Japanese Macroeconomic Policy:

Solutions to Monetary and Fiscal Policy Challenges

Pension Reform in Japan: is NDC the Solution?

Hironori Ishizaki, Boon Loong Ngiang, Onyi Lam

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Executive Summary

The primary goal of this paper is to assess the current financial status of Japanese public pension system and study whether the Notionally Defined Contribution (NDC) scheme can help to build a more resilient system. For the NDC scheme to be effective in enhancing Japan's public pension system, it must advance the dual purposes of enhancing the pension system's resilience through ensuring solvency, and also address inter-generational inequalities through the raising of pension replacement rates.

To ascertain the NDC scheme's effectiveness, a numerical simulation is conducted using the best publicly available data and projection. The results, while preliminary, suggest that a NDC plan can achieve financial stability through its built-in stabilizers, but not in the short run. It is also showed that while the NDC can potentially enhance replacement rate relatives to the status quo, the scheme by itself is unlikely to deliver adequate return for retirement.

Through complementary policy measures like a reserve fund and raising pension fund investment returns, the NDC scheme's brake mechanism and provision of added incentive to retire later would likely result in relatively higher stability and pension replacement rates for Japan's public pension system. Together, they are therefore effective in enhancing Japan's public pension system.

The paper begins with a brief introduction of the current Japanese pension system and the issues it is faces. Subsequently, an empirical assessment of the current system is conducted. It highlights issues of sustainability and equality within the pension system and summarizes their policy implications. Finally, the key elements of a Japanese NDC model are stipulated and their effectiveness in promoting financial stability assessed. The paper concludes with policy measures that may potentially enhance Japan's public pension system.

Content

1. Introduction

Many developed countries are facing serious issues in the long-term sustainability of their Pay-As-You-Go (PAYGO) public pension plan as the PAYGO pension scheme largely delinks the benefit formula from demographic and macroeconomic conditions. The effect is particularly pronounced in Japan, where longer life expectancy, a shrinking labor force as well as two decades of economic stagnation, has together put mounting pressure on the pension system. Recently, Notional Defined Contribution (NDC) has been adopted in several European countries and is considered to be a potential solution to the financing issue of public pension. NDC is usually an unfunded or partially funded defined benefit (DB) scheme where workers' contribution histories are directly tied to their retirement benefits, which in principle should respond better to any socioeconomic shocks compared to PAYGO.

The report is structured as follows. We begin with a brief introduction of the current Japanese pension system and the issues it faces. Then we provide a quantitative assessment of the current system, highlighting the sustainability and the inequality issues. Finally, we stipulate key elements of a Japanese NDC model and assess its effectiveness in promoting financial stability.

2. Japanese Current Condition

According to Walt Witman Rostow, a professor of vital economics at Harvard University, Japan is facing its fourth challenge since the 17th century. First challenge was in the Tokugawa Era when Japan was forced to open the country to Europe. Japan persistently rejected relations with other foreign countries and that period was called "Sakoku". In its second challenge, Japan faced a choice between pursuing Western modernization and sticking to traditional values. Japan finally succeeded in modernization and has often been considered to be the most successful example of transitioning into modernity in Asia. Third, it was the reconstruction after the World War 2. GHQ demanded a change of Japanese Constitution and pushed for political reform. Japan accepted the philosophy and directions imposed by the United States and at last, Japan achieved in becoming one of the great powers and its GDP was at one point, the second largest in the world.

So, what is Japan's fourth challenge? Japan is the most rapidly aging society in the world in three aspects: Life expectancy, the number of elderly people and the speed of aging. Life expectancy for women is 85.52 years old (in 2005), the longest in the world. The high quality of Japanese medical treatment has contributed much to extended life expectancy and as a result, the percentage of elderly people amounts to more than 20% of the population and is still growing. However, why is the speed of aging in Japan so fast? Figure 1 shows the transition of birth rate in Japanese history. After the first baby boom around 1950, the birth rate in Japan dropped rapidly. The speed picked up again during the second birth boom, but has been declining gradually until now. Japanese government noted that the decline in birth rate would be detrimental to economic development in the long run, but the government had been concentrating on other issues like the shortage of foods, unemployment and environmental issue instead of population problem in the past.

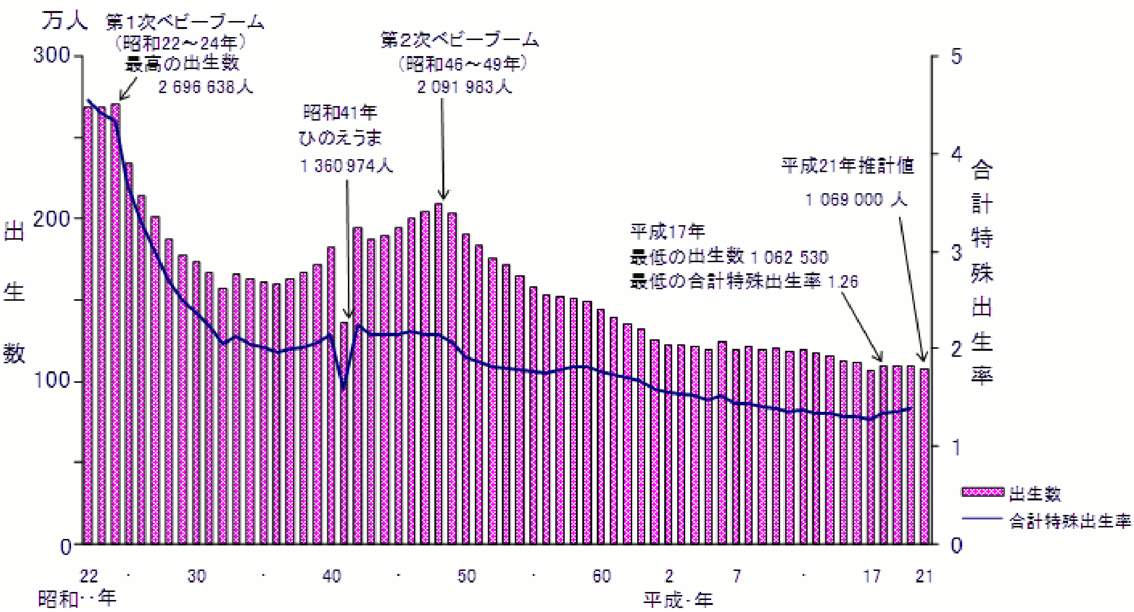


Figure 1

There are several reasons that can explain the decline in birth rate. First of all, it is noted that such decline is a universal phenomenon observed in most developed countries in the world. As economy grows, life expectancy becomes longer and the birth rate declines. According to Demographic Transition theory (Figure 2), there are 5 stages in the whole transition process. In stage one, the country is a pre-industrial society and both death rate and birth rate are high and roughly in balance. Population growth is typically very slow. In stage two, which is typical in developing countries, the death rate drops rapidly due to improvement in food supply and sanitation. The countries in this stage experience large increase in population. Stage three occurs during the urbanization process. At this stage, birth rate starts declining, resulting in low death rate and low birth rate. Finally, stage four leads us to aging society where birth rate is lower than death rate, a typical case for most of developed countries.

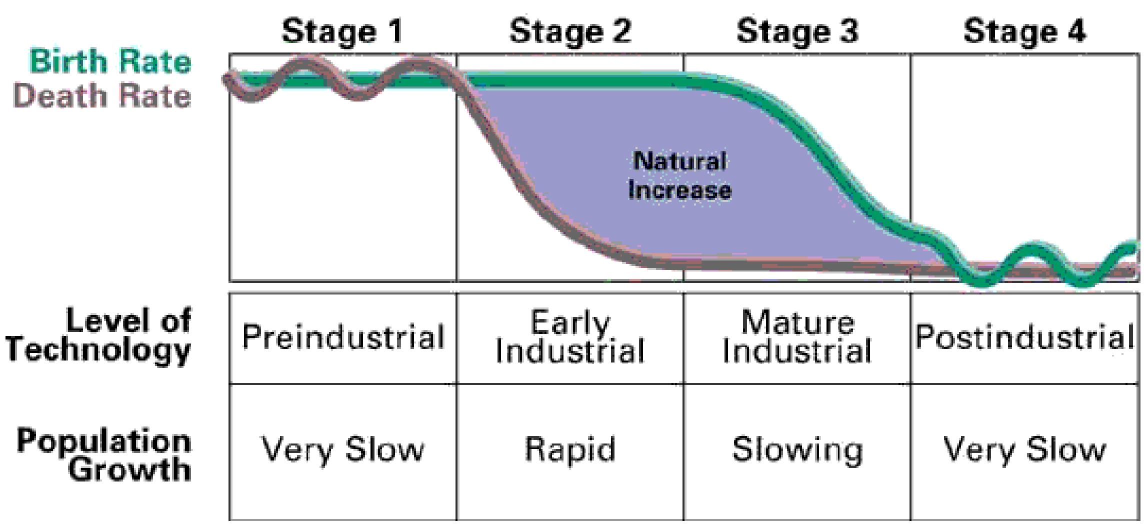


Figure 2

Transition described by this theory can be well applied to Japan. Now due to changes in social structure, more women join the workforce. Furthermore, the more mobile the society, the harder it is to settle and spend stable life as before. These situations pose bad incentive for women to get married and give birth. Technical improvements like medical abortion also contribute to lower birth rate. Even though it may be particular in Japan, it seems that people are not as concern about marriages and having their own children. Amazingly people are more interested in pets than in children and they spend huge amount of money on pets. Moreover,, about 30% of Japanese men will be unmarried. Such changes of social structure and individual preference in lives have undesirable influence on population issue in Japan.

2.1 Relationship between Economy and Population

What relation exists between economy and population? Here, I introduce some economic models that express the relation between economy and population. First, Cobb-Douglas function shows that the total input of labor affects directly the amount of productions:

$$Y = L^{\alpha} K^{1-\alpha}$$

This model is very useful and can be well applied in many situations. Next, the simple growth model illustrates the importance of the quality of labor force:

$$\frac{Y}{N} = \frac{Y}{L}\frac{L}{N}$$

Pop xc(x)

We can easily accept the assumption that the efficiency of labor differs in accordance to age of labor. Not only the quantity but also quality of labors affects the amount of production. At stage two and three in the Demographic Transition Theory, labor over total population, which is called support ratio increases and that leads to high growth rate of GDP per capita. Increase in support ratio produces first demographic dividend. Moreover, as the population structure changes, the longer life expectancy leads to the generation of second demographic dividend. People save more to prepare for their lives after retirement, which becomes longer than before, and through such process the accumulation of wealth can be attained temporarily. If the government succeeds in making good investment and appropriate policies, the country can enjoy significant benefits which continue for longer time than first demographic dividend. However, second demographic dividend can occur only in closed economy, so it is hard to apply this theory to modern countries. Thus, support ratio is decreasing in Japan and cannot expect demographic dividend any more. The economic environment in Japan is becoming more severe.

