# Future Change of Old-age Dependency Ratio in Japan -Relating to the Public Pension-

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## Introduction

The purpose of this paper is to discuss the future change of old-age dependency ratio in Japan relating to its demographic impact on the public pension scheme. First, we review the relation between Japanese public pension scheme and old-age dependency ratio. Then, we review the population projections of Japan and old-age dependency ratio with various assumptions. Next, we analyze the changes of the old-age dependency ratio using variable-r method. Finally, we propose a new definition of the old-age dependency ratio applying equivalent retirement age, and compare with usual old-age dependency ratio.

## 1 Japanese Public Pension Scheme and Old-age Dependency Ratio

The Japanese pension scheme is managed by partial funding method. However, it is close to PAYGO, so its financial status is largely influenced by the ratio of the number of beneficiaries to the insured in the future. Therefore, demographic impact on the scheme could be evaluated by the future old-age dependency ratio $DR(t)$, which is the ratio of the population aged 65+ to the population aged from 20 to 64, defined by

$$DR(t) = \frac{\int_{65}^{\infty} N(a,t)da}{\int_{20}^{65} N(a,t)da}$$

where $N(a,t)$ is population aged $a$ in time $t$. Therefore, we will mainly focus on the projected old-age dependency ratio in this article.

The Japanese official projection release by NIPSSR in 2006 is based on three alternate assumptions about fertility and also three assumptions for mortality. In 2005, TFR is 1.26, and is 1.26 in medium variant, 1.55 in high variant and 1.06 in low variant in 2055. In 2005, life expectancy at birth is 78.53 for male and 85.49 for female, and is 83.67 for male and 90.34 for female in medium variant, 82.41 for male and 89.17 for female in high variant and 84.93 for male and 91.51 for female in low variant in 2055.

There are also assumptions for international migration. However, in the official projection, only one assumption has been made for international migration. So, here we put another ”high net migration”

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assumption for the numbers of net immigrants, which assumes that non-Japanese net migrants per year will be 200 thousand.

Figure 1 shows the projected old-age dependency ratio. In the medium variant fertility and medium variant mortality, the old-age dependency ratio is projected to be 85.0% in 2055, which was 33.1% in 2005. The increase in 50 years is almost 52% point. After 2055 in ancillary projection, it continues to increase and is 91.7% in 2073, which is the peak value. Then it declines and is 85.6% in 2105.

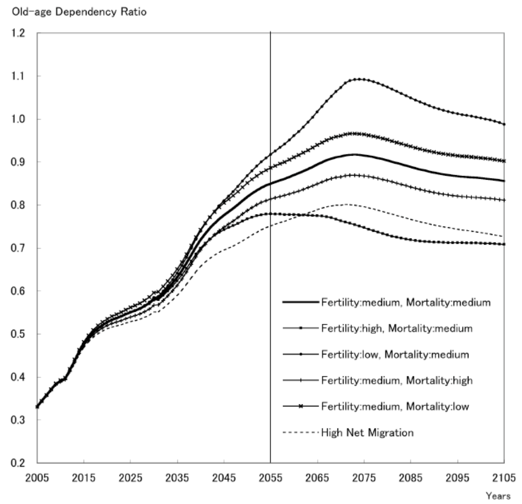


Figure 1 Projected of Old-age Dependency Ratio (from 2005 to 2105)

To discuss how to deal with these changes in old-age dependency ratio, it would be necessary to analyze the factors which are responsible to increase the ratios. According to the decomposition analysis in the change of old-age dependency ratio applying variable-r method (Figure 2), the increase in the old-age dependency ratio is mainly determined by the birth and death factors. We can observe that the magnitudes of both factors are almost same. Sometimes the effect of low fertility on the increase of old-age dependency ratio is emphasized in discussion in Japan. However, we can observe from this decomposition that the effect of mortality improvement also plays an important role.

## 2 New Old-age Dependency Ratio Applying Equivalent Retirement Age Approach

We saw in the last section that the death factor for increase in old-age dependency ratio is steady. One reason of this is that we fix the lower limit of old-age population as 65 years old. However, considering increase in life expectancy, the status of 65 years old in our life cycle is not same over time. The concept of "equivalent retirement age", which has been studied by some researchers, is an approach to deal with this kind of problem.

