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Chapter Title: Changing the Japanese Social Security System from Pay as You Go to Actuarially Fair

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7 Changing the Japanese Social Security System from Pay as You Go to Actuarially Fair

Tatsuo Hatta and Noriyoshi Oguchi

The current Japanese public pension system is essentially pay as you go; hence, its rate of return is not actuarially fair for each participant. This is the root of the three problems that the Japanese public pension system faces.

First, the system transfers income intergenerationally. In particular, the generation following the baby boomers is expected to make a large transfer to the baby boomer generation. By the year 2025, the average Japanese worker will have to support twice as many retirees as in 1990. This period, which is characterized by a higher percentage of retirees, will be referred to in this paper as the high-average-age period (HAAP). The arrival of the HAAP will increase the required social security contributions to maintain the promised benefits resulting in significant income redistributions among different generations. It may even make the very existence of the public pension system uncertain.

Second, the system also transfers income within each generation in a way that is difficult to justify. For example, the nonworking wife of a corporate president typically gets a much higher rate of return on her pension benefits than a worker of that company who never marries.

Third, since the social security contribution is not directly linked to the future benefit payments, the current system distorts the labor supply.

Had the system been actuarially fair from the beginning, these problems would not have arisen. Once a pay-as-you-go system is in place, however,

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making it actuarially fair may create new problems. The principal aim of the present paper is to evaluate the economic effects of various reform plans that would eventually make the system actuarially fair.

Specifically, we examine the following three plans.[1]

1. *Switch to the Fully Funded System.* This quickly increases the government budget surplus to the level of social security wealth before the arrival of the HAAP.
2. *Switch to the Actuarially Fair System.* This switches the system over to an actuarially fair one before the HAAP. People in the baby boomer and subsequent generations will contribute the amount that exactly matches benefits received. The cumulative budget surplus never reaches the level of the social security wealth; the system never becomes fully funded.
3. *Gradual Shift to the Fully Funded System.* After an actuarially fair system is established as in plan 2, several generations pay taxes at levels greater than the actuarially fair amount until the system is eventually made fully funded. The burdens of building up the fund are shared by several generations.

Note that plan 3 contains the other two plans as special cases: plan 3 degenerates into plan 1 if it takes only one generation to build up the full fund and into plan 2 if it takes an infinite number of generations. For discussion purposes, we will consider as plan 3 the reform whereby five generations after the baby boomers equally share the burden of building up the full fund. We will study the economic effects of these reform plans on intergenerational income transfers, national saving, and government surplus using the simplest possible overlapping generation model that incorporates the HAAP.

Auerbach and Kotlikoff's (1984, 1985, 1987) pioneering work studies various economic effects of reforming a social security system in the face of demographic changes. Their empirical simulation model incorporates production function and realistic demographic changes. Honma, Atoda, and Otake (1988) and Otake (1989) also develop such models for the Japanese economy. Noguchi (1987a, 1987b) presents a model that is more abstract in production than these others but one that still assumes substitution between factors. We, on the other hand, employ a simulation model that abstracts from reality to an extreme degree. For example, per capita output level is fixed, the interest is

1. Auerbach and Kotlikoff (1984, 1985, 1987) examine the economic effects of plan 1 for the U.S. economy. Plan 2 is similar to Boskin, Kotlikoff, and Shoven's (1985) reform proposal for the United States. It is also similar to Tsukahara's (1989) "modified pay-as-you-go plan" and Honma, Atoda, and Otake's (1988) and Otake's (1989) "switch to the fully funded." Tsukahara's plan, which essentially preserves the features of the pay-as-you-go system, does not solve the problems of intragenerational distribution and labor disincentives. But his plan and our plan 2 yield identical economic effects on intergenerational distribution, national saving, and budget deficit. Honma, Atoda, and Otake (1988) and Otake (1988) assume that the pension participants do not realize the link between the social security tax and the benefit; hence, even intergenerational distributional effects are quite different from our plan 2. Hatta (1988) and Hatta and Oguchi (1989a, 1989b) propose plan 3.

given by the foreign country, and consumers have Cobb-Douglas utility functions. There are three purposes for this abstraction.

First, our model isolates the effects of the arrival of the HAAP under various public pension plans. Thus, it brings to the surface the common patterns of interactions between the HAAP and public pension plans underlying the various models constructed for both the Japanese and the U.S. economies. Also, it produces qualitative results associated with pension systems thus far found only through complicated models, such as Auerbach et al.'s (1989) observations that a pay-as-you-go system creates a positive saving after the HAAP.

Second, our model brings out sharply the qualitative differences in the economic effects between immediately building up the social security fund and merely making the system an actuarially fair but unfunded one.

Third, our model enables us readily to analyze the net government transfer to the private sector created by different public pension systems. In particular, we will give an institutional framework where the government net transfer to the private sector is represented by an increase in the balance of a government bond. It will be shown that the government could attain exactly the same economic effects as our reform plans 2 and 3 by taking the following steps: (*a*) issuing a government bond, to be called the "liquidation bond," that pays off the pension benefits of the retired at the time of reform; (*b*) immediately establishing the pension funds for subsequent generations; and (*c*) possibly redeeming the bond by increasing tax rates on subsequent generations.

After a brief review in section 7.1 of the policy issues associated with the Japanese social security system, we present the model and compare the economic effects of adapting a pay-as-you-go and a fully funded system in section 7.2. Section 7.3 discusses the effects of reforming the social security system. Section 7.4 in turn examines the effects of the reform plans on the cumulative government transfer to the private sector, and section 7.5 explores the public pension fund as an accounting concept. Concluding remarks are given in section 7.6.

7.1 Issues in the Japanese Public Pension System

In this section, we describe the public pension system in Japan and the policy issues associated with it.

7.1.1 The Public Pension System of Japan

Japan has three major public pension systems:

a) the private-sector-employee pension system;
b) the government-employee pension system; and
c) people's pension system.

The first two systems share similar structures in that both have two benefit components: the basic pension benefits and the earnings-related pension ben-

efits. The former component yields benefits solely on the basis of years of participation; it does not reflect the participant's earnings.

Anyone who is not covered by the first two pension systems is required to join the people's pension system. This provides benefits identical to those of the basic pension component of the first two systems. The required contribution for the people's pension system is ¥8,400 ($60) per month per person. In the employee pension systems, all the benefit payments including the basic pension benefit are financed by the earnings-related social security taxes as well as by the government subsidies. In March 1990, the social security tax rate for the private-sector-employee pension system was 14.3 percent of the "standard monthly earnings" for men and 13.8 percent for women.

The basic pension benefit for a participant of forty years is ¥55,500 ($400) per month, and benefit payments start at age 65. Payments for the private-sector-employee pension systems start at age 60 for men and 58 for women. The three pension systems are subsidized by the General Account of the government budget, which is financed by non–social security taxes. All three systems can be considered virtually pay-as-you-go systems. Indeed, Ueda, Iwai, and Hashimoto (1987) estimate that, for a household headed by a 60-year-old in 1985, the percentage of a government transfer in pension benefits is 87 percent for the private-sector system and 85 percent for the people's pension.

The postwar Japanese public pension systems were established in 1954, overhauling the then existing systems. The new systems were essentially fully funded at the beginning. As time passed, however, benefits were raised more than contributions, and they became less and less fully funded. This tendency toward a pay-as-you-go system became entrenched by the reform in 1973, which introduced indexation and set the replacement ratio to be 60 percent for an average earner. It was carried out under the extreme optimism of a pre-OPEC high-growth period.

7.1.2 Intergenerational Redistribution

When a more modest growth rate is expected, maintaining a replacement ratio of 60 percent will cause a rapid depletion of the accumulated fund. Since a sharp demographic change is expected in Japan, this will entail a heavy burden on the working-age generation as the percentage of the retired population increases.

As figure 7.1 shows, the ratio of those people 65 years of age or older to the total population stayed constant until the mid-1950s but has risen sharply since then. This ratio is expected to rise until approximately 2025. In fact, it is predicted that it will double in only twenty-six years in Japan, whereas it took 115 years in France, eighty-five years in Sweden and forty-five years in the United Kingdom and West Germany for this ratio to increase from 7 to 14 percent. This steep increase in the proportion of aged people reflects a significant decline in the mortality rate during the postwar period and a sharp rise in the birth rate immediately after the war.

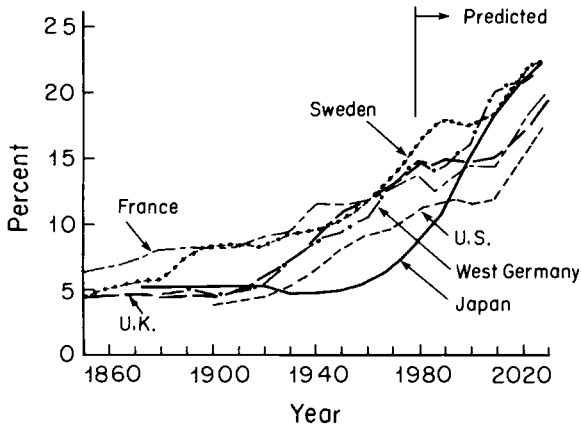

Fig. 7.1 The percentage of those 65 years old or older to the total population
Source: Institute of Demographic Studies, Ministry of Welfare, *Demographic Statistics* (1986).

Figure 7.2 shows the age-based demographic composition of Japan in 1985. We see a relatively high concentration of the population between the ages of 35 and 60, including a bulge at ages 35–40 that reflects the post-war baby boom. Under a pay-as-you-go system, this demographic structure will cause large income transfers from the post–baby boomers to the baby boomers.

7.1.3 Intragenerational Redistribution

The Japanese pension systems redistribute income not only among different generations but also within each generation. Although a certain limited equalization of income within a generation occurs, income is also redistributed in directions that are difficult to justify:

1. *From the wives of the self-employed to the nonworking wives of the employed.* The wife of a self-employed person has to join the people's pension and make social security contributions in order to receive basic pension benefits in the future. The nonworking wife of the employed person can receive the same benefits without any additional contributions made either by herself or by her husband.
2. *From unmarried employees to nonworking wives of employees.* A nonworking wife of an employee receives the following from her husband's employee pension system: (*a*) survivors' benefits if the husband dies; and (*b*) basic pension benefits. Despite these additional benefits given to the wife, her husband's social security contribution stays the same regardless of his marital status. The rate of return on public pension that a nonworking wife of a company president receives is much higher than that of a worker of the same company who stays single for her entire life.

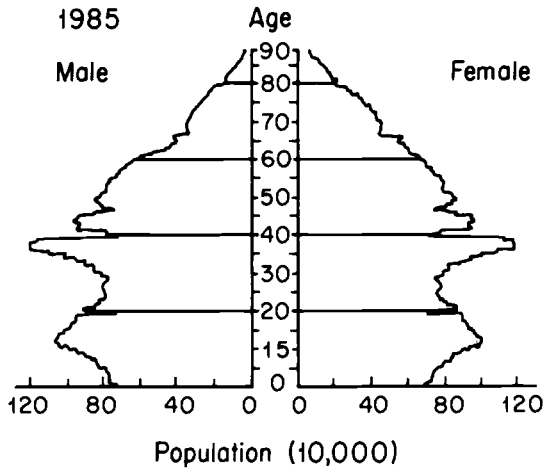

Fig. 7.2 Japan's demographic composition by age
Source: Ministry of Welfare, *Nihon no Jinkou—Nihon no Shakai* (Demography of Japan—Society of Japan) Tokyo: Toyo Keizai Shinposha Press, 1988, 104.

