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1 Projection of Japanese Public Pension Costs in the First Half of the Twenty-First Century and the Effects of Three Possible Reforms

Seiritsu Ogura

1.1 Introduction

Only very recently has aging started to attract national attention. During the past two decades, however, Japan has been aging very rapidly. In fact, some people claim that no other country in history has aged more rapidly, although it is obviously very difficult to verify this assertion. Two factors that usually contribute to the process of aging—declining mortality and declining fertility—have indeed been present in Japan. Of these two factors, the most dominant since the mid-1960s has been the decline in mortality. Almost all newborn babies are now expected to reach age 65 (fig. 1.1), and more than half of them are expected to reach age 80. This is the best mortality record in the world, and probably in the history of humankind.

In 1960, there were only 501,000 men and women who were 65 years old. Thirty years later, in 1990, 1,193,000 Japanese were this age. The life expectancy at this particular age was 11.6 years for men and 14.1 years for women in 1960. In 1990, it was 16.2 years for men and 20.0 years for women (fig. 1.2). As the size of the population at age 65 doubled and the life expectancy increased by 50 percent, we would expect the size of the elderly population to have at least tripled over these 30 years. This is, in fact, what happened in Japan.

This alone is a very dramatic change, but it is only part of the story. Close to 2 million baby boomers born during the years immediately after World War II will reach age 65 in the second decade of the twenty-first century. At that time, the number of elderly will be at least twice that in 1990 if life expectancy remains the same.

Moreover, in the past 10 years the decline in the birthrate has started to

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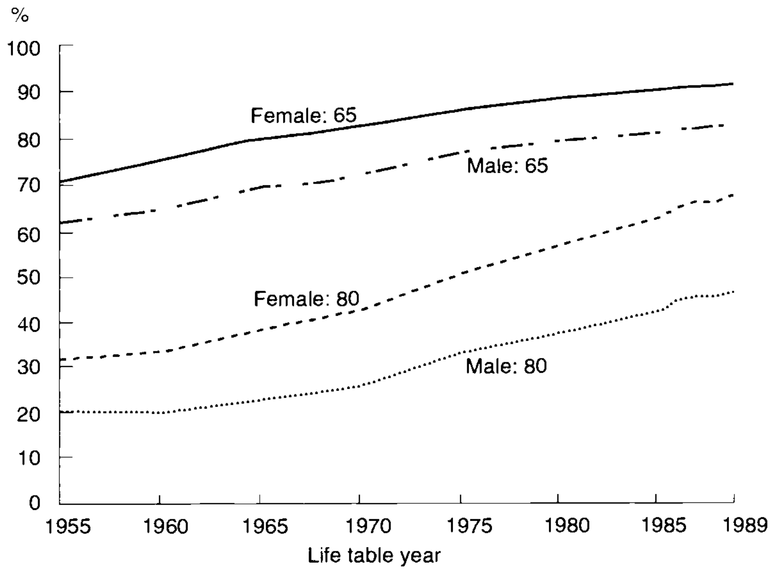

Fig. 1.1 Probability of survival to ages 65 and 80 (newborn babies)

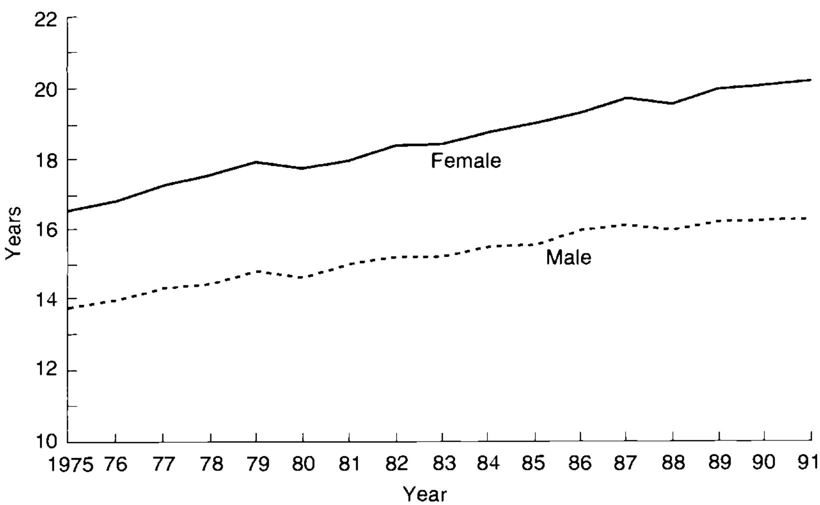

Fig. 1.2 Life expectancy at age 65

accelerate Japan's population aging process. In 1960, 1,606,000 babies were born in Japan. In 1990, 1,221,000 babies were born, a decline of almost 25 percent. The total fertility rate (TFR) of Japanese women was 2.0 in 1960 but only 1.54 in 1990. If this low fertility rate persists, and we believe that it will, in the first quarter of the next century only three-quarters of the present working population will be supporting almost twice the present elderly population. Thus, the ratio of the elderly to the working population will be about 8/3, or more than 2.5 times, the present ratio.

Judging from the current population structure, by the first quarter of the twenty-first century, the rapid population aging process will be over in Japan, but it will be followed by a slow, steady aging process as long as the low fertility rate persists. In May 1991, at JCER, we published our own population projection for the next 30 years (Ogura 1991). We followed it with a series of demographic studies (e.g., Ogura 1992; Ogura and Dekle 1992). All available evidence so far indicates that the birthrate is very unlikely to rebound in the next few years, as is expected in the government's 1992 official population forecast. Not only is the low fertility rate here to stay, but a further decline in TFR is very likely to occur in the next few years. In fact, the government recently announced that TFR dropped to 1.47 in 1993, but it has not abandoned its optimistic projection. It is almost certain that new public policies will be introduced to help raise the fertility rate, but it is not clear how effective these interventions will be in this delicate area unless we are willing to abandon the present family structure in Japan.

We must, therefore, take the expected increase in the elderly population relative to the working population up to, say, the year 2020 as a given. It is either too late or too expensive to try to change that substantially. In contrast, in spite of our projections here, changes in public policies and social institutions could have substantial effects on the population structure in the second quarter of the twenty-first century.

Although aging is expected to have far-reaching effects on all aspects of our lives, many public systems have not had time to adjust to these expected changes, particularly since the government is not yet fully convinced of the need to adjust. In terms of the effects on the national economy, the most serious effects will be those on health care costs and public pension costs. Both will almost directly reflect the expected increase in the elderly population, and we should carefully examine whether present financing mechanisms will be able to withstand the crunch.

In this paper, we estimate the costs of public pension benefits, and the insurance tax rates needed to support them, using the Social Insurance Model developed by this author and others. The results of our analyses clearly illustrate the instability of the Japanese public pension systems. The insurance tax rates of pension programs for employees will climb in an almost straight-line fashion, from less than 15 percent today to 40 percent in the second quarter of the next century. This paper investigates three alternative measures that can control the cost of future benefits: (1) delay of the start of old-age pensions, (2) disposable income slide or benefit taxation, and (3) price indexation. Measure 1 will reduce the required tax rate by only 5 percent, while measures 2 and 3 will reduce it by 10 percent each. Various combinations of these measures will have greater effects than any one measure alone, but much less effect than the simple sum of these measures.

In the next section, we outline our public pension simulation model and its key variables, providing necessary accounts of Japanese public pension systems. We then present the simulation results, showing what will happen if we maintain the present public pension structure as the baseline scenario. Finally, we discuss the effects of the three possible reforms, which could be introduced separately or in various combinations, on the total cost of public pensions.

1.2 Outline of the Simulation Model

Our simulation model consists of the Population Model and the Social Insurance Model, which in turn consists of the Public Health Insurance Sub-Model and the Public Pension Sub-Model.

