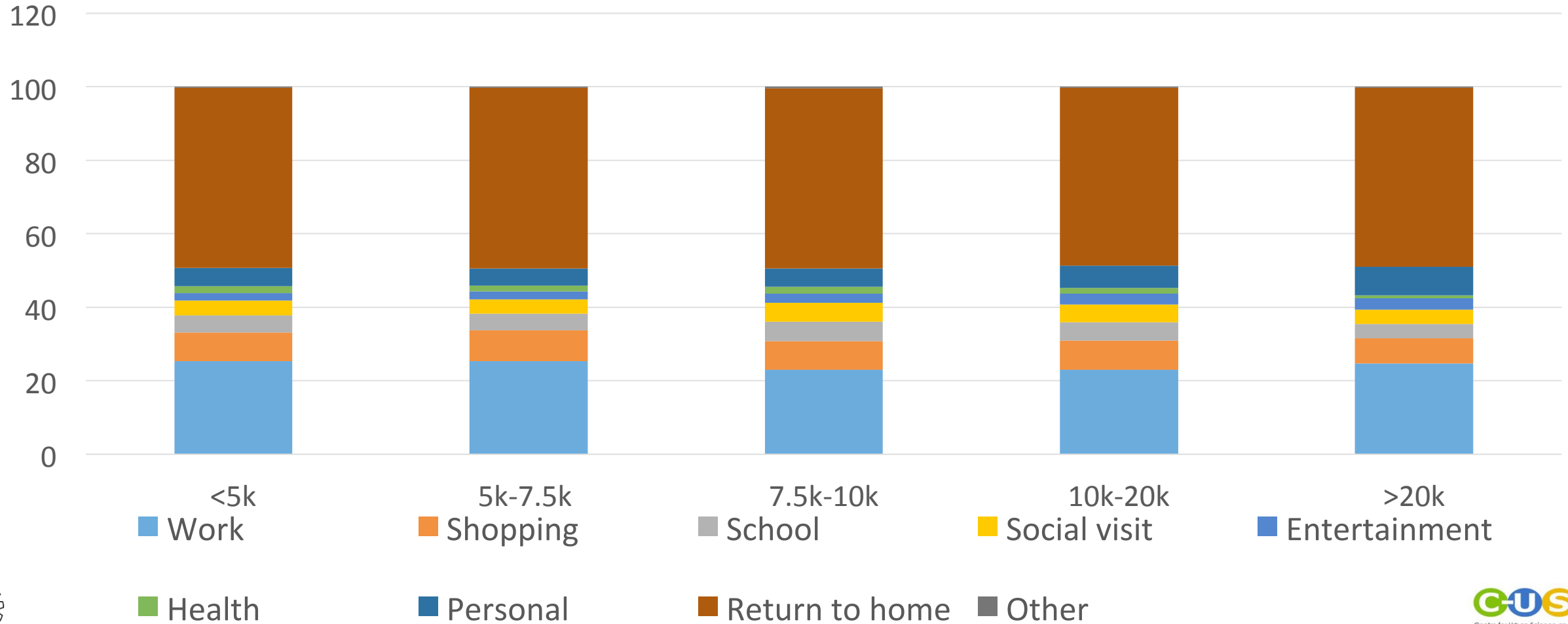
Travelling patterns in Mumbai: Descriptives

Commute time (mins)

Data source- Baker et. al (2005)

Changing patterns

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ICT in India

Internet Mobile Phone
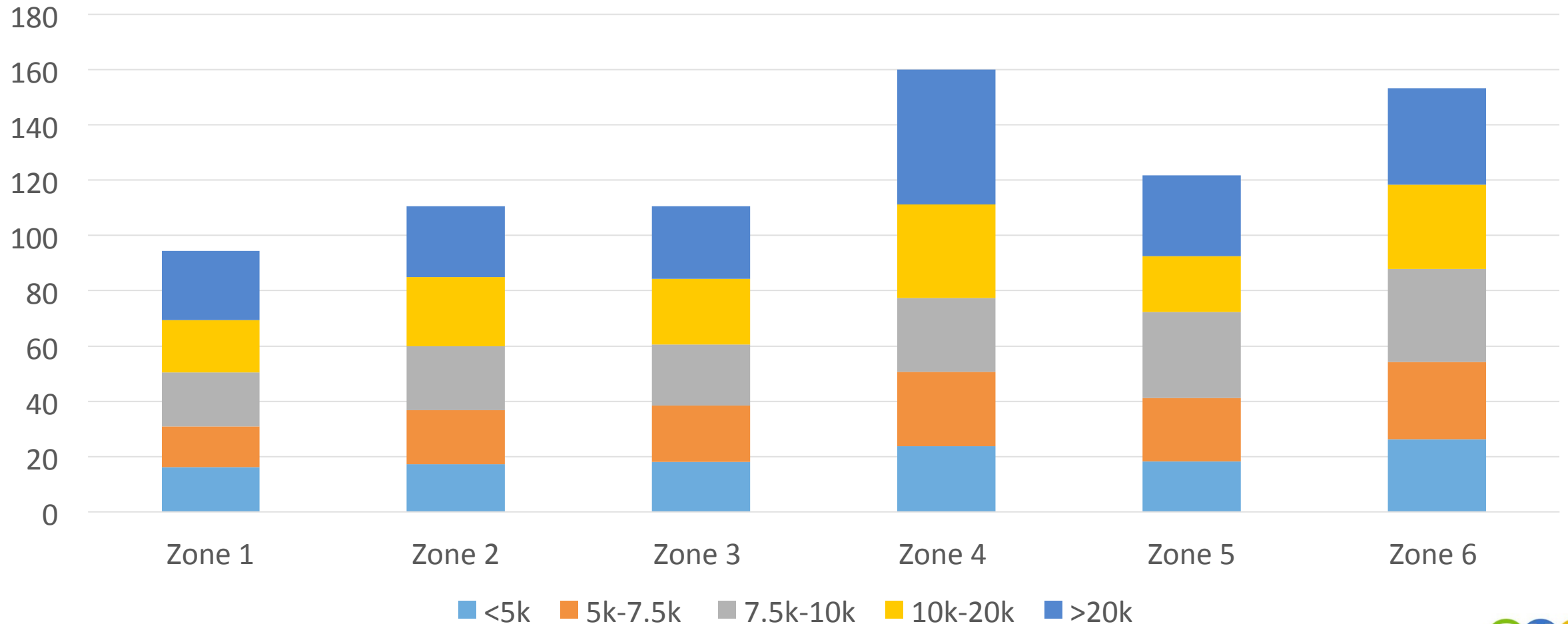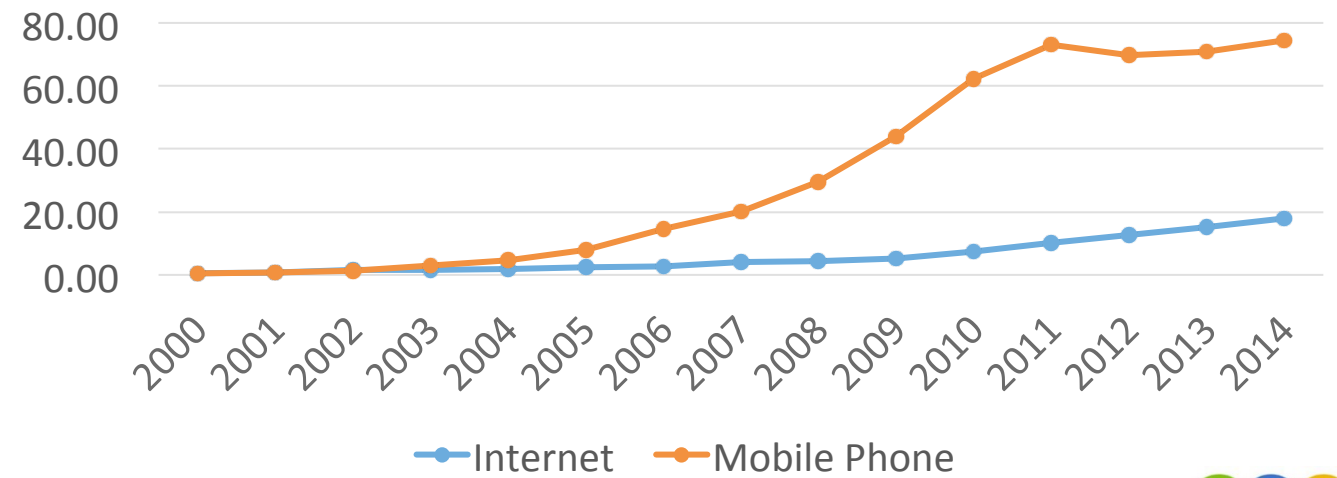
Data source: ITU (2014)

