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PII: S0922-1425(17)30125-1
DOI: https://doi.org/doi:10.1016/j.japwor.2018.02.002
Reference: JAPWOR 911

To appear in: *JAPWOR*

Received date: 27-10-2017
Revised date: 9-2-2018
Accepted date: 26-2-2018

The Future Prospect of the Long-term Care Insurance in Japan *

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February 2018

Abstract

This paper explores the impact of population aging on the Japanese public long-term care insurance (LTCI) within a numerical dynamic general equilibrium model with multiple overlapping generations. The impact of three policy options, such as an increase in co-payments, an earlier starting age of contribution, and more distribution of the cost to the public sector, is also examined. The numerical results show that in the next about forty years the burdens on the first (age 65 and over) and second (age 40 to 64) groups become more than 1.7 times and more than 2.7 times as much, respectively. A relatively more increase in the burdens on the second group cannot be avoidable, even if adjustment of the cost distribution between both groups is made every three years in the future in accordance with the schedule by the MHLW. Furthermore, in order to reduce future burdens in the LTCI, an increase in co-payments is most preferable, rather than an earlier starting age of contribution in the longer duration with lower annual burdens, or a shift of the cost to the public sector with a very high consumption tax.

Keywords: Long-term Care Insurance, Population Aging, Japan, Simulation

JEL Classification: C68, H51, E62, H55, and J16

*Grant-in-Aid for Scientific Research by Japan Society for the Promotion of Science (No. 15K03525) is acknowledged.

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1 Introduction

This paper explores the impact of population aging on the Japanese long-term care insurance (LTCI) within the Auerbach and Kotlikoff (1987) model, and three policy options are also examined.

The National Institute of Population and Social Security Research (IPSS) released the latest population projection of Japan in year 2017, and Figures 1 shows the dependency ratio[1]. The total population is expected to shrink to less than 60 million in the next 100 years. Reflecting rapid population aging, the surrounding environment of the LTCI will become more severe in a graying Japan.

Within the Auerbach and Kotlikoff (1987) model[2], Braun and Joines (2015) recently examined public medical benefits, which can be interpreted as benefits through the national health services as well as the LTCI. Kitao (2015a) separated the LTCI from the national health services explicitly. This paper expands the literature by taking into account more realistic aspects: First, the latest population projection by the National Institute of Population and Social Security Research (IPSS) (2017) is used for future demographics. All existing studies use the older version of the population projection by IPSS (2012). They assume the lower dependency ratio in the future steady state, but the future demographics given in this paper is quite different from the existing literature. Second, several assumptions in the latest version of *Economic and Fiscal Projections for Medium to Long-term Analysis* (EFPMLA: January 2016) are used to specify the future economy. EFPMLA (2016) numerically embodies the so-called *growth strategy*, the main policy of Abenomics. Third, the future path of already highly accumulated public pension fund is assumed to decrease to follow the future plan by the Ministry of Health, Labor and Welfare (MHLW). In the existing literature, the accumulated public pension fund has not been considered explicitly. Fourth, the general

[1]The dependency ratio is defined as the ratio of age 65 and over to the total number of age 20 to age 64.

[2]Several studies on the Japanese LTCI emperically explored the scheme. These studies include Yamada et al (2006), Mitchell et al (2008), Ohwa and Chen (2012), Shimizutani (2014), and Tanaka (2016). Ueda et al (2014), Tajika and Kikuchi (2014), and Akimura (2016) estimated the cost in the LTCI.

account, the public pension account, and the long-term care insurance (LTCI) are explicitly separated. Several existing studies combine these three sectors in a single government budge constraint. This paper separately introduces the budget constraint of each sector, and also explicitly considers transfer programs between sectors.

This paper also discusses three possible policy options; an increase in co-payments by the elderly (Option 1), a wider coverage of contributing cohorts (Option 2), and a change in the cost distribution between the public sector and the insured (Option 3). The elderly currently has to co-pay a 10 % of the total cost when the elderly uses services through the LTCI. Option 1 examines the impact of an increase in the co-payment rate. As the second policy option (Option 2), a change in a coverage of contributing cohorts is explored. Under the current scheme, all cohorts have to contribute to the scheme when they become age 40. In this second option, a starting age of contribution becomes earlier from age 40 to 30 or 35. The third policy option (Option 3) is on the distribution of the cost between the public sector and the insured. Currently, the cost is equally distributed between the public sector (50 %) and the insured (50 %), and the equal distribution is modified.

Several numerical results are obtained as follows: First, population aging leaves more burdens on the LTCI. In the next about forty years, the burdens on the first group (age 65 and over) and the second group (age 40 to 64) become more than 1.7 times and more than 2.7 times as much, respectively. The MHLW plans to adjust the distribution of the cost every three years to reduce the cost on the second group (age 40 to 64). However, the burden on the second group (age 40 to 64) increases substantially even after adjustment in an aging Japan. Second, among three possible policy options, a policy to increase co-payments (Option 1) is most preferable. This implies that all cohorts most prefer the case where they pay the cost by themselves when they need services through the LTCI. Third, if a policy to increase co-payments (Option 1) is not available, then almost all cohorts choose a policy (Option 3) to reduce the burdens on both groups followed by an increase in the consumption tax. In this policy option, the ratio of the cost on the insured decreases, and that on the public sector increases. More distribution of the cost to the public sector induces an increase in the consumption tax. The equal distribution of the cost between the public sector and the insured is modified to a 60 % of the cost to the public sector, followed by a relatively slight increase in a consumption tax. However, particularly future cohorts do not prefer a policy with too much more distribution of the cost to the public sector, since such a policy is followed by a very high consumption tax. Finally, Option 2 with an earlier starting age of contribution of age 35 is the third best policy option for future cohorts. However, a too early starting age of contribution of age 30 in Option 2 is least preferable among all three policy options. An earlier starting age in Option 2 results in the longer duration of contribution but lower burdens every year. This implies that cohorts do not prefer too long duration of contribution even with much lower burdens per year.

Population aging in Japan will induce a substantial increase in burdens in the LTCI. In such a future environment, all cohorts most prefer co-paying the increasing cost by themselves through an increase in co-payments. More distribution of the cost to the public sector is also preferable, even though a consumption tax rate increases. However, particularly future cohorts prefer not to induce too much more distribution to the public sector, since such distribution results in a very high consumption tax rate. Furthermore, cohorts also prefer an earlier starting age of contribution. An earlier starting age of contribution implies the longer duration with lower monthly contributions. However, cohorts do not prefer too long duration of contributions, although monthly contributions become further lower.

This paper is organized as follows. The next section introduces the model in detail. Section 3 explains calibration, and Section 4 presents numerical results in detail. Section 5 concludes the paper.

2 The Model

2.1 Demographic Structure

An overlapping generations economy in discrete time with a model period of one year is considered[3]. The representative household in each cohort appears in the economy at age 20 as a decision maker[4]. Although the household faces uncertainty regarding its death in each period, it dies with certainty at the end of its age of 99 if it is alive until age 99. It is assumed that there is no uncertainty regarding the size of the total population in each period. Denote the survival rate by P_s, which is defined by $P_s = \prod_{i=1}^{s} q_i$, where q_{j+1} is the conditional survival rate of a j years old household which survives to $j+1$ years old. Due to uncertainty of lifetime in each period, accidental/unintended bequests generated by death of all cohorts exist in each period, and such bequests are distributed to the surviving household in a particular age. Denote the pre-taxed amount of accidental/unintended bequests inherited in age s at time t by $bq_{s,t}$, and each cohort receives the net bequests denoted by $(1-\tau_{q,t})\, bq_{s,t}$ once in its life, where $\tau_{q,t}$ is the inheritance tax rate at time t. No bequest motives are assumed so that the representative household of each cohort enters an economy with no assets. No liquidity constraint is imposed. The age-specific fertility and mortality rates are time variant, both of which are calculated based on the actual past data and the projection of year 2017 by the IPSS. This implies each cohort has different fertility and mortality rates over time, and P_s differs among different cohorts.

2.2 The Representative Household

The representative household in each cohort is forward-looking, and future events affect decisions made today. The representative household faces lifetime uncertainty in each period, but there is no other uncertainty such as an income shock through its lifetime[5]. The

[3]Table 1 provides the list of all variables.

[4]This paper uses the basically same model as Kato (2017) for analyzing the Japanese LTCI.

[5]If there is also uncertantiy in lifetime wage income, then precautionary savings motives exist. Thus, with the assumption of no income shocks, the magnitude of the impact of any policy change on savings, thus

representative household consists of four different types of workers. Workers differ, depending on the gender as well as the types of the job contract. Workers are differentiated by the difference in their job types with their employer; regular workers (Seiki koyo) and non-regular workers (Hi-Seiki koyo). The latter workers include part-time, dispatched, or fixed term workers. Thus, there are four different workers in the representative household in each cohort; male regular, female regular, male non-regular, and female non-regular workers, respectively. While the representative household consists of four different workers, there is no heterogeneity in terms of preference among them, and the representative household in each cohort is assumed to have unitary preference[6].

The representative household is assumed to maximize its expected lifetime utility with respect to its own consumption and leisure time. The household's expected lifetime utility of cohort g, denoted by $E\left[V_g\right]$, is given

$$E\left[V_g\right] = \sum_{s=20}^{99} P_s \left(1+\delta\right)^{-(s-20)} \frac{u\left(c_{s,t}, l_{s,t}\right)^{1-\rho}}{1-\rho}, \tag{1}$$

where ρ is a reciprocal of the elasticity of substitution between consumption at the different time. δ is the time preference. $c_{s,t}$ and $l_{s,t}$ are consumption and leisure of a s years old household at time t, respectively. Note that there is a relationship of $t = g + s$. The felicity function of u is given by:

$$u\left(c_{s,t}, l_{s,t}\right) = \left[c_{s,t}^{\frac{\xi-1}{\xi}} + \kappa l_{s,t}^{\frac{\xi-1}{\xi}}\right]^{\frac{\xi}{\xi-1}}, \tag{2}$$

where ξ denotes the elasticity of substitution between consumption and leisure, and κ denotes the weight parameter for leisure. All variables are listed in Table 1.

on the capital labor ratio, will be smaller. However, qualitative results should not be affected.

[6]For simplicity, the collective approach to modelling the household is not adopted. See Basu (2006) and Agenor (2017) for the collective approach.

The budget constraint of the representative household is:

$$a_{s+1,t+1} = [1 + (1 - \tau_{r,t}) r_t] a_{s,t} + (1 - \tau_{w,t} - \tau_{p,t} - \tau_{e,s,t}) e_s (1 - l_{s,t} - lc_{s,t} - le_{s,t}) w_t$$
$$+ (1 - \tau_{w,t}) b_{s,t} + d_{s,t} + (1 - \tau_{q,t}) bq_{s,t} - (1 + \tau_{c,t}) c_{s,t} - h_{s,t} - IC_{s,t} - \theta_t LT_{s,t}, \quad (3)$$

where $a_{s,t}$ is the amount of assets held by a s years old household at the beginning of time t. e_s is the measure of efficiency of labor of the household, and e_s is the weighted average of efficiency of four different workers. Note that efficiency is different in age among all four different workers as well. $lc_{s,t}$ and $le_{s,t}$ denote the time spent on child rearing and elderly care, respectively, both of which are assumed to be exogenously given to the household. $d_{s,t}$ and $h_{s,t}$ denote a financial child allowance given by the government and the financial cost of child rearing in age s at time t, respectively. The representative household in each cohort is assumed to have the average number of children when it becomes age 28 (the age of its child is 0)[7]. As expressed by (1), the representative household does not have any utility from having a child. It starts rearing its own child until its child becomes age 20, thus until its own age of 48[8]. To reflect reality, a financial child allowance is given to the representative household by the time when its own child becomes age 15. This implies that the representative household in each cohort receives a child allowance between its own ages of 28 and 43, while it has to pay the financial child rearing cost until its own age of 48. The actual data of $d_{s,t}$ from Cabinet Office of Japan is used to specify the value in the model[9]. On the value of $h_{s,t}$, the study on the financial cost of child rearing conducted by Cabinet Office of Japan (2010) is used.

$\tau_{r,t}$, $\tau_{w,t}$, $\tau_{p,t}$,and $\tau_{c,t}$ are the interest income tax rate, the wage income tax rate, the public pension contribution rate, and the consumption tax rate, respectively. $\tau_{e,s,t}$ is the contri-

[7]The average number of children the representative household in each cohort has is calculated by the ratio of the total number in the cohort of age 0 to the total number in the cohort of age 28 in each period.

[8]Precisely speaking, the household keeps rearing its own child until the end of age 19 of its own child.

[9]The Cabinet Office of Japan conducted an analysis on the financial cost of child rearing based on a questionnaire by internet (2009), and this paper calculates the value of $d_{x,t}$ based on the questionnaire analysis.

bution rate to the long-term care insurance (LTCI), which is applied to the representative household while it is working in age s at time t[10]. After retirement, the representative household still has to contribute to the LTCI. The fixed amount of contributions is denoted by $IC_{s,t}$ in age s at time t. Note that an individual starts to contribute to the LTCI once she becomes age 40 in Japan. Between age 40 and 64, all individuals belong to the second group (age group between 40 and 64), and the amount of their contributions depends on their earnings. Their contribution rate is given by $\tau_{e,s,t}$. Once an individual becomes age 65, then she is transferred to the first group (age group of 65 and over), in which she still has to contribute to the LTCI, but the amount of contributions is fixed by $IC_{s,t}$. This paper takes into account such a realistic aspect of the LTCI, and the contribution rate for the second group (age group between 40 and 64) and the fixed amount of contributions for the first group (age group of 65 and over) are both calculated based on A Summary of the Long-term Care Insurance by the Ministry of Health, Labor and Welfare (MHLW; 2017). $LT_{s,t}$ is the total cost of obtaining services through the LTCI, and the θ_t is the co-payment rate at time t. $LT_{s,t}$ is calculated based on Survey of Long-term Care Benefit Expenditure (SLCBE) of year 2014, and $LT_{s,t}$ is assumed to be age-dependent, but time invariant. θ_t is assumed to be 0.1 to reflect the current rate.

Labor efficiency of four different workers is obtained from the data. In this paper, Basic Survey of Wage Structure (BSWS) of year 2011 and Labor Force Survey (LFS) of year 2012 are both used to specify the efficiency profile of each worker over time. The weight for efficiency of the household in age s, e_s, was calculated from these two data sets. In the simulation section, efficiency of male non-regular workers in age 20 - 24 is used to normalize efficiency of other workers in different age. Note also that the wage rate, w_t, the household faces is determined in the competitive labor market, and the total wage income of the household is the weighted average wage income of four different workers. The wage profiles

[10]Precisely speaking, although the retirement age is assumed to be fixed at age 65, the positive rate of $\tau_{e,s,t}$ is applied up to age 64, and it becomes zero when the representative household becomes age 65. When the household becomes age 65, it starts paying the fixed amount of contributions.

of four different workers are obtained from the above two data sets. The time spent on child rearing and elderly care is also differentiated among four different types of workers; male regular, male non-regular, female regular, and female non-regular workers.

