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Rethinking Pension Reform –Simple Application To The Japanese Situation

Arun Muralidhar
Chairman of Mcube Investment Technologies, LLC.

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RETHINKING PENSION REFORM – SIMPLE APPLICATION TO THE JAPANESE SITUATION[1]

ABSTRACT

As with all countries around the world, the ageing of Japanese society is putting severe pressure on the public pension system. The Japanese system is complex with a basic pension for all citizens, but different forms of additional support for self employed, private sector and public sector employees. The basic pension is covered through contributions and a subsidy by the government. This government contribution is derived from general taxation and is increasing over time as a percentage of the overall wage bill, but is a fundamental pillar of the concept of social solidarity. The public Social Security pension system for private sector workers has the highest coverage of the 3 working groups (30 million out of a total of 70 million) and has recently been converted to a "fixed premium" system, whereby contributions of employers and employees is being raised gradually but fixed thereafter. In other words, it appears that the system is being converted to ensure that additional taxes are not forced on the working population or companies as the population pyramid deteriorates, and to pass on some risk to pensioners by potentially lowering benefits and ensuring a "limited balanced system". Some attempt has been made to prevent a major decline of benefits through certain options making the system largely defined benefit. Japan has a unique set of favorable circumstances. The surplus of contributions over pensions in the past has been accumulated in a Trust Fund. These monies were previously loaned to the government but a recent reform led to a transition of this fund to a market-based global portfolio with appropriate governance and oversight. We apply some insights from Modigliani and Muralidhar (2003) to the Japanese system and demonstrate that given the unique and far-thinking measures already undertaken by the Japanese, that the financing of pensions is robust. However, rather than gradually depleting the fund over the next 95 years, if a small improvement can be made to the target return of the fund, potentially contributions could be reduced, while also lowering the volatility of contributions. Modigliani and Muralidhar (2003) showed that keeping a system partially funded was beneficial relative to a pure pay-as-you-go system as it could lower the volatility of contributions and make countries more competitive (as contributions are a tax on companies and could lead to higher wages). Japan has a unique opportunity to manage the most dramatic ageing of a population globally through some innovative, minor modifications, especially since they area at a very advantageous situation currently relative to countries such as the United States.

[1] Dr. Muralidhar is Chairman of M^{cube} Investment Technologies, LLC. This research was conducted with the gracious support of the University of Tokyo and Center for Advanced Research in Finance, Japan during Dr. Muralidhar's stay as Visiting Professor. I thank Profs. Takao Kobayashi (Univ of Tokyo), Yasuhiro Yonezawa (Waseda Univ), Tanaka-sensei (Nihon University), Kazuhiko Ohashi, and Toshiki Honda (Hitotsubashi University), Mr. Junichi Sakamoto (NRI), Mr. Masataka Hama and Kazunori Kanaura (DIAM), and Messrs Sakaguchi, Ogishima and Fujii (Nomura Securities) for their support and guidance. I owe a special debt of gratitude to Mr. Masakazu Arikawa (Mcube Japan), Masaharu Usuki (NLI) and Masaki Tsumagari (World Bank) for the constant feedback, correction of mistakes and introducing me to Japanese scholars and experts. These are the personal views of the author and any errors are my own.

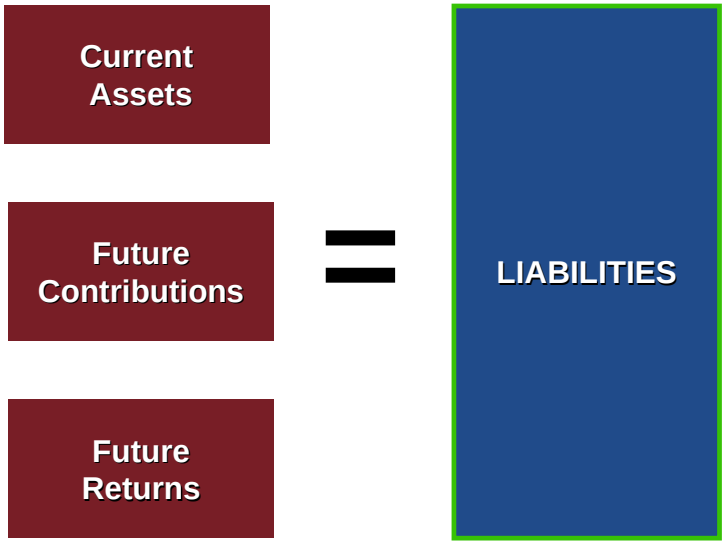
INTRODUCTION

Public pension systems around the world are facing a severe crisis because of ageing populations and moderate forecasts for economic growth. One of the reasons for the crisis is that many pension systems adopted a Pay-as-you-go (PAYGO) scheme whereby the pensions of the retirees would be paid through taxes on the working population. Such a system is sustainable if population and productivity increases are adequate, but over the last few decades not only has population growth and estimates for economic growth been scaled back, but also improvements in medical sciences has extended the life expectancy of retirees post-retirement and the population growth rate is very low. Japan is facing such a crisis as the population is ageing dramatically with the ratio of population aged 64 and higher to total population is expected to rise from 17.4% in 2000 to 28.7% in 2025 and increase thereafter. As a result, the number of workers to support a retiree will drop from 3.6 in 2000 to 1.5 fairly rapidly.

In any pension system, the pensions of the retirees can be financed through three basic approaches: pay-as-you-go, full funding or a combination of the two (partial funding). The simplistic Chart 1 from Muralidhar (2001)[2] shows that the pensions can be paid either through contributions (pure pay-as-you-go) or contributions plus the return on current and future assets (a funded mechanism).

[2] *Innovations in Pension Fund Management* (2001), by Arun S. Muralidhar, Stanford University Press, CA, USA. Translated into Japanese by Mr. Masakazu Arikawa.

Chart 1 – The Pension Fund Balance Sheet



Why did so many countries opt for PAYGO? The simple reason is that in a fully funded system, the pension is paid out of the accumulated capital stock of each retiree's account. Therefore, only those who have contributed for their entire working life will receive a full pension. Participants, who are close to retirement and did not contribute to the pension system, receive nothing. Under PAYGO, however, current workers' contributions are used to pay full pensions to all workers from day one, as if the retirees had contributed in full throughout their working life. For this reason, when a universal mandatory pension system is begun, PAYGO provides the most appealing solution. The decision to use PAYGO is, in effect, a transfer to pensioners who, without having contributed, receive a pension at the expense of future generations, who lose the capital accumulation of a funded system.

As many countries aged, the contributions required to sustain the PAYGO system become unbearable and many countries opted for reform. Chile was one of the first

countries to reform its pension system in 1981, by moving away from PAYGO to a total or partial return to some form of a funded system. This shift was based, primarily, on the premise that investing accumulated assets in income yielding assets would provide a significantly higher return than the implicit return offered by PAYGO, which is the long run growth rate of wages.

This transition was effected by requiring individuals to redirect their contributions to individual accounts, invested in financial assets. The system would eventually eliminate the role of Social Security and the public sector, and for that reason has come to be known as the "privatization of Social Security." This approach soon became the standard that was replicated in numerous other developing countries, often at the urging/coercion of agencies such as the World Bank. A number of academicians and politicians in developed countries, such as the United States, favor this approach. The Chilean model, however, suffers from very serious flaws, that can be corrected by better design. In fact, even the Chilean have recognized the flaws of their system and announced in 2006 that they would reform the reform and the state would start to play a much larger role than in the past because the expectations for benefits under defined contribution were too low, and the profitability of asset management companies was too high – close to a return of 50% on assets annually (effectively another reason why benefits are low as high costs/lower net return imply lower benefits).[3] In addition, some thought is being given to bundling participants or even getting a state administrator involved to help reduce commissions.

[3] "Chile Proposed to Reform Pension System – Partial Retreat from Privatization Would Increase Benefits" *New York Times,* December 26, 2006, page A18.

Countries such as Australia and Hungary have opted for systems whereby collective arrangements attempt to mitigate the problems in individual account models. In addition, a number of countries are in a position to make the transition from systems on the verge of bankruptcy to a more robust system that protects retirees from (i) retiring poor, (ii) bearing unnecessary risk, or (iii) being forced to make decisions on investment matters in which they have little or no expertise.

Japan is in a unique position compared to other countries such as the United States or some European countries and has adopted a reform to preserve defined benefits. In this paper, we will first review the conclusions and analytic approach of Modigliani and Muralidhar (2003), hereafter MM.[4] We will then provide a quick summary of our understanding of the Japanese system. Thereafter, we will demonstrate that with very moderate changes, Japan has a unique ability to achieve the objectives and pension system outlined in MM. While we are not experts on the Japanese system and have spent a very short time understanding all the nuances of the system, the idea here is to provide some alternative scenarios to an already robust system to ensure that Japanese Social Security can guarantee retirees a safe retirement without risk of falling into poverty while at the same time allowing for Japanese labor to be competitive by potentially lowering the level and volatility of the Social Security tax.

[4] *Rethinking Pension Reform* (2004), by Prof. Franco Modigliani and Dr. Arun Muralidhar, *Cambridge University Press*, Cambridge, UK.

SECTION 2: THE MODIGLIANI- MURALIDHAR APPROACH TO PENSION REFORM

MM made a few key points that were different from the conventional Anglo-Saxon wisdom on pension reform and social security systems and hence the title of their book, "Rethinking Pension Reform". Critically, they highlighted that two distinct issues to be considered, with respect to any proposed reform are: (a) what the system should look like for the future and (b) how one should achieve that system if it is different from the current model, given the current economic and political realities (the transition problem). Many analysts had confused the two and while it may be desirable to have an effective system, in many cases, initial conditions and social, economic and political realities may limit the degree of transition to a new system.

Their key conclusions of the reforms they analyzed in the US, Spain (subsequently Luxembourg[5]) and emerging markets, but applied more generally to any country reviewing the pension system are summarized below:

- The crisis in Social Security was only a funding crisis of focusing pension systems largely on PAYGO
- There was no need to convert systems to defined contribution (DC) schemes and that the so-called "privatization" of Social Security only privatized risk. DC schemes would lead to wide spread old age poverty because individuals were not skilled in investment issues, administrative costs are high and the cost to

[5] See Muriel Bouchet's proposal for Luxembourg in *Reforming European Pension Systems (*forthcoming in 2007), eds. Drs. Serge Allegarazza and Arun Muralidhar, Luxembourg Institute for European and International Studies, Luxembourg.

governments of averting old age poverty would be much higher than under DB schemes.

- Basing a system on the principle of PAYGO is not optimal as such a system over the long term (or in steady state) leads to higher and, more important, a greater volatility of contributions versus an equivalent funded system[6]. As shown in Appendix 1, for small changes in parameters underlying a PAYGO system, the change in contributions could be quite large compared to a funded system. This analysis is generic and could be easily applied to assumptions of key parameters for Japan.
- It is not possible to transition immediately from PAYGO to funding as funding dominates only because assets have been accumulated in the past. MM shows that given relatively generous pension benefits in many countries, assets under the control of a public pension system under a "fully funded" system would exceed reasonable thresholds and hence they suggest a transition to a partially funded system and demonstrate an analytical approach to establishing a stable and solvent pension system.
- They suggested a simpler concept for the statement of benefits under a DB scheme: namely, guarantee a return on contributions (as a guaranteed return on contributions was the effective equivalent of a traditional DB scheme) and solve the problem of complex pension formulae with weak links to contributions.

[6] Most researchers focus only on the level of the contribution and not its volatility. Hence, very often they claim that there is no Pareto improvement from moving from a PAYG system to a funded system. However, when volatility of contributions is considered, one can make a strong case for Pareto improvement from a transition to a more funded or mixed system.

- To manage the political risk of assets being managed by the public sector and being scrutinized every time the stock market dipped, they suggest the creation of a swap contract that guarantees the Social Security agency a fixed rate of return in exchange for the return of a portfolio of assets invested based on market capitalization weights. These assets would be under the supervision of a Blue Ribbon Board and hence managed with optimal governance. Canada and Ireland were cited as examples of countries where such Boards have managed assets effectively.
- Additionally, they demonstrate that a partially funded system with variable contributions may ensure the most effective system from the point of view of lowering the level and volatility of contributions for a given defied benefit.

MM provides a very simple equation to explain how one can examine the dynamics of a pension system regardless of how it is financed. Define A_t to be the asset to wage ratio at time t (and this could be zero in a pure PAYGO system), c_t to be the contribution rate at time t (i.e., contributions divided by wages), ρ to be the rate of growth of real income, made up of two components (the growth of the labor force, n, and productivity growth, q), r to be the gross real rate of return on financial assets and p_t to be the pensions-to-wages ratio also called the cost ratio. When the pension system reaches a steady state, the following fundamental relationship must hold:

$$p_t = c_t + A_{t-1}(r-\rho)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

We will call this equation the "Golden SS Rule" and the derivation is provided in Appendix 1. The net return on the system's reserves, combined with the contributions

must cover the benefits. If this is not the case, *A* will be rising or declining or *c* will need to be altered and the pension fund is not in steady state.

In the case of the United States and Spain[7], MM demonstrates that without immediate reform and a greater move towards partial funding, contributions can rise quite dramatically. This is because the cost ratio of the defined benefit system is also gradually rising to a relatively stable level of 19% of US wages by 2070 (from a current level below12%). Therefore, in the United States, combined contributions of employers and employees would rise from 12.4% of wages to approximately 19% - an increase of 50%. This is inspite of the fact that the United States has accumulated some assets in a Trust Fund (equivalent to approximately 30% of wages currently), but the ageing of the population will lead to a depletion of the assets in approximately 40 years causing a jump in contributions. However, since the problem is not immediate and such a transition occurs many years in the future, it is easy for politicians to delay reform and pass on the big shock to future generation. Unfortunately, the cost of reform keeps increasing every day the reform is delayed. MM demonstrates that if surpluses from the Clinton Administration been used to increase the funding of the U.S. system in 2000, combined with a sensible investment policy that is based on sound financial principles and with effective governance, that contributions could actually have been lowered rather being raised in the future. Since the Bush Administration spent this surplus through a reduction in personal taxes, the only way to ensure permanent solvency in the United States is to raise contributions permanently by 1.1% and implement an effective investment policy on the assets immediately. Such a reform would ensure that contributions for all future

[7] See also application to Luxembourg by Muriel Bouchet in Allegeraza and Muralidhar (2007).

generations can be stabilized at 13.5% as opposed to rising closer to 19%. The balance of 5.5% of the pension over the contribution is financed through the returns on assets, which in the MM equilibrium is a net return on assets (net of inflation, productivity growth and population growth) of 5.2% earned on a portfolio that is approximately 1.5 times wages.