3. *From the working wives of employees to the nonworking wives of employees.* When the husband of a working wife dies, she has to choose between receiving benefits from her own employee pension or survivors' benefits from her husband's pension. She cannot receive both. If she chooses the former, she cannot enjoy the benefits that all nonworking wives receive. If she chooses the latter, she wastes the contributions she has made to her own pension program.

The rate of return on the current pension system is not linked to the market rate of return. Because of this, it is hard for an individual to estimate how much net benefit or loss he or she receives from the public pension system. This creates a situation where political forces tend to dominate the direction of redistribution. This seems to be the reason why the Japanese pension system has erratic income transfers.

7.1.4 Policy Issues

To sum up the arguments so far, the Japanese social security system is essentially pay as you go rather than actuarially fair, and this fact is the source of the dual problems of inter- and intragenerational redistribution the system has. This fact also creates two other well-known problems.

First, the pay-as-you-go system distorts labor supply. The participant in this system perceives the social security contribution as a tax since there is no clear-cut link between future benefits and the amount of the contribution he makes now. The Japanese system especially discourages housewives' partici-

pation in full-time employment. On the other hand, an actuarially fair social security system does not distort labor supply. An actuarially fair system gives the same rate of return as the market return. Thus, a contributor will perceive the contribution as his own saving and hence as a part of his own income.

Second, the pay-as-you-go system reduces the cumulative saving of an economy since people will reduce their saving for retirement when the benefits are guaranteed in the future. If the government has increased its saving by the amount that individuals have reduced private saving, then national saving will not be affected. Under the pay-as-you-go system, however, the social security contribution will be used up for the benefit payments to the current recipients, and the government will maintain, not increase, its saving. The pay-as-you-go system, therefore, reduces national saving.

These problems would not have arisen had the system been actuarially fair.[2]

7.2 Basic Pension Systems

In this section, we formally analyze the effects of introducing a pay-as-you-go public pension system and compare them with these of introducing a fully funded system. We will focus particularly on the effects on intergenerational redistribution, national saving, and budget surplus.

7.2.1 The Model

The Japanese social security system is characterized by the relatively recent implementation of a pay-as-you-go system and a rapidly increasing proportion of aged people. In this section, we present the simplest possible model that captures these characteristics.

Consider a two-period life-cycle model, where the working period and the retirement period are of equal length. There are an infinite number of generations, but we focus on ten, which we refer to as 0–IX. Among them, generation III is the baby boom generation; we assume that its population consists of two people, while all other generations contain one person. In each period, the generation in its working age and another in its retirement live concurrently. Figure 7.3 depicts the population size of each generation in each period. The horizontal axis measures the period and the vertical axis the generations. The white boxes show the size of the working-age population and the shaded boxes the size of the population in retirement.

In interpreting this model in the context of the Japanese economy, we regard the working ages to be 40–59 and the retirement ages to be 60–79. The former may be partially justified because the wage profile rises steeply in the Japanese seniority system. In view of figure 7.2, it is possible to regard generation I as

2. The U.S. Social Security system shares many of these problems, as pointed out by Kotlikoff 1987). An important difference between the Japanese and the U.S. systems is that there is little penalty for working in the Japanese system.

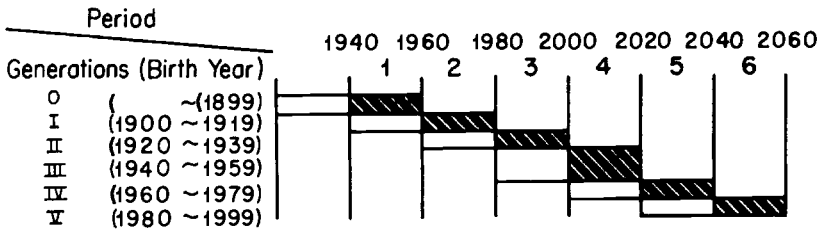

Fig. 7.3 Demographic composition

born between 1900 and 1919, generation II between 1920 and 1939, generation III between 1940 and 1959, and generation IV between 1960 and 1979.

We assume that one worker produces ten units of output when he is young but does not work in old age. Accordingly, we have

$$Y_t = 10N_t, \tag{1}$$

where Y_t is the output level of the economy and N_t the population size of the working generation in period t.

We further assume that an individual saves half his expected lifetime disposable income when he is young and dissaves it when he retires. (This amounts to assuming a Cobb-Douglas utility function.) The interest rate is assumed to be zero. The government has no expenditures other than pensions, and there are no taxes other than the social security tax. Taxes are imposed only on the working generation of the period. There are no inheritances or bequests. Thus, the aggregate budget equation for the working generation in period t is written as

$$C_t^y = C_{t+1}^r = (Y_t + B_{t+1} - T_t)/2, \tag{2}$$

where C_t^y is the aggregate consumption level of the working generation in period t, C_{t+1}^r is that of the retired generation in period $t + 1$, B_{t+1} is the public pension benefit that the retired generation in period $t + 1$ receives, and T_t is the tax that the working generation pays in period t.

When no public pension system exists, a person in any generation consumes five units during his working years and another five units during his retirement years. The consumption of any person in any period is equal. Define national saving, S_t, by

$$S_t = Y_t - C_t^y - C_t^r. \tag{3}$$

There is no investment in this economy, and the macro saving gap is adjusted by the balance of trade. Positive national saving implies a surplus in the balance of payments, while positive cumulative national saving implies a positive net foreign asset position.

Once N_t, B_{t+1}, and T_t are given, equation (1) determines the output level, (2) the consumption levels, and (3) the national saving.

7.2.2 Intergenerational Redistribution

Let b_t be the social security benefit one retiree receives in period t and τ_t the social security tax that a working person pays. Then by definition we obtain

$$T_t = \tau_t N_t \tag{4}$$

and

$$B_t = b_t N_{t-1}. \tag{5}$$

The *net benefit* or *net transfer* that a working person in period t receives during his lifetime, $g[t]$, is given by

$$g[t] = b_{t+1} - \tau_t.$$

Throughout the paper we assume that $b_t = b$ holds if the pension benefit is paid in period t. Thus, we have

$$g[t] = b - \tau_t.$$

A Fully Funded System

Now suppose that in period 2 an actuarially fair public pension system is introduced. By definition we have

$$B_{t+1} = T_t, \quad t > 1, \tag{6}$$

and, hence,

$$b = \tau_t, \quad t > 1.$$

This pension will not affect the consumption pattern of any generation and, hence, will not redistribute income among generations.

When a pension system is actuarially fair from the beginning of its establishment, the system has a cumulative budget surplus equal to the social security wealth, as we will see in section 7.2.4 below. Hence, we will call this system *fully funded.*

A Pay-as-You-Go System

Now suppose that the pay-as-you-go system is implemented in period 2. By definition, the benefits are financed by the social security taxes paid by the currently working generation. Thus,

$$B_t = T_t, \quad t > 1. \tag{7}$$

This yields

$$\tau_1 = 0$$

and

$$bN_{t-1} = \tau_t N_t, \quad t > 1.$$

Thus, the net benefit of each generation can be written as

$$g[1] = b$$

and

$$g[t] = b(1 - N_{t-1}/N_t), \quad t > 1.$$

After the system is introduced, therefore, the net benefit of the working generation in a given period is positive if and only if the population of the retired generation in the same period is smaller than its own.

Figure 7.4 depicts per capita pension benefits received, contributions, and net benefits of each generation under the assumption that $b = 4$. (We will make this assumption in all subsequent figures.) The benefits are shown as a positive number and contributions as a negative number; if the net benefit line is above (below) the horizontal axis for a generation, it receives a net benefit (loss).

The figure reveals two features of a pay-as-you-go system. First, the introduction of the system increases the sum of consumption of all generations. Figure 7.4 shows that the net benefit of generation III is equal to the net loss of generation IV since the population size of the former is twice the latter. Hence, the economy as a whole gains by the net benefit of generation I, that is, by four. Thus, the introduction of a pay-as-you-go system creates a net increase in the consumption for the economy as a whole.

Second, an introduction of the pay-as-you-go system creates income inequity among generations, as observed earlier. Generation I, which is in retirement when the pension system is introduced, receives the most net benefits from the system. The baby boomers receive net benefits to some extent because the tax rate they face when young is low. Generation IV, which comes immediately after the baby boom generation, receives negative net benefits because it has to support the retired baby boomers.

7.2.3 National Saving

Public pension systems affect national saving. We now turn to study this relation in the face of demographic changes.

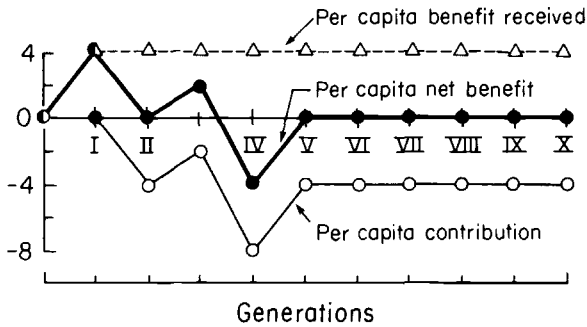

Fig. 7.4 Net benefits under the pay-as-you-go system

Even in the absence of a public pension system, fluctuations in demographic composition can cause national saving to vary each period in our model, where the per capita saving of each generation is kept constant. Indeed, from (1), (3), (5), and (6), we have

$$\begin{aligned} S_t &= Y_t - \frac{1}{2}Y_t - \frac{1}{2}Y_{t-1} \\ &= 5(N_t - N_{t-1}). \end{aligned}$$

The national saving is therefore positive (negative) if the population size of the working generation is greater (less) than that of the retired generation.

The thick line of figure 7.5a shows the fluctuations of national saving when a public pension system is unavailable. The level of national saving reaches its peak in period 3, when the baby boomers are of working age, while it reaches its bottom in period 4, when a large number of baby boomers are dissaving.[3]

The thick line in figure 7.5b shows the cumulative balance of national saving when a public pension system is unavailable. The balance is positive when the baby boomers are of working age; it reaches zero when they are retired and remains zero afterward.

A Fully Funded System

As previously observed, the introduction of an actuarially fair pension system does not affect the consumption patterns of any generation and, hence, does not affect national saving in any period.

A Pay-as-You-Go System

The introduction of a pay-as-you-go public pension system in period 2, however, does affect consumption patterns and therefore national saving.

