

Impacts of Spatial and Functional Relationships on Suburban Growth in Metropolitan Areas

Eom, Hyuntae and Woo, Myungje
Dept. of Urban Planning and Design, University of Seoul, South Korea

서울시립대학교
UNIVERSITY OF SEOUL

Abstract
Recently, it has been witnessed that many suburban areas have experienced decline in terms of population and employment, while some central cities turn out to gain growth. The revitalization of central cities is certainly a good news. However, the decline of suburban areas, which grew before, would be a threat to the region in terms of sustainable development. Many local factors, such as aging population, crime, financial condition of local governments, have been blamed for such decline. However, while these local factors may contribute to urban decline, an increasing interaction between cities and regions may also play a key role in keeping jurisdictions

growing. In this line, the purposes of this study are to calculate spatial and functional relationships between central areas and suburban jurisdictions and measure their impacts on growth and decline of suburban areas using multiple regression model. Changes in population, employment and GRDP of suburban-counties are used as dependent variables in three models, and the indicators of functional and spatial relationships along with other control variables are used as independent variables. The results may reveal that the spatial and functional interactions as well as local factors are crucial to the growth of suburban areas, reminding the significance of the networks on regional growth.

1. INTRODUCTION

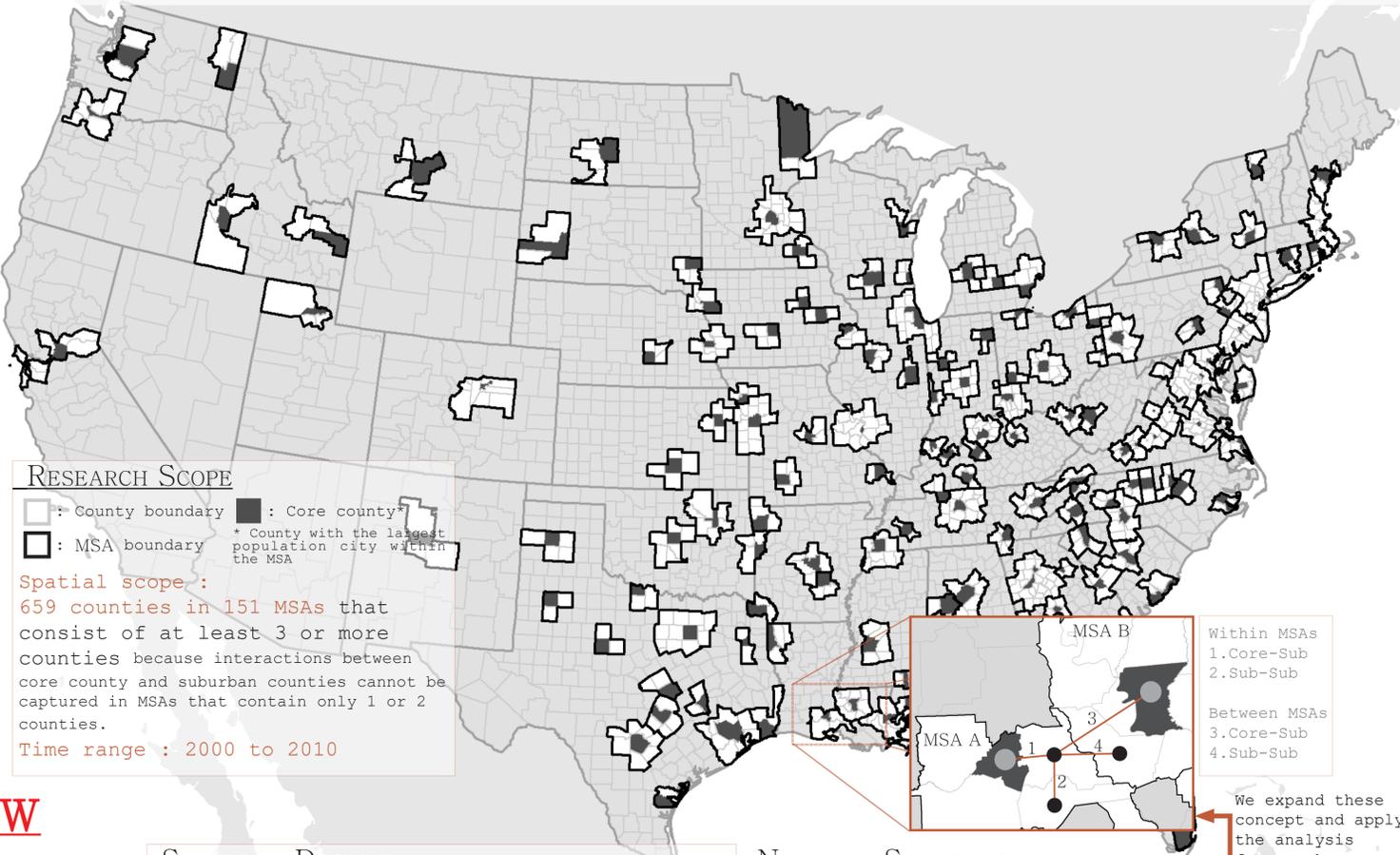
RESEARCH BACKGROUND

Many suburban areas have recently experienced decline in terms of population and employment, and some central cities turn out to gain growth.

