Title: Applying Swedish "Automatic Balance Mechanism" to Japanese Population

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Abstract

As many researchers in the world know, Japan is one of those countries that have the most rapidly graying population. During the pension reform in 2004, some Japanese economists argued the issue of "Intergenerational Inequality" using the balance sheet of Japanese State Pension Scheme, which I believe is completely incorrect.

During my study, I was interested in Swedish pension reform. Among many reform measures, such as Notional Defined Contribution, Financial Defined Contribution, and so-called Orange Envelopes, I evaluate that the "Automatic Balance Mechanism" is the most useful tool for governing the financial soundness under the Pay-as-you-go (Pay-Go) system.

Under the Automatic Balance Mechanism, "Contribution Asset (CA)" is calculated and treated as the "quasi asset" in Pay-Go system. Although CA is expressed as the product of the annual premium and "Turnover Duration", it is characterized as the actuarial liability of the hypothetical "Steady State Population" assuming the wage increase rate as the discount rate. To the extent that the sum of CA and the real fund (F), which are constituents of the asset side of the balance sheet, exceeds the pension liability (L), the scheme will be operated without any problem. If the ratio of CA+F to L went to less than 1, the Automatic Balance Mechanism would be activated and the accrued benefits of both active and inactive participants would be adjusted.

Although introducing the balance sheet for Pay-Go state pension schemes is a kind of innovation, the new concept should be analyzed from various points of view.

In this paper, I tried to apply the mechanism to Japanese Population using a very simple old age pension model. The population projection and key assumptions are based on "The Population Projections for Japan: 2001-2050" issued by the National Institute of Population and Social Security Research in 2002, and "The Report of 2004 actuarial valuation on Employees' Pension Insurance and National Pension in Japan" issued by the Ministry of Health, Labor and Welfare in 2005.

I show that, although the "Automatic Balance Mechanism" works efficiently to some extent, it has its own limit under the decreasing population because it does not assume the rate of annual decrease in the discount rate.

1. Background

Facing the rapidly graying demographic pressure, Japan introduced the financial stabilizer called "Macro Economic Indexation" to its Social Security Pension System in the 2004 reform. Under the new indexation system, the rate of indexation will be adjusted based on the growth rate of the total wages of insured persons and the factor which offsets longevity cost until the actuarial equivalence for the next 95 fiscal years will be achieved[1]. Currently, the adjustment period is expected to expire in 2024. Accordingly, the financial discipline of Japanese Social Security Pension System is set on the basis of the actuarial balance of income, expenditure, and the buffer fund for 95-year period[2].

During the discussion of the reform bill, some economists severely criticized the current system by pointing out the issue of the intergenerational inequality[3]. They used the "Balance Sheet" of the pension system and asserted that there existed the inequality because the system did not have enough funds in comparison with the accrued benefits liability. Because it is clear that the existence of funding deficit isn't the sufficient condition for the intergenerational inequality[4], I believe that their logic is completely incorrect.

At that tide, I got interested in the "Automatic Balance Mechanism" in Swedish Public Pension System[5], and found another "Balance Sheet" which is quite deferent from that in Japan. The main characteristic of Swedish balance sheet is the fact that it does not use the future projection. Although the Swedish approach might be another method for getting the financial discipline, I thought that it should be also analyzed under the different scenario such as the Japanese population projection, the main scenario of which assumes low fertility rates and results in the severely shrinking population.

2. Review of the Swedish Automatic Balance Mechanism

According to Settergren & Mikula [2003][6], the quasi-asset called "Contribution Asset (CA)" characterizes the Swedish balance sheet. Although CA is defined as the product of the total amount of the contributions and so called "Turnover Duration (TD)" which is the difference of money-weighted average ages for active and retired participants, it equals to the Actuarial Liability

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[1] More precisely, during the adjustment period, each year's revaluation factor before the pensionable age is defined as Min {Net Wage Growth Rate, Max {Net Wage Growth Rate + Population Growth Rate - 0.3%, 0%}}, while the factor in payment is defined as Min {Price Inflation Rate, Max {Price Inflation Rate + Population Growth Rate - 0.3%, 0%}}. Here, the 0.3% is defined as the adjustment rate that offsets the increase of the cost for longevity.