Thus, the total labor supply by the representative household in age s at time t is such that:

$$\begin{aligned} e_s\left(1-l_{s,t}-lc_{s,t}-le_{s,t}\right) = {} & \nu^s_{m,ft} e^s_{m,ft}\left(1-l_{s,t}-lc_{s,t,m,ft}-le_{s,t,m,ft}\right) \\ & + \nu^s_{fe,ft} e^s_{fe,ft}\left(1-l_{s,t}-lc_{s,t,fe,ft}-le_{s,t,fe,ft}\right) \\ & + \nu^s_{m,nf} e^s_{m,nf}\left(1-l_{s,t}-lc_{s,t,m,nt}-le_{s,t,m,nt}\right) \\ & + \nu^s_{fe,nf} e^s_{fe,nt}\left(1-l_{s,t}-lc_{s,t,fe,nt}-le_{s,t,fe,nt}\right), \end{aligned} \tag{4}$$

where m, fe, ft, and nt denote male, female, regular contract, and non-regular contract, respectively. Thus, $e^s_{k,n}$ denotes labor efficiency of gender k of contract type of n in age s. $v^s_{k,n}$ denotes the weight of gender k of contract type of n in age s in efficiency of the household. Note that both $e^s_{k,n}$ and $v^s_{k,n}$ are also calculated from LFS (2012) and BSWS (2011). $lc_{s,t,k,n}$ and $le_{s,t,k,n}$ are time spent on child rearing and elderly care by gender k of contract type of n in age s at time t, respectively. $lc_{s,t,k,n}$ and $le_{s,t,k,n}$ are calculated from Survey on Time Use and Leisure Activities (STULA) of year 2012. All four different workers in the representative household retire at the end of their age of 65, and they never come back to the labor market after their retirement.

$b_{s,t}$ is the amount of public pension benefits in age s at time t[11]. w_t and r_t are the wage rate per the efficiency unit and the interest rate, respectively. Public pension benefits are given by

$$b_t = \begin{Bmatrix} \epsilon_t\left(H_t+\overline{H}_t\right); & s \geq RH \\ 0; & s, < RH \end{Bmatrix}, \tag{5}$$

where RH is the retirement age of 65, and fixed through this paper. This implies that

[11]A simplified assumption on the pension benefits is made in this paper. For more detailed studies, see, for instance, Yamada (2011) and İmrohoroğlu et al (2016).

the representative household optimally chooses labor supply in intensive margin but not in extensive margin. Public pension benefits are taxed to reflect reality. ϵ_t is the replacement rate[12]. $\overline{H}_t$ and H_t denote the fixed amount of basic pension benefits and earning related benefits, respectively, and H_t is given by:

$$H_t = \frac{1}{RH} \sum_{s=20}^{RH} w_t e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right).$$

It is assumed that the representative household maximizes (1) with respect to $c_{s,t}$ and $l_{s,t}$ subject to (3), and the first order conditions yield the following optimal equations:

$$u'\left(c_{s,t}, l_{s,t}\right) u\left(c_{s,t}, l_{s,t}\right)^{-\rho} = \frac{q_{s+1,g}\left[1 + \left(1 - \tau_{r,t+1}\right) r_{t+1}\right]}{1+\delta} \frac{1+\tau_{c,t}}{1+\tau_{c,t+1}} \times u'\left(c_{s+1,t+1}, l_{s+1,t+1}\right) u\left(c_{s+1,t+1}, l_{s+1,t+1}\right)^{-\rho}, \tag{6}$$

$$l_{s,t} = \left[\frac{\kappa\left(1+\tau_{c,t}\right)}{\left(1 - \tau_{w,t} - \tau_{p,t} - \tau_{e,s,t}\right) w_t e_s}\right]^{\xi} c_{s,t}, \tag{7}$$

where

$$u'\left(c_{s,t}, l_{s,t}\right) = \frac{\partial\left(c_{s,t}, l_{s,t}\right)}{\partial c_{s,t}}.$$

2.3 The Firm

The firm is assumed to maximize its profits, taking the wage rate and the interest rate as given. The wage rate and the interest rate are determined in perfectly competitive factor markets in equilibrium in each period. The aggregate private production function is assumed to be Cobb- Douglas such that

$$Y_t = \Omega_t L_t^{\alpha} K_t^{1-\alpha}, \tag{8}$$

[12]There are several definitions of the replacement rate of the public pension scheme. See İmrohoroğlu et al (2016) in detail. This paper uses the Japanese official definition of the replacement rate, which is defined as the ratio of pension benefits, which a typical household of a 65 years old husband of category 2 and a wife only with the basic fixed amount of pension benefits receives, to average disposal earnings of category 2 male workres. The replacement rate based on this definition is currently just above 60 %.

where Y_t, K_t denote aggregate output, and capital at time t. L_t is total labor demand measured in the efficiency unit. Ω_t is technology of production of the private sector. The fully competitive assumption of factor markets yields:

$$w_t = \alpha \frac{Y_t}{L_t}, \tag{9}$$

$$r_t = (1-\alpha) \frac{Y_t}{K_t} - \varphi, \tag{10}$$

where φ is the depreciation rate.

2.4 The Government

The government sector consists of a long-term care insurance account, a general account, and a public pension account. The government issues government bonds, and accumulates the public pension fund. Each account is separately considered as follows.

2.4.1 Long-term Care Insurance (LTCI) Account

The budget constraint of the long-term care insurance (LTCI) is given by:

$$TLT_t = FIC_t + TIC_t + OIC_t + E_t, \tag{11}$$

where TLT_t is the total expenditure in the account at time t, and it is given by:

$$TLT_t = \sum_{s=RH-1}^{99} (1-\theta_t) LT_{s,t} POP_{s,t}. \tag{12}$$

E_t is the amount of transfers from the general account to the long-term care insurance account at time t. $LT_{s,t}$ is the total cost through the LTCI, and the θ_t is the co-payment rate imposed on the representative household at time t. $POP_{s,t}$ denotes the total population of age s at time t.

FIC_t and TIC_t, are aggregated revenues contributed by each household at time t, which are such that:

$$FIC_t = \sum_{s=40}^{RH-1} \tau_{e,s,t} w_t e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right) POP_{s,t},$$

$$TIC_t = \tau_{e,RH-1,t} w_t e_{RH-1} \left(1 - l_{RH-1,t} - lc_{RH-1,t} - le_{RH-1,t}\right) POP_{RH-1,t} + \sum_{s=RH}^{99} IC_{s,t} POP_{s,t}.$$

Note that FIC_t and TIC_t are the total contributions by the household which belongs to the first group between age 40 and 64, and to the second group between age 65 and over, respectively. The household has to pay a part of the total cost as a co-payment when it receives services through the long-term care insurance. The current co-payment rate, θ, is 10 %. OIC_t is the total amount the household pays by itself when it receives services through the long-term care insurance at time t, which is given by:

$$OIC_t = \sum_{s=RH-1}^{99} \theta_t LT_{s,t} POP_{s,t}.$$

In order to reflect reality, $\tau_{e,s,t}$ and $IC_{s,t}$ are both endogenously calculated to satisfy (7) in the following simulations.

2.4.2 General Account

The budget constraint of the general account is such that:

$$D_{t+1} - D_t = AG_t + r_t D_t + P_t + E_t + CH_t - R_t, \tag{13}$$

where D_t denotes the amount of outstanding government debts at time t. AG_t is the total government expenditure. P_t is the amount of transfers from the general account to the public pension account at time t. CH_t denotes the total amount of a child allowance given to each household. A child allowance is assumed to be given to the household while it is between age 28 and 43. Thus,

$$CH_t = \sum_{s=28}^{43} d_{s,t} POP_{s,t},$$

where $d_{s,t}$ denotes the amount of a child allowance per household. R_t is the total tax revenue, which is given by:

$$R_t = \tau_{w,t} \left(w_t L_t + AB_t \right) + \tau_{r,t} AS_t + \tau_{c,t} AC_t + \tau_{q,t} BQ_t, \tag{14}$$

where[13]

$$\begin{aligned} L_t &= \sum_{s=0}^{RH} e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right) POP_{s,t} \\ &= \sum_{s=0}^{RH} \left[\nu^s_{m,ft} e^s_{m,,ft} + \nu^s_{fe,ft} e^s_{fe,ft} + \nu^s_{m,nf} e^s_{m,nf} + \nu^s_{fe,nf} e^s_{fe,nt} \right] \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right) POP_{s,t}. \end{aligned} \tag{15}$$

The aggregated values of AB_t, AS_t, AC_t, and BQ_t are given by:

$$\begin{aligned} AB_t &= \sum_{s=RH}^{99} b_{s,t} POP_{s,t} \\ AS_t &= \sum_{s=20}^{99} a_{s,t} POP_{s,t} \\ AC_t &= \sum_{s=20}^{99} c_{s,t} POP_{s,t} \\ BQ_t &= \sum_{s=20}^{99} bq_{s,t} POP_{s,t}. \end{aligned}$$

[13]The labor market is assumed to be fully competitive, and (15) is also interpreted as an equilibrium condition of the labor market

2.4.3 Public Pension Account

On the public pension account, the budget constraint is such that:

$$F_{t+1} - F_t = r_t F_t + P_t + CP_t - AB_t, \tag{16}$$

where F_t denotes the accumulated pension fund at time t. CP_t is the total amount of contributions collected at time t, which is given by:

$$CP_t = \sum_{s=20}^{RH} \tau_{p,t} w_t e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right) POP_{s,t}.$$

2.5 Competitive Equilibrium

For a given sequence of all demographic parameters, $\{POP_t, P_{t-g}\}_{t=0}^{\infty}$, a given sequence of all government policies, $\left\{D_t, F_t, d_{s,t}, \tau_{w,t}, \tau_{r,t}, \tau_{c,t}, \tau_{q,t}, \tau_{p,t}, \tau_{e,s,t}, \tau_{e,RH-1,t}, \theta_t, b_t, IC_{s,t}, \epsilon_t, \overline{H}_t\right\}_{t=0}^{\infty}$, and a given sequence of the financial cost of child rearing as well as of elderly care services, $\{h_{s,t}, LT_{s,t}\}_{t=0}^{\infty}$, the perfect foresight competitive equilibrium is defined as the sequence of $\{r_t, w_t\}_{t=0}^{\infty}$,which satisfies the following conditions:

1. The optimal conditions for the representative household, (6) and (7), are satisfied for all generations in each period with the non-ponzi condition.

2. The optimal conditions for the firm, (9) and (10), are satisfied in each period.

3. Three budget constraints for the government, (13), (16), and (11), are satisfied in each period.

4. The capital market equilibrium condition is satisfied in each period such that:

$$AS_t + F_t = K_t + D_t.$$

5. The goods market equilibrium condition is satisfied in each period such that:

$$Y_t = AC_t + K_{t+1} - (1 - \varphi) K_t + AG_t.$$

6. The sequence of the consumption tax rate, $\{\tau_{c,t}\}$, is endogenously determined to satisfy (13) from year 2019.

7. The sequence of the contribution rate of the public pension scheme, $\{\tau_{p,t}\}$, is endogenously determined to satisfy (16) until year 2017.

8. The sequence of the replacement rate of the public pension scheme, $\{\epsilon_t\}$, is endogenously determined to satisfy (16) from year 2018.

9. The sequence of the revenue instruments of the LTCI, $\{\tau_{e,s,t}, \tau_{e,RH-1,t}, IC_{s,t}\}$, is endogenously determined to satisfy (11) in each period.

3 Calibration

Parameter values have been set to reproduce the values of key variables in the model as close to real values in year 2012 as possible in the following benchmark. The detailed values of parameters are given in Table 2.

As Auerbach and Kotlikoff (1987) and De Nardi et al (1999) pointed out, the impact of policy changes is quite different among different generations. The impact on an economy on the transition matters in a computable general equilibrium model, and this paper explores the impact on transition.

3.1 Demographics

The assumption on the demographics is a key factor. From year 2016 to year 2115, the latest population projection by the IPSS (2017) is used for age groups of 0 to 100[14]. The medium variant values for fertility and mortality rates are used. From year 2116, the same distribution

[14]The populaiton projection by the IPSS consists of the usual estimate for the first 50 years and a reference estimate for another 50 years. This paper uses both estimates for entire 100 years from year 2016 to 2115.

as that of year 2115 is assumed for another 100 years. The latest population projection by the IPSS (2017) shows that the Japanese economy converges to a new steady state with the high dependency ratio as shown in Figure 1. In the growing literature all studies assume that the Japanese economy converges to a new steady state with a low dependency ratio after experiencing its very high ratio at peak. Hofwever, this paper uses the entire estimates by the IPSS (2017) until year 2115.

Regarding the past demographic structure, the actual data from year 1920 to year 2015 is used[15]. The demographic structure before year 1920 is assumed to have the same distribution as that of year 1920.

Since all parameter values of the total population and the survival rate are calculated by using the actual and projected data, the demographics in the model can perfectly capture the actual and projected demographic structure shown in Figure 1.

3.2 Preference and Production

Key parameter values in (1) and (2) are shown in Table 2. On the values of tax rates and parameter values in production, available values from Hayashi and Prescott (2002) as well as Hansen and İmrohoroğlu (2016) are used. Ihori et al (2006) pointed out that all simulation results are quite sensitive to the value of technological progress (Ω_t). Note that in EFPMLA (2016) the future economic growth rates are given as targeted values. This paper exogenously gives the value of Ω_t, so that the endogenously calculated rate of economic growth in the model becomes close to the targeted value of economic growth rate given in EFPMLA (2016). The model values of economic growth calculated endogenously in the benchmark model will be shown in Section 3.4.

[15]The data of age 85 and over from year 1920 to 1946 was calculated based on the actual survival rate of age 85 and over between year 1947 and 1948. The data of all ages from year 1941 to 1943 are missing, and missing data were recursively calculated based on the survival rates of all ages between year 1947 and 1948 with the data of year 1944.

3.3 Government

The Japanese government has been trying to stimulate the Japanese economy based on the so-called *growth strategy*. In order to accomplish the growth strategy, the government documented concrete figures[16] of several key variables such as the future primary balance and economic growth as targeted figures[17].

In EFPMLA (2016), there are two assumptions on the future economic environment up to year 2024; a recovery case and a baseline case. Figure 2-1 to 2-3 show the different assumptions between two cases. In all figures the actual data is used until year 2014. As all figures show, the recovery case seems quite optimistic in comparison with the past trend. Based on this observation, this paper follows assumptions made in the baseline case in EFPMLA (2016).

3.3.1 Long-term Care Insurance (LTCI) Account

The public long-term care insurance (LTCI) for the elderly was introduced in year 2000. The expenditures basically depend on the demographic structure and population aging, and the expenditures are assumed to be exogenous in the paper. Figure 3-1 shows the future expenditures in the LTCI based on the assumption that the age-dependent cost is time-invariant. For given values of expenditures, this paper endogenously calculates the fixed amount of contributions by the first group and the contribution rate for the second group in order to balance the budget of the LTCI account.