The Japanese case appears to be very similar to the case of the United States with minor variations and with substantially better conditions for Japan. The system is a defined benefit system with provision for old-age, disability and survivor pensions. Contributions are shared equally by employer and employee[8], benefits have some element of price/wage indexation, the target replacement rate is approximately 50% of average wages[9], a trust fund exists and the cost ratio appears to be rising from a current level of 22% to a steady state level of 29% by 2050. The Japanese investment policy is far more enlightened than the current US Social Security system as the funds have been invested in stocks, bonds in domestic and foreign markets, whereas the US Social Security Trust Fund is effectively lent to the US government for non-marketable securities. In this paper, we will attempt to apply the MM approach to reforming the Japanese public pension system. We will first review key aspects of the Japanese system and then see if the simulations applied in MM to the US and Spanish (and even Luxembourg) case provide any interesting results for Japan. Given the favorable initial conditions in Japan, it can be shown that small changes to the system can have long term beneficial impact to the country, but because they involve decisions on investments and contributions that can have political implications, we try to address these issues as well.

[8] Though MM argues that this really does not matter. It is who bears the tax that is more relevant than who pays the tax and in all likelihood, on average, the employee is bearing the entire tax.
[9] In the US case, it based on the 35 best years of service.

SECTION 3: BACKGROUND ON JAPANESE PENSION SYSTEM FOR PRIVATE SECTOR WORKERS[10]

The pension system in Japan is very complex with many layers of pensions offered both from government, employers and industries for self-employed workers. There is a periodic review every 5 years to ensure solvency of the system for the following 95 years and hence the reform process is dynamic and not static. The system, as of the last reform, can be summarized very briefly as follows:

- A basic pension is provided to 70 million participants and this basic pension is financed through general revenues (or a government subsidy) and individual contributions. The contributions to this scheme are set in Yen terms (as opposed to a percentage of salary) so all participants pay the same burden.
- Additionally, there is a supplementary pension that varies based on type of employment
    - Self employed workers (approximately 20 million participants) have access to a defined contribution scheme
    - Private sector workers (approximately 32 million participants) are covered under the Employees' Pension Insurance Scheme (EPI) and this is a contributory scheme based on total compensation which includes salary plus bonus.

[10] This summary is based on data gathered from Ministry of Health Labor and Welfare website http://www.mhlw.go.jp/english/org/policy/p36-37a.html and various conversations with leading experts in Japan on these topics. All errors of interpretation are mine.

- Public sector workers (approximately 4.7 million participants) are covered under a Mutual Aid Pension.

For the purpose of this paper, we will focus solely on the EPI system as being the critical pillar of the Japanese Social Security system as it impacts the private sector and implicitly the competitiveness of the economy. This is an unusual plan as the system was originally defined benefits with the current replacement rate closer to 60% but with a gradual decline of the replacement rate to 50.2% of average salary by FY 2023. The reason for this transition was that a recent reform enacted many changes in the structure with a goal to ensuring financial stability of the fund through 2100. The changes are highlighted below:

- The system has been recently converted to a “fixed premium”/contribution system through a “step-wise premium raising method”. In other words, the contribution levied on employers and employees is being gradually raised from 14.288% in FY 2005 to 18.3% in FY 2017, but then fixed thereafter. In short, the contribution is raised in steps of 0.354% until 18.30% is achieved.
- The government subsidy as a percentage of wages will continue to increase over time.
- By working towards a system where the rise in contributions of employees and employers is capped, the reform effectively transfers the volatility of various parameters to the benefits paid and thereby to the pensioner (or replacement rate of the pensioner) as opposed to allowing the premiums to increase over time. This

appears to be a sensible move as: (a) with a rapidly aging population, supporting a replacement rate of 60% of average salary would lead to a dramatic increase in contributions; and (b) in many countries, including the United States, the target replacement rate for Social Security is approximately 50% of career average wages.

- Even with these changes, the cost ratio is increasing over time from 22% to 29% of wages as shown in Table 1, column 1 (and hence without any adjustments, contributions would have risen dramatically).
- In other words, benefits adjust over time based on "macro-economic adjustment" whereby the benefit is lowered because of the decrease in labor force and increase in life expectancy. Such adjustments are made to the Basic Pension. In addition, modifications have been made to the indexation of benefits to moderate the growth of pensions below the projected growth of wages (of 2.1%).
- However, many options have been included to prevent pensions from declining below a certain level and hence a strong element of the defined benefit is being preserved while allowing for benefits to adapt to changing economic realization. Therefore, if the inflation indexation rate would fall below 0% while wages rose, the true indexation is prevented from falling below 0%. However, if wage growth was negative, then the inflation indexation would match the rate of wage growth.
- A substantial pool of assets has been designated as a trust fund to ensure the solvency of the system and the newly created Pension Reserve Fund Administration and Investment Agency (PRFA) will be responsible for investing

the assets.[11] The current asset size including marketable and non-marketable assets is already in excess of 100 Trillion Yen (approximately USD 1 trillion) and this is projected to grow over time as contributions are raised. The current Trust Fund is estimated to be in excess of 100% of wages as shown in Table 1. The structure and composition of these assets is discussed below.

- The objective of the system is to ensure "limited balance" by 2100, which means that the Trust Fund will be drawn down over time to meet the rising cost ratio while capping employer and employee contributions. By 2100, the Trust Fund will hold a balance of just one year's benefit (as opposed to a current level of nearly 5 years' coverage). However, with a rolling 5 year review plan, the actual coverage for the year 2100 will keep increasing as the rolling target of one year's coverage will keep drifting 5 years out[12].
- Given an anticipated growth of nominal wages of 2.1%, projected inflation of 1%, it is estimated that a nominal return of 3.2% (or 1.1% above wage growth) will be adequate to achieve this objective of "limited balance". This target return is used by PRFA to establish the appropriate asset allocation to achieve this result and the bias is to achieve through a diversified portfolio of largely index and passive investments (i.e., get the returns from beta as opposed to alpha). We will discuss investment issues later.
- In other words, the transition that will take place will move the EPI system from a partially funded system to a less partially funded system in 2100 and potentially

[11] Formerly known as GPIF.
[12] I thank Sakamoto-san for this clarification.

back to PAYGO beyond 2100. However, such long term projections are difficult to make and hence this degree of solvency gives comfort to the decision makers.

In Japan, one must consider the modified Golden SS Rule as follows:

$$p_t = c_t + s_t + A_{t-1}(r-\rho)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

where s_t is the government subsidy at time t for the Basic pension.

However, as column 4 of Table 1 demonstrates, the government contribution is non-trivial and currently at 3% of wages and rising over time to 6% of wages. From an economic point of view, this is also a tax on competitiveness as ultimately government contributions are financed by higher taxes on individuals and this number can vary over time as projected currently. This should not come as a surprise as the cost ratio is increasing and as we demonstrate in equation 1 above, if *p* is rising to 26%-29% and if *c* is fixed at 18.3%, then without additional contributions or sales of assets, benefits cannot be paid. With *s* rising over time to only 6%, then the balance of the 5% between pensions and all inflows (or what we call the PRFA surplus) is being covered over time through sales of assets and hence *A* is declining.

Therefore, at some point, *A* will approach zero and contributions will have to rise. As shown in column 9 of table 1, such an event will take place after 2100, which is just beyond the forecast period and hence such a system exports the crisis to the future

generations. We can refer to such a date as the “BIG SHOCK” as the Social Security tsunami will hit the population and contributions will have to rise dramatically. One way to prevent such a BIG SHOCK has been to implement the rolling 5 year plans and thereby gradually push this point out 5 years at a time.

One reason for such a dramatic change of the system is that wages are projected to grow at 2.1% in nominal terms, inflation is projected to grow at 1%, and the annualized nominal rate of return is projected to be just 3.2%, but the rate of growth of the labor force is expected to be negative! However, such a profile of declining funding is intentional as it is clear that the system is being converted to a more PAYGO system. One of the apparent reasons for such a move was to reduce the size of assets under government control as that was a major concern.

However, the target rate of return is a choice variable and if one chose a higher return, the dynamics of the entire system could change. The target return from this investment portfolio is currently 3.2% and results in PRFA making a large strategic allocation to domestic bonds (target is expected to be 67% in government bonds). While we will discuss the potential impact of investing a large portion in government bonds at a time when interest rates will potentially rise, the more important issue is why is the portfolio invested so heavily in bonds? The explanation is provided in MHW literature which suggests that the assets of PRFA/GPIF must be invested “safely” meaning immune from market fluctuation. This is probably a result of experiencing losses on the equity portfolio when Japanese stocks performed poorly from 2000 – 2003. But the concept of “safe

investment" when applied in reference to the purely investment portfolio implies a potentially lower rate of return than is achievable on the assets. Therefore, a safe portfolio which targets a lower return than is feasible in the markets can mean a more PAYGO system that, as we indicated earlier and demonstrated in Appendix 1, may keep contributions higher and more volatile than if the system was more funded!

This is what we already see in the case of the pension system in Table 1 and will demonstrate the additional implications from such an investment policy. Moreover, as shown in MM, there are effective ways to raise the return of the GPIF/PRFA portfolio while ensuring that the Social Security system is safe. We will first provide some simulations about various possible impacts on the EPI system from changing the assumptions about target rate of return, additional contributions etc to see the interplay between rates of return and EPI taxes. Later on, we will examine whether the size of funds and other financial issues will make such a transition to a more funded system feasible or whether such an experiment is a nice academic idea that cannot be implemented in Japan because of practical difficulties. We will demonstrate later that effective investment policy and implementation of investment decisions, especially large cash flows, for GPIF/PRFA may provide the additional returns that can allow for a potential reduction of contributions and a more stable long term system.

Let us assume that the goal stated in MM is that a pension system must be designed to provide a stable DB benefit, at whatever desired level, and that an attempt must be made to (a) lower contributions for a given benefit; and (b) reduce the volatility of

contributions. In Japan, it appears that they have recognized this and while the average total contribution is 23%, the volatility has been reduced by floating the benefits. However, the contribution will rise dramatically after 2100 and hence this is not an optimal system from the MM model perspective. In the next section, we will attempt to show how the system could potentially be made more optimal through (a) an increase in contributions; (b) a higher target return; and (c) some combination of both. In fact, it can be shown that for a given investment policy, contributions may be stabilized at a level lower than today's current level. The one key variable which we will monitor to ensure the solvency is the PRFA/GPIF Surplus (Table 1, Column 8) which measures the difference between inflows and outflows. If this value is negative, and permanently so, then the Trust Fund is being depleted as we can see from Chart 1. If we can ensure that this variable approaches zero and stays there, then a stable system can be ensured.

For simplicity we utilize a simple model of the EPI forecasts taken from data from the Ministry of Health, Labor and Welfare (MHLW). This is clearly not the full actuarial model that is used to make the long term projections by MHLW, but such a simple model allows us to understand the dynamics of the system. We have converted all the data from the MHLW projections into analysis based on ratios as a percentage of the wage bill as this is the approach followed by MM and normalizes nominal values on parameters such as taxes and size of assets by the growth of the economy. The steps followed to create such a table are highlighted in Appendix 2. As a result, we plot the key financial variables in Chart 1 for the current reform. As one can see, the Surplus is negative from about 2040 onwards leading to a sharp decline in the Trust Fund as a percentage of wages, especially

since the Cost Ratio is stabilizing in the neighborhood of 26.22% after briefly rising beyond 28%.

Chart 1: EPI Financial Dynamics with Current Reform = BASE CASE

Other ratios (LHS) (as a percentage of wages) Trust Fund (RHS)