The retired in period 2 will consume all the unexpected benefit in this period, which yields

$$C_2^r = \frac{1}{2}Y_1 + B_2.$$

Also, from (2) and (3) we have

$$C_t^y = C_{t+1}^r = (Y_t + B_{t+1} - B_t)/2, \quad t > 1. \tag{8}$$

In view of (3), (1), and (5), therefore, we have the following:

3. As fig. 7.5a shows, the post-HAAP dissaving occurs regardless of the pension system. Horioka (1989), using a saving function based on international cross-sectional data of demographic compositions and saving ratios, predicts that Japanese private saving will become negative after 2012, when the ratio of retirees to working-aged people becomes high. Fukao and Doi (1985), Noguchi (1987a), and Auerbach et al. (1989) also obtain similar predictions.

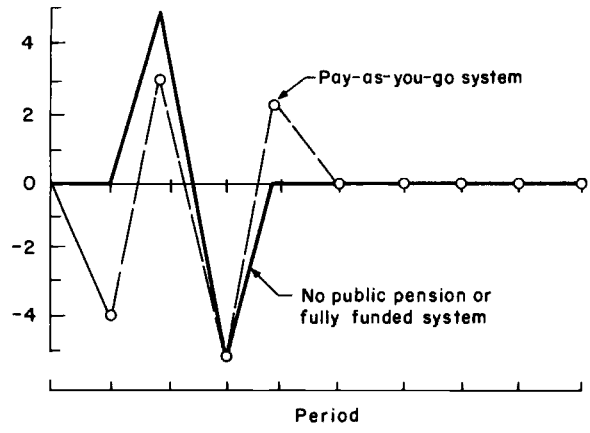

Fig. 7.5a National saving

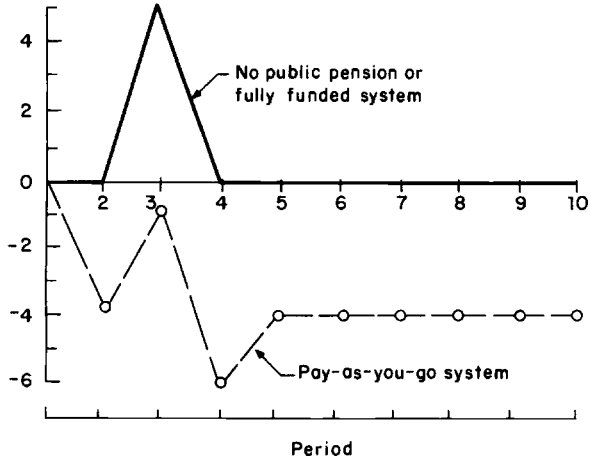

Fig. 7.5b Cumulative balance of national saving

$$S_2 = 5(N_2 - N_1) - \frac{b}{2}(N_2 + N_1),$$

$$S_t = 5(N_t - N_{t-1}) - \frac{b}{2}(N_t - N_{t-2}), \quad t > 2.$$

Thus, national saving in a given period is influenced by the population size of the current and possibly two preceding generations.

The thin line in figure 7.5a indicates the fluctuations of national saving under the pay-as-you-go public pension system. The graph has two troughs

and two peaks. The first peak in period 3, which immediately precedes the HAAP, is lower than under the fully funded system. The positive saving in the second peak in period 5, which is immediately after the HAAP, did not exist under the fully funded system. Two factors explain these features.

The first relates to the consumption surge by generation I in period 2, which receives the unexpected free-ride benefits from the newly started social security system. This creates a negative saving balance in the second period. If the population size did not change thereafter, national saving in each period after period 2 would remain zero permanently.

The second relates to the existence of the baby boomers, or generation III. In period 3, the baby boomers, who are then in their working years, consume more under the pay-as-you-go system than under the fully funded system because they receive positive net benefits during their lifetime. This is the reason why national saving is smaller under the pay-as-you-go system than under the fully funded system. Moreover, national saving in period 5, which is immediately after the HAAP, is positive because the post–baby boomer generation, with reduced per capita lifetime disposable income, is dissaving in this period at a lower rate than under the fully funded system. This was called the "overshooting" of saving by Auerbach et al. (1989).

The thin line in figure 7.5b indicates that the negative cumulative balance of savings in period 2 is created by generation I, as we have already discussed. The balance fluctuates during periods 3 and 4, when baby boomers work and retire. In period 5, when the baby boomers have disappeared, the savings balance returns to its original level and remains constant. Even if the baby boomer generation did not exist and the population remained constant, the negative cumulative balance of savings created in period 2 would remain permanently. Thus, the influence of the baby boomers on the cumulative balance of savings is transitory; the cumulative balance returns to the pre–baby boom level when the economy returns to the steady state.

In sum, the introduction of a pay-as-you-go public pension system immediately creates a negative national saving balance, which is carried forward permanently. On the other hand, the saving fluctuations caused by the baby boomers eventually die out and, therefore, have no long run effect.

We pointed out in section 7.2.2 that the introduction of the pay-as-you-go system increases the sum of the consumption of all generations by the amount of the net benefits received by the first generation. The introduction of the pay-as-you-go system also creates the negative cumulative balance of savings to be carried forward to future generations by the amount that is exactly equal to the net benefits to the first generation. In other words, the "consumption increase" caused by the pay-as-you-go system is made possible by a reduction in the cumulative saving; the apparent welfare improvement is a result of a Ponzi game. A correct evaluation of the welfare increase must be based on a combined consideration of the utility increase and the change in the cumulative saving, which embodies the potential utility.

7.2.4 Budget Surplus

The government budget surplus and deficit created by a public pension system rightly or wrongly have attracted public attention.[4]

Define the government *budget surplus*, S_t^g, by

$$S_t^g = T_t - B_t. \tag{9}$$

Assuming that there was no public pension system until $t = 0$, we can write the *cumulative budget surplus*, Z_t^g, as

$$Z_t^g = \Sigma_0^t S_j^g. \tag{10}$$

When there is no public pension system, $T_t = B_t = 0$ holds; hence, the yearly and cumulative budget surpluses are zero in any period.

A Fully Funded System

A social security system may be called actuarially fair in period t if it satisfies (6) for a given t. It may be called *fully funded* in period t if the cumulative budget surplus is equal to the social security wealth, that is, if it satisfies

$$Z_t^g = B_{t+1} \tag{11}$$

for a given t. Note that, in general, a system satisfying (6) in period t does not necessarily satisfy (11) for the same t if

$$S_j^g \neq 0 \quad \text{for some } j < t.$$

Thus, a system that happens to be actuarially fair in a given period is not necessarily fully funded in the same period.

Suppose that an actuarially fair pension system is introduced in period 2 in the same manner as before. Then (6) holds for all $t > 1$. This and (9) yield

$$\begin{aligned} S_t^g &= B_{t+1} - B_t \\ &= b(N_t - N_{t-1}) \end{aligned} \tag{12}$$

for all $t > 1$. Thus, the relative population size of the working and retired generations determines the budget surplus.

The thin line in figure 7.6a shows the budget surplus under this system. It indicates that government saving is positive in period 2, when the system is introduced, since no benefits are paid out in that period. It is also positive in period 3, when the baby boomers are in their working ages, because their contributions exceed the amount of benefits being paid out. Government saving turns negative in period 4, however, since the retirees outnumber the young. It remains zero thereafter.

Equations (10) and (12) imply that

4. The definition of budget surplus in the presence of a public pension system is arbitrary, as Kotlikoff (1986, 1988, 1989) has emphasized.

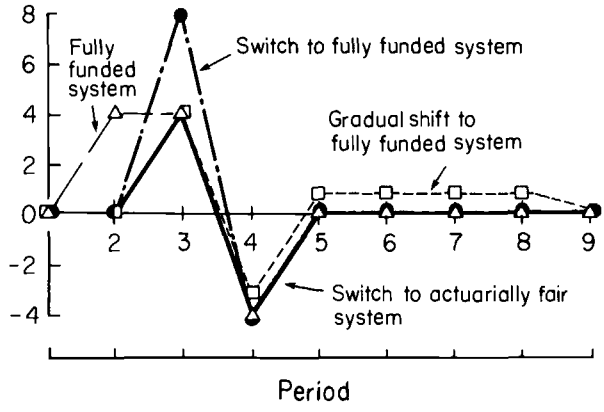

Fig. 7.6a Budget surplus after reforms

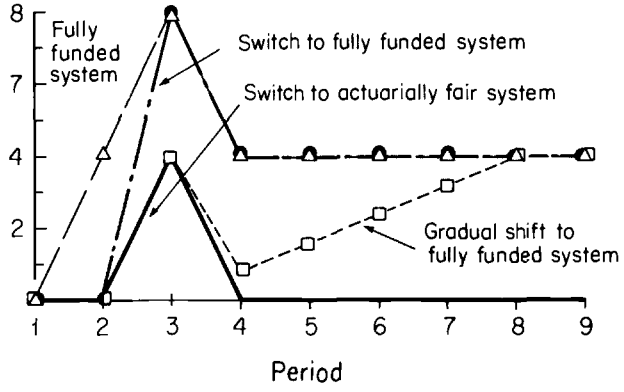

Fig. 7.6b Cumulative budget surplus after reforms.

$$Z_t^g = \Sigma_2^t(B_{j+1} - B_j)$$
$$= B_{t+1} - B_2$$

for all $t > 1$. Noting that $B_2 = 0$, we have (11) for all $t > 1$. If a social security system is actuarially fair in every period of its existence, therefore, it is also fully funded in each of these periods.

The thin line in figure 7.6b indicates the cumulative balance of the budget surplus under the fully funded system. It reaches its peak in period 3, when the baby boomers are in their working years, and returns to a steady-state level of four in period 4, when they retire. Under the fully funded system, therefore, the government will never have to borrow.

Despite the cumulative budget surplus it creates, the introduction of an actuarially fair pension system has no influence on the saving of the economy as

a whole, as we have seen earlier. The positive government saving created by this system is exactly offset by the reduced saving by the consumers.

A Pay-as-You-Go System

If the pay-as-you-go system is introduced in period 2, from (9) and (3), the budget surplus is always zero, and we have

$$S_t^g = 0, \quad t > 1. \tag{13}$$

This and (10) yield

$$Z_t^g = 0, \quad t > 1. \tag{14}$$

The introduction of a pay-as-you-go pension system in an economy where no public pension system existed, therefore, does not affect the level of the cumulative budget surplus. This contrasts with our earlier observation that it affects the cumulative balance of national saving.

7.2.5 Summary

The observations in this section may be summarized as follows. First, in the absence of a public pension system, a positive cumulative balance of national saving is created when the baby boomers are of working age. But the cumulative balance returns to zero in the HAAP and afterward.

Second, an introduction of a fully funded system does not affect consumption patterns of any generation. Hence, it causes no intergenerational transfer of income. Nor does it affect the national saving in any periods. However, the introduction does create a positive cumulative balance of government budget surplus, or government saving. This is consistent with the fact that the introduction does not affect the national saving; the cumulative balance of private saving is reduced exactly to offset the budget surplus of the government.

Third, an introduction of a pay-as-you-go system creates a negative cumulative balance of national saving, which is permanently carried forward. Also, it creates income inequity among generations: it benefits the first and the baby boomer generations, while a net burden is borne by the generation that comes immediately after the baby boomers. Moreover, the introduction increases the sum of the present value of consumption of all generations while reducing the cumulative balance of saving at the steady state by exactly the same amount.