Potential effect on travel behavior

Orders grocery home

Online ticketing

Stays connected online

Use of a service which provides information

Time

Space
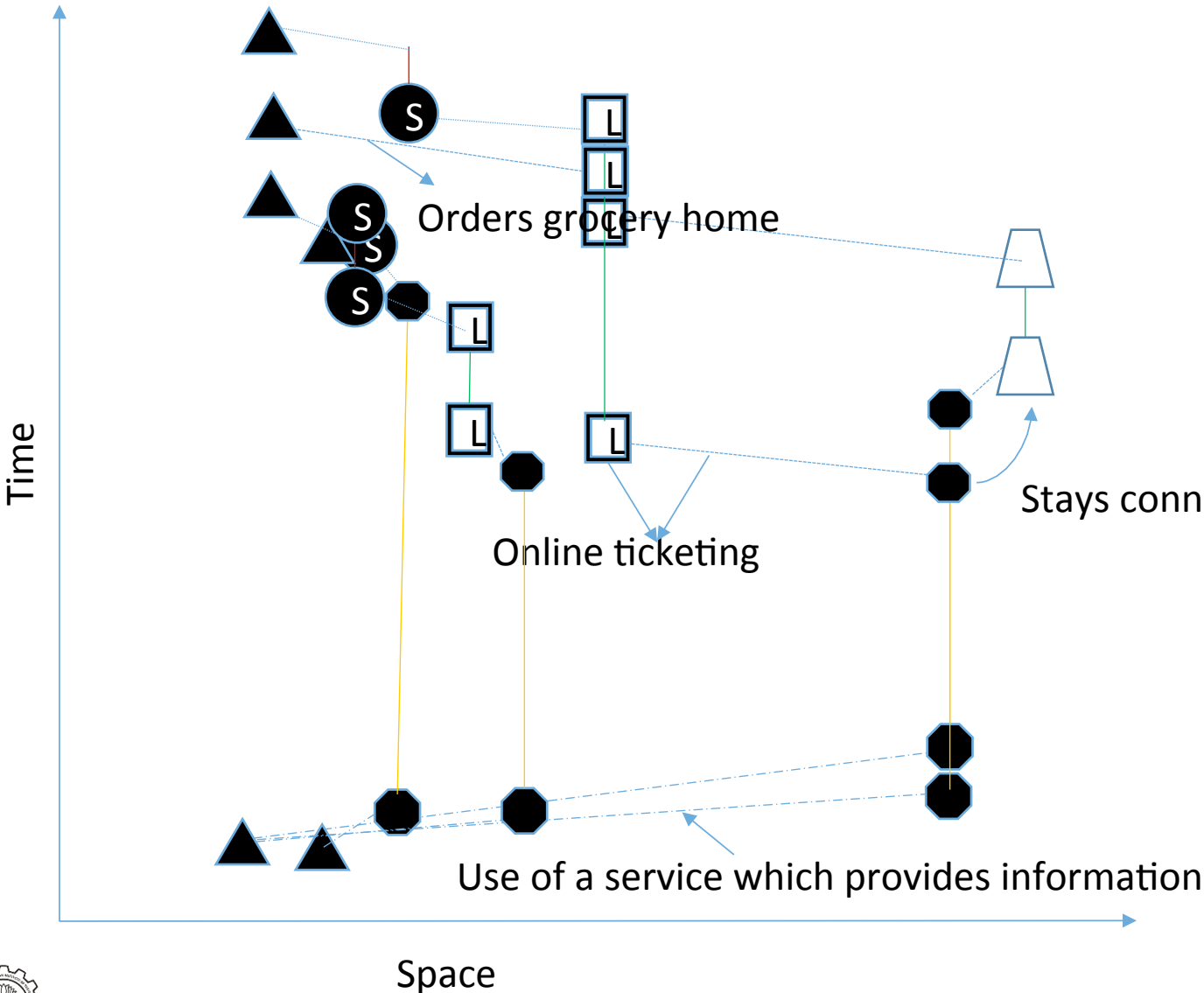
Socioeconomic factors
HH size, relationships, gender, age, level of education, vehicle ownership, type of housing, marital status, type of occupation, HH/individual income.

Spatial factors
Access to job, amenities (such as school hospital etc.). Distance to job centre, jobs to population ratio.

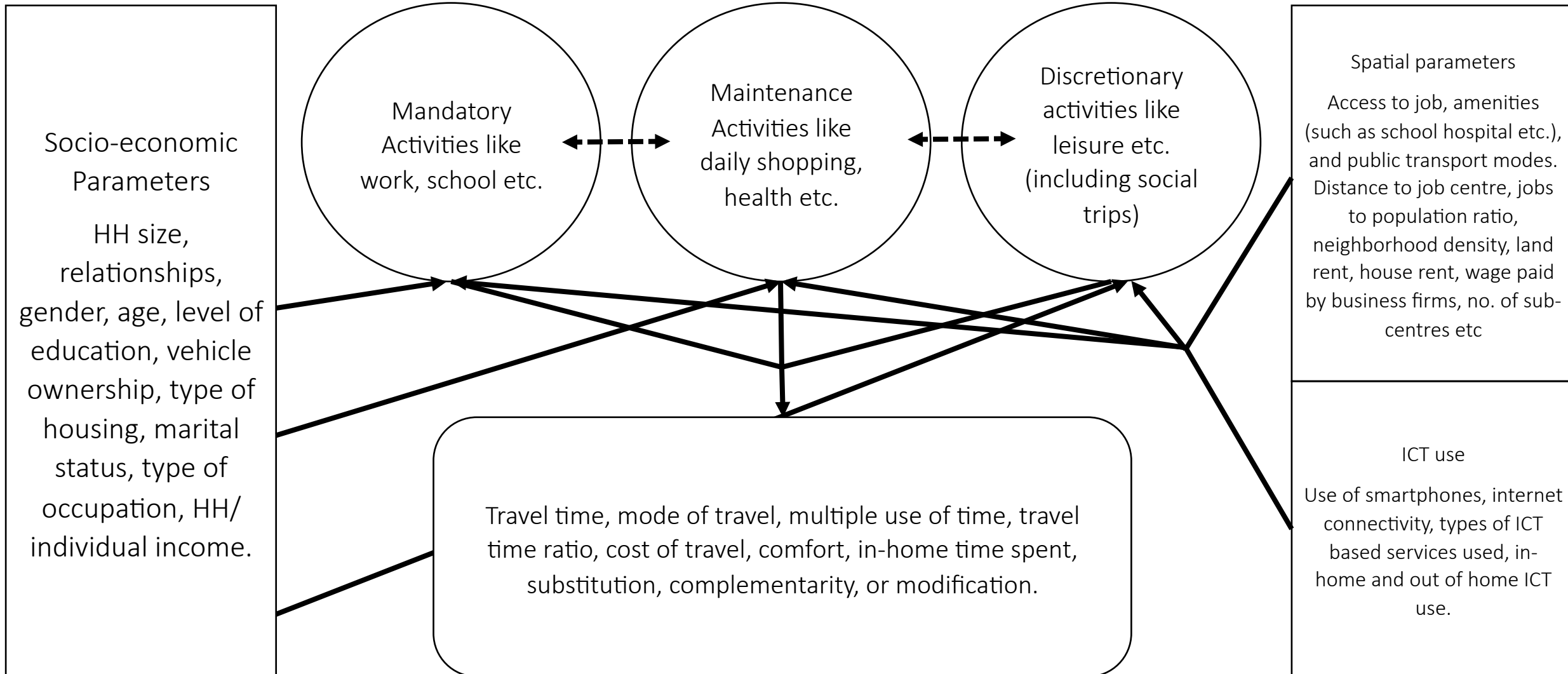**ICT use**

Use of smartphones, internet connectivity, types of ICT based services used, in-home and out of home ICT use.

Use of ICT   Low capability   Change of spatial structure

Research gaps & Ideation

Research Objectives

For a society with existing disparity, travel contributes to productivity and individuals aren't just looking to reduce travel but are looking for better access to different opportunities. In such a scenario, the effects of different endogenous and exogenous variables (pertaining to spatial change and ICT use) on travel will vary based on the purpose of activities and the socio-economic characteristics of individuals.

a) To identify network factors which affect residential choice at a local level in developing nations taking the case study of Mumbai.
b) To evaluate the importance of travel time savings for different socio-economic groups.
c) Comprehensively model travel behavior adopting both spatial parameters and parameters related to ICT use, along with socio-economic, individual and household parameters.
d) To identify the change in time uses for different cohorts (e.g. age, gender etc.) based on the above mentioned parameters.
e) To evaluate the concept of value of access in context of a developing country like India, succinctly identifying the parameters that can improve access to opportunities for a larger section of society.
f) To suggest policy recommendations related to spatial change and ICT use, which can improve the overall access to activity opportunities in a city.