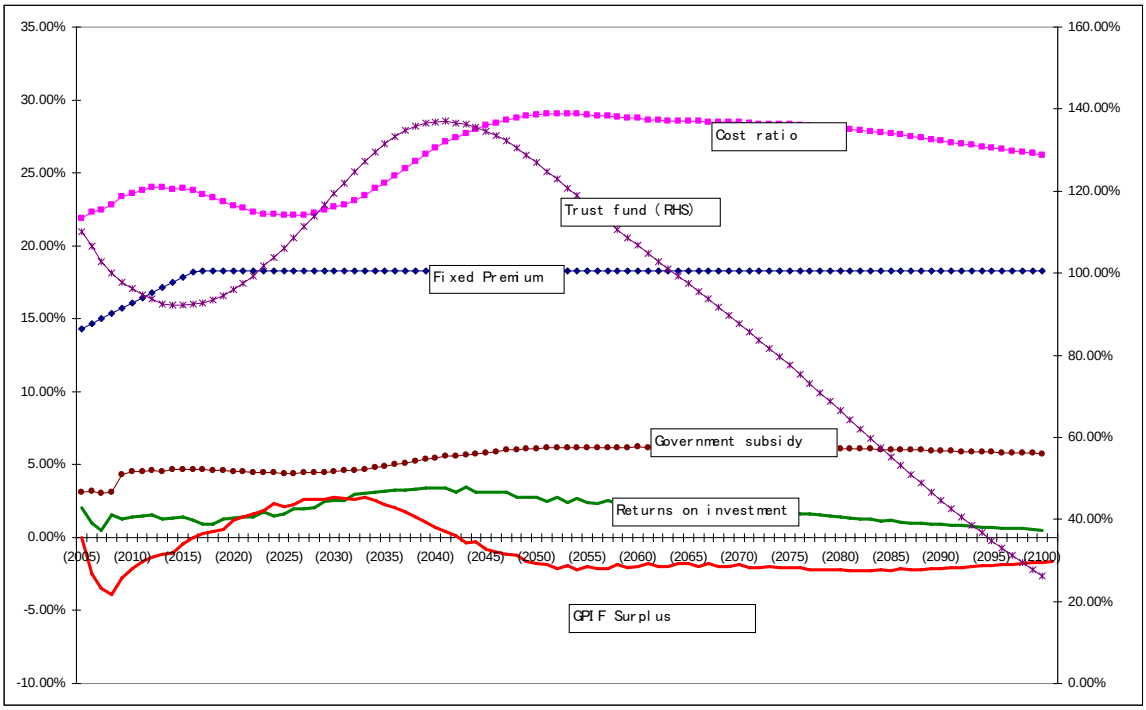


Table 1: Japanese Pension System with No Reform

	Pensions or Cost Ratio	Household/ Employer Contrib. to Pensions	Tax Rebate from Govt ownership of stocks	Govt Contribution	Top up (from cell K2)	Total Contributions = (2)+(3)+(4)+(4a)	Trust Fund Accrued Interest = $(9)_{-1}$*(Int Rate-LF-RealSal)	Inflows to SS = (6)+(5)	SS Surplus = (7)-(1)	Trust Fund = $(9)_{-1}$+(8)	Total Assets/ Benefits =(9)/(1)
	(1)	(2)	(3)	(4)	(4a)	(5)	(6)	(7)	(8)	(9)	(10)
(2005)	21.91%	14.29%		3.09%	0.00%	17.38%	2.06%	19.44%	-2.47%	110.11%	5.03
(2006)	22.30%	14.64%		3.19%	0.00%	17.83%	0.99%	18.82%	-3.48%	106.63%	4.78
(2007)	22.43%	15.00%		3.05%	0.00%	18.05%	0.46%	18.51%	-3.92%	102.71%	4.58
(2008)	22.80%	15.35%		3.14%	0.00%	18.49%	1.52%	20.01%	-2.79%	99.92%	4.38
(2009)	23.40%	15.70%		4.29%	0.00%	20.00%	1.30%	21.30%	-2.10%	97.82%	4.18
(2010)	23.61%	16.06%		4.53%	0.00%	20.59%	1.39%	21.98%	-1.64%	96.19%	4.07
(2011)	23.78%	16.41%		4.52%	0.00%	20.93%	1.46%	22.39%	-1.39%	94.80%	3.99
(2012)	24.02%	16.77%		4.57%	0.00%	21.34%	1.52%	22.86%	-1.16%	93.64%	3.90
(2013)	24.00%	17.12%		4.55%	0.00%	21.67%	1.29%	22.96%	-1.04%	92.59%	3.86
(2014)	23.89%	17.47%		4.65%	0.00%	22.12%	1.34%	23.46%	-0.43%	92.17%	3.86
(2015)	23.96%	17.83%		4.69%	0.00%	22.52%	1.43%	23.95%	-0.01%	92.15%	3.85
(2016)	23.81%	18.18%		4.66%	0.00%	22.84%	1.22%	24.06%	0.25%	92.41%	3.88
(2017)	23.53%	18.30%		4.67%	0.00%	22.97%	0.95%	23.92%	0.39%	92.80%	3.94
(2018)	23.31%	18.30%		4.63%	0.00%	22.93%	0.94%	23.87%	0.56%	93.36%	4.00
(2019)	23.01%	18.30%		4.60%	0.00%	22.90%	1.29%	24.19%	1.18%	94.54%	4.11
(2020)	22.77%	18.30%		4.52%	0.00%	22.82%	1.34%	24.17%	1.40%	95.94%	4.21
(2021)	22.59%	18.30%		4.50%	0.00%	22.80%	1.39%	24.19%	1.60%	97.54%	4.32
(2022)	22.32%	18.30%		4.42%	0.00%	22.72%	1.44%	24.16%	1.84%	99.38%	4.45
(2023)	22.16%	18.30%		4.46%	0.00%	22.76%	1.75%	24.51%	2.35%	101.74%	4.59
(2024)	22.20%	18.30%		4.49%	0.00%	22.79%	1.52%	24.30%	2.11%	103.84%	4.68
(2025)	22.09%	18.30%		4.42%	0.00%	22.72%	1.60%	24.31%	2.23%	106.07%	4.80
(2026)	22.08%	18.30%		4.41%	0.00%	22.71%	1.96%	24.66%	2.58%	108.65%	4.92
(2027)	22.13%	18.30%		4.44%	0.00%	22.74%	1.99%	24.73%	2.60%	111.25%	5.03
(2028)	22.22%	18.30%		4.48%	0.00%	22.78%	2.07%	24.85%	2.63%	113.88%	5.12
(2029)	22.46%	18.30%		4.48%	0.00%	22.78%	2.44%	25.22%	2.76%	116.65%	5.19
(2030)	22.65%	18.30%		4.53%	0.00%	22.83%	2.53%	25.35%	2.71%	119.36%	5.27
(2031)	22.83%	18.30%		4.58%	0.00%	22.88%	2.57%	25.44%	2.61%	121.97%	5.34
(2032)	23.11%	18.30%		4.63%	0.00%	22.93%	2.95%	25.88%	2.77%	124.74%	5.40
(2033)	23.48%	18.30%		4.69%	0.00%	22.99%	3.05%	26.04%	2.56%	127.30%	5.42
(2034)	23.93%	18.30%		4.79%	0.00%	23.09%	3.10%	26.19%	2.26%	129.56%	5.41
(2035)	24.33%	18.30%		4.88%	0.00%	23.18%	3.16%	26.34%	2.02%	131.58%	5.41
(2036)	24.81%	18.30%		5.02%	0.00%	23.32%	3.22%	26.54%	1.73%	133.31%	5.37
(2037)	25.28%	18.30%		5.12%	0.00%	23.42%	3.28%	26.70%	1.42%	134.73%	5.33
(2038)	25.79%	18.30%		5.21%	0.00%	23.51%	3.34%	26.85%	1.06%	135.79%	5.26
(2039)	26.30%	18.30%		5.34%	0.00%	23.64%	3.36%	27.01%	0.71%	136.50%	5.19
(2040)	26.71%	18.30%		5.43%	0.00%	23.73%	3.39%	27.12%	0.41%	136.91%	5.13
(2041)	27.11%	18.30%		5.57%	0.00%	23.87%	3.41%	27.28%	0.16%	137.08%	5.06
(2042)	27.41%	18.30%		5.60%	0.00%	23.90%	3.12%	27.02%	-0.39%	136.69%	4.99
(2043)	27.72%	18.30%		5.69%	0.00%	23.99%	3.46%	27.44%	-0.28%	136.41%	4.92
(2044)	28.01%	18.30%		5.76%	0.00%	24.06%	3.13%	27.19%	-0.82%	135.60%	4.84
(2045)	28.24%	18.30%		5.83%	0.00%	24.13%	3.12%	27.25%	-1.00%	134.60%	4.77
(2046)	28.44%	18.30%		5.90%	0.00%	24.20%	3.10%	27.30%	-1.14%	133.46%	4.69
(2047)	28.63%	18.30%		6.01%	0.00%	24.31%	3.09%	27.40%	-1.23%	132.23%	4.62
(2048)	28.76%	18.30%		6.02%	0.00%	24.32%	2.79%	27.11%	-1.65%	130.58%	4.54
(2049)	28.92%	18.30%		6.07%	0.00%	24.37%	2.78%	27.16%	-1.76%	128.82%	4.45
(2050)	29.00%	18.30%		6.09%	0.00%	24.39%	2.78%	27.16%	-1.84%	126.98%	4.38
(2051)	29.02%	18.30%		6.13%	0.00%	24.43%	2.46%	26.89%	-2.13%	124.85%	4.30
(2052)	29.06%	18.30%		6.14%	0.00%	24.44%	2.72%	27.16%	-1.90%	122.95%	4.23
(2053)	29.04%	18.30%		6.14%	0.00%	24.44%	2.43%	26.86%	-2.18%	120.78%	4.16
(2054)	29.08%	18.30%		6.15%	0.00%	24.45%	2.67%	27.12%	-1.96%	118.82%	4.09
(2055)	28.99%	18.30%		6.15%	0.00%	24.45%	2.39%	26.84%	-2.15%	116.67%	4.02
(2056)	28.93%	18.30%		6.15%	0.00%	24.45%	2.35%	26.80%	-2.13%	114.54%	3.96
(2057)	28.90%	18.30%		6.16%	0.00%	24.46%	2.58%	27.04%	-1.86%	112.67%	3.90
(2058)	28.81%	18.30%		6.16%	0.00%	24.46%	2.31%	26.77%	-2.04%	110.63%	3.84
(2059)	28.76%	18.30%		6.16%	0.00%	24.46%	2.28%	26.74%	-2.03%	108.61%	3.78
(2060)	28.73%	18.30%		6.20%	0.00%	24.50%	2.45%	26.95%	-1.78%	106.83%	3.72
(2061)	28.65%	18.30%		6.13%	0.00%	24.43%	2.24%	26.68%	-1.97%	104.86%	3.66
(2062)	28.60%	18.30%		6.13%	0.00%	24.43%	2.21%	26.64%	-1.96%	102.90%	3.60
(2063)	28.57%	18.30%		6.14%	0.00%	24.44%	2.36%	26.81%	-1.77%	101.13%	3.54
(2064)	28.58%	18.30%		6.19%	0.00%	24.49%	2.33%	26.82%	-1.77%	99.37%	3.48
(2065)	28.54%	18.30%		6.15%	0.00%	24.45%	2.11%	26.57%	-1.97%	97.40%	3.41
(2066)	28.54%	18.30%		6.20%	0.00%	24.50%	2.25%	26.75%	-1.79%	95.61%	3.35
(2067)	28.50%	18.30%		6.16%	0.00%	24.46%	2.05%	26.52%	-1.98%	93.62%	3.29
(2068)	28.46%	18.30%		6.13%	0.00%	24.43%	2.02%	26.45%	-2.00%	91.62%	3.22
(2069)	28.46%	18.30%		6.17%	0.00%	24.47%	2.15%	26.63%	-1.84%	89.78%	3.15
(2070)	28.45%	18.30%		6.14%	0.00%	24.44%	1.96%	26.41%	-2.05%	87.73%	3.08
(2071)	28.41%	18.30%		6.14%	0.00%	24.44%	1.94%	26.38%	-2.03%	85.70%	3.02
(2072)	28.37%	18.30%		6.14%	0.00%	24.44%	1.91%	26.35%	-2.02%	83.68%	2.95
(2073)	28.36%	18.30%		6.14%	0.00%	24.44%	1.85%	26.29%	-2.07%	81.61%	2.88
(2074)	28.32%	18.30%		6.14%	0.00%	24.44%	1.83%	26.27%	-2.06%	79.56%	2.81
(2075)	28.31%	18.30%		6.14%	0.00%	24.44%	1.80%	26.24%	-2.07%	77.49%	2.74
(2076)	28.26%	18.30%		6.13%	0.00%	24.43%	1.62%	26.05%	-2.21%	75.28%	2.66
(2077)	28.21%	18.30%		6.12%	0.00%	24.42%	1.60%	26.02%	-2.19%	73.09%	2.59
(2078)	28.16%	18.30%		6.11%	0.00%	24.41%	1.55%	25.96%	-2.19%	70.90%	2.52
(2079)	28.13%	18.30%		6.13%	0.00%	24.43%	1.51%	25.93%	-2.20%	68.70%	2.44
(2080)	28.04%	18.30%		6.08%	0.00%	24.38%	1.38%	25.76%	-2.28%	66.42%	2.37
(2081)	27.98%	18.30%		6.09%	0.00%	24.39%	1.34%	25.73%	-2.25%	64.17%	2.29
(2082)	27.92%	18.30%		6.07%	0.00%	24.37%	1.30%	25.67%	-2.25%	61.93%	2.22
(2083)	27.86%	18.30%		6.05%	0.00%	24.35%	1.28%	25.64%	-2.22%	59.71%	2.14
(2084)	27.76%	18.30%		6.03%	0.00%	24.33%	1.16%	25.48%	-2.27%	57.43%	2.07
(2085)	27.70%	18.30%		6.04%	0.00%	24.34%	1.20%	25.54%	-2.16%	55.27%	2.00
(2086)	27.61%	18.30%		6.04%	0.00%	24.34%	1.08%	25.42%	-2.18%	53.09%	1.92
(2087)	27.48%	18.30%		6.01%	0.00%	24.31%	0.97%	25.28%	-2.20%	50.89%	1.85
(2088)	27.41%	18.30%		5.98%	0.00%	24.28%	1.01%	25.29%	-2.12%	48.78%	1.78
(2089)	27.29%	18.30%		5.97%	0.00%	24.27%	0.91%	25.19%	-2.10%	46.67%	1.71
(2090)	27.19%	18.30%		5.94%	0.00%	24.24%	0.88%	25.12%	-2.07%	44.61%	1.64
(2091)	27.10%	18.30%		5.91%	0.00%	24.21%	0.85%	25.06%	-2.03%	42.57%	1.57
(2092)	27.00%	18.30%		5.91%	0.00%	24.21%	0.82%	25.03%	-1.98%	40.59%	1.50
(2093)	26.91%	18.30%		5.90%	0.00%	24.20%	0.79%	24.99%	-1.93%	38.67%	1.44
(2094)	26.79%	18.30%		5.87%	0.00%	24.17%	0.71%	24.87%	-1.92%	36.75%	1.37
(2095)	26.70%	18.30%		5.85%	0.00%	24.15%	0.68%	24.83%	-1.87%	34.88%	1.31
(2096)	26.61%	18.30%		5.82%	0.00%	24.12%	0.65%	24.77%	-1.83%	33.05%	1.24
(2097)	26.52%	18.30%		5.81%	0.00%	24.11%	0.63%	24.73%	-1.78%	31.27%	1.18
(2098)	26.43%	18.30%		5.80%	0.00%	24.10%	0.60%	24.70%	-1.73%	29.53%	1.12
(2099)	26.33%	18.30%		5.78%	0.00%	24.08%	0.54%	24.62%	-1.72%	27.81%	1.06
(2100)	26.22%	18.30%		5.74%	0.00%	24.04%	0.51%	24.55%	-1.67%	26.15%	1.00

SECTION 4: OPTIONS FOR ADDITIONAL REFORM

For simplicity, we will assume that the benefits will remain unchanged per the forecast as reducing benefits is politically infeasible. As MM demonstrates, systems where the Asset-to-Wage ratio is declining would be second best to systems that are able to satisfy the Golden SS Rule and create a partially funded system so that future benefits can be paid partly from contributions and partly from returns on the Trust Fund. Given the declining profile of the Asset-to-Wage ratio in the Base Case, this provides us with two levers to improve the future solvency of the pension system – contribution policy and investment policy[13]. However, changes to contribution policy raise another complication – namely, of inter-generational equity. It is quite obvious that there are numerous changes to contributions policy or the government subsidy that can impact the solvency of the system. For example, if contributions or subsidies are raised in the early years to improve the solvency and lowered thereafter when solvency is improved, then it is implicitly taxing current generations to the benefit of future generations. Conversely, keeping the system in a dangerous financial situation in the future by keeping contributions/subsidies low today is a transfer to current generations from future generations. Therefore, following MM, we will attempt to solve this issue by reviewing a <u>one-time increase or decrease in contributions</u> so that all generations are impacted equally. In addition, we will first look at changes to return of the investment portfolio and then later examine the feasibility of such returns and other investment policy implications to achieve such returns.

