How Will the Aging and Shrinking of Japan's Population Progress? Spatial Analyses Using Small Area Population Projection Data

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Introduction

As is well known, Japan is currently the most rapidly aging country in the world, and as a result, the population has been declining since 2008 (Inoue et al., 2021). Therefore, analyzing how the aging and shrinking of Japan's population will progress in the future is extremely important not only for Japan but also for other countries. However, there have been few studies that have used small area population projection data to examine such trends in Japan's population. This is because such projection data was unavailable for Japan before the website 'The Web System of Small Area Population Projections for the Whole of Japan (SAPP for Japan)' was launched by the author in 2016. SAPP for Japan opened the small-area and long-term projected population of Japan for the first time on the World Wide Web (http://arcg.is/1GkdZTX). The purpose of this study is to analyze the aging and shrinking of Japan's population from a spatial demographic perspective using data from the SAPP for Japan, and to clarify their future process of change.

Theoretical Focus

In general, small areas are more homogeneous than larger ones, i.e., municipalities, prefectures, or nations. Therefore, when we analyze the population aging and shrinking by focusing on the geographical or demographic homogeneity of target areas, handling small areas has an advantage over handling municipalities, prefectures, or nations. This is the reason that we analyze using data from the SAPP for Japan.

SAPP for Japan has projected the population based on the cohort change ratio method formulated by Hamilton & Perry, which is a representative method for population projections. However, merely applying this method to small area populations leads to unstable results that frequently maximize the projected population. Thus, the SAPP for Japan has smoothed two demographics, the cohort change ratio (CCR) and the child-woman ratio (CWR), which are indispensable for the cohort change ratio method, prior to applying the Hamilton-Perry method. Various methods for estimating small area

demographics have been developed or considered, and those methods essentially perform data smoothing using population statistics from neighboring or adjoining small areas, some of which are based on empirical Bayes smoothers. However, empirical Bayes smoothers have disadvantages when applied to population projections. Consequently, the SAPP for Japan has used a new method suggested by the author (Inoue, 2017), which has a limited advantage over previous methods, and has smoothed the two demographics of CCR and the CWR.

DATA

The following procedure was used for calculating the data provided by the SAPP for Japan: First, we downloaded the 2010 and 2015 small area census population data by sex and 5-year age group from the website 'Portal Site of the Official Statistics of Japan.' Second, CCR and CWR were calculated and smoothed. The CCR was given by the ratio of the 2015 population of a certain cohort to the 2010 population of the same cohort, and the CWR was given by the ratio of the 2015 population aged 0–5 to the 2015 female population aged 20–39. We smoothed these two demographics for a small area using the prefectural CCR and CWR. The numerical formulas are similar to the Stein-type shrinkage estimator, although they differ from the estimator in that the weight is changeable. Third, the population projected by small area was calculated from the smoothed CCR and CWR using the Hamilton-Perry method. We obtained the 2020 projected population by applying smoothed CCR and CWR to the 2015 census population and obtained the long-time projected population by iterating the above procedure. Finally, the projected population derived was adjusted to match that of the official population forecasting at the prefectural or national level.

Research Method

The analyses are performed using two methods:

One is to analyze the differences in the progression of aging in each cluster by clustering small areas. For this reason, a non-hierarchical cluster analysis is performed using two statistics on aging: the elderly population proportion and the elderly population change index (EPCI). The EPCI represents the ratio (%) of the elderly population in each year to that in the initial year. Non-hierarchical cluster analysis has been widely utilized in studies on spatial clustering and can classify many small areas into some homogeneous clusters. This study examines the demographic and geographical features of such homogeneous clusters, introduces a concept of the stage in the population aging process, and analyzes the relationship between the features of homogenous clusters

and the stages.

The other is to analyze how much population decline or becoming uninhabited will progress using a logit model based on the four explanatory variables for each small area. These variables are assigned a value of 1 if a small area satisfies the following criteria and 0 if they do not: the female population aged 20-39 declines by 50 percent or more during the target period; the elderly population proportion is 50 percent or more in the initial year; the population per square kilometer in the initial year is less than 4,000 persons; the location is outside of the three major metropolitan areas. This study examines the risk of population shrinking for each small area, introducing a concept of the stage in the population shrinking based on the population change index (PCI).

Expected Findings

As regards the future process of Japan's population aging, the following findings are expected to be obtained. In each area of Japan, first, the total population begins to decline; second, the elderly population begins to decrease; and finally, its proportion begins to decrease. These stage shifts of population aging progress relatively slowly in the suburbs of metropolitan areas with a low proportion of the elderly population because the proportion will rise most rapidly for a long time and the increase in the elderly population will be the largest. On the other hand, those stage shifts progress relatively rapidly in rural areas with a high proportion of the elderly population because the size of younger cohorts will reduce owing to long-term fertility decline.

As regards the future process of Japan's population shrinking, the following findings are expected to be obtained. The high proportion of the elderly population is the greatest risk factor for the shift to a more serious stage in the population shrinking, followed by the sharp decline in the female population aged 20-39. In contrast, low population density and non-metropolitan locations do not have a significant impact on the population shrinking.

References

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