[2] It is assumed that the system will preserve the buffer fund equal to the one-year expenditure at the end of the 95-year period.

[3] In this paper, the intergenerational inequality is defined as the situation in which the internal rate of return in the system varies for each cohort.

[4] A mature pay-as-you-go public pension system under the steady state population will not generate any inequality. This will be a counter example.

[5] So called "Notional Defined Contribution (NDC)" part of the system

[6] Reference No. 5

for the steady state population. The Actuarial Liability will be expressed as follows using ρ+δ as assumed interest rate.

$$V = \int_0^\omega L_0 \cdot l_x \cdot e^{-\delta \cdot x} \int_x^\omega {}_{u-x|}p_x \cdot e^{-(\delta+\rho)(u-x)} \cdot \left[R_u \cdot k \cdot \overline{W} \cdot e^{\rho(u-x)-\varphi(u-r)} - A_u \cdot c \cdot \overline{W} \cdot W_u \cdot e^{\rho(u-x)}\right] dudx$$

$$= L_0 \cdot \overline{W} \int_0^\omega \int_x^\omega l_u \cdot e^{-\delta \cdot u} \cdot \left[R_u \cdot k \cdot e^{-\varphi(u-r)} - A_u \cdot c \cdot W_u\right] dudx$$

where,

V = Actuarial Liability,

u, x = age,

r = pensionable age,

ω = limiting age of the mortality tables,

L_0 = number of persons of age 0,

l_x = survival function (l_0 =1),

${}_{u-x|}p_x$ = probability of life between ages of ***x*** and ***u,***

ρ = rate of growth in the average wage,

δ = rate of fertility-driven population growth,

φ = adjustment rate of pension indexation relative to the rate of growth in the average wage[7],

R_x = number of retirees in proportion to the number of individuals in age group ***x,***

A_x = number of active participants in proportion to the number of individuals in age group ***x,***

k = average pension replacement ratio relative to average wage,

$\overline{W}$ = average wage per unit of time,

W_x = average wage for age group ***x***, as a ratio of the average wage for all age groups,

c = required rate of contribution under a financially stable pay-as-you-go pension system.

Under the pay-as-you-go method, the rate of contribution c is defined as follows.

$$c = \frac{k \cdot \int_0^\omega l_x \cdot e^{-\delta \cdot x - \varphi(x-r)} \cdot R_x dx}{\int_0^\omega l_x \cdot e^{-\delta \cdot x} \cdot A_x \cdot W_x dx}$$

In determining the size of the hypothetical steady state pension system, we assume the amount of the annual contribution under the steady state to be equal to the actual amount C.

$$C = L_0 \cdot \overline{W} \int_0^\omega l_x \cdot e^{-\delta \cdot x} \cdot A_x \cdot c \cdot W_x dx$$

If we divide V by C, the answer will be independent of the size of the plan.

$$\frac{V}{C} = \frac{\int_0^\omega \int_x^\omega l_u \cdot e^{-\delta \cdot u} \cdot k \cdot e^{-\varphi(u-r)} \cdot R_u dudx - \int_0^\omega \int_x^\omega l_u \cdot e^{-\delta \cdot u} \cdot A_u \cdot c \cdot W_u dudx}{\int_0^\omega l_x \cdot e^{-\delta \cdot x} \cdot A_x \cdot c \cdot W_x dx}$$

[7] φ equals to 0.016 in Swedish Pension System.

$$= \frac{\int_0^{\omega} x \cdot l_x \cdot e^{-(\delta+\varphi)x} \cdot R_x dx}{\int_0^{\omega} l_x \cdot e^{-(\delta+\varphi)x} \cdot R_x dx} - \frac{\int_0^{\omega} x \cdot l_x \cdot e^{-\delta \cdot x} \cdot A_x \cdot W_x dx}{\int_0^{\omega} l_x \cdot e^{-\delta \cdot x} \cdot A_x \cdot W_x dx}$$