[13] See also Innovations in Pension Fund Management (2004) by Arun Muralidhar, Japanese edition, edited by Mr. Masakazu Arikawa and colleagues from Sony

Simple Model: Ensure Solvency through an Increase in Contribution/Subsidy

In this approach, we do not change the investment policy or strategy of GPIF/PRFA and attempt to evaluate the increase required in either contributions or subsidy to create a system that will be more financially stable through the creation of a sustainable partially funded system. As shown in Table 2 and Chart 2, this would require an immediate increate in contributions of 0.30% from 2007 (column 4a). We do not show this in the table, but delaying this further will only increase the cost. For example, if the increase in contribution or subsidy is not made immediately and postponed to 2015, then future generations will have to pay 0.44% additional contributions. How can we show that the increase in contributions will provide solvency?

Chart 2: Increasing Contributions to Improve Financial Stability
Investment Return = 3.2%; Additional Contribution = 0.33%

Other ratios (LHS) **(as a percentage of wages)** **Trust Fund (RHS)**

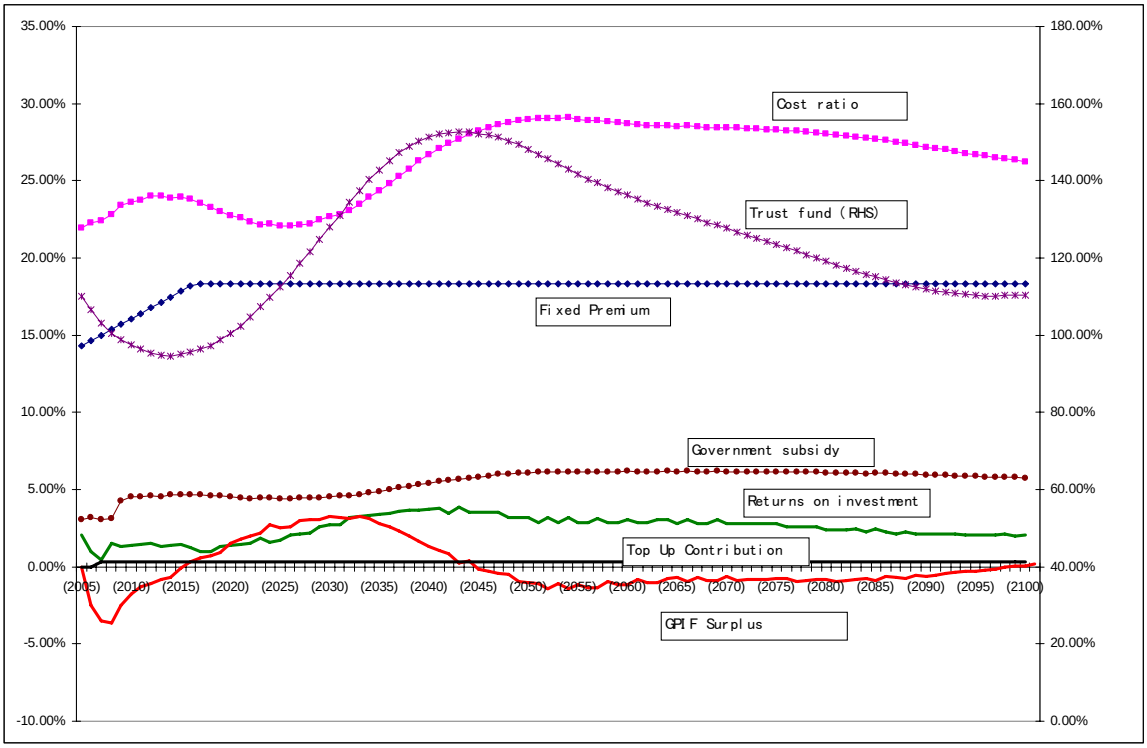


Table 2: Increasing Contributions to Create an MM Stable System

	Pensions or Cost Ratio	Household/ Employer Contrib. to Pensions	Tax Rebate	Govt Contribution	Top up (from cell K2)	Total Contributions = (2)+(3)+(4)+(4a)	Trust Fund Accrued Interest = $(9)_{t-1}$*(Int Rate-LF-RealSal)	Inflows to SS = (6)+(5)	SS Surplus = (7)-(1)	Trust Fund = $(9)_{t-1}$+(8)	Total Assets/ Benefits =(9)/(1)
	(1)	(2)	(3)	(4)	(4a)	(5)	(6)	(7)	(8)	(9)	(10)
(2005)	21.91%	14.29%		3.09%	0.00%	17.38%	2.06%	19.44%	-2.47%	110.11%	5.03
(2006)	22.30%	14.64%		3.19%	0.00%	17.83%	0.99%	18.82%	-3.48%	106.63%	4.78
(2007)	22.43%	15.00%		3.05%	0.30%	18.35%	0.46%	18.80%	-3.62%	103.01%	4.59
(2008)	22.80%	15.35%		3.14%	0.30%	18.79%	1.53%	20.31%	-2.49%	100.52%	4.41
(2009)	23.40%	15.70%		4.29%	0.30%	20.30%	1.30%	21.60%	-1.79%	98.73%	4.22
(2010)	23.61%	16.06%		4.53%	0.30%	20.89%	1.40%	22.29%	-1.33%	97.40%	4.12
(2011)	23.78%	16.41%		4.52%	0.30%	21.23%	1.48%	22.71%	-1.07%	96.33%	4.05
(2012)	24.02%	16.77%		4.57%	0.30%	21.64%	1.54%	23.18%	-0.84%	95.49%	3.98
(2013)	24.00%	17.12%		4.55%	0.30%	21.97%	1.31%	23.28%	-0.72%	94.77%	3.95
(2014)	23.89%	17.47%		4.65%	0.30%	22.42%	1.37%	23.79%	-0.10%	94.67%	3.96
(2015)	23.96%	17.83%		4.69%	0.30%	22.82%	1.47%	24.29%	0.32%	95.00%	3.96
(2016)	23.81%	18.18%		4.66%	0.30%	23.14%	1.25%	24.39%	0.59%	95.58%	4.01
(2017)	23.53%	18.30%		4.67%	0.30%	23.27%	0.98%	24.25%	0.72%	96.31%	4.09
(2018)	23.31%	18.30%		4.63%	0.30%	23.23%	0.98%	24.21%	0.90%	97.20%	4.17
(2019)	23.01%	18.30%		4.60%	0.30%	23.20%	1.34%	24.54%	1.53%	98.74%	4.29
(2020)	22.77%	18.30%		4.52%	0.30%	23.12%	1.40%	24.52%	1.75%	100.49%	4.41
(2021)	22.59%	18.30%		4.50%	0.30%	23.10%	1.46%	24.56%	1.97%	102.45%	4.54
(2022)	22.32%	18.30%		4.42%	0.30%	23.02%	1.51%	24.53%	2.21%	104.67%	4.69
(2023)	22.16%	18.30%		4.46%	0.30%	23.06%	1.84%	24.91%	2.75%	107.41%	4.85
(2024)	22.20%	18.30%		4.49%	0.30%	23.09%	1.60%	24.69%	2.49%	109.90%	4.95
(2025)	22.09%	18.30%		4.42%	0.30%	23.02%	1.69%	24.70%	2.62%	112.52%	5.09
(2026)	22.08%	18.30%		4.41%	0.30%	23.01%	2.07%	25.08%	3.00%	115.52%	5.23
(2027)	22.13%	18.30%		4.44%	0.30%	23.04%	2.11%	25.16%	3.03%	118.55%	5.36
(2028)	22.22%	18.30%		4.48%	0.30%	23.08%	2.20%	25.28%	3.06%	121.61%	5.47
(2029)	22.46%	18.30%		4.48%	0.30%	23.08%	2.60%	25.69%	3.23%	124.84%	5.56
(2030)	22.65%	18.30%		4.53%	0.30%	23.13%	2.70%	25.83%	3.18%	128.02%	5.65
(2031)	22.83%	18.30%		4.58%	0.30%	23.18%	2.75%	25.92%	3.09%	131.12%	5.74
(2032)	23.11%	18.30%		4.63%	0.30%	23.23%	3.17%	26.40%	3.29%	134.41%	5.82
(2033)	23.48%	18.30%		4.69%	0.30%	23.29%	3.28%	26.57%	3.09%	137.50%	5.86
(2034)	23.93%	18.30%		4.79%	0.30%	23.39%	3.35%	26.74%	2.81%	140.31%	5.86
(2035)	24.33%	18.30%		4.88%	0.30%	23.48%	3.42%	26.90%	2.58%	142.88%	5.87
(2036)	24.81%	18.30%		5.02%	0.30%	23.62%	3.49%	27.11%	2.31%	145.19%	5.85
(2037)	25.28%	18.30%		5.12%	0.30%	23.72%	3.57%	27.29%	2.00%	147.19%	5.82
(2038)	25.79%	18.30%		5.21%	0.30%	23.81%	3.65%	27.46%	1.67%	148.86%	5.77
(2039)	26.30%	18.30%		5.34%	0.30%	23.94%	3.68%	27.63%	1.33%	150.20%	5.71
(2040)	26.71%	18.30%		5.43%	0.30%	24.03%	3.72%	27.76%	1.05%	151.25%	5.66
(2041)	27.11%	18.30%		5.57%	0.30%	24.17%	3.77%	27.93%	0.82%	152.07%	5.61
(2042)	27.41%	18.30%		5.60%	0.30%	24.20%	3.46%	27.66%	0.25%	152.31%	5.56
(2043)	27.72%	18.30%		5.69%	0.30%	24.29%	3.85%	28.13%	0.41%	152.73%	5.51
(2044)	28.01%	18.30%		5.76%	0.30%	24.36%	3.50%	27.86%	-0.14%	152.58%	5.45
(2045)	28.24%	18.30%		5.83%	0.30%	24.43%	3.51%	27.93%	-0.31%	152.27%	5.39
(2046)	28.44%	18.30%		5.90%	0.30%	24.50%	3.51%	28.01%	-0.43%	151.84%	5.34
(2047)	28.63%	18.30%		6.01%	0.30%	24.61%	3.51%	28.12%	-0.51%	151.33%	5.29
(2048)	28.76%	18.30%		6.02%	0.30%	24.62%	3.19%	27.81%	-0.95%	150.38%	5.23
(2049)	28.92%	18.30%		6.07%	0.30%	24.67%	3.20%	27.88%	-1.04%	149.34%	5.16
(2050)	29.00%	18.30%		6.09%	0.30%	24.69%	3.22%	27.90%	-1.10%	148.24%	5.11
(2051)	29.02%	18.30%		6.13%	0.30%	24.73%	2.87%	27.60%	-1.42%	146.82%	5.06
(2052)	29.06%	18.30%		6.14%	0.30%	24.74%	3.20%	27.94%	-1.12%	145.70%	5.01
(2053)	29.04%	18.30%		6.14%	0.30%	24.74%	2.87%	27.61%	-1.43%	144.27%	4.97
(2054)	29.08%	18.30%		6.15%	0.30%	24.75%	3.19%	27.94%	-1.14%	143.13%	4.92
(2055)	28.99%	18.30%		6.15%	0.30%	24.75%	2.88%	27.62%	-1.36%	141.77%	4.89
(2056)	28.93%	18.30%		6.15%	0.30%	24.75%	2.86%	27.60%	-1.33%	140.44%	4.85
(2057)	28.90%	18.30%		6.16%	0.30%	24.76%	3.16%	27.92%	-0.98%	139.45%	4.83
(2058)	28.81%	18.30%		6.16%	0.30%	24.76%	2.86%	27.62%	-1.19%	138.26%	4.80
(2059)	28.76%	18.30%		6.16%	0.30%	24.76%	2.84%	27.60%	-1.16%	137.10%	4.77
(2060)	28.73%	18.30%		6.20%	0.30%	24.80%	3.09%	27.89%	-0.84%	136.26%	4.74
(2061)	28.65%	18.30%		6.13%	0.30%	24.73%	2.86%	27.59%	-1.06%	135.20%	4.72
(2062)	28.60%	18.30%		6.13%	0.30%	24.73%	2.84%	27.58%	-1.02%	134.18%	4.69
(2063)	28.57%	18.30%		6.14%	0.30%	24.74%	3.08%	27.83%	-0.75%	133.43%	4.67
(2064)	28.58%	18.30%		6.19%	0.30%	24.79%	3.07%	27.86%	-0.72%	132.71%	4.64
(2065)	28.54%	18.30%		6.15%	0.30%	24.75%	2.82%	27.57%	-0.96%	131.74%	4.62
(2066)	28.54%	18.30%		6.20%	0.30%	24.80%	3.05%	27.85%	-0.70%	131.04%	4.59
(2067)	28.50%	18.30%		6.16%	0.30%	24.76%	2.81%	27.57%	-0.93%	130.12%	4.57
(2068)	28.46%	18.30%		6.13%	0.30%	24.73%	2.81%	27.54%	-0.92%	129.20%	4.54
(2069)	28.46%	18.30%		6.17%	0.30%	24.77%	3.03%	27.80%	-0.66%	128.54%	4.52
(2070)	28.45%	18.30%		6.14%	0.30%	24.74%	2.81%	27.55%	-0.90%	127.64%	4.49
(2071)	28.41%	18.30%		6.14%	0.30%	24.74%	2.82%	27.56%	-0.86%	126.79%	4.46
(2072)	28.37%	18.30%		6.14%	0.30%	24.74%	2.82%	27.56%	-0.81%	125.98%	4.44
(2073)	28.36%	18.30%		6.14%	0.30%	24.74%	2.79%	27.53%	-0.83%	125.15%	4.41
(2074)	28.32%	18.30%		6.14%	0.30%	24.74%	2.80%	27.54%	-0.78%	124.36%	4.39
(2075)	28.31%	18.30%		6.14%	0.30%	24.74%	2.82%	27.56%	-0.76%	123.61%	4.37
(2076)	28.26%	18.30%		6.13%	0.30%	24.73%	2.59%	27.32%	-0.94%	122.66%	4.34
(2077)	28.21%	18.30%		6.12%	0.30%	24.72%	2.61%	27.33%	-0.88%	121.78%	4.32
(2078)	28.16%	18.30%		6.11%	0.30%	24.71%	2.59%	27.30%	-0.86%	120.92%	4.29
(2079)	28.13%	18.30%		6.13%	0.30%	24.73%	2.57%	27.30%	-0.84%	120.08%	4.27
(2080)	28.04%	18.30%		6.08%	0.30%	24.68%	2.41%	27.09%	-0.95%	119.13%	4.25
(2081)	27.98%	18.30%		6.09%	0.30%	24.69%	2.40%	27.09%	-0.89%	118.25%	4.23
(2082)	27.92%	18.30%		6.07%	0.30%	24.67%	2.39%	27.06%	-0.86%	117.39%	4.20
(2083)	27.86%	18.30%		6.05%	0.30%	24.65%	2.43%	27.09%	-0.77%	116.62%	4.19
(2084)	27.76%	18.30%		6.03%	0.30%	24.63%	2.26%	26.88%	-0.87%	115.75%	4.17
(2085)	27.70%	18.30%		6.04%	0.30%	24.64%	2.42%	27.06%	-0.64%	115.11%	4.16
(2086)	27.61%	18.30%		6.04%	0.30%	24.64%	2.26%	26.89%	-0.71%	114.39%	4.14
(2087)	27.48%	18.30%		6.01%	0.30%	24.61%	2.09%	26.70%	-0.78%	113.62%	4.14
(2088)	27.41%	18.30%		5.98%	0.30%	24.58%	2.26%	26.84%	-0.57%	113.05%	4.12
(2089)	27.29%	18.30%		5.97%	0.30%	24.57%	2.11%	26.68%	-0.60%	112.44%	4.12
(2090)	27.19%	18.30%		5.94%	0.30%	24.54%	2.12%	26.66%	-0.53%	111.91%	4.12
(2091)	27.10%	18.30%		5.91%	0.30%	24.51%	2.13%	26.64%	-0.46%	111.46%	4.11
(2092)	27.00%	18.30%		5.91%	0.30%	24.51%	2.14%	26.65%	-0.36%	111.10%	4.11
(2093)	26.91%	18.30%		5.90%	0.30%	24.50%	2.15%	26.65%	-0.26%	110.84%	4.12
(2094)	26.79%	18.30%		5.87%	0.30%	24.47%	2.02%	26.49%	-0.30%	110.54%	4.13
(2095)	26.70%	18.30%		5.85%	0.30%	24.45%	2.04%	26.49%	-0.20%	110.33%	4.13
(2096)	26.61%	18.30%		5.82%	0.30%	24.42%	2.06%	26.48%	-0.12%	110.21%	4.14
(2097)	26.52%	18.30%		5.81%	0.30%	24.41%	2.08%	26.49%	-0.03%	110.18%	4.16
(2098)	26.43%	18.30%		5.80%	0.30%	24.40%	2.11%	26.50%	0.08%	110.26%	4.17
(2099)	26.33%	18.30%		5.78%	0.30%	24.38%	2.00%	26.38%	0.04%	110.30%	4.19
(2100)	26.22%	18.30%		5.74%	0.30%	24.34%	2.03%	26.37%	0.15%	110.45%	4.21

