THE IMPACT OF TRANSPORTATION IMPROVEMENT ON INTERREGIONAL MIGRATION IN JAPAN

-By using Cohort Analysis-

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abstract: It is well known that interregional migration would be influenced by development of high speed transportation facilities. On the other hand, a cohort analysis is quite useful because probability of migration deeply affected by the population size of the age groups. This study first, employs the share analysis for understanding time series changes of origin/destination of migrants, and the second, introducing an index of accumulated net migration rate to take account of cohort sizes. Major findings of this paper are as follows. First, migration rate in Tohoku region has been decreasing year by year. The second, improvement of transportation facilities accelerated centrality of the large city rather than Tokyo in terms of migration rate. Third, the migration turnaround, which is widely believed in Japan, cannot be identified between the case of Tokyo and Tohoku.

1. INTRODUCTION

Migration forms part of the total population and a its pattern depends on the age of migrants. Suppose more people immigrate into a particular city when compared with historical trend, there are two major reasons behind it. First, it is case that the migrants might choose a city as a destination because of improved attractiveness and/or environment of the city. Secondly, if people, who belong to a cohort having a strong inclination to immigrate into a better city, will increase, then immigrant to preferred city also increase accordingly. In second case, why people choose their destination without changing migration factors in fact, however, it is easy to misunderstand that migration pattern has changed. It is impossible to understand the migration choice without distinguishing these types of two changes; choice migration and cohort scale migration. In interregional migration, to understand accurately the reason on destination choices, it is necessary to remove the influence by cohort scale.

Some previous papers studied the effect of transportation improvement on interregional migration(Nakamura et al(1989), Ueda(1991), Ohno(1996)), however, these studies ignored demographic factors. This paper aims to discuss the effect of transportation improvement on interregional migration taking account of time series changes of cohort sizes. Tohoku expressway and Tohoku Shinkansen were chosen as the transport facilities. Tohoku region, comprised of Aomori, Iwate, Akita, Miyagi, Yamagata and Fukushima prefecture, were chosen as the study area.

2. STUDY FRAMEWORK AND BASIC CONCEPT

In interregional migration, the nature of migration flow differs with direction. This is

because the direction of migration flow depend on the reason for migration and attributes of migrants. As such analysis of gross migration will be more important than that of net migration. But it is impossible to analyze gross migration in detail, because there is no data which shows origin and destination of migration and age of migrants in Japan. Since net migration analysis has begun from a few years ago, a few detail studies were thus available. Hence, to understand interregional migration in detail, this paper analyzes it by prefectures and by age of migrants.

The study frame work is shown in Fig-1. Firstly, the accumulated net migration rates(ANMR) are calculated by all cohorts(five year age range). This is done to understand the changes in migration pattern influenced by cohort sizes(Kawabe(1985)). Comparing the changes of ANMR in the year when transportation facilities were constructed and operated upon (the year when Shinkansen or Tohoku expressway was opened), the influence of transportation improvement on interregional migration structure can be well understood if only the changes of cohort sizes are considered. Secondly, share of origin and destination of migration is discussed by prefecture based on historical migration patterns. The share is calculated in thirty five years during the period of 1960 and 1995. Share is defined as the number of immigrants (emigrants) from a prefecture divided by the number of immigrants (emigrants) from all over Japan. In case of the migration between Tokyo and Tohoku region, emigration ratio from Tohoku into Tokyo are calculated as follows; dividing the number of emigrants into Tokyo from Tohoku by sum of emigrants from all prefectures in Tohoku. Immigration ratios from Tokyo are also calculated as follows; dividing the number of immigrants from Tokyo into all prefectures in Tohoku by sum of immigrants into Tohoku.

3. INTERREGIONAL MIGRATION PATTERN

3.1 Analysis Method

a) Scope of Analysis

Fig-2 shows the steps to estimate ANMR. First, survival rates are estimated by every cohorts. Secondly, net migrants belong to every cohorts in a prefecture are estimated by every five years with the help of the cohort component method. Net migration rates of every cohorts are calculated by dividing net migrants by the number of all survivors. Finally, these migration rates are accumulated through aging of cohorts. Thus ANMR of every cohorts are obtained.