Thus, an introduction of a pay-as-you-go system creates income inequality among generations, but it does not create efficiency gain or loss within this model. If the model is expanded to incorporate elastic labor supply, then the price distortions created by the pay-as-you-go system will cause inefficiency on top of the income inequality that this model shows.

7.3 Evaluation of the Reform Plans

7.3.1 Overview

As we have seen in the previous two sections, if an actuarially fair system had been implemented from the beginning, it would not have caused such microeconomic problems associated with a pay-as-you-go system as inter- and intragenerational redistribution and labor supply disincentives.

Let us now assume that a pay-as-you-go system was introduced in period 2 and that the system is reformed in period 3 in order to attain an actuarial fairness eventually. Specifically, we will consider the effects of the three reform plans outlined above on intergenerational distribution, national saving, and government budget surplus.

7.3.2 Economic Effects

Switch to the Fully Funded

Let us first consider the reform that makes the system fully funded in period 3 and afterward, which we will call a *switch to the fully funded.* The reform will be attained by (*a*) raising the tax rate on generation III so as to finance not only the current benefit payment for generation II but also the future benefit payment for generation III and (*b*) imposing taxes on generation IV and subsequent generations by the amount equal to the benefits received. Thus, the taxes and benefits satisfy the following:[5]

$$T_3 = B_3 + B_4, \qquad T_t = B_{t+1}, \quad t > 3. \tag{15}$$

Equations (15) imply that the per capita tax rates after the reform are

$$\tau_3 = b + b/2, \qquad \tau_t = b, \quad t > 3. \tag{16}$$

The chain line in figure 7.7 depicts the net benefits of each generation after the switch to the fully funded. Generation IV and all subsequent generations receive zero net benefits. But the switch turns the net benefit of generation III from positive to negative.

The switch to the fully funded gives a rattle to the macroeconomic balance of period 3. The chain line in figure 7.8a shows this.[6] When the system is switched in period 3, national saving reaches a peak of seven, exceeding the

5. Since the system is made fully funded, (11) holds for all $t > 2$. In particular, $Z_3^g = B_4$. Since $Z_2^g = 0$, we have $S_t^g = B_4$. On the other hand, equations (9) and (10) yield $T_3 = B_4 + B_3$.

6. From (8), we have $C_3^y = 5$. From (1), (2), and (15), we attain $C_3^y = C_4^y = (20 - 4)/2 = 8$ and $C_t^y = C_{t+1}^y = (10 - 0)/2 = 5$ for $3 < t$. Thus, from (3), we obtain $S_3 = 20 - 13 = 7$, $S_4 = 10 - 13 = -3$, and $S_t = 0$ for $4 < t$.

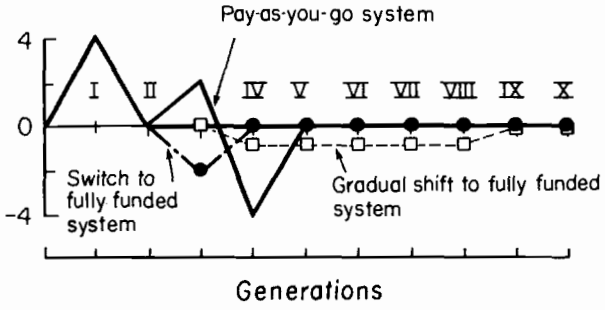

Fig. 7.7 Net benefits after reforms

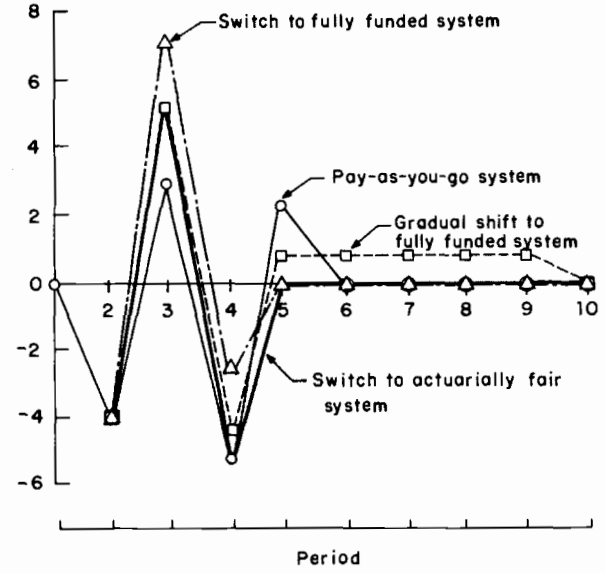

Fig. 7.8a National saving after reforms

level under the fully funded system. This is because the baby boomers now have to save more than they need for their own retirement. As the chain line in figure 7.8b depicts, the cumulative balance of national saving is no longer negative in period 4 and afterward.

The chain line in figure 7.6b shows that in period 3 the cumulative budget surplus becomes equal to the size of the social security wealth. The switch gives a wild fluctuation in government budget, as illustrated by the chain line in figure 7.6a.[7] It soars to eight in period 3, plummets to minus four in period 4, and then returns to zero after that period.

7. From (15) and (9), we have $S_3^g = (B_4 + 4) - B_3 = 8$, $S_4^g = B_5 - B_4 = -4$, and $S_t^g = B_{t+1} - B_t = 0$ for $t > 4$.

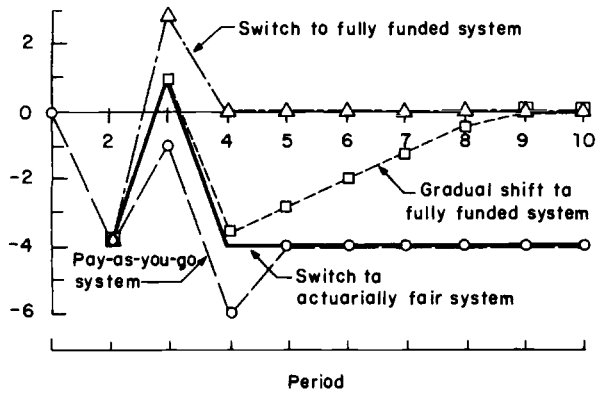

Fig. 7.8b Cumulative national savings after reforms

Even though the problems of the Japanese public pension system pointed out earlier will disappear in the HAAP and afterward, this reform is politically difficult to accomplish. First, it puts a large burden on the baby boom generation—the working and the decision-making generation when the switch is made. Second, it will have the destabilizing macro effect in the HAAP.

Switch to the Actuarially Fair System

The system can be made actuarially fair without being accompanied by the shortcomings that the switch to the fully funded causes.

Let us assume that the pay-as-you-go system is switched to an actuarially fair one in period 3. This reform will be attained by making the tax rate on generation III and subsequent generations exactly equal to the present value of the benefit each of them receives. Thus, we have (6) for all $t - 2$; hence,

$$t_t = B_{t+1}, \quad t \geq 3. \tag{17}$$

This implies that the per capita tax rates after the reform are

$$\tau_t = b, \quad t \geq 2.$$

We will call this reform a *switch to an actuarially fair system.* Generation III faces a higher tax rate after the reform under this system than under the pay-as-you-go system.

The horizontal axis in figure 7.7 depicts the net benefits of each generation after this reform. Generation III and all subsequent generations receive zero net benefit. Thus, intergenerational income inequity is eliminated after the reform.

In period 3 and afterward, national saving is equal to the level that would be attained if the system were actuarially fair from the beginning, as the thick line in figure 7.8a depicts. (Compare this and the thick line in fig. 7.5a.) This

is natural for period 4 and afterward, when both working and retired generations live only under the actuarially fair system. But it also holds in period 3 since the then retired, who have paid social security tax under the pay-as-you-go system, happen to consume the same level as when the system was actuarially fair from the beginning. As the thick line in figure 7.6b indicates, the cumulative budget surplus will be zero after period 4; the system will never be made fully funded by this reform.

The switch to an actuarially fair system has advantages that the switch to a fully funded one does not have. The net benefit of generation III is no longer negative, and the national saving in period 3 is lower. This reform has the merits of an actuarially fair system without the side effects of the switch to the fully funded.

Gradual Shift to the Fully Funded System

From the macroeconomic viewpoint, there is a difference between the fully funded system and the merely actuarially fair system discussed above; the cumulative balance of national saving is zero in the former when the steady state is reached, while it remains negative in the latter. In some situations, because of the macroeconomic considerations it may be necessary to make the system fully funded eventually. The following gradual reform would do this without causing the turbulence associated with the switch to the fully funded:

a) First, switch the system to actuarially fair in period 3.

b) Then impose taxes on several generations subsequent to the baby boomers at rates higher than the actuarially fair level of the expected social security benefits in order to build up the cumulative budget surplus. This process would continue until the system is made fully funded. We will call that portion of taxes paid by a generation in excess of the actuarially fair level of the expected benefit the *pension surtax* of the generation.[8] Thus the several generations after the baby boom generation pay actuarially fair taxes plus pension surtaxes.

c) After the system becomes fully funded, the pension surtaxes are eliminated, and the system returns to actuarially fair.

To make the proposal concrete, we assume that a pension surtax of 0.8 is imposed on each person in generations IV–VIII so as to make the cumulative budget surplus in period 9 exactly equal to social security wealth. Thus, taxes after the reform may be written as

$$
\begin{aligned}
T_3 &= B_4, \\
T_t &= B_{t+1} + .8N_t, \quad 3 < t < 9, \\
T_t &= B_{t+1}, \quad 8 < t.
\end{aligned}
\tag{18}
$$

8. In the context of this reform, there are no unexpected benefits, and the pension surtax is equal to the difference between the tax payments and the total benefit receipts of the generation concerned. Thus, the pension surtax is equal to the negative of the net pension benefit received by the generation in this case.

The corresponding per capita tax rates are

$$\begin{aligned} \tau_3 &= b, \\ \tau_t &= b + .8, \quad 3 < t < 9, \\ \tau_t &= b, \quad 8 < t. \end{aligned} \tag{19}$$

We will call this reform *gradual shift to fully funded.*

Intergenerational Redistribution. The dashed line in figure 7.7 depicts the net benefits of each generation under the gradual shift. Generations I and II are not affected by this shift. On the other hand, each member of generation III now receives zero net benefits. Since generation IV and subsequent generations pay a pension surtax of 0.8 in addition to the four units of the actuarially fair contribution to the pension fund, each member of these generations pays 4.8 in total per capita tax while receiving four units of benefit. The figure clearly shows that the shift mitigates the inequity of income distribution among generations.

Macro Balance. The dashed line in figure 7.8a shows that, when the system is reformed in period 3, national saving reaches five, equaling the level under the fully funded system.[9] This level is higher than under the pay-as-you-go system but lower than under the switch to the fully funded. The reform reduces the national dissaving in HAAP (period 4) to 4.6 from the level of five under the pay-as-you-go system. This is because the reform reduces the consumption of the baby boomer generation in this period more than it increases the consumption of the post–baby boomer generation. The reform makes national saving in period 5 lower than under the pay-as-you-go system. This is because the post–baby boom generation now consumes more; it no longer has to support the baby boomers, who now finance their retirement consumption by the pension fund that they themselves have accumulated during their working years.