3. Japanese Pension System

Pension system has three main objects. First, it aims to smoothen consumptions over life cycle. As income does not align with consumption over the lifetime, public pension helps individuals prepare for retirement by smoothening disposable income at each period to attain utility maximization. The second object is to redistribute income for greater equality. The percentage of income that should be transferred to employees' pension is based on the amount of salaries. It takes similar role as progressive tax, which contributes the reduction of poverty. Third object is to prepare for longer life than expected. There is always a possibility that people do not have sufficient amount of asset and income in old age. Public pension assures that the beneficiaries can keep receiving pension benefit without time limitation. The role of public pension is growing as the proportion of elderly is rising in Japan. A sustainable and fair pension system is essential for the well-being of our society.

Let me talk about Japanese pension scheme. There are 3 tiers in the current Japanese pension scheme (Figure 3). First tier is national pension. Normally Japanese citizens are obligated to join tier 1 pension and contribute a flat rate of 15,000 yen per month. Second tier is employees' pension, which requires salaried workers to contribute about 16% of their salaries in total, split equally between the individual and company. It is clear that the given the current contribution amount benefit level cannot be sustained and therefore, the amount of contributions has been mandated to increase year by year. For first tier pension, the pension contribution will amount to 17,000 yen in near future and for second tier pension the percentage of transfer is increasing by 0.354% every year to 18.3%. Ironically, such desolate situation makes people concerned over pension sustainability and the amount of pension asset contributed by individual has been decreasing (Figure 4/ Figure 5). Finally, third tier is private pension, provided by private insurance companies. It is not obligated but those who wish to enjoy richer lives after retirement participate in private pension.

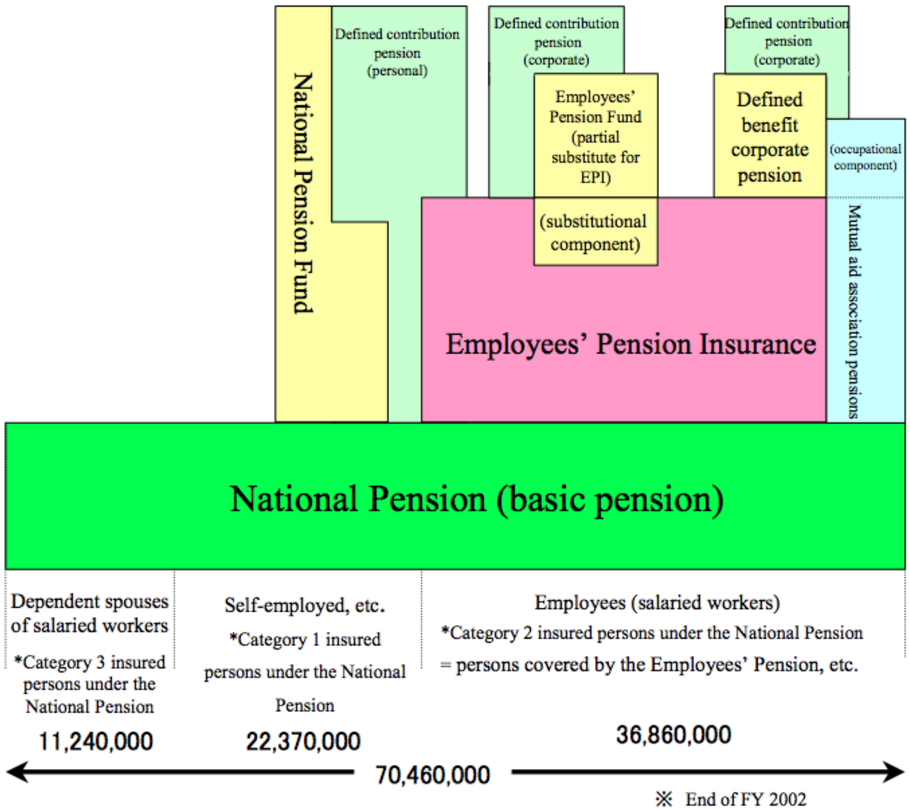


Figure 3

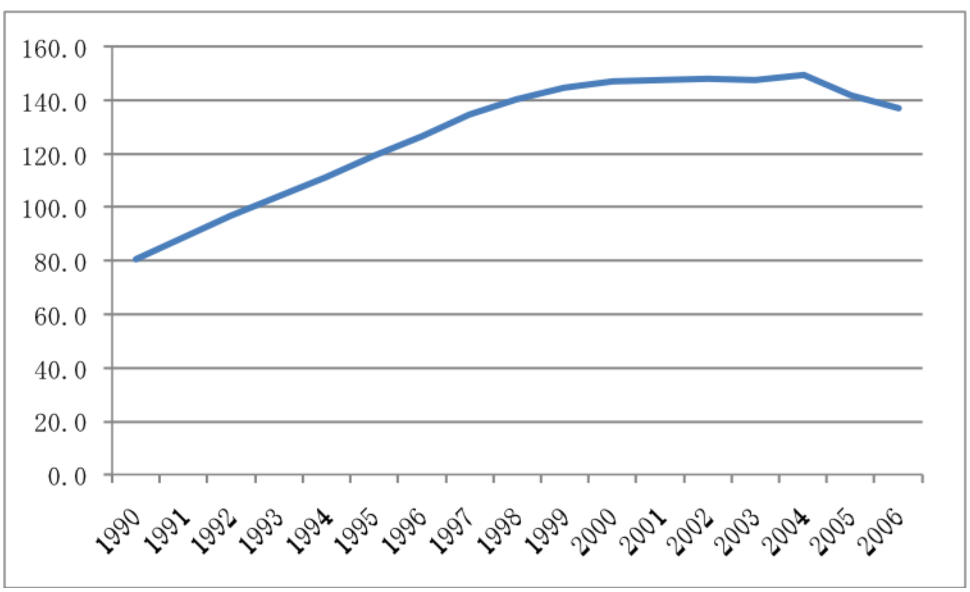


Figure 4

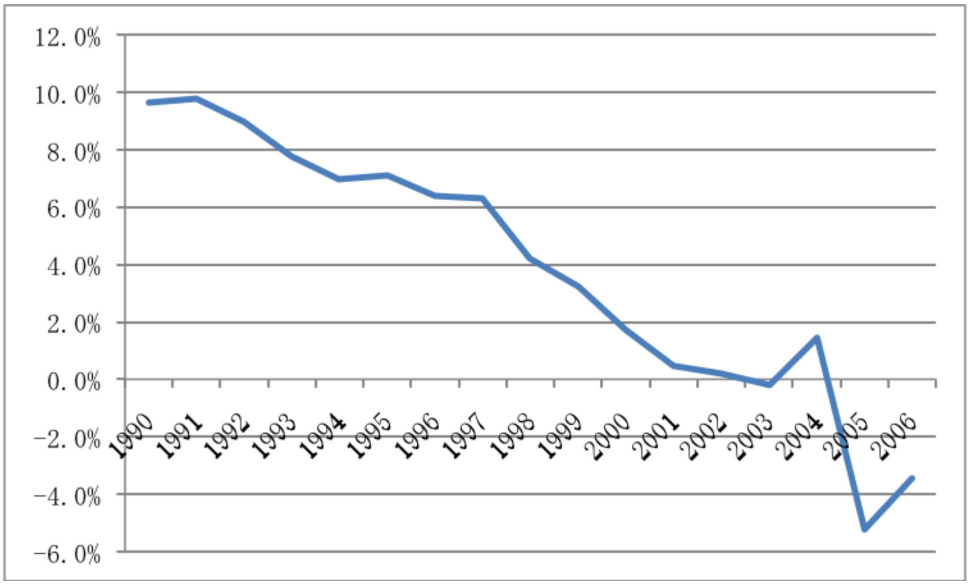


Figure 5

Japan's public pension system is Pay As You Go and Government Pension Investment Fund (GPIF) is in charge of pension asset. Specifically, GPIF utilizes other financial institutions to invest. Total amount of pension asset is 116 trillion. Despite huge amount of total asset, the rate of return is just 0.62%, which is about the same as the average market rate of return. The low return rate can be explained by the choice of asset in the investment portfolio (Figure 6). Almost 70% of total pension asset is invested to domestic bond, which only yields minimal return. Proportion of pension portfolio is fixed to certain extent and the distribution of investment cannot be altered easily.

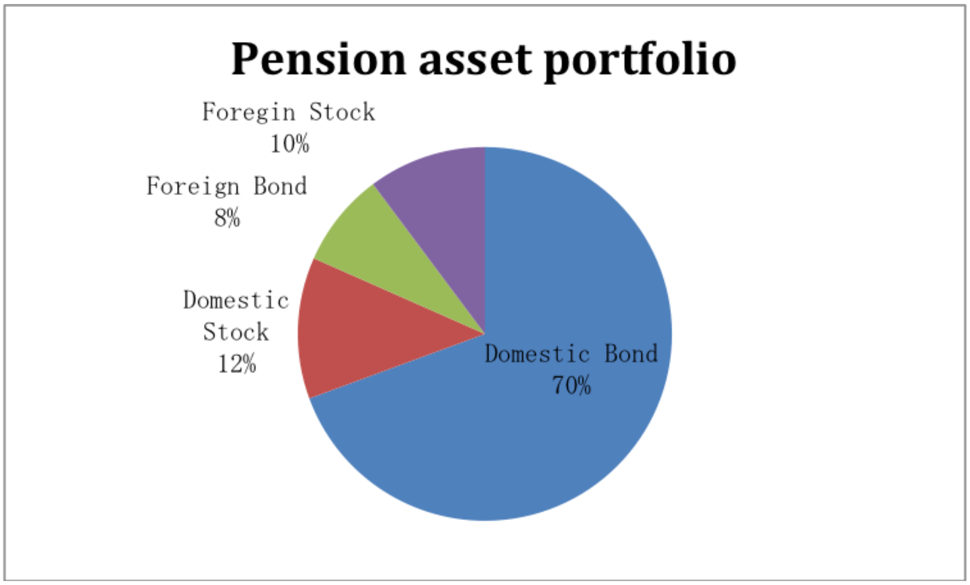


Figure 6

The pension assets invested in the manner described above generates income, along with the contribution from the working population and tax subsidy, are distributed to pension beneficiaries. Those who pay pension contribution for at least 25 years can meet pension eligibility. There is a lag between time of contribution and benefit, so we have to take the change of price level and wages into consideration of benefit level. There are mainly three slide systems. First slide is price slide that adjusts pension benefit amount for those who have already started accepting the pension by price level. Suppose that price level increases by 1%, the amount of pension benefit will also increase by 1%. As price level increases, it becomes harder for people to live, so this slide system was introduced. Second one is wage revaluation that adjusts pension benefit for those will accept pension benefit in the future by wage level. Suppose that real wage level increases by 2%, the amount of pension benefit also increases by 2%. This system takes change of life standard into consideration. Finally, the macroeconomic slide adjusts pension amount by considering the projection of population structure and life expectancy. Taking shortage of productive labor and longer life expectancy into account, the amount of pension benefit should be adjusted downward by 0.6% and 0.3% respectively, assuming that the labor force participation rate will diminish by 0.6% and life expectancy of pensioners will increase by 0.3%. This macroeconomic slide is applied to both price slide and wage revaluation. Using macroeconomic slide together, if price level increases by 1%, the total amount of pension benefit increases just by 0.1%. As well as price slide, if real wage level increases by 2%, the amount of pension benefit increases by 1.1%. It seems very useful at a glance, but this slide merely reduces pension benefit amount without leading to more pension asset. So we cannot say that this slide system is sufficient.