1.2.1 Population Model

Assumption on mortality. The Population Model was run for every year from 1990 to 2050; the rest of the model was run for every five-year period. The initial values for population regarding age and sex were set at 1990 census values, and the numbers of deaths by age and sex were estimated using the mortality data in the 1990 life table. Contrary to the government's projection of a continued decline in mortality, we assumed that long-run mortality rates will remain as they are. In the past few years, for several major diseases such as cancer, cerebrovascular disease, and cardiovascular disease, the mortality rates of the most elderly group have either stopped declining or started to rise more sharply, suggesting the possibility of an upturn in the long run.

Assumption on fertility. Our Population Model includes an innovative method of estimating the number of new births. In the past, government estimates were based on the projection of the number of married women and their fertility rate at each age. This simple method could be easily manipulated by the fertility rate projection, as is evident in the government's notorious 1986 official projection. In this regard, Ogura (1991) presented the empirical fact that the fertility of a married woman of a given age is determined more by the number of years since her marriage than by her biological age itself, and they proposed to use this fact as the basis for fertility rate projections. For instance, two 30-year-old married women can have completely different likelihoods of giving birth in the course of a year if one has been married for 10 years and the other for 1 year. The odds of the former giving birth are slightly better than 50 to 1 (2 percent), while those of the latter are better than 2 to 1 (54 percent). Averaging these two probabilities involves a considerable risk in population projection if there is no guarantee that the "vintage" mix will remain reasonable constant over time.

The methodology we adopted was very simple. If we denote the number of women of age n who have been married z years in year t as $k(n, z; t)$ and the probability of a woman giving birth to her first child as $\pi_1(n, z)$, the number of first children born out of this group is given by

$$c_1(n, z; t) = \pi_1(n, z)k(n, z; t).$$

As an example, figure 1.3 shows the probability π_1 for women aged 18–41 who have been married one to five years. In the projection, z runs up to 9 years for first children and 12 years for other children. Probabilities were obtained as averages of the ratio $c_1(n, z; t)/k(n, z; t)$, where values of t were chosen to be 1980, 1985, and 1989. We should note that the data for $c_1(n, z; t)$ and $k(n, z; t)$ were obtained directly from *Vital Statistics* (Ministry of Health and Welfare, various years), which excludes the case of couples whose cohabitation started prior to the calendar year when they reported their marriage. This group accounts for about 10 percent of all marriages reported, but in the absence of detailed information on the childbearing behavior of these couples, we computed the $\pi_1(n, z)$ ratios without data for them. We believe that this will not affect the results of our fertility projection too much, but it is possible that the probability shown in figure 1.3 may have a small bias.

Summing $c_1(n, z; t)$ over z, we obtained the total number of first children for women of age n, or

$$c_1(n; t) = \Sigma c_1(n, z; t).$$

We then summed $c_1(n; t)$ over n and obtained the total number of first children born to women of all ages, or $C_1(t)$:

$$C_1(t) = \Sigma c_1(n; t),$$

out of which 50.37 percent were assumed to be boys and the rest girls. In our model, we repeated the same procedure two more times—once for second children and again for third or more children.

Assumption on marriage rates. The number of women getting married at age n was assumed to be a fixed proportion ($\kappa(n)$) of the female population of that age, or $f(n; t)$; hence,

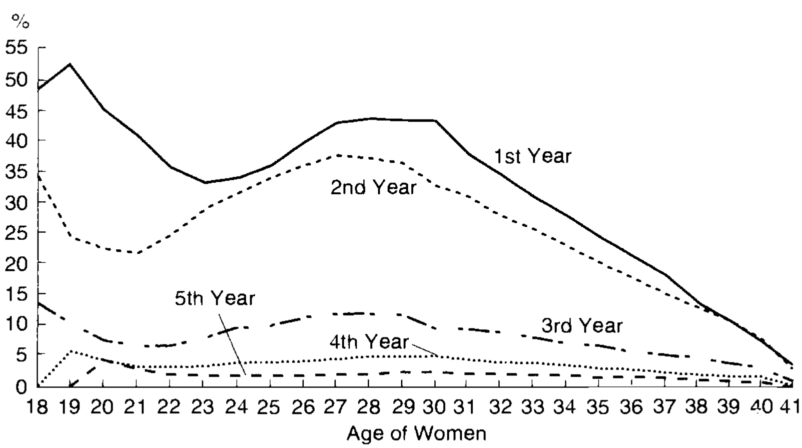

Fig. 1.3 Probability of giving birth to a first child

$$k(n, 0; t) = \kappa(n)f(n; t).$$

For $\kappa(n)$, or the rate of marriage at age n, we took the number of women married in 1989 whose cohabitation and marriage coincided in the same calendar year and divided it by the female population of age n in 1989. In year $t + 1$, all married women who survive increase by one year in both age (n) and years married (z), or

$$k(n + 1, z + 1; t + 1) = s_f(n)k(n, z; t),$$

where $s_f(n)$ is one minus the mortality rate at age n. The marriage rate as computed from 1989 data includes both first marriages and second or third marriages. In view of the increasing share of second marriages, it may be worthwhile to model divorce behavior in future population projections. One valid criticism of this procedure is that the marriage rate should be replaced by the marriage probability conditional on being single. More specifically, according to this view the number of women getting married in their thirties (numerator) is small simply because the number of single women in their thirties (denominator) is small, but as the size of this latter group increases, the size of the former should increase as well. Thus, by directly linking marriage to population, our projection may have a downward bias, particularly for women in their thirties.

Results of population projection. At the start of industrialization, in 1872, the Japanese population was estimated to be around 34.8 million, and it has continued to increase during each of the past 120 years, with 1944 being the only exception. According to the projection of our model, however, this phase will be over in 10 years.

Births will increase in the next 10 years, reflecting childbirths to the second baby boomers, but this third baby boom will be a very modest one, peaking at less than 1.4 million, compared with 2 million births for their parents' generation. Following the third baby boom, the number of births will continue to decline for the first quarter of the twenty-first century, which will be interrupted only briefly by the fourth baby boom around the year 2030. The fourth baby boom will be very feeble, producing slightly over 900,000 babies, and the number of births will start to fall quickly; by the middle of the twenty-first century it will be about half of the current number.

In contrast, the number of deaths will continue to increase monotonically until it reaches 1.8 million in 2025, and it is expected to remain at that level for almost a decade and a half. As a result of these two divergent trends in births and deaths, the total Japanese population will reach its peak in 2005 and will decline at an accelerating rate thereafter. The rate of decrease will stabilize in the second quarter of the twenty-first century, but in 2025 the number of deaths will be almost twice the number of births, reducing the population by almost 900,000 people a year.

Age composition of population. Table 1.1 shows the composition of the Japanese population in different age groups. In this table, people in their sixties and eighties are grouped in five-year age groups, while the rest are shown in ten-year groups. From this table, we can see that in 1990 about 11.5 percent of the population was 65 years of age or older, but according to our projection the proportion will more than double by 2020. By 2040, the proportion will be close to 30 percent.

1.2.2 Social Insurance Model

Our Social Insurance Model inherited its basic structure from the Public Health Insurance Model of Ogura and Irifune (1990) and includes the Public Pension Model that originated in Ogura and Nishimoto (1984). We have adopted this strategy primarily because, in Japan, public health insurance programs collectively have the most extensive coverage of all social insurance schemes. For instance, as of the end of March 1990, a simple sum of all individuals covered by any public health insurance program was 123,600,000, which was slightly greater than the entire population of Japan at the time. Moreover, availability of information on the economic, social, and other characteristics of participants in major public health insurance programs is far better than that for public pension programs. Finally, similarities exist between public health insurance programs and public pension programs, as shown in table 1.2.

Roughly speaking, the workers covered by Health Insurance Managed by Associations (HIMA) are employees of corporations large enough to form independent health insurance groups (interpreted as corporations with more than 700 employees), while those covered by Health Insurance Managed by Government (HIMG) are employees of the rest of the corporations. With respect to public pensions, both groups are covered by the Welfare Annuity Plan (WAP).

