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Elderly Care, Child Care, and Labor Supply in an Aging Japan

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Abstract

This paper numerically examines the impact of the financial and time cost of child care as well as elderly care on economic growth and welfare in an aging Japan within a dynamic general equilibrium framework of multi-period overlapping generations with endogenized labor supply. Simulation results indicate that the replacement rate of the public pension scheme becomes below 50 percent from year 2039, even if the currently accumulated public pension funds are used up for paying pension benefits by year 2115. Financial burdens for the first group (age 65 and over) and for the second group (age 40 - 64) in the public long-term care insurance in year 2060 become more than double and more than five times as much as the level of year 2010 in an aging Japan, respectively. While increased child benefits stimulate savings and thus they improve welfare, the impact of elimination of the time cost of child care and elderly care is quite mixed, depending on the gender and job contract types of workers within the household. When the time cost of elderly care spent by all workers irrespective of gender and job contract types is eliminated, many generations enjoy welfare gain, but when the time cost of child care by all workers is eliminated, then almost all generations, except for relatively elder generations, reversely suffer from welfare loss. When a starting age to contribute to the long-term care insurance becomes earlier from the current age of 40 to age 35, welfare of all generations improves.

Keywords: Child Care, Child Benefits, Elderly Care, Long-Term Care Insurance, Public Pension, Female Labor Supply,, Aging, Economic Growth, Simulation, CGE Model

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

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1 Introduction

This paper numerically examines the impact of the cost of child care and elderly care on economic growth and welfare in an aging Japan within a dynamic general equilibrium framework of multi-period overlapping generations with endogenized labor supply. The impact of population aging on the public pension and the public long-term care insurance schemes is also explored under realistic assumptions in order to evaluate actual on-going policies for these schemes. Not only the financial cost but also the time cost of child care and elderly care are both taken into account when the impact of the change in the cost and child benefits is examined.

If the current demographic structure does not change and future rapid population aging is unavoidable, then, as our research results (Ihori et al (2006 and 2011)) suggest, two options could be considered to weaken the negative impact of rapid population aging on sustainable economic growth; stimulation of more female labor supply and/or opening a door to immigrants, in order to have the labor force enough for sustainable economic growth[1]. Then, this paper particularly focuses on the gender difference in labor supply when the impact of child care and elderly care is explored. Females spend more time on child care and elderly care in comparison with males in Japan, and consideration of the gender difference is very important to examine the impact of child care and elderly care on labor supply. In particular, the impact of the financial and the time cost of child care and elderly care on female labor supply matters when the effect of more female labor supply on sustainable economic growth is studied.

Another key issue, when female labor supply is examined, is that labor force has recently been observed to be divided into two different categories in Japan; full-time labor force and non full-time labor force. The former is called 'Seiki' labor force, and the latter is called

[1]Stimulating higher fertility could be another option for sustainable economic growth. Ishida et al (2012), Oguro et al (2011), Oguro and Takahata (2013), and Okamoto (2016) argue the impact of several child benefits policies on fertility within a endogenized fertility model. Oguro and Yasuoka (2016) presents a theoretical framework to discuss the relationship between child care and fertility.

'Hi-Seiki' labor force. The latter labor force includes part-time, dispatched, and fixed term workers. The recent division of labor force can be observed not only in female but also in male labor force. This paper also takes into account this difference in labor force explicitly, and assumes that there are four different types of labor force; male full-time, female full-time, male non-full-time, and female non-full-time labor force, since labor condition and wage differences can clearly been observed in data among these different four labor force, as demonstrated by Kato and Kawade (2015). Based on Kato and Kawade (2015), this paper examines the impact of population aging and the financial as well as time cost of child care and elderly care on economic growth and welfare of Japan.

Simulation results are as follows. First of all, population aging results in more burdens on the public pension and the long-term care insurance schemes. The replacement rate of the public pension scheme becomes below 50 % from year 2039, if the contribution rate is fixed at 18.3 % from year 2018 and hereafter. Note that this situation cannot be avioded even if the currently accumulated public pension funds are used up for paying pension benefits by year 2115. Since the Ministry of Health, Labor and Welfare (MHLW) announces that the replacement rate would not be below 50 % even in an aging Japan, the result in this paper is pessimistic. Regarding the impact of population aging on the public long-term care insurance, the contributions to the long-term care insurance scheme increase. The fixed amount of contributions for the first group (age 65 and over) in year 2060 becomes more than double as much as the level of year 2010. The contribution rate for the second group (age 40 and 64) in year 2060 increases by more than five times as much as the level of year 2010, even if the distribution ratio of the cost between two groups is adjusted according to the demographic distribution of the two groups every three years.