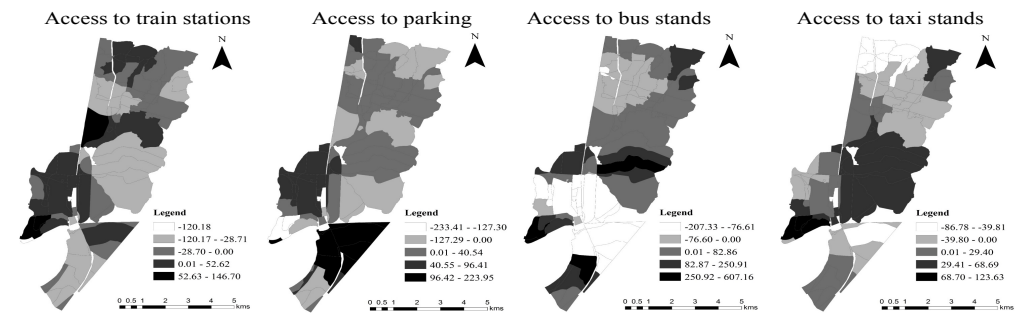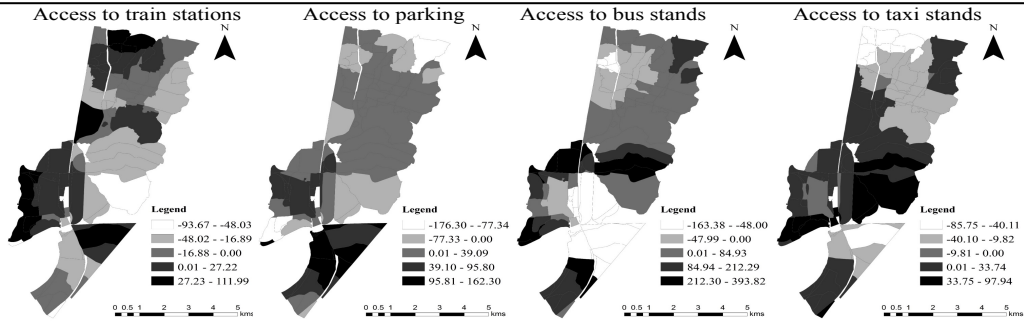# Real estate pricing and transport network
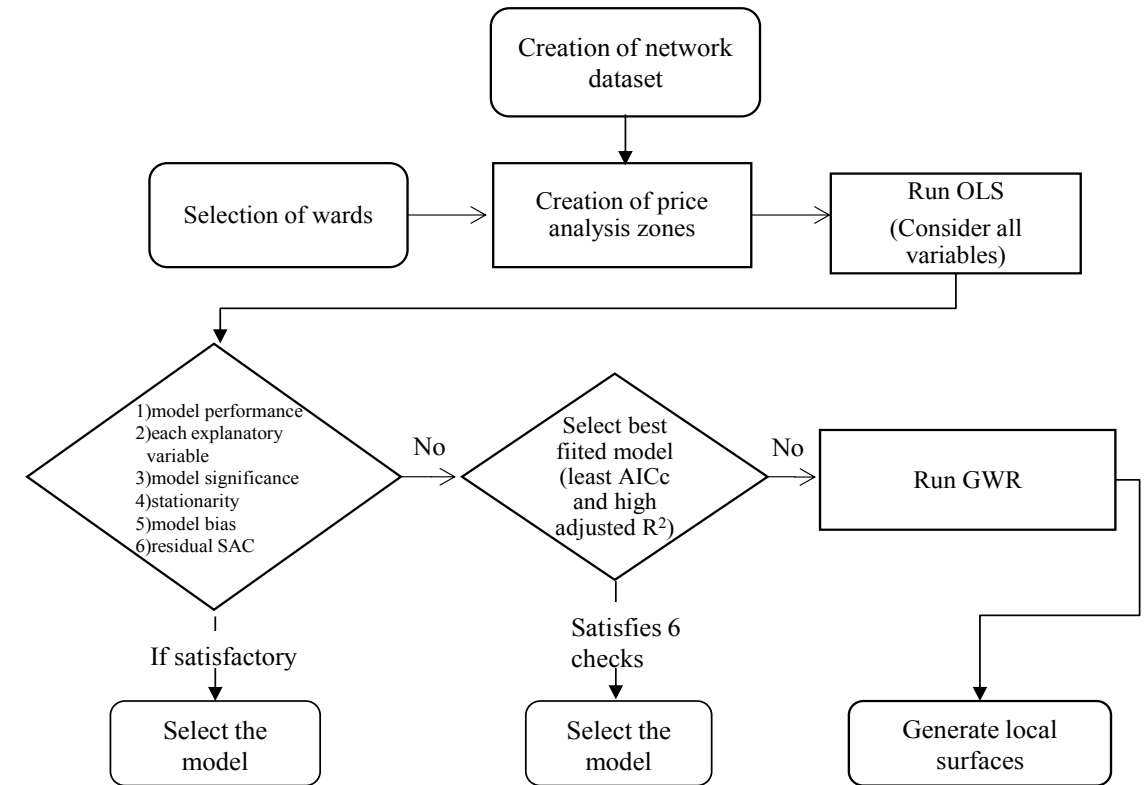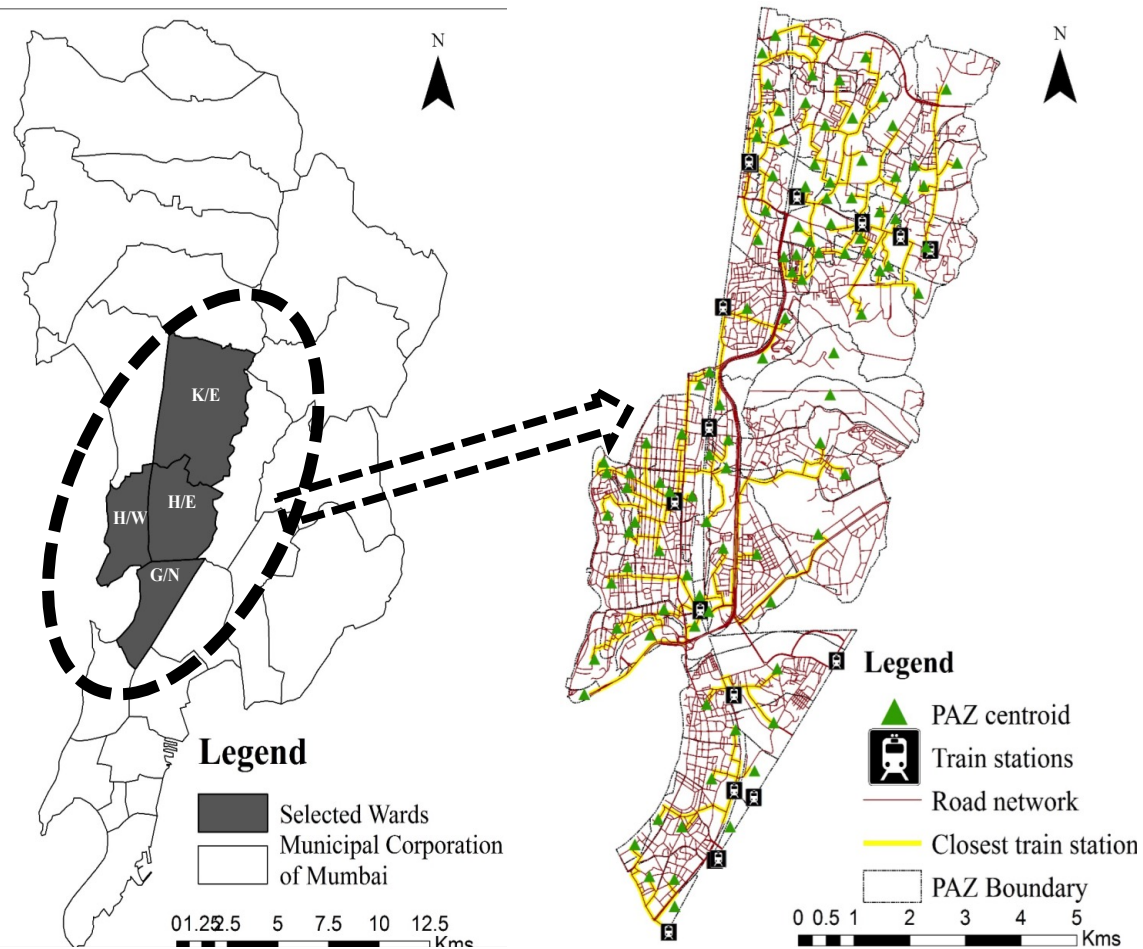
Varghese, V., Sarkar, S., Bardhan, R., Velaga, N. & Jana, A. (2015). Transport network characteristics and real-estate undercurrents: The effect of spatial nonstationarity on property pricing in Mumbai. Paper accepted for presentation at the 3rd Conference of the Transportation Research Group of India (CTRG), Kolkata, India.
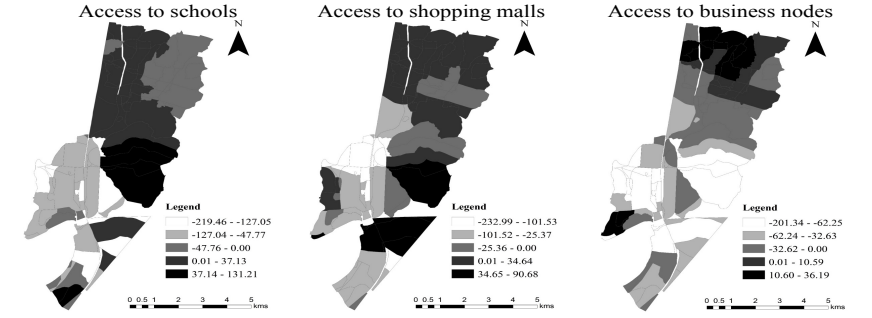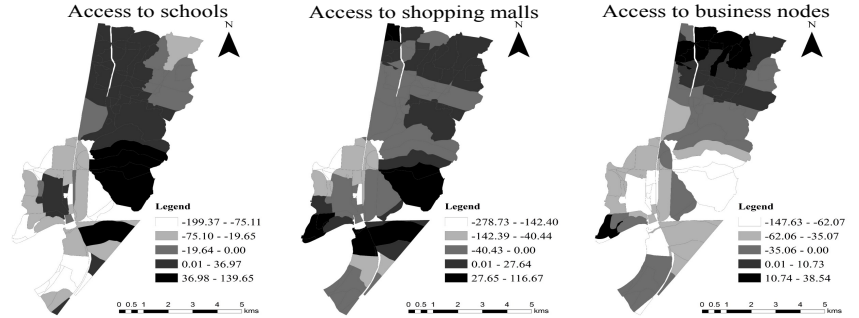
17