Table 1.1 **Projection of Age Composition of the Japanese Population (percent)**

Age Group	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
0–9	18.3	16.3	15.8	11.7	9.4	9.7	7.9	7.5	7.9	7.1
10–19	21.8	16.3	14.7	15.4	11.4	9.4	10.2	8.6	8.3	8.9
20–29	17.7	19.0	14.4	13.5	15.0	11.3	9.9	11.0	9.4	9.2
30–39	14.5	16.0	17.1	14.1	13.2	15.0	11.8	10.7	12.1	10.5
40–49	10.5	12.7	14.1	15.7	13.7	13.0	15.5	12.7	11.6	13.4
50–59	8.4	8.9	11.0	12.7	14.9	13.3	13.3	16.3	13.6	12.6
60–64	3.1	3.6	3.8	5.4	6.0	7.4	6.0	7.2	8.1	6.8
65–69	2.3	2.9	3.4	4.0	5.5	6.4	6.9	6.2	8.6	7.3
70–79	2.7	3.3	4.3	5.4	7.6	9.5	12.0	11.4	12.2	15.3
80–84	0.5	0.6	0.9	1.4	1.9	2.9	3.5	4.8	4.0	5.0
85+	0.2	0.3	0.5	0.7	1.5	1.9	2.9	3.6	4.3	3.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Ogura (1991) and author's computations.

Table 1.2 **Coverage of Public Health and Public Pension Plans (thousand individuals)**

Public Health Insurance Programs		Public Pension Programs	
Health Insurance Managed by		Welfare Annuity Plan	
Total	31,509		29,921
Associations (large firms)	14,173		
Government (small firms)	17,336		
Mutual Aid Associations		Mutual Aid Associations	
Health Insurance for		Pension Plan	
National Government	1,707		1,656
Local Governments	2,957		3,277
Private Schools	393		384
National Health Insurance		National Pension Plan	
All NHI Programs	43,789		17,799

Sources: Social Insurance Agency (1992) and author's computations.

Mutual Aid Associations (MAA) provide health insurance and pension insurance for workers in national government, local governments, and other public corporations. Municipal governments provide National Health Insurance (NHI) plans for self-employed residents and employees of unincorporated businesses, who are obligated to join the National Pension Plan (NPP).

Our model starts with the current allocation of participants in public health insurance programs and adjusts this number to obtain the allocation of participants in public pension programs. By comparing these two numbers, it is clear that only small adjustments are required as far as the WAP is concerned. The problem is the NPP, which is plagued by a high noncompliance ratio.

Allocation of labor force entrants. In the framework of our model, workers enter the labor market for the first time in the two five-year age groups 15–19 and 20–24. They are absorbed into one of three sectors, each of which represents a public health insurance plan, according to the rules in table 1.3.

The remainder of the cohort will either become self-employed, to be covered by the NHI/NPP, or be dependent family members of employed workers insured by the HIMA, HIMG, or MAA. To arrive at the number of those to be insured by the NHI/NPP, it is necessary to estimate the number of dependent family members of workers covered by the HIMA, HIMG, or MAA; then

$$\begin{aligned}\text{NHI coverage} = {} & \text{Cohort population} \\ & - (\text{HIMA workers} + \text{HIMG workers} \\ & + \text{MAA workers}) \\ & - (\text{HIMA dependents} + \text{HIMG dependents} \\ & + \text{MAA dependents}).\end{aligned}$$

Allocation of dependents of employed workers. Ogura and Irifune (1990) estimated the number of family dependents of employed workers from the cross-

Table 1.3 **Allocation of Labor Force Entrants**

Age Group	Sex	HIMA (%)	HIMG (%)	MAA
15–19	Male	4	5	59,000
	Female	6	6	3,000
20–24	Male	23	22	317,000
	Female	31	23	180,000

Source: Author's computations based on Ministry of Health and Welfare (1993).

tabulation of numbers and ages of dependents and workers using the latest available HIMA and HIMG data. These cross-tabulations are available for each of the four possible combinations of sexes for worker and dependent. For instance, in the given data, if we denote the number of female dependents in the kth age group supported by the sth age group as $f_m(k, s)$ and the number of male workers in the sth age group as $M(s; 0)$, the probability that a male worker in the sth age group supports a female family member in the kth age group, denoted as $\mu_{fm}(k, s)$, is computed as follows:

$$\mu_{fm}(k, s) = f_m(k, s) \,/\, M(s; 0).$$

Repeating the process for all possible s and k, we can obtain the support probability matrix $[\mu_{fm}(k, s)]$. We can then postmultiply this matrix by the age-group column vector of the number of male workers at time t, or $[M(s; t)]$, and obtain the age-group column vector of the number of female dependents supported by male workers in this system, or $[F_{fm}(k; t)]$. We can repeat this procedure for female-female, male-male, and male-female combinations to obtain $[F_{ff}(k; t)]$, $[M_{mm}(k; t)]$, and $[M_{mf}(k; t)]$. Female dependent vectors can then be added to yield the total number of family dependents in this system. This was the procedure adopted by Ogura and Irifune (1990).

The problem with this procedure is that the number of family dependents at a given time reflects family formation behavior such as marriage and fertility during the preceding years. Thus, in view of the fundamental changes that have been taking place in Japanese family structure, if we apply this method directly we will end up substantially overestimating the number of dependents of employed workers and hence substantially underestimating the population in the self-employed sector.

To avoid this problem, in this model we computed the share of dependents for each male and female worker; for instance, instead of computing $[f_m(k, s)/M(s; 0)]$, we computed $[(f_m(k, s)/F(k; 0))/M(s; 0)]$, where $F(k)$ is the female population of the kth age group. Postmultiplying this share matrix by the age-group vector of the number of male workers, or $[M(s; t)]$, we obtained the age-group vector of the proportion of the female population that will be supported by employed male workers in this system, or $[\theta_{fm}(k; \mathrm{t})]$. Multiplying each component of this vector by the female population in the appropriate age group, or $F(k; t)$, we obtained the new number of female dependents supported by male workers covered by each plan. This procedure takes care of the effect of changes in fertility, but not of the effect of changes in marital behavior. We have yet to adjust for the latter in the current version of our model.

Net quit rates. The labor force entrants absorbed in each system will move across the systems over time. The quality of available data on intersystem mobility is not sufficiently high to enable us to model such behavior, and in the past we used crude "net quit rates" (Ogura 1989; Ogura and Irifune 1990). The net quit rate of male workers in a system is simply the expected number of male workers of the $(k + 1)$-th age group in the next period per one male worker of the kth age group in the system. As such, the rate reflects both entry and exit behaviors of workers in the system in different age groups. We constructed these rates for male workers in both the WAP and the MAA, using the combined data of the HIMG and the HIMA during the 1980s, and assumed that they remain constant during the entire period of our simulation exercise.

As for female workers, in view of the upward trend in their labor force participation rates, we decided to incorporate the expected changes in their net quit rates. Currently, the labor force participation rates of Japanese women follow an M shape, with ages 20–24 as the first peak (about 75 percent) and ages 40–44 and 45–49 forming the second peak (about 70 percent). At present, the valley is located at ages 30–34, but it has been getting shallower every year. Most long-term economic forecasts predict that early in the twenty-first century the valley between the two peaks will virtually disappear, as it has in most Western industrialized countries. We adjusted our net quit rates in such a way that, by the year 2010, the labor force participation rate will assume a flat pattern at around 70 percent, as is the case in the United States.

1.2.3 Welfare Annuity Plan Sub-Model

Estimation of the average cost of benefits We estimated the average cost of benefits separately for retired male and female workers in each cohort, as they become eligible for WAP benefits.

