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Assessing the types of urban growth and shrinkage based on indicators of population and economic activity

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Abstract

Many studies have discussed changes in the growth and shrinkage of cities primarily through population indicators. However, both population and economic activity indicators should consider because it has a limitation that it is difficult to fully capture the growth and shrinkage of cities only by population change. In the study, a conceptual model of 8 quadrants of growth and shrinkage involving both the demographic and economic aspects proposed. The characteristics of different types of growth and shrinkage patterns were analyzed, focusing on Korean cities. As a result, growing cities and shrinking cities appeared differently depending on which of the two indicators of population change and economic activity was intense. Shrinkage is not the same, and shrinkage may have a growth aspect. Even with a declining population, some cities are difficult to see as shrinkage because the economy is very active. This study reconsidered that researcher should consider both population and economic activity indicators when diagnosing and classifying urban changes. Policymakers should offer appropriate regional policies for each type.

Keyword: *shrinking, growing, demographic change, economic change, classification*

Introduction

Changes in cities can explain by growth or shrinkage. With the growing interest in shrinking cities around the world (Hollander, 2011; Oswalt & Rieniets, 2006; Hartt, 2019), studies categorizing the types of urban growth and shrinkage are increasing (Bartholomae et al., 2017; Liu et al., 2020). The concept of urban shrinkage has mentioned as a city that has experienced both population and economic decline, but many studies have classified shrinking cities only in terms of population change (Oswalt & Rieniets, 2006; Schilling & Logan, 2008; Pallagst, 2009; Rink et al., 2012; Stryjakiewicz, 2013; Wiechmann & Wolf, 2013; Hospers, 2014; Wang & Immergluck, 2019). However, some studies mention that it is necessary to determine the growth and shrinkage of cities, including economic changes as well as population changes (Martinez-Fernandez et al.,

2012; Pallagst, 2014; Rink et al., 2014, Bartholomae. et al., 2017, Hartt, 2017; Liu et al., 2020). Population growth did not directly link to economic growth, and population decline can coexist with economic growth (Glaeser & Resseger, 2010). The population's size is decreasing, but the city may not decline because the urban development is possible due to the formation of new industries' clusters (Bartholomae et al., 2017; Hollander, 2018; Liu et al., 2020). Economic change can be an essential factor in classifying urban growth and shrinkage, and economic decline leads to demographic and physical deterioration (Ma, 2017). Therefore, it is necessary to consider economic changes and population changes when classifying growing and shrinking cities (Großmannet al., 2013; Bartholomae et al., 2017; Lee et al., 2014).

Urban classification studies using population and economic indicators were categorized into four types, mainly because they deal with the increase/decrease of two indicators. It classified as a growing type in which both the population and economy grow, the type in which the population increases and the economy decreases, the type in which the population decreases but the economy increases, and the shrinking type in which both the population and economy decreases (Bartholomae et al., 2017; Thorsten & Karina, 2012; Lee et al., 2014). This classification method is helpful in that it uses two indicators to classify it. Still, it has a limitation that it is difficult to determine that the increasing one of the two indicators is a growing or shrinking city. Even if the population decreases, the economy grows tremendously, which can become a growing city. However, there is currently no guide to judge this criterion.

Therefore, a new urban type classification method was proposed in this study. Also, this study noted that growth and shrinkage might appear differently in areas where the increase or decrease of population and economic indicators is the opposite. There are many types of shrinkage, and shrinkage can have a positive aspect shrinkage. Therefore, this study analyzed its characteristics by subdividing the types according to the relative size of both population and economic activity indicators.

Conceptual framework

In this study, population change means a change in the resident population. Population growth and decline were caused by post-industrialization, industrial structure changes, and changes in economic conditions, leading to population inflow or outflow (Yim, 2018). In this study, economic activity changes mean changes in employments in cities and are used as variables to measure economic prosperity and suffering (Weaver et al., 2017; Hartt, 2017). Economic growth and decline refer to changes that appear as jobs increase or decrease and structural transformation of economic activities (Wiechmann & Pallagst, 2012; Liu et al., 2020).

In this section, we proposed an urban classification matrix using population and economic activity indicators as a method for diagnosing urban growth and shrinkage (Figure 1). To distinguish between the size of relative changes in population and economic indicators, the diagonals of $y = \pm x$ were introduced and classified into

eight areas (Table 1). In this study, we analyzed the slope representing the relative effect of population and economic activity as 1.