On the revenue side, a 10% of the total cost is paid by the insured as co-payments. A half of the remaining cost (90 % of the total cost) is covered by transfers from the general

[16]Several official documents have been made. This paper follows several assumptions made by the Cabinet Office of Japan (*Economic and Fiscal Projection for Medium to Long-term Analysis* (January 2016)).

[17]Miyazawa and Yamada (2015) examined the growth strategy of Abenomics, and they concluded that the growth strategy seems difficult to be achieved even under very optimistic assumptions made in one of the official documents, *Economic and Fiscal Projections for Medium to Long-term Analysis* (July 2014). This paper uses several assumptions made in the latest version of EFPMLA (2016) to specify the future government policy, and expands Miyazawa and Yamada (2015) by separately introducing the government accounts in a more realistic way.

account (E_t). Another half of the remaining cost is paid by the insured. A 28 % and a 22% of the remaining cost are currently paid by people belonging to the second group, and the first group, respectively. Note that the scheme is compulsory so that people between age 40 and 64 have to belong to the second group, and people of age 65 and over have to belong to the first group.

The current ratios of the distribution of the cost between the first group (age 65 and over) and the second group (ages between 40 and 64) are 22 % and 28%, respectively. While the total ratio paid by the insured remains at 50% (=22 % + 28 %) of the 90 % of the total cost, the ratios between two groups will be modified according to the future demographic structure in the actual future plan by the MHLW. The MHLW announced that the ratios will be modified every 3 years, and indeed the actual ratios have been changed since its launch in year 2000. Table 3 shows the actual ratios in the past as well as the future calculated ratios based on the guideline made by the MHLW. This paper endogenously calculates the contribution rate ($\tau_{e,s,t}$) for the second group and the fixed amount of contributions ($IC_{s,t}$) for the first group to satisfy (7), based on the given ratios in Table 3.

3.3.2 General Account

The future government expenditures and future deficits are both exogenously given. The future government expenditures are assumed to increase according to population aging based on the latest Population Projection by the IPSS (2017). Figure 3-2 shows the future given value of government expenditures.

On the future deficits, the assumption made in the baseline case in EFPMLA (2016) is used, and the future given value is shown in Figure 3-3.

The consumption tax rate is assumed to be endogenously calculated after year 2019 in order to satisfy (13). Before year 2019, the consumption tax rate exogenously remains at 8% until year 2018, while the wage income tax rate is endogenously calculated until 2018 to satisfy (13)[18]. All other tax rates are exogenously given as shown in Table 2. The consumption tax is only used to measure to the extent how much population aging affects the general account in the government budget[19].

3.3.3 Public Pension Account

The decreasing trend of the GDP ratio of accumulated public pension fund has already started since year 2003 in reality. Then, by following the actual plan of decreasing the fund in the next 100 years by the MHLW, the public pension fund is assumed to keep decreasing down until year 2115. Figure 3-4 shows the actual past trend and the future values given in the following numerical analysis. Until year 2014, the actual values are used in the figure.

A half of the total amount of basic pension benefits is transferred annually from the general account in reality, which is P_t in (13) and (16). This paper incorporates this fact[20].

The contribution rate ($\tau_{p,t}$) and the replacement rate (ϵ_t) are used as policy instruments in order to satisfy (16). In order to reflect the actual policy change, the contribution rate is endogenously calculated until year 2017 with the fixed replacement rate. Until year 2017 the contribution rate is an endogenous policy instrument to satisfy (16). From year 2018 the contribution rate is exogenously given at 18.3%, and the replacement rate is endogenously calculated to satisfy (16)[21]. From year 2018 the replacement rate becomes a new policy instrument to satisfy (16).

The MHLW reported that the replacement rate in year 2009 was 62.3 %[22], and the

[18]The exogenously given values of the consumption tax rate in all simuations are 0 %, 3 %, 5 %, and 8 % for before year 1989, between 1989 and 1997, between 1997 and 2014, and between 2014 and 2018, respectively. The wage income tax rate is given exogenously after year 2018 at the same value of that of year 2018.

[19]As pointed by Kitao (2015a), the wage income tax is more distortinary to labor supply than the consumption tax, and thus a more welfare loss is generated by the wage income tax. This paper only uses the consumption tax to finance the future government policy.

[20]Until year 2003 the actual transfer rate, defined as the ratio of transfers from the general account to the total basic pension benefits, was one-third, and it was gradually increased to 50% from year 2004 to year 2009. Since year 2010, the rate has remained at 50%.

[21]In the actual plan by the MHLW, it is assumed that the contribution rate remains at 18.3% from year 2018, and also that the replacement rate is adjusted to balance the budget with the fixed rate of the contribution rate of 18.3%.

[22]Note that this is the offical replacement rate. See Kitao (2015a) for different definitions of the replacement

exogenous replacement rate is assumed to be fixed at 62.3 % until year 2017. From year 2018 the replacement rate is endogenously calculated, while the contribution rate is exogenously fixed at 18.3 % afterwards.

3.4 Benchmark

Year 2012 is assumed to be a benchmark year. This implies that parameter values have been given so that the values of key variables calculated within the model become as close to actual values as possible in year 2012. Table 4 shows the comparison between actual and model values in year 2012. Figures 4-1 and 4-2 show model prediction of the primary balance and the real GDP growth rate, respectively. Note that in both figures future actual values are obtained from the baseline case in EFPMLA (2016). Note also that the annual economic growth rate assumed in the baseline case in EFPMLA (2016) is 0.8 % from year 2019 to 2024.

Figure 4-3 shows the endogenously calculated value of technological progress (Ω) in (8). Note that the value of Ω given in Figure 4-3 resulted in the model value of the GDP growth rate given in Figure 4-2.

In the following numerical experiments, technological progress is assumed to follow the value given in Figure 4-3, in order to realize the assumption in the baseline case in EFPMLA (2016).

rate. The official replacement rate used here is different from the definition of the replacement rate used in Kitao (2015a, 2015b, and 2017).

4 Numerical Results

4.1 Impact of Population Aging

Figure 5 shows the impact of population aging on the Japanese LTCI in the benchmark[23]. The increasing trend rises from population aging, and both groups have to pay more cost. In the next about forty years, the burdens on the first and second groups become more than 1.7 times (5,514 yen in year 2017 to 9,457 yen in year 2060) and more than 2.7 times (2.07 % in year 2017 to 5.68 % in year 2060) as much, respectively.

As shown in Table 3, the MHLW is going to reduce the future ratio of the burdens on the second group (age 40 to 64). However, the burdens on the second group increases more than those on the first group. This is because the relative size of the second group to the first group drastically decreases due to rapid population aging. The cohorts, which basically obtain elderly care services through the LTCI, belong to the first group. This implies that the second group further has to support the first group through the LTCI in a graying Japan. It could be interpreted that the intergenerational transfer mechanism exists in the Japanese LTCI.

4.2 Policy Options

In this section, the impacts of three possible policy options are explored; an increase in co-payments, a wider coverage of contributing cohorts, and a change in the cost distribution between the public sector and the insured. These three options have currently been argued in actually ongoing discussions.

In the following experiments, a policy change occurs in year 2018 and it continues onwards.

[23]In Figure 5, the distribution of the cost between the first (age 65 and over) and second (age 40 to 64) groups has been adjusted according to Table 3.

4.2.1 Policy Option 1: Higher Co-payments

Currently the elderly has to co-pay a 10 % of the total cost when the elderly uses elderly care services through the LTCI. The impact of an increase in the co-payment rate is explored. In this experiment, the co-payment rate increases from 10%, the current rate, to 20% or 30 %.

4.2.2 Policy Option 2: Earlier Contributing Age

A change in a coverage of contributing cohorts is examined in this experiment. Under the current scheme, all cohorts have to contribute to the scheme once they become age 40. In this option, a starting age of contributing to the LTCI becomes earlier from the current age of 40 to 30 or 35.

4.2.3 Policy Option 3: More Distribution of the Cost to Governments

The last policy option changes the distribution of the cost between the public sector and the insured. Currently, the remaining total cost after paid by the insured as co-payments is equally distributed between the public sector (50 %) and the insured (50 %). In this last option, the ratio of the cost distributed to the public sector increases to 60 % or 70 % from the current ratio of 50 %.

4.3 The Impact of Policy Options

Since the cohorts, which belong to the first group, use elderly care services through the LTCI[24], higher co-payments in policy option 1 increase direct payments by the first group. Since the cohorts, which belong to the second group, contribute to the LTCI for the longer duration in policy option 2, an earlier contributing age imposes burdens on the second group. Since policy option 3 increases more burdens on the public sector, more cohorts share burdens through an increase in the consumption tax. In policy option 3, not only cohorts belonging

[24] The cohoorts between age 40 and 64, which belong to the second group, can also obtain the services through the LTCI. However, this is an exceptional case.

to either the first group or the second group, but also all other cohorts have to share burdens. While both policy option 1 and 2 try to share the cost within the cohorts belonging to the LTCI, policy option 3 redistributes a part of the cost to the cohorts which do not belong to the LTCI. While policy option 1 studies the impact of choice between direct and indirect payments, policy option 2 explores the impact of choice between shorter and longer duration of contributions. Policy option 3 investigates the impact of sharing the cost between only within the LTCI and with all cohorts.

4.3.1 The Impact on the First Group (age 65 and over)

Figure 6-1 shows the impact of three policy options on the fixed monthly amount of contributions by the first group. In all policy options, the fixed monthly amount of contributions decreases. The increasing trend over time rises from population aging as shown in Figure 5. Policy option 3 substantially reduces the monthly contributions, since it redistributes a part of the total cost outside the LTCI. Policy option 2 with a starting age of 35 initially reduces more monthly contributions than policy option 1 with 30 % co-payment rate. However, monthly contributions under such a policy option eventually become larger than policy option 1 with 30 % co-payment rate from year 2026.

4.3.2 The Impact on the Second Group (age 40 to 64)

Figure 6-2 shows the impact on the contribution rate for the second group. While Figure 6-2 shows the similar tendency to Figure 6-1, the impact of policy option 2 on the contribution rate is stronger than on the fixed amount of monthly contributions. Policy option 2 makes the duration of contribution by the second group longer, and the monthly contribution rate for the second group is reduced. Thus the impact of policy option 2 on the contribution rate is stronger than that on the fixed monthly contributions

4.3.3 The Impact on the Consumption Tax Rate

Both the fixed monthly contributions by the first group and the contribution rate for the second group are most reduced under policy option 3. Policy option 3 induces more distribution of the cost to the public sector. More distribution of the cost to the public sector implies an increase in E_t in (11) and (13). Since the consumption tax rate is adjusted to satisfy (13), more distribution of the cost to the public sector also implies a higher consumption tax. In policy option 3, the cost is distributed to all cohorts alive through an increase in the consumption tax rate.

Figure 6-3 shows the impact of policy option 3 on the consumption tax rate. The increasing trend rises from population aging. The benchmark shows to the extent how much the consumption tax rate should increase under the current LTCI scheme in a graying Japan. While policy option 3 reduces the burdens in the LTCI, the consumption tax rate should increase. In policy option 3, burdens in the LTCI becomes smaller but the consumption tax rate increases. Thus, policy option 3 does necessarily not induce welfare gain, and the overall impact of each policy option on the whole economy should be evaluated based on welfare of each cohort.

4.3.4 The Impact on Welfare

The impact of the three policy options on welfare of different cohorts is calculated based on consumption equivalence. Consumption equivalence measures a percentage change in consumption to make the household indifferent between the benchmark and alternative three policy options. If the calculated value of consumption equivalence is greater than 1, then the household prefers an alternative policy option. Figure 7-1 shows the welfare effect of each policy option. Except very old cohorts born before year 1947, all cohorts most prefer policy option 1 with the co-payment rate of 30 %. More future cohorts prefer it more. Figure 7-1 shows that policy option 1 is most preferable compared to policy option 2 and policy option 3.

Figure 7-2 shows consumption equivalence of policy option 2 and policy option 3 only. Figure 7-2 is exactly the same as Figure 7-1 without the cases of policy option 1. Figure 7-2 shows that the second best policy option is policy option 3 with a shift of the cost to the public sector from 50 % to 60 %. However, more distribution of the cost to the public sector is not necessarily preferable particularly by future cohorts. If the currently equal distribution of the cost is modified to the distribution of a 70 % by the public sector, then policy option 2 with an earlier contributing age of 35 is more preferable than policy option 3. This is because more distribution of the cost to the public sector induces a much higher consumption tax rate. Such a policy is not preferable particularly among future cohorts. Figure 7-2 also shows that an earlier contributing age of age 30 is least preferable by all cohorts among all policy options. This result implies that all cohorts do not prefer the policy in which all cohorts to start to contribute to the scheme too early and thus for too long duration with further lower burdens per year.

The results are summarized. An increase in co-payments is most preferable among all three options. This implies that all cohorts most prefer the case where they pay the cost by themselves when they need services through the LTCI, rather than the policy of the longer duration of contribution (policy option 2) or the policy followed by a higher consumption tax (policy option 3). As the second best policy, almost all cohorts choose a policy of distribution of a 60 % of the cost to the public sector with a relatively slight increase in a consumption tax. However, particularly future cohorts do not prefer a policy with too much more distribution of the cost to the public sector, since such a policy is followed by a very high consumption tax. Finally, while an earlier starting age of contribution of age 35 is the third best policy option for future cohorts, a too early starting age of contribution of age 30 is least preferable among all policy options even for future cohorts.

5 Concluding Remarks

This paper examined the impact of population aging on the Japanese public long-term care insurance (LTCI) within a numerical dynamic general equilibrium model with multiple overlapping generations.

Numerical results show that in the next about forty years the burdens on the first and second groups become more than 1.7 times and more than 2.7 times as much, respectively. A relatively more increase in the burdens on the second group cannot be avoidable, even if adjustment of the cost distribution between both groups is made every three years in the future in accordance with the schedule by the MHLW. In counterfactual experiments, the impact of three possible policy options were also examined; an increase in co-payments by the elderly, a wider coverage of contributing cohorts, and a change in the cost distribution between the public sector and the insured. Then, an increase in co-payments was the most preferable option. Furthermore, while almost all cohorts prefer an earlier starting age of contribution to the current age of 40. This is because an earlier starting age of contribution reduces burdens every year. However, a too early staring age of contribution, thus too long duration of contribution is not preferable. While a shift of the cost to the public sector from the insured is also preferable, a too much shift of the cost is not preferable, since a large shift of the cost to the public sector is followed by a drastic increase in the consumption tax. These results show that cohorts prefer to pay the cost by themselves when they obtain elderly care services through the LTCI, rather than sharing the cost through their life in the very long duration of contribution to the LTCI, or paying the cost with a high consumption tax.