Effect of transport network characteristics on real estate prices- Results

Model parameters		
Residential	Distance to nearest parking	
	Distance to nearest bus station	
	Distance to nearest taxi stand	
	Distance to nearest school	
	Distance to nearest mall	
	Distance to nearest business node	
Commercial	Distance to nearest mall	
	Distance to nearest business node	
Office	Distance to nearest train station	
	Distance to nearest parking	
	Distance to nearest bus station	
	Distance to nearest taxi stand	
	Distance to nearest school	
	Distance to nearest mall	
	Distance to nearest business node	

Red color imply negative association

Access to train stations

Access to shopping malls

Access to business nodes

Commercial

Legend
-183.06 – -69.52
-69.51 – 0.00
0.01 – 123.46
123.47 – 363.09
363.10 – 915.92

Legend
-1266.09 – -954.89
-954.88 – -52.08
-52.07 – 0.00
0.01 – 91.91
91.92 – 287.44

Legend
-777.39
-777.38 – -371.11
-371.10 – -119.57
-119.56 – 0.00
0.01 – 7.57

Access to train stations

Access to parking

Access to bus stands

Access to taxi stands

Legend
-93.67 – -48.03
-48.02 – -16.89
-16.88 – 0.00
0.01 – 27.22
27.23 – 111.99

Legend
-176.30 – -77.34
-77.33 – 0.00
0.01 – 39.09
39.10 – 95.80
95.81 – 162.30

Legend
-163.38 – -48.00
-47.99 – 0.00
0.01 – 84.93
84.94 – 212.29
212.30 – 393.82

Legend
-85.75 – -40.11
-40.10 – -9.82
-9.81 – 0.00
0.01 – 33.74
33.75 – 97.94

Access to schools

Access to shopping malls

Access to business nodes

Residential

Legend
-199.37 – -75.11
-75.10 – -19.65
-19.64 – 0.00
0.01 – 36.97
36.98 – 139.65

Legend
-278.73 – -142.40
-142.39 – -40.44
-40.43 – 0.00
0.01 – 27.64
27.65 – 116.67

Legend
-147.63 – -62.07
-62.06 – -35.07
-35.06 – 0.00
0.01 – 10.73
10.74 – 38.54

Access to train stations

Access to parking

Access to bus stands

Access to taxi stands

Legend
-120.18
-120.17 – -28.71
-28.70 – 0.00
0.01 – 52.62
52.63 – 146.70

Legend
-233.41 – -127.30
-127.29 – 0.00
0.01 – 40.54
40.55 – 96.41
96.42 – 223.95

Legend
-207.33 – -76.61
-76.60 – 0.00
0.01 – 82.86
82.87 – 250.91
250.92 – 607.16

Legend
-86.78 – -39.81
-39.80 – 0.00
0.01 – 29.40
29.41 – 68.69
68.70 – 123.63

Access to schools

Access to shopping malls

Access to business nodes

Office

Legend
-219.46 – -127.05
-127.04 – -47.77
-47.76 – 0.00
0.01 – 34.64
37.14 – 131.21

Legend
-232.99 – -101.53
-101.52 – -25.37
-25.36 – 0.00
0.01 – 34.64
34.65 – 90.68

Legend
-201.34 – -62.25
-62.24 – -32.63
-32.62 – 0.00
0.01 – 10.59
10.60 – 36.19

Effect of transport network characteristics on real estate prices- Concluding discussions

Residential   Commercial   Office

Legend
0.14 - 0.40
0.41 - 0.60
0.61 - 0.75
0.76 - 0.88
0.89 - 1.00

Legend
0.10 - 0.33
0.34 - 0.49
0.50 - 0.61
0.62 - 0.76
0.77 - 0.96

Legend
0.21 - 0.44
0.45 - 0.63
0.64 - 0.73
0.74 - 0.85
0.86 - 1.00
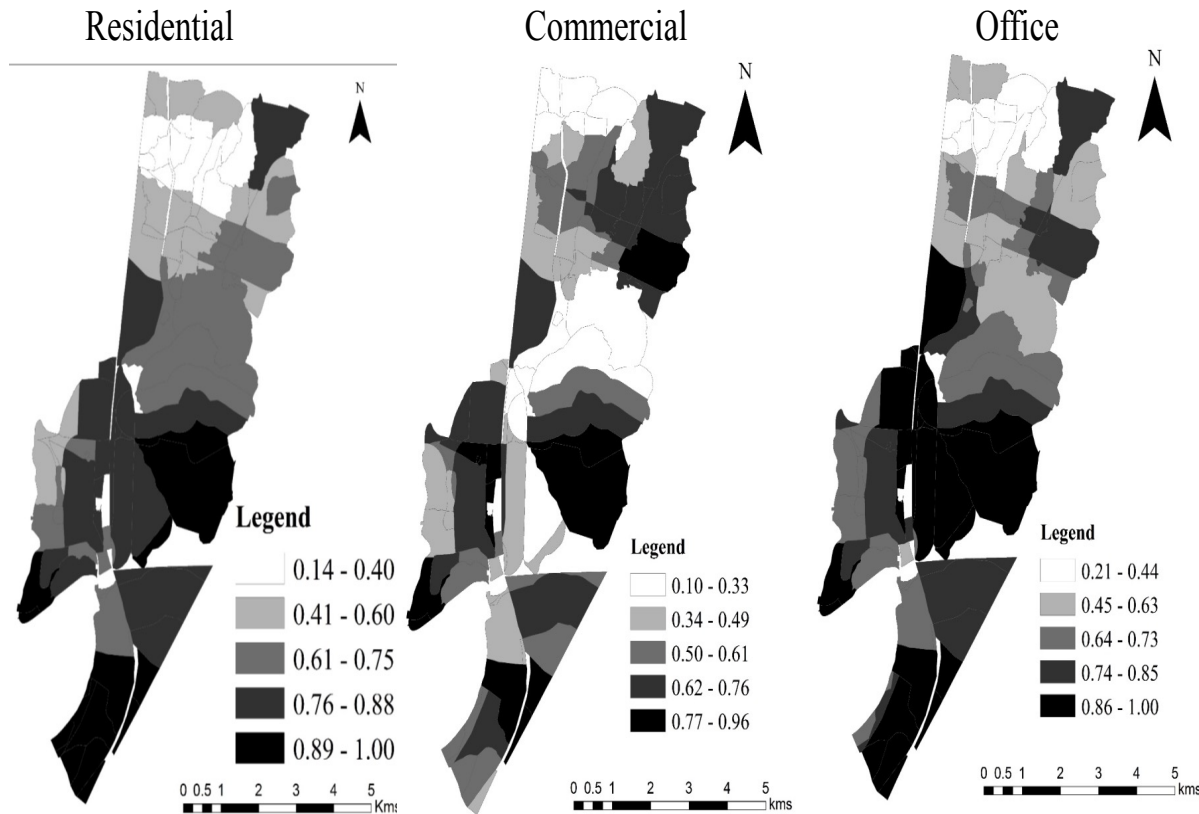
- Real estate market is influenced by speculation, which is largely a local phenomenon.
- Distance to train stations negatively influenced residential property prices at Bandra-Kurla complex and distance to bus stops had a severe negative impact on housing prices in Dharavi, Dadar and Andheri.
- Distance to **schools** also have negatively influenced both residential and office property prices, while the distance to **shopping malls and business districts** have emerged as a significant factor in estimating property prices for all different types land use.
- A strong correlation between office and residential prices hint towards **the willingness of people to stay near their workplaces**.