3.1 Problems of Japanese Pension System

There are many problems in the current public pension scheme. As Japan revised its pension scheme and regulations many times in the past, Japanese pension scheme is very complex. Because of such complexity, most of the citizens do not understand how pension scheme works. Furthermore, intergenerational inequality exists. The pay-as-you-go nature of the system and an aging economy distributes the financial burden unequally among generations. Moreover, current pension creates bad incentive for educated and productive people to retire earlier. As educated and relatively rich people are less worried about their lives after retirement, they want to retire earlier compare to poorer people. In the end, it causes negative effect to accumulation of pension asset. As such, the sustainability of pension scheme poses the largest problem. As discussed above, Japan is in severe economic condition and is facing lots of difficulties, and at such the sustainability of Japanese pension scheme is doubtful.

3.2 Possible solutions for Japanese Pension System

Here, we propose some possible solutions to the problems that Japanese pension system has. First of all, pension age should be lifted. This is most simple but effective way to maintain current pension scheme. Reallocation of pension asset can be another possible solution. High percentage of current pension asset is invested to Japanese governmental bond, resulting in a low return rate. Furthermore, in the longer term, population policy is worth trying. While all of these can be effective policy measures, in this paper, we are going to focus on new type of pension scheme, NDC. Sweden and some other European countries have transitioned to NDC and significantly improved their financial situation. We will examine whether NDC can be a potential solution to Japan's pension problem.

4. Assessment of Japan's Pension System

4.1 Projection Model Overview

Using a basic dynamic model of Japan's pension system, this section examines its stability in terms of solvency and pension replacement rates. The model incorporates the pension system's key features as described in the prior sections of this paper. The purpose is to elicit insights into pertinent trends that the pension system may encounter going forward, as well as to identify premises that would meaningfully inform Japanese pension reform. Due to data limitations and challenges in predicting unexpected shocks, it is not asserted that the model would be able to identify with precision specific points in time, whereby the pension fund may become insolvent. Instead, the goal of the exercise is to surface key trends and identify points in time whereby the most significant challenges may occur. This section would conclude with pertinent considerations that would have to be taken in account in order to meaningfully reform Japan's pension system.

The key assumptions of the model are as follows:

- 2% Real GDP Growth
- 2.1% Real Wage Growth
- 1% Inflation

$$\ln\left(\frac{Wage_{t+1}}{Wage_{t}}\right) = g_{t,t+1} - \ln\left(\frac{LFTP_{t+1}}{LFTP_{t}}\right)$$

The key assumptions conform to the above equation which is adapted from Bloom et al. (2011)'s Demographic Dividend Model. "Wage" refers to real wages, "g" indicates the real GDP growth rate and "LFTP" stands for labor force divided by total population. According to Bloom et al. (2011), the log of $Waget_{+1}$ divided by $Wage_t$ can be used to compute real wage growth. Similarly, the log of $LFTP_{t+1}$ divided by $LFTP_t$ enables the demographic dividend to be obtained. The equation implies that real wage growth is equals to real growth rate minus the demographic dividend. In Japan's case, due to its projected shrinking population, the demographic dividend is negative and on average –0.1% from 2010 to 2055. Using the Japanese Cabinet Office (2009)'s

New Growth Strategy's target of real growth rate at 2%, it is assumed that real wage growth is 2.1%. Changes in this assumption and its associated impact would be tested in the sensitivity analysis portion of this section.

4.2 Projection of Japan's Pension Assets

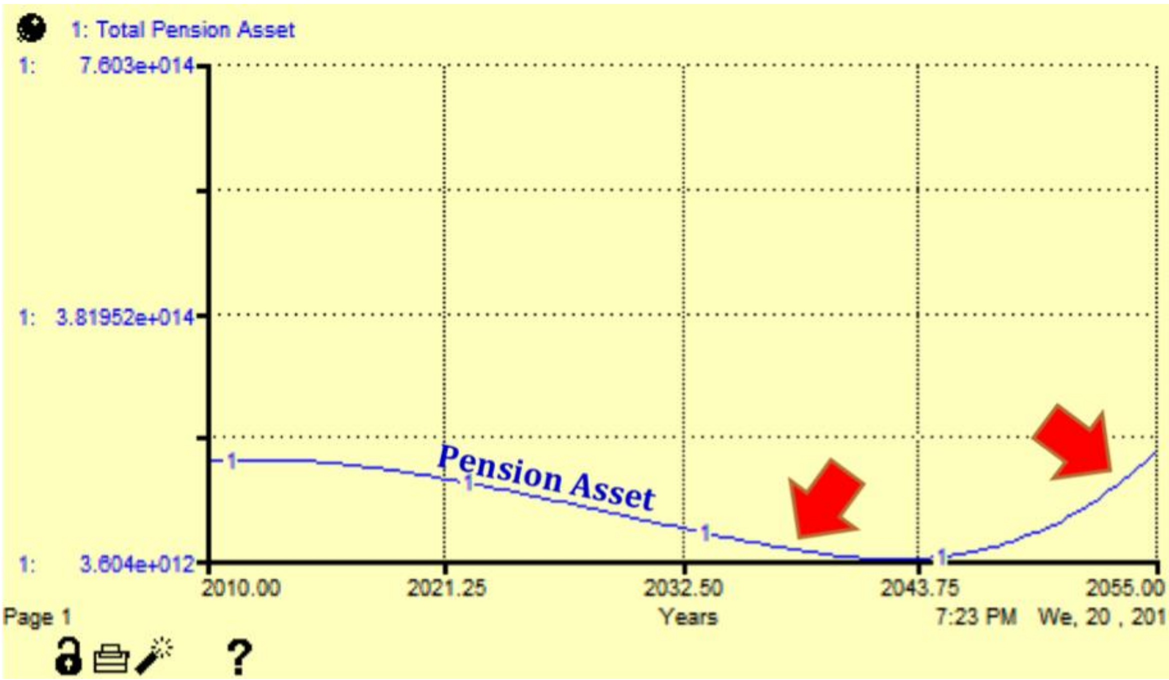


Figure I: Projection of Japan's Pension Assets

The projected trajectory of Japan's pension assets from 2010 to 2055 is reported in Figure I. Pension assets are expected to decline from 2014 onwards and arrive at its lowest point in 2043. It subsequently rebounds and an upward trend is observed. The decline in pension assets is caused by a steep rise in the number of retirees receiving pension benefits which are withdrawn from the pension fund, thereby reducing its assets.

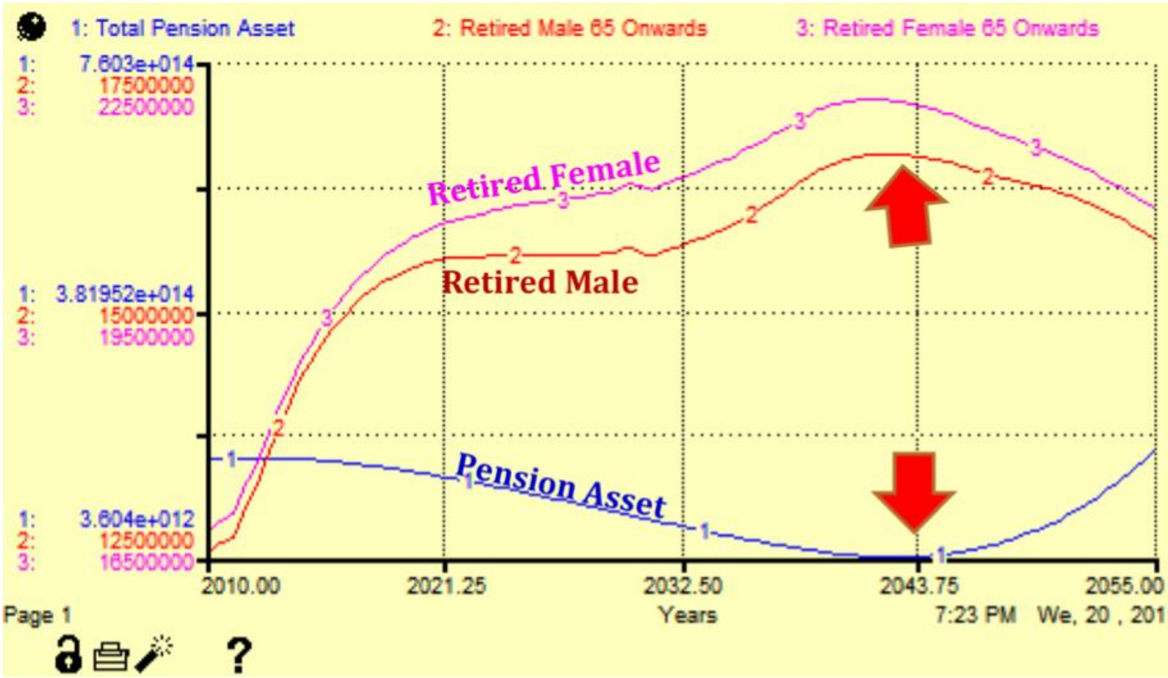


Figure II: Pension Assets versus Retirees

As can be seen in Figure II, the trajectory of the number of Japanese male and female retirees is negatively correlated with that of pension assets. When the number of male retirees reaches its highest point in 2043, the pension assets are correspondingly at its lowest level. It is interesting to note that the number of female retirees peaks in 2041, two years in advance. Whilst the total number of female retirees is larger than that of male retirees, the former tend to receive relatively lower pension benefits on average. This implies that in the existing pension system, the total number of male retirees has a greater impact on Japan's pension assets. When the total number of both male and female retirees declines after 2043, the country's pension assets rise again in opposite tandem.

From the lenses of demographical changes, the projection indicates that Japan's pension system would encounter its greatest strain in 2043. Additionally, if pension benefits for female retirees are raised to address inter-gender inequality, without complementary measures to increase the inflow of pension assets, then the point in time whereby the country's pension system would face the greatest stress would be brought forward.