The easiest way to see this result is to notice three key variables in Chart 2. First, the black line from the bottom left corner of the picture that is drawn at 0.33% denotes the "Top Up Contribution" or additional subsidy included in the system. This additional resource impacts the GPIF/PRFA Surplus so that now the red line is approximately zero closer to the end of the forecast period of 2100. In Chart 1 (No Reform Base Case), this line falls below 0% in 2039 and stays below 0% and hence such a reform is a clear improvement to the financial stability of the system. Equally important, the Trust Fund is stabilized at a level equal to approximately 1.1 times wages. The asset-to-wage ratio is also currently 1.1 and rises as surpluses lead to additional accumulation to a level of approximately 1.55 times, but then declines as pensions peak around 2045 and stabilizes at 1.1 Such an increase in the proportion of assets to wages from 1 time wages to 1.5 times wages and then falling back to 1.1 times wages is less of an issue for Japan than it was for the U.S.A. This follows. because Japan has wisely chosen to invest its portfolio with a global perspective, whereas initial recommendations for the U.S.A. in MM suggested a purely domestic portfolio to address political realities. Most critically, the U.S. Trust Fund had not been invested in marketable securities to begin with. Therefore, in the U.S., the issue of the SS Trust Fund "crowding out" private investment and influencing capital markets is more severe than for Japan as in Japan assets are invested globally.

Now the cost ratio of 26.22% in steady state is being met through total contributions of 24.3% (18.3% + 5.7%+0.33%) and the balance through the return on investment which is equal to 1.9% of wages. The interest element of 1.9% is generated by a nominal return of

3.2% deflated by nominal wage growth of 2.1%, combined with the decline in labor force and the difference multiplied by the Asset to Wage ratio of 1.1. One can argue that this additional contribution is not needed as the current reform ensures that all benefits can be paid for the next 95 years. However, from a long term perspective, maintaining a partially funded system is preferable to reverting to pure PAYGO and hence this simulation.

A partially funded system is nothing but a combination of a pure PAYGO and a fully funded system, with the degree of funding determining the weights of each. Hence, we can split up this mixed system into a fully funded and a pure PAYGO system. The technique for conducting such an analysis is described in MM, Chapter 8. Effectively, we can consider 2.2% being directed to the funded system, which with an asset-to-wage ratio of 1.1 and a gross return of 3.2%, generates total resources of 4.1%.[14] The balance of the contribution = 22.14% (24.3% - 2.2%) combined with 4.1% from the funded system results in the payment of the cost ratio of 26.3%.

Notice a big difference here from the Base Case. While in the Base Case, the ratio of Assets-to-Benefits is gradually targeting 1 in 2100; in the MM approach, we are targeting a ratio between 4 and 5 which is much closer to current levels than in the Base Case. Hence the fundamental difference between the current Japanese reform approach and the MM approach is to maintain a partially funded system (MM) as opposed to reverting to a PAYGO system (current Japanese reform).

[14] Such a system would be generating a replacement rate on average salary of 10.77% on the assumption of 40 years of service and 18 years of life expectancy post retirement, with inflation at 1%, growth of nominal wages at 2.1% and return of assets at 3.2%.

Partial Model: Ensure solvency through higher returns

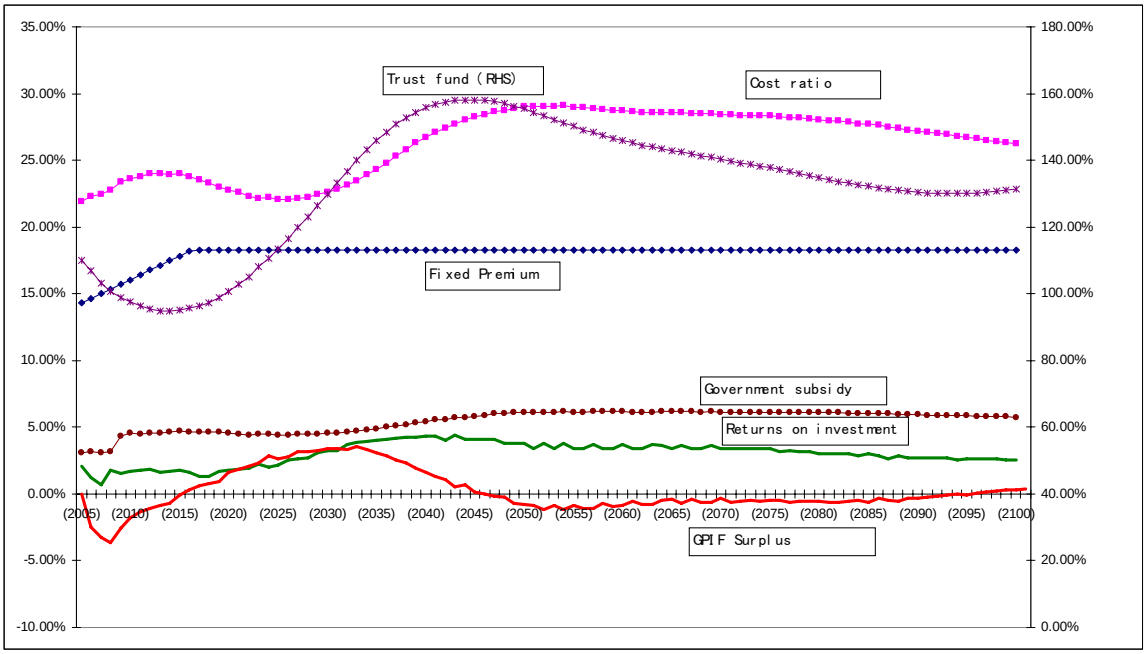
In this approach, we evaluate the impact on the system if instead of targeting just 3.2% nominal returns (or 1.1% above the annual rate of increase of wages), the MHLW directed PRFA to earn a higher rate. This return is not set arbitrarily. Instead, using the MM approach the target level is set at a rate of return that creates a stable pension system (based on the ability to pay pensions without depleting the asset-to-wage ratio) and hence is set 0.3% higher at 3.5%. As Chart 3 demonstrates, earning a higher investment return on the Trust Fund by 0.3% would create a stable system where the Asset-to-Wage ratio is stabilized at 1.3 times wages. As we can see in Chart 3, the cost ratio of 26.3% can be met easily through a total contribution of 24.04% (18.3% + 6.1%) and the balance 2.2% from the returns of the Trust Fund. Coincidentally, with a higher target rate of return, the required asset-to-wage ratio to ensure solvency is only marginally higher (than the current level) at 1.3 times and this has important implications for whether such a solution is feasible.

We provide such a simulation in this paper as it is politically more feasible to improve the long term solvency of the system through appropriate investment policy as opposed to raising contributions, especially since a higher return may create a more stable system for the future. We will show that such an additional return is easy to achieve given the current fund structure of the PRFA and the likely changes occurring to the portfolio from maturing loans and related cash flows. It is quite amazing that just a small increase in the target rate of return can convert the Japanese pension system from a potentially unstable

long term PAYGO system to a very viable and long term financially stable partially funded system. In discussing such initial findings with many Japanese scholars, our understanding is that such insights were not discussed during the reform process and hence the importance of such simulations.

Chart 3: Improving Financial Stability through Higher Investment Returns
Investment Return of 3.5%; No Additional Contribution

Other ratios (LHS) (as a percentage of wages) Trust Fund (RHS)



Ideal Model: Ensure solvency through better returns and lower contributions

Given the results from the previous simulations, we went the additional step to ask what would be the impact on contributions/subsidies if the PRFA portfolio had a return of 4.2% nominal. We will examine the feasibility and possible implications for asset

management operations of PRFA later, but as shown in Chart 4, continuing in a similar approach, we can show that if the investment return was raised by 1% to 4.2%, then no additional contribution would be required, but instead contributions can be cut by 0.9% immediately!! In Chart 4, the "Top Up Contribution" lies below the 0% line, the PRFA Surplus is stabilized at 0%, and the Trust Fund approaches 1.2 times wages.

Again, we can split up this mixed system into a fully funded and a pure PAYGO system. Effectively, we can see this at 1.93% being directed to the funded system, which with a asset-to-wage ratio of 1.2 and a gross return of 4.2%, generates total resources of 5.13%.[15] The balance of the contribution = 21.21% (23.14% - 1.93%) combined with 5.13% from the funded system results in the payment of the cost ratio of 26.3%.

Given such a stunning result that maintaining the current investment return target of 3.2% will require an immediate increase in social security taxes of 0.3% to create a more stable system as suggested in MM, whereas generating a higher return of 4.2% could lead to a permanent reduction of contributions of 0.90%, one has to conclude that the investment policy and investment procedures of GPIF/PRFA may need to be reviewed, but with a much higher goal of ensuring the long term solvency of the pension system. However, in order to move in such a direction, one must be convinced that the benefit of taking on any additional political risk of targeting a higher investment return is worth the benefit of lowering contributions and also the volatility of contributions as the greater the

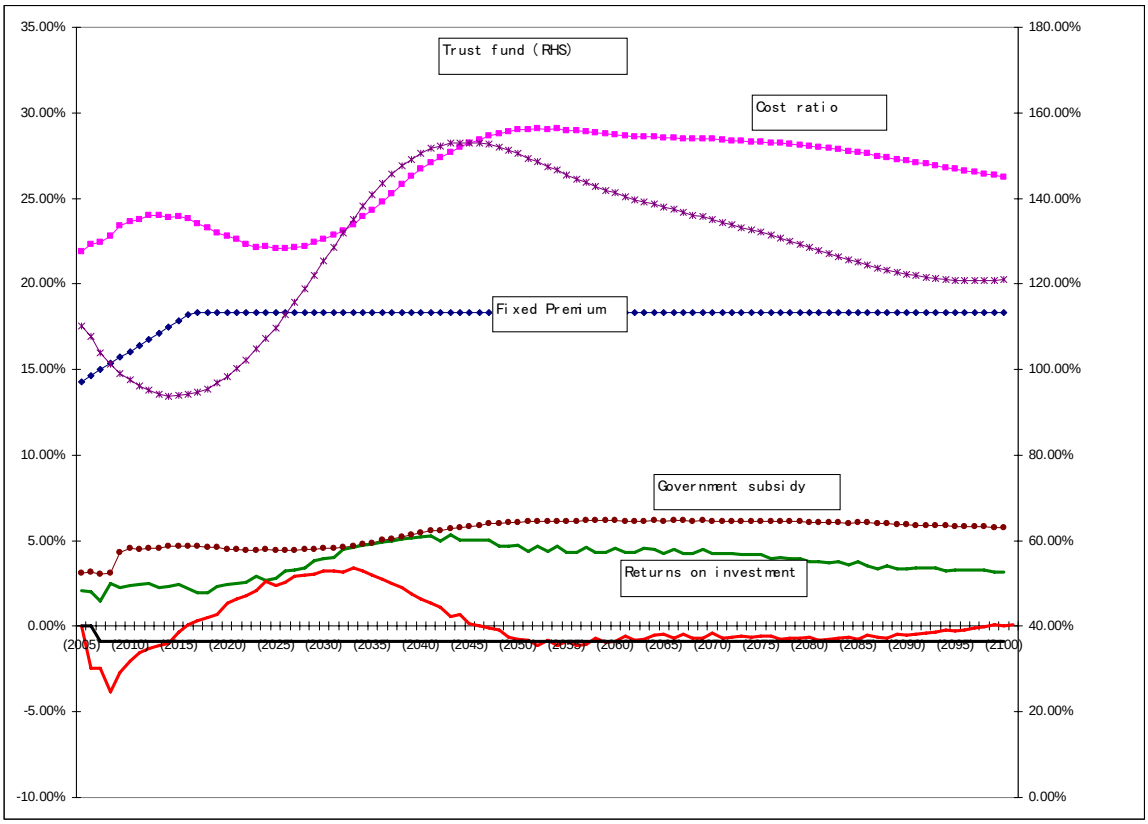
[15] Such a system would be generating a replacement rate on average salary of 12.66% on the assumption of 40 years of service and 18 years of life expectancy post retirement, with inflation at 1%, growth of nominal wages at 2.1% and return of assets at 4.2%. This suggests a greater contribution from the funded system in paying benefits versus a model with a lower return on assets.

component of funding, the less susceptible the system is to small changes in population or productivity growth as shown in Appendix 1.