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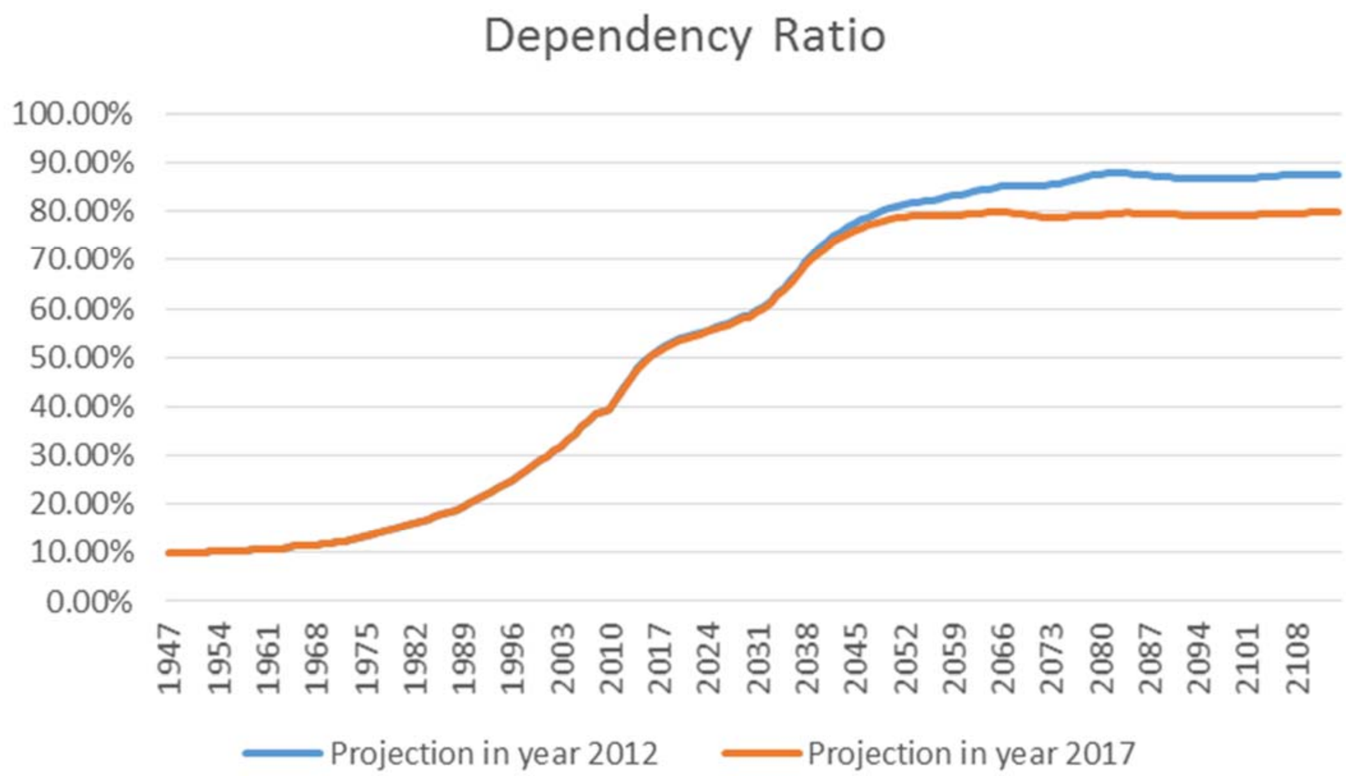
Figure 1: Dependency Ratio



Data: the actual data from Statistics Bureau, Ministry of Internal Affairs and Communications, and the future projections from the National Institute of Population and Social Security Research (IPSS)

Table 1: List of Variables

Variable	Description	Corresponding Equation Number
P_s	Survival rate	(1)
δ	Subjective discount factor	(1)
ρ	Risk aversion	(1)
$c_{s,t}$	Consumption of a *s* years old household at time *t*	(1)
$l_{s,t}$	Time spent on leisure by a *s* years old household at time *t*	(1)
ξ	Relative preference	(2)
κ	Weight parameter for leisure	(2)
$a_{s,t}$	Assets held by a *s* years household at the beginning of time *t*	(3)
e_s	Labor measured in efficiency of a *s* years old household	(3)
w_t	Wage rate at time *t*	(3)
r_t	Interest rate at time *t*	(3)
$b_{s,t}$	Public pension benefits received by *s* years old household at time *t*	(3)
$lc_{s,t}$	Time spent on child rearing by a *s* years old household at time *t*	(3)
$le_{s,t}$	Time spent on elderly care by a *s* years old household at time *t*	(3)
$d_{s,t}$	Financial child allowance given to a *s* years old household at time *t*	(3)
$h_{s,t}$	Financial cost of child rearing to a *s* years old household at time *t*	(3)
$bq_{s,t}$	Bequests inherited by a *s* years old household at time *t*	(3)
$\tau_{q,t}$	Inheritance tax rate at time *t*	(3)
$\tau_{r,t}$	Interest income tax rate at time *t*	(3)
$\tau_{w,t}$	Wage income tax rate at time *t*	(3)
$\tau_{p,t}$	Public pension contribution rate at time *t*	(3)
$\tau_{c,t}$	Consumption tax rate at time *t*	(3)
$\tau_{e,s,t}$	Contribution rate of the LTCI to a *s* years old household at time *t* applied to the second group (age 40 to 64)	(3)
$IC_{s,t}$	Fixed amount of contributions paid by a *s* years old household at time *t* applied to the first group (age 65 and over)	(3)
$LT_{s,t}$	Total cost of elderly care services when a *s* years old household obtains the services at time *t*	(3)
θ_t	Co-payment rate applied to elderly care services in the LTCI	(3)
$e^s_{m,ft}$	Labor efficiency of male regular workers of age *s*	(4)

$e_{m,nt}^{s}$	Labor efficiency of male non-regular workers of age *s*	(4)
$e_{fe,ft}^{s}$	Labor efficiency of female regular workers of age *s*	(4)
$e_{fe,nt}^{s}$	Labor efficiency of female non-regular workers of age *s*	(4)
$v_{m,ft}^{s}$	Weight parameter on efficiency of male regular workers of age *s*	(4)
$v_{m,nt}^{s}$	Weight parameter on efficiency of male non-regular workers of age *s*	(4)
$v_{fe,ft}^{s}$	Weight parameter on efficiency of female regular workers of age *s*	(4)
$v_{fe,nt}^{s}$	Weight parameter on efficiency of female non-regular workers of age *s*	(4)
$lc_{s,t,m,ft}$	Time spent on child rearing by male regular workers of age *s* at time *t*	(4)
$lc_{s,t,m,nt}$	Time spent on child rearing by male non-regular workers of age *s* at time *t*	(4)
$lc_{s,t,fe,ft}$	Time spent on child rearing by female regular workers of age *s* at time *t*	(4)
$lc_{s,t,fe,nt}$	Time spent on child rearing by female non-regular workers of age *s* at time *t*	(4)
$le_{s,t,m,ft}$	Time spent on elderly care by male regular workers of age *s* at time *t*	(4)
$le_{s,t,m,nt}$	Time spent on elderly care by male non-regular workers of age *s* at time *t*	(4)
$le_{s,t,fe,ft}$	Time spent on elderly care by female regular workers of age *s* at time *t*	(4)
$le_{s,t,fe,nt}$	Time spent on elderly care by female non-regular workers of age *s* at time *t*	(4)
RH	Retirement age	(5)
$\overline{\boldsymbol{H}}_{\boldsymbol{t}}$	Fixed amount of public pension benefits	(5)
$\boldsymbol{H_t}$	Earning related public pension benefits	(5)
$\boldsymbol{\varepsilon_t}$	Replacement rate of the public pension scheme at time *t*	(5)
$\boldsymbol{Y_t}$	Aggregate output at time *t*	(8)
$\boldsymbol{Y_t}$	Aggregate output at time *t*	(8)
$\boldsymbol{K_t}$	Capital at time *t*	(8)
$\boldsymbol{L_t}$	Labor at time *t*	(8)
$\boldsymbol{\Omega_t}$	Parameter of production technology at time *t*	(8)
$\boldsymbol{TLT_t}$	Total expenditure in the LTCI at time *t*	(11)
$\boldsymbol{E_t}$	Transfers to the LTCI account from the general account at time *t*	(11)
$\boldsymbol{FIC_t}$	Revenue in the LTCI contributed by the first group (age 65 and over) at time *t*	(11)
$\boldsymbol{TIC_t}$	Revenue in the LTCI contributed by the second group (age 40 to 64) at time *t*	(11)
$\boldsymbol{OIC_t}$	Revenue in the LTCI co-payed by the elderly who used elderly services through the LTCI at time *t*	(11)
$\boldsymbol{POP_{s,t}}$	Total population size of *s* years old households at time *t*	(12)
$\boldsymbol{D_t}$	Outstanding government debts at time *t*	(13)

AG_t	Total government expenditure at time *t*	(13)
P_t	Transfers from the general account to the public pension account at time *t*	(13)
CH_t	Total amount of a child allowance at time *t*	(13)
AB_t	Total amount of public pension benefits at time *t*	(14)
AS_t	Total amount of private savings at time *t*	(14)
AC_t	Total amount of consumption at time *t*	(14)
BQ_t	Total amount of bequests at time *t*	(14)
F_t	Accumulated public pension fund at time *t*	(16)
CP_t	Total amount of contribution collected in the public pension account at time *t*	(16)

Table 2: Parameters

Parameter	Description	Value/Source
P_s	Survival rate	IPSS(2017)
δ	Subjective discount factor	0.0286 / Kitao (2015a)
ρ	Risk aversion	3.0 / Kitao (2015a)
ξ	Relative preference	0.15
κ	Weight parameter for leisure	0.00001
$\tau_{r,t}$	Interest income tax rate	35.57 %/ Hansen and İmrohoroğlu (2016)
$\tau_{w,t}$	Wage income tax rate *	33.24 %/ Hansen and İmrohoroğlu (2016)
$\tau_{q,t}$	Inheritance tax rate	35 .00 %
α	Labor income share	0.6217/ Hansen and İmrohoroğlu (2016)
φ	Depreciation rate	8.421 %/ Hansen and İmrohoroğlu (2016)

*) The wage income tax rate is endogenously calculated until year 2018, and it is exogenously given at this value from year 2019.

Figure 2-1: Primary Balance

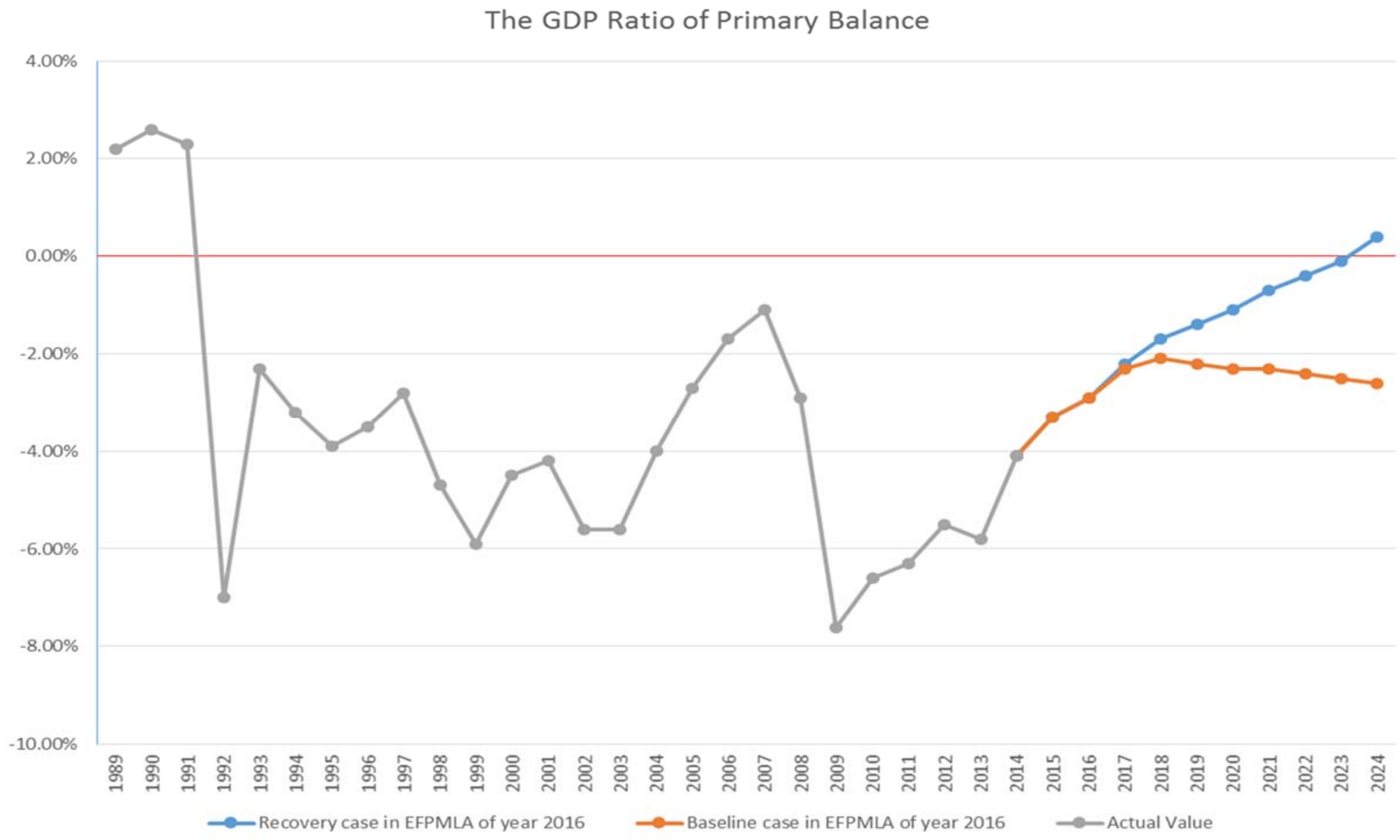
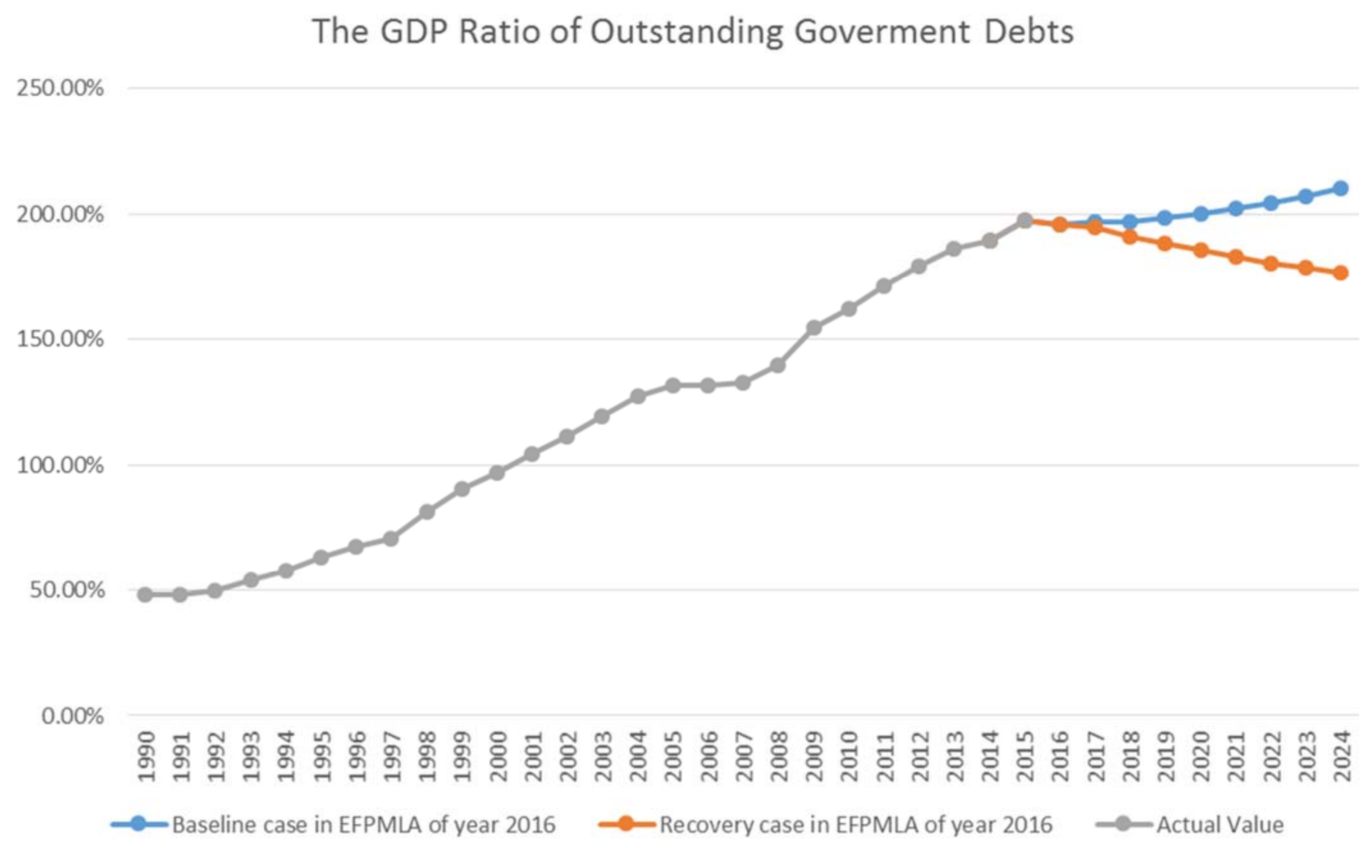