During periods 4–9, saving under this regime is higher than under the pay-as-you-go system. The reason is that generations IV–IX reduce their consumption to pay the pension surtax. We have seen that the negative cumulative balance of saving remains permanently under the pay-as-you-go system as indicated by the thick line in figure 7.8b. On the other hand, the dashed line in that figure shows that the level of national debt is gradually reduced after the reform and reaches zero in period 9 under the gradual shift. This reduction essentially pays off the consumption increase enjoyed by generation I at the time the pay-as-you-go system was created.

Thus, the gradual shift reduces the fluctuations of national saving and the

9. We have $C_3^3 = 5$ from (8) and $C_3^3 = C_4^4 = 10$ and $C_t^t = C_{t+1}^t = 4.6$ for $3 < t$ 9 from (19) and (2). Thus, we obtain $S_3 = 20 - 15 = 5$, $S_4 = 10 - 14.6 = -4.6$, $S_t = 10 - 9.2 = .8$ for $4 < t < 9$, $S_9 = 10 - 9.6 = .4$, and $S_t = 0$ for $9 < t$.

trade balance associated with the arrival of the HAAP but gives macro repercussions for a longer period than the reforms considered earlier.

Budget Surplus. The dashed line in figure 7.6a shows the budget surplus.[10] It takes a positive value in period 3, when the baby boomer generation is paying the pension tax. In period 4, when the baby boomers retire, the high level of benefit payments leads to negative government saving. But the size of the deficit is not quite as big as in the case of pay-as-you-go because generation IV and subsequent generations are paying the pension surtax. The government surplus remains positive from period 5 through period 8 for the same reason. Figure 7.6b shows the process of accumulating the cumulative balance of the budget surplus to the steady-state level of the pension fund.

7.3.3 Evaluation of Reform Plans

Switching the pension system to fully funded before the arrival of the HAAP places an unusually high burden on the baby boom generation, creating new inequity among generations. At the time of reform, it also creates a large national saving that even exceeds the amount that would take place if the system were fully funded from the beginning. Thus, this reform causes instability both in distribution and in macro balance during the transition phase.

We have examined two other reform plans that make the system actuarially fair eventually. Both will reduce intergenerational distributional inequity and labor disincentive problems associated with the current system, but neither creates the transitional problems. The switch to the actuarially fair system never builds up a cumulative government budget surplus to the level of social security wealth, while the gradual shift eventually builds up a cumulative budget surplus to that level. The choice between the two reforms should be made on the basis of macroeconomic considerations.

In fact, the final target of the cumulative government surplus need not be limited to the level of either zero or the social security wealth. Any amount in between the two levels or even an amount above the social security wealth level will do. Gradually building up the cumulative budget surplus toward any such amount after first making the system actuarially fair will be more desirable than continuing the pay-as-you-go system or the switch to the fully funded, so long as such a surplus is built up through a fair allocation of the pension surtax rates among different generations.

So far we have assumed that the interest rate is zero. In the economy where the international interest rate is positive, switching the system to actuarially fair is critically different from the gradual shift to the fully funded in that the latter reduces the interest payment to foreign countries to zero when the re-

10. The government budget surpluses are obtained from (18) and (9): $S_3^g = B_4 - B_3 = 4$, $S_4^g = (B_5 + .8) - B_4 = 4.8 - 8 = -3.2$, $S_t^g = .8$ for $4 < t < 9$, and $S_t^g = 0$ for $8 < t$.

form is completed, whereas the former does not. Even then, however, the present value of the total income from foreign investments exactly matches the present value of the sum of the pension surtaxes collected to build up the budget surplus. Under both these reform plans, postreform generations are contributing at least an actuarially fair amount for their pension systems. The question here is how much surtax should be imposed on these generations to pay off the national debt caused by the prereform generations, in particular the first generation. This is not a problem specific to the pension reform, but it should be viewed as a type of the general optimal saving problem.

7.4 Government Saving in the Agency View

7.4.1 The Principal View versus the Agency View

In the previous section, we defined the government budget surplus by (9). Budget surplus (or deficit), however, is "an inherently arbitrary accounting construct," as Kotlikoff (1986, 53) eloquently argues. Budget surplus or government saving is more generally defined as follows:

(20) Government saving = Government revenue
− Government expenditures.

What should be called government revenue or government expenditures is not unique. For example, depending on whether the social security contributions are treated as a tax or as private saving, the amount of government revenue changes.

The Principal View

We have so far regarded social security contributions as government tax revenue and benefit payments as government expenditures. Government saving was equal to the difference between the social security contributions and benefits. Thus, the government was regarded as the saving principal rather than as an agent who simply manages the saving of the private sector. We will call this the *principal view* of government saving. When we refer to *government saving* or *budget surplus* later without qualifications, the concept will be in the principal view.

The Agency View

Alternatively, we may regard the social security system as a pension system that a government operates in lieu of private pension funds. We will call this the *agency view* of government saving since the government is viewed as an agent who manages the saving of the private sector.

In the agency view, the portion of the social security contribution that matches the expected future benefits is regarded as a premium for the pension, and hence private saving, but not as a tax. Thus, only the pension surtax (the

portion of social security contribution that exceeds the actuarially fair present value of the expected benefits) is regarded as the tax paid by the working generation of the given period. Similarly, the expected portion of the social security benefits may be regarded as the dissaving of the retirees in the program rather than as their income and government expenditure. Only the unexpected benefits paid in the given period may be regarded as the income of the retirees and a government expenditure in that period. The government saving in the agency view in a given period is, therefore, equal to the pension surtax paid by the working generation minus the unexpected benefits paid to the retirees of the period.

This view regards the government as managing an imaginary public pension fund, from which the retiree withdraws benefits and to which the working generation makes actuarially fair contributions. We will call this imaginary pension fund the Pension Fund, which is essentially an accounting concept.

In the agency view, therefore, the government's involvement with the public pension is twofold: (i) receiving (or making) a transfer from (to) each generation and (ii) managing an actuarially fair Pension Fund. We will discuss the transfer between the government and the private sector in the rest of this section and the Pension Fund in section 7.5.

7.4.2 The Budget Surplus in the Agency View and Income Transfers

We can regard the income transfers between a person and the government through a pension system to be generated either at the time of his retirement or at the time he realizes that he can expect to receive benefits in the future. We will call the former the *postpaid version* and the latter the *prepaid version* of the agency view.

If a pension system already exists, working-age people will expect to receive benefits in their retirement. They plan their lifetime consumption in their youth after taking into account their total lifetime income, including the net income transfer. Thus, it is natural to consider that the net income transfer to members of this generation is already generated when they are in their working years. In this paper, therefore, we adopt the prepaid version of the agency view. When we say simply the "agency view" without qualifications, we mean the prepaid version.

Let us now decompose the benefit B_t into the expected component B_t^e and the unexpected component B_t^u. Thus, we have

$$B_t = B_t^e + B_t^u.$$

In the agency view, B_t^e is the income of the currently retired generation in the previous period and B_t^u the income of the same generation in this period.

In the agency view, the government receives the tax revenue of T_t from the working generation in period t, while it pays this generation the transfer of B_{t+1}^e and the retired generation the transfer of B_t^u in the same period. Letting $\bar{S}_t^g$ denote the government saving in the agency view, therefore, we have

$$\tilde{S}_t^g = T_t - B_{t+1}^e - B_t^u \tag{21}$$

from (20). This represents the income transfer from the generations living in period t to the government that takes place in period t. Thus, $\tilde{S}_t^g$ is a better measure of income transfer in period t than S_t^g in that it measures the effect of the government pension activities in this period on the lifetime utility level of the generations living in this period, unlike the latter.

Now assume that the public pension system is introduced in period 0 for the first time, by which we mean that none of the following happens before period 0: (i) the working generation pays pension tax; (ii) future pension benefits of the currently working generation are announced; and (iii) the retired generation receives unexpected benefit payments. Then we can define the cumulative balance of the government surplus in the agency view as

$$\tilde{Z}_t^g = \Sigma_0^t \tilde{S}_j^g. \tag{22}$$

Equations (21) and (22) yield the following:

$$\tilde{Z}_t^g = [-B_0 + \Sigma_0^{t-1}(T_j - B_{j+1})] + (T_t - B_{t+1}^e). \tag{23}$$

The term B_0 on the right-hand side represents the unexpected benefits by the retired generation in period 0. (This can of course be zero.) This equation states that the cumulative government saving in the agency view equals the sum of (*a*) the cumulative income transfer to the government from all the generations older than the current working generation and (*b*) the pension surtax paid by the currently working generation. In this sense, the cumulative budget surplus in the agency view may be regarded as the cumulative transfer from the past and current generations to the future generations.

Equation (23) can be rewritten to yield yet another interpretation of $\tilde{Z}_t^g$:

$$\begin{aligned} \tilde{Z}_t^g &= \Sigma_0^t(T_j - B_j) - B_{t+1}^e \\ &= Z_t^g - B_{t+1}^e. \end{aligned} \tag{24}$$

Thus, the cumulative budget surplus in the agency view is the cumulative budget surplus in the principal view minus the expected benefit payment to the working generation in the given period. This difference is caused by the fact that the expected benefit payment is treated as the government expenditure of this period in the agency view but as that of the next period in the principal view.

Note that, if the retired generation in period $t + 1$ receives only expected benefits, equations (21), (23), and (24) become

$$\tilde{S}_t^g = T_t - B_{t+1}, \tag{21'}$$

$$\tilde{Z}_t^g = \Sigma_0^t(T_j - B_{j+1}) - B_0, \tag{23'}$$

$$\tilde{Z}_t^g = Z_t^g - B_{t+1}, \tag{24'}$$

respectively.

If a system is actuarially fair in period t, for example, equations (21′) and (6) yield

$$\bar{S}_t^g = 0. \tag{25}$$

This is only natural since the government receives no transfers from the private sector in period t under the actuarially fair system. If the system is fully funded in period t, (24′) and (11) yield

$$\bar{Z}_t^g = 0, \tag{26}$$

implying that the government receives zero cumulative transfers from the private sector.

If a pay-as-you-go system is introduced in period 2, the budget surpluses in both flow and the cumulative balances are zero from (13) and (14). Thus, (24′) implies

$$\bar{Z}_t^g = -B_{t+1}. \tag{27}$$

This indicates that, under the pay-as-you-go system, the cumulative budget surplus in the agency view in a given period is equal to the social security wealth in that period. The variables $\bar{S}_t^g$ and $\bar{Z}_t^g$ are depicted for the case of pay-as-you-go in figures 7.9a and 7.9b, based on (21′) and (27), respectively.