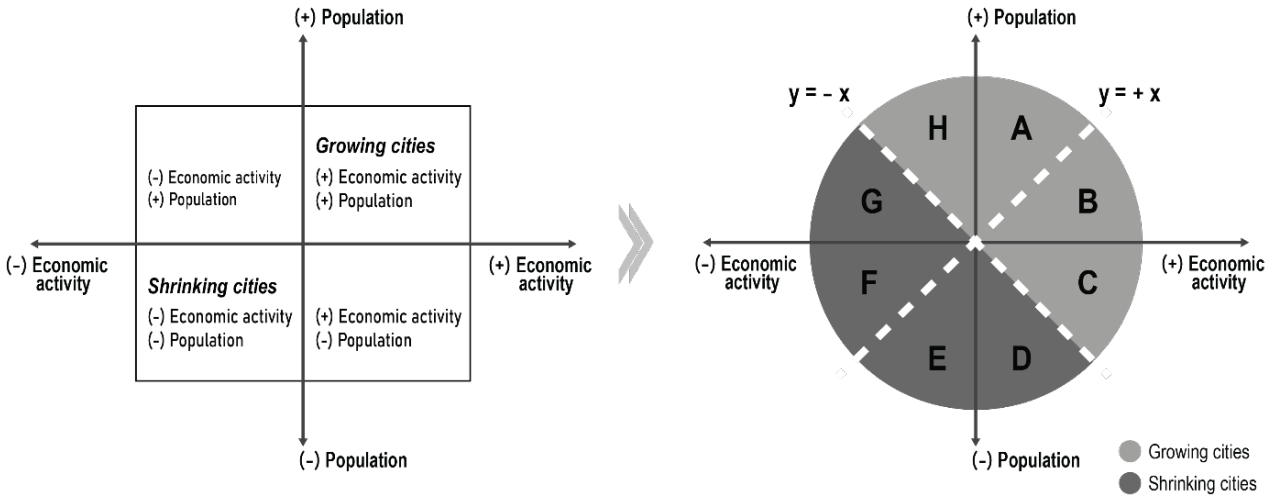


Figure 1. *Matrix of urban growth and shrinkage using economic activity and demographic indicators*

Table 1. Classification of types according to concept

Types	Name of type	Positive / negative correlation
Type A	Growing city with very rapid population growth and moderate increases in economy	(+) Economic activity (++) Population
Type B	Growing city with very rapid economic growth and moderate increases in population	(++) Economic activity (+) Population
Type C	Growing city with very rapid economic growth and moderate decreases in population	(++) Economic activity (-) Population
Type D	Shrinking city with very rapid population decline and moderate increases in economy	(+) Economic activity (--) Population
Type E	Shrinking city with very rapid population decline and moderate decreases in economy	(-) Economic activity (--) Population
Type F	Shrinking city with very rapid economic decline and moderate decreases in population	(--) Economic activity (-) Population
Type G	Shrinking city with very rapid economic decline and moderate increases in population	(--) Economic activity (+) Population
Type H	Growing city with very rapid population growth and moderate decreases in economy	(-) Economic activity (++) Population

Methods

This study targets Korea's county (called si, gun, gu in Korean), and population and economic activity indicators were calculated as annual average rate of change. In the studies categorizing urban change, the long-term study was analyzed as a period of twenty years (Wiechmann & Wolf, 2013; Koo et al., 2016), and from the short-term perspective, it was investigated as five years (Pallagst, 2009; Stryjakiewicz, 2013). Due to rapid urbanization and economic growth, Korean cities are primarily classified as growing cities when analyzed from a long-term perspective, making it challenging to reflect recent urban trends. Therefore, this study classified and analyzed Korean cities by type, focusing on the last five years, a short-term perspective. As a result of categorizing Korean cities by using the city matrix, one city was classified as Type G. This was regarded as an outlier because it was challenging to show representativeness. Also, none of the cities in Korea were classified as Type H. Therefore, this study analyzed 288 cities in Korea classified into six types except for Type G and H. Second, it was verified whether the urban typification classified according to the concept presented above was well organized. The Kruskal-Wallis test was performed to confirm differences by type using the GRDP data of Korea's county. The Kruskal-Wallis test is a nonparametric statistical test that evaluates the difference between three or more groups that follow a nonnormal distribution. It is a method that compares ranks without comparing group means (Kruskal & Wallis, 1952; Elliott & Hynan, 2011). In this study, since it did not follow the normality assumption, the Kruskal-Wallis test was performed to confirm a difference for each type. The post-hoc test was used to analyze which types of differences were significant. Third, the characteristics of each type were derived. Finally, to derive the characteristics of urban change patterns, the study period's scope was analyzed by dividing it into long-term and short-term. In this study, 54 cities with a change in type from long-term (twenty years) to short-term (last five years) among 228 cities in Korea were extracted and analyzed.

