Spatial Differentiation and Mobility of Residents in Daejeon Metropolitan City, Korea

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Abstract The aim of this study was to determine the correlation between age distribution and housing type in Daejeon, Korea. In 2005, the predominant population consisted of people aged 20-40, and only 6.78% of the population was over 65 years. Compared to the year of 1995, in 2005, the major age group districts show the following changes: decrease in the number of districts 15-29 and increase of 30-49, 50-64, and over-65 years. In 2005, the age group district of 30-49 years old comprised the largest proportion and strongly correlated with apartment complexes. The correlation between mobility and housing type was positive for apartment complexes and negative for detached housing type. Therefore, this study shows that, compared to detached houses, the apartments are more conducive to promoting the replacement of residents.

Key words: spatial differentiation, residential area, housing, mobility, Daejeon, Korea

1. Introduction

1.1 Purpose and research method

Sustainable urban development is the most important keyword for urban planning. This includes economical and social aspects in addition to environmental aspects. The concept of social mix is an essential part of the social aspect of urban planning. This implies that a sustainable community should include citizens of various ages, career backgrounds, and annual incomes, etc. Housing type is also an important factor in the development of a sustainable community. Depending on the type, price, and structure, the housing environment has an effect on lifestyle.

The aims of this study were to identify the age groups of the residents that occupied the city of Daejeon, Korea and determine their correlation with housing type. The housing type most suitable for the continuous replacement of residents currently remains unknown. The results of this study may help identify a method for planning the sustainable development of housing estates in urban areas where the population aging.

I assumed that if the residents live permanently in a particular district, the latter would experience an increase in aging population as the residents become older. On the other hand, if the migration ratio is high, the possibility of an increase in aging population would be lower.

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because migration would cause the rotation of the resident generations. Therefore, migration (mobility) would be a significant factor. According to this assumption, I calculate the mobility rate and use regression analysis to explain the relationship between mobility and housing type.

1.2 Overview of Daejeon Metropolitan City

The survey area is Daejeon Metropolitan City (short for Daejeon) which has 1.5 million population and is located in the central part of Korea (Figure 1).

The residential areas of Daejeon Metropolitan City are divided into two parts: the old area and the newly developed area. The old area was developed before 1980 with detached housing, whereas the new area was developed after 1980 with apartment complexes. For reference, the urban housing type of Korea is largely unique comparing with western countries. Since 1980s, most of urban housing estates have been developed with apartment complex type (Picture 1). Therefore, we can find a lot of apartment complex in urban area, even in suburban area; actual apartment complexes are largely located in suburban area.

According to the book, 100 years of Daejeon History (Daejeon-Gwangyeokshi 2002), the city began with the building of Daejeon Station in 1905 (p. 2543) and became an administrative city

Figure 1  Location of Daejeon Metropolitan City, Chungcheongnam-do, and Seoul
in 1949 (p. 2187). The city was raised to the status of a metropolitan city with a population of over one million when it merged with Dae-deok Gun; and then it became autonomous in 1989.

With regard to administration, transportation, and education, Daejeon is the central city of Chungcheongnam-do province. Administratively, Daejeon is the home of the provincial government of Chungcheongnam-do, the third-government complex, the Daejeon city hall, and various government offices. As a transportation center, the city is a nodal point for the expressway and the high-speed railway. As an education center, Daejeon has five colleges and twelve universities. Therefore, the city is recognized as a regional central city.

The city is generally known as a scientific and technological center because of the Dae-deok Research and Development Special Zone, which was established in 1978. The zone includes almost sixty research institutes, such as the Korea Institute of Science and Technology (KAIST), the Korea Advanced Institute of Science and Technology, and other institutes. The city is also famous as the location of the Daejeon Exposition, which was held in 1993.