Chart 4: Lowering Pension Taxes while Preserving Financial Stability through Higher Investment Returns

Investment Return of 4.2%; Reduction in Contribution = -0.9%

Other ratios (LHS) (as a percentage of wages) Trust Fund (RHS)



In the next few sections we examine the impact of a passive change in the target allocation and other mechanisms to improve returns, combined with a discussion of how such investments can be protected from political manipulation or frequent changes as investing in capital markets implies volatility of returns. As MM argue, the government with an infinite time horizon has the ability to bear this risk, especially since it has smartly decided to retain DB benefits when most other countries want to shift to DC and

transfer investment risk to participants (who are least capable of bearing it). In short, the benefit of compounding returns at a rate of growth that is potentially higher than the growth of real income allows for resources for pensions to be gathered at a greater rate. However, to gain the advantage of compounding, reforms cannot be delayed because as shown above, every delay in reforms implied additional costs to future generations.

SECTION 5: BACKGROUND ON INVESTMENTS:

MM Approach to Managing Portfolio and Resulting Volatility – "The Swap"

MM start with the key innovative conclusion that a DB pension fund can be ensured by guaranteeing a particular rate of return to participants. This has also been shown implicitly in the simulations above and in the Appendix 1. Since MM favors partially funded systems to PAYGO systems, they provide a series of investment recommendations as to the portfolio composition, management and governance of the assets to demonstrate that recommendations by other analysts to privatize Social Security were based on poor assumptions of incompetence and corruption on the part of government officials and that investment returns can be ensured by appropriate policies and procedures.

They recommend that the portfolio be invested in global capital markets, in a market capitalization weighted approach (to remove relative arbitrariness in portfolio selection made by the Clinton Administration to favor a bond heavy portfolio). However, they recognized that it would be politically difficult to have the Social Security Administration

(SSA) report variable returns to an unsophisticated public. To ensure that the volatility of returns was not transferred to the SSA, they proposed an innovative swap between the Treasury in the United States and SSA. This is an off-market transaction, but in effect the Treasury would pay SSA the required guaranteed return (based on the expected return of the portfolio) and receive the volatile market-based returns from SSA. This would ensure that SSA would receive investment returns that were fixed annually and with zero volatility thereby convincing the lay person that Social Security was well funded and not buffeted by market volatility. Their recommendation was based on the assumption that it is the responsibility of the government to provide Social Security and given its infinite life, was more capable of bearing investment volatility than any individual (this is less relevant for Japan that is committed to defined benefits with government sponsorship). This swap would also prevent the political manipulation of assets as any poor investments of the SSA portfolio would lead to low returns on the portfolio and therefore lower payments by SSA to Treasury, in turn leading to losses for Treasury in the swap. This was an attempt by MM to make any manipulation of assets transparent and costed immediately as opposed to transferring such problems to future generations. However, to the extent that the guaranteed rate was vastly different from actual experience (as capital markets may provide a higher or lower return than expected), they constructed a balancing mechanism whereby contributions would be kept flexible, but with very strict rules as to when and how contributions would be modified. MM were also very forceful that this portfolio should be managed by a professional investment team under the supervision of a Blue Ribbon Board, that would be independent of political interference, much like the Canadian and Irish example. MM also suggested that initially it would

probably make sense to invest these assets in a relatively passive manner, though this could lead to problems in the capital markets if a large portion of the local stock market was not managed with a keen eye on corporate governance etc. Hence, MM opened up the possibility that external managers could be hired to outperform such benchmarks through their superior knowledge of valuations, while at the same time ensuring that SSA earned a return close to the benchmark return.

GPIF/PRFA Investment Issues and Issues Specific to Japan[16]

The target return of the PRFA fund is set 3.5% nominal, but with expenses and other costs, the net return is expected to be 3.2% with a standard deviation of 5.5%. It appears that in the reform process discussion, most of the focus was spent on setting the benefits and contribution levels, and less focus on examining the impact of various investment returns on these two parameters. In addition, it was made clear that one of the key interests of Japanese politicians was to reduce the size of the assets of the GPIF/PRFA (i.e., government control), but it is quite likely that the trade-off between reducing the size of assets and possible raising of contributions was not highlighted in these discussions. Hence the simulations in the previous sections are of particular interest and the question is whether additional returns can be secured, if so how, and can the political issues be managed in Japan so that contributions may even be lowered in the future? Clearly, some of the desire to invest the GPIF/PRFA portfolio largely in bonds (and not mark them to market) may reflect the desire to not have to report variable and negative

[16] I have benefited from listening to a presentation by Mr. Kawase, President of PRFA, at the Nomura Securities Conference in Tokyo, November 2006. Again, any errors in understanding are mine.

rates of return to the public, who may see such short term variations in the GPIF/PRFA portfolio as an indication that their pensions are at risk.

The process of converting the return target to a practical portfolio is delegated to GPIF/PRFA, which is advised by a number of academic experts and representatives from various vested groups (employers, employees etc). Over the next three years, the fiscal loan fund will be converted to fixed income instruments (indexed to the Nomura BPI) over time thereby ensuring that the portfolio will be a fully marketable portfolio in 3 years. For FY 2008, the target for GPIF/PRFA will be as follows:

Domestic Fixed Income (Nomura BPI Index) = 67%,
Domestic Stocks (TOPIX) = 11%;
International Stocks (MSCI-KOKUSAI) = 9%,
Foreign Bonds (Citi World Govt Bond ex Japan) = 8%
Cash = 5%.

This can be seen as a portfolio 75% in Bonds, 20% in Equities and 5% in Cash. We will term this long term portfolio the Strategic Asset Allocation or SAA. Most of the investments will be made passively and indications are that as much as 80% will be invested passively. Given the relatively low target return, the focus for PRFA will be more on managing “beta” than on trying to generate alpha.

The basic assumption is that government bonds will provide a nominal return of approximately 3% (inflation is estimated at 1%) and that equities is expected to provide an equity risk premium of approximately 3%. Hence, the GPIF/PRFA portfolio can be weighted quite heavily in government bonds and Cash to achieve the target rate of 3.2%, after costs, with minimal volatility. In addition, there appears to be an implicit restriction that the foreign stock allocation should be below that of the Japanese stock market. Some estimate appears to have been made as to whether GPIF/PRFA holdings in any one market is likely to constitute a substantial portion of a market given the size of the fund (and potential impact on market liquidity) and the general conclusions appears to be that it is not the case.[17] However, in the case of the government bond portfolio, many of the listed bonds are held by government entities and not traded and hence analyses on GPIF/PRFA holding versus total market capitalization or total bond issuance may underestimate the true impact on liquidity in this market. The key point here is that PRFA is very sensitive to the issue of market impact of its portfolio given the substantial size of assets exceeding Yen 100 Trillion (approximately USD 1 Trillion).

One practical reality of managing portfolios, is that impossible to maintain a portfolio at a fixed set of weights since markets are dynamic and moving every day at different rates of return thereby affecting the relative weights of each of these asset categories. Therefore, ranges have been set around the SAA within which the portfolio is allowed to deviate.

17 We base this comment on a presentation by Mr. Suzuki at the Pacific Pensions Institute Conference in Seoul, Korea in June 2006. The author did not attend the conference, but received a copy of the presentation and hence there may be problems in interpretation. Based on current GPIF/PRFA allocations (as of June 2006) to Domestic Bonds of 36 Trillion Yen is only 7.6% of the domestic bond market capitalization; Domestic Stocks at 17 Trillion Yen is only 5.5% of domestic stock market capitalization; Foreign bonds at 8% of the fund is only 0.9% of market share and foreign stocks of 10 Trillion Yen is only 0.4% of market capitalization.

This is very common practice for pension investment portfolios. The permissible ranges across assets is very wide: in Domestic Bonds +/-8%; Domestic Stocks +/-6%; Foreign Assets +/-5%. Because there is a risk to the downside of the fixed income portfolio if interest rates rise given the historical level of Japanese rates, it appears from the publicly available literature that GPIF/PRFA is planning to use “Buy and Hold” accounting, which carries the asset at par as opposed to marking-to-market lower if rates rise. As indicated earlier, such accounting policies appear to be an attempt to insulate such institutions from naïve criticisms that pensions are unsafe because returns are negative for a given period. In an interesting way, this is implicitly a variation of the swap mechanism suggested by MM, but just for the fixed income portfolio.

Can GPIF/PRFA Achieve a Higher Rate of Return Given the Size of the Portfolio and Other Restrictions?

It seems like Japan is already effectively creating the swap mechanism described in MM through the approach of not marking fixed income assets to market. However, we would recommend that PRFA and MHLW consider the swap approach proposed in MM as opposed to “Buy and Hold” accounting just for fixed income assets as the swap approach (a) would apply to the entire portfolio and removes the problem that short term negative performance in markets causes people to accuse the government or GPIF/PRFA employees of bad asset management or worsening the long term solvency of EPI; and (b) makes any potential deficits transparent and prevents issues of weak solvency from being hidden for many years.

In addition to the volatility of returns as a source of concern, perhaps the most contentious issue for Japan is less the rate of return of investments than the size of the fund. We have addressed the issue of volatility of returns through the idea of the swap and will now address the issue of the size of assets. There are two angles to the size of assets problem; (a) a political one of people feeling that too large a portfolio in government hands is dangerous; and (b) the economic aspect of managing a large fund and whether the size is large in nominal terms or relative to wages.

On the political front, it appears that the case for partial funding may not have been made as explicitly as in MM. From our discussions, it appears that the appearance of a large fund under government control was the key issue. However, one must trade-off the potential benefits against any perceived problems and in this case, one could argue that the goal of creating a financially stable long terms system is truly worth striving to achieve, unless the large asset pool truly creates economic problems. Therefore, if the political parties can be convinced of the virtues of creating a partially funded system, with the intent of making the system more financially stable for the long term with a potentially lower longer term tax on employees and employers, then there are a few different choices to consider for raising the target rate of return that fall within the context of generating returns purely from beta investments (and not investing in hedge funds etc.).

From an economic perspective, one cannot see the size of the fund in nominal Yen terms without normalizing for the growth of the economy and hence our focus on reporting the Trust Fund as a percentage of wages. As can be seen from Charts 1 – 4, under our proposed reform options of raising contributions or returns, the asset-to-wage ratio is generally in the neighborhood of current levels and hence should ideally not create any economic (or ideally even political issues) that are different from today. Therefore, unless there is a serious concern about the current asset-to-wage ratio of approximately 1.3, one must question why there is an issue with such a level being maintained as a long term steady state level. In the U.S. case, the ratio had to rise from 0.3 to 1.5 which was a meaningful increase – in the Japanese case, the long term level is so similar to the current level that the economic case should be very simple. If the current asset-to-wage ratio is not crowding out private investment or creating disruption in global market (and to date, there is no evidence of the case), then there is no case against retaining a moderate level of assets to maintain a partially funded system, especially when the fund is invested in global capital markets.

We have tried to dispel the objections that could arise from a political or economic perspective to keeping the asset-to-wage ratio between 1.1 and 1.3 (depending on the solution chosen). However, the approach taken to achieve these lofty goals of creating long term pension financial stability can lead to additional political problems. We now address how the rate of return of the GPIF/PRFA portfolio may be achieved.

In terms of raising the return on the portfolio, there are many possibilities but for simplicity[18], we will examine two simple approaches as they require minimal changes to current PRFA/GPIF operations: (a) Changing the long term SAA to target a higher expected return without changing the asset composition; and (b) Managing the assets effectively to generate potentially higher returns without changing the SAA or overall rebalancing policies. In addition, we will focus the attention of the analysis primarily on raising returns by approximately 0.3% to create a long-term stable partially funded system without permanent changes to the contribution rate. Should policy makers decide that an even higher rate of return of 1% leads to desirable welfare gains because they can lead to lower contributions, then some variant or combination of the approaches listed below can be adopted quite easily.

Changing the Long Term SAA

The simplest approach to raising the expected return on the assets would be to increase the allocation of equities by 10%-15%. With a 3% equity premium, an increase in equity of 10%-15% would lead to an additional return of 0.3%-0.45%. It would also potentially lead to a slightly more volatile portfolio, but since we do not have access to the assumptions made on volatilities or correlations across assets, we are unable to comment on the exact magnitude of the change. This incremental additional volatility is not much

[18] Among the many possibilities that we do not consider are investing in alternative assets such as real estate and private equity, and targeting active management as a source of excess returns over the benchmarks. One can imagine that the portfolio management personnel at GPIF/PRFA are under pressure to consider active management strategies, but we will show that focusing on the beta assets can provide adequate opportunities for adding the needed returns without having to create new infrastructure to examine external active managers.

of an issue if the swap mechanism is implemented, but could lead to optical/political problems if the swap is not implemented. This follows as an increased allocation to stocks would increase the expected return, but could potentially lead to additional negative periods of performance. MM examined such possibilities in the context of U.S. data and found that increasing allocations to equities, based on historical data, increased volatility, but did not impact other typical pension risk measures. Future research on portfolio allocations by GPIF/PRFA staff or research analysts should replicate the MM simulations on various asset allocations with Japanese data.

It appears that the more pressing political issue is whether it makes sense to increase the allocation of the portfolio to Domestic Stocks? MM provide a series of asset allocation choices between equities and fixed income assets for the U.S. market and show that keeping allocations to fixed income assets high has the effect of lowering the rate of return, but also increasing the risk of not achieving pension objectives (along multiple risk parameters). Given that the current ownership of PRFA of the total TOPIX market cap is already 5.5%, a 10-15% increase in the allocation to the TOPIX could lead to a meaningful percentage of the market being held by a single entity and can cause liquidity problems for other investors and PRFA. The other simple alternative would be to invest all of the assets in foreign equity, which given the percentage of market capitalization owned by PRFA is going to have a miniscule impact on market liquidity. However, such an approach will cause the allocation percentage of foreign stocks to exceed the allocation percentage to domestic stocks and this could lead to political problems given the previously stated objective that the allocation to foreign stocks should be lower than

domestic stocks. Hence our earlier recommendation of creating allocations to assets that reflect market capitalization weights of assets as this makes allocation decisions less political and arbitrary and using a market capitalization basis, just for equities, would make a clear case for a larger allocation to foreign stocks than domestic stocks.