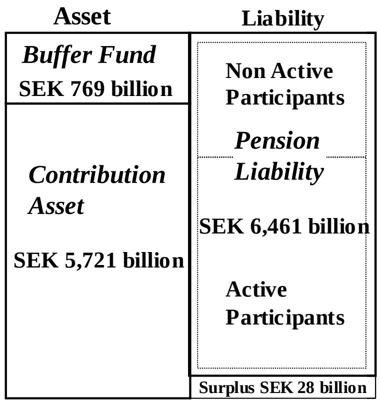
Because each of the first and second term of the right-hand side of the above equation expresses the weighted average of retirees ($\bar{x}^p$) and that of active participants ($\bar{x}^a$), the right-hand side means the turnover duration ($TD = \bar{x}^p - \bar{x}^a$). Thus, we obtain the following equation, which, by the definition, is equal to the Contribution Asset (CA).

$V = C \cdot TD = CA$

When we consider the Pay-as-you-go pension system, the Contribution Asset might be understand as the transfer wealth of the system based on the intergenerational solidarity. If we accept this concept, the balance sheet of a mature pay-as-you-go public pension system under the steady state population will be balanced, using CA as the asset and V as the liability.

According to "The Swedish Pension System Annual Report 2005"[8], the balance sheet of the Swedish Public Pension System (NDC part) for the fiscal year 2005 was calculated as Figure 1.

Figure 1 Balance Sheet of the Swedish Public Pension System (NDC part) as of the end of 2005



Total SEK 6,490 billion

Balance Ratio at the end of 2005 = 1.0044

Source: The Swedish Pension System Annual Report 2005

Finally, we should note that Sweden assumes the rate of fertility-driven population growth δ as zero. According to the recent population projection conducted by Statistic Sweden, because of the relatively high assumed total fertility rate (TFR)[9] in addition to the immigration effect, Swedish total population is projected to grow steadily from 9.0 million in 2005 to 10.5 million in 2050. The population growth rate δ should be carefully examined when we apply the Swedish approach to

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[8] Reference number 6

[9] The TFR for each year is assumed to be from 1.81 to 1.85, which is much higher than that of Japan. In the population projection issued in January 2002, Japan assumed the long-term TFR to be 1.39 in intermediate scenario, which is now revised to be 1.26.

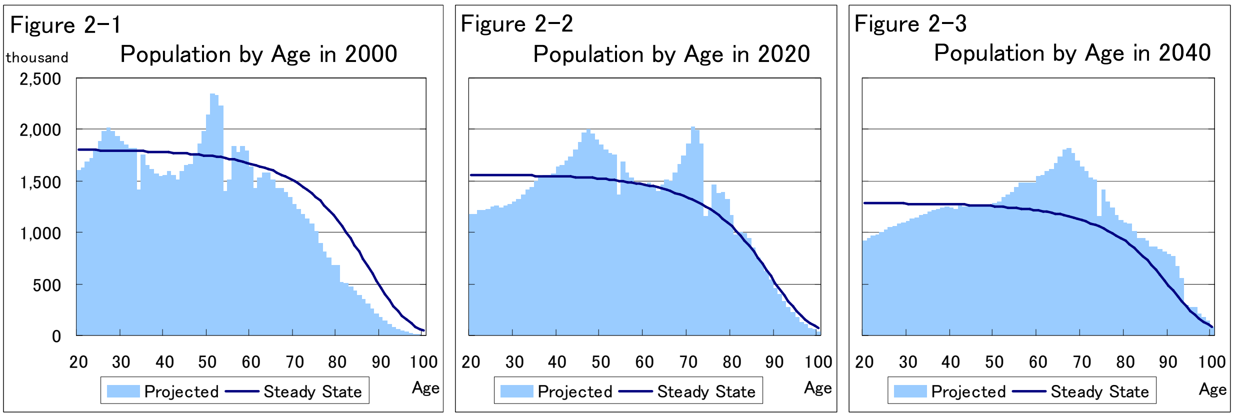
Japan. We also need to introduce the method, which converts the total fertility rate to the population growth rate.

3. *Key Assumptions for the Simulation*

Although the Swedish approach might be a new method for setting the financial discipline, I thought that it should be analyzed under the different scenario such as the Japanese population projection, where the main scenario assumes the low TFR and resulted in the severely shrinking population. Because my purpose is to examine the usefulness of the mechanism in different population scenario, I assumed the following simple model.