Secondly, an increase in the co-payment rate in the long-term care insurance reduces the fixed amount of contributions for the first group (age 65 and over). Since the household privately pays co-payments on its own when it receives the elderly care services through the public long-term care insurance scheme, an increase in the co-payment rate simply reduces

the cost paid through the public scheme. However, a rise in the co-payment rate reversely increases the contribution rate for the second group (age 40 - 64). This surprising result can be explained as follows. Since a rise in the co-payment rate implies more private burdens of the cost of elderly care when the household obtains elderly care services in its old age, the household prepares for more financial burdens when it becomes aged, and thus it increases its savings. Stimulated savings result in more capital, and the capital labor ratio increases. The higher capital labor ratio results in the higher wage rate. Since the financial cost of elderly care services through the long-term care insurance is measured in wage, increased wage induces the higher cost of elderly care services. Thus, the contribution rate for the second group (age 40 - 64) increases. Furthermore, higher income created by the increased capital labor ratio results in higher welfare of future generations. While a rise in the co-payment rate increases the contribution rate for the second group (age 40 - 64), which consists of relatively younger generations, stimulated savings result in welfare gain of the future generations. While welfare of old generations decreases, future generations can enjoy welfare gain by a rise in the co-payment rate. This positive impact of an increased co-payment rate on stimulating savings as well as on improving welfare is similar to Ihori et al (2011).

Thirdly, if the basis of contributions to the public long-term care insurance is widen by making the household start to contribute to the scheme in its earlier age, then the annual burdens of both groups decrease. Thus, elder generations can enjoy welfare gain. On the impact on welfare of future generations, it depends on the age when the household starts to contribute to the scheme. If the starting age becomes earlier from the current age of 40 to 35, future generations can enjoy welfare gain. However, if the starting age becomes earlier to age 30, then future generations suffer from welfare loss. Note that while an expansion of the contribution basis by making the starting age earlier results in the reduction of the *annual* burden rate, it obviously implies that each generation has to start to contribute to the scheme earlier and thus in a longer period. While the former impact of a lower annual burden rate

is positive, the latter impact of longer contribution is negative for future generations. When the starting age becomes age 35, the former positive impact outweighs the latter negative impact, thus, resulting in future generations becoming better off. However, the starting age becomes age 30, the latter negative impact is stronger than the former positive impact, and future generations suffer from welfare loss. This implies that welfare of all generations increases when the starting age becomes earlier to age 35.

Fourthly, the impact of elimination of the time cost of elderly care is quite mixed and the overall impact depends on the difference in gender and types of job contracts of workers; full-time or non-full-time. More private and public provision of elderly care such as an expansion of elderly care at nursing homes could reduce the time on elderly care which the household privately spends on. The impact depends on the time of workers of whom/which type of job contracts within the household is eliminated. Note that elimination of the time cost of elderly care implies that the household can enjoy more available time, which was used for elderly care before. More available time can increase both leisure and labor supply. If labor supply increases, then the wage rate decreases in the labor market, and thus the total labor income does necessarily not increase. Any change in the total labor income affects savings. A change in the wage rate affects labor supply decision, depending on its substitution and income effects, and whether labor supply increases depends on the relative magnitude of both effects. Since the interest rate also changes, the impact on savings is more complicated. The impact of elimination on economic growth (the capital labor ratio) and welfare substantially depends on whose time spent on elderly care is eliminated. However, if the time privately spent on elderly care by *all* workers (male full-time, male non-full-time, female full-time, and female non-full-time) becomes available instead of caring the elderly, then elimination of the time cost of elderly care has a positive (negative) impact on economic growth after (before) year 2042. On the impact on welfare, all generations, except for the generations born between year 2001 and year 2039, can enjoy welfare gain.

Fifthly, increased child benefits stimulate savings, and the capital labor ratio increases.

While only generations which receive child benefits can obtain benefits of the increase directly, stimulated savings induce higher income, thus resulting in other generations becoming better off as well.