7.4.3 Effects of Reforms on Transfers between the Government and the Private Sector

Under a pay-as-you-go system, therefore, the cumulative transfer from the government (i.e., the future generations) to the current and past generations is equal to the social security wealth of the current period. Thus, the cumulative transfer fluctuates as the economy passes through the HAAP. Our three reform plans may be viewed as different methods of managing this transfer and stabilizing its movements.

To examine how our three plans affect $\bar{S}_t^g$ and $\bar{Z}_t^g$, the following proposition is useful.

PROPOSITION 1. *Suppose that a pay-as-you-go public pension system is reformed in period 3. Assume that under the reformed system all the pension benefits are announced prior to the payments and that taxes are still paid only by the working generations. Then the following holds:*

$$\bar{Z}_t^g = -B_3 + \Sigma_3^t(T_t - B_{j+1}), \quad t \geq 3. \tag{28}$$

Proof. Equation (23′) implies

$$\bar{Z}_t^g = \Sigma_0^2(T_j - B_j) - B_3 + \Sigma_3^t(T_j - B_{j+1}).$$

Since the system satisfies $B_j = T_j$ for $0 \leq j \leq 2$, this yields the proposition. Q.E.D.

Thus, $\bar{Z}_t^g$ is equal to the cumulative sum of the pension surtaxes paid by the

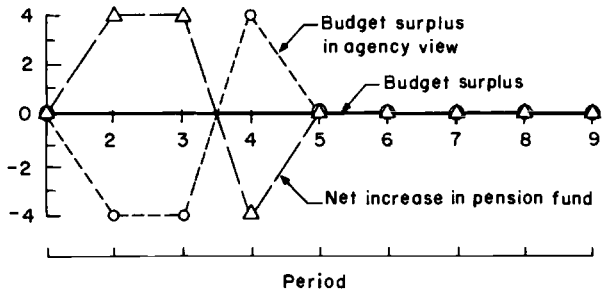

Fig. 7.9a Budget surplus under the pay-as-you-go system

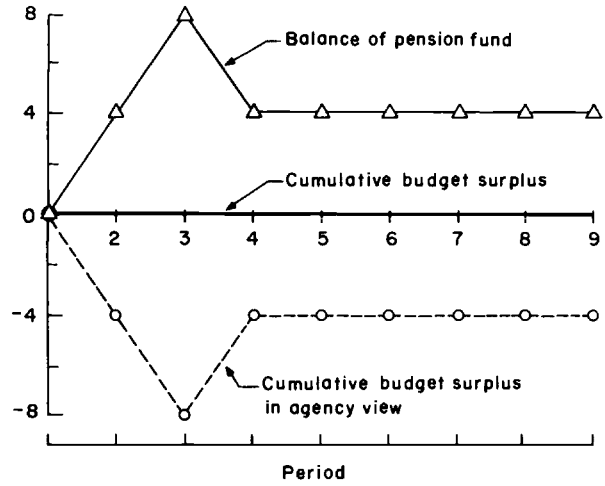

Fig. 7.9b Cumulative budget surplus under the pay-as-you-go system

working generations during periods 3 through t minus the benefits received by the retired in period 3. Note that this formula holds only if the prereform pension system is pay as you go. An interpretation of this equation is straightforward. Since the economy is under the pay-as-you-go system in period 2, the term $-B_3$ on the right-hand side of (28) is equal to the cumulative balance of the government saving in the agency view in period 3 from (27). In view of (21′), this balance is increased in each period by the amount of the pension surtax. Thus, (28) indicates that the cumulative balance of government saving in the agency view in period t is equal to the balance in period 2 plus the increase in the balance that took place after the reform.

Switch to Fully Funded

Suppose that the system is switched to fully funded in period 3. Then from (15) and proposition 1 we have $\tilde{Z}_t^g = 0$ for $t \geq 3$. Thus, the cumulative bud-

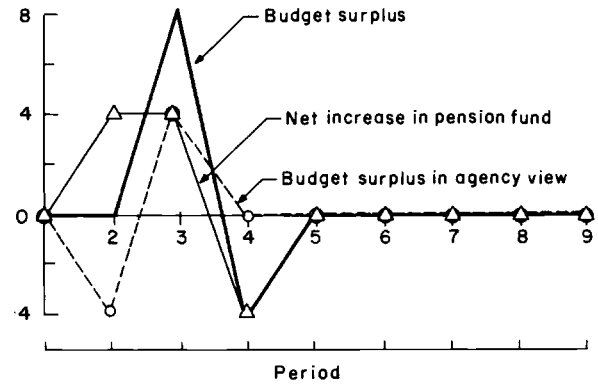

Fig. 7.10a Budget surplus after the switch to the fully funded system

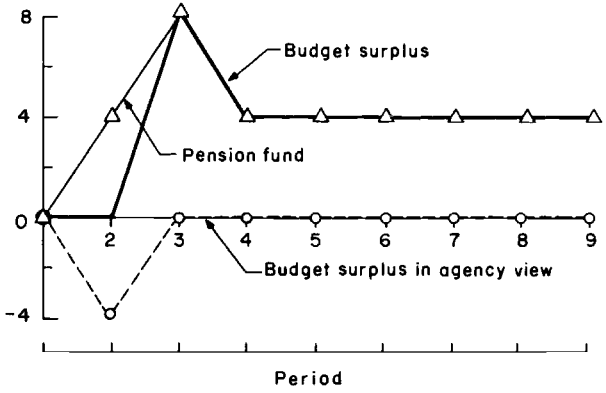

Fig. 7.10b Cumulative budget surplus after the switch to the fully funded system

get surplus in the agency view disappears immediately. The dashed line in figure 7.10b shows this. Also, from (15) and (21′) we have $\bar{S}_3^g = B_3$ and $\bar{S}_t^g = 0$ for $t \geq 4$. The dashed lines in figure 7.10a shows that a positive transfer to the government takes place in period 3.

Switch to Actuarially Fair

When the system is switched to actuarially fair in period 3, proposition 1 and (17) imply $\bar{Z}_t^g = -B_3$ for $t \geq 3$. Thus, the cumulative budget deficit in the agency view remains fixed at the level of the pension payment in period 3. The dashed line in figures 7.11b shows this. Also, from (17) and (21′) we have $\bar{S}_t^g = 0$ for $t \geq 3$. The dashed lines in figures 7.11a shows this.

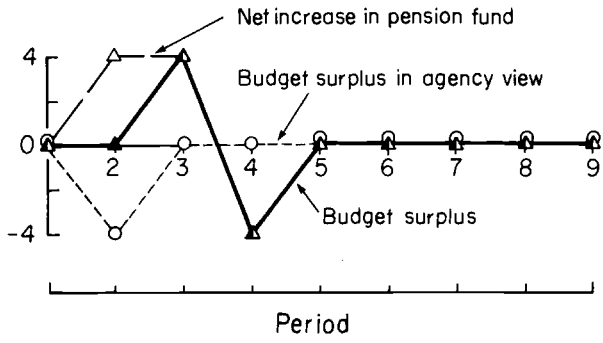

Fig. 7.11a Budget surplus after the switch to the actuarially fair system

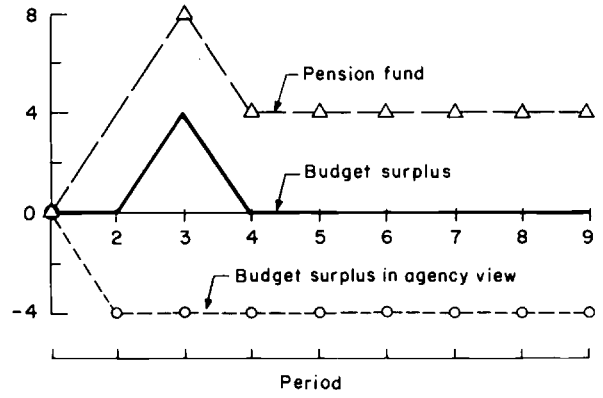

Fig. 7.11b Cumulative budget surplus after the switch to the actuarially fair system

A comparison of figures 7.10a and 7.11a shows that the budget surpluses in the agency view between the two reform plans are different only in period 3.

Gradual Shift to Fully Funded

When the system is gradually shifted to fully funded starting in period 3, (18) and proposition 1 imply

$$
\begin{aligned}
\bar{Z}_3^g &= -B_3, \\
\bar{Z}_t^g &= -B_3 + .8\,\Sigma_3^t N_t, \quad 3 < t \leq 8, \\
\bar{Z}_t^g &= 0, \quad 8 \leq t.
\end{aligned} \tag{29}
$$

The dashed line in figure 7.12b depicts the fluctuation $\bar{Z}_t^g$. The cumulative budget surplus in the agency view, that is, the cumulative government transfer to the private sector, gradually diminishes until it reaches zero in period 8. The pension surtax spreads the burden of reducing the cumulative government transfer evenly among generations.

On the other hand, (18) and (21′) imply $\bar{S}_3^g = 0$, $\bar{S}_t^g = .8N_t$ for $3 < t < 9$, and $\bar{S}_t^g = 0$ for $9 \leq t$. The budget surplus in the agency view during periods 4–8 reflects the pension surtax paid by the working generations of these periods. The dashed line in figure 7.12a depicts the fluctuation of $\bar{S}_t^g$.

We may sum up our observations here as follows. Under the pay-as-you-go system, the cumulative government transfer to the private sector (i.e., cumulative government saving in the agency view) in a given period is equal to the promised pension benefit payments to the working generation of that period. The switch to the fully funded eliminates this cumulative government transfer immediately. The switch to the actuarially fair keeps the cumulative balance fixed at the level of period 2. The gradual shift to the fully funded reduces the balance over time until it is eliminated.

Each of the three reform plans smooths the fluctuations of the cumulative government transfer after the reform. Not all the plans smooth the fluctuations of the government flow transfer after the reform, however. The switch to the fully funded requires a heavy transfer to the government in period 3. The other two reforms smooth the movement of the transfer in each period like that of the cumulative transfer. In planning a gradual building up of the cumulative budget surplus as in the gradual shift to the fully funded, the government can allocate the burden fairly among generations by using the concept of the cumulative government deficit in the agency view.

7.5 Pension Fund

7.5.1 The Pension Fund and Pension Wealth

Earlier, we saw that, in the agency view, the government's involvement with the public pension is twofold: receiving transfers from the private sector and managing the actuarially fair Pension Fund. We turn now to the Pension Fund.

The growth of the Pension Fund may be described as follows. In period t, the young generation contributes to the Fund by B_{t+1}^e, which is $T_t - (T_t - B_{t+1}^e)$,[11] while the retired generation receives the benefit of B_t^e from the Fund. Thus, the net increase of the Fund in this period, denoted ΔF_t, is

$$\Delta F_t = B_{t+1}^e - B_t^e. \tag{30}$$

11. The social security tax T_t minus the pension surtax $T_t - B_{t+1}^e$ may be equivalently expressed as the sum of the social security tax T_t and the transfer income that the young generation receives in this period, i.e., $B_{t+1}^e - T_t$.

