Impact of Society on Urban Railway Lines in the Tokyo Metropolitan Area

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Abstract: Japan has the fastest growth of aging ratio in the world. In addition to population decrease, the combination of the aging population with a diminishing number of children is becoming a critical issue. It is said that aging reduces the total railway demand. The study clarifies the number of immigrants and emigrants in each area along railway lines. The migrations between the railway lines having different characteristics of trends in age-structure are compared in the study. In the Tokyo Metropolitan Area, aspects of the population migrations are different in each area, and as a result, the difference in age structure causes a difference of railway passengers. In considering the details of population migration as presented in this study, additional strategic railway policy is necessary in the near future.

Keywords: railway strategy, population migration, aged society, depopulation, Tokyo metropolitan area

1. Introduction

1.1 Background and objectives

Since 2005, the total population of Japan has started to decline. The population decrease, combined with aging population and diminishing number of children is becoming a critical issue. The National Institute of Population and Social Security Research (JPSS) reported the following two points. The first is that in the 50-year period from 2010 to 2060, the total population of Japan will decrease by 30% to around 87 million (Figure 1). The second is that in terms of age the population of youth age (under 15 years) and productive age (15-64 years) will decrease, while the population of old age (65 years and over) will increase. The rate of aging is becoming a major issue. Compared to other countries in the world, Japan records highest aging rate (percentage of total population aged 65 and over). The United Nations reported that the aging rate in Japan would increase to over 30% in 2015—a first for any country—and that Japan would retain the top position after that year (Figure 2). Following Japan, the aging rate in European and North American industrialized countries such as Germany, Italy and France and in East Asian countries like South Korea, Hong Kong, and China is also expected to get above 30%. Japan will be the first country in the world to deal with this issue. Therefore, policy research on an aging population combined with a diminishing number of children is a future-oriented research for any other country that will be confronted with the issue.

While the total population in Japan is decreasing, it is said that the population of the Tokyo
metropolitan area (TMA: Tokyo, Kanagawa, Saitama, and Chiba) would increase until 2015. However, the rapid aging is a problem in the TMA as well. JPSS also forecasted in 2007 that in the TMA, the population of old-age will grow to 10.6 million by 2035, approximately 1.8 times that of 2005. The growth rate of the population of old age is larger than that of any other metropolitan area in Japan. It is therefore important for the TMA to address this situation immediately.

Changes in population and age structure significantly vary by time and area. In some areas an aging rate is especially high, in other areas young people flow continuously. Recently, a phenomenon called the “return to central Tokyo” has occurred. In 1996, the first social increase in the population of Tokyo’s 23 wards (central area of the TMA) since 1963 was recorded. On the other hand, in some large-scale “New Town” (built during the 1960s) suburban areas, rapid aging and decrease of population have caused serious problems such as a decline in the vitality of local society and local community. It has been pointed out that railway passenger demand has decreased due to aging. Due to aging, although the private demand is increase, commuter demand is decrease. As a result, the total railway demand is decrease. This is a significant concern for railway companies (Hibino et al. (2007)). However, the situations vary by time and area. While the management of some railways is expected to become more difficult due to a decrease in demand, other railway networks are expected to become increasingly congested. In such conditions, to achieve sustainable urban and railway management, railway companies and local governments have been discussing various measures, such as mixed residences for multi generation (Kajitani et al. (2012)). To manage urban development and railway strategies in depopulating and aging societies, it is very important to precisely capture the time-space characteristics of population dynamics and age-structure. Policy research on an aging population combined with a diminishing number of children is future-oriented research for any other city that will face the problem.

data source: Projections of future population produced by JPSS

Figure 1. Population and aging rate of Japan
1.2 Literature review and scope

Although there are many studies on population and migration in domestic and international literature, we could not find the foreign research on relation between aging society and railway businesses. In Japan, the following topics have been under investigation for many years: population concentration in large cities during period of high economic growth, suburbanization or the donut phenomenon, and the phenomenon referred to as the “return to central Tokyo”. Esaki (2006) provided an overview of the migration of the TMA. According to the study, the “return to central Tokyo” phenomenon is explained as follow. Although in the past many people who came from the provinces to the center of the TMA have migrated to the suburban areas, in recent years that stay the center of the TMA. Focusing on age-structure of areas along railways, Hibino et al. (2007) pointed out that although the overall numbers of railway demand in the TMA increase, there are several lines where demand decrease contrary to overall trend due to aging(Figure 3). Oda et al. (2011) and Makimura et al. (2012) clarified region-by-region characteristics of changes in population and age-structure. According to these studies, there are areas along railways in which aging is especially rapid because changes in age-structure are very slight, whereas there are other areas that receive a continuous inflow of young people. However, few Japanese researchers have dealt with migration and railways in a depopulating and aging society; herein lies the originality of this study. The authors clarified region-by-region characteristics of changes in population and age-structure. This paper develops these studies and clarifies it about a population migration to cause the difference in age structure and railway passengers occurring because of the difference in age structure. Local governments are willing to promote inflow of more young people for reason that the aging of society causes depression of local economy. However, the policy of local governments for this issue is constraint because of the limits of their budget. On the other hand, urban railway companies also hope that more young people live in the area along their railway from the perspectives that aging society makes a negative impact on not only only passenger revenue but also the revenue from the side business along the urban railway lines such as housing, commercial facilities, entertainment facilities and so on. For
many Japanese urban railway companies the revenue of side business is often equal to or
greater than revenue from passengers. Aging causes reduction of their incoms. Therefore, it is
important that local governments and urban railway companies implement measures against
aging population together. It is expected that this study recommend railway operators the
efforts for in-migration of people and for the sustainable economy in each region with local
governments.