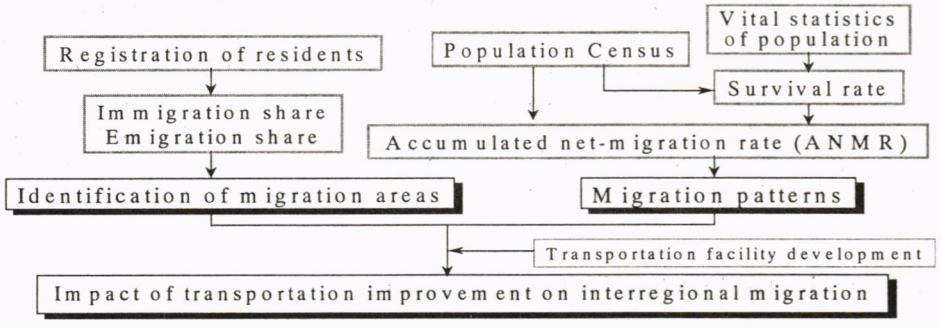

Fig-1 Framework of This Study

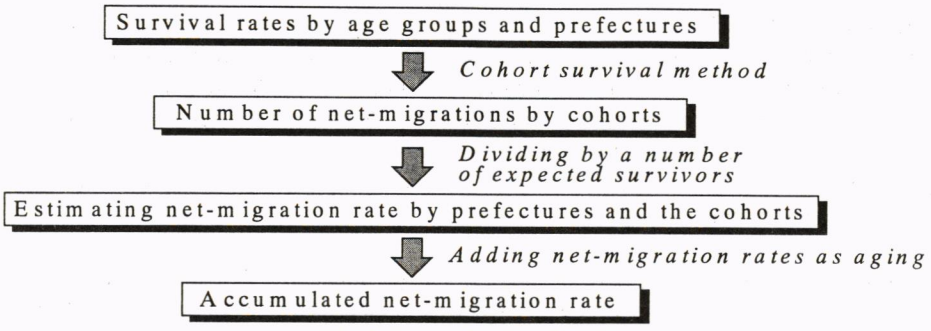

Fig-2 Estimation for ANMR

b) Survival Rate

Survival rate of every prefecture are estimated by using population of every age group and the number of death. Census data contains the population of every age group in a prefecture. Vital statistics contains death rate of every age group in a prefecture. Survival rate is based on the assumption that it doesn't change during five years. Eq.(1) shows survival rate.

$$S_{x \to x+5} = \left(1 - \frac{D_x^t}{P_x^t}\right)^5 \quad (1)$$

$S_{x\text{-}x+5}$: Survival rate for age(x~x+4) at five years later, D_x^t :A number of death for age(x~x+4) at year t
P_x^t :Population for age(x~x+4) at year t

c) Estimation of Net Migration

There is no data that shows the number of migrants by origin/destination(OD) and by their age in Japan. Hence the number of net migrants by five year age group is estimated from existing data by using the cohort component method. There are two methods, the forward and backward methods expressed in Eq.(2) and Eq.(3) respectively. Net migrants is estimated by taking the average of both methods as shown in Eq.(4).

The forward method estimates net migrants by comparing between real population at the year end and estimated population at the year end. Hence the forward method is based on two assumptions; population changes in a term due to death and migration occurs at the end of a term. The backward method estimates net migrants by comparing real population at the start of a year with estimated population at the start. Hence a backward method assumes that migration occurs at the start of a year.

Since both above assumptions aren't suitable in the real world, an average migrants between both methods are employed as net migrants which is thought to be more suitable than both two methods. Accordingly, an average migrants is expressed by Eq.(4).

$$M'_x = P_{x+t} - S_x \times P_x \quad \cdots (2)$$

$$M''_x = \frac{P_{x+t}}{S_x} - P_x \quad \cdots (3)$$

$$M_x = \frac{M'_x + M''_x}{2} \quad \cdots (4)$$

M_x': Net migrants estimated by forward method, M_x'': Net migrants estimated by backward method,
M_x: Average migrants from forward and backward method, P_x: Population at age(x~x+4)
P_{x+5}: Population at age(x~x+4) five years later, S_x: Survival ratio at age(x~x+4) during five years,

d) Estimation of ANMR

Changes of AMNR by every age group are observed. From the result, it can be surmised that transition of migration pattern involved cohort sizes. ANMR is obtained by accumulating net migration rates for every five years. Net migration rate is calculated by dividing the number of migrants by expected survivors. It is very important to note that net migration rate of cohorts are added for every five years. ANMR is given by Eq.(5) and the number of expected survivors by Eq.(6).