(1) Population

I used the intermediate scenario in "The Population Projections for Japan: 2001-2050" issued by the National Institute of Population and Social Security Research in 2002. In this scenario, the life expectancy in 2050 is assumed to be 80.95 for male and 89.22 for female, and TFR in the same year to be 1.39. Figure 2 show the population structure in selected years. The line charts, which represent the steady state population assuming δ as zero, were set so that total numbers of population from age 20 to 64 for "Projected" and "Steady State" are the same.



(2) Labor force participation rate (A_x)

The labor force participation rates showed in Figure 3 were assumed. They are the long term rate[10] assumed in "The Report of 2004 actuarial valuation on Employees' Pension Insurance and National Pension in Japan", issued by the Ministry of Health, Labor and Welfare in 2005.

(3) Plan Design

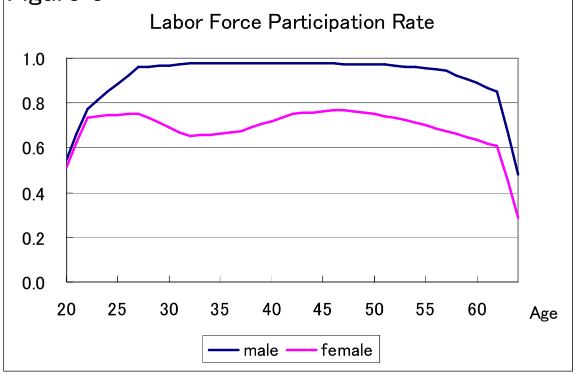
Only Old Age Pension Benefits are to be payable from age 65. The benefit formula is defined as follows, which means that an average wage earner with 40 years of participation will receive the pension equal to 40% of average wage of then active participants.

Pension Benefit = Career Averaged Wage (revaluated by wage index) x 1% x Years of Participation

[10] Rates for 2025 or later

CPI indexation is applied to pensions in payment as far as the adjustment based on the automatic balance mechanism is not activated.

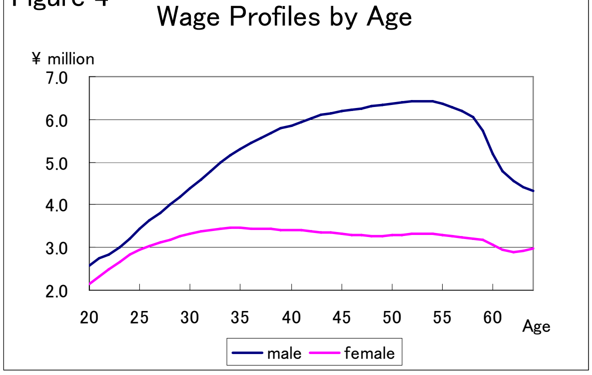
Figure 3



(4) Economic Assumption

The wage profiles, which represent the seniority pay structure, are assumed as shown in Figure 4.

Figure 4



I assumed the annual rate of inflation as 1.0%, the rate of wage increase as 2.1%, the rate of return on the pension asset as 3.2% (real rate of return: 1.1%=3.2%-2.1%) for all projected years. These rates are the same as the long-term rates assumed in "The Report of 2004 actuarial valuation on Employees' Pension Insurance and National Pension in Japan".

(5) Other Assumptions

The rates of contributions calculated on the Pay-Go basis for each year's hypothetical steady state population are applied. The discount rate for the calculation of Contribution Asset and Pension Liability is set to be equal to the wage increase rate. The results are shown in net of wage increase, i.e. in the year 2000 wage base.

4. *Key findings of the Results*

Like Swedish public pension system, Japanese Employee Pension Insurance, which covers employees in the private sector, also has the plan assets managed by the Government Pension Investment Fund. The total amount of the fund approximately equals to 5 times of annual outlays. So I set the initial funding level to be that level.