Special benefits before age 65. For male employed workers covered by the WAP, we incorporated the four following full components (the parameters in **boldface** are those directly determined by laws or regulations, and those in *italics* are our estimates using WAP data up to 1990):

$$\begin{aligned}\text{Special benefit} = {} & \text{Fixed benefit} + \text{Proportional benefit}\\ & + \text{Spouse benefit} + \text{Special benefit,}\end{aligned}$$

where

$$\begin{aligned}\text{Fixed benefit} = {} & \mathbf{1{,}388} \times \textbf{Adjustment rate } (t)\\ & \times \textit{Average months credited } (t),\end{aligned}$$

$$\text{Proportional benefit} = \textbf{Coefficient}\ (t) \times \textit{Average monthly earnings} \times \textit{Average months credited}\ (t),$$

$$\text{Spouse benefit} = \textbf{209,100} \times \sum_n \textit{Dependent spouse ratio}\ (n, t),$$

$$\text{Special spouse benefit} = \textbf{Special benefits constant}\ (t) \times \sum_n \textit{Dependent spouse ratio})\ (n, t).$$

For female employed workers covered by the WAP, however, only the first two components were incorporated in the computation. Those receiving partial benefits due to continued employment at ages 60–64 were assumed to receive 80 percent of full benefits.

WAP benefits. With respect to male retired workers over age 65, the average cost of a benefit was computed

$$\text{WAP cost} = \text{Husband's basic pension} + \text{Wife's basic pension} + \text{WAP benefit},$$

where

$$\text{Husband's basic pension} = \textbf{725,300} \times \textit{Credited month ratio}\ (t),$$

$$\text{Wife's basic pension} = \textbf{725,300} \times \textit{Credit month ratio}\ (t) \times \sum_n \text{Dependent spouse ratio}\ (n, t) + \textbf{Transfer benefit}\ (t),$$

$$\text{Credit month ratio} = \textit{Average months credited}\ (t) \ / \ \text{Number of creditable months}\ (t),$$

$$\text{WAP benefit} = \text{Proportional benefit} + \text{Spouse benefit for wife less than 65 years old} + \text{Special spouse benefit for wife less than 65 years old.}$$

Survivor benefit

$$\text{Male receiving survivor benefit} = \mathit{13{,}000} \times 12,$$

$$\text{Female reveiving survivor benefit} = \mathit{75{,}000} \times 12.$$

Intersystem benefit

$$\text{Intersystem benefit} = \mathit{0.2} \times \text{WAP benefit}.$$

Credited months. On the basis of the 1981 and 1986 data on the distribution of workers according to the number of credited months in each age group, published in the *Official Projection of Public Pension Costs* (Ministry of Health 1990), we computed the increment in the number of credited months during those 60 months for each sex and age group. Taking the 1986 data as 1990 values, we used this sex and age-group profile of increments of credited months to obtain the 1995 average number of credited months for workers in each sex and age group.

Numbers of recipients. Eighty-five percent of workers who were covered by HIMA and HIMG at age 55 and who reach age 60 are assumed to qualify for WAP special benefits by accumulating more than 300 credited months. Subsequently, another 10 percent of these workers are assumed to qualify for WAP basic pension benefits at age 65, through additional employment between ages 60 and 65. One-sixth of those who receive WAP special benefits receive reduced benefits because of continued employment, while the rest receive full benefits. In addition, the number of workers who will not be able to accumulate the necessary 300 credited months within the WAP itself but who have more than 300 credited months scattered among the WAP, MAA, and NPP and qualify for the intersystem benefit is assumed to be equal to 20 percent of those who receive WAP special benefits.

Average monthly earnings. The computation of lifetime average monthly earnings is based on the estimated 1990 average monthly earnings of WAP workers for each sex and age group, which is obtained as the weighted average monthly earnings for each sex and age group of HIMG and HIMA, with the weights being the estimated numbers of insured workers in the two systems. Assuming that this sex and age-group profile of monthly earnings has persisted and will continue to persist indefinitely, for our baseline case in which we assume stationary wage levels we computed simple arithmetic averages of monthly earnings during continuous periods of time ending at age 59, equal to the credited months in length. The only factor that can change lifetime average monthly earnings is the number of credited months, but according to our assumptions, this figure becomes stationary very quickly after increasing for the first few periods. Thus, in our baseline case, lifetime average monthly earnings are very close to constant.

1.2.4 Mutual Aid Association Sub-Model

MAA plans are a collection of plans for employees of the national government, local governments, Japan Railways System, Nippon Telephone and Telegraph, private schools, and so forth, covering 5.5 million workers and their 7.5 million family members. In spite of this significant size, little attempt has been made to analyze this sector as a social insurance group, mainly because the plans are so fragmented and no single ministry has been able to collect the data necessary for analysis. Recently, the *Statistical Yearbook of Social Secu-*

rity began publishing data on the cost of benefits, but information on the workers still remains very scarce compared with information on those in the WAP.

As a social insurance group for employed workers, the MAA is currently facing the most serious aging problems, with the cost of benefits outpacing revenues. It is clear that many plans in the MAA will not be able to remain independent much longer, but the conditions under which they, or the MAA in general, will be accepted by the WAP remain to be worked out.

Number of workers in the MAA. Using the Labor Force Survey, we obtained the number of workers in the MAA for each sex and age group in 1990, then adjusted the figure by a common factor so that the sum of all workers would be equal to the number of insured MAA workers given by the *Statistical Yearbook of Social Security* (Office of the Prime Minister, 1990). We then estimated the number of dependent family members in each sex and age group using the same procedure as for the WAP (using the support share matrix of HIMA and the age-group vectors obtained above).

Average monthly earnings. Since the MAA does not publish data on the average monthly earnings of its workers in each sex and age group, we used HIMA data and adjusted them by a common factor so that the total size of the MAA's tax base (sum of the products of average monthly earnings and number of workers) coincides with the figure in the *Statistical Yearbook.*

1.2.5 National Pension Plan Sub-Model

Coverage of the NPP. Legally speaking, every Japanese adult under age 60 is required to join the NPP unless he or she is covered by the WAP or MAA as an insured worker or a dependent spouse. NPP coverage is almost identical to that of NHI programs as a whole, except that adult nonspouse dependent family members of employed WAP/MAA workers are required to join the NPP on their own. In spite of this mandatory participation, NPP coverage is not automatically initiated when a person reaches age 20; he or she must go to the local social insurance office in person to get a special passbook. Then the person will have to keep on paying NPP monthly taxes for the next 40 years, which will be verified by the stamps in the passbook.

From a practical point of view, unlike the Social Security system in the United States, NPP coverage is not a prerequisite for either employment or tax payment in Japan. This has made the NPP almost a voluntary passbook savings account system. Recently, however, as the NPP tax has continued to rise, the government is finding it increasingly difficult to "compete" with private annuity insurance in rate of return. So far, this lack of mandatory coverage has not affected NPP coverage too much. But it is almost certain that the NPP tax will very soon reach its limit, beyond which nonpayment will dramatically increase. Compared with the population covered by the NHI programs, the number of people covered by the NPP is about 75 percent of those in their twenties, about 50 percent of those aged 30–34, and over 90 percent of those aged 35 and up.

Number of credited months. Starting from the average number of credited months for each sex and age group contained in the 1990 official government forecast, we added the proportion of a period (namely, 60 months) that corresponds to the average NPP coverage ratio of the age group for each sex.

Average old-age pension benefit. The full old-age pension benefit for those who joined the NPP for the maximum possible months before age 60 is 725,000 yen per year. This is prorated according to the ratio of credited months to maximum possible months (480 months, except for those born before 1941).

Number of pension beneficiaries. We have assumed that 75 percent of those covered by the NHI in the 55–59 age group will become vested for an old-age pension benefit by accumulating at least 300 credited months before they reach age 60. This ratio is based on records for the past few years. Of those who become vested, we have again assumed that 11 percent of men and 18 percent of women will elect to receive reduced (50 percent) pension benefits when they reach age 60 but that the rest will wait until age 65 for full pension benefits.

Cost of other benefits. Since the disability benefit of the NPP is far more generous than the old-age benefit, its share of the total cost of the NPP exceeds that of the WAP disability benefit by a wide margin. We have not yet modeled the following benefits individually: partial credit benefits, survivor benefits, and disability benefits. We have added 40 percent of the cost of old-age benefits to account for the costs of these benefits.