Eight cohorts; from the cohort born during 1935-1940 until the cohort born during 1970-1975, are analyzed. The cohort of 1935-1940 was named as 1950 cohort, next cohort as 1955 cohort and so forth until the final cohort, born during 1970-1975 named as 1980 cohort. The reason why these cohorts were named as given is that these cohorts start to be analyzed in the age year of 10-14 years old. In this paper, ages are on October 1 of each observation year. It is young and middle age groups, from ten years old until forty four years old, has the greatest influence on social increase. Hence net migration rate are accumulated from 10-14 years old cohort. Cohort of 0-9 years old are excluded from this analysis. Because they will migrate with their parents without their own decision.

$$A_{X+n} = \sum_{k=0}^{n} \left(\frac{M_{X+k}}{L_{X+k}} \times 100 \right) \tag{5}$$

$$L_{X+n} = P_X \times S_{X+1} \times S_{X+2} \cdots \times S_{X+n} \tag{6}$$

$L_X = P_X$, n =1,2…8, X is 10-14 years old, (X+1) is 15-19years old

A_{X+n}: ANMR until age(X+n), L_{X+n}: The number of expected survivors at age(X+n)

M_{X+n}:Net migrants from age(X+n) to age(X+n+1), S_{X+n}:Survivor ratio of age(X+n) during five years

3.2 Change of Migration Pattern by Cohorts/Prefectures

a) Background

Fig-3 shows the study area. Tohoku expressway was constructed and opened to public in stages involving four prefectures; Fukushima(1974), Miyagi(1975), Iwate(1978) and Aomori(1986). Tohoku Shinkansen line was opened in 1982 running from Tokyo to Iwate.

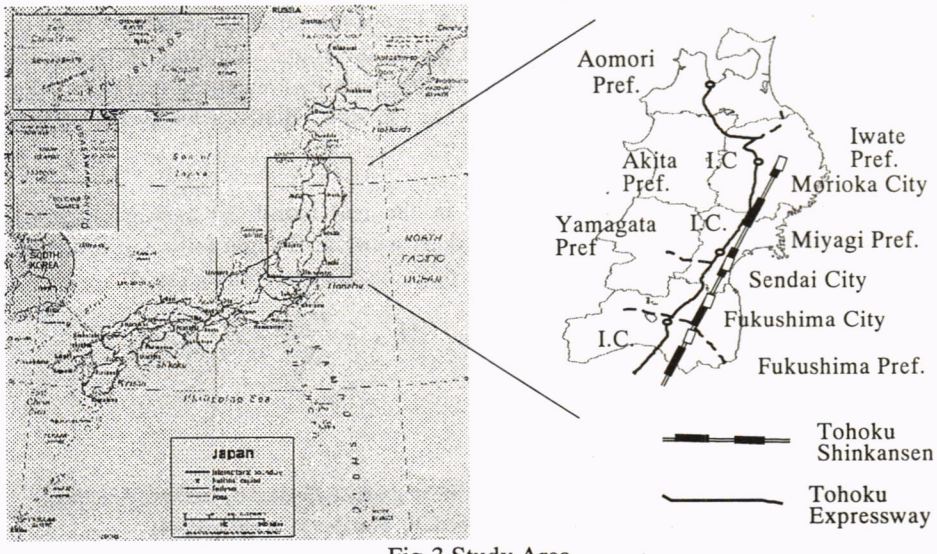

Fig-3 Study Area

b) Change of ANMR in Tohoku Region

Fig-4 to Fig-9 show changes of ANMR by every cohorts in the six prefectures. These figures demonstrate migration history of each cohort from the view point of emigration and immigration. If ANMR slope is negative, it means that the number of emigrants is more than that of immigrants, and the opposite if the slope is positive. Since ANMR is estimated by all cohorts, a historical change of the migration trend can be surmised from these figures.

