

Suburbanization of poverty and changes in transportation access

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Overview

- 1 Research Motivation and Hypothesis
- 2 Literature review
- 3 Methodology
- 4 Empirical Setting
- 5 Descriptive Analysis
 - Sociodemographic change
- 6 Results

Research Motivation

- Between 2000 and 2011, the population below poverty limit living in the suburbs increased by 64 percent in the US
 - 1 Employment decentralization
 - 2 Affordable housing scarcity
 - 3 Gentrification
- In areas with no access to public transportation, the poor are often forced to commute by personal vehicle
 - 1 Increases their transportation cost
 - 2 Traffic congestion problems
 - 3 Longer commutes even if they have access to public transportation
- **Current research gap**
 - 1 Research in this area has focused on the sociodemographic trends, while changes in transit access over time have not been fully considered

- Despite transit improvements in the Raleigh–Durham– Chapel Hill area, transit accessibility for the low-income population may have decreased on average due to their suburbanization
- **Research Objective:**
 - Estimate the changes in transit access of low-income households over time using historical data of bus routes in the Raleigh-Durham-Chapel Hill area
 - ① Accessibility to transit: how easily an individual reaches a bus station by walking or biking
 - ② Accessibility by transit: how easily an individual reaches a low-wage or low-skill job by transit

Current Accessibility Measure

The measure of accessibility should include (Geurs, 2004):

- the amount, quality, demand, supply, and spatial distribution of opportunities at each destination;
- the travel distance or time between an origin and a destination using a specific transportation mode, which can involve the time costs and effort ;
- the availability of opportunities throughout a day and the time available for individual to access opportunities;
- the need to access certain activities and access abilities

Current Accessibility Measure

There are different measures being developed:

- Infrastructure-based measures: analyzes the performance of transport infrastructure, , such as “level of service of the road network”
- Location-based measures: analyzes the accessibility to spatially distributed activities, such as “the activities that can be reached within 10 minutes by transit”
 - 1 Contour measure
 - 2 Gravity measure
- Person-based measures: analyzes accessibility based on the individuals, such as “the activities that an individual can participate within a given a constraint of time”
- Utility-based measures: measure the amount of 'benefits' individual derive from access to the spatially distributed activities by using the expected maximum utility as the measure of accessibility

We use the gravity-based measure developed by Hansen(1959):

$$A_i = \sum_j a_j f(c_{ij}) \quad (1)$$

where a_j is the number of bus stops in zone j ; $f(c_{ij})$ is an impedance function of traveling from zone i to zone j , where

$$f(C_{ij}) = \begin{cases} 1 & \text{if walking time to bus stops} \leq 10 \text{ min} \\ C_{ij}^\beta * \exp(\gamma * C_{ij}) & \text{if walking time to bus stops} > 10 \text{ min} \end{cases} \quad (2)$$

Accessibility by Transit

We adopt the measure developed by Shen (1998) to capture the spatial distribution of demand:

$$A_i = \sum_j \frac{a_j f(C_{ij})}{D_j}, D_j = \sum_k P_k f(C_{kj}) \quad (3)$$

where A_i is the accessibility to zone j for job seekers living in zone i ;

a_j is the number of jobs in zone j ;

D_j is the number of job seekers seeking for jobs at zone j ;

P_k is the number of job seekers living in zone k seeking the same opportunities;

C is the travel time between two zones;

$f(C)$ is the impedance function between two zones, where

$$f(C_{ij}) = \begin{cases} 1 & \text{if travel time} \leq 35 \text{ min} \\ C_{ij}^\beta * \exp(\gamma * C_{ij}) & \text{if travel time} > 35 \text{ min} \end{cases} \quad (4)$$

Accessibility by Transit

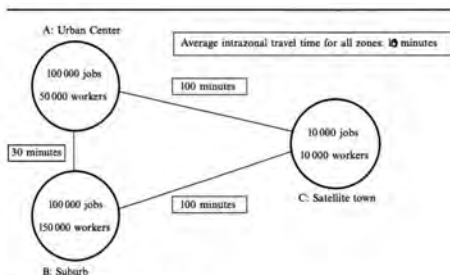


Figure 1. A simplified urban system.