1.3 Simulation Results of the Public Pension Model

1.3.1 Framework of Simulation

As our baseline case, we fixed the system parameters in the benefit equations and the wage structures at 1990 levels, as in our Social Insurance Model, and measured the effects of changes in population structure as well as in cohort-specific parameters in the benefit equations. Literally interpreted, this case reflects no growth in real wages in the next half-century. More realistically, however, it should be interpreted as a case in which all system parameters in the benefit equations are fully indexed to keep pace with changes in real wages. The advantage of our method is that by measuring everything in terms of units of labor, it is far easier for us to comprehend intuitively the sizes of benefits and burdens in the distant future and compare them with the present.

With respect to wage indexation, the present Japanese public pension laws require the government to reevaluate past earnings every five years to reflect changes in market wage rates. We should note that the laws have left room for the government to decide how closely past earnings should be indexed to changes in real wages. The government quietly took advantage of this loophole in the last evaluation (1989) and limited the long-run indexation of real wage rates to about 70 percent without any explanation.

1.3.2 Numbers of Recipients

By adding together the numbers of recipients of all the benefits, one may not obtain a good quantity index to indicate the cost of the public pension systems. In 1990, for the WAP, old-age benefits accounted for 50 percent of recipients but 70 percent of the cost. In contrast, survivor benefits accounted for 20 percent of the number of recipients but only 14 percent of the cost because the average cost of survivor benefits is only half that of old-age benefits. For this reason, in figure 1.4, we show only the numbers of old-age benefits recipients in the three systems through the first half of the next century (with the present system parameters). In 1990, there were 3.94 million recipients in the WAP; this number will increase to 7.59 million by 2000 and 14.39 million by 2020. There were 1.71 million recipients in the MAA.

1.3.3 Total Cost of Benefits

Figure 1.5 shows the total cost of benefits (in 10 billion yen) for the three systems in our baseline simulation case. According to our model, the total cost of WAP benefits, which stood at 9.2 trillion yen in 1990, will surpass 16 trillion yen in 2000, reach almost 23 trillion yen in 2010, and almost 28 trillion yen in 2020.

The total cost of the MAA, which stood at 5.6 trillion yen in 1990, will

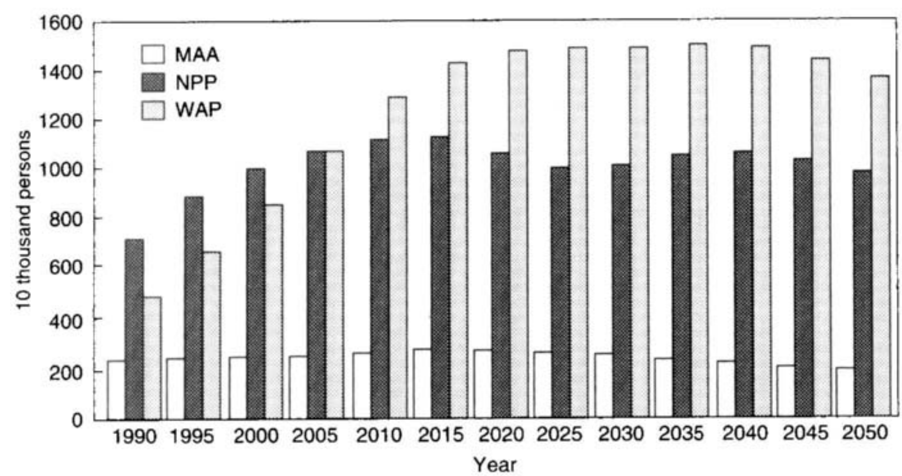

Fig. 1.4 Estimated number of old-age pension recipients

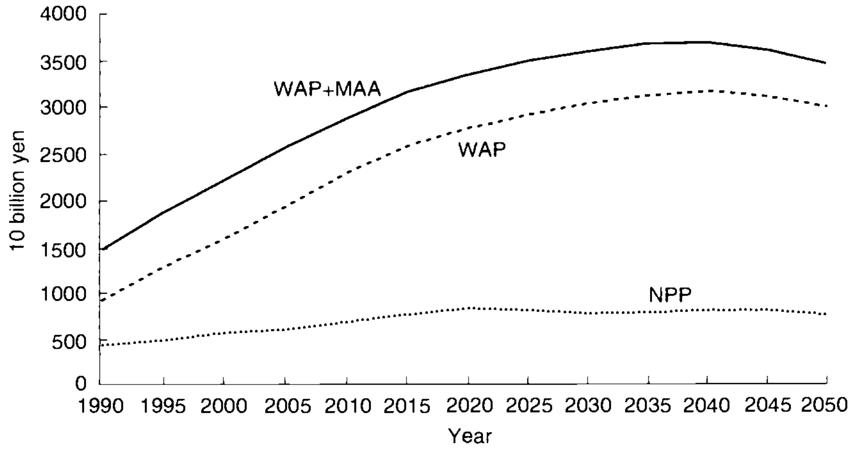

Fig. 1.5 Total costs of benefits

increase only moderately to 6.2 trillion yen in 2000, after which it will begin a slow decline. The combined costs of benefits for these two employee pension plans will increase at a rate of 3 trillion yen every five years, from 14.8 trillion yen in 1990 to 36 trillion yen in 2030, or 2.5 times the 1990 level.

As for the NPP, the cost of benefits, which stood at 4.3 trillion yen in 1990, will reach 5.6 trillion yen in 2000, 7 trillion yen in 2010, and 8.5 trillion yen in 2020, which will be the peak. The cost will remain around 8 trillion yen for some time afterward. Although the number of NPP recipients will increase by only 50 percent, costs will increase by 100 percent as a result of an increase in credited months.

To summarize, given the present parameters of our public pension systems, the total cost of public pensions was 19 trillion yen in 1990; this cost will increase to 28 trillion yen in 2000, 36 trillion yen in 2010, and 42 trillion yen in 2020, after which the rate of increase will become less sharp.

1.3.4 Cost of Basic Pension Benefits

Figure 1.6 shows how much of the total cost of public pensions is accounted for by the cost of basic pension benefits. The basic pension includes not only the basic pension costs themselves but also what are usually referred to as their "equivalents" in the WAP and MAA for the claims already existing when the basic pension was introduced. Currently, the basic pension accounts for slightly more than one-third of the total cost, but in 2015 it will account for almost one-half of the total. This implies that it will become much more difficult to reduce the cost of benefits in the next century.

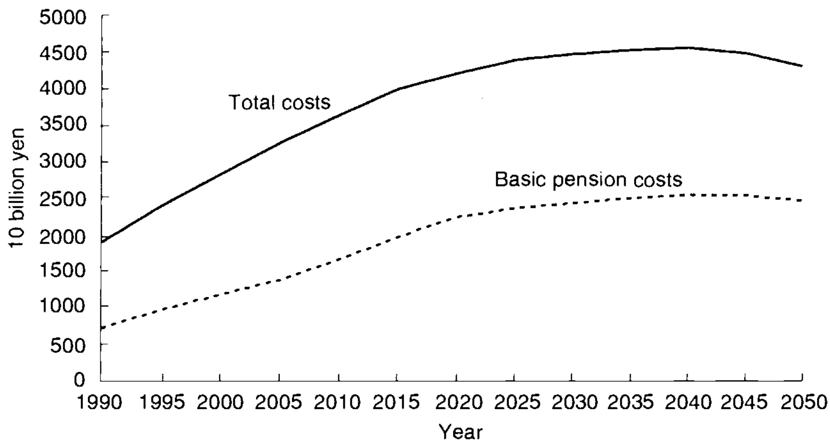

Fig. 1.6 Total costs and basic pension costs

1.3.5 Cost of Benefits Borne by Each System

Under the current Japanese public pension arrangement, each system does not automatically bear the full cost of its benefits, to be paid by either its own insurance taxes or income earned from accumulated funds, if any. Adjustments must be made for both the national government subsidy and the cross-subsidization involved in the Basic Pension Program. The national government subsidy is, however, tied to the Basic Pension Program, so we discuss only the structure of the Basic Pension Program here.

