

Hierarchical central place system and agglomeration economies on households

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Executive summary

Central place theory shows that the shortage of distribution of goods and services in rural areas can be substituted from upper hierarchically-ordered central places. However, this paper demonstrates that spatial consumer exclusion may exist if transportation network is not well organized. Besides, income level varies among households in general. Under these circumstances, the importance of agglomeration economies in rural areas has been revealed even though these sizes are small. While these economies may be replaced by the well-organized infrastructure on interregional transportation, it is observed that the replacement should be done for specific goods and services. Those goods and services are namely luxury types rather than normal types, since spatial consumer exclusion on essential goods and services are much more problematic. However, rural areas may be difficult to satisfy above criteria, and the argument would be concluded by suggesting mixed strategic policy regarding the availability of goods and services through both regional and interregional access under the minimum sufficient transportation system by utilizing the benefit of agglomeration in a small unit at the lower hierarchically-ordered region.

1 Introduction

An overview

- Spatial economics: producer and consumer surpluses vary among different regions
- Higher hierarchically-ordered regions: Sufficient attractiveness to both producers and households – urbanization economies
- Lower hierarchically-ordered regions: Disadvantages on them due to physically limited conditions; more concretely, limited scale, scope, and complexity
- Hierarchical regional structure in central place theory: Lösch (1944 [1954]) in terms of market areas - How final goods are distributed across an economic space
- Scale, scope, and complexity: Agglomeration economies, if these are spatially-constrained internal and external economies (Parr, 2002)
- Problems: Central places or higher hierarchically-ordered regions typically remark severe spatial congestions or urbanization diseconomies
- Mulligan (2013): The future of rural areas or non-metropolitan areas -- there are regions which continue to prosper and which continue to decline
- Solutions: Spread population and economic activity across the county or country involving rural regions
- Rural areas have several limitations to achieve sufficient regional development unless lower

hierarchically-ordered regions or rural areas own enough attractiveness on both producers and households

- Such attractiveness can be typically referred to tax competition and other pecuniary policies, although these tend to be more difficult under the background which the budget constraint on local governments become more tightly limited in many cases
- Attractiveness of region: Quality of life or amenity attainment
- Importance of quality of life or amenity: Empirically demonstrated by various relevant series of literature (Rickman and Rickman, 2011; Olson and Munroe, 2012; Rodriguez-Pose and Ketterer, 2012; Brown and Scott, 2012; Desmet and Rossi-Hansberg, 2013)
- How to increase attractiveness forces in lower hierarchically-ordered regions without relying on tax competition and other pecuniary policies
- Optimal scale, scope, and complexity of regional economic activity but not to specify these maximum levels
- c.f., Data envelope analysis by Suzuki et al. (2012) and Takeguchi and Suzuki (2012)
- Spatial policy on sustainable regional growth across a country applying the framework of hierarchical central place theory and a part of household economics
- Central place theory: a shortage of distribution of goods and services in rural areas can be substituted from upper hierarchically-ordered central places
- However, spatial consumer exclusion may remain if transportation network is not well-organized
- Spatial consumer exclusion (Nakamura, 2010): A situation where there are consumers who are not able to obtain some goods and services because of the presence of excess transportation costs together with the profit maximization behavior of the firm; Income level varies among households in general
- Mulligan (1991): Accessibility to goods and services in terms of equality
- Nakamura (2014): Equity and social capital

Main focus of the paper

- Trade-off between agglomeration economies on households and interregional transportation
- Compare and contrast the primary difference between different types of goods and services -- Possibly related to the law of economic growth stage in national and regional level (Rostow, 1956 and Parr, 2001); Mulligan (2010): Interindustry linkages of the employment in rural areas
- Total surplus to evaluate the impact of transportation costs on the trade of goods and services in the spatial market
- Spatial consumer exclusion and quality of life or well-being on local households
- A mixed strategic regional policy on the availability of goods and services through both regional and interregional access under the minimum sufficient transportation system
- Forecasting regional economy by applications of Israilevich et al. (1997) and Sonis and Hewings (2003)