(1) Financial Trend

Figure 5 Projection of Financial Positon without the activation of the Balance Mechanism
(Initial Fund: 5 times annual outlays, Real Rate of Return on the fund: 1.1%)

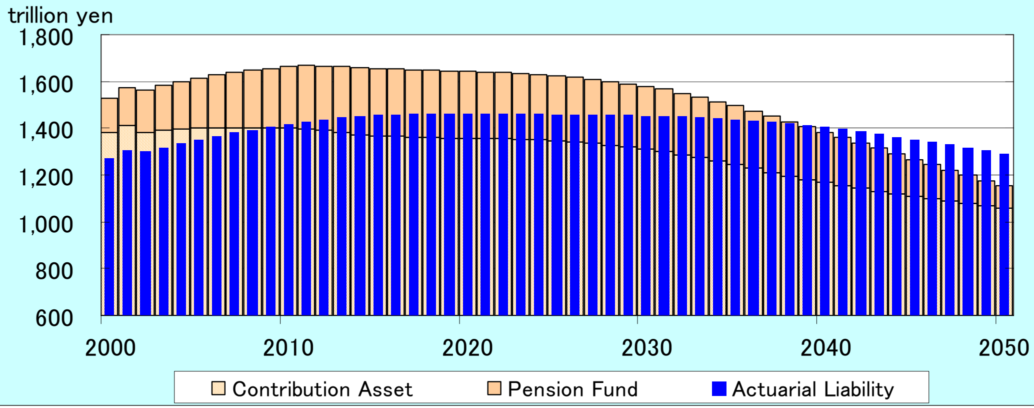
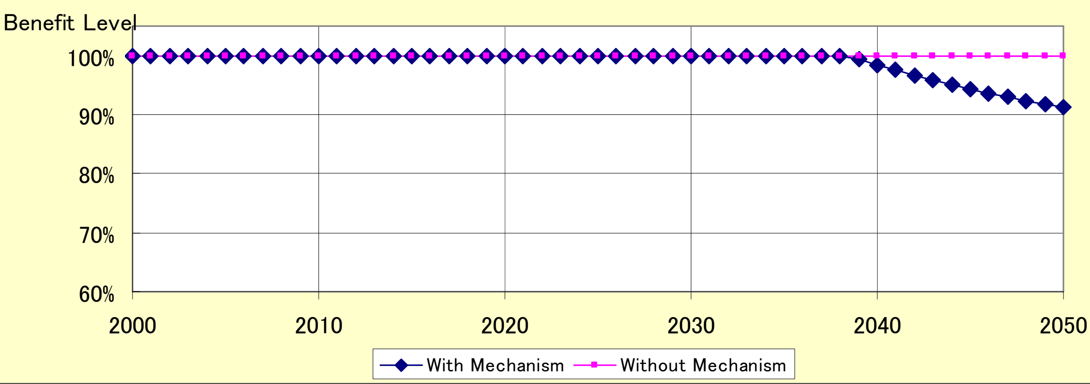


Figure 5 shows the financial status of the model system for each year. It assumed that there would be no activation of the automatic balance mechanism. Because the Japanese Baby Boomers, who were born from 1947 to 1949, took an active role in the labor market in 2000, the initial status of the model pension system is not a matured one. So the pension assets will increase for more than a decade. But as they retire and the successive generations cannot fill the labor force shortage, the plan asset will begin to decrease from 2017.

Although the balance ratio comes down below 1.0 in 2039, the plan asset will not be exhausted in 2050. If the automatic balance mechanism were activated in 2039, the benefit level would gradually decline to around 90% of original level in 2050 (Figure 6).

Figure 6 Effect of Automatic Balance Mechanizm



Such trends are analyzed in Figure 7. Because the fluctuations of "Increase in CA" and "Increase in Liability" in initial two years arise from irregular treatment[11] in the population projection, they are not important. We should note the following factors.