source: Hibino et al. (2007)

Figure 3. Differences between 2000 and 2015 passenger flow for all purpose

2. Data and research analytical flow

Both the migrant data of the National Population Census and the Report on Migration of
basic resident register are used for the analysis as statistical data of population migration. The
National Population Census is an inventory survey and the data of that enable to analyze the
migration in detail, such as by age and inter-area. On the other hand, because the survey is
conducted once every ten years and the data only understand habitation five years ago, it is
difficult to understand short-term trend of the migration. Although the Report on Migration of
basic resident register can understand the inter-prefecture migration every year, it cannot
understand by age and sex. Therefore, this study uses these data to complement. Table 1
shows the properties of these data.

The following is research analytical flow. First, it analyzes changes in population migration
about total of the TMA. Next, it analyzes changes in population migration in each area of the
TMA and along railway lines.
### Table 1. properties of data

<table>
<thead>
<tr>
<th></th>
<th>the migrant data of the National Population Census</th>
<th>the Report on Migration of basic resident register</th>
</tr>
</thead>
<tbody>
<tr>
<td>survey interval</td>
<td>annually</td>
<td>every 10 years</td>
</tr>
<tr>
<td>period of migration</td>
<td>migration for one year (the person moving resident card)</td>
<td>habitation 5 years ago</td>
</tr>
<tr>
<td>respondent to a survey</td>
<td>resident card base</td>
<td>present habitation base</td>
</tr>
<tr>
<td>resolution</td>
<td>inter-prefecture</td>
<td>inter-prefecture by age, by sex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inter-city</td>
</tr>
</tbody>
</table>

3. Changes in the population migration of the total of the TMA

Figure 5 shows trends in the number of net migration in three major metropolitan areas (Tokyo, Osaka and Nagoya). In high economic growth period (mid-1950s – mid-1970s), the number of net migration have been positive in both areas. After the mid-1970s, the number of net migration in the Osaka metropolitan area (OMA) and Nagoya metropolitan area (NMA) shifted to negative. It is a situation of over concentration of the population in the TMA.

![Figure 4. Locations of three major metropolitan areas](image)
Figure 5. Trends in number of net migration

net migration = in-migrants – out-migrants

Figure 6. Trends in number of migrant to/from the TMA

(summation graph)
In the TMA, there are three characteristics periods. The first has a peak in 1962, the second has a peak in 1987 (from 1976 to 1995), and the third has a peak in 2008 (from 1995). The first shows the situation of migration into large cities in high economic growth period. In high economic growth period, concentration of the population in large cities occurred in connection with change in industrial structures. Figure 6 shows trends in the number of migration to/from the TMA. Both the second and the third periods have similar characteristic on the following points. Trends in the number of net migration are positive because although trends in the number of migration to the TMA remain at approximately the same level, that of from the TMA decline (Figure 6). People who migrated to the TMA are becoming not to return to rural. Recently, it is said that the excess concentration of population in the TMA is a significant problem in Japan. The actual situation is not so much as that too many people gather in the TMA as that many people do not come back to the rural hometown.

Focusing on the age structure, figure 7 shows the number of migration between the TMA and other area by age in three periods (1985 to 1990, 1995 to 2000 and 2005 to 2010). These data are available only at the three periods. In both three periods, although the number of net migration of 15-19 years and 20-24 years is significantly large, others are small. Migration in the TMA depends to a large extent on people of 15-24 years, which age is college entrance time. Seeing in chronological order, the number of migration of 15-24 years is declining year by year.