Finally, the impact of elimination of the time cost of child care is also quite mixed. More public provision of nursery facilities for small children could reduce private time spent on child care. While the household spends more time on elderly care when it becomes aged, it spends more time on child care when it is before age 45. Since the household accumulates savings as it becomes aged, this implies that elimination of the time cost of child care has a smaller impact on savings rather than elimination of the time cost of elderly care. Indeed, the impact on economic growth (the capital labor ratio) is smaller than the case of elimination of the time cost of elderly care, when the time of child care of all workers becomes available for more leisure and additional labor supply. On the impact on welfare, opposite to the case when the time cost of elderly care is eliminated, almost all generations suffer from welfare loss, except for relatively elder generations. Note that all workers spend more private time on elderly care when their wage profiles past their peak level, and they already start declining. and also that the amount of labor supply is relatively smaller in comparison with the amount when they have to spend time on child care. This implies that the impact of elimination of the time cost of elderly care on an economy is relatively smaller, and the household can use more available time for more leisure, thus resulting in more generations having welfare gain. However, when the time cost of child care is eliminated, then the household spend additional available time more on labor supply. Workers spend more time on child care when they are actively working, and their wage profiles keep increasing. This implies that the impact of the change in their decision on an economy is relatively larger, and, except for relatively elder generations, many generations suffer from welfare loss when they have more available time which was used for child care[2]. Indeed, except for the generations born before 1954, almost all generations suffer from welfare loss in the simulation.

[2]Note that this argument does not consider any cost of child care.

The paper is organized as follows. The next two sections explain the background of the discussion and the related literature. Section 4 introduces the model, and Section 5 explains the conducted simulation analysis in detail. Section 6 concludes the paper.

2 Background

Figure 1 shows the past and future trend of population aging in Japan. In accordance with rapid and high population aging, the total population also started to decline, which Japan has never experienced before. An aging population in Japan has attributed to a prolonged lifetime and the declining fertility rate, where the former has resulted in more importance of the elderly care, and the latter induced an argument on the cost of child care. Such a rapid change in the demographic structure will induce a serious shortage of labor force in future Japan.

An increasing trend of the national medical expenditure has been mainly caused by population aging in Japan (Ihori et al (2011)), and more financial burdens on the public pension, national health services, and the public long-term care insurance are forecasted in Japan. The long-term care insurance is compulsory, and everyone in age 40 and over has to contribute to the scheme. People between age 40 to 64 are categorized in the second group, and they have to pay the different amount of contributions based on their salary in general. People from age 65 and over are categorized in the first group, and they also have to contribute to the scheme, while the amount of contributions is fixed. Basically people only in the first group can obtain elderly care services through the public long-term care insurance, while they also have to pay a certain amount of the cost of services (co-payments). Figure 2 shows the total cost paid through the long-term care insurance in year 2010. Note that the cost is normalized based on the annual income of the non-full-time male worker in age 20. The financial cost through the long-term care insurance drastically increases after age 90 and over. Figure 3 shows the time cost of caring the elderly. While the public long-term

care insurance covers the financial cost, people often spend time on caring the elderly. In Figure 3, the relative time spent on elderly care to working hours is shown. As shown in Figure 3, the time spent on elderly care becomes longer as the carer gets aged, irrespective of differences in gender and job contract. More population aging implies that Japan will face higher financial burdens on the public schemes and also lower labor supply.

On child care, the government has been providing child care benefits since year 1994. Figure 4 shows the ratio of child care benefits to GDP. While it shows the increasing trend, the amount is still small in Japan. Regarding the time cost and the financial cost of child care, Figure 5 and 6 are shown. Figure 5 shows the relative time spent on child care to working hours, and it is shown in the figure that females spend lots of time on child care between age 25 and 35. Cabinet Office of the Japanese Government conducted a questionnaire research by internet in year 2009 on the financial cost of child care, and Figure 6 shows the financial cost of child care, where the result from a questionnaire research by Cabinet Office of the Japanese Government in year 2009 is used. According to the result, the total amount of child care per child until a child becomes age 22 is calculated to be about 32 million Japanese yen. As shown by Figure 5 and 6, raising kids in Japan is costly, and the lower fertility rate and less female labor supply would be caused by the high cost of child care.

These observations suggest that in an aging Japan stable economic growth seems more difficult, and also that future GDP will decline with a shrinking population and higher burdens on the public schemes.