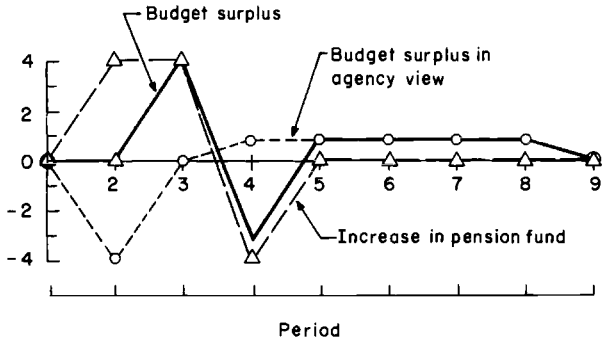

Fig. 7.12a Budget surplus under the gradual shift to the fully funded system

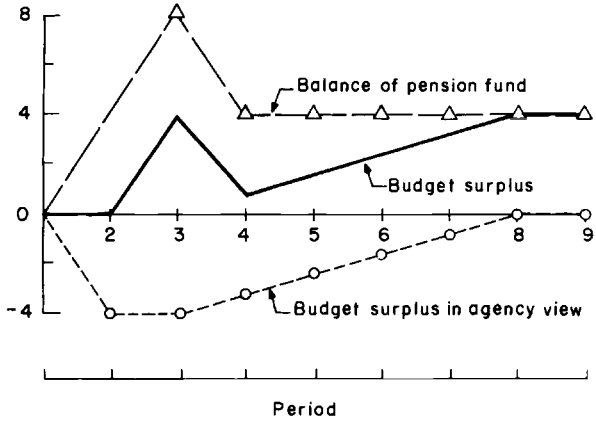

Fig. 7.12b Cumulative budget surplus under the gradual shift to the fully funded system

Define the cumulative balance of the Pension Fund by

$$F_t = \Sigma_0^t \Delta F_j, \tag{31}$$

where it is assumed that the public pension system is introduced for the first time in period 0. From (30) and (31) and the fact that $B_0^e = 0$, we have

$$F_t = B_{t+1}^e, \quad t \geq 0. \tag{32}$$

Thus, the balance of the Pension Fund is always equal to the pension wealth B_{t+1}^e. This holds whether the social security system is fully funded, pay as you go, or somewhere in between.

Note that, if the retired generation in period $t + 1$ receives no unexpected benefits, equations (30) and (32) collapse to

(30′) $$\Delta F_t = B_{t+1} - B_t,$$

(32′) $$F_t = B_{t+1}.$$

These can easily be computed from the population data. The identical thin lines in figures 7.9a, 7.10a, 7.11a, and 7.12a depict the fluctuation of ΔF_t if a per capita social security payment of b is started in period 2. These lines are the same no matter how the benefits are actually financed. The identical thin lines in figures 7.9b, 7.10b, 7.11b, and 7.12b depict the fluctuation of F_t for the same case.

7.5.2 The Pension Fund and Government Saving

How can the imaginary Pension Fund be funded? According to the following proposition, the growth (cumulative balance) of the Pension Fund can be financed by the budget surplus (cumulative budget surplus) and the government transfer (cumulative government transfer) to the private sector.

PROPOSITION 2. *The increase in the Pension Fund has the following relation with saving in the principal and agency views:*

(33) $$\Delta F_t = S_t^g - \tilde{S}_t^g \quad t > 1.$$

The cumulative balances of each variable satisfy the following:

(34) $$F_t = Z_t^g - \tilde{Z}_t^g, \quad t > 1.$$

Proof. From (9), (30), and (21), we observe (33). Thus, (10) and (31) yield (34). Alternatively, (34) can also be obtained from (24) and (32). Q.E.D.

If a system is actuarially fair in period t, proposition 2 and (25) imply

(35) $$\Delta F_t = S_t^g.$$

Since the increase in the Pension Fund is equal to the budget surplus in this case, the lines for the increase in the Pension Fund in figures 7.9a, 7.10a, 7.11a, and 7.12a are drawn identically to the line for the budget surplus for the fully funded system in figure 7.6a. If the system is fully funded in period t, (26) and proposition 2 immediately yield

(36) $$F_t = Z_t^g.$$

In this case, therefore, the balance of the Pension Fund is equal to the cumulative budget surplus in the same period. Thus, the lines for the Pension Fund in figures 7.9b, 7.10b, 7.11b, and 7.12b are identical to the lines for the cumulative budget saving for the fully funded system in figures 7.6a and 7.6b. As we observed earlier, an actuarially fair system in period t may not be fully funded in the same period. Thus, (35) does not necessarily imply (36).

If a pay-as-you-go system is introduced in period 2, proposition 2 and (13) imply

(37) $$\Delta F_t = -\tilde{S}_t^g;$$

hence,

$$F_t = -\tilde{Z}_t^g, \tag{38}$$

for all $t > 1$. Under a pay-as-you-go system, therefore, the increase in the Pension Fund in any given period is the mirror image of the government transfer to the private sector. Also, the balance of the Pension Fund is equal to the cumulative government transfer to the private sector under this system. Proposition 2 is illustrated for this case in figures 7.9a and 7.9b.

Figure 7.10b shows that the cumulative budget surplus and the Pension Fund coincide when the cumulative government transfer disappears in period 3. Figures 7.10a–7.12b illustrate proposition 2 for each tax reform plan.

7.5.3 The Institutional Pension Fund

The Pension Bond

We have seen that, if the system is fully funded in period t, the Pension Fund is equal to the cumulative government surplus. Now suppose that the system is not fully funded in period t; hence,

$$F_t \neq Z_t^g.$$

Must the Pension Fund necessarily be imaginary in this case? The answer is no. The government can institutionally establish a Pension Fund that has a balance equal to the pension wealth, F_t, as long as it issues a government bond to finance the difference between F_t and Z_t^g. We will call this bond the *pension bond* and denote its balance by D_t. By definition, we have

$$D_t \equiv F_t - Z_t^g. \tag{39}$$

In order to maintain the institutional Pension Fund after its establishment, the government has to adjust the outstanding balance of the pension bond in response to the gap between the Pension Fund and the cumulative saving increases. If the gap increases, additional pension bonds must be issued; if it decreases, some of the pension bonds must be redeemed.

If the system is kept actuarially fair while the institutional Pension Fund is being maintained, the outstanding balance of the pension bond will stay constant from (35) and (39). No new bond is issued and no outstanding bond redeemed. In this case, the cumulative balance of the budget surplus will fluctuate in parallel response to the balance of the Pension Fund.

Even under the pay-as-you-go system the government can institutionally establish a Pension Fund by issuing a pension bond to finance it. Since there is no cumulative budget surplus in this case from (39), we have $D_t \equiv F_t$; hence, the balance of the pension bond must be at the level of the Pension Fund itself. This and (20) yield

$$D_t = B_{t+1}. \tag{40}$$

Suppose that the government institutionally establishes a Pension Fund by issuing the pension bond in period 2 while the system is still pay as you go. Then the switch to the fully funded system in period 3 would eliminate the outstanding balance of the pension bonds since the switch would make the cumulative balance of the budget surplus exactly equal to the balance of the Fund. On the other hand, the switch to the actuarially fair system would not affect the outstanding balance of the pension bond at all since the switch keeps constant the difference between the cumulative balance of the budget surplus and the balance of the Fund at the level of period 2. Finally, the gradual shift to the fully funded would not affect the outstanding balance of the pension bond in period 3 but would gradually reduce it as the cumulative balance of the budget surplus is built up to the level of the Pension Fund.

Note that issuing the pension bond does not affect the government budget surplus or deficit at all. The budget deficit created by this bond exactly cancels out the increase in the budget surplus brought about by the establishment of the Fund.

The Pension Bond and Government Saving in the Agency View

The definition of D_t and (34) yield the following interpretation of the pension bond.

PROPOSITION 3. *When the Pension Fund is institutionally maintained in period t, the balance of the outstanding pension bond is equal to the cumulative government budget deficit in the agency view, that is,*

$$D_t = -\tilde{Z}_t^g. \tag{41}$$

Thus, the pension bond is nothing but the cumulative government deficit in the agency view. Issuing the pension bond at the time the institutional Pension Fund is created, therefore, simply exposes the cumulative government deficit that already existed in the agency view at the time of issuing; it does not create a new government deficit even in the agency view. Proposition 3 can also be viewed as giving an institutional interpretation to the government deficit in the agency view.

Suppose that a pay-as-you-go pension system for which the Pension Fund has been institutionally established is reformed in period 3. Then from propositions 1 and 3 the balance of the pension bond in period t is expressed as:

$$D_t = B_3 - \sum_{j=3}^{t}(T_j - B_{j+1}), \quad t \geq 3. \tag{42}$$

Since the economy is under the pay-as-you-go system in period 2, B_3 on the right-hand side of (42) is the balance of the pension bond in period 2 from (40). In view of (41) and (21′), the bond is redeemed in each period by the amount of the pension surtax. Thus, (42) indicates that the outstanding balance of the pension bond in period t is the outstanding balance in period 2

minus the cumulative redemption of the bond after the reform. Equation (42) gives an alternative explanation for the fluctuations of D_t under various reform plans discussed earlier.[12]

Kotlikoff (1986, 57) called the social security wealth the "social security bond." Equation (40) shows that, under a pay-as-you-go pension system, the pension bond is equal to the social security wealth in that period. As equation (39) shows, however, this equality does not generally hold under other pension systems.[13]

Modified Pension Reform Plans

We now consider issuing a bond for a purpose different from that of the pension bond. Suppose that a pay-as-you-go system is reformed in period 3 in the following manner.

First, the government issues bonds in period 3 to finance the benefits of the retirees of this period. Second, the Pension Fund is institutionally established in period 3 and is maintained afterward. No less than actuarially fair taxes are imposed on generation III and subsequent generations to finance the Pension Fund. Third, the pension surtax, if positive, is used to redeem the bond. Since the tax revenue can be decomposed as $T_t = B_{j+1} + (T_j - B_{j+1})$, the government can contribute B_{j+1} to the Pension Fund and use the pension surtax $T_j - B_{j+1}$ to redeem the pension bond. (Note that $T_j - B_{j+1} \geq 0$ by assumption.)

The purpose of issuing the pension bond was to supplement the cumulative budget surplus in establishing and maintaining the Pension Fund institutionally, and it could be issued in any period. On the other hand, the purpose of issuing a bond in the present reform proposal is to pay off the benefit of the last contributor to the pay-as-you-go system through the revenue raised by the bond, thereby liquidating the pay-as-you-go system. Hence, we will call the bond the *liquidation bond.* Issuing this bond enables the government to establish the Pension Fund from scratch by financing it with the tax revenues from the postreform generations. We will call such a pension reform a *reform plan through liquidation bond.*

Each of our three reform plans has its counterpart among the reform plans through liquidation bond. Suppose that the government issues liquidation bonds in period 3 to finance the benefits of the retirees of this period and then imposes taxes on generation III and subsequent generations at the same rates as each of the three reform plans does. Since none of the three modified reform plans imposes a negative pension surtax, the tax revenue can institution-

12. If the system is switched to actuarially fair, e.g., (42) implies that $D_t = B_3$ holds for all $t \geq 3$; the pension bond is maintained constant at the level of B_3. If the system is gradually shifted to fully funded, $D_t = B_3 - .8\,\Sigma_3^t N_t$ holds for $3 < t \leq 8$ and $D_t = 0$ for $8 \leq t$, eventually eliminating the pension bond.