The one additional advantage to investing in foreign stocks, assuming that they are invested on an unhedged basis[19], is that it will lead to sales of yen and purchases of foreign currencies, which can have the effect of leading to a depreciation of the yen. This can be beneficial to Japanese businesses that compete globally and also for monetary policy. Given the likely debate over investing additional assets abroad, the compromise may be to invest some portion in the domestic market and some portion in the foreign market so as to not violate the principle that foreign stock allocations not exceed domestic stock allocations.

We have ignored the possibility of including other assets into the SAA, but it is possible to increase the expected return without increasing volatility of additional asset classes are included that are not highly correlated with the existing assets. Many pension funds globally have invested in hedge funds and other strategies and given the marginal increase required in the expected return, we do not advocate such an approach. However, it may be wise to consider other liquid, transparent and broadly accepted asset classes to increase the return while managing volatility.

[19] See "Hedging Currency Risk in International Trade and Investment (2006)", by M. Arikawa and A. Muralidhar, Center for Advanced Research in Finance Working Paper, University of Tokyo. It covers issues relating to currency hedging of foreign investments by Japanese pension funds.

Increasing Returns by 0.3% Through Effective Management of Current Assets.

There are four key observations that we make to present an alternative option to changing the SAA as a means of raising GPIF/PRFA returns without changing any administrative issues or creating political problems. The four observations are: (a) it is impossible to maintain a portfolio constantly at its SAA weights because markets are moving daily; (b) GPIF/PRFA has implemented extremely wide ranges around each asset class to prevent constant rebalancing; (c) the government loans are maturing in the next few years and will be sent to GPIF/PRFA as cash flows that require investing in markets and where and how these cash flows are invested can be a source of return (or if badly made a source of negative returns); and (d) the cash flow position of the fund will change rapidly as in FY 2008, GPIF/PRFA will experience cash out flows. In effect, these four observations lead us to the recommendation that GPIF/PRFA consider "Intelligent Rebalancing" or "Dynamic and Intelligent Beta Management" as a means to add additional return from their day-to-day asset operations.[20]

In short, every decision that is made by GPIF/PRFA staff to invest the cash inflows or outflows affects the final return – in short, GPIF/PRFA staff are taking active bets even if they are keeping the asset allocations within the prescribed ranges around the SAA. Equally important, since asset markets go through cycles and are not highly correlated,

[20] See "The Case for View Based Dynamic ALM for Japanese Pension Funds: A New Approach to Liability Driven Investing" by M. Arikawa, A. Muralidhar and S. Muralidhar, Center for Advanced Research in Finance Working Paper, University of Tokyo. This paper expands on the concept highlighted here, but from an asset-liability management perspective and shows how innovative Japanese funds can implement a smart rebalancing to improve their solvency.

there will be periods when it will be optimal to be allocating more to one asset class as opposed to another. In the past, pension funds have allocated these cash flows with the objective to always trying to achieve the SAA, but such an approach which we call "Naïve Rebalancing" has the potential of causing staff to buy assets which are already declining or have a high probability of declining in the future. Under the "Intelligent Rebalancing" method, GPIF/PRFA staff should leverage their investment committee or consultant/external manager expertise to build simple rules based on observable economic factors to help them understand what the likely impact will be on asset performance from such phenomena. In short, the operations and governance of GPIF/PRFA can be greatly enhanced because they will adopt the same investment practices that are used by the best asset managers globally. Moreover, creating such formal rules across all assets creates a disciplined investment process.

To be more explicit, Intelligent Rebalancing requires a responsible investor such as GPIF/PRFA to determine what factors affect whether the assets in their portfolio will perform well or poorly based on current market factors and make appropriate decisions on beta assets to reflect such analysis.[21] All the analysis to make such intelligent decisions are publicly available and have been researched by the many banks and academics. Being smart with respect to Beta is about creating simple rules that can capture the available market research, but more important have relevance to the Liabilities of this fund. The regular output of such rules is the recommended asset allocation weights to Beta assets depending on whether assets are favored or not in the

[21] This is quite different from tactical asset allocation (TAA) which is often unconstrained, though the same discipline of a good TAA program can be applied to just the beta assets and constraints.

current environment. Hence beta management is about Dynamic Asset Allocation (DAA) and not static allocation. Dr. Woody Brock would term Beta Management as Dynamic Passive Management.

We provide some examples using factors that can help manage allocations between Japanese Stocks and Bonds. For example, two profitable rules could be specified as follows: favor Domestic Stocks to be overweight by 0.25% over the benchmark weight of 11% when dividend yields are high or 2-month moving average of the Topix is greater than a 6-month moving average of the Topix. On the other hand, underweight Domestic Stocks by 0.25% when the opposite is true. Clients can evaluate many such ideas and ensure that their consistent application can lead to positive outperformance.[22] Combining many such rules across multiple assets can lead to diversification of results and still provide a very clear set of recommendations to GPIF/PRFA as to the aggregate recommendation. For example, if the dividend yield rule favors stocks, while the momentum does not, then it is an indication to GPIF/PRFA staff to be at the benchmark weight for Domestic Stocks.

[22] Such a process was demonstrated in the context of currency in Arikawa and Muralidhar (2006).

We created a combination of a number of such rules[23] to ensure that GPIF/PRFA could rebalance its assets using cash flows within the range with minimal turnover so as to not impact markets. We report in Table 3, the annualized excess returns over the SAA that would have been generated by applying such a multi-factor "Intelligent Rebalancing" approach. In addition, we provide typical pension risk and performance statistics such as relative risks, return-to-risk ratios, worst single month versus SAA from adopting "Intelligent Rebalancing", maximum drawdown, number of positive months (success ratio), ratio of Good/Bad risk and Annual Turnover. In this simulation,

Table 3: The Historical Potential Value-Added from an Intelligent Rebalancing Approach (07/03/1995 – 10/26/2006; No transaction cost assumed)

Performance Summary

Total Period

		Annualized Return	Annualized Standard Deviation	Annualized Return-Risk Ratio	Worst 'Single' Negative Performance	Maximum Drawdown	Confidence in Skill	Success Ratio	Ratio of Good/ Bad Risk	Annual Turnover
Total	Excess	0.35%	0.22%	1.6	-0.15%	-0.35%	100%	68.89%	1.42	4.05%

Source: AlphaEngine® - www.mcubeit.com

The most interesting result is that such an approach of "Intelligent Rebalancing" could have added 0.35% annually with minimal risks and a very high success ratio of 69% of

[23] The factors used in this model ranged from the strength of the yen, slope of yield curves, global equity risk, seasonality of markets, momentum of markets, momentum of 10 year yields, and default premiums to help GPIF staff allocate intelligently across Domestic Stocks, Domestic Bonds, Foreign Stocks, Foreign Bonds and Cash. *Each factor is **used to manage the allocation** between specific asset pairs to create a single rule and rules are combined to produce the Intelligent Rebalancing decisions.* Decisions are made just once a month thereby requiring infrequent decisions and coincident potentially with when cash flow decisions will be made. We have ignored transactions costs, but these could be easily added. Given the low annual turnover for the given added value, costs are unlikely to affect the profile dramatically. Past results are not a guarantee of future results, and hence this simulation is indicative of one possible result among many possibilities.

the months adding value relative to the SAA. Chart 5 shows the historical cumulative growth of the GPIF/PRFA SAA (Green) against the Intelligently Rebalanced Portfolio (Blue) and drawdowns of excess returns (Red and RHS). Clearly, based on this single historical simulation, which was not optimized, it can be shown that the performance could have been improved (with the usual caveats of historical simulations).

More critically, since GPIF/PRFA staff are always going to make such rebalancing decisions, this process of "Intelligent Rebalancing" not only makes decisions transparent, formal and state-of-the-art thereby improving the governance of the GPIF/PRFA fund and making it less susceptible to external criticism, but has the potential to raise the overall return by using market dynamic and cash flow decisions within the SAA range to favor assets likely to do well and underweight assets likely to do poorly for net gain to the overall fund. This is not a result that is specific to GPIF/PRFA but is something that can be applied by any investor in any part of the globe because of the dynamism of assets and the implicit bets being made by investment staff as they invest in cash flows.[24][25]

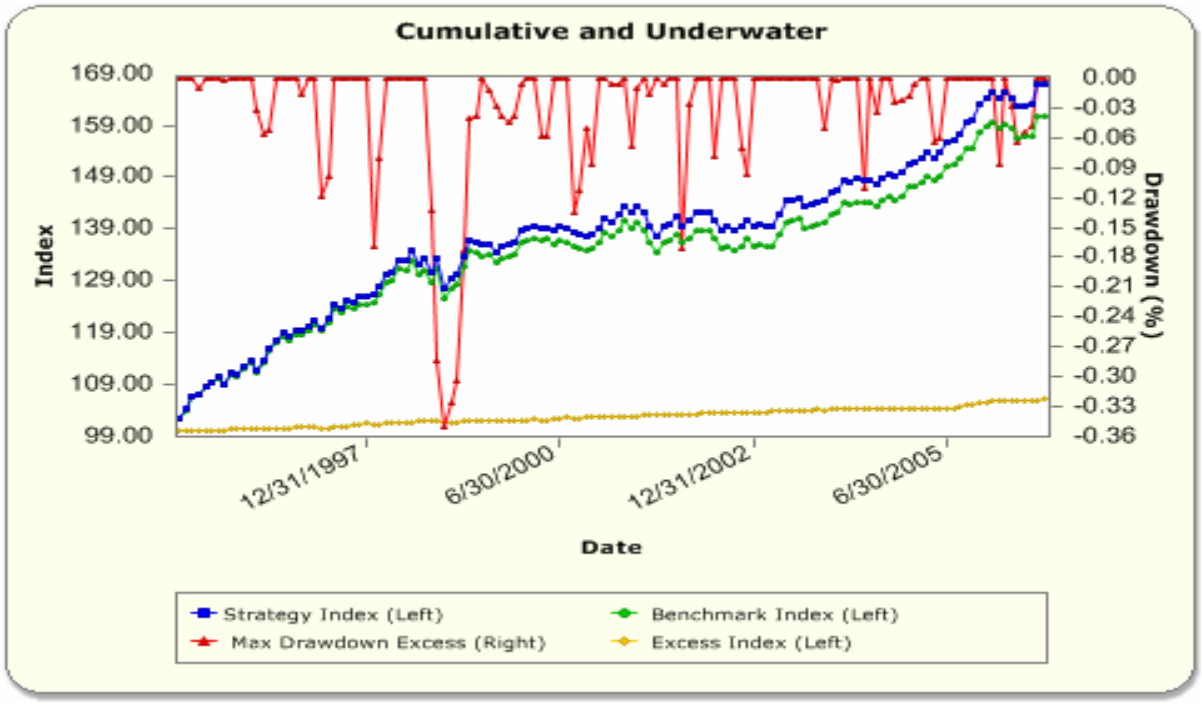
In short, this section was meant to highlight that given the current SAA for GPIF/PRFA, dynamism of markets, the ranges around the DAA, and the fact that staff will be making cash flow decisions on an ongoing basis, there is a potential to generate additional returns from intelligent management of the portfolio on only beta assets. Given the political

[24] See also "Beta Management: An integrated, transparent, rules-based framework (2006)", Tim Barrett, Executive Director and Chief Investment Officer, San Bernardino County Employees' Retirement Association, presentation at Institutional Investor - Hedge Fund Conference, October 23, 2006, Chicago, USA.

[25] Arikawa, Muralidhar and Muralidhar (2006) use the same techniques as mentioned in Barrett (2006) to focus on using intelligent beta management to improve solvency.

issues surrounding changes to the SAA, it may be more feasible to attempt to improve the returns of the GPIF/PRFA portfolio from applying state-of-the-art investment techniques to the operations of the portfolio management. If the portfolio managers feel that such a task is beyond their capabilities, then it is possible to outsource such decision making to external managers, but for now we have assumed that such a process can be implemented by GPIF/PRFA staff (as this has been done by staff of many public funds in the United States).

Chart 5: Cumulative Growth of SAA (green), Intelligently Rebalanced Portfolio (Blue) and Drawdown of Excess Returns (Red)



Source: AlphaEngine® - www.mcubeit.com

Section 6: Conclusions

In this paper, we have demonstrated that Japan, through its EPI system, has established an effective reform by retaining defined benefits when most of the world was drifting towards defined contributions (only to recognize the limited value of such a system). In addition, the reforms are broad and have helped temper the impact on benefits of significant ageing of the population. Moreover, through a judicious policy of creating a partially funded system Japan has a unique set of favorable circumstances that can allow it to achieve long term pension stability, especially since these monies are being transitioned to a market-based global portfolio with appropriate governance and oversight

We apply some insights from Modigliani and Muralidhar (2003) to the Japanese system and demonstrate that given the unique and far-thinking measures already undertaken by the Japanese, that the financing of pensions is robust. However, rather than gradually depleting the fund over the next 95 years, if a small improvement can be made to the target return of the fund, potentially contributions could be reduced, while also lowering the volatility of contributions. Modigliani and Muralidhar (2003) showed that keeping a system partially funded was beneficial relative to a pure pay-as-you-go system as it could lower the volatility of contributions and make countries more competitive (as contributions are a tax on companies and could lead to higher wages). In addition, we demonstrated that the basic improvement in return to keep contributions stable at the current level while achieving long term pension stability in steady state can

be achieved by either modifying the SAA, but if such a move is politically sensitive, then the additional 30 bps of returns could be easily achieved through a process of “Intelligent Rebalancing.” Such a process is not only good governance, but easily achievable by GPIF/PRFA especially since the fund will be impacted by cash inflows from maturing deposits and cash outflows to pay pensions, and the range around the SAA permits such intelligent management of assets given the cyclicality of financial markets. However, inspite of these measures, Japan may benefit from implementing the swap proposed by MM between GPIF/PRFA and MHLW to (a) prevent political interference in the management of assets and (b) to ensure that volatility in short term returns are borne by the government to achieve the higher goal of long term pension stability.

Japan has a unique opportunity to manage the most dramatic ageing of a population globally through some innovative, minor modifications to investment policy and implementation, especially since they area at a very advantageous situation currently relative to countries such as the United States. If such measures are not taken quickly, Japan could find itself in a situation where contributions may have to be raised or the volatility of contributions will be high. Such an outcome in the future would be a pity given that the currently implemented reforms have already put Japan on a much more stable path for pension stability in the EPI system.