- If we use the simple gravity, Zone A and Zone B have the same accessibility while Zone C has the lowest accessibility
- Zone A should have the highest accessibility
- Zone B has a lower accessibility than Zone B, because at least one third of them must commute to other zones
- Accessibility in Zone C can be lower or higher than Zone B

Picture source: Shen (1998)

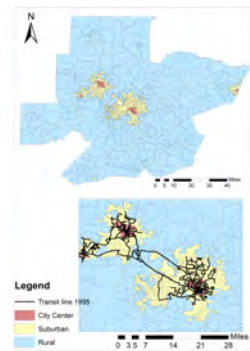
Study Area: Raleigh-Durham-Chapel Hill, NC



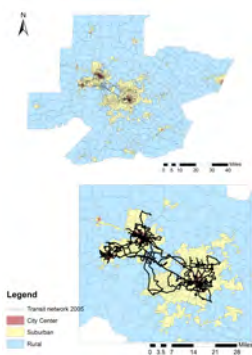
Figure source:

<https://triangletravelsurvey.com/base/triangleweb/theme/img/region.jpg>

Urban-Suburban-Rural Change from 1990 to 2000



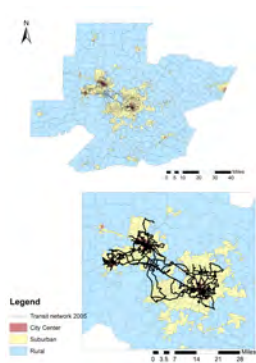
(a) 1990



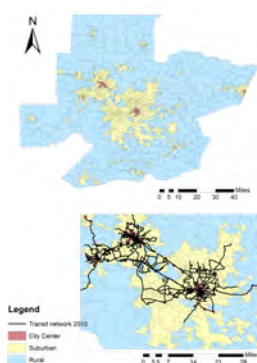
(b) 2000

- Suburban area: Census Urban Boundary data
- City center area: pre-1940 housing density more than 400 per square mile or pre-1940 housing density more than 200 and population density more than 1000 per square mile

Urban-Suburban-Rural Change from 2000 to 2010



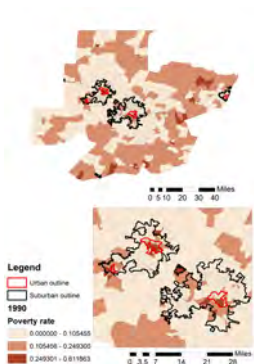
(c) 2000



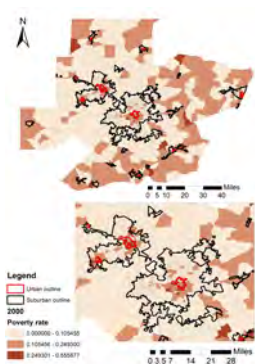
(d) 2010

- Suburban area is growing over time while city center area does not have significant change
- The transit system has been expanding over time

Poverty Change from 1990 to 2000



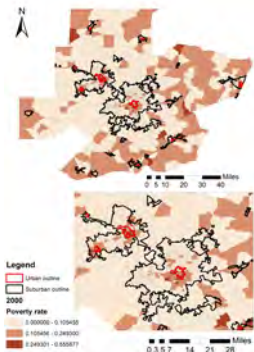
(e) 1990



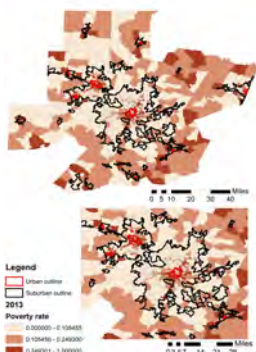
(f) 2000

- No obvious change in poverty between 1990 and 2000
- The poverty has a higher poverty rate in city center in 1990