2. Spatial differentiation of residence by age group

2.1 Measuring method of spatial differentiation

In South Korea, the population census is a source of data on the demographic characteristics of residents by neighborhood in each city. A Dong is the smallest administrative area in a city and is established for the convenience of administrative management. A Dong in the city's
outskirts generally becomes an extensive area. For that reason, these Dongs might be extremely various with regard to land use. That is, most Dong in the outskirts include urbanized areas and open spaces. However, it is impossible to obtain data for each residential district because the compilation of census data is based on each administrative division. On the other hand, the relationship between residents’ characteristics and the year of residential development will be clarified by overlaying them with the figures on residential area development.

The demographic data is based on a classification of five-year. The age groups are divided into five stages corresponding to life cycle and the results are as follows: 0-14 for childhood; 15-29 for young adulthood to for marriage; 30-49 for rearing children; 50-64 for independence, children’s marriage and retirement; over 65 for the aging population. Using these divisions, the areas where particular age groups concentrated were distinguished. For the extraction of a concentration area, a one-point standard score was used as the cut-off point. For example, if the 0-14 age group is 30 percent in a particular area has standard score of one, 30 percent becomes the cut-off point. And the area is designated as 0-14 district. The calculation results indicated 30 percent for the 15-29 age group, 35 percent for the 30-49 age group, 20 percent for the 50-64 age group, and 20 percent for the over-65 age group. Accordingly, the areas in which above cut-off points are designated as 0-14 district, 15-29 district, 30-49 district, 50-64 district, and over-65 district. The 0-14 district was excluded because it was conflated with the 30-49 age group.

2.2 Spatial differentiation and its change of residents by age

The target years of the research are 1995 and 2005; therefore, changes within this decade are examined. The structure of each year is elucidated first, and then the differences between 1995 and 2005 are examined.

Figure 2 shows the age structure of Daejeon in three periods, 1995, 2000, and 2005. The figure shows the age structure in five-year terms, 1995, 2000, and 2005. The predominant age groups in each year are as follows: 10-39 in 1995, 15-44 in 2000, and 20-49 in 2005. In terms of aging population, the proportion was as 4.5%, 5.5%, and 6.9% for each year of 1995, 2000, and 2005.

The spatial differentiation of residents by age in Daejeon is as follows. Figure 3 indicates the results for 1995. The districts of three age groups—15-29, 30-49, and 50-64—were recognized. The number of the 15-29-district was the highest in thirty-nine districts. Most of these districts are located in the old development area surrounding Daejeon Station. Several districts were located in the western part of the city. The highest concentrations of the 30-49-district were in the northern area of Doon-san New town, which is a residential zone developed in the 1990s, and in the research facilities zone, Daedeok Science Town. Concentrations of the 50-64-district were in the southwestern area, Gi-seong Dong. Over-65-district with high concentrations of the over-65 age group did not exist in 1995.

Figure 4 shows the spatial distribution of each age group in 2005 according to district as
follows: 11 in 15-29, 16 in 30-49, 9 in 50-64, and 3 in over-65. That is, the 30-49-district indicated the highest number. The 15-29-district showed a stronger concentration in university areas. The 30-49-district were located in Doon-san and the outskirts, except in the southeast. The 50-64-district were in the Daejeon Station area, its neighboring districts, and the peripheral areas of Gi-seong and Dae-cheong (northeast) Dong. The over-65-district overlapped several 50-64-district, the Daejeon Station area, and the Gi-seong and Dae-choeng Dong.

A comparison of the concentration of age groups district in 2005 with 1995 revealed that number of the 15-29-district decreased, while those of the 30-49 and 50-64-district increased. The over 65-district were newly emerged. The 30-49-district indicated a tendency to disperse into the outskirts.