Under the program, the government first adds up the costs of the basic pension benefits for all three major systems. The total cost is then prorated to each system according to the number of insured individuals in the system (instead of the number of recipients) to arrive at the cost of the Basic Pension Program assessed to each system. For the WAP and the MAA, the number of insured individuals includes not only the workers themselves but also their dependent spouses. Thus, for each system,

$$\begin{aligned}\text{Basic pension cost assessed} &= \text{National cost of basic pension benefits}\\ &\quad \times \text{Share of insured individuals}\\ &\quad\ \ \text{in the basic pension system.}\end{aligned}$$

The national government subsidizes one-third of this assessed cost for each system, and each system bears two-thirds of this assessed value as far as basic pension benefits are concerned. Therefore, the cost actually borne by each system is given by

$$\begin{aligned}\text{Cost actually borne} &= \text{Cost of benefits other than basic pension}\\ &\quad + (2/3) * \text{Basic pension cost assessed.}\end{aligned}$$

1.3.6 Tax Bases

For the WAP and MAA, we can approximate the tax rates required to keep the systems solvent as a ratio of the costs actually borne to the size of the tax base. For these two systems, the tax base is essentially the annual payroll (excluding semiannual bonuses), which is primarily determined by the number of employed workers. For the NPP, which collects what is essentially a poll tax, the number of insured individuals is its tax base. Figure 1.7 shows the changes in the number of insured workers over time in each system as predicted by our model. Although our model is based on a set of very rigid and mechanical assumptions, it is nevertheless quite clear that, sooner or later, each system must face a declining number of insured workers.

Both the MAA and the NPP are already facing a long, slow decline in workers toward 2020, at which time they will begin to experience a rapid decrease. For the MAA, the number of workers will decline slowly from 5 million in 1990 to 4 million in 2020. As for the NPP, the number of insured individuals will decline from 15 million in 1990 to 13 million in 2020, after which the rate of decrease will accelerate.

In our scenario, the only short-run exception is the WAP, which will show a net increase of more than 2 million insured workers between 1990 and 2000. This will be brought about by a combination of two factors: the participation of the second baby boom generation in the labor market and the continued increase in female labor force participation. After the year 2000, the number of male workers in the WAP is expected to decline sharply, but the decline in the number of female workers will be more gradual. As a result, in 2020, compared to 1990, there will be 2 million fewer male workers but about the same

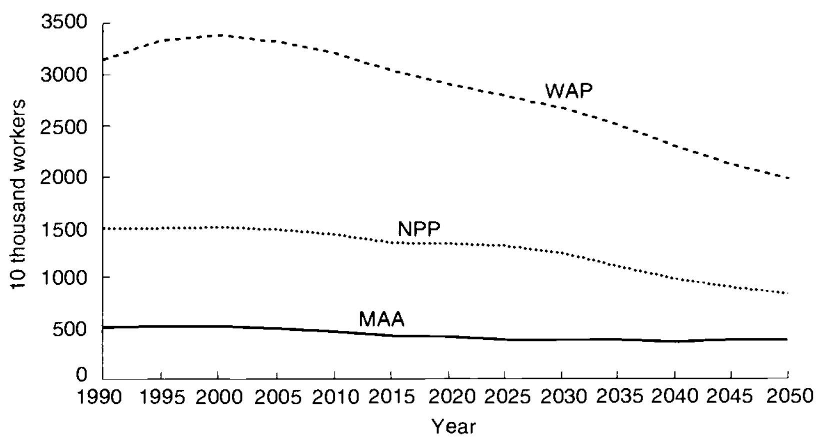

Fig. 1.7 Estimated number of insured workers

number of female workers. In the following 20 years, the number of both male and female workers will decline by more than 20 percent.

In addition to the number of employed workers, the size of the WAP and the MAA annual payrolls will be affected by their sex/age mixes. Figure 1.8 shows the changes in their tax bases, assuming that the sex/age profile of wages of WAP workers remains constant. The two curves decline rather sharply, reflecting decreasing employment. At the same time, however, figure 1.8 shows that we can maintain the current size of our tax bases if we secure a 1 percent annual increase in real wages in the next half-century.

1.3.7 Required Tax Rates

The required tax rates are computed by dividing the costs borne by the tax base for the WAP and the MAA separately and for them as a single system. In reality, the WAP in particular still holds a very substantial fund at this point, and this fund, as well as its interest income, could be used to pay for part of its costs. Therefore, calling the ratio a "required tax rate" may be inappropriate. Although this is a valid criticism, it is clear that this ratio gives the upper bound of taxes required to keep the systems solvent. Moreover, we feel strongly that the significance of the system's fund is blown out of proportion for the following two reasons.

First, although the nominal interest income seems to be very large, most of it is depreciation of capital due to inflation, and the real interest income is a small portion of it. In fact, at present, the real rate of interest is only about 1 percent. The accumulated fund of the public pension systems collectively

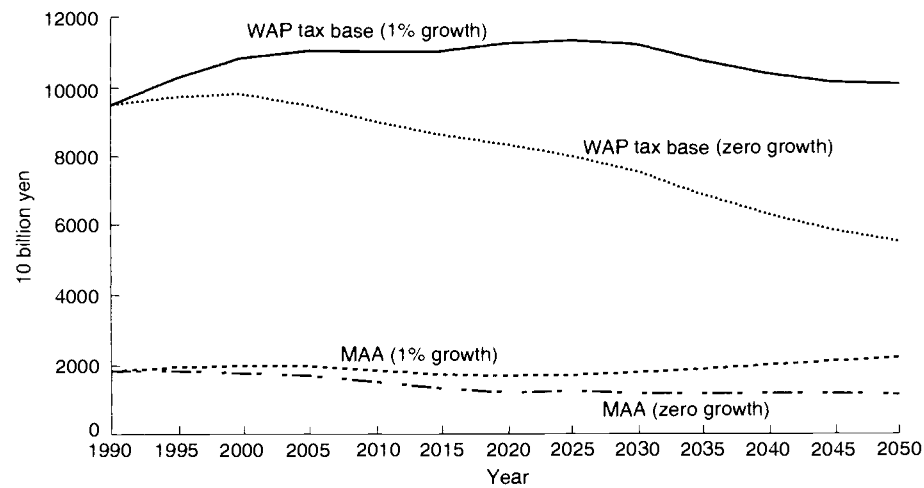

Fig. 1.8 WAP and MAA tax bases and growth of real wages

amounts to around 130 trillion yen, or about six years' cost of all benefits at the current rate. A real interest rate of 1 percent a year will pay only 1.5 months of benefits on a permanent basis, even if the cost of benefits remains the same. Second, in a public pension system that promises wage indexation of benefits, the whole real interest income cannot be used to pay for the benefits on a permanent basis; the relevant interest rate must be the difference between the nominal interest rate and the rate of increase in nominal wages, or the difference between the real interest rate and the rate of increase in real wages. Past experience suggests that this is very close to zero in Japan.

As figure 1.9 shows, we should expect the required tax rate of the WAP to keep increasing by almost 5 percent every five years, from 11 percent in 1990 to 17 percent in 2000, 23 percent in 2010, 28 percent in 2020, 33 percent in 2030, and 40 percent in 2040. In contrast, the tax rate of the MAA in 1990 was already very high, 31 percent, and we do not expect it to increase much more. Its peak will come around 2101 at 35 percent, and it will remain at about 33 percent for a long time. If the WAP and MAA are viewed as a combined system, something almost certain to become a reality in the near future, their tax rate was 14 percent in 1990, and we expect it to increase to 39 percent in 2040, following almost a straight line.