From Fig-7, change in trend of ANMR occurred in Miyagi. It can be inferred that excess of immigrants over emigrants changed to excess of emigrants over immigrants at 24 years old group(change in slope of curve). In addition, it can also be said that mobility of migration is getting lower and lower as can be seen from the ANMR curve shifting upward in recent years. Comparing with other prefectures, ANMR trend under twenty four years old doesn't change from an excess of emigrants, and ANMR trend over twenty five years old is still an excess of immigrants. This implies that there isn't a big structure change of immigration/emigration. Except for Miyagi, the ANMR for other prefectures also shifts upward suggests that migration rate may be getting lower.

From these ANMR changes, two facts were ascertained; migration rate for the prefectures are decreasing, and in Tohoku region except for Miyagi migration pattern is negative at the term end since the 1950 cohort. With considering low migration rate, it can be thought that immigrants into those five prefectures except for Miyagi will not increase.

3.3 Share Changes of Interregional Migration

Fig-10 to Fig-16 shows the share changes of Tohoku region. While Tohoku region consists of six prefectures as mentioned earlier, Tokyo metropolitan area(expressed as Tokyo) consists of four prefectures; Tokyo, Kanagawa, Saitama and Chiba prefecture. From Fig-13, it can be surmised that the main origin or destination on migration in Miyagi is Tokyo and Tohoku. Those shares of the other prefectures are occupied by Tokyo, Tohoku region and Hokkaido. In other words, most of immigration into prefectures in Tohoku come from Tokyo and the neighborhood prefectures in Tohoku. In addition, Miyagi share as destination of emigration from other prefectures have also increased. This trend means that the concentration of immigration into Tokyo was relieved. Same phenomenon can be observed on immigration into Tohoku. Immigration ratio from Tokyo into prefectures in Tohoku is decreasing while emigration ratio from Miyagi into Tohoku except for Miyagi is increasing.

Care should be taken when dealing with these share changes. Because the figures only indicate share changes which don't include information about cohort sizes. As shown by previous studies, destination of emigration depends on age groups of migrants strongly. (Ohnishi(1982), Nakajima et al(1988), Yuzawa et al(1993)). For instance, people in their twenties contribute a higher population of emigrants from Tokyo into rural area, while the reversed can be seen for people in their teens. By this token if there are many people in their late teens, the level of concentration into Tokyo may be reinforced, since the number of immigrants into Tokyo increase. Of course, the opposite can also take place. Thus without considering cohort sizes, understanding current circumstances from only share figures proves inaccurate and also meaningless in comparing historical sizes. The inclination has been the practice continuously over some years, but saw a shift in trend by

including the influence of cohort sizes on migration. In other words, if new inclination in share has been observed continuously over some years, structural change on migration has taken place in selecting destination.

Historical share changes perceivable from the figures shown highlighted two facts; declining Tokyo's position as origin/destination of migration and rising position of Miyagi as a destination of immigration. Since these trend has continued for long years, it can be considered that the pattern of selecting a destination changed even if cohort sizes are taken into account.