3. Influence of housing type on mobility

3.1 Housing types in Daejeon

The most predominant housing type in Daejeon is apartment. As in Figure 5, the major housing type was detached housing until 1990. However, since 1995, the rate of apartment developments has been increasing and more than fifty percent of the houses were apartments in 2005. Therefore, detached houses built before 1990s, and apartments built after the 1990s represents main housing type in Daejeon.
Furthermore, the number of self-owned properties in Daejeon has been increasing. Thus, an increasing number of apartments are being sold, and not lease (Figure 6). This is related to the unique circumstance of the South Korean housing market, i.e., the price of apartments in South Korea is higher than that of a detached house. Several studies have shown that the higher demand for apartments compared to detached houses is attributable to the convenience of an apartment-based lifestyle (Jung 1998; Lee and Jeon 2003).

3.2 Measuring method of mobility

First, 50 percent is used as the cut-off point for each housing type area. For example,
over 50 percent of apartment dwellers are included in an apartment-centered area (hereafter apartment district).

Second, mobility is calculated as follows. The predicted population of 2005 was calculated using the life table of 1997 from the national census, which was based on 1995 data. The migrated population was calculated as a gap between the expected figure and the real population in 2005. That is, the difference between the real population in 2005 and the predicted population of 2005 (based on 1995 data) became the migrated population between 2005 and 1995. The formula for the predicted population and mobility is as follows.

![Figure 4 Age districts in Daejeon, 2005](image)
(1) Formula for the predicted population of 2005:

\[
\hat{X} = dP_{1995} \times \left( \frac{\sum_{a=0}^{4} L_{a+10}}{\sum_{a=0}^{4} L_{a}} \right)
\]

(2) Formula for mobility between 1995 and 2005:

\[
dM = \left( \frac{\sum_{a} \bar{X}_a - \bar{X}_a}{\sum_{a} \bar{X}_a} \right) \times 100
\]

where \( \hat{X} \) is the predicted population; \( X \) is the real population of 2005; \( d \) is the particular area, Dong; \( P_{1995} \) is the population in 1995; \( a \) is age; \( L \) is a coefficient of the life table between ages \( x \) and \( x+1 \); \( M \) is the mobility rate.

Because the 2005 national census is the most recent, this data and the 1995 census data
were compared. Therefore, the analysis term is ten, which is used in formula (1). The spatial data unit is *Dong*. Because there were 70 *Dongs* in 1995 and 84 in 2005, in order to determine rates of mobility, the number of *Dongs* in 2005 was converted by adjusting to the 1995 data.

### 3.3 Housing type and mobility

Based on the division of *Dong*, apartment districts numbered 38, whereas detached housing districts numbered 23. The location of apartment districts was mainly limited to *Dong* in the outskirts. Doon-san and the south-central part of the urbanized area were also classified.
as apartment districts. Several other areas were also recognized as dominated by apartment housing although these did not include apartment complexes, which could be interpreted to indicate that apartments became a dominant dwelling type in many areas even where large-scale apartment complexes did not exist. On the other hand, districts in which detached housing was predominant were distributed in the old CBD and surrounding areas, southwestern urbanized areas, and undeveloped areas (Figure 7).

The results of the calculation of mobility in Daejeon are follows: the average ratio is 35.3 percent; and 35.5 percent, 36.5 percent, 23.3 percent and 18.6 percent for each age group of 15-29, 30-49, 50-64, and over-65, respectively. The mobility ratio indicates decreasing pattern according to increasing age. However, the highest ratio is in the 30-49 age group. Thus, the most active migration in Daejeon is by people in this age group. In addition, the mobility

![Figure 8 Mobility of each Dong in Daejeon](image-url)
of each Dong is shown in Figure 8. Generally, the northwestern area indicates higher mobility than in southeast in the southwest–northeast axis. The degree of mobility is the absolute migration rate; therefore, inflows and outflows are expressed as positive values. The higher mobility in the northwest area was caused by inflows of residential area development by the Housing-site Development Project. Higher mobility rates in the old CBD, Gi-seong, and Dae-cheong were based on outflows.