Results

As a result of the Kruskal-Wallis test analysis, the p-value (Prob>chi2 = 0.0001) was smaller than .05, indicating a significant difference between the five types of urban dynamics overall (Table 2). Bonferroni was performed to determine the differences between types, and it was possible to divide them into two groups (Table 3). As a result of the analysis, it was possible to group Type-A, B, C, and Type-D and EF into two groups. In particular, Type-C and D areas, which were previously difficult to be classified as growth and shrinkage, were distinguished. Type C had little difference between the growing city types Type-A and B and between groups with the shrinking city type Type-EF. On the other hand, Type-D differed between the growing city types Type-A and B and showed little difference between the shrinking city types Type-EF and the group.

Through the analysis results, Type-C and D were classified into growth and shrinkage groups. Since Type-C has similar characteristics to Type-A and B, which are typical growing city types, it can be said that it is a high

probability of being a growing city. Since Type-D appeared similar to Type-E and F, which are typically shrinking city types, it can be said that it is highly likely to be a shrinking city type.

Table 2. Result of Kruskal-Wallis test

Type	Type-A	Type-B	Type-C	Type-D	Type-EF
Obs	12	56	142	12	6
Rank Sum	1934	7297	15966	719	190

Kruskal-Wallis test: chi2(4) = 27.038 Prob>chi2 = 0.0001

Table 3. Result of Dunn's post-hoc test (Bonferroni) of Kruskal-Wallis test

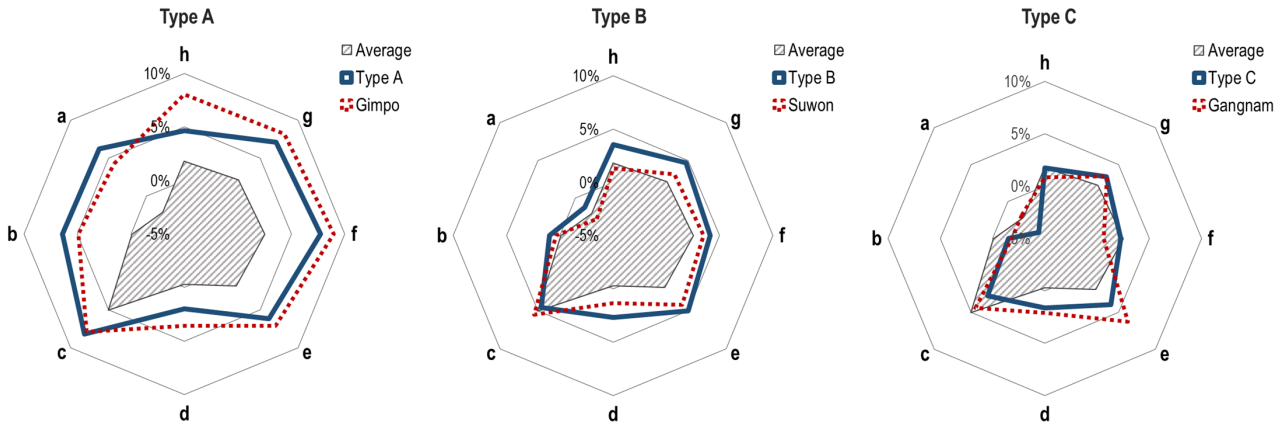
Col Mean-Row Mean	Type-A	Type-B	Type-C	Type-D
Type-B	1.4709 (0.7066)			
Type-C	2.4574 (0.0825)	1.7166 (0.4303)		
Type-D	3.7599* (0.0008)	3.3545* (0.0040)	2.6485* (0.0404)	
Type-EF	3.9265* (0.0004)	3.4811* (0.0025)	2.9379* (0.0165)	0.8566 (1.0000)

Note: * p<0.05

As a result of the analysis (Figure 1), Type-A has the characteristics of a residential-led growth city. In particular, this type of city has the characteristics of a growing city with a marked increase in population. Many people have flowed into it due to a suitable living environment, and stable housing prices have been formed through new town development projects. Type-B is a type of growth city and has the characteristics of an economy-led growing city. It has the characteristics of a city or industrial cluster with both population and economic activity increased. Type-C is a city where the population decreases but economic activity increases, and economic activity is more prominent than the population. It is a city with an increase in the number of people commuting to and from other cities as the increase in jobs and the development as a transportation hub coincided with active consumption. In particular, it can be said that it is growing smartly by replacing the vacuum of population decline with economic activities.