1.4 Three Policies to Alleviate Future Burdens

Given current public pension systems and demographic factors, we have shown that the pension tax burden on the working population in half a century will be almost three times higher than it is now. Furthermore, as the population continues to age, health care costs will increase rapidly, and most of these costs

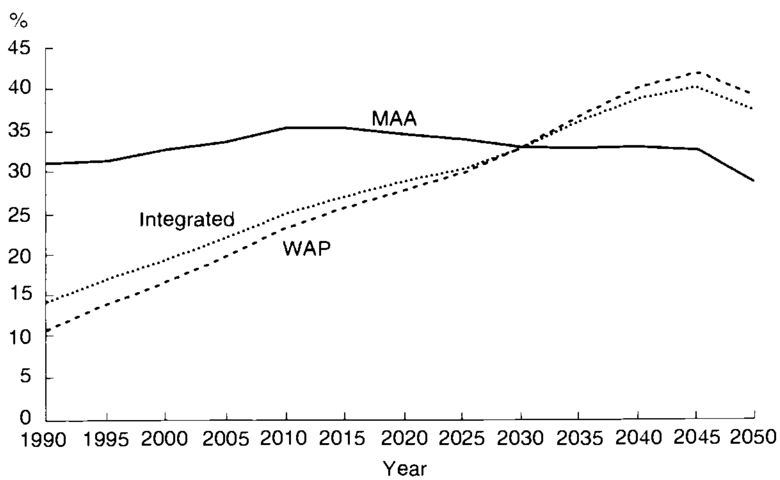

Fig. 1.9 Required tax rates for WAP and MAA

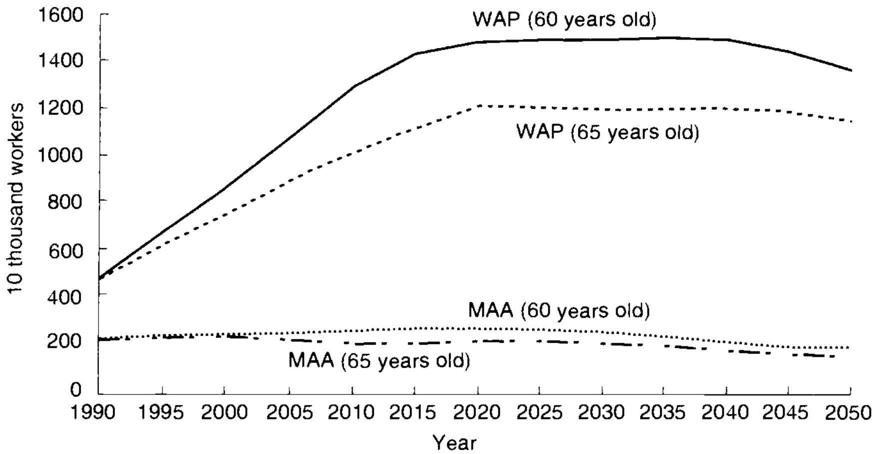

Fig. 1.10 Reduction in number of old-age pension recipients

will be borne by the future working population. To strike a proper balance in the burdens between generations, we must find a way to alleviate the burden of future generations effectively without eroding the confidence of the elderly in the pension systems. In this section, we measure the impacts of three alternative policies that could serve this purpose: (1) delay of the start of payments until age 65, (2) a form of indexation of pension benefits to the real disposable income of the working population, and (3) price indexation of pension benefits.

1.4.1 Delay of the Start of Pension Benefits

Number of recipients. Figure 1.10 shows the reduction in the number of pension recipients if the start of WAP and MAA benefits is delayed until age 65. The transition is assumed to start in 1995, at the rate of one biological year for every five years, and it is assumed to be completed in the year 2015. In terms of actual computation, the proportion of baseline case recipients who will actually receive benefits in the 60–64 age group is reduced by one-fifth every five years, until it reaches zero in 2015. Our results suggest that the total number of old-age WAP recipients will be reduced by about 2.5 million individuals once the transition is completed. This amounts to one-sixth of the baseline old-age benefit recipients.

Cost of benefits. In terms of the total cost of benefits, the delay in the start of payments will save about 3 trillion yen for the WAP and about 0.5 trillion yen for the MAA. These savings are much smaller than the reduction in the number of old-age pension recipients might suggest because survivor benefits will be affected very little by the measure.

Required tax rate. In figure 1.11, we show how the required payroll tax rate will evolve if we move to delay the start of pension payments. After 2015, this measure will reduce the required tax rate by 4–5 percent.

1.4.2 Indexation to Disposable Income or Taxation of Benefits

The most compelling reason to control the future cost of pension benefits is that if we leave the current system as it is now, it is quite possible that the net disposable income of the future working population will be reduced to less than that of the pension recipients. Considering this possibility, some argue that pension benefits should be indexed, not to wages, but to the disposable income of the working population, as in Germany (Takayama 1992). It is not easy to simulate this case, and know what this proposal will mean in terms of the required tax rate within the current framework, without modeling the entire public sector. Therefore, we consider an alternative scheme in which insurance taxes are collected from pension benefits. This alternative measure not only adequately captures the spirit of disposable income indexation but also has considerable merit on its own.

First of all, under this scheme, if an increase in the insurance tax reduces the disposable income of the working population, it will reduce the disposable income of retirees at exactly the same rate. Social insurance tax rates by themselves will not affect the relative amounts of disposable income between generations.

Second, the consequence of this measure is very predictable. Suppose that under the present scheme the total cost of the benefits program at time t is given by $B(t)$ and its tax base is given by $X(t)$. Under this measure, although the total cost of the benefits remains unchanged, the new tax base is the sum of the original tax base and the total cost of the benefits, or $B(t) + X(t)$. Thus,

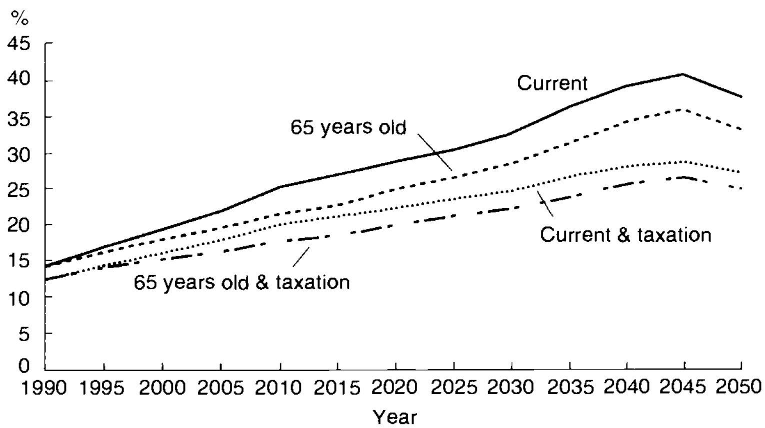

Fig. 1.11 Comparison of effects of delay of start (65) and taxation of benefits

if we denote the ratio of $B(t)$ to $X(t)$ as $b(t)$, the new (net) required tax rate, $\tau^*(t)$, will be given by

$$\tau^*(t) = b(t)/[1 + b(t)],$$

which is very simple to calculate. However, the government will pay part of the benefits, say $\lambda(t)B(t)$, where $\lambda(t)$ is the ratio of the government's subsidy to the total cost of the benefits. Thus, the cost charged to the unit tax base of the program is given by $[1 - \lambda(t)]b(t)$, and the required tax rate will be given by

$$\tau^*(t) = [1 - \lambda(t)]b(t)/[1 + b(t)].$$

To simplify the matter further, we will assume that each program can "tax" the benefits only up to the sum actually charged to it, or $[1 - \lambda(t)]B(t)$. Under these assumptions, the required tax rate will be given by

$$\tau^*(t) = [1 - \lambda(t)]b(t)/[1 + (1 - \lambda(t))b(t)],$$

or simply

$$\tau^*(t) = \tau(t)/[1 + \tau(t)],$$

where $\tau(t)$ is the required tax rate for the baseline case.

The relationship between the new required tax rate $\tau^*(t)$ and the baseline tax rate $\tau(t)$ is quite nonlinear; for example, if $b(t)$ is 30 percent, the new tax rate will be 23 percent, and if $b(t)$ is 40 percent, the new tax will still be only 29 percent. Figure 1.11 shows the path of the new tax rate. From the figure, we can see that even if we continue to start paying the old-age pension at age 60, we will still be able to keep the required tax rate under 30 percent in the 2040s, when it is at its peak. Delaying the start of the old-age pension by five years will shave off 2 percent more at the peak.