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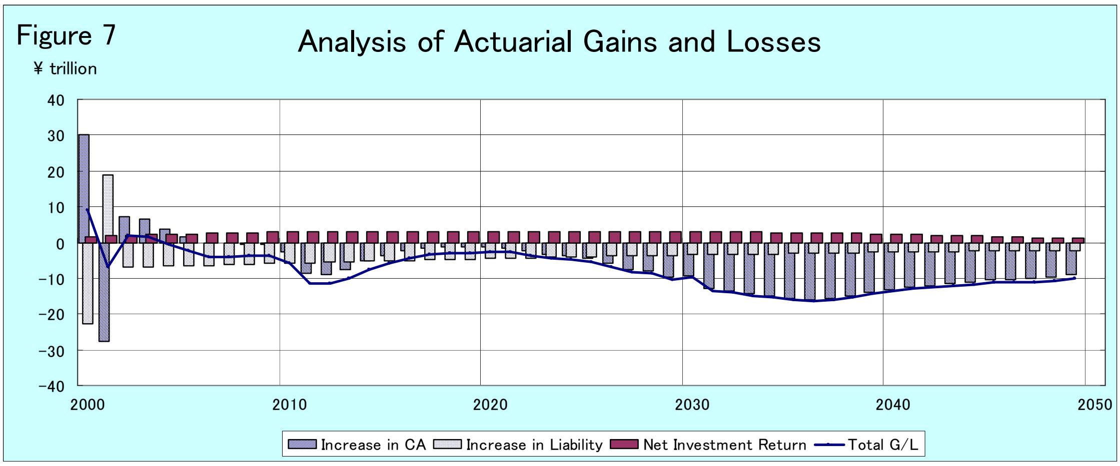
[11] Population in 2001 is not continuous with the before and after years, because it reflects the experience in 2000.

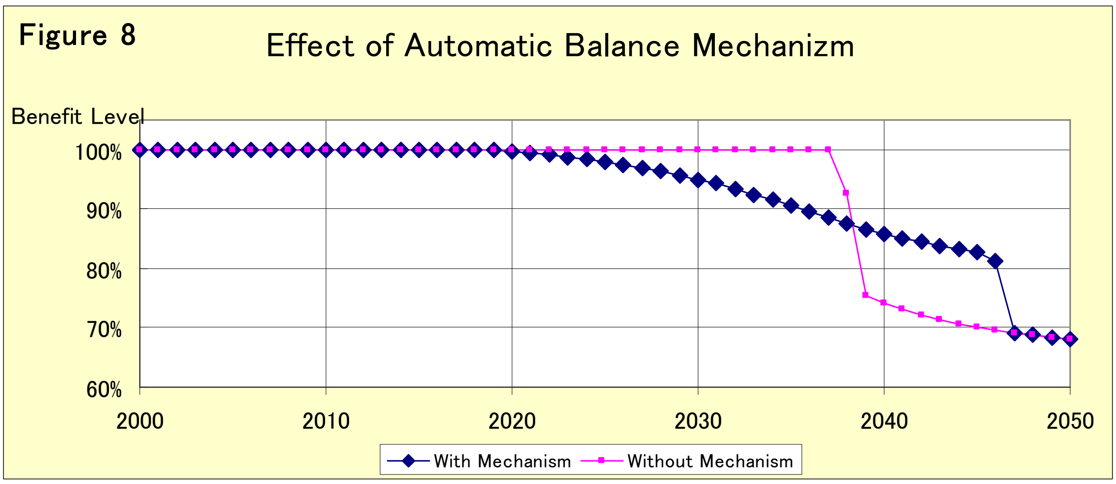
- Steady Improvement of Mortality Table
- Net Return on Buffer Fund
- Decreasing population of working age, especially in those years after Generation Y retires

The result significantly depends on the assumptions. For example, if we assume the rate of return on plan asset at 4.2% instead of 3.2%, the balance ratio will not go below 1.0.



(2) Usefulness of the Automatic Balance Mechanism

For the purpose of the evaluation of the Automatic Balance Mechanism, I assumed the initial fund to be zero with other assumption left unchanged. In this case, the balance ratio will go bellow 1.0 in 2020. If the mechanism is not activated, the plan asset will be exhausted in 2038 and the benefit level will decline to around 70% in 2040's. Even if the mechanism is activated, the plan asset will run only to 2045, and the results in 2047 or later are the same as the non-activate case (Figure 8).