2 Location model

- Simple location model: Regional economic agents are producers, households, and local governments
- A region: Has producers whose primary locations are either at other regions or at that region, has local residents who are consumers and also labors, and has the local government
- A representative firm: Maximizes his profit under his given production function
- A representative household: Maximizes her utility under her given budget constraint
- The local government: Maximizes social welfare at that region
- Two different types of region: Urban and rural areas
- Local government solely pursues social welfare maximization at that region applying their part of budget; Accessibility to goods and services may be kept at a minimum sufficient level, and actual welfare depends on the optimal size of the market and scope as well as the optimal size of economic activity
- Conventional central place theory: Optimal structure of the market can be always found applying the hierarchical structure, even though there are a number of restrictions in economic activity; Namely, a shortage of goods and services would be supplied from upper hierarchical central places
- However, the socially optimal hierarchically central place system works only if transportation network is well-organized -- Otherwise, spatial consumer exclusion may occur, in particular, a situation where income level widely varies among local households
- Transportation costs: closely related to market access or accessibility
- Accessibility on households may affect the level of consumer surplus; Fig. 1

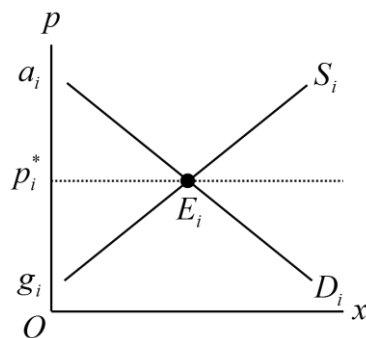


Fig. 1 Producer and consumer surpluses

- In spatial term, further necessary to employ the notion of transportation costs
- Producer and consumer surpluses at region r : Fig. 2
- where s ($s > 0$) = unit transportation cost, and σ ($\sigma > 0$) = transportation cost burden to the firm which does not charge from households

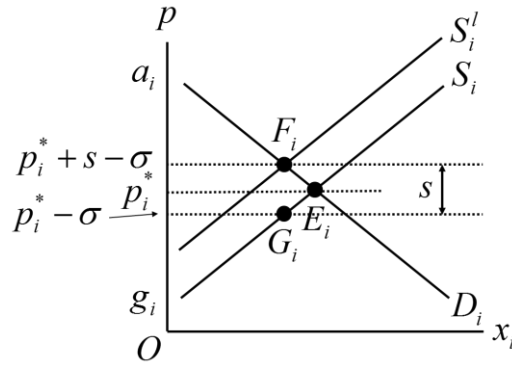


Fig. 2 Producer and consumer surpluses at region k

- Better accessibility improves total surplus
- Accessibility is related to a part of infrastructure development on transportation by the local government
- Two types of transportation network: Regional and interregional segments
- Regional transportation: Internal element to the region
- Interregional transportation: External element to the region: longer distance than regional segment in general

3 Hypothetical analysis

- What kind of goods and services needs to be locally available applying the notion of regional and interregional transportation costs
- Two types of goods and services: Essential and luxury types
- Spatial consumer exclusion on essential goods and services are much more problematic
- Unless interregional transportation network is perfectly organized, these types of goods and services always have to be locally distributed
- Regional and interregional transportation are sustainable as long as enough demand exists
- Problems may occur more frequently in rural areas where local population and economic activity constantly decline
- Effect of agglomeration economies to the local economic activity
- An agglomeration of the market in a rural area may not only increase sales revenue on producers but also save regional transportation costs on households

$$\sum_{j=1}^m (p_j + t_j) \cdot 1 \leq B \quad : \text{Consumer goes to the shopping to obtain one commodity per trip}$$

$$\sum_{j=1}^m p_j + \left(\sum_{j=1}^m t_j \right) / m \leq B \quad : \text{Consumer goes to the shopping to obtain several items per trip}$$

$$\sum_{j=1}^m (p_j + t_j) \cdot 1 - \left(\sum_{j=1}^m p_j + \left(\sum_{j=1}^m t_j \right) / m \right) = \beta \quad : \text{Extent of cost-saving opportunity by an agglomeration}$$

- where p_j ($p_j > 0$) ($j = 1, \dots, m$) = mill price of commodity j , t_j ($t_j > 0$) = unit transportation cost of commodity j , and B ($M > 0$) = budget constraint

4 An extension

- Sustainable regional growth and environmental concern: minimization behavior of energy consumption -- community-level central place system
- Safety and security concern: accessibility to vital commodities; visible qualities of goods and services
- Possibility of mixed strategy on distribution of goods and services: an increase of β
- Firms should set their market areas not only at the higher hierarchically-ordered regions but also at rural central places

5 Further avenues

- Regional and interregional transportation system as private arrangement or public sector -- Environmental concern: public transportation preferred -- Utilize efficient facilities on transportation
- Specification of the type of local industry whether these are raw-material oriented or market oriented; also important to forecast the change of industrial type in the long run
- Forecasting: i.e., regional econometric input-output model, originally investigated by Israilevich et al. (1997); Connection between input-output analysis and central place theory by Sonis and Hewings (2003)

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