3 Literature

Within the Auerbach and Kotlikoff framework (1987), many studies have been conducted in order to discuss the effect of tax and social security reforms of Japan. Homma et al (1987) is the first study which applied Auerbach et al (1983) to the Japanese context to examine

the impact of the tax reform[3]. Then, the conventional Auerbach and Kotlikoff model has been extended by incorporating actual future demographic forecast of Japan, in order to re-produce the future demographic structure within the model (Kato (1998 and 2002)), where several new features have also been taken into account such as government deficits and public capital. Kawade (2007 and 2009) introduced income difference in households generated by heterogeneity in labor efficiency in order to discuss the impact of fiscal reforms actually ongoing in Japan. Ihori et al (2011) particularly paid attention to the national health services in an aging Japan to discuss the effects of several policy changes in the drastic reform of the national health services of Japan. One of our results shows that the increasing trend of national medical expenditure is mainly caused by population aging, and several policy changes in the reform such as an increase in the co-payment rate for the services has little effect on the reduction of the increasing trend of national medical expenditure in the future. Kato and Kawade (2015) investigated to the extent how much an increase in female labor supply would stimulate the Japanese economy in the long-run, where they particularly paid attention to the impact of an increase in labor supply by females who could not join the labor market due to child care. Kato and Kawade (2015) explicitly considered the difference not only in gender but also in the type of work contract in its labor-supply endogenized model, where there are four types of labor; male full-time, male non-full-time, female full-time, and female non-full-time labor. They found out that the amount of female labor which cannot join the labor market due to child care is rather small so that the impact of an increase in such female labor supply on economic growth is very little. They also found out that a big gap in the wage profile between male and female labor causes the very small impact of an increase in such female labor supply on economic growth. While it seems difficult to identify the reason why the wage profile of female labor is much lower than that of male labor, discontinuous labor supply by females due to child care could be one of the reasons.

[3]Hatta and Oguchi (1999) suggested that the Japanese public pension scheme should move from the pay-as-you-go system to the fully funded system to avoid further burdens on the working generation in an aging Japan.

While the impacts of the long-term care insurance and child care on the Japanese economy have not been studied explicitly in the literature of applications of the Auerbach and Kotlikoff framework[4], there are several empirical studies. Tajika and Kikuchi (2004), Iwazaki et al (2006), Kitaura and Kyotani (2007), and Ueda et al (2011) empirically estimated the long-run cost of long-term care insurance. Unayama (2011, 2014, and 2015) empirically investigated the impact of an expansion of nursery services on female labor supply and marriage decision. There are also several empirical studies on the impact of several government policies on marriage decision and female labor supply (Higuchi (1994), Shigeno and Ohkusa (1998 and 1999), Suruga and Nishimoto (2002), and Nagase (2007). Asai et al (2015) empirically investigated the impact of child care on maternal employment by using panel data in Japan.

While there are several excellent empirical studies on the impact of policies related to child care as well as to the long-term care insurance, these two important issues have not been explored substantially in the context of an aging population in Japan in my best knowledge. Kato and Kawade (2015) only studied the impact of an increase in labor supply by females who cannot join the labor market due to child care without any detailed policy instruments.

This paper expands Kato and Kawade (2015): The financial and time costs of both child care and elderly care are explicitly taken into account. Child care benefits provided by the government are also considered. The public long-term care insurance for the elderly is taken into account in addition to the public pension scheme. While Kato and Kawade (2015) studies the impact under the assumption of balanced government budget, this paper allows the government to issue government bonds, so that more realistic case of the existence of future government deficits can be investigated. Similar to Kato and Kawade (2015), based on the latest Projection of Future Population in Japan by the National Institute of Population and Social Security Research (NIPSSR), the most realistic future demographic structure is assumed in its general equilibrium dynamic multi-period overlapping generations

[4]There are several excellent studies within the Auerbach and Kotlikoff framework to discuss the impact of child care on fertility, where fertility decision is endogenized. See Oguro et al (2011), Ishida et al (2012), and Oguro and Takahata (2013). See also Oguro and Yasuoka (2016) as an excellent reference for the discussion on the relationship between child care and fertility decision.

model. Labor is endogenized, and the differences in gender and the type of work contract are explicitly considered in order to reflect the actual aspect of the Japanese labor market.

4 Model

The computable general equilibrium model of this paper employs the dynamic multi-period overlapping generations model initially developed by Auerbach et al. (1983). This paper expands Kato and Kawade (2015) by explicitly considering the cost of child care and elderly care. Both the financial and time costs to care the child and the elderly are taken into account.

The gender difference as well as different types of workers are considered; Seiki (full-time workers) and Hi-seiki (part-time, dispatched, or fixed term workers; non-full-time). Thus, there are four different types of workers; male full-time, female full-time, male non-full-time, and female non-full-time workers.