Figure 2-2: Government Deficits



Central and local governments debts are included.

Figure 2-3: Economic Growth

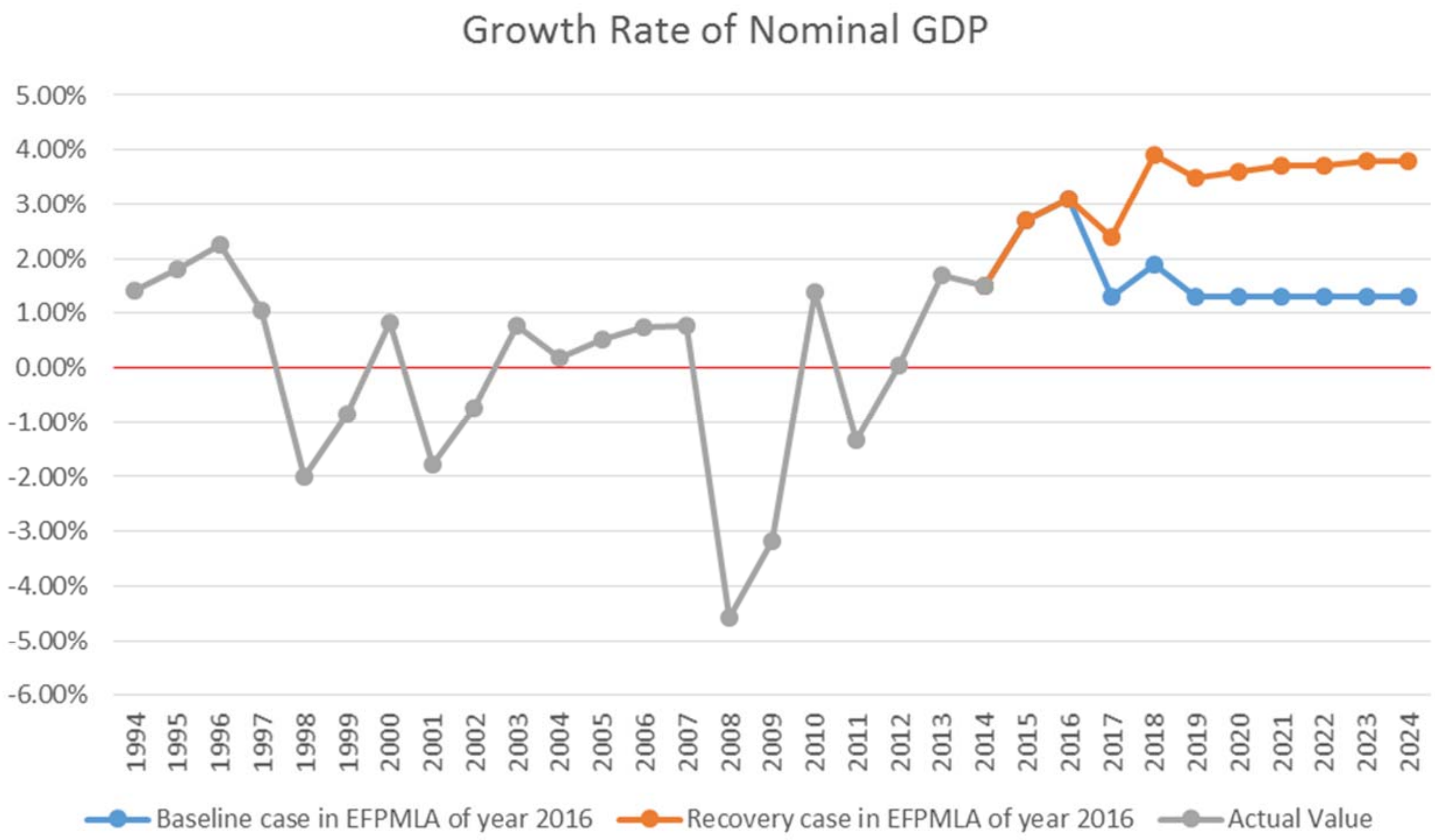
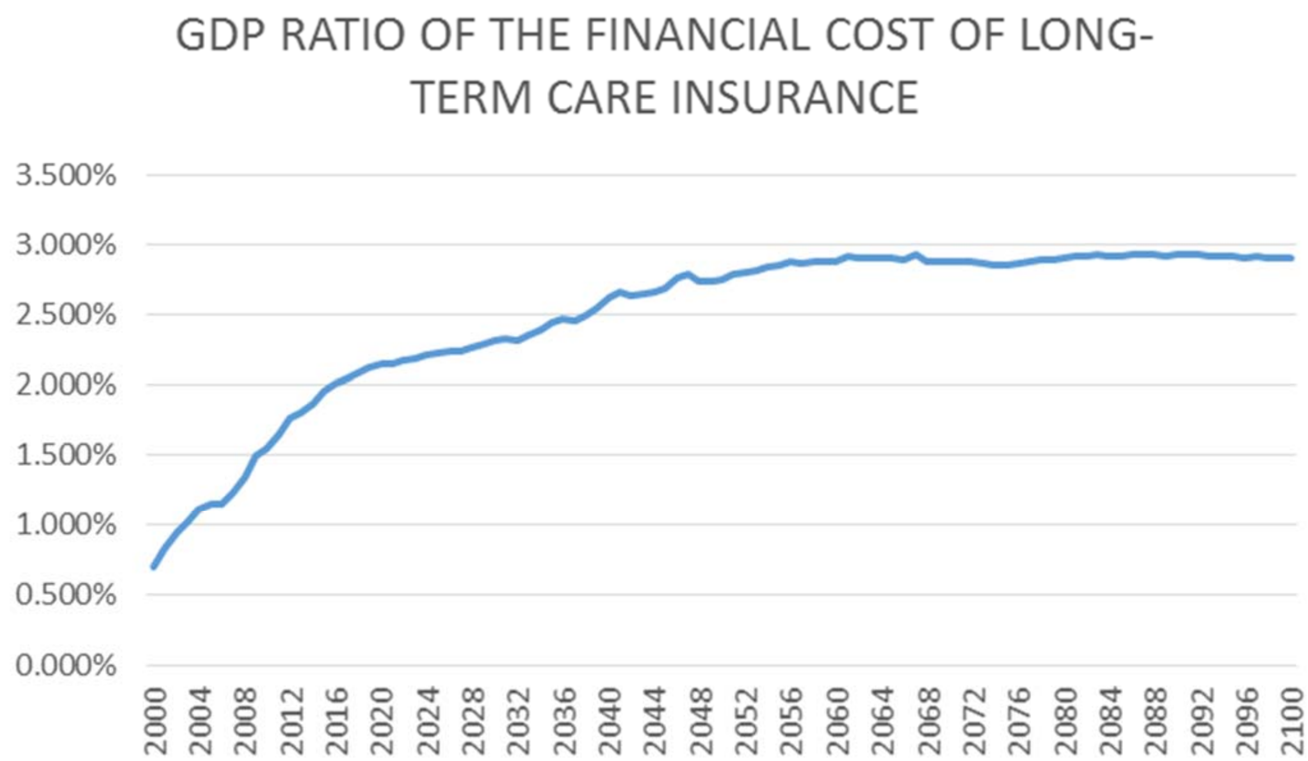


Figure 3-1: The GDP Ratio of the Expenditures of the Long-Term Care Insurance



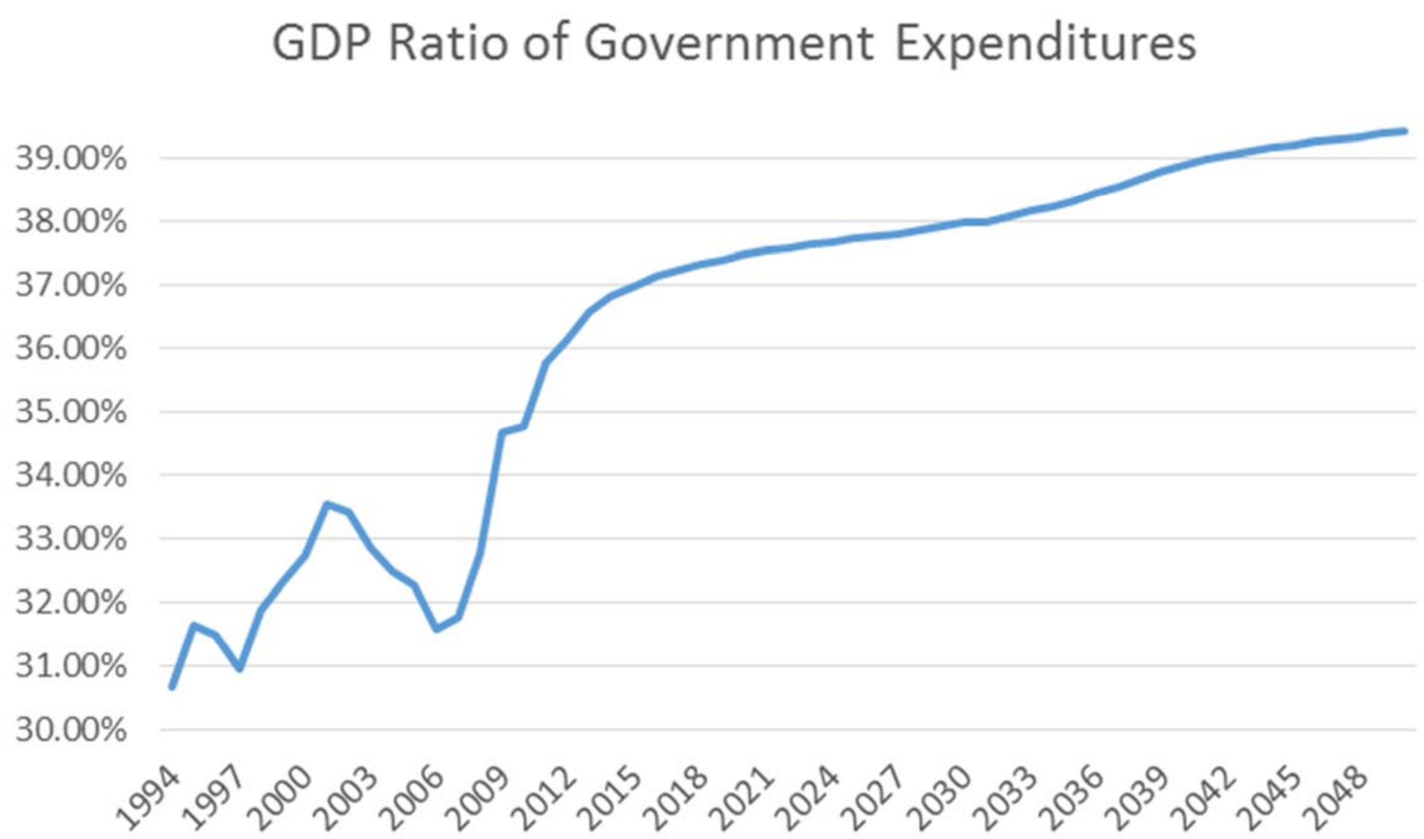
Until 2014, the actual data is used.
The amount of Co-payments paid by the insured is not included.