1.4.3 Price Indexation

In the baseline case, we have seen that if we try to index public pension benefits fully to wages, we must expect an unrealistically heavy burden on the future working population. The proposed delay of the start of old-age benefits by five years will help to reduce the burden, but only by about 5 percent, which hardly makes a dent in the problem. This is precisely the reason we have investigated the implication of disposable income indexation. In this section, as an alternative to disposable income indexation, we look at the effect of indexing benefits to the price level.

Every five years, public pension systems take account of changes in the wage level, reevaluate the historical wages of pension recipients, and recompute pension benefits. For the years in between, the benefits are indexed to the price level. In the baseline case, we have assumed that pension benefits are fully indexed to the wage index. This was the case until 1986, when the WAP law was revised.

Since the last revision of the WAP law, however, historical wages are no longer given an across-the-board full-wage indexation. In fact, the rates at which historical wages are reevaluated are decreasing functions of the time elapsed. That rate is 100 percent for the preceding five years and declines to around 70 percent for 30-plus years. Since this indexation is one of the most important parts of the public pension systems, it should not be left to the discretion of the government.

If there is no growth in real wages, it makes no difference whether we index benefits to the wage level or the price level. In what follows, we assume some growth in real wages. No one knows, however, what the rate of growth in real wages will be in the next 50 years, and all we can do is assume a reasonable rate of growth. In fact, we will assume that real wages will grow 1 percent per year, which is modest enough to be within the reach of our economy and yet sizable enough to make a real difference in the proposed scheme.

In figure 1.12, the curve at the top stands for standardized wages of male workers of different ages in 1990 who belonged to HIMG. The horizontal axis represents age in decreasing order, and the vertical axis represents wages expressed in terms of thousands of yen. We can interpret this curve as the reevaluated values of the historical wages a retiring worker will get at age 60 if he has worked in a small firm for most of his life and if his past wages are reevaluated by reflecting all the increases in wages until his retirement.

The second curve from the top stands for the results of reevaluation using the price level instead of the wage level. We are assuming a difference of 1 percent per year between the two indices. Because of the change in indexation, for a worker to whom the maximum 480 months are credited, the lifetime average of his monthly earnings will be about 86 percent of the average in

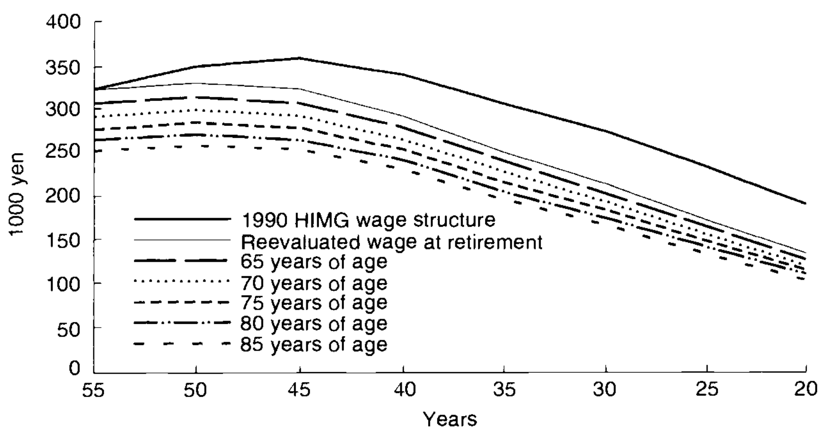

Fig. 1.12 Effects of reevaluation of wages, by private index (1 percent real wage growth assumed)

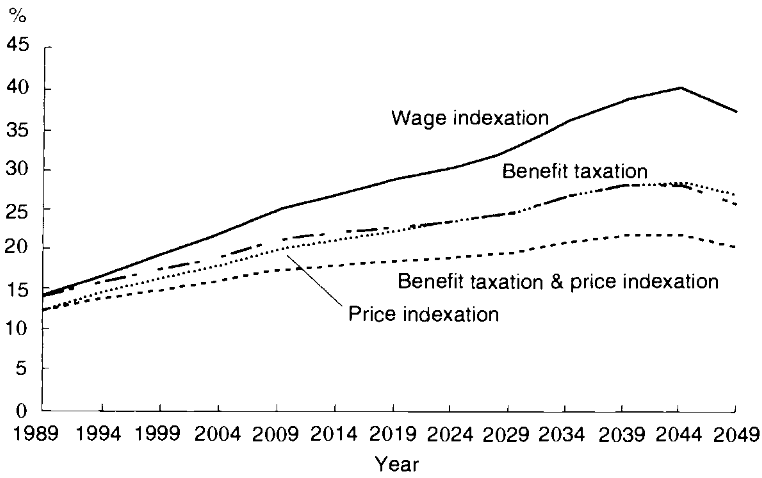

Fig. 1.13 Effects of price indexation on required tax rates (1 percent real wage growth assumed)

the wage indexation case. If he has only the minimum 300 months' credit, the lifetime average will be 95 percent of the baseline case.

After retirement, the worker will receive only the price indexation, not the wage indexation. The five bottom curves reflect the relative values of his re-evaluated wages vis-à-vis the working population at subsequent ages. As a result, for a worker who has 480 months' credit, the lifetime average will be about 67 percent, or two-thirds, of the average in the full-wage indexation case.

Required tax rate. Figure 1.13 shows the path of the required tax rate if we start price indexation of all past earnings in 1995. It also shows the path for the case of benefit taxation combined with price indexation. For reference purposes, paths for the baseline case and for benefit taxation with wage indexation also are shown. By and large, price indexation alone has about the same effect as the taxation of benefits, and price indexation and taxation can keep the maximum tax rate below 25 percent.

1.5 Concluding Remarks

The results of our simulation of the baseline case clearly illustrate the instability of the Japanese public pension systems. The insurance tax rates of pension programs for employees will climb in an almost straight-line fashion until they reach 40 percent in the middle of the next century. The generation born in the 30 years after 2020 will have to bear about twice the burden of the preceding generation. It is very hard to justify such rapid changes in the distribution of income between generations. Under a reasonable set of circumstances, it is quite possible for the economic welfare of the future working population to fall below that of the retired population.

The most effective way to deal with this problem is to control the cost of future benefits. In the preceding analyses, we have investigated the effects of three possible measures: (1) delay of the start of old-age pensions, (2) indexation of benefits to disposable income or taxation of benefits, and (3) price indexation of benefits. We have seen that option 1 will reduce the required tax rate by 5 percent, option 2 by 10 percent, and option 3 by 10 percent, if they are implemented separately. Various combinations of these options will have greater effects but much less effect than the simple sum of all the options.

The JCER-NBER joint Hakone Conference on Aging, where this paper was first presented, was held in September 1993. In spring 1994, the Japanese government prepared a comprehensive WAP reform package and sent it to the Diet. The package had three major components: (1) minimization of work disincentive by redesigning partial benefits, (2) postponement of full benefits until age 65, and (3) formal adoption of disposable income indexation instead of wage indexation. With regard to the second point, under the government proposal, starting in 2013 those aged 60–64 who currently qualify for WAP special benefits would lose the equivalent of the basic pension. Retired employees and spouses would also have to wait until age 65 to receive basic pension benefits. With regard to the third point, the government formally proposed abandoning full indexing of past earnings to the current wage level, which it did de facto in 1990. The idea of disposable income indexation, however, invited another question: Whose disposable income should be chosen as the index?

The reform bill passed, and the government was able to get what it wanted—disposable income indexation and a reduction in the special benefit by an amount equal to the basic pension. The government has also prepared its official 1994 projections of public pension costs, but as the technical details of these projections are not made public, we cannot compare them with ours. The government is, in any case, constrained by its own unrealistic population projections, which must account for some of the difference with ours. The government's projections are substantially more optimistic than ours.

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