19

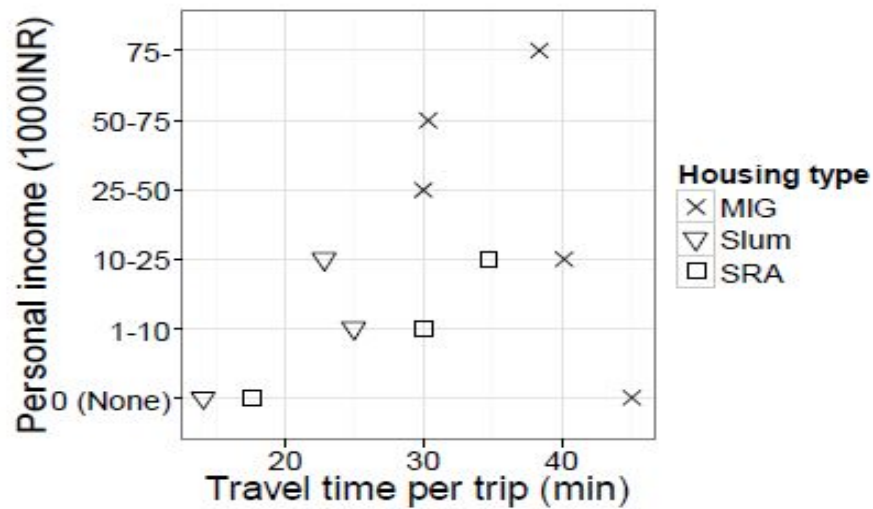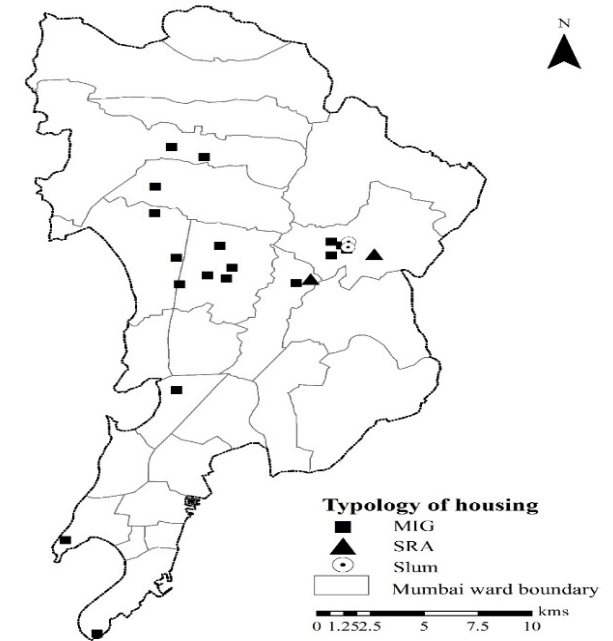# Travel time savings or the value of access- case study of Mumbai- Concept

When people are less capable to enjoy "beings and doings" which add value to life, then people attach more importance to the production aspects of travel, and gradually put more value on the consumption aspects of travel with the increase in their capability.
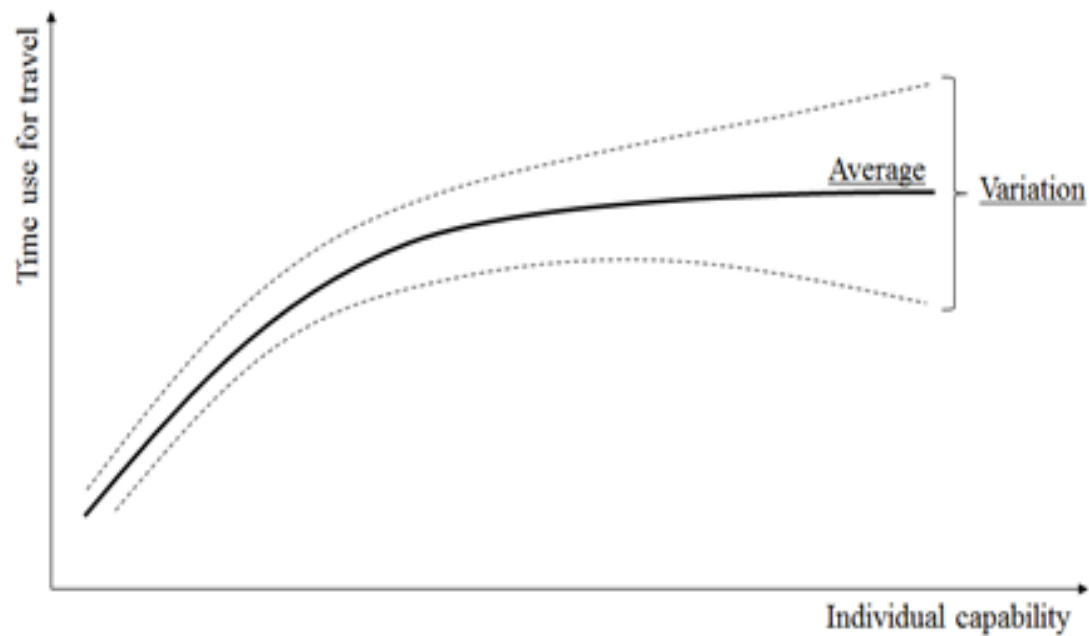

1. Travel time is significantly related to individual capability and is lower for less capable

2. The variance of travel time, indicating the degree of freedom of movement, has positive association with individual capability

Chikaraishi, M., Jana. A., Bardhan, R., Varghese, V., Fujiwara, A. Revisiting travel time in Mumbai: the value of time saving or the value of access? Paper submitted at the 95th TRB annual conference.

Travel time savings or the value of access- case study of Mumbai: Study area and data collection

Type of housing	Individuals	Households
MIG	48	22
Slum	58	23
SRA	52	28
Total	158	73

Typology of housing
■ MIG
▲ SRA
⊙ Slum
▢ Mumbai ward boundary
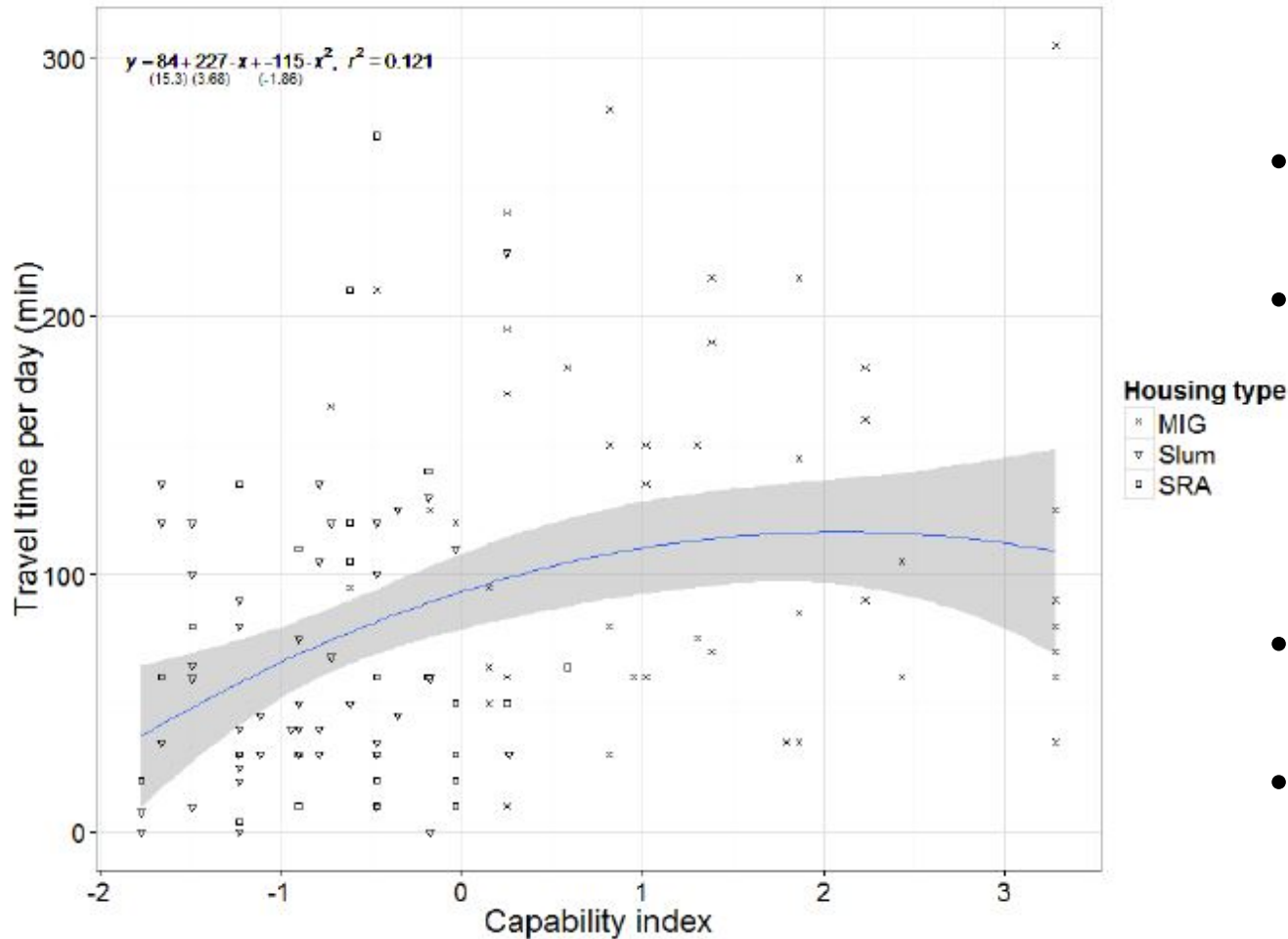
0 1.25 2.5   5   7.5   10 kms