Table 3: The Planned Distribution of the Remaining Cost of the Long Term Care Insurance by the MHLW

	Contributins by		Tax
Year	1st group	2nd group	
2000—2002	17%	33%	50%
2003—2005	18%	32%	50%
2006 - 2008	19%	31%	50%
2009 - 2011	20%	30%	50%
2012 - 2014	21%	29%	50%
2015 - 2017	22%	28%	50%
2018 - 2020	23%	27%	50%
2021 - 2023	23%	27%	50%
2024 - 2026	24%	26%	50%
2027 - 2029	24%	26%	50%
2030 - 2032	24%	26%	50%
2033 - 2035	25%	25%	50%
2036 - 2038	26%	24%	50%
2039 - 2041	27%	23%	50%
2042 - 2044	27%	23%	50%
2045 - 2047	28%	22%	50%
2048 - 2050	28%	22%	50%
2051 - 2053	28%	22%	50%
2054 - 2056	28%	22%	50%
2057 - 2059	28%	22%	50%
2060 - 2062	28%	22%	50%
2063 - 2065	29%	21%	50%
2066 - 2068	29%	21%	50%
2069 - 2071	29%	21%	50%

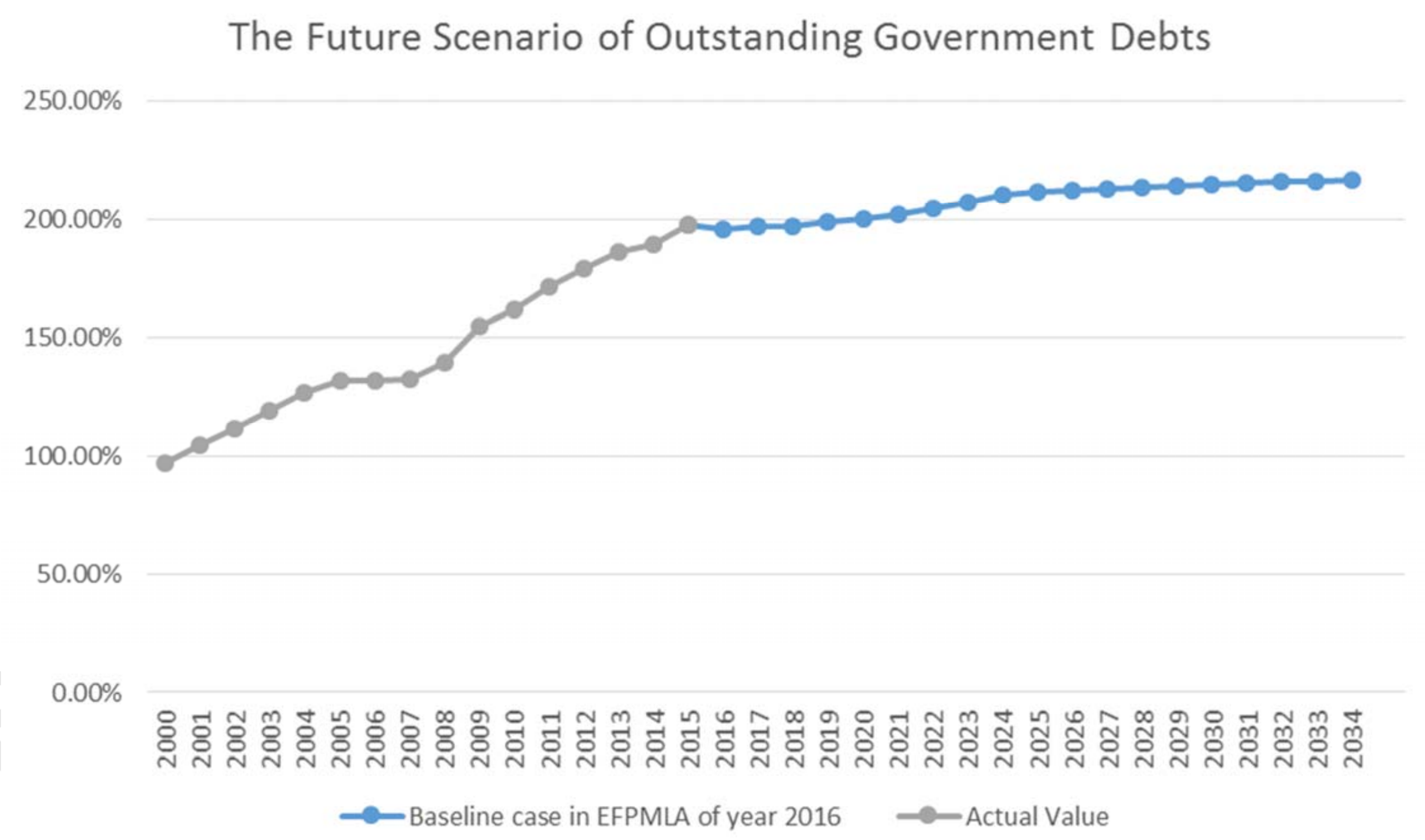
1st Group: Age 65 and Over
2nd Group: Age 40 – 64
Remaining Cost = Total Cost (100%) minus Co-payments (10%)

Figure 3-2: The Government Expenditures



The actual values have been used until year 2014.

Figure 3-3: Future Deficits Ratio to GDP



The actual values have been used until year 2014.

Figure 3-4: Public Pension Fund

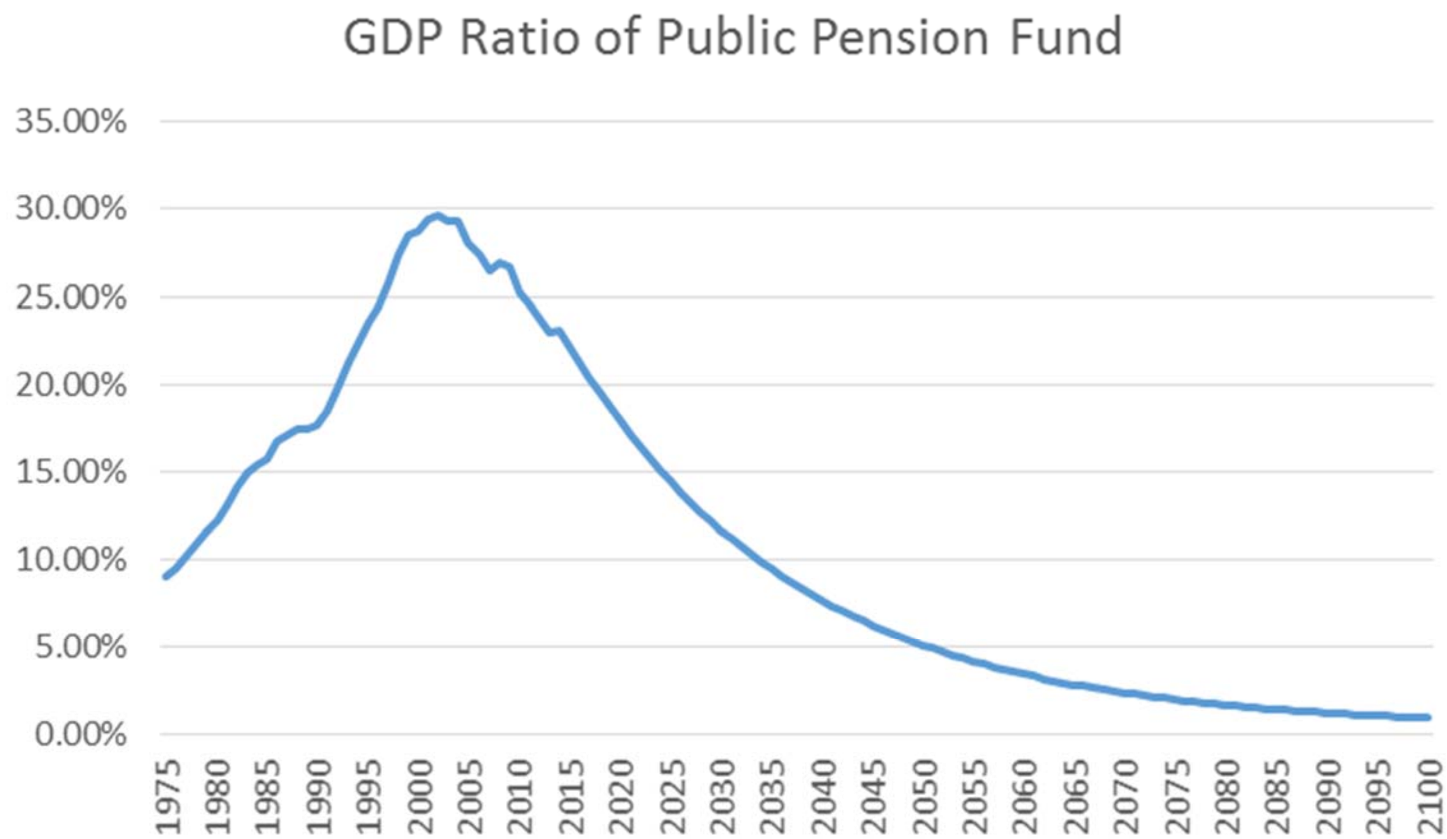


Table 4: The Values in Year 2012

Variables	Actual	Model
GDP ratio of outstanding government bonds	179.11 %	179.11 %
GDP ratio of public pension fund	23.79 %	23.79 %
GDP ratio of government expenditures	36.14 %	36.14 %
GDP ratio of childcare benefits	0.49 %	0.49 %
GDP ratio of long-term care insurance expenditures	1.758 %	1.758 %
Primary balance	-5.50 %	-5.00 %
GDP growth rate (real)	0.9 %	1.1 %
National burden ratio	40.6 %	40.61 %
Fixed average amount of monthly contributions by the first group (age 65 and over) in the LTIC	4972 yen	5191 yen
Contribution rate for the second group (age 40 – 64) in the LTIC *	1.55 %	1.88 %
Contribution rate in the public pension **	16.766 %	15.366 %
Contribution rate in the public pension in year 2017 ***	18.3 %	18.29 %
Wage income tax rate in year 2018**	33.24 %	33.78 %

Sources: Ministry of Finance, Cabinet Office, and Ministry of Internal Affairs and Communications

*) The actual value is the contribution rate of the general insured in Kyokai Kempo
**) Both contribution rates are of the Kousei-Nenkin. The contribution rate is endogenously calculated until year 2017.
****) The wage income tax rate is endogenously calculated until year 2018.

Figure 4-1: Model Prediction for the Primary Balance

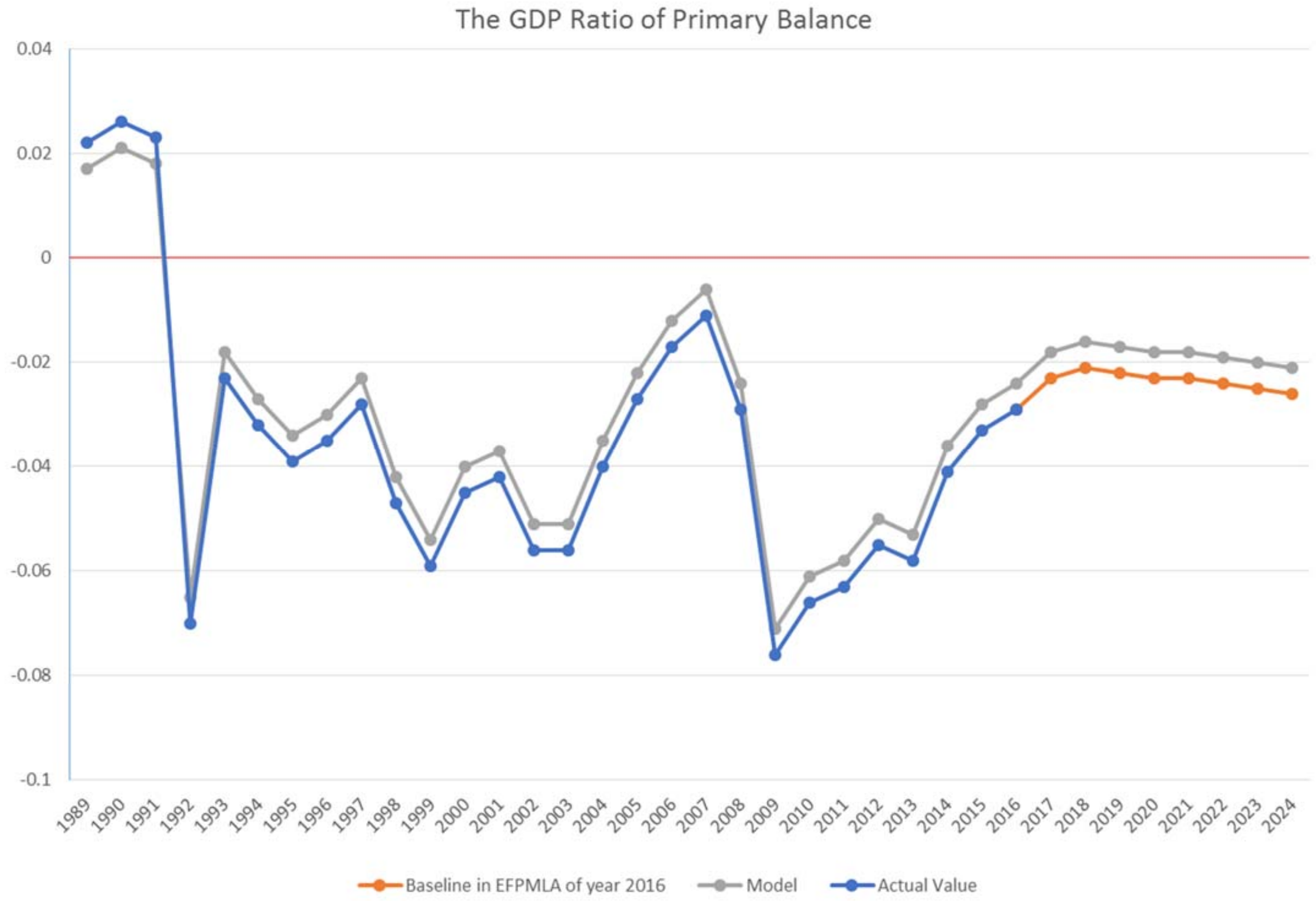


Figure 4-2: Model Prediction for GDP Growth Rate

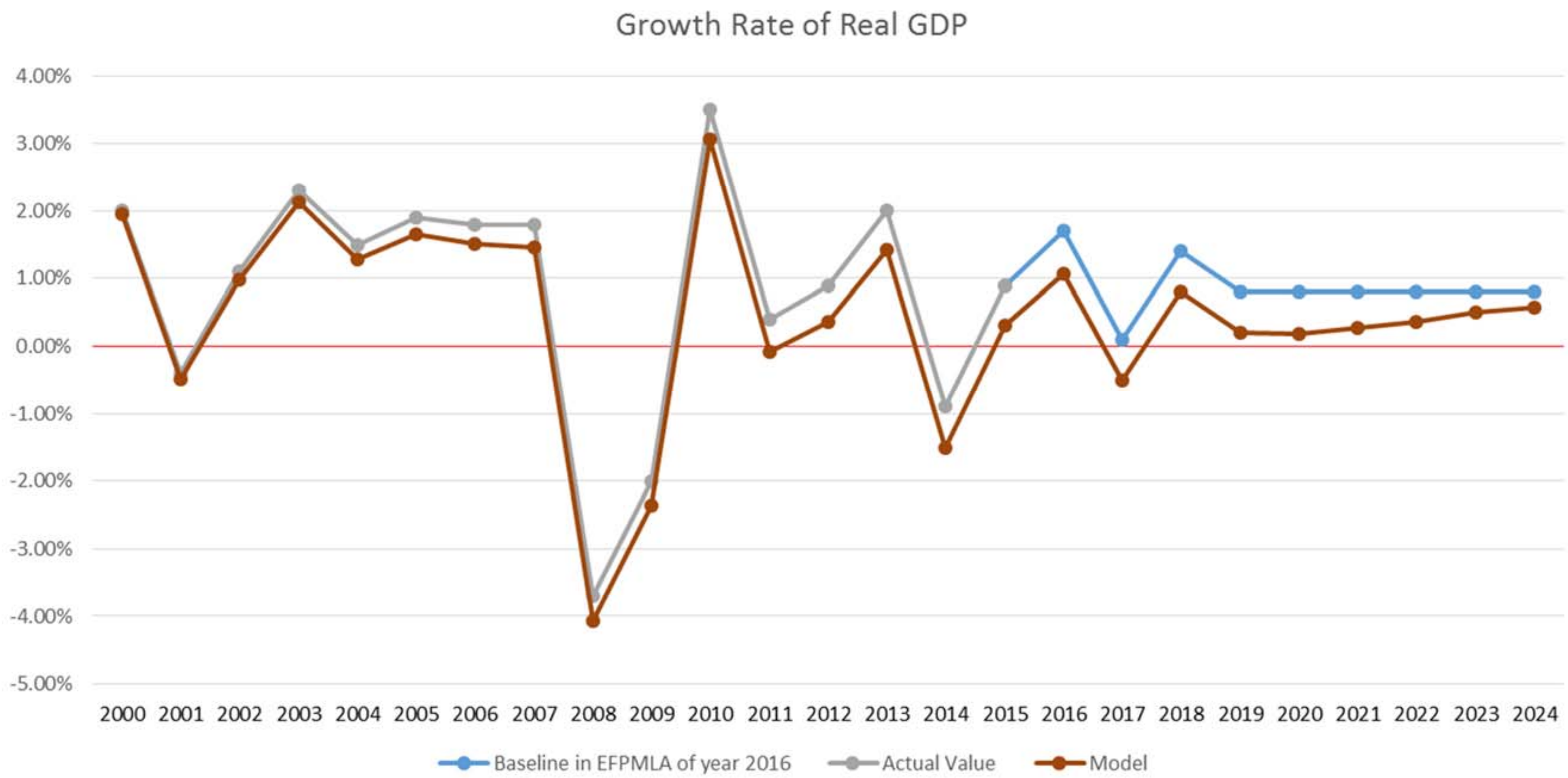


Figure 4-3: Parameter Value of Technological Progress (Ω)