Poverty Change from 2000 to 2013



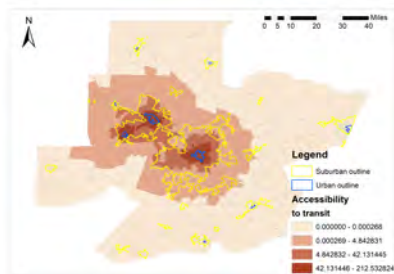
(g) 2000



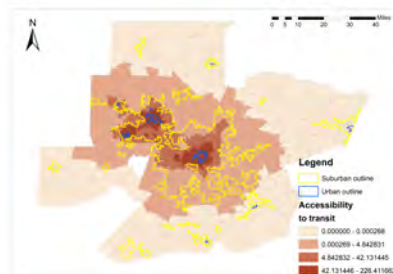
(h) 2013

- Significant increase in poverty rate in suburban and rural area

Accessibility to Transit Results



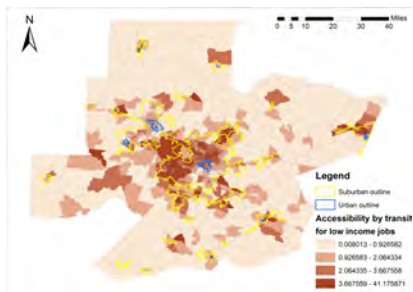
(i) 2006



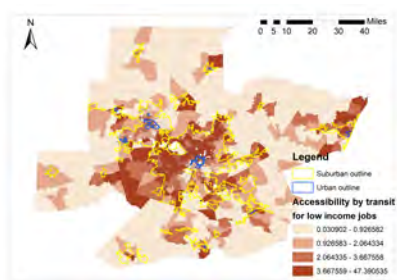
(j) 2015

- Accessibility significantly increases in the North-East part of suburban area and rural area

Accessibility to Low Income Jobs by Transit Results



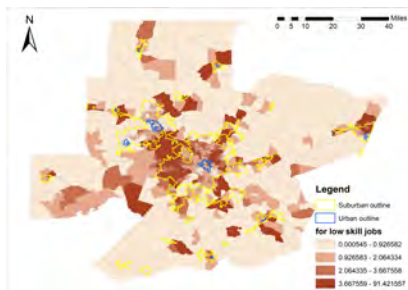
(k) 2006



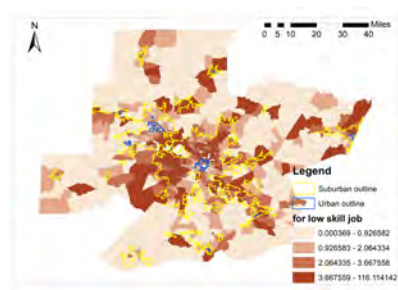
(l) 2015

- Accessibility significantly increases in suburban area
- The boundary area between suburban area and rural area also experience significant increases of accessibility

Accessibility to Low Skill Jobs by Transit Results



(m) 2006



(n) 2015

- Accessibility to low skill jobs are always better than to low income jobs
- Experience similar trends as accessibility to low income jobs

Accessibility Change by Area Results

Access to transit	Urban	Suburban	Rural
2015	113.45	31.14	6.07
2006	113.93	29.47	5.4
Increase percent	0%	6%	12%

Access to low-income jobs	Urban	Suburban	Rural
2015	2.95	3.19	2.33
2006	1.73	2.32	1.69
Increase percent	71%	38%	38%

Access to low-skill jobs	Urban	Suburban	Rural
2015	2.09	3.75	3.63
2006	1.4	2.91	2.75
Increase percent	49%	29%	32%

- Urban always has the highest accessibility to transit over time
- Suburban has the highest accessibility to both type of jobs over time
- The highest increase percent occurs in rural for accessibility to transit, while in urban for accessibility to jobs

Questions?