(a) Travel time per trip
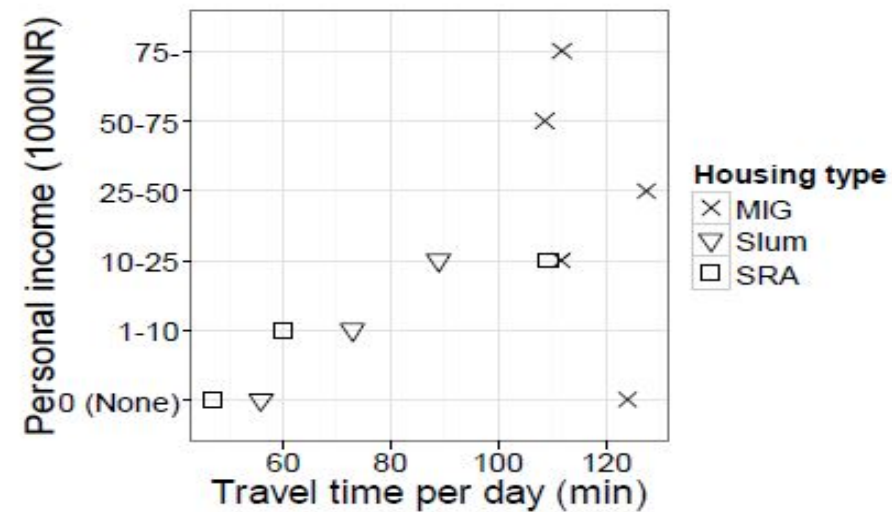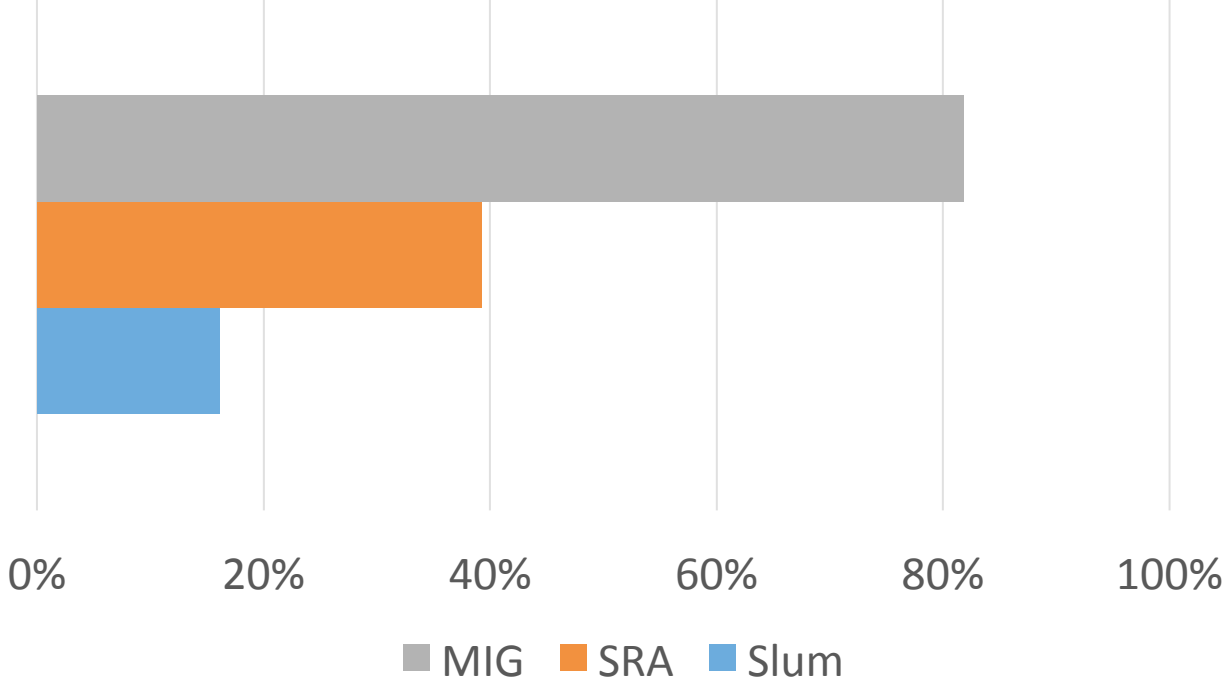

(b) Travel time per day

Travel time savings or the value of access- case study of Mumbai: Results and discussion
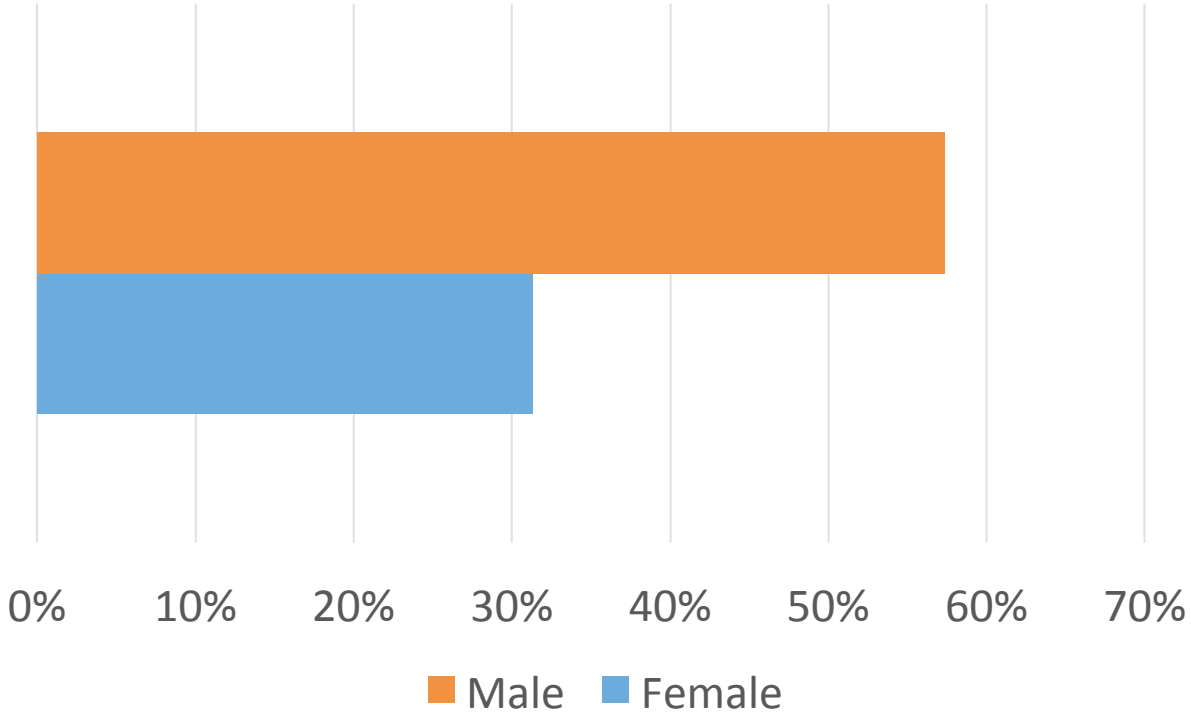

- The mean capability and travel time of individuals from MIG housing was found to be significantly higher than those of Slum and SRA.
- The variance in travel time increased with the capability of the individual
- Individuals with higher capability had the ability to spend more time to discretionary activities, whereas people in the lower order of capability were constrained to spend more time in mandatory activities.
- MIG have more flexible mode choices whereas other groups rely more on walking.
- Travel time savings would substantially underestimate the benefit of the infrastructure investment.
- Exploring the concept of value of access w.r.t. spatial policies and ICT use