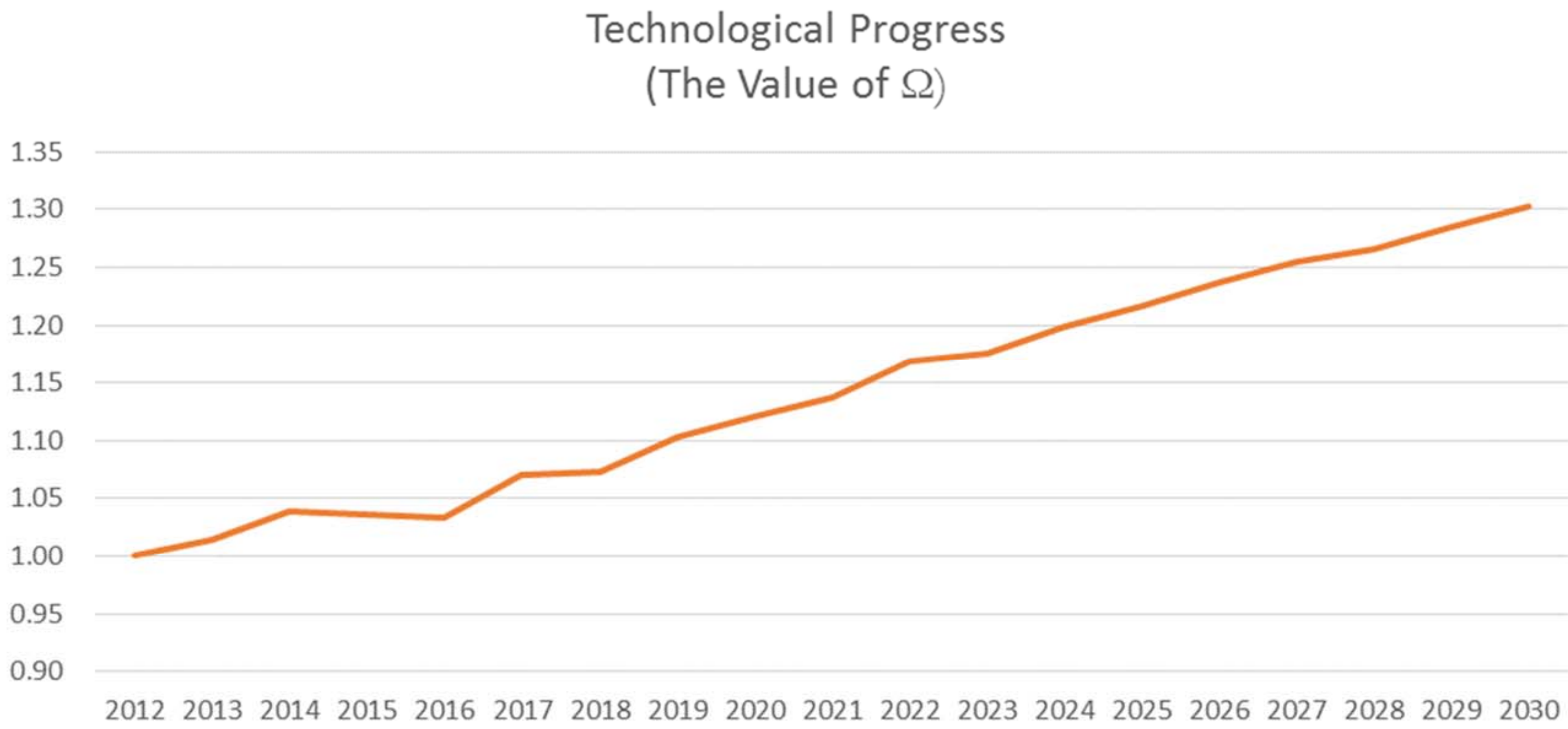
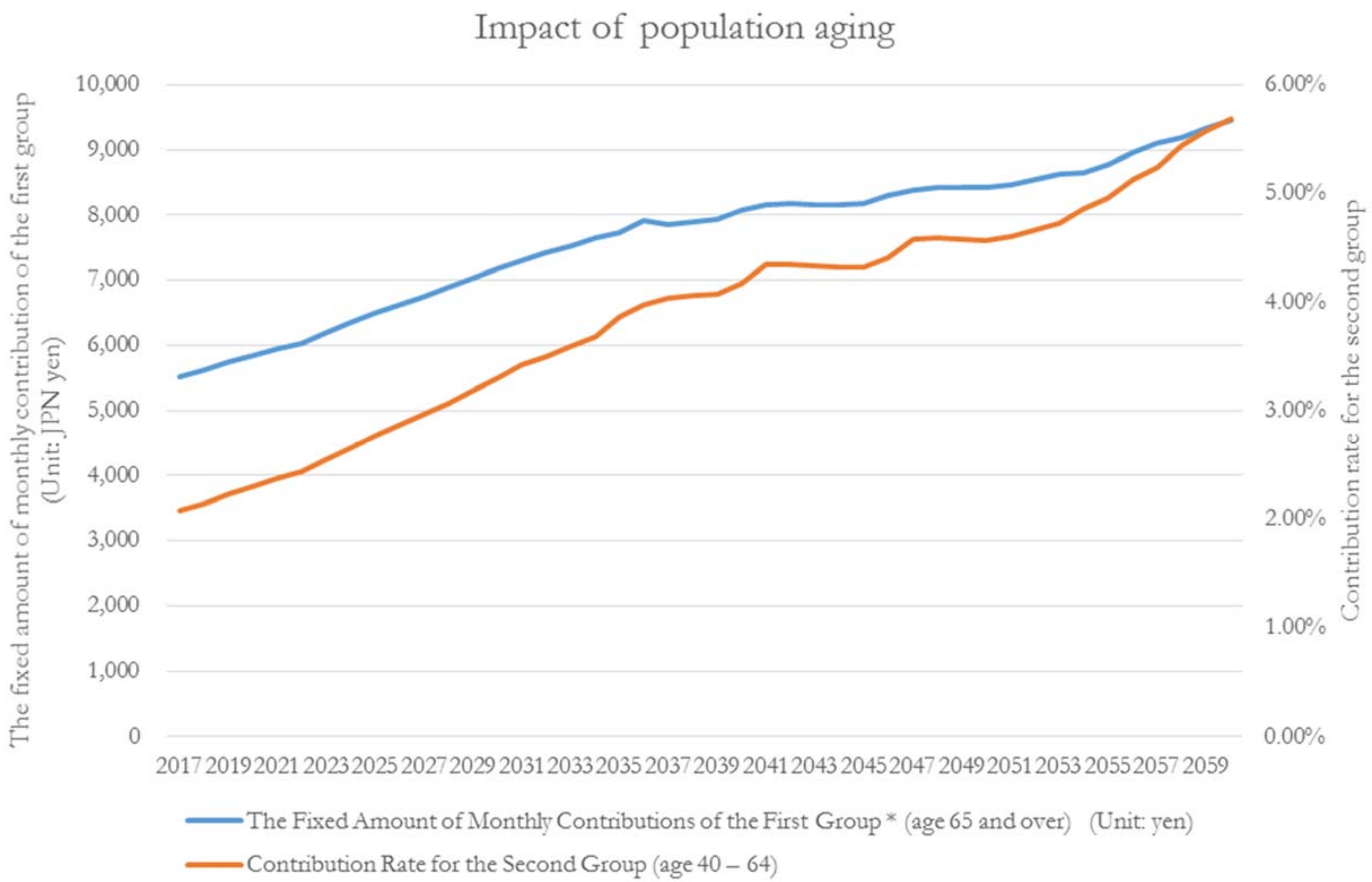
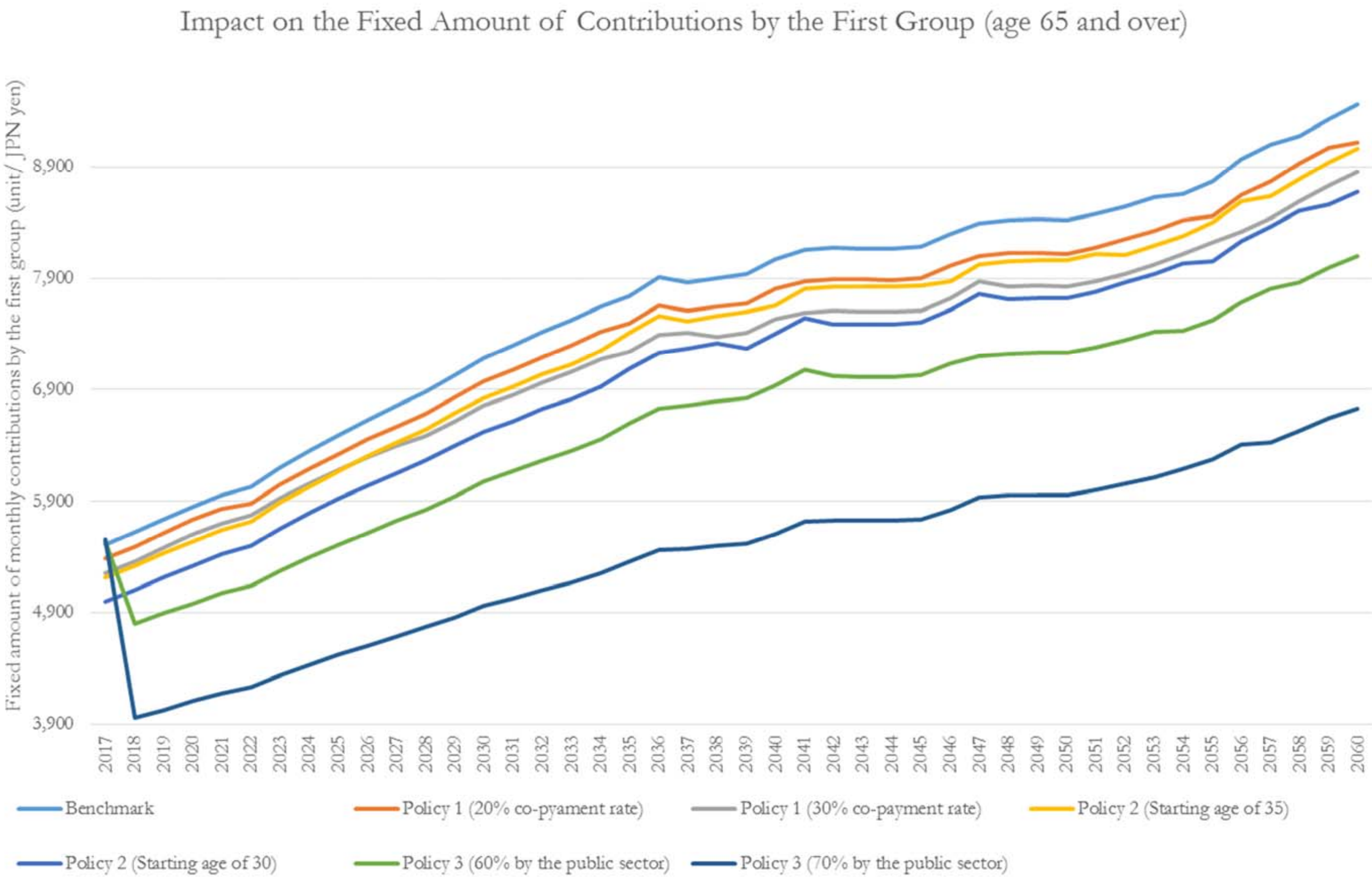


Figure 5: The Impact of Population Aging on the LTCI in the benchmark



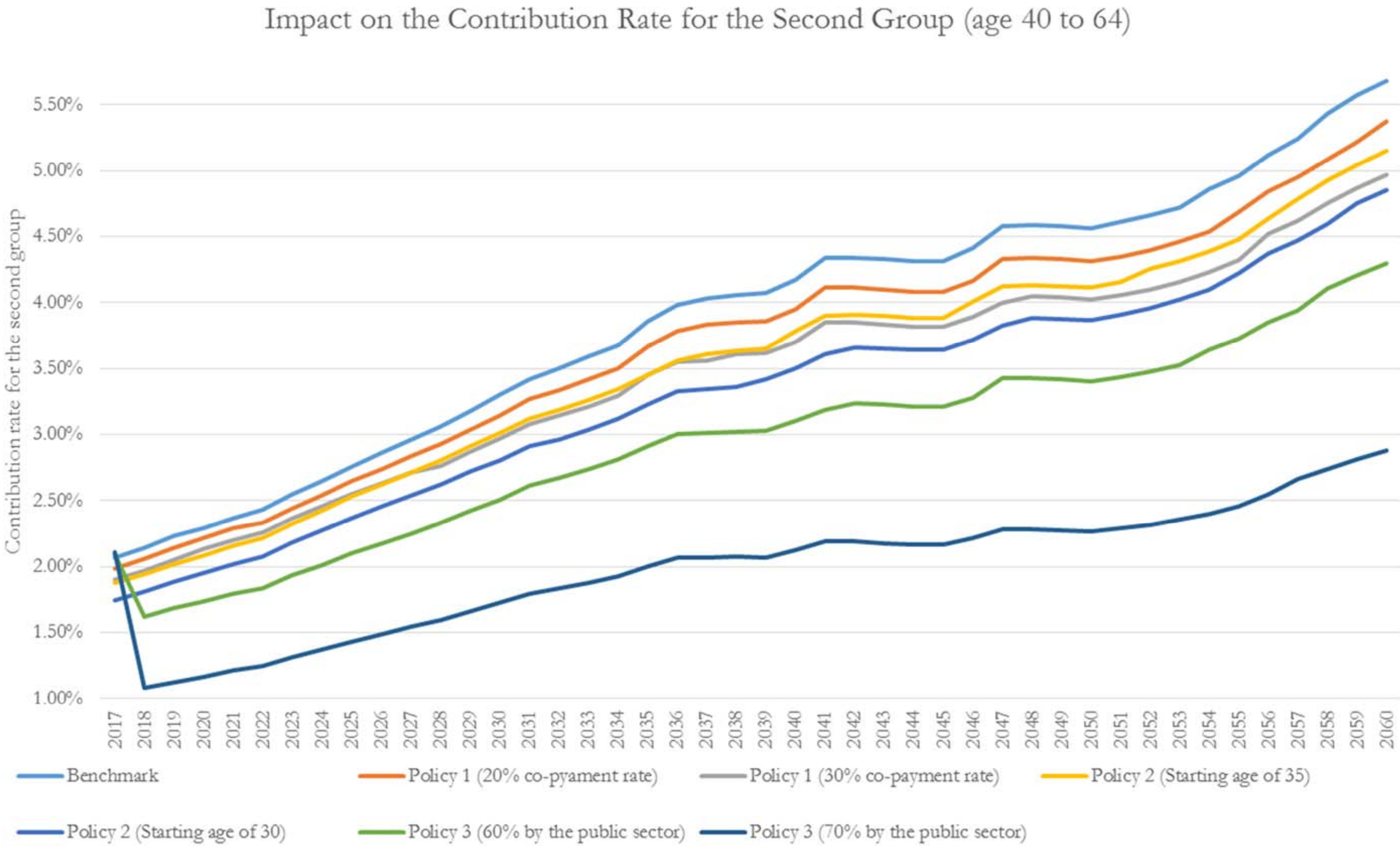
*) The fixed monthly amount of contributions of the first group is the average amount of Kyokai Kempo.. The contribution rate for the second group is the rate in Kyokai Kempo.