The decline and growth of suburban areas are closely related to the central city. This means that an increasing interaction between cities and regions may play a major key role as well as spatial adjacency in the growth and decline of the suburban areas.

In this line, the purposes of this study are

- To calculate functional relationships between central areas and suburban jurisdictions in terms of commodity flow and commuting
- To measure their impacts on growth and decline of suburban areas
- To compare both impacts of spatial and functional relationships.



RESEARCH SCOPE
 □ : County boundary ■ : Core county
 □ : MSA boundary * : County with the largest population city within the MSA
Spatial scope :
 659 counties in 151 MSAs that consist of at least 3 or more counties because interactions between core county and suburban counties cannot be captured in MSAs that contain only 1 or 2 counties.
 Time range : 2000 to 2010

4. RESULTS OF ANALYSIS

RESULTS OF REGRESSION MODELS

| Variables | | Model 1 Population | Model 2 Employment | Model 3 GRDP |
|--|--|-----------------------|-----------------------|-----------------|
| Interaction with core county within the same MSA | Spatial relationship | -0.034** | -0.016 | 0.003 |
| | Functional relationship -commuting | 0.005 | 0.009 | -0.003 |
| | Functional relationship -commodity flow | 0.001 | 0.011* | 0.017*** |
| Interactions with counties within the same MSA | Commuting | 0.004 | 0.005 | -0.002 |
| | Commodity flow | 0.004 | 0 | -0.015** |
| Interactions with core-counties between MSAs | Commuting | 0.009** | 0.01* | -0.003 |
| | Commodity flow | 0.016 | 0.001 | 0.009 |
| Interactions with counties between MSAs | Commuting | -0.002 | 0.003 | -0.004 |
| | Commodity flow | -0.022** | -0.008 | 0.004 |
| Social variables | Growth of core-county | 0.467*** | 0.244*** | 0.578*** |
| | Rate of white | 0.061*** | 0.039* | -0.065*** |
| | Rate of native american | -0.002 | 0.005 | 0.012** |
| | Rate of asian | 0.016** | 0.001 | -0.029*** |
| Economical variables | Rate of population aged above 65 age | -0.277*** | -0.282*** | 0.031^ |
| | Share of employees in manufacturing | 0.004 | -0.038*** | -0.03*** |
| | Share of employees in wholesale | -0.001 | -0.012 | -0.013* |
| | Share of employees in retail | 0.09*** | 0.015 | -0.042** |
| | Share of employees in finance | 0.026** | 0.057*** | 0.01 |
| Financing variables | Share of employees in real estate | 0.035*** | 0.083*** | -0.026** |
| | Expenditure per capita, county | -0.049*** | -0.065*** | 0.015 |
| | Share of state's county own-source revenue from property tax | -0.001 | -0.008 | 0.019 |
| Cons. | | 0.338** | 0.456** | -0.349** |
| Adj R-sq | | 0.5167 | 0.3918 | 0.4606 |

*** p < 0.01 ; ** p < 0.05 ; * p < 0.1 ; ^ p < 0.11

[Control variables]

Some control variables have significant effects which were generally consistent with the results of previous studies.

[Impacts of interactions]

A 1% increase in the commuting interactions with core-counties in different MSAs results in 0.009% and 0.01% increases in the population and employment growth, respectively. But, commodity interactions with suburban counties have significantly negative influence on growth of population and GRDP (respectively -0.015% and -0.022%).

[Comparisons between spatial and functional relationships]

Growth of core-county considering spatial relation has a significantly negative value for suburban population. But Growth of core-county reflecting functional relation has a significantly positive influence on employment and GRDP of suburban counties. These results show that a county closer to core-county has lower population growth, and more interactions with core-county have higher economical growth.