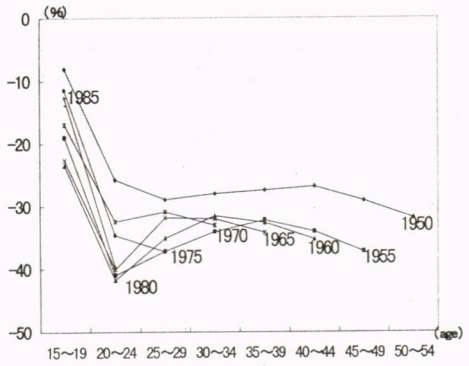

Fig-4 ANMR of Aomori

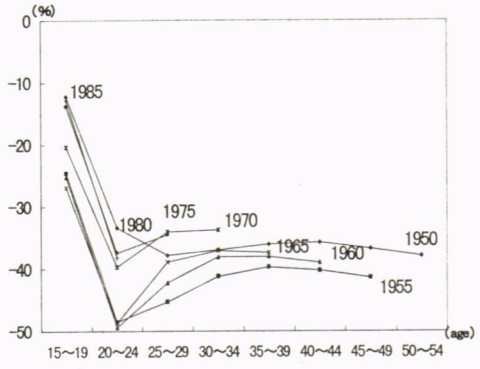

Fig-5 ANMR of Iwate

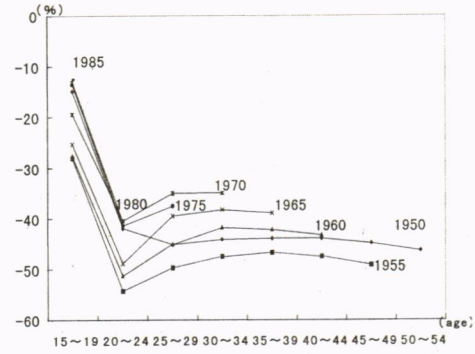

Fig-6 ANMR of Akita

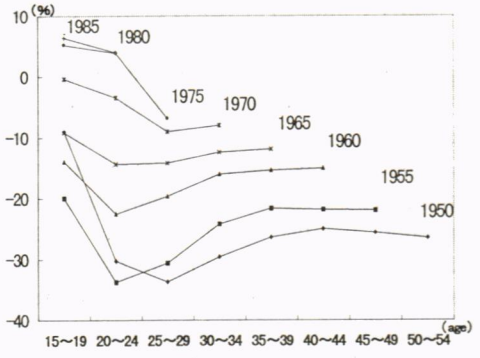

Fig-7 ANMR of Miyagi

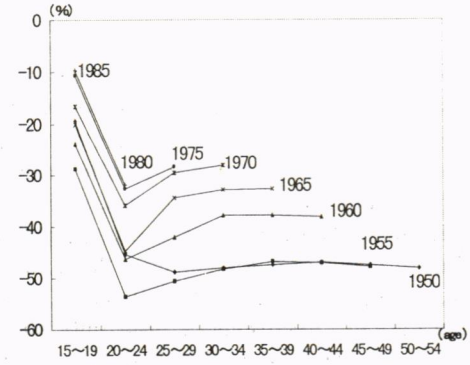

Fig-8 ANMR of Yamagata

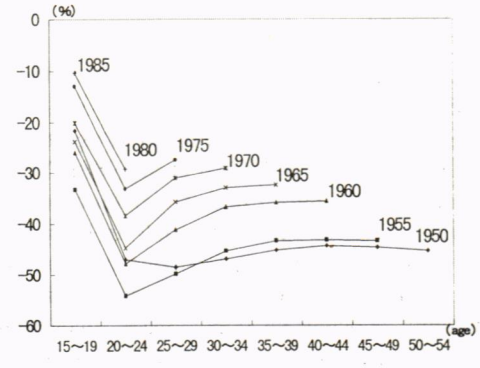

Fig-9 ANMR of Fukushima

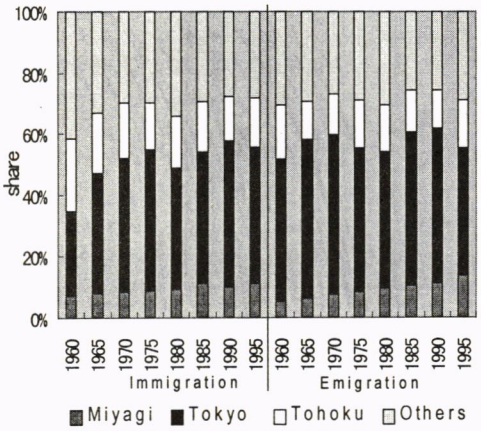

Fig-10 Share of Aomori

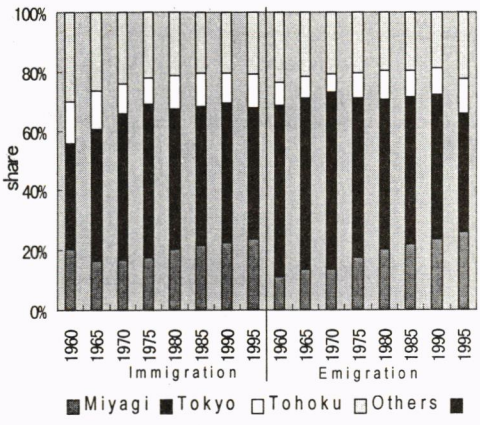

Fig-11 Share of Iwate

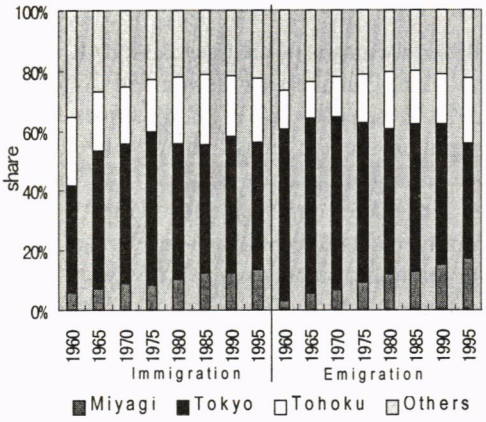

Fig-12 Share of Akita

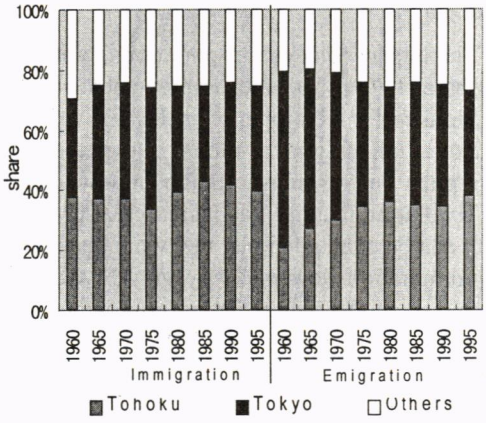

Fig-13 Share of Miyagi

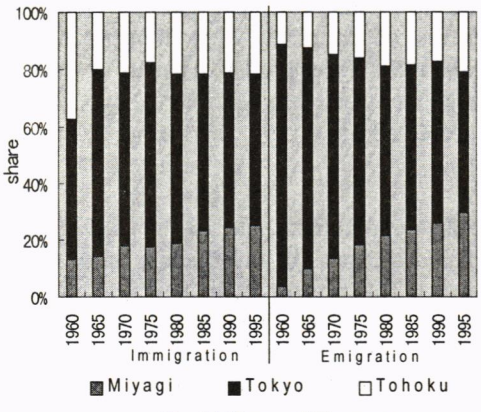

Fig-14 Share of Yamagata

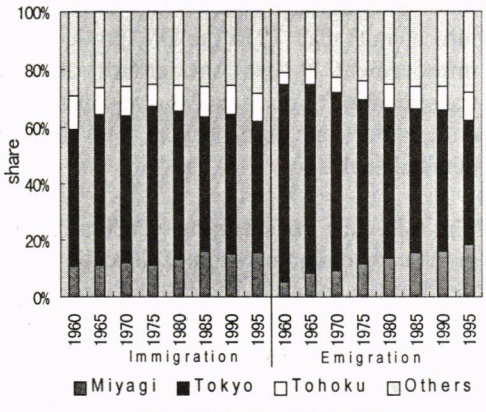

Fig-15 Share of Fukushima

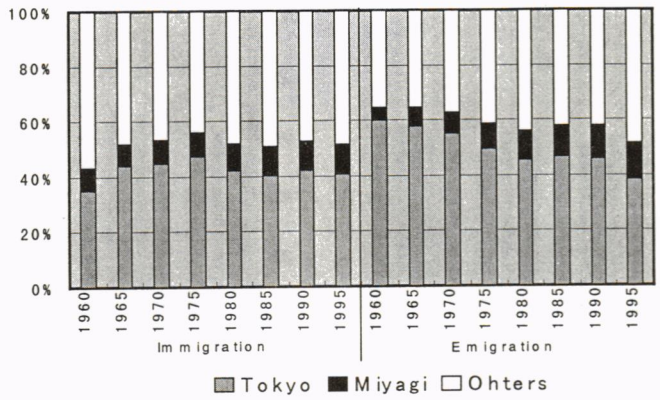

Fig-16 Emigration and Immigration Ratio between Tokyo and Tohoku

4. DISCUSSION

The impact of new transportation facilities is analyzed by means of changes in ANMR and shares before and after improvement. In this case taking Tohoku expressway and Tohoku Shinkansen were opened in Miyagi in 1975 and 1982, respectively. Fig-7 illustrates that excess of emigration turned into excess of immigration for late teens and early twenties groups due to transportation improvement. Since immigration share Miyagi from other Tohoku prefectures has increased after 1975, then it has been at the same level after 1975. It can be concluded that the two transportation improvements selected have accelerated the immigration flow into Miyagi. ANMR in Tohoku are rather stable except for Miyagi, the impact of the transportation improvement was suspected to turn Miyagi into a destination of emigrants from other Tohoku region instead of Tokyo prior to improvement. In other words, development of transportation facilities has risen the popularity and/or attraction of Miyagi as a central city in Tohoku region and reinforced the stratified structure between cities.