Figure 6-1: The Impact of Policy Options on the First Group (age 65 and over)



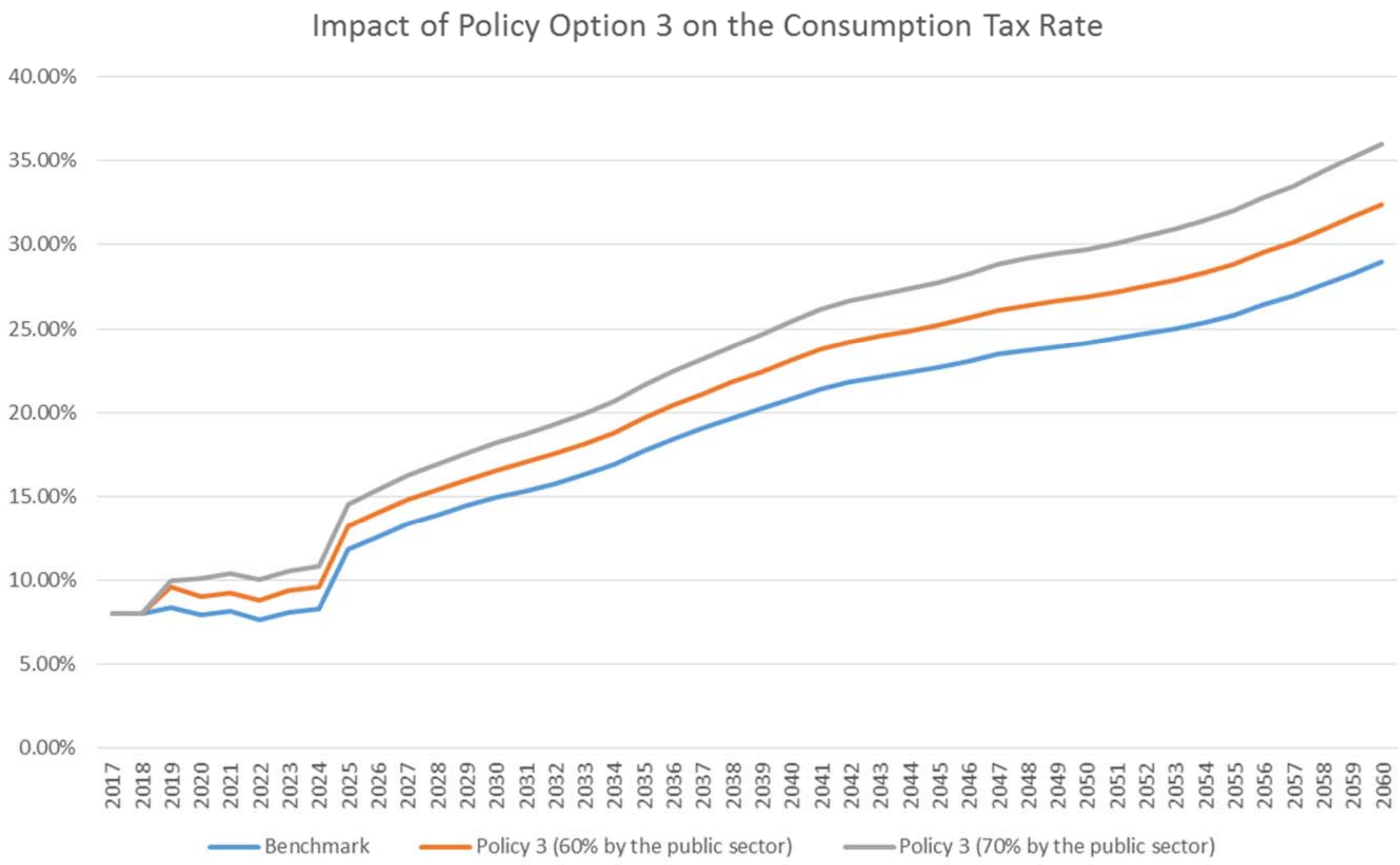
Benchmark: Co-payment rate = 10%, Starting age = 40, and 50% = contribution by the public sector

Figure 6-2: The Impact of Policy Options on the Second Group (age 40 to 64)



Benchmark: Co-payment rate = 10%, Starting age = 40, and 50% = contribution by the public sector

Figure 6-3: The Impact of Policy Option 3 on the Consumption Tax Rate



Benchmark: Co-payment rate = 10%, Starting age = 40, and 50% = contribution by the public sector

Figure 7-1: Welfare

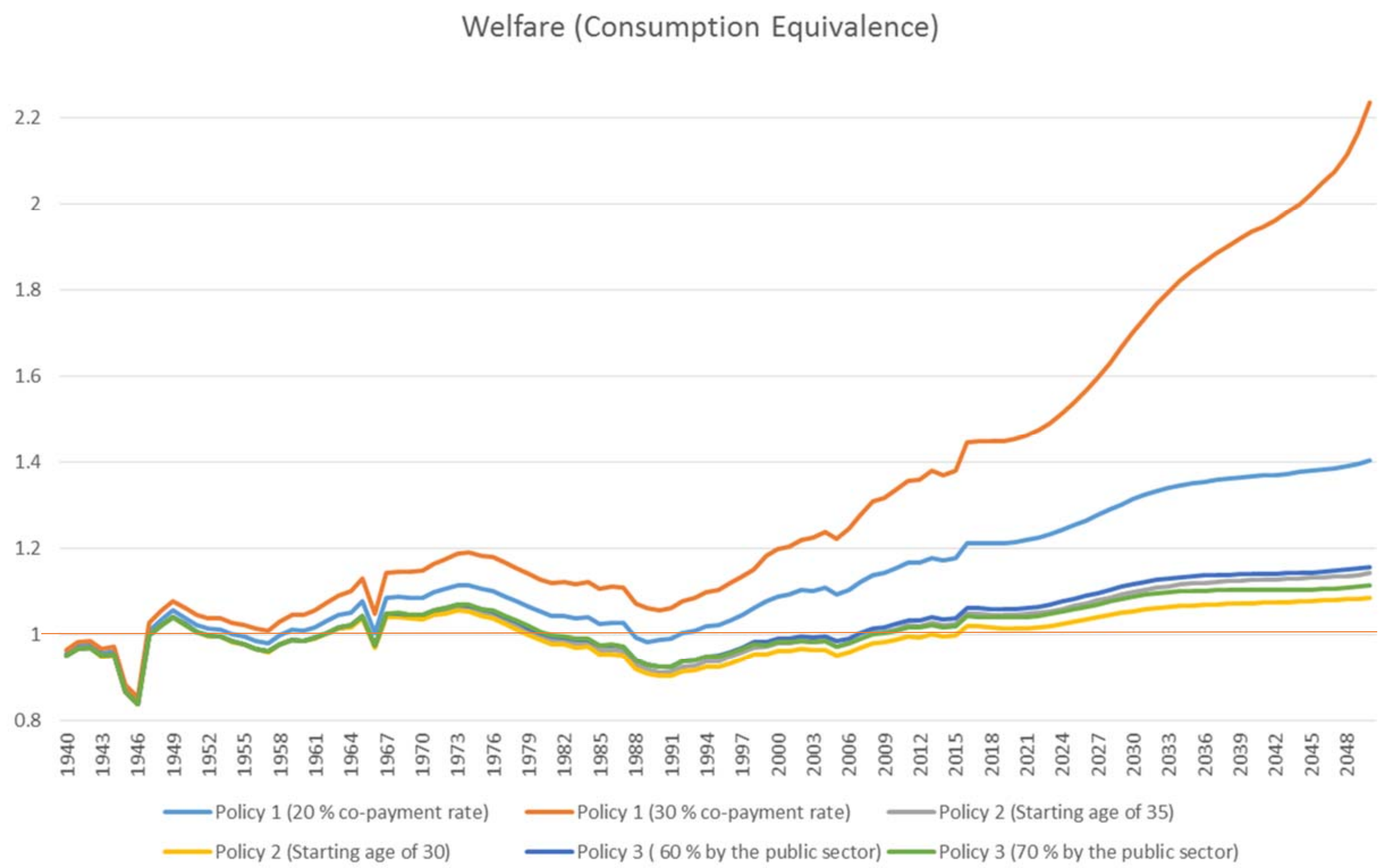
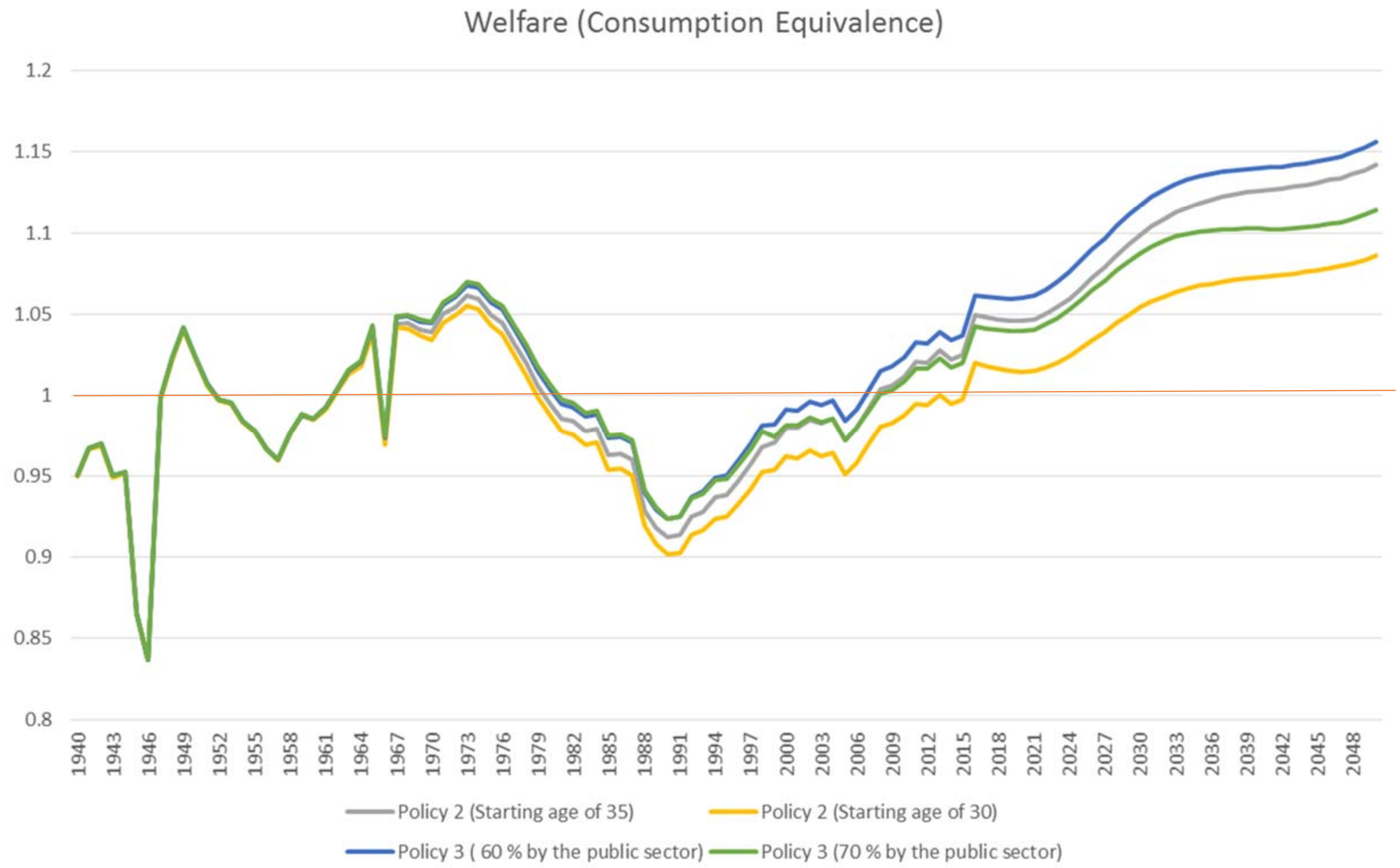


Figure 7-2: Welfare



Highlights

The paper title: "The Future Prospect of the Long-term Care Insurance in Japan"

The highlights of this paper include the following:

1. The Japanese long-term care insurance (LTCI) has been explored within the Auerbach-Kotlikoff model.
2. Using the latest population projection by the IPSS (2017), this paper has constructed the realistic future demographics in its analysis. The future economic environment given in the model also reflects several assumptions in the actual policy of Abenomics.
3. The future burdens in the LTCI in an aging Japan have numerically been presented. In the next about forty years, the burdens on the first group (age 65 and over) and the second group (age 40 to 64) become more than 1.7 times and more than 2.7 times as much, respectively.
4. The impact of three policy options, all of which have been argued in ongoing debates for the reform, has been examined. The three policy options include a) an increase in co-payments by the elderly, b) a wider coverage of contributing cohorts, and c) a change in the cost distribution between the public sector and the insured.
5. Among the three options, a policy to increase the co-payments to reduce financial burdens of the LTCI is the most preferable.