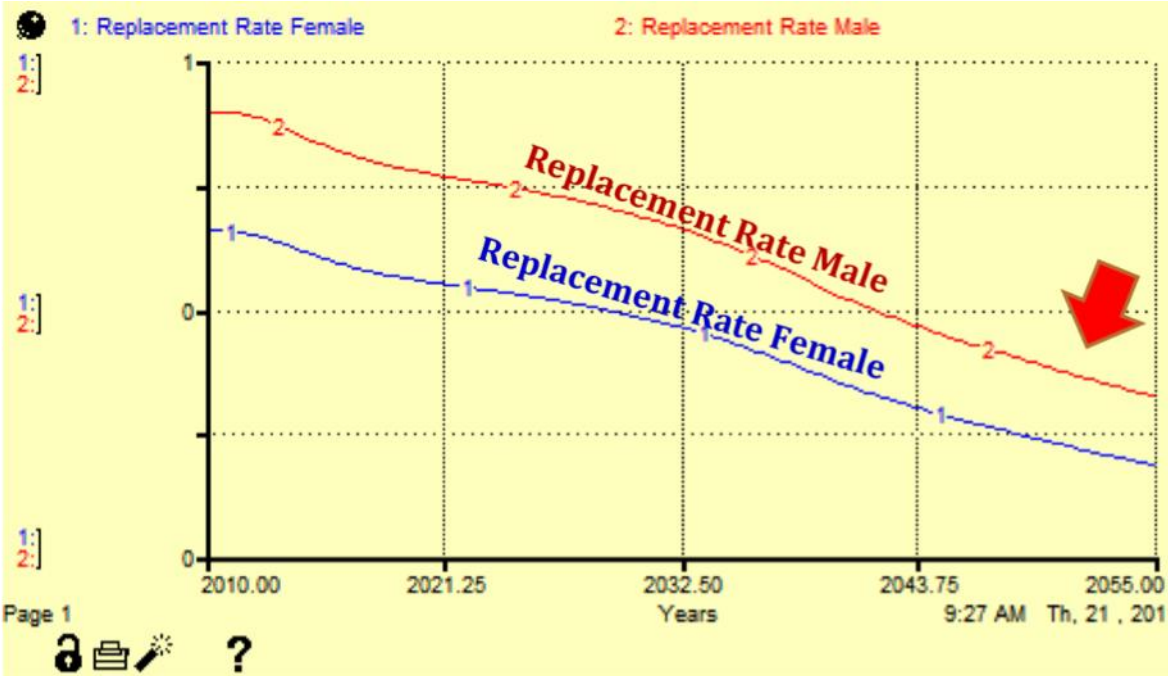


Figure III: Projection of Japan's Pension Replacement Rates

The pension replacement rate measures the effectiveness in which pension benefits that are paid out to retirees replace the main source of income prior to retirement. Figure III presents the projected trends of the replacement rate for Japanese retirees. Pension replacement rates for both male and female retirees are observed to decline. Between 2010 and 2055, replacement rate for male retirees falls from 52% to 30%, while the same measurement for female retirees dips from 43% to 25%. As the projection model factors in inflation, real wage growth and demographical changes in determining pension benefits payouts, with inflation and real wage growth assumed to be relatively constant, the decline in replacement rates are caused by Japan's decreasing labor force and longer life expectancy.

Pertaining to inter-generation equality, this implies that retirees in 2055 would receive substantially less pension benefits than their pre-retirement income as compared to retirees in 2010. As the replacement rate for female retirees remains lower than that of male retirees, it is implied that inter-gender inequality would likely persist. To address these inequalities, it may be pertinent for policy makers to raise future pension replacement rates.

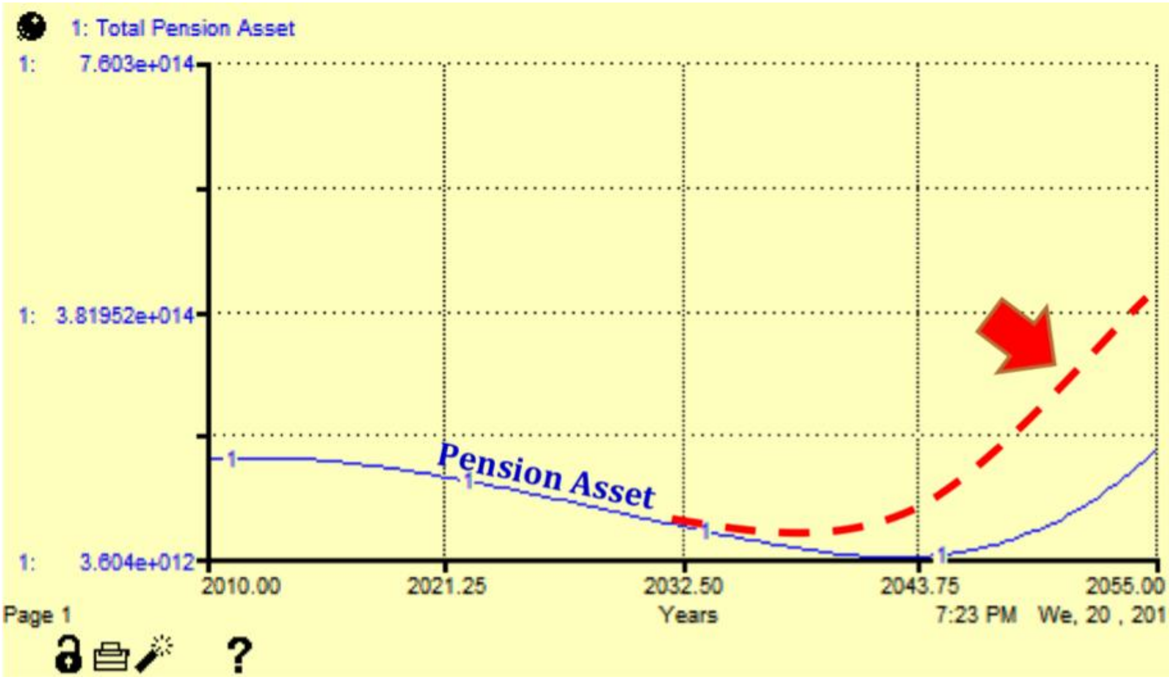


Figure IV: Projection of Japan's Pension Assets without Real Wage Adjustments for Benefits

The key determinant of pension replacement rates is the amount of pension assets that are paid out in the form of benefits. Figure IV presents the projected trajectory of Japan's pension assets if pension payouts are not adjusted for real wage growth. As observed, the total amount of pension assets would increase and its trajectory would shift upwards sharply. This is because as the real wages of the labor force rise, the total amount of pension contribution also increases, leading to a larger inflow of pension assets. If pension payouts do not adjust for real wage increases, then the pension assets outflow would not increase at the same rate, prompting an accumulation of pension assets. However, with lesser pension benefits being paid out, replacement rates would fall.

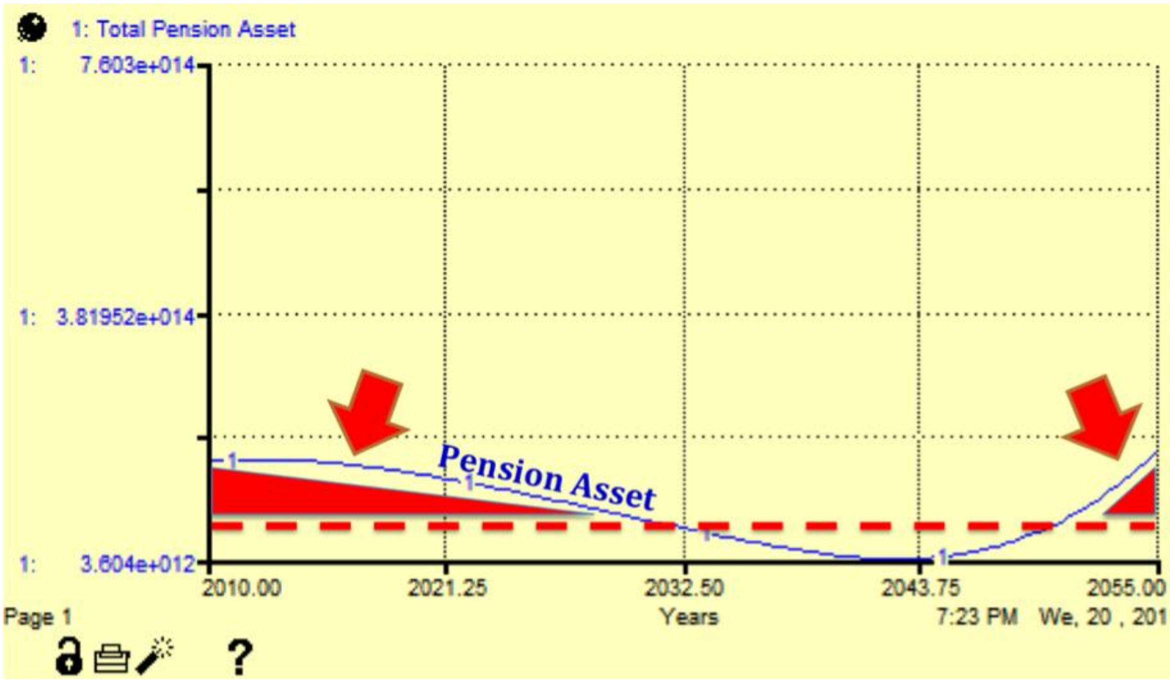


Figure V: Japan's Pension Asset versus Hypothetical Optimal Level of Pension Assets

The greater accumulation of pension assets is positive in the sense that Japan's pension system is less likely to become insolvent. However, the building up of pension assets comes at an opportunity cost. To raise replacement rates, more pension assets would have to be paid out as pension benefits. The dotted line in Figure V illustrates a hypothetical optimal level of pension assets to be retained so as to ensure the solvency of the country's pension fund. If additional pension assets as indicated by the shaded regions are paid out as pension benefits, then pension replacement rates could be raised. If the purpose of Japan's pension system is to provide the highest possible pension replacement rates for its retirees whilst ensuring the solvency of the system, then these should be paid out as pension benefits.

However, the question is begged on how can an adequate level of pension assets be determined so as to maintain solvency? Adapting Ostry et al. (2007)'s definition on solvency, the adequate level of Japan's pension asset would be that the present value of pension liabilities do not exceed the present value of pension assets. In other words, the present value of pension assets should be able to cover all future payouts. Thus, to ensure solvency, the optimal level of pension assets to be accumulated in the pension fund should be equal to the fund's future liabilities. As long as the pension fund remains solvent, its stability is likely be very much enhanced.