On going work

Smart phone/Internet use vs housing type

Smart phone/Internet use vs gender

On going work

Type of services used

Transport information	
Games	
Cab services	
Social networking apps	
rating app (complimentarity)	
e-shopping	
Online ticketing	

0% 10% 20% 30% 40% 50%
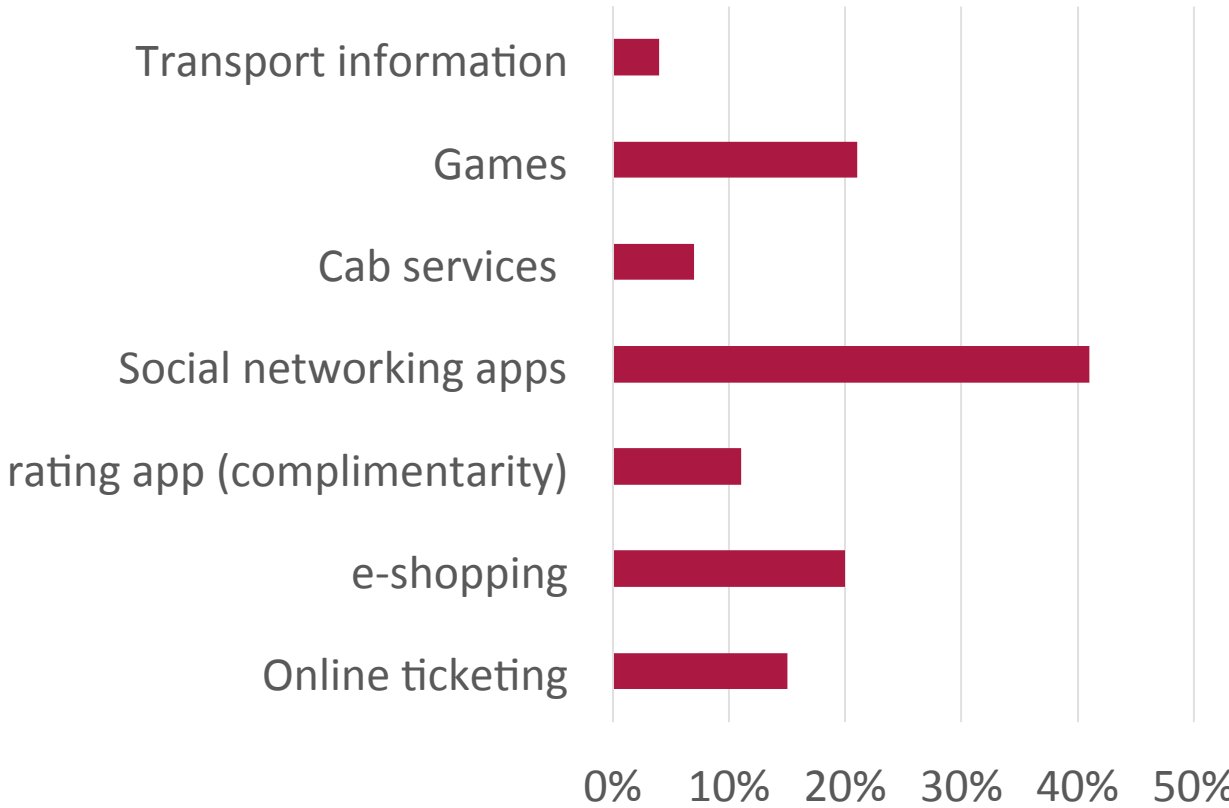
Time use while traveling

Talking to other passengers	
Working	
Eating	
Playing games	
Sleeping	
Window gazing	
Gets bored	
Uses internet	
Listening to music	
Reading	

0% 10% 20% 30% 40% 50%
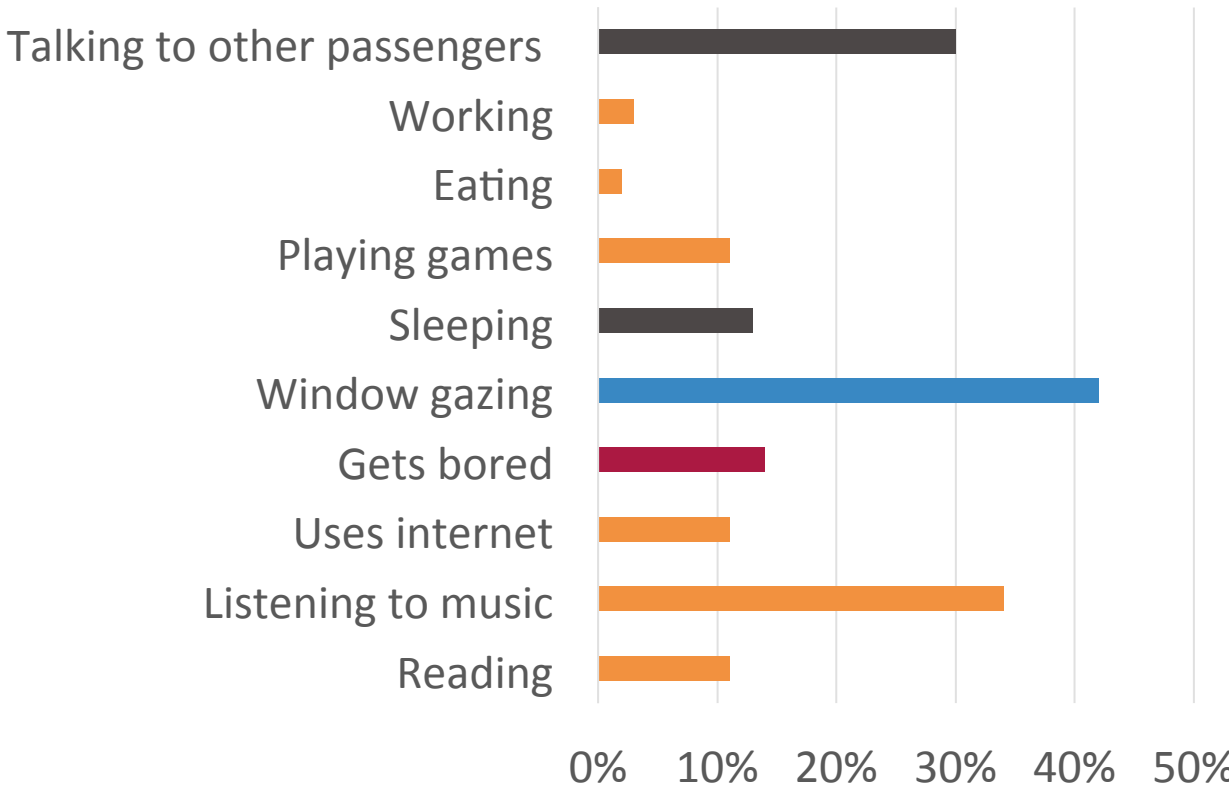
Inter-region travel in India- Destination choice
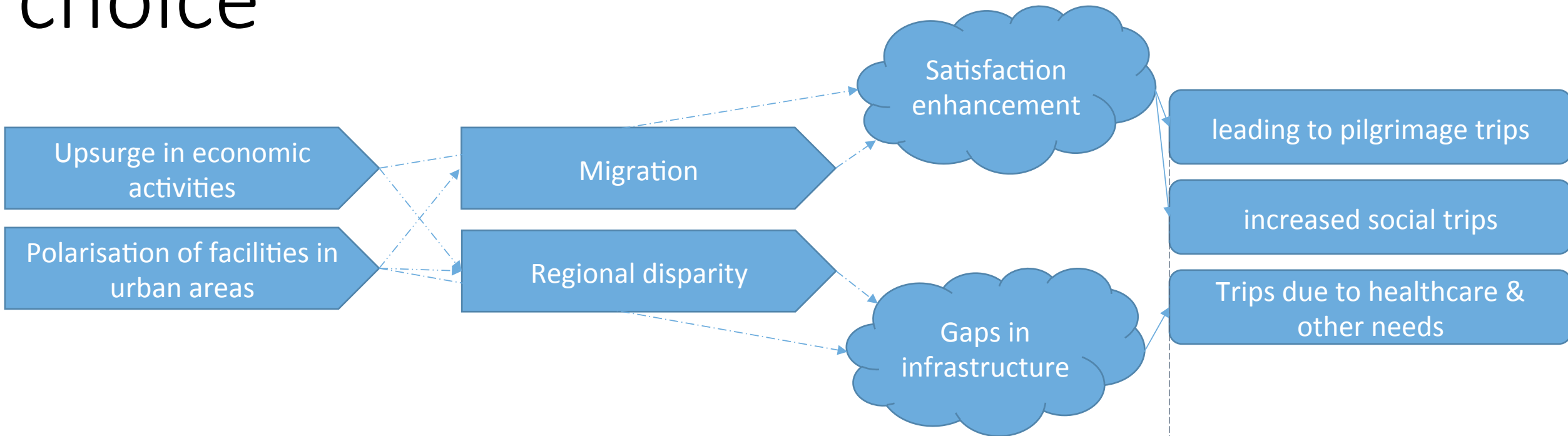
"to analyse regional travel patterns in India by studying social, health, and pilgrimage trips"
This might be significant to