### Table 2. Area classification

<table>
<thead>
<tr>
<th>Block</th>
<th>Prefecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido and Tohoku</td>
<td>Hokkaido, Aomori, Iwate, Miyagi, Akita,</td>
</tr>
<tr>
<td></td>
<td>Yamagata, Fukushima</td>
</tr>
<tr>
<td>Kita-Kanto</td>
<td>Ibaraki, Tochigi, Gunma</td>
</tr>
<tr>
<td>Chubu and Hokuriku</td>
<td>Niigata, Toyama, Ishikawa, Fukui, Yamanashi, Nagano, Gifu, Shizuoka, Aichi, Mie</td>
</tr>
<tr>
<td>Kinki</td>
<td>Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama</td>
</tr>
<tr>
<td>Chugoku and Shikoku</td>
<td>Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, Kochi</td>
</tr>
<tr>
<td>Kyushu</td>
<td>Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, Okinawa</td>
</tr>
</tbody>
</table>

4. Changes in population migration in the TMA

This section focuses on migration of people in each area of the TMA. Especially, it focuses on a phenomenon called the “return to central Tokyo” (4.1) and characteristics by the area along with railways (4.2). For example, when many people inflow into the TMA during the period of rapid economic growth, many people moved to suburban area due to increase in real estate values in the inner-city area. This suburbanization differ in regions; first, population inflow into the south and west areas (Kanagawa Prefecture) increased, then the increase of population in the north (Saitama Prefecture) and east (Chiba Prefecture) area was delayed. The migration and age-structure differ from region to region. Thus, in discussing age structure of the area along railway it is important to overview the migration of population.

4.1. Changes in population migration about each areas in the TMA

Figure 8 shows the TMA zones. The TMA consist of Tokyo, Kanagawa, Saitama and Chiba prefectures. Tokyo prefecture is divided into 23 wards of Tokyo and Tama area. In addition, 23 wards of Tokyo is divided into 3 areas (the first is 3 wards of central Tokyo area, the second is 9 wards of surrounding central Tokyo area, the third is the edge of 23 wards of Tokyo).
Figure 9 shows trends in the number of net immigration in total of Tokyo, 23 wards of Tokyo, Kanagawa, Saitama and Chiba. Figure 10 shows the same data as figure 9 by prefecture. There are significantly different characteristics between the second period and the third period; both periods discussed in section 3. In the period of the second (from 1976 to 1995), although the number of net migration of Kanagawa, Saitama and Chiba are positive, that of Tokyo and 23 wards of Tokyo are negative. On the other hand, in the third period (from 1995), although that of Tokyo and the 23 wards of Tokyo is very large, that of Kanagawa, Saitama and Chiba is small or negative. Thus, although increasing of migration to the TMA in the second period is due to suburbanization, that increasing of migration to the TMA in the third is due to the “return to central Tokyo”. The actual state of the “return to central Tokyo” phenomenon is not so much as due to transference from the suburban areas as due to transference from the rural areas.

Figure 11-13 show the number of migrant to/from the central Tokyo area, the surrounding central Tokyo area and the edge of Tokyo area at two points of time (one is from 1985 to 1990 the other is from 2005 to 2010). Figure 14,15 show the net migration in the TMA by diagram. These figures make it possible to analyze the migration by od-base in detail. At point of time from 2005 to 2010, although the number of migration of the central Tokyo area and the surrounding central Tokyo area to/from the suburban areas (Kanagawa, Saitama and Chiba) is positive, that of the edge of Tokyo area is negative. Thus, the “return to central Tokyo” phenomenon shows especially the return to the 3 wards of central Tokyo and the 9 wards of surrounding the central Tokyo area.
**Figure 9. Trends in number of net migration in the TMA**

Net migration = in-migrants – out-migrants

**Figure 10. Trends in number of net migration in TMA of the total (summation graph)**

Data source: the Report on Migration of basic resident register
Figure 11. Number of migrant to/from central Tokyo area

1985 to 1990
-14
-19
-5
-7

2005 to 2010
3
7
2
11

Data source: the National Population Census

Figure 12. Number of migrant to/from surrounding central Tokyo area

1985 to 1990
-14
-25
-43
-36

2005 to 2010
-3
6
1
1
9

Data source: the National Population Census

Figure 13. Number of migrant to/from edge of Tokyo area

1985 to 1990
-7
6
-76
-49

2005 to 2010
-7
6
-17
-21
-19
-4

Data source: the National Population Census
Figure 14. Net migration in the TMA (from 1985 to 1990)
Net migration = in-migrant – out-migrant

Figure 15. Net migration in the TMA (from 2005 to 2010)
Net migration = in-migrant – out-migrant
4.2. Changes in population migration along railway lines

In the TMA, there are different age structure types among railways. The in-migration volume of young generations in the areas along the railway in south and west directions such as Toyoko-line, Chuo-line, Den-en-toshi-line and so on area higher than that in noth and east directions such as Isesaki-line, Tojo-line and so on. That is, the speed of aging in the north and east areas is much higher than that in south and west areas. Although we analyzed all lines, this paper describes contrast of two typical lines because of space constraint.