Share of emigrants from Miyagi into Tokyo has increased since the latter half of 1980's. It turned out that 1975 cohort produced an excess of emigrants after transportation improvement at two age groups of 20-24, and 25-29(see Fig-7). That is to say, transportation improvement can increase immigrants from Miyagi into Tokyo. But emigration share from Miyagi into Tokyo has decreased after 1990, then it needs more detailed analysis.

The following considers the concerns between Tokyo and Tohoku. Fig-16 shows that the number of emigrants from Tohoku into Tokyo has decreased for thirty years. Since this trend has been observed for long term, the position of Tokyo seems to be lower, although cohort sizes are considered. Since immigrants from Tokyo into Tohoku have also been constant, these flows can be thought as the return migration which based on personal reason. These results shows that emigration into Tokyo from Tohoku tends to decrease and immigration from Tokyo into Tohoku has been at a certain level.

Before the transportation improvement, most of migration origin/destination for people who live in Tohoku region were Miyagi and Tokyo. This has not changed even after

transportation improvement. Only the balance between Tokyo and Miyagi has changed. It seems that transportation improvement didn't have a strong influence that can cause an inversion of migration pattern called migration turnaround.

A scheme for decentralizing population to rural area for Japanese national develop plan are discussed here. It turned out that transportation improvement doesn't have strong influence producing inversion of migration pattern, however, it can change the balance of migration between regions. It also turned out that, immigrants will increase from Tohoku into Miyagi with transportation improvement. Emigrants from Miyagi into Tokyo are increasing, however, its extent is much smaller than that of immigrants into Miyagi from another prefectures in Tohoku. In short, people who emigrate from other prefectures in Tohoku will select Miyagi as a destination instead of Tokyo. Considering migration, it can be said that decentralization of population from Tokyo will be achieved by maintaining population