APPENDIX 1 - Overview of long term contributions required under PAYGO vs. a funded system[26]

We ignore transition issues initially and begin by reviewing the forces that determine the required long term contribution rate in steady state, for the two alternative financing approaches: PAYGO and FULL FUNDING. [i] For each financing method, the contribution rate depends on a number of parameters, reviewed below. Some of these are "exogenous", *i.e.*, outside the direct control of policy makers. They include:

i) The rate of growth of real income (ρ), and its two components (items ii and iii);

ii) the growth of the labor force (n);

iii) productivity growth (q);

iv) longevity (e); and

v) the rates of return on various financial assets (r), and their volatility.

The policy determined parameters include:

i) the standard retirement age, which together with longevity determines the average duration of the pension annuity;

ii) the portfolio in which the accumulated capital of the fund is invested (important mostly for a funded scheme since under a pure PAYGO there is, in principle, no accumulated capital to invest); and

iii) the so-called "rate of replacement", or the ratio of the pension to some measure of income earned while working and contributing. The

[26] Adapted from Modigliani and Muralidhar (2003).

specification of the replacement rate involves detailing what measure of income should be used (*e.g.*, terminal versus lifetime average) and how it is related to the years of contribution.

Define a_t to be assets in a funded system at time t, and w_t to be the wage bill at time t. Also, defined A_t to be the asset to wage ratio, c_t to be the contribution rate at time t (i.e., contributions divided by wages) and p_t to be the cost ratio. In a funded system, one can observe the following dynamics.

$$A_t = [a_{t-1}(1+r)]/[w_{t-1}(1+\rho)] + c(t)-p(t)\ldots\ldots\ldots\ldots\ldots\ldots\ldots(A.1)$$

As a result, *A* can be approximated by the following:

$$A_t = A_{t-1}(1+ r-\rho)+c(t) -p(t), \text{ where } \rho = n + q\ldots\ldots\ldots\ldots\ldots(A.2)$$

Which can be rewritten as

$$A_t - A_{t-1} = A_{t-1}(r-\rho)+c(t) -p(t)\ldots\ldots\ldots\ldots(A.3)$$

But when the pension system reaches a steady state, assets must grow at the same rate as the wage bill, i.e., the growth of A(t) must be zero, implying the following fundamental relationship:

$$c(t) = p(t) - A_{t-1}(r-\rho)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(A.4)$$

We will call this equation the “Golden SS Rule.” The net return on the system’s reserves help pay a portion of the benefits, but provided that the net return is positive or $r>\rho$, which is the necessary condition for funding to be preferred to PAYGO.

The effect of the major parameters on the required contribution rate under different financing schemes is illustrated in Tables A.1A and A.1B which also serve to support our contention that, under realistic assumptions, a funded system is distinctly preferable to PAYGO, both because it requires lower long term contributions and because insolvency poses less of a problem. The rate of return (*r)* in the tables is the real (gross) rate of return. However, there are situations as shown in Tables A.1A and A.1B where PAYGO requires a lower contribution rate than funding, namely when $r < \rho$.

For our calculations we assume a set of parameters, which we regard as plausible though not necessarily coinciding with those relevant for the United States or any other country. These include: 40 years of contributions and a replacement rate of 50% of life average income (if we changed the assumptions on the replacement rate, all the contribution rates reported would change in proportion). As for average length of life after retirement, we show the implications of two alternative assumptions. In the left portion of the tables, we assume life expectancy of 16 years while on the right-hand side, life expectancy is assumed to be 18 years. Japan has similar characteristics with a more likely life expectancy scenario being 18 years. *It is further assumed that, for the funded scheme of Table A.1B, the assets of the fund are invested in the 'indexed portfolio' of all marketable securities, and swapped for the real interest rate indicated in the leftmost column.*

Tables A.1 A and A: Comparing contribution rates for different scenarios

(As a percentage of wages - some cells intentionally left blank)

Table 3.1A
Cost and Contribution Rates for Alternative Systems and Selected Scenarios
Assumptions: Working Life = 40 Years; Average Salary = 50% Replacement

Cost Ratio = *Pay-as-you-go* Scheme Contribution Rates for Different Scenarios

	Retired Life - 16 Years				Retired Life - 18 Years			
	Real Productivity Growth				Real Productivity Growth			
	0%	1.00%	1.40%	2.00%	0%	1.00%	1.40%	2.00%
Population Growth								
0%	20.00%	15.40%	13.40%	11.90%	22.50%	17.20%	N/A	N/A
1%	15.05%	11.70%	10.40%	9.00%	16.77%	N/A	N/A	N/A
2%	11.24%	8.80%	7.00%	N/A	12.41%	N/A	N/A	N/A

Table 3.1B
Cost Ratio = *Funded* Scheme Contribution Rates for Different Scenarios

	Retired Life - 16 Years				Retired Life - 18 Years			
	Real Productivity Growth							
	0%	1.00%	1.40%	2%	0%	1.00%	1.40%	2%
Return on Assets								
0%	20.00%	20.11%	20.15%	20.23%	22.50%	22.62%	22.67%	22.75%
1%	15.05%	15.33%	15.45%	15.63%	16.77%	17.08%	17.21%	17.41%
2%	11.24%	11.60%	11.75%	11.97%	12.41%	12.81%	12.97%	13.22%
3%	8.33%	8.70%	8.86%	9.10%	9.12%	9.53%	9.70%	9.96%
4%	6.13%	6.48%	6.63%	6.86%	6.66%	7.04%	7.21%	7.46%
5%	4.49%	4.80%	4.93%	5.14%	4.84%	5.17%	5.32%	5.54%
6%	3.26%	3.53%	3.64%	3.82%	3.50%	3.78%	3.90%	4.09%
Approx. replacement on final salary	50%	41%	38%	34%	50%	41%	38%	34%

The PAYGO scheme

Table A.1A shows an estimate of the ratio of current pensions to contemporaneous (taxable) wages, or the so-called "cost ratio for pensions" for different parameter values. However, under a pure PAYGO financing scheme, since pension outlays must, by and large, be equal to current contributions, the cost ratio also measures the ratio of required contributions to wages or the "equilibrium contribution rate".

The main thing to note in Table A.1A is the extreme sensitivity of the contribution rate to growth parameters of population (n) and productivity (q), and hence their sum, (ρ). The required contribution rate declines with population growth (n), through the well-known "age pyramid" effect. The lower n, the higher the ratio of retired beneficiaries to the active workers that must support them with their contribution, and hence the higher the required contribution rate and the quantitative effect is impressive. The effect of productivity growth is more complex, but it works in the same direction and is quantitatively very similar. Thus the required contribution depends essentially on the sum: ($n + q = \rho$). It is seen from the table that a decline in ρ by two percentage points from two to zero requires a rise in contribution of some nine percentage points from 11% to 20%! But for many of the countries in Europe (*e.g.*, Italy), the replacement rate is up to 80% of terminal income, which means around 100% of average income, and therefore the figures in the table must be doubled (Modigliani and Ceprini 1998). In particular, with a productivity growth closer to 1.5%, and little population growth the table suggests an equilibrium contribution of 20-25%, which is close to what SS levies actually are in

those countries. In the case of Japan, productivity growth is estimated at approximately 1.1% (difference between growth of wages of 2.1% and inflation of 1%), but the labor force growth is expected to be negative making these figures less attractive for PAYGO.

In short, with PAYGO financing, the required contribution is much too susceptible to small and very plausible changes in prospective growth and therefore that approach *does* n*ot provide the basis for a stable pension system* – one that is not continuously threatened by major crises, such as the current one.

The funded scheme

Table A.1B that reports the contribution rate needed under a funded system. In a funded scheme, in steady state, outlays are financed by the sum of contributions and interest on accumulated assets. This is shown in equation (A.4). One of the interesting things that equation (A.4) gives us is the opportunity to examine the dynamics of this equation to changes in *n* and *q*. These dynamics will help us understand the implications for various variables for the funded system. We first start with population growth, which we know has no implication for the contribution rate.

$$dp/dn = 0 + (-A_{t-1}) + (r-\rho)dA/dn \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A.5)$$

$$or\ dA/dn = (1/(r-\rho))[dp/dn + A_{t-1}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A.6)$$

We know that the cost ratio is a declining function of population growth, which means that if population growth increases, then there must be an appropriate adjustment in the asset-wage ratio. In general, *A* will be in the neighborhood of 2-3, and *dp/dn* (from Tables A1A and B) is of the order of 4-5, and hence *dA/dn* is also negative suggesting that the asset-wage ratio must decline. The intuition behind this, from work by Modigliani and Brumberg (1963), is that wealth is largely an increasing function of age, and population growth increases the ratio of young to old. Therefore, with population growth, the wealth-income ratio tends to decline.

The more difficult scenario is the impact of productivity growth on the variables. We know that $dp/dq < 0$, and $dc/dq > 0$ from Tables A.1A and B (as real wages increase, contribution rates need to increase to be able to sustain the higher annuities required to sustain a given replacement rate).

$$dp/dq = dc/dq + (-A_{t-1}) + dr/dq\,(A_{t-1}) + (r-n-q)dA/dq \quad \text{(A.7)}$$

$$dA/dq = (1/(r-n-q))[dp/dq - dc/dq + (1-dr/dq)\,(A_{t-1})] \quad \text{(A.8)}$$

In general, *dr/dq* could be assumed to be greater than zero. Given the previous analysis for population growth, this would suggest that *dA/dq* would also be <0.

A comparison of Table A.1A with Table A.1B reveals in striking fashion the much smaller required contribution for given benefits under the funded system.[ii] The reason for the difference is that, in the funded scheme, a large portion of the pensions is paid not

from the cash contribution, but by the interest on the accumulated wealth. Take for instance the case most favorable to the funded system in Table A.1B: a zero growth of income, 6% rate of return on investment and 18 years retirement. Here the PAYGO contribution is 22.5% versus only 3.5% for the funded system! Such a difference may seem impossibly large. The explanation, of course, is that by the time the funded system reaches maturity, the Social Security trust funds (TF) holds assets amounting to about 3.2 times wages, the return on which at 6% is sufficient to fill the gap.

To be sure, the above illustration is rather extreme, but the difference remains large even for more realistic cases. For instance, let us consider the case most similar to the long run growth assumptions for the United States corresponding to the so-called "intermediate cost" projections. The corresponding contribution required under PAYGO is shown by the shaded entry in the right side of Table 3.1A, namely 17.2% (which is the 1999 estimate of the OAS cost ratio for pensions by the third quarter of this century). We see from the corresponding column of Table A.1B that the required contribution for the funded system is less than 4% for a rate of return of 6%, and for a rate of return of 5% it is just over 5% or more than 2/3 lower. Even with a return as low as 4% (roughly 150 bps higher than the current real rate on U.S. Treasury Inflation-proof bonds) the equilibrium contribution is but 7% or 60% lower.

Tables A.1A and A.1B also bring out several other aspects in which a funded system dominates PAYGO financing (Feldstein 1997). We have already argued that, in a funded system, the required contribution is independent of (n). Table A.1B demonstrates that it

is also hardly affected by (q), and then in the direction opposite than under PAYGO; namely, it declines if (q) declines (because of the resulting increase in the "adjusted" rate of return). Not surprisingly, the contribution is seen to increase with life expectancy, (e) but the effect is surprisingly small. With a 5% return, a rise in (e) from 16 to 18 years, which is a fairly large one, requires an increase in contribution of only around 35 basis points, while under PAYGO the increase is close to 200 basis points. But even that small effect can be made to disappear by relying on the often-proposed remedy of somehow "indexing" the standard retirement age to life expectancy. Specifically, we suggest that the retirement age (i.e., the years of contribution) be tied to life expectancy in such a way that the increased contribution offsets the cost of the partially increased expected duration of the stream of pension payments. Of course, we would retain the present option to retire earlier than the standard, but with a cut in the pension, reflecting the smaller contribution and longer benefit periods.

To summarize, the results of this section provide the evidence for the claim set out in the summary that on grounds of the current cost-to-benefit ratio, of flexibility and of stability of required contributions with respect to likely changes in exogenous parameters, the fully funded system is superior to PAYGO (in steady state). Further, this analysis gives us three key conclusions:

i) The cost ratio and the net returns depend on growth and hence the dominance of funding over PAYGO may be overstated if one carelessly disregards the role of growth;

ii) In the PAYGO system, a decline in the growth rate has a large impact on the required contribution (for given benefits), while with a funded system the effect is of a smaller magnitude (and opposite in sign) as a result of the accompanying increase in the asset-wage ratio (we will examine the impact of growth on nominal rates of return later); and

iii) If the asset-wage ratio rises, it may lead to a decline in *r*. This in turn, may make the funded system less dominant. Under such scenarios mixing systems may make sense.

APPENDIX 2 – STEPS TO CREATE MM MODEL FOR JAPAN

Step 1: We needed to calculate the wage assumptions underlying the entire analysis through 2100. To do so, we took the value of the contributions from employer and employee and since we know what percent of wages it is, we extracted the wage bill in Yen terms from the EPI forecast.

Step 2: The government subsidy in Yen terms was then extracted from the EPI Forecast Tables = (TOTAL INCOME - CONTRIBUTION BY EMPLOYER/EMPLOYEE – RETURNS INVESTMENT). This was then converted to a percent of wages.

Step 3: The return on the investment portfolio for every year through 2100 was calculated by taking the return amount for every year in Yen terms from the EPI forecast and dividing it by the previous year's Trust Fund

Step 4: Based on the wages calculated in Step 1, we also calculated the growth rate of nominal wage bill (which includes the rate of growth of wages and changes to the labor force participation.

Step 5: All parameters are converted to percent of wages. We now examine all the sources of funds (contributions from employers and employees; government subsidy; returns on assets) with the uses of funds (pension payments). The difference of these parameters gives the surplus which is added to the previous year's asset-to-wage ratio. This asset-to-wage ratio multiplied by the nominal return of 3.2% minus the growth of the nominal wage bill, gives the return earned for the following year.

Step 6: We calculate additional ratios such as Asset/Benefit Ratio, though for MM purpose the Asset-to-Wage ratio is most interesting and relevant.

Step 7: To calibrate the model for the base case to the MHLW projections meant we had to ensure that the ratio of assets to benefits was 1.0 in 2100 and the total contribution in 2100 was 26.22%. Therefore, we had to add an additional return of 0.04% annualized. This does not affect the calculations but was the only way we could calibrate our simplistic model with the MHLW model assuming the base case.

Step 8: Once the basic model is set up, we can add or subtract contributions or returns from the base case to see how the system will perform and how various financial parameters are affected.

[i] This section is based on hypothetical data to demonstrate the marked differences in contributions between the two approaches.
[ii] Sections of Table A.1A are intentionally left blank as they do not add to the analysis.