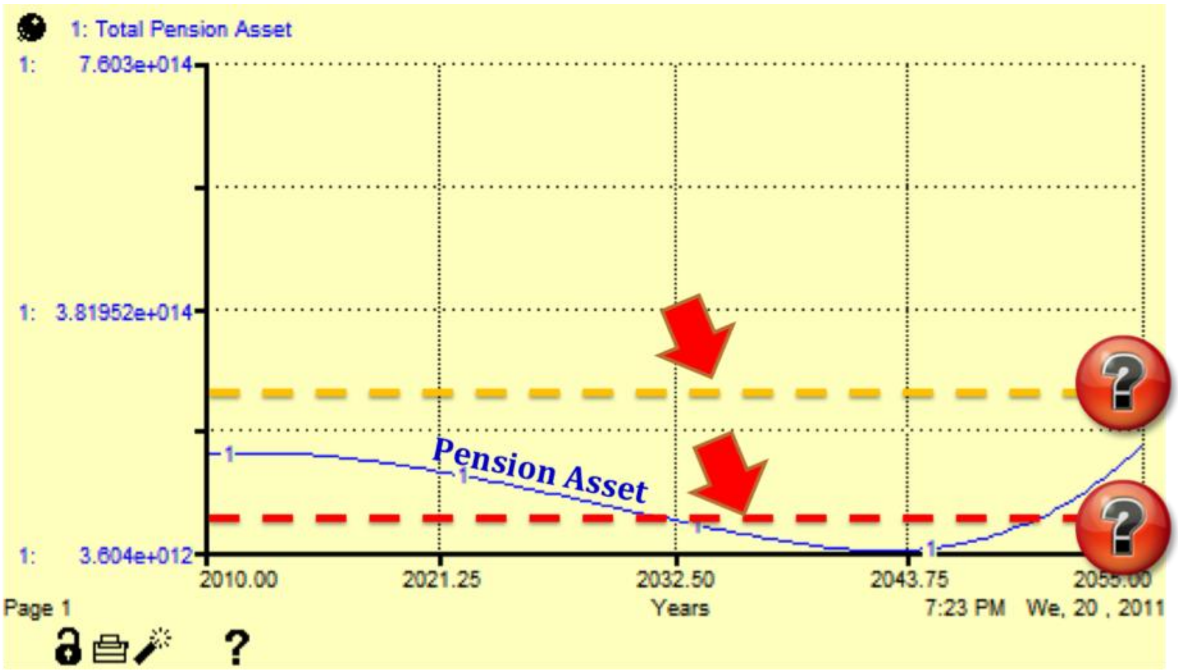


Figure VI: Japan’s Pension Asset versus Subjective Optimal Pension Asset Level

This raises another problem of being able to reliably compute Japan’s pension liabilities. If pension payouts for all future retirees are taken into consideration, then pension liabilities would be infinite. By predetermining a timeframe (e.g. 10 years), a more useful figure for pension liabilities could be elicited. However, the timeframe would have to be arbitrarily determined. Figure VI illustrates the potential problem that could arise from a subjectively selected timeframe to compute pension liabilities. If the chosen timeframe is too long, then the resultant optimal pension assets level may be too high. Otherwise, if the optimal pension assets level is set too low, then it may not be useful in maintaining the pension fund’s solvency.

If pension liabilities could be reliably determined, then that would be the optimal level of pension assets to maintain in the pension fund. When pension assets exceed liability, then pension payouts could be increased to raise replacement rates. Inversely, if pension liabilities exceed assets, then benefits could be reduced until the pension fund returns to solvency. Such a mechanism could enhance both the stability and replacement rates of Japan’s pension system.

In summary, the assessment of Japan’s pension system indicates that Japan’s pension system would likely encounter its greatest strain in 2043. Although the slide system appears to be effective in enhancing the stability of the pension system and replacement rates, the latter indicator is likely to substantially decline between 2010 and 2055. This implies that inter-generational equality in terms of replacement rate would likely be negatively impacted. Additionally inter-gender inequality would likely to persist. However, it should be cautioned that without first addressing the demographical strains on the pension system, policy measures to address inter-gender inequality might bring forward potential instability in the pension system. To mitigate these inequalities, policy makers would have to improve the pension system by devising a mechanism to reliably determine pension liabilities and dispense pension assets that are in excess liabilities as payouts so that pension replacement rates could be raised.

4.3 Sensitivity Analysis using Dynamic Model of Japan's Pension System

A key assumption of the projection model is that Japan's real wage growth remains constant at 2.1%. This is likely to be optimistic as the country has been facing severe economic challenges which are complicated by the Great East Japan Earthquake in 2011. In using sensitivity analyses, this section explores the impact of changes to real wage growth assumptions. Subsequently, the effect of policy measures that may enhance the country's pension system is also investigated.

Figure VII: Sensitivity Analysis on Real Wage Growth

The simulated impact of varying real wage growth between 0.1% and 5.1% on Japan's pension assets is reported in Figure VII. It is discerned that at lower real wage growth levels (0.1% and 1.1%), the trajectory of pension assets actually shifts upwards. This is counterintuitive as lower real wage growth levels imply that pension contribution decreases and the inflow of pension assets should correspondingly become lower, leading to reduced pension assets. However, as pension payouts are adjusted downwards in response to lower real wage growth and there being relatively more individuals in the labor force contributing to the pension fund as compared to retirees who draw pension benefits, the total amount of assets within the pension system actually increases. This is good news for Japan as slower wage growth due to the country's economic challenges may contribute to a more stable pension system.

However, if real wage growth were to rise to higher levels (3.1% to 5.1%), then the higher pension payouts may result in the pension system's insolvency as pension assets get depleted. Thus, higher real wage growth rates may ironically cause instability in the pension system. The sensitivity analysis on real wage growth reinforces the observation that Japan's pension system may need an additional mechanism that takes into consideration the discrepancy between pension assets and liabilities in order to achieve greater stability.

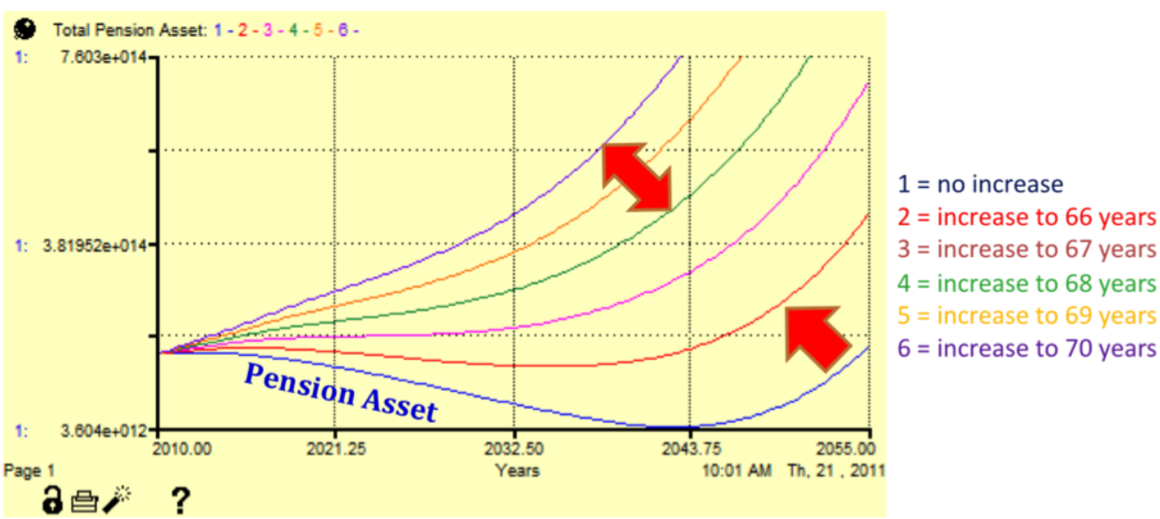


Figure VIII: Sensitivity Analysis on Raising Retirement Age

In determining the impact of the raising of Japan's retirement age between 66 to 70 years old, it could be seen that it dramatically increases the accumulation of pension assets. The results of the sensitivity analysis are reported in Figure VIII. The increase in pension assets is partly due to an overall reduction in the number of retirees in the system receiving pension benefits. It is also noted that the effect is subjected to marginal diminishing returns. The diminishing impact of raising retirement age may be attributed to three factors: 1) Pension contribution is mandatory for workers up to only 60 years old, so the inflow of pension assets does not substantially increase; 2) In any case, the average salary of older workers decreases with age, thus the contribution amount dips; and 3) Mortality rate increases with age, thus there are lesser older workers contributing to the pension fund.

It is also noteworthy that although pension assets increases, implying that the stability of the pension system is enhanced, as the accumulated assets do not translate into additional pension payouts. Thus, replacement rates are not likely to increase. Furthermore, from the experience of countries like Singapore, the raising of retirement age may lead to older workers who otherwise would be retired, being unable to secure employment and at the same time also unable to meet the criterion to receive pension benefits (The Online Citizen, 2007). Pertaining to Japan, this may unintentionally create additional strains to social security in other areas like unemployment benefits. Thus, the raising of retirement age may substantially improve the stability of the pension system, but it may not necessarily enhance the social welfare of retirees, in particularly in terms of pension replacement rates. Instead, it may be pareto improving to adapt the pension system to encourage older workers to continue contributing to the pension fund beyond the age of 60 years old and retire later. However, the changes should also be flexible enough to allow individual workers to choose for themselves the optimal retirement age would be welfare maximizing for their own unique circumstances.

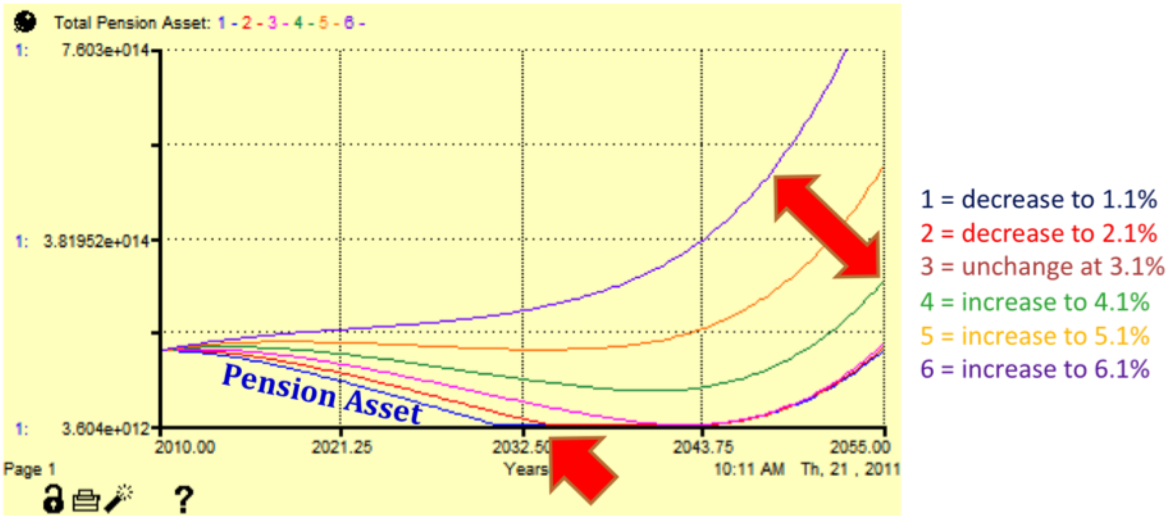


Figure VIV: Sensitivity Analysis on Pension Assets Investment Return Rates

Figure VIV presents the sensitivity analysis for pension assets nominal investment return rates between 1.1% and 6.1%. Unsurprisingly, it was found that raising the return rates for pension assets shifts the trajectory of pension assets upwards. Additionally, it can be seen that there are increasing returns at higher return rates. This is likely due to the compounding effect of higher return rates. However, it is also noted that at lower return rates (1.1% to 2.1%), pension assets may diminish to the extent that the pension system may become insolvent. Therefore, it seems imperative that the investment return rates for Japan's pension assets to be raised so as to ensure that the system remains stable.