The correlation between housing type and mobility rate was computed using an SPSS program. Seventy-six areas were used for the calculation, which included apartments, detached houses, and other districts. The results are shown in Table 1. The results are significant with a $p$-value of under 0.01. The coefficient indicates $-0.145$ for detached houses and $0.212$ for apartments. Although the coefficient value is not inside of ±0.03, the value indicates a positive correlation with apartments and a negative correlation with detached housing districts. Thus, the mobility is estimated higher in districts where apartment housing is predominant.

<p>| Table 1 Correlation of mobility with detached houses and apartments |
|-----------------------------|-----------------------------|</p>
<table>
<thead>
<tr>
<th>Mobility rate</th>
<th>Detached house rate</th>
<th>Apartment rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.145^{**}$</td>
<td>$0.212^{**}$</td>
<td></td>
</tr>
</tbody>
</table>

**: $p<.01$

4. Summary

The phenomenon of the concentration of particular age groups in certain districts was confirmed in the case of Daejeon. The result of overlapping residential area development with the distribution of ages in districts indicated different distribution patterns by age group in residential area development. In particular, the 30–49 age group showed the tendency to concentrate where apartment complexes are located. On the one hand, the 50–64 age group concentrated in the old CBD, its surrounding area, and the undeveloped peripheral area. The over 65–age group overlapped in the old CBD and the undeveloped peripheral area. In sum, the 30–49 age group is concentrated in areas where apartment complexes are the predominant housing.

Furthermore, the 30–49 age group showed higher rates of mobility. In terms of spatial distribution, the western area shows higher mobility than other areas. In Daejeon, there are more areas where apartments predominate than areas where detached housing predominates. Apartment housing predominates in districts in the western part of the city and in the outskirts. Mobility has a positive correlation with apartment–centered areas and a negative correlation with detached house–centered areas. That is, mobility is higher in apartment–centered districts. Thus, the possibility of resident stagnancy is relatively lower in districts where apartment housing predominates and higher in districts where detached housing predominates.
Acknowledgements

I would like to especially thank Prof. Hino Masateru for his thoughtful advice and guidance. I also appreciate the instructions rendered by Prof. Isoda Yuzuru.

Notes

1) This is usually shortened to Technopolis in South Korea.
2) This is usually shortened as Daedeok Innopolis in South Korea.
3) The \( L \) value of a life table is shown for each age : 0, 1, 2, and so on. However, the author calculated the values as 5-year ranges. The results are as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Remaining population</th>
<th>Age</th>
<th>Remaining population</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>495,953</td>
<td>45-49</td>
<td>468,499</td>
</tr>
<tr>
<td>5-9</td>
<td>494,852</td>
<td>50-54</td>
<td>456,492</td>
</tr>
<tr>
<td>10-14</td>
<td>494,158</td>
<td>55-59</td>
<td>439,261</td>
</tr>
<tr>
<td>15-19</td>
<td>493,001</td>
<td>60-64</td>
<td>414,729</td>
</tr>
<tr>
<td>20-24</td>
<td>491,039</td>
<td>65-69</td>
<td>379,930</td>
</tr>
<tr>
<td>25-29</td>
<td>488,803</td>
<td>70-74</td>
<td>329,244</td>
</tr>
<tr>
<td>30-34</td>
<td>486,131</td>
<td>75-79</td>
<td>259,330</td>
</tr>
<tr>
<td>35-39</td>
<td>482,448</td>
<td>80-84</td>
<td>175,466</td>
</tr>
<tr>
<td>40-44</td>
<td>476,906</td>
<td>Over 85</td>
<td>117,596</td>
</tr>
</tbody>
</table>

4) Few apartments are now being leased in South Korea. Although an apartment may be for sale, it is possible for that the owner would lease the apartment.
5) Wol-se and Jeon-se refers to the leasing system : Wol-se refers to the system of placing a deposit along with a monthly fee, where a Jeon-se involves placing a deposit without a monthly fee. Therefore, the deposit of Jeon-se is much higher than that of Wol-se.
6) I used the 1997 life table because it was made after 1995 and the closest to 1995.
7) The figure below indicates the name of each administrative Dong.

References