2. LITERATURE REVIEW

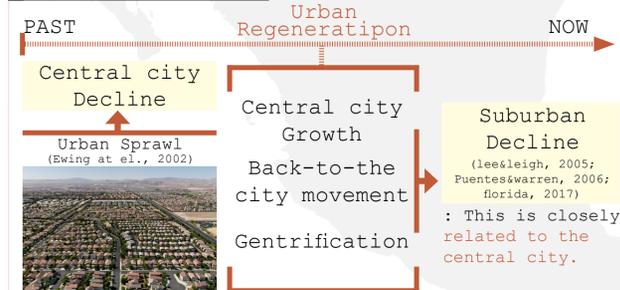
URBAN NETWORK

An urban network is where two or more independent cities functionally complement each other and achieve an integrated economy (Battenm 1995; Cappello, 2000).

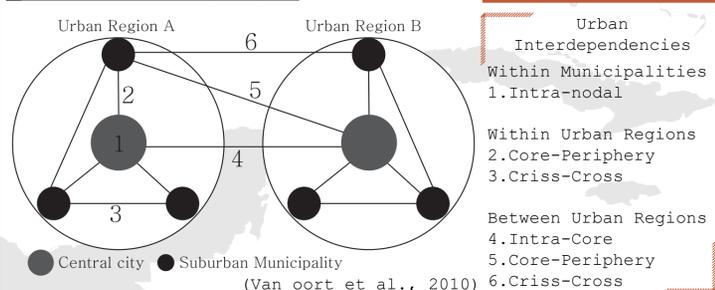
Central place theory (Christaller, 1933)
 : Spatial-hierarchical, Spatial adjacency, Spatial relationship

Central flow theory (Taylor, Hoyler & Verbruggen, 2010)
 : Interlocking network, Urban network, Functional relationship

SUBURBAN DECLINE



NETWORK STRUCTURE



5. CONCLUSIONS

These results show that the interactions with other counties as well as local factors are crucial to the growth of suburban areas

The functional relationship between cities and regions may also play a more important key role in keeping jurisdictions growing than spatial relationships.

This implies that we need to consider urban network when urban regeneration policies and urban growth management policies are developed at the regional level.

3. METHODOLOGIES

INDICATORS OF URANNETWORK

Interactions with core county

$$w_{ij} = \frac{O_{ij} + D_{ij}}{\sum_{j=1}^n O_{ij} + D_{ij}}$$

w_{ij} : i county's interdependency with j county
 O_{ij} : Commodity flow from i county to j county
 D_{ij} : Commodity flow from j county to i county
 n : Number of counties

Interactions are calculated in terms of commuting and commodity flow.

| Network | | j |
|--------------|----------|--|
| Within MSAs | core-sub | A core county in same MSA |
| | sub-sub | Counties in same MSA without core county |
| Between MSAs | core-sub | core counties in different MSAs |
| | sub-sub | counties in different MSAs |

Spatial relationships

Growth of Central city / Distance (km) *
 (Population, Employment, GRDP)
 * Euclidean distance from the center of core-county to the center of each suburban county.

Interactions with core-county are used to compare both spatial and functional relationships.

Functional relationships

Growth of Central city * Interactions (Population, Employment, GRDP) with core-county

MODELS AND VARIABLES

Multiple regression models (Log-Log)

$$\begin{aligned} \text{Pop}_i &= f(R_i, S_i, E_i, F_i) \\ \text{Emp}_i &= f(R_i, S_i, E_i, F_i) \\ \text{GRDP}_i &= f(R_i, S_i, E_i, F_i) \end{aligned}$$

Pop_i : Change rate of population
 Emp_i : Change rate of employees
 GRDP_i : Change rate of GRDP
 R_i : Spatial and functional relationships
 S_i : Social characteristics
 E_i : Economical characteristics
 F_i : Financing characteristics

Variables in Models

| Dependent variables | | Pop _i | Emp _i | GRDP _i |
|---------------------|--------------|--|---|--|
| R _i | Within MSAs | Pop _{core-county} /Distance | Emp _{core-county} /Distance | GRDP _{core-county} /Distance |
| | Between MSAs | Pop _{core-county} * Interaction (commuting, commodity) | Emp _{core-county} * Interaction (commuting, commodity) | GRDP _{core-county} * Interaction (commuting, commodity) |
| | | Interactions with counties in same MSA without core-county | | |
| | | Interactions with core-counties in different MSAs | | |
| | | Interactions with counties in different MSAs without core-counties | | |
| S _i | | POP _{core-county} | Emp _{core-county} | GRDP _{core-county} |
| | | Ethnic structure (White, native American, Asian) | | |
| | | Rate of population aged above 65 age | | |
| E _i | | Industrial structure (manufacturing, wholesale, retail, finance and real estate) | | |
| | | Expenditure per capita, county | | |
| F _i | | Share of state's county own-source revenue from property tax | | |