(1) Better understand travel with respect to the existing disparity in infrastructure provisioning and economic opportunities

(2) Analyse the purpose that prompted the travel activity,

(3) Characteristics of the trips based on mode used, duration of the trip and spatial location of the destination, and

(4) Policy implications related to long distance travel

Bardhan, R., Varghese, V., & Jana, A. (2015). Analyzing Regional Travel Patterns in India: Disaggregated Analysis of Social, Health and Pilgrimage Trips. Journal of the Eastern Asia Society for Transportation Studies (in press)

Conceptual Framework

Social trips

Destination outside the district but within the state

Destination outside the state but within the country

Destination within the district

Pilgrimage trips

Healthcare trips

□ Is there any significant difference in travel patterns with respect to 'within district', 'outside district but within state' & 'beyond district'?
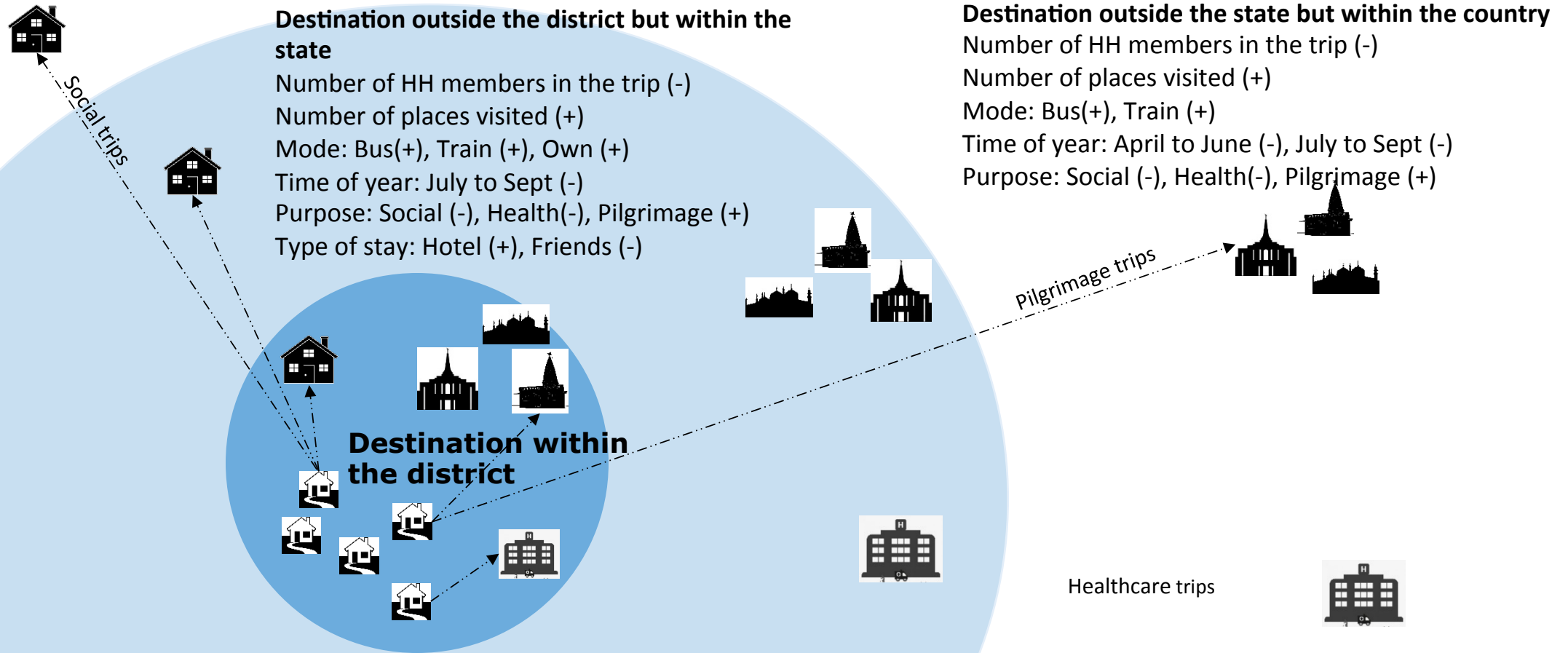
□ On what factors do long distance travel depend in India?

□ "Clustering of opportunities/ infrastructure might hold the key to longer distance trips in India"

Centre for Urban Science and Engineering

Research methodology

NSS data on domestic tourism

MNL models
Outcome variable:
Trip destination

ESDA for social, health & pilgrimage trips
Unit of analysis: District

MNL for overnight trips

MNL for sameday trips

Local Moran's I in the type of trips viz. Social, health and pilgrimage trips.

Policy implications, discussions and future scope

O/N trips (Findings)

Destination outside the district but within the state
Number of HH members in the trip (-)
Number of places visited (+)
Mode: Bus(+), Train (+), Own (+)
Time of year: July to Sept (-)
Purpose: Social (-), Health(-), Pilgrimage (+)
Type of stay: Hotel (+), Friends (-)

Destination outside the state but within the country
Number of HH members in the trip (-)
Number of places visited (+)
Mode: Bus(+), Train (+)
Time of year: April to June (-), July to Sept (-)
Purpose: Social (-), Health(-), Pilgrimage (+)

Social trips

Pilgrimage trips

Destination within the district

Healthcare trips

Sameday trips(Findings)

Destination outside the district but within the state

Number of HH members in the trip (+)

Number of places visited (+)

Mode: Bus(+), Train (+), Own (+)

Time of year: July to Sept (-)

Purpose: - Social (+), Pilgrimage (+)

Type of stay: Hotel (+), Friends (+)

Destination outside the state but within the country

Number of HH members in the trip (+)

Number of places visited (+)

Mode: Train (+), Own(-)

Purpose: Social (-), Pilgrimage (+)

Social trips

Pilgrimage trips

Destination within the district

Healthcare trips
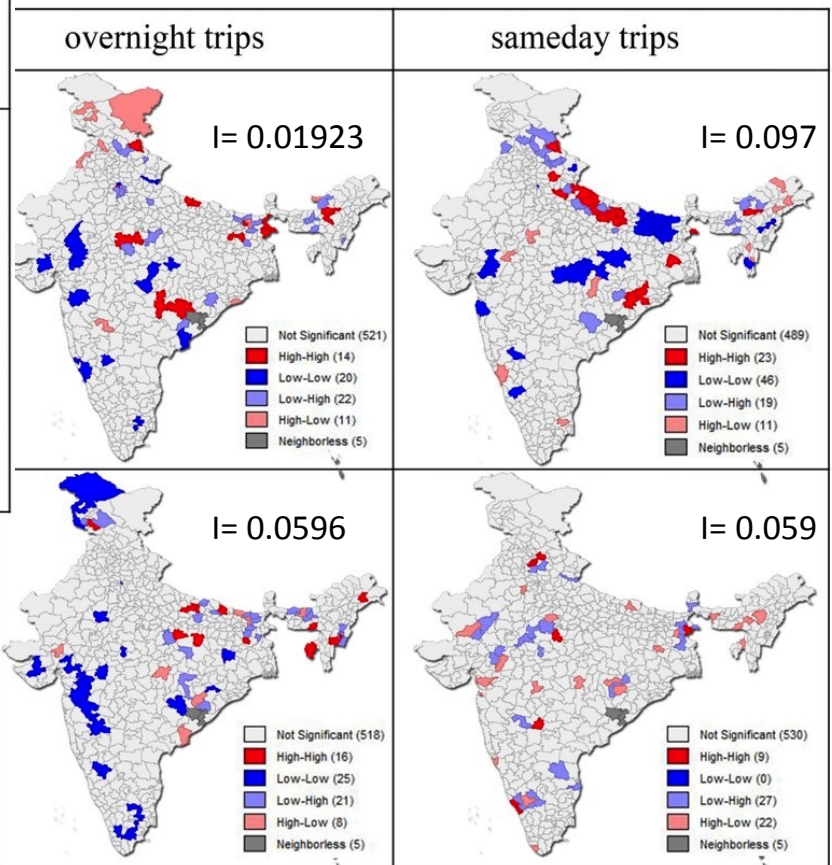
Clustering and Spatial Autocorrelation

Social trips

Pilgrimage trips

Health trips

Discussions

- Lack of employment opportunities and other allied services such as education, force people from rural areas to migrate to urban areas.

- Current healthcare planning in India hierarchically allocates healthcare facilities based on certain population thresholds, which creates a lopsided distribution of sophisticated health centres in urban areas.

- Study provides the basis for travel induced infrastructure delivery planning. Transport policies reducing impedances towards social and pilgrimage activities, while provisioning of infrastructure to reduce the need for travelling for health activities can subsequently lead to the improvement of quality of life.

ありがとうございます

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