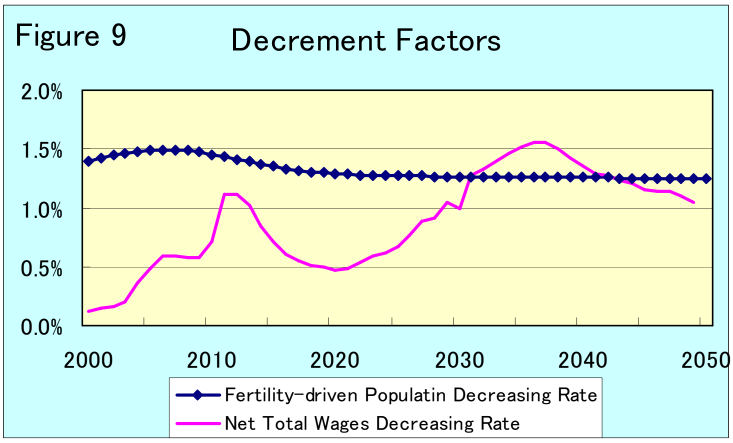


As I did not take the rate of annual population decrease δ into account in setting the discount rate, the mechanism works only to the limited extent. This means that if we apply the automatic balance mechanism to continuously decreasing population, we should carefully consider the way of benefit adjustment to appropriately reflect the trend.

5. *Concluding Remark*

In the 2004 Pension Reform, Japan introduced the financial stabilizer called "Macro Economic Indexation" to its Social Security Pension System. Under the new indexation system, the rate of indexation will be adjusted based on the growth rate of the total wages of insured persons and the longevity cost until the actuarial equivalence for the next 95 fiscal years will be achieved. This could be one way of proper benefit adjustment.

The other way would be, like Settergren & Mikula [2003], to take the fertility-driven population-decreasing rate into account in setting the steady state population and discount rate. In order to consider those approaches, I calculated the net decreasing rate of total wages and the fertility-driven population-decreasing rate[12] for each year based on my model. Figure 8 shows the result[13].



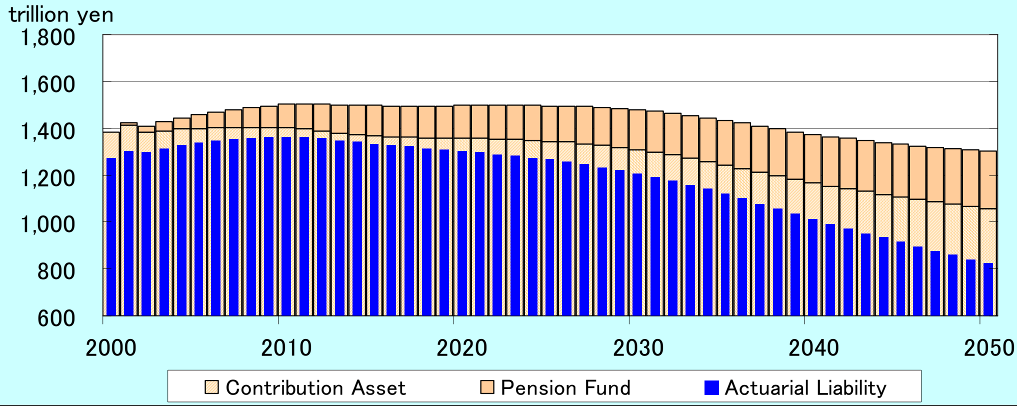
If we apply the Swedish approach taking the fertility-driven decrement factor δ into account, the normal cost will soar dramatically by around 60%. That means that adopting this approach will result in accumulating huge amount of plan assets, and I concern the feasibility issue.

[12] Although we can obtain the analytical solution of δ by approximating the fertility curve to a normal distribution function, I used the solver function in Excel.

[13] The population projection assumes the cohort-fertility curve, where the total fertility rate converges to 1.39. As the age of marriage become higher, the cohort-fertility curves shift to higher ages year by year. As a result, when the cohort-fertility curves are converted to the period fertility curves, the period TRF declines in near term. That the reason why the fertility-driven population decreasing rate increases for several years.

Another approach could be the use of the net total wage-decreasing rate for the adjustment factor. This approach would be similar to the indexation in Japan in the adjusting period or the interest rate in the Italian NDC system. Figure 10 shows the result, which means that Automatic Balance Mechanism does not work well. In this case, a future simulation would be necessary in order to decide when the adjustment should be ceased and the actuarial equivalence will be achieved.

Figure 10 Projection of Financial Positon without the activation of the Balance Mechanism (Initial Fund: zero, Real Rate of Return on the fund: 1.1%)



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