in the county in the long term. Decentralization of population into the country may progress by means of a policy which keeps population in the country at current level. The policy should have much weight compare to the policy which makes population in Tokyo decentralize into the country. Of course, a policy which decentralizes from Tokyo must also be employed at the same time. Decentralization of population may need a long time frame

5. CONCLUSION

This paper analyses the impact of transportation improvement on interregional migration in Japan. Conclusion are outlined as follows.

- Migration rates in Tohoku region will be getting lower and lower.
- Transportation improvement has the influence of making the centrality of the largest city in a region stronger. In other words, it reinforces stratified structure between cities.
- Transportation improvement didn't have a strong influence worth producing an inversion of migration pattern.

Since ANMR of each prefectures considered shifted upward, it can be said that migration in Tohoku region will be getting lower and lower. Considering the migration pattern in Miyagi changing from excess of emigrants to excess of immigrants at teenage group and that immigrants from Tohoku into Miyagi are increasing after transportation improvement, the position of Miyagi as the center of Tohoku region seems to have been strengthen. The pattern that people in Tohoku would emigrate into Tokyo in their high teens and return to Tohoku in their twenties seems to be stable for long term although cohort sizes are taken into account. It can be thought that the migration turnaround, (migration concentration into Tokyo changed to decentralization from Tokyo) didn't exist. The transportation improvement is to reinforce a usual migration pattern, and it didn't have the influence producing an inversion of migration pattern. To strengthen these discussions further, expansion in prefectures number and discussion of migration structural changes in detail need to be explored for further studies.

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