13. Note that Kotlikoff's concept of social security wealth is the postpaid notion, while ours is the prepaid notion. But (24) can also be established for the postpaid notions of $\tilde{Z}_t^s$ and B_{t+1}^s.

ally finance the Pension Fund in each case. The pension surtaxes, if positive, are used to redeem the liquidation bond. We thus obtain reform plans through liquidation bond that are counterparts to our three reform plans. Since the tax and benefit structures of each of our pension reform plans and their counterparts in the reform through liquidation bond are identical, their real effects on the economy are identical.

Moreover, the outstanding balance of the liquidation bond in a given period would be identical to the outstanding balance of the pension bond had it been issued instead. The amount of the liquidation bond issued in period 3 is B_3, while the total amount of redemption is represented by the summation of the pension surtaxes paid by the postreform generations, $\sum_{j=3}^{t}(T_j - B_{j+1})$. By construction, therefore, we can write the outstanding balance of the liquidation bond in period t as

$$L_t = B_3 - \sum_{j=3}^{t}(T_j - B_{j+1}), \quad t \geq 3. \tag{44}$$

This and (28) immediately show that

$$L_t = \tilde{Z}_t^g \quad t \geq 3. \tag{45}$$

Thus, the liquidation bond may be viewed as yet another interpretation of the government saving in the agency view. Equations (44) and (42) also show that

$$L_t = D_t, \quad t \geq 3.$$

Thus, the liquidation bond may also be viewed as an interpretation of the pension bond.

Incidentally, the amount of the liquidation bond issued in period 3 is equal to the amount of the benefits received by generation I since generations I and II receive the same net benefits from the pay-as-you-go system in our numerical setting. Thus, the implicit government deficit that the liquidation bond brings out is the one created by the free-ride benefit that generation I received at the time the pay-as-you-go system was implemented in period 1.

Finally, note that our interpretation of the cumulative government saving in the agency view in terms of pension bond and liquidation bond given by proposition 3 and (45) depends crucially on the particular definition of government saving we adopted here: the prepaid version of the agency view. If we had adopted the postpaid version, proposition 3 and (45) would not hold unless the definition of the Pension Fund were similarly adjusted.

7.5.4 Summary

In this section, we have observed the following. First, an actuarially fair pension system in a given period can be interpreted as the one where the gov-

ernment transfer to the private sector in the agency view is zero in that period, while a fully funded system in the given period can be interpreted as the one where the cumulative government transfer in the agency view to the private sector is zero.

Second, all three reform plans we discussed inherit the cumulative government transfer to the private sector from the pay-as-you-go system. The switch to an actuarially fair system carries it over forever to the future. The gradual shift to the fully funded system reduces this cumulative government transfer in the long run. The switch to the fully funded system immediately eliminates this cumulative transfer in the period of reform.

Third, according to proposition 2, the net increase in the Pension Fund is financed by the budget surplus and the government transfer to the private sector. The Pension Fund is an accounting concept, but it can be institutionally established by issuing the pension bond.

Fourth, according to proposition 3, the outstanding amount of the pension bond is equal to the cumulative balance of the transfer from the private sector to the government by that period. Hence, the net increase in the Pension Fund may be viewed as being financed by budget surplus and by the new issue of pension bonds.

Fifth, Kotlikoff's "social security bond" is the equivalent of our pension bond under a pay-as-you-go system, but that is not generally the case under different pension systems.

Sixth, the gradual shift to the fully funded may be carried out by issuing a liquidation bond. The amount of this bond issued in the first period of the reform is exactly equal to the cumulative balance of the government transfer to the private sector that was implicit under the pay-as-you-go system in the period immediately before the reform.

Seventh, the concept of the cumulative government transfer to the private sector is useful in planning the tax policy to distribute the burden of institutional building up the Pension Fund among generations fairly.

7.6 Concluding Remarks

In the present paper, we have observed the following. First, the fact that the Japanese social security system is pay as you go creates problems with respect to both distribution and efficiency. In particular, it places a heavy burden on the post–baby boom generation by transferring income from it to the baby boom generation.

Second, switching the system to the fully funded one in one generation shifts the heavy burden to the baby boom generation. Also, it will make the national saving in the switching period even larger than what would be attained if the system were fully funded from the beginning.

Third, a switch to an actuarially fair but unfunded system eliminates microeconomic problems of the Japanese social security system without causing instability in the transition phase.

Fourth, if the accumulation of cumulative budget surplus is necessary to make the system fully funded from a macroeconomic point of view, it can be done by first changing the system into an actuarially fair but unfunded one and then gradually building up the fund by taxing several generations. Economic effects of such a gradual shift were analyzed.

Fifth, a few different interpretations of the cumulative balance of government deficit in the agency view were given. It was interpreted as the transfer from future generations to the present and past generations. It was also interpreted as the pension bond necessary to supplement the cumulative budget surplus in establishing the Pension Fund institutionally. The outstanding balance of this bond is zero when the system is fully funded, while it is equal to the social security wealth when the system is pay as you go. A systematic reduction of the outstanding amount of this bond enables the government to spread the burden of building up the fund evenly among several generations. Moreover, the cumulative balance of government deficit in the agency view was shown to be equal to the outstanding balance of the liquidation bond if the pension reform is carried out by issuing the liquidation bond.

Although the merits of the fully funded system are well known, economists are usually apprehensive about switching an existing pay-as-you-go system to the fully funded one because it creates instability in both distribution and macro balance in the transition phase. It is not necessary, however, to accumulate the budget surplus for the purpose of eliminating the distributional and efficiency problems associated with the pay-as-you-go system like the current Japanese social security system. A switch to an actuarially fair but unfunded system attains this objective.

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Comment

Edward P. Lazear

This was an excellent paper. I was impressed by the clarity of thought and exposition, and I learned a great deal by reading it. I recommend it to you. It is a very nice model for tracing out the effects of various funding schemes on savings, government deficits, and trade balances.

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I must confess to having a real soft spot for simplicity. The words "simple model" are overused. Almost every author calls his model simple. This one really is, but it gets to the essence of what the authors want to discuss. In particular, it does an excellent job of exposing what is real and what is illusory, that is, what is truly of economic significance and what is merely accounting.

I view it as a starting point for thinking about these problems. In order to start, it is important to know the effects of the different funding patterns on the key driving variables. Thus, knowing the effect on the driving variables of changing from a pay-as-you-go funding system to a fully funded one is essential before we can ask some bigger questions. What I would like to do is address some of the big questions that I believe are not yet covered in this paper. I see these as extensions of the current work, but I believe that some are very important extensions that should be undertaken so that we can understand the significance of the effects that Tatsuo Hatta and Noriyoshi Oguchi are tracing out.

The main shortcoming of the paper to my mind is that it focuses a bit too heavily on accounting and ignores economic behavior. To put it most generally, there is no way in the current model to evaluate which scheme is best. While the model does an excellent job of tracing out the savings and consumption patterns of the different generations under the two scenarios, the authors do not attempt to analyze which is better. In fact, they cannot perform that analysis in the current model because savings plays no role in a macroeconomic sense. Let me be a bit more specific.

In the model, there is no effect of current consumption and therefore savings on future income. The investment side of the problem is not modeled. I will return to this point later, but the main idea here is that intergenerational savings does not perform a useful function as it does in the traditional overlapping generation models or as it does in the newer increasing-returns-based growth models. Specifically, a fully funded pension scheme does not result in a different flow of total income over time from the pay-as-you-go system. But pay as you go yields a different pattern of savings than a fully funded system. In a closed economy, one might expect this to make a difference to the income path because it affects capital accumulation, and the differences might carry over to an open economy as well.

One obvious possibility is that changes in savings over time may have very different efficiency effects because the different tax rates and structures may imply different distortions. Any distortionary effects of the tax changes are ignored in the current model.

Even ignoring issues of capital accumulation, the pay-as-you-go scheme implies a different distribution of income and consumption than does the fully funded one. There is no way to evaluate the two different approaches, however. Because the analysis is not embedded in a maximizing framework, one cannot tell whether fully funded is preferable to pay as you go. Similarly,

while the switch from pay as you go to fully funded seems to work in this context, there is no way to make any welfare judgment about the switch. In the pay-as-you-go scheme, the post–baby boom generation gets hit badly, and a switch to fully funded evens this out. But depending on the nature of intergenerational transfers and altruism, this could have either beneficial, detrimental, or no effects on utility.

Investment is not modeled in the current discussion. This leaves us begging for more because investment may have a life of its own. While this will not be true in a closed economy, the discussion in this paper is explicit in thinking of Japan as an open economy. Reference to trade surpluses and deficits are found throughout.

Others have looked at the relation of savings to investment. Feldstein in particular has argued that savings and investment are not as independent as they should be in a perfect capital market open economy. But this does not mean that they are the same.

The point is best seen by comparing the United States and Japan. The United States is currently running a trade deficit. Hatta and Oguchi say that a high savings rate and large trade surplus are inevitable when the baby boom generation is in its working years. This does not fit the United States. While we are not aging as quickly as Japan, the difference results from relatively high levels of investment in the United States that are financed by foreign savings. And we have a negative trade balance. In the open economy context, the difference between savings and investment is an important one, which might be discussed in the current paper.

To make another general point, the government is modeled in two ways in this paper, what the authors call the principal view and the agency view. These analyses were informative, but they could be extended. In particular, there is no discussion of other sources of government revenue and other areas of expenditure. This may be a useful approximation, but I think that it is problematic. There is evidence for the United States, compiled by John Cogan, that reveals that the trend has been to raise trust fund revenues against general fund revenues.[1] Cogan finds that during the postwar period there is a dollar-for-dollar substitution of trust fund for general fund revenue relative to GNP. This suggests that, if Japan changes the structure of social security funding, we may expect a corresponding change in other aspects of the tax structure. If this kind of substitution occurs, a change in the funding structure may not alter government receipts the way the model predicts.

A related question arises. Even if there is no corresponding cutback in other sources of government revenues, will social security funding be dedicated to expenditures on social security payments, or will it generate an expansion in

1. See John F. Cogan, "The Federal Deficit in the 1990s: A Tale of Two Budgets," in *Thinking about America: The United States in the 1990s*, ed. Annelise Anderson and Dennis L. Bark (Stanford, Calif.: Hoover Institution Press, 1988), 277–87.

other kinds of government expenditure so that the post–baby boom generation is left in almost the same shape as it would have been had the switch in funding not occurred?

To make one final point, there is no discussion of the effects of government savings on private savings. Assumptions about the displacement of private savings by government savings should be made explicit because this is an important part of the controversy over any funding plan.

In sum, this is an excellent paper that allows us to begin to think about some of the related big questions. It is a first step, and without it we would have had no hope of thinking about the other issues that I have discussed in any systematic way.