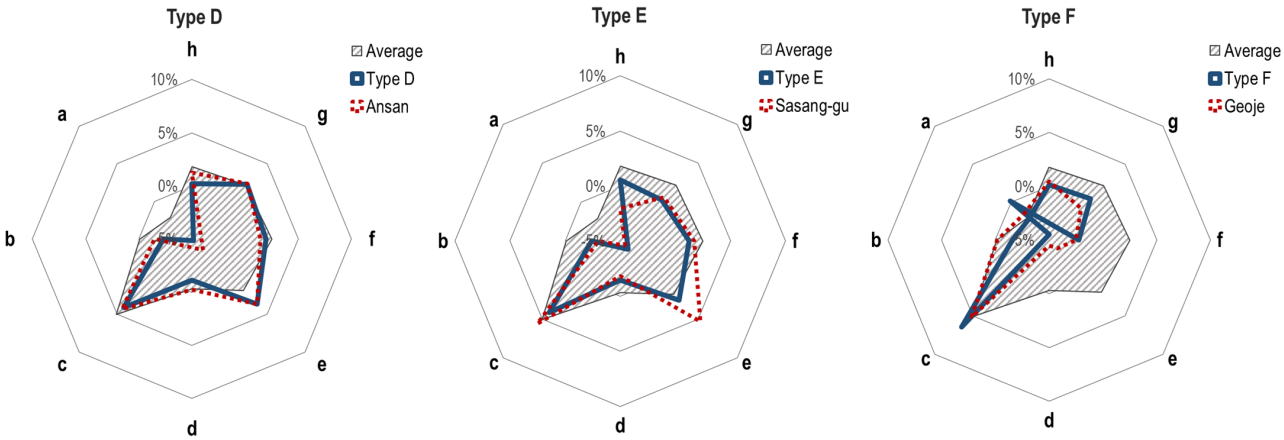
Type-D shows that all shrinking cities are cities with better shrinkage, not bad ones. This type of city is characterized by many highly educated populations and a high proportion of knowledge-based industries.

Type-E is a city that shows both population and economic decline, but the population decline is more pronounced, and features of the aging old downtown and industrial complexes. As a result, the city's self-sufficiency has declined, and it can be said that the city is experiencing an extreme decline. It can be seen that this type cannot be transformed into an industrial group for future generations and remains as a traditional industry. Type-F is a city with population and economic decline, but the decline in economic activity is more pronounced. The decline of a specific industry had a significant impact on economic activity, resulting in job loss. As a result of which families moved to another city, the population decreased significantly.



a. Age(0-14 years) **b.** Age(15-64 years) **c.** Age(65+ years) **d.** Mining (Manufacturing) **e.** Construction **f.** Retail, Food & Accommodation
g. Service (Busines & Personal & Public Service Business) **h.** Electricity & Transport & Telecommunication & Finance

Figure 2. *Population and industrial structure changes of growing cities (Type A, B, C)*



a. Age(0-14 years) **b.** Age(15-64 years) **c.** Age(65+ years) **d.** Mining (Manufacturing) **e.** Construction **f.** Retail, Food & Accommodation
g. Service (Busines & Personal & Public Service Business) **h.** Electricity & Transport & Telecommunication & Finance

Figure 3*. Population and industrial structure changes of shrinking cities (Type D, E, F)*

Discussion and Conclusion

Although demographic change has been used as a significant indicator for diagnosing the growth and shrinkage of cities, recent studies have mentioned that economic indicators are also important. Since there

are parts where demographic change cannot distinguish between urban growth and shrinkage, this study emphasized that population and economic indicators are essential indicators in classifying cities.

In this study, a new urban matrix methodology was proposed to compensate for the limitation that it is difficult to distinguish between growth and shrinkage in which one of the two indicators of population and economic activity increases. According to the urban matrix typography, it was possible to subdivide the types according to the relative sizes of population and economic indicators. Even in the same growth/shrinkage city, the characteristics of each type were different. There are three types of growing cities: growing cities with a prominent population increase (Type-A), growing cities with a prominent economy (Type-B), and smartly growing cities (Type-C). There are three types of shrinking cities: a mitigative shrinking city (Type-D), a shrinking city with a noticeable population decline (Type-E), and a shrinking city with economic activity markedly decreased (Type-F).

Since the characteristics of each type of city are different, urban policymakers need to consider the need for policy proposals suitable for each type. According to the study that classified cities using only the population indicator, Type-C, D, E, and F were recognized as shrinking cities, and efforts were made to restore the city by introducing a job policy. According to the research on shrinking cities, Type-C was classified as a shrinking city because the population decreased. The policy of fostering new growth industries was suggested as a policy for the recovery of the shrinking city. However, as a result of this study, Type-C is a growing city. Type-D, E, and F also appear different depending on whether the reduction is due to the employment policy or the residential environment. Type-C is a city where jobs are already actively increasing, and urban policies for influencing the resident population are needed rather than fostering new growth industries (knowledge-based industries, etc.). It means that when a city's diagnosis is wrong, policy prescriptions can lead to incorrect results.

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