Here, we define and consider a new old-age dependency ratio applying this concept. Define $x_r(t)$ as

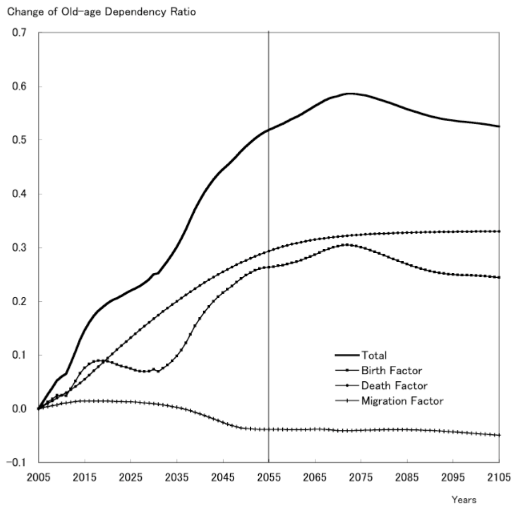


Figure 2　Decomposition of Change of Old-age dependency ratio (from 2005 to 2105)

the age which satisfies

$$\frac{T^{(t)}_{x_r(t)}}{T^{(t)}_0} = \frac{T^{(2005)}_{65}}{T^{(2005)}_0}$$

where $T^{(t)}_x$ is the stationary population in the life table at time $t$. Then using $x_r(t)$ as the lower limit of old-age population , we define a new old-age dependency ratio

$$DR_{new}(t) = \frac{\int_{x_r(t)}^{\infty} N(a,t)da}{\int_{20}^{x_r(t)} N(a,t)da}$$

Figure 3 shows Old-age dependency ratios in usual and new definition. In medium mortality variant, $DR_{new}(2055) = 67.7\%$ and $DR_{new}(2105) = 68.1\%$, where $DR(2055) = 85.0\%$ and $DR(2105) = 85.6\%$. The differences are 17.3% point in 2055 and 17.5% point in 2105. The death factors are 29.4% point in 2055 and 33.0% point in 2105, therefore the ratio of the differences to the death factors are 0.59 in 2055 and 0.53 in 2105. Thus, the new dependency ratio can mitigate about the half of the death factor.

Moreover, the new dependency ratio succeeds to hedge the risk of mortality improvement. From Figure 3, we can observe that $DR_{new}(t)$'s take almost same values even though the mortality assumption changes, whereas $DR(t)$'s do not.

## 3　Remarks on the Japanese Public Pension Scheme

For the long run, the age structure would be largely affected by the level of fertility and the level of net migration. Therefore, we should discuss the policy that influences the level of fertility and migration to deal with future increase of old-age dependency ratio. However, the effect by fertility change is not prompt, and for the effect of increasing level of net migration, we should pay attention that the aging of

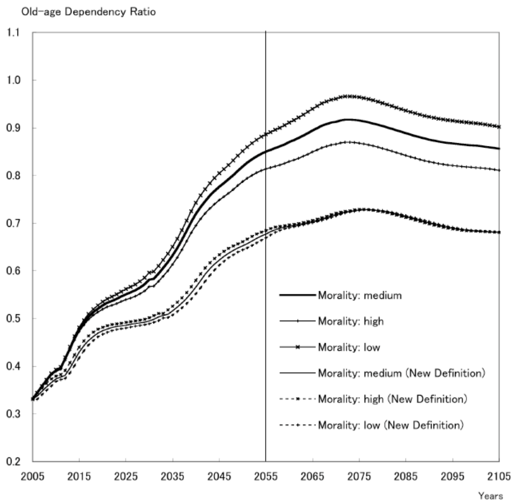


Figure 3 Old-age dependency ratios in usual and new definition (from 2005 to 2105)

immigrants weaken the effect of decreasing dependency ratio in the long term, and the effect is mainly caused by the birth factor after 2055, which would be affected by the immigrants' fertility level.

On the other hand, we have observed that mortality improvement also affects the increase in old-age dependency ratio steadily. Therefore, we should take some action to mitigate the increasing effect by mortality improvement in short or middle term. The new definition of the old-age dependency ratio suggests that we can reduce some part of the death factor and deal with the uncertainty of mortality improvement if we could move the lower limit of old-age population in response to the future mortality change. To accomplish this, we should change the eligible age for the public pension scheme and normal retirement age corresponding to the life table.

Modification of indexation introduced by the recent Japanese pension reforms has decreased the relative level of benefit in older ages to the worker's wages. However, the coefficient variance of length of life, which could be interpreted as the necessity for pooling risk corresponding to the uncertainty of life expectancy, increases in older age. Therefore, recent mortality improvement could have produced a mismatch between the need and the level in the public pension benefit from life course viewpoint . Moreover, future mortality improvement might increase the degree of mismatch in the current pension scheme.

To deal with future increase of the old-age dependency ratio, it would be important to discuss not only macro viewpoint but also life course viewpoint such as equivalent retirement age. Therefore, it would be desirable to take some action immediately that people could live healthier and work longer to cope with prolonging life expectancy, along with the discussion of the long term policy about the level of fertility and migration.