Is it realistic for Japan to raise the rate of returns for its pension fund? The projection model assumes that pension assets nominal return rates remain constant at 3.1% (pegged to model assumptions on nominal wage growth rate of 3.1%). Whilst this is higher than the current investment return rates of Japan's pension fund, this is not unrealistic. The Norwegian pension fund achieved a net real annualized return of 2.58% since 1998 (Financial Times, 2010). Singapore's Government Investment Corporation obtained a real rate of return of 5.7% in 2009 (GIC, 2010). Referencing the investment models of other government pension investment funds, there appears to be significant scope for Japan to enhance its pension fund return rates. The compounding effect of higher return rates would lead to a greater accumulation of pension assets which in turn can be used to raise pension replacement rates.

4.4 A Case for Reform of Japan's Pension System

Although Japan's pension system would likely only encounter its greatest strain in 2043, implying that there is substantial time for Japan to pursue pension reforms, it should be noted that Japan's evolving economic situation and the possibility of unexpected shocks could rapidly deteriorate the stability of the country's pension system. This could be seen from the sensitiveness of Japan's pension system to different assumptions in real wage growth and pension assets return rates. Thus, it is recommended that pension reforms should be undertaken as soon as conditions permit.

It is also noted that the objective of pension reform should serve the dual purpose of enhancing stability through ensuring solvency, and also address inter-generational (if possible also inter-gender) inequalities by increasing pension replacement rate for later retirees. To accomplish these ends, putting in place policy measures to encourage older workers to retire later and continue contributing to the pension system beyond the age of 60 years old, whilst allowing flexibility for workers to decide for themselves their optimal retirement age based on their unique circumstances, could increase the total amount of pension assets in the system. Additionally, there appears to be significant scope for Japan to enhance its pension fund investment return rates through adapting the investment models of other government pension funds. The resultant increases in pension assets would enhance the pension system's resilience and could be redistributed to raise pension replacement rates and thereby addressing inequalities within the system.

However, the missing jigsaw in the puzzle is a reliable and fair mechanism to determine Japan's pension liabilities and thereby allow assets in excess of liabilities to be redistributed. To this end, the Notional Defined Contribution pension scheme could be adapted to the Japanese context. The preceding section evaluates whether the enhancement can indeed help to build a more resilient pension system and improve replacement rates.

5. The Notional Defined Contribution Scheme

The idea of Notional, or Non-Financial, Defined Contribution (NDC) pension schemes can be traced back to Buchanan (1968). NDC is designed to address issues on labor incentive and fiscal sustainability in the PAYGO system. In the broadest sense, NDC, a non-prefunded scheme, tries to mimic the structure of a funded Financial Defined Contribution plan, of which individuals' contribution throughout the career is recorded in their notional accounts and accumulate at an interest rate linked to a specific system return. Unlike an actual DC plan, the account value is only a "virtual balance" with no backing of financial assets. For the individual, this can be expressed in the following:

$$NPW_{t+1} = NPW_t(1 + r_t^i) + T_t$$

where *NPW* is the notional pension wealth of the individual, T is the payroll tax and *r* is the specific rate of return earned annually by the accounts and paid by the annuity. This implicit rate of return is generally linked to the growth rate of wages and labor force, which given the PAYGO setting should help make NDC systems more fiscally sustainable without any political interventions. Furthermore, the individual entitlement after retirement depends directly on the lifetime contribution so incentive for early retirement is significantly lessened. When the individual retires, his/her notional account value is converted to annuity:

$$X_t^t = \frac{NPW_{t-1}}{G[LE, r_t]}$$

where X^t_t is the annuity in year *t*, and G is the annuity factor. G is a function of two factors: life expectancy LE and internal rate of return, r, computed over the same period.

In principle, retirees can return to the labor force without facing pension penalty. Such design helps bringing in more transparency into the system and forces beneficiaries to consider their retirement benefits in terms of notional account value rather than entitlements from the government. The advantage of a more transparent system is that it can potentially reinstall trust in the program, particularly among young workers. A side effect is that workers are likely to perceive the accrual value of their notional account as private saving, which is expected to displace private saving.

By incorporating a symmetric automatic stabilizer of benefits in the system, NDC responses better to demographic and socioeconomic shocks compared to the PAYGO system. Specifically, when the asset liability ratio falls below 1, the system applies an adjustment factor to the original accrual rate, reducing the rate of return earned on all accounts and annuity until asset level is restored. Similarly, when asset-liability ratio is above 1, benefits can be adjusted upward. It should be noted that if neither contribution rate nor annuity after retirement is allowed to fluctuate, this stabilizing mechanism would not be effective. Stating it formally, the brake mechanism can be represented as follows:

$$b = \frac{F + C}{NPW + P}$$

where F is the level of financial assets and C is a contribution of a given year in the numerator. The denominator of is the total pension liability of the system, equals to notional pension wealth of current workers (NPW) plus the benefits due to current retirees (P) at a given year. The balance measure can be computed entirely base on observed values with no involvement of projected value. This has the advantage of reducing the risk of political manipulation but the disadvantage of not using all potential information on hand (Auerbach, 2006). When the brake triggers, the adjusted internal rate of return can be expressed as:

$$r_t^a = (1 + r_t)(1 + A(b_t - 1)) - 1$$

where b_t is the asset-liability ratio, and A is some scaling factor between 0 and 1 to spread the fiscal burden among generations.

Since NDC benefits is calculated based on the lifetime contributions from individual earnings, it is very possible that not everyone will have sufficient earnings before retirement to produce sufficient benefits in old age. As oppose to many defined benefits formulas, an NDC scheme does not redistribute system’s revenue across cohort. Therefore, an NDC scheme should be supplemented with low-income support or a catch-all safety net in the form of, for example, minimum benefit guarantee. This would require a transfer from general tax revenue or other exogenous income source.

A strict NDC model is not funded and is entirely financed by the contributions of the labor force in a given year. Inevitably, the system faces year-to-year surplus and deficit, which deems a reserve fund necessary. In addition, it can be expected that in an aging economy like Japan where labor force is shrinking, a strict NDC system will generate low or even negative returns. To cope with that, the reserve fund, if managed properly, can lift the system return and can serve to provide a smooth transition from PAYGO to NDC. As discussed in Lu and Mitchell (2007), another drawback of the NDC plan, which is particularly pronounced in Japan is that fertility may be further suppressed. The current PAYGO scheme is in favor for the non-working spouse, in that they enjoy shared retirement benefits even though the non-working spouses are not required to contribute to the system. Switching to NDC is likely to take away the incentive to stay home and may therefore discourage child rearing.

To this date, NDC has been implemented in several European countries including Sweden and Italy. Italy, with its similar socioeconomic conditions, serves as an especially relevant comparison to Japan. According to Franco (2002), pension spending in Italy is proportionally higher than any other Western industrial country (15.5% GDP in 2002) and the fertility is the lowest (1.2 children per woman of childbearing age). The ratio of the population aged 65 and over to the 15 to 64 age group is expected to increase from 26.6% in 2000 to 37.2% in 2020.

Italy's pension reform to an NDC-based scheme in 1995 has significantly altered the fiscal landscape. At the core, features such as individual pension accounts and returns linking to macroeconomic conditions were implemented. However, Italy has opted out an automatic balancing mechanism such that benefits would not be adjusted in time to response to any shocks in demography or economy. Despite that, the result of the reform was striking. Franco reported that average time spent in retirement is reduced by 23%, and as a result, reduction in per capita benefit reached 34%. Replacement rate also fell markedly, dropping to around 63% from 81% for individuals retiring at the age of 65.

The pension system in Italy, however, remains vulnerable due to the absence of built-in stabilizer. The public is still aware of the long-term financial disequilibrium. Contributions from young workers remain low since many perceive that the return to their contribution is uncertain.

6. Adapting the NDC system to the Japanese Context

The basic outline of the NDC scheme has been presented above. We will now proceed with describing the various details and assumptions in adapting the NDC system to the Japanese context before presenting our quantitative assessment.

Contribution

According to the 2004 actuarial valuation on Employees' Pension Insurance and National Pension in Japan, contribution rate at present is13.58%, split equally between employees and employers. The 2004 revision lifts the annual contribute rate by 0.354% annually and by 2017, reaches to 18.3% (9.15% for employees and employers). We further assume that wage grows at a constant rate of 2.1% and inflation stands at 1% annually, consistent with most other projections.

As for the basic pension contribution, the current contribution amount is 15,000 yen flat to all insured individuals per month. It is expected the contribution amount will be increased to 17,000 yen in average soon and we take that as our Basic Pension contribution amount. Using the current BP to EP ratio, we assume that 32% of the population aged 15 to 64 will contribute to the Basic Pension. This 32% of working age population can be considered as the self-employed individuals who do not contribute to the EPI and are enrolled to BP only.

Tax subsidy is entirely left out because it is considered to be an exogenous policy measure in our model. We proceeded without tax subsidy as an income source to assess, first, whether the NDC system can achieve financial stability by itself, and second, how much subsidy is required to bring the replacement rate up to the desired level.

Benefits

Our simulation assumes that retirement age remains at the current level at 65 and everyone retires and starts receiving benefits after that. However, as discussed previously, NPW is likely to induce workers to stay in the workforce longer but we decided to forego modeling such behavioral response and instead, pursue a stricter assumption. Another issue that is perhaps of more pertinence is that a non-negligible portion of aged 65 or over remains working in Japan, which strikes a startling contrast with most western industrialized economies. While we acknowledge that this assumption is subject to further review, due to data limitation on wage information for aged 65 and over, we decided to operate under this assumption.