Figure 16 shows location of two railway lines. Table 3 shows the characteristics of areas along railway lines. Figure 17 and 18 show trends in population by age who live along Tokyu Den-en-toshi line and Tobu Isesaki line. According to Oda et al (2011), in the area along Tokyu Den-en-toshi line it is difficult to observe aging because young people continuously flow into these areas. On the other hand, the area along Tobu Isesaki line aging rate is exceptionally high because changes in age-structure are very small. Focusing on the migration, there are different characters in each areas from this perspective. Figure 19 and 20 show the migrant to/from the cities along Tokyu Den-en toshi line and Tobu Isesaki line. The volume of migration of the area of Tobu Isesaki line is smaller than that of Tokyu Den-en toshi line. In addition, the number of migration from the outside the TMA to the area along Tobu Isesaki line is smaller than that to the area along Tokyu Den-en toshi line. In a word, the difference of age structure of population between both areas is cased as the result of the difference of migration of population.

![Figure 16. Location of the cities along railway lines](image)

<table>
<thead>
<tr>
<th>Table 3. the characteristics of areas along railway lines</th>
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<tbody>
<tr>
<td>Railway line</td>
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<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Tokyu Den-en-toshi line</td>
</tr>
<tr>
<td>Tobu Isesaki line</td>
</tr>
</tbody>
</table>
Figure 17. Trends in age structure along Tokyu Den-en-toshi line

Figure 18. Trends in age structure along Tobu Isesaki line

Figure 19. Number of migrant to/from the city along Tokyu Den-en-toshi-line

Figure 20. Number of migrant to/from the city along Tobu Isesaki-line
Figure 21 shows trends in productive age (15-64 years) population along both lines by distance from the center of Tokyo. Most of railway demands are commuter passengers in the TMA. Therefore, reduction in productive age population has an influence on the railway demand. The difference of trends in productive age population between both areas is cased as the result of the difference of age structure of population. After 1995 in spite of the period over concentration of the population in the TMA, productive age population along Tobu Iseasaki-line is decreasing. The tendency is in particular remarkable in the suburbs more than 10km. Figure 22 shows trends in percentage change from the previous year of passenger kilometer. After about 1994 in both lines passenger kilometer are decreasing. However, the decrease in passenger kilometer of the Tobu Iseasaki Line is bigger than Den-en-toshi Line. It is assumed that a decrease in productive age population is greatly caused by the decrease in passenger kilometer. There are few inflows of people including young generation in the area along the Tobu Iseasaki Line. As a result, in recent years the share of Japanese baby boom generation is becoming large. Their retirement causes decrease in many working people and decrease in commuter demands whose trip length is typically longer than the other trip. On the other hand, the area along Den-en-toshi Line is popular and has power of brand. In addition, Tokyu running Den-en-toshi Line implements the child care support measure positively, In the area, and It is said that the area is attractive to young generation. It is assumed that the difference of railway management strategies such as transportation service or the life-related service contribute to cause the difference in age structure.

![Graph showing trends in productive age population by distance from the center of Tokyo.](image1)

**Figure 21.** Trends in productive age population by distance from the center of Tokyo

![Graph showing trends in percentage change from the previous year of passenger-kilometer.](image2)

**Figure 22.** Trends in percentage change from the previous year of passenger-kilometer

(data source: the National Population Census)

(data source: Annual report on urban traffic by ITPS)
5. CONCLUSIONS

This study focuses on population migration in a depopulating and aged society and clarifies the time-space characteristics of population migration along railway lines. The changes in the population migration of the TMA are outlined. It is shown that there are three characteristics periods in the TMA. The study clarifies the number of immigrants and emigrants by area in each area along railway lines. The study compares the migration between the railway lines having different characteristics of changes in age-structure. In the area where the aging rate is high, the number of immigrants as well as emigrants is fewer. In late years in spite of the overconcentration to the Tokyo Metropolitan area, the area along railway line with a little, population migration productive population decreases by low birthrate and aging, and, as a result, the rail passenger kilometer decreases.

Conclusions of the study are as follows. In order to ensure a consistent number of railway passengers, it is important to boost the city’s appeal, thus making it more fascinating; this is accomplished in collaboration with local governments and railway companies. On the other hand, many railway companies in Japan not only provide the rail transport service but also develop a suite of services such as housing land development and the operation of commercial facilities, including station buildings and supermarkets. In considering the details of population migration as presented in this study, additional strategic railway policy is necessary in the near future.

6. ACKNOWLEDGEMENTS

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7. REFERENCES


Applied Population Laboratory, University of Wisconsin-Madison (2009), *Population Change & Characteristics in the Eau Claire Area*


Institution For Transport Policy Studies, Annual report on urban traffic

the Bureau of Statistics in Japan, the National Population Census

the Bureau of Statistics in Japan, the Report on Migration of basic resident register