We further assume that while everyone above the age of 65 is qualify for Basic Pension, only 52% of aged 65 and over receive EPI pension, which is consistent to the current EPI beneficiaries and BP beneficiaries ratio. In our model, the amount of BP benefit is pegged to the inflation, serving as an effective minimum benefit guarantee.

Another important assumption that we made is that men, on average, have 18 years of remaining life while women have 25 years post retirement. This is taken from the average life expectancy projection in 2055 from the Institute of Population and Social Security Research (IPSS). While people are generally expected to live longer and longer, we do not expect that there is a significant jump in our 50-year projection period. Women currently accounts for 40% of labor force and thus, we assume that 40% of EPI contributions are from women. This again, is subject to further review, as the NDC plan should encourage more women to join the workforce but endogenous behavioral change is not considered in our model.

Capital Income

There are two rate of return in our model: one for the asset return and the other is the internal rate of return within the pension system. In the initial transition period, contributions from working cohorts are accumulated and invested. We assume that the asset return equals to the sum of wage growth and inflation, and thereby a 3.1% asset return is assumed throughout our simulation period. The internal rate of return is the implicit return credited to the individual's account and paid by annuity, which is computed as the sum of labor force growth and the wage growth. Since labor force is expected to shrink, the internal rate of return is therefore always less than the asset return in our simulation. As explained earlier, when the brake is triggered, the internal rate of return will be adjusted.

Initial Conditions

To facilitate a smooth transition from the current PAYGO system to the NDC plan and to avoid the need to calculate contribution retrospectively for the current workforce, we assume that workers joining the workforce in 2012 will be the first batch of the workforce to be transitioned to the NDC plan. Assuming that most of them are college graduates, they will retire from the workforce in 2055, at which their notional account value are converted into annuity. From the system's point of view, the period between 2012 and 2055 can be considered as the reserve built-up period where no benefits are paid out; 2056 to 2105 operates as a full-fledged NDC scheme.

7. Simulation Approach for NDC

Our simulation comprises of two models: the individual model and the aggregate model. The individual model tracks the individual's lifetime contributions and provides insight on how NDC benefit payout compared to the current PAYGO system. The aggregate model tracks cash inflows and outflows between 2056 and 2105 and allows us to assess the financial stability during this time period.

We adopt a bottom-up approach for the individual model and a top-bottom approach for the aggregate model. In the individual model, we stipulated the model for both male and female joining the workforce in 2012, taking into account their average wage given any work age and applied a constant wage growth throughout their career. We then computed the model replacement rate for both male and female based on the assumed remaining life and inflation. After that, we used the replacement rate as an input parameter for the aggregate model to calculate benefits across cohorts. NPW of retirees will be reduced as benefits start being paid out. As for the contributions in the aggregate model, it is computed base on the expected labor force, contribution rate, ratio between Basic Pension and Employee Pension as explained in the previous section.

8. Simulation Results for NDC

Our individual model shows that the gross replacement rate for male, using the average lifetime salary as the denominator, stands at 43% while female is a meager 33%. The replacement rate is higher for male at 46% but lower for female at 30% when the last salary prior to retirement is used. The discrepancy between genders can be explained by the longer life expectancy of women. Under the current PAYGO system, single male who works 40 years is expected to achieve a replacement rate of 43% pension benefit while single women at 53%. This translates to 167,000 yen and 129,000 yen (in 2004 value) per month. However, replacement rate is expected to fall to 36% for male and 45% for female, in numeric terms 170,000 yen and

131,000 yen (in 2004 value) respectively, for cohorts retiring after 2025 due to the pension reform in 2004.

Next we turn to the aggregate model. Again, we separated the model by genders. Figure 1a shows the asset liability distribution for male with no brake applied. Asset liability ratio (green line) quickly drops below 1 in around 2062. NPW outgrows financial asset and the asset liability ratio appears to stabilize and exhibits a slight downward trend after 2062. Figure 1b shows the cash inflow and outflow of the system. Basic Pension benefit payout declines gradually as the overall population is expected to shrink, which translates to a fall in the catch-all basic pension benefit. As shown in the same figure, Basic Pension contribution is rather small compared to its payout since contribution excludes salaried workers and their spouses. EP payout consistently exceeds EP contribution in the projection period but capital income has exhibited an upward trend, which helps to stabilize the asset liability ratio.

Figure 2a shows the asset liability distribution for female with no brake applied. In startling contrast with that of male, after a slight drop in the beginning, the asset liability ratio jumps up thereafter. Strikingly, the contribution level exceeds that of benefit payout in the case of female largely because the model does not take survivor benefits into account and women workforce participation rate is expected to increase relative to men. The lower replacement rate of female workers thus allows financial asset to accumulates in a much faster speed than the growth of NPW, as shown in the exponential growth of capital income in figure 2b.

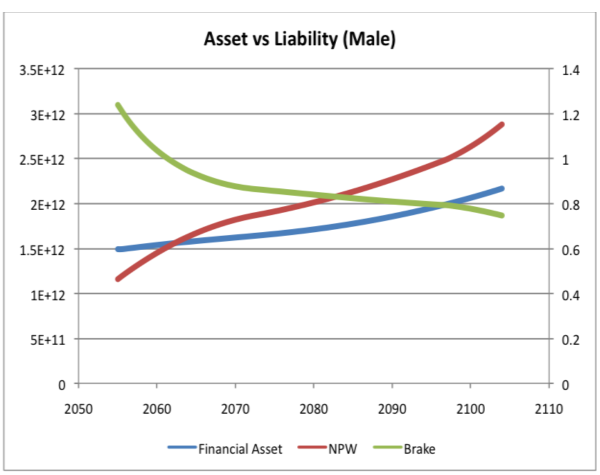


Figure 1a. Asset vs Liability, Male, no brake

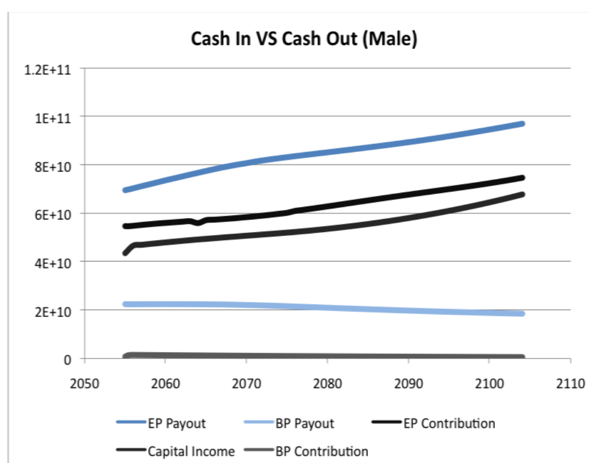


Figure 1b. Cash in vs Cash Out, Male, no brake

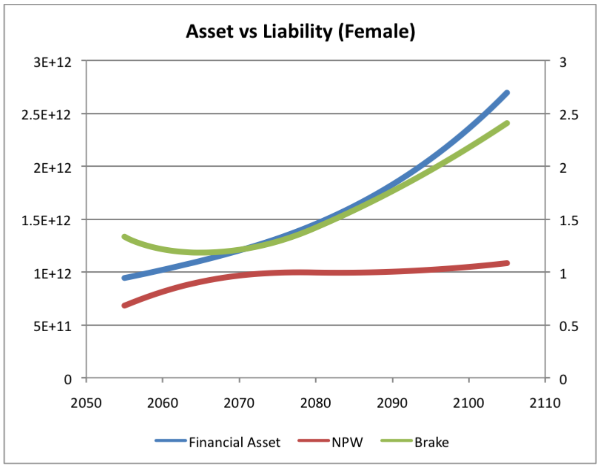


Figure 2a. Asset vs Liability, Female, no brake

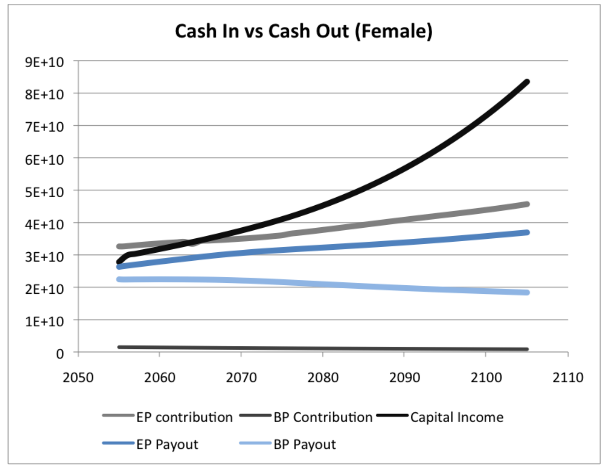


Figure 2b. Cash in vs Cash Out, Female, no brake

In our next scenario, we examined the effectiveness of the brake mechanism in the NDC model. We have shown that asset liability ratio for male quickly falls below 1 around 2062. We thus applied the brake in 2062 to curb the growth rate of NPW and annuity. Replacement rate for male falls to 42% from 46% (last salary prior to retirement) as a result. Using this new replacement rate, we found that system-wide financial stability restored slowly and it takes approximately 29 years to 2091 for the asset-liability ratio to approach 1 again. Figure 3b reveals that growth of capital income exceeds that of EP contribution, and as a result, allows the asset to slightly outgrows liability in the years following 2062. In this scenario, BP benefits are held unchanged since any forms of minimum benefit guarantee should not subject to change even in the times of financial health deterioration.

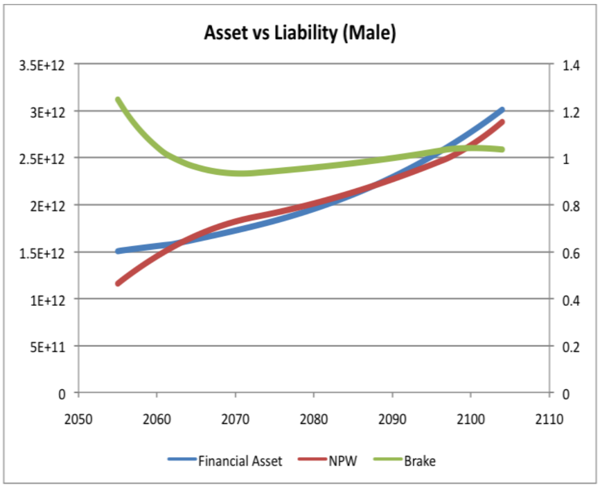


Figure 3a. Asset vs Liability, Male, brake

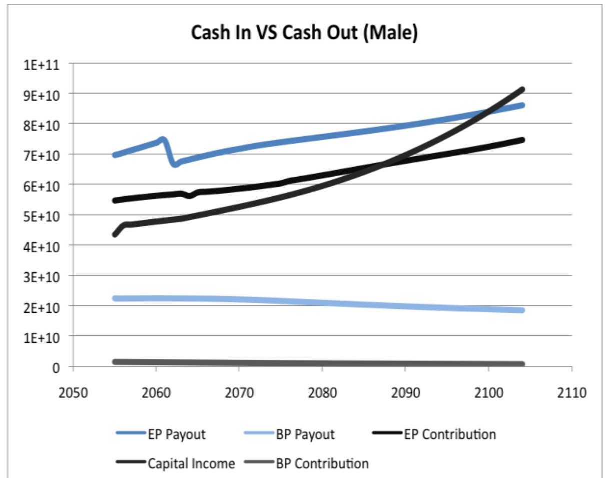


Figure 3b. Cash in vs Cash Out, Male, brake

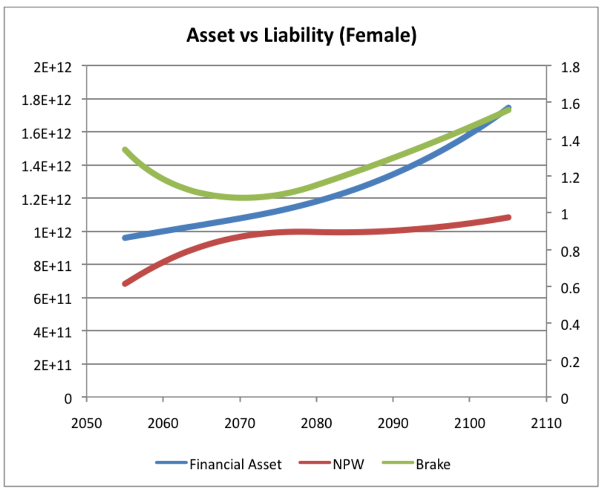


Figure 4a. Asset vs Liability, Female, brake

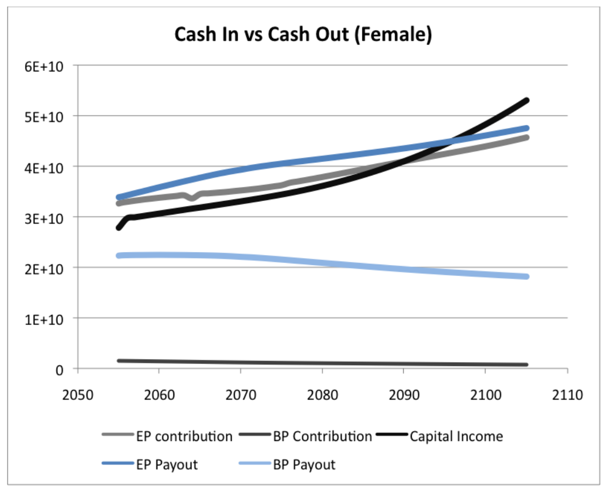


Figure 4b. Cash in vs Cash Out, Female, brake

With the excessive reserve built up in the female's system, we also adjusted the internal rate of return and replacement rate improved from 30% to 37% (last salary prior to retirement) as of 2055. Figure 4a reflects this improvement. Despite an already significant improvement (more than 20% increase) in replacement rate, the asset-liability ratio continues to trend upward and there appears room for further increase in benefit payout. Since the gap between EP contribution and EP benefits is narrower compared to that of male, financial asset accumulates at a faster pace than NPW and the increase capital income follows.

We next lowered the expected asset return from 3.1% to 2.1% and examined how the system responds. Figure 4a shows that system health deteriorates hastily as NPW and financial asset diverges away. Capital income declines and financial asset depletes overtime. In the long run, the benefit payout exceeds contribution, consistent with the previous scenarios.

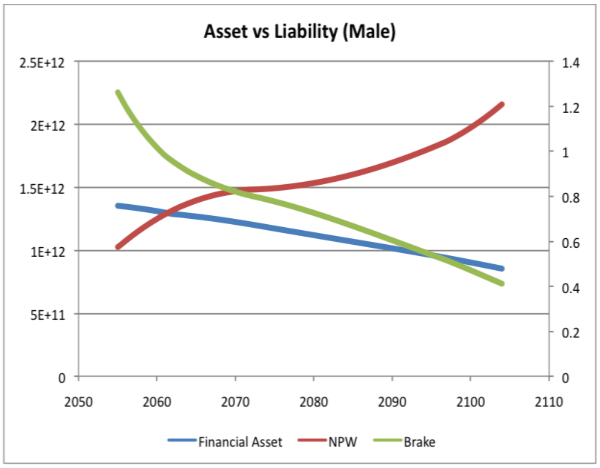


Figure 5a. Asset vs Liability, Male, low return

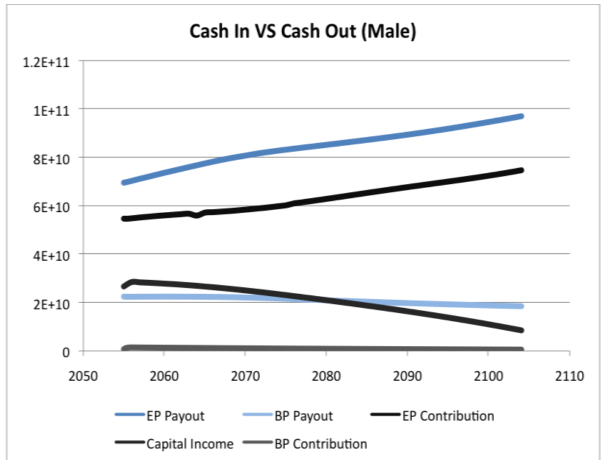
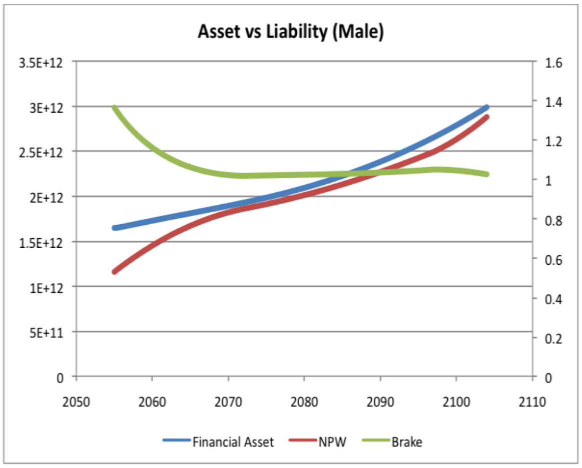


Figure 5b. Cash in vs Cash Out, Female, low return

Finally, we investigated at the possible impact of including dependent spouses into the contribution base of Basic Pension. Currently, dependent spouses of salaried workers are automatically enrolled to the Basic Pension with no obligation to contribute the monthly premium. Whether it is actuarially fair would be a different investigation topic in itself, we merely present the likely impact to the pension system if dependent spouses were mandated to contribute to BP. The result is significant. Figure 5a is the asset vs liability projection for *male* should non-working spouses are contributing to BP. System health improves markedly compared Figure 1a. NPW never exceeds financial asset. Figure 5b shows despite BP contribution remains a rather small portion to overall income, capital income improves drastically as a result of extra contribution throughout the projection period.



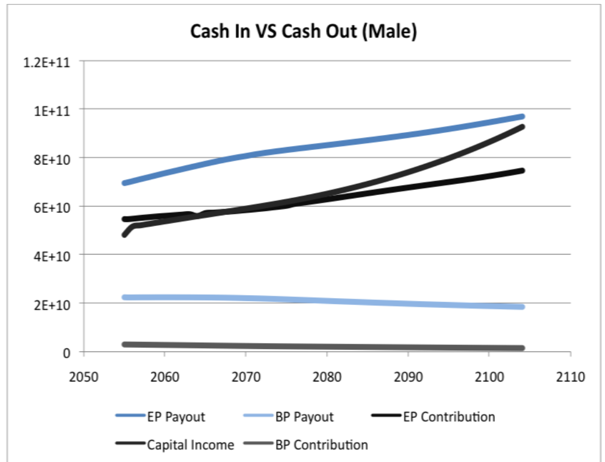


Figure 6a. Asset vs Liability, Male, non-working spouses included

Figure 6b. Cash in vs Cash Out, Male, non-working spouses included

9. Conclusion

The primary goal of this paper is to assess the current financial status of Japanese public pension system and study whether NDC can help to build a more resilient system provided with the best-practice pension fund management. For NDC to effective in enhancing Japan's public pension system, the scheme must advance the dual purposes of advancing the pension system's resilience through ensuring solvency, and also address inter-generational inequalities through the raising of pension replacement rates.

To ascertain the NDC scheme's effectiveness, we conducted a numerical simulation using the best publicly available data and projection. Our results, while preliminary, suggest that a NDC plan can achieve financial stability through its built-in stabilizer but not in the short run. We also showed that while NDC can potentially enhance replacement rate relative to the status quo, but the scheme by itself is unlikely to deliver adequate returns for retirement. In this view, a reserve fund that can produce consistent steam of income would be of vital importance to the long-term stability of the plan. Capital income, in all cases, has been demonstrated to affect the system health dramatically since contribution cannot be altered easily in response of any socioeconomic shocks. To increase capital income, there appears to be significant scope for Japan to enhance the investment rate of return for its pension fund to that of the level comparable to other similar government institutions. In addition, as the individual entitlement after retirement depends directly on the lifetime contribution, the NDC scheme provides an incentive for workers to retire later and continue contributing to the pension system beyond the age of 60 years old. The scheme also allows flexibility for workers to decide for themselves what would be their optimal retirement age based on their unique circumstances. Through a reserve fund, higher investment returns and the incentive to retire later, financial assets within the pension system is likely to rise. With the NDC's brake mechanism, whereby when the asset-liability ratio is above 1, benefits would be adjusted upwards. This key mechanism would likely result in overall higher pension replacement rate, as well as greater stability within the pension system. Thus, with additional complementary policy measures, the NDC scheme is likely to be effective in enhancing Japan's public pension system.

This study has also attempted to provide further insights into the workings of NDC in the context of Japanese public pension, and has placed emphasis on the different benefit received between an average male and female. A more detailed model can help answer the role of tax subsidy in NDC plan under a target replacement rate, and incorporate the joint benefits of a couple, taking into account the difference in working paths of women: women who quit the workforce and never return after marriage, women who quit after giving birth, and women who rejoin the workforce after child-rearing.

Future research could pursue several directions. This study has focused on investigating the fiscal sustainability of the pension system, in absence of considerations on how *well* are the retirees prepared for retirement. To answer this question, individual level panel data would deem necessary. Secondly, this study does not evaluate the redistributive impact of the NDC system relative the PAYGO plan. It appears that the current EP plan subsidizes married couples relative to single workers (Lu and Mitchell, 2007). In principle, NDC should be actuarially fairer than the PAYGO plan since individual contributions are closely aligned with benefit amounts but a more rigorous quantitative assessment shall illuminate additional policy questions in transitioning to NDC.

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