Each household consists of these four different workers, and it is assumed that each household optimizes its intertemporal consumption through its lifetime, taking the wage rate, the interest rate, and its own survival rates as given. The tax and subsidy system, the public pension scheme, and the public long-term care insurance scheme are also assumed to be taken as given by each household. The household is assumed to obtain its wage income by supplying labor elastically until it retires, and once it retires it never returns to the labor market. There are no altruistic bequest motives and Ricardian equivalence does not hold.

The firm is assumed to maximize its profit by taking the wage rate and the interest rate as given. The wage rate and the interest rate are determined in each fully competitive factor market in equilibrium.

The government sector is assumed to collect taxes and contributions from households. The government sector is also assumed to issue government bonds, so that the impact of government deficits can be explored.

The government sector has three different accounts; the general account, the public pension account, and the long-term care insurance account. In order to capture the realistic aspect of its accounts, the government is assumed to have transfers from the general account to the public pension account and the long-term care account. The public pension account is assumed to be run under the pay- as-you-go scheme.

It is assumed that there is no private life insurance, and thus there is no mechanism for the household to hedge the risk of dying in each period. Since the household is assumed to have no bequest motives, this assumption implies that the household leaves an accidental bequest when it dies. However, it is also assumed that there is no uncertainty in the whole economy in terms of the size of each generation, and thus there is no uncertainty in the total (aggregate) amount of bequests inherited in each period.

4.1 The Household

The representative household consists of four different types of workers. Workers differ, depending on the gender as well as the types of the work contract. Workers are differentiated by the difference in their work contract condition with their employer; Full-time work contract condition, or not. The former workers are called Seiki workers, and the latter workers are called Hi-seiki workers. The latter workers include part-time, dispatched, or fixed term workers. Thus, there are four different workers in each household: Male full-time, female full-time, male non-full-time, and female non-full-time workers, respectively.

Each household appears in the economy at age 20 as a decision maker. 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.

The household is assumed to maximize its expected lifetime utility with respect to its own consumption. The household's expected lifetime utility of generation g, denoted by

$E[V_g]$, is given

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

where ρ is a reciprocal of the elasticity of substitution between consumption at the different time. δ is the time preference. P_s is a probability weight of the survival rate 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 survives to $j+1$ years old. $c_{s,t}$ 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:

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

where ξ denotes the elasticity of substitution between consumption and leisure, and κ denotes the weight parameter for leisure. The budget constraint of each household is:

$$\begin{aligned} a_{s+1,t+1} = {} & [1 + (1-\tau_{r,t}) r_t] a_{s,t} + (1 - \tau_{w,t} - \tau_{p,t} - \tau_{e,s,t}) e_s (1 - l_{s,t} - lc_{s,t} - le_{s,t}) w_t \\ & + (1-\tau_{w,t}) b_{s,t} + d_{s,t} + (1-\tau_{q,t}) bq_{s,t} - (1+\tau_{c,t}) c_{s,t} - h_{s,t} - IC_{s,t} - \theta LT_{s,t} \end{aligned} \tag{2}$$

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 time spent on child care and elderly care, respectively, both of which are assumed to be exogenously given to the household. $d_{s,t}$ and $h_{s,t}$ denote child care benefits given by the government and the financial cost of child care in age s at time t, respectively. The actual data of $d_{s,t}$ from Cabinet Office of Japan is used to specify the value in the model. On the value of $h_{s,t}$, the study on the financial cost of child care 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

contribution rate to the long-term care insurance, which is applied to the representative household while it is working in age s at time t[5]. After retirement, the representative household still has to contribute to the long-term care insurance by paying the fixed amount of $IC_{s,t}$ in age s at time $t.LT_{s,t}$ is the total cost of obtaining the long-term care, and the θ is the co-payment rate. $IC_{s,t}$ and $LT_{s,t}$ are calculated based on the actual data, and θ is assumed to be 0.1 to reflect reality.

Labor efficiency of four different workers can be obtained from the data. In this paper, Rohdoryoku Chosa (2012) and Chinginkouzou Kihontoukei Chosa (2011) are 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 the non-full-time male worker in age 20 - 24 is used to normalize efficiency of other workers in different age. Note also that the wage rate the household faces is also the weighted average of wages of four different workers. The wage profiles of four different workers have been obtained from the above two data sets. The time spent on child care and elderly care is also differentiated among four different types of workers; male full-time, male non-full-time, female full-time, and female non-full-time workers.

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

$$\begin{aligned} e_s\left(1-l_{s,t}-lc_{s,t}-le_{s,t}\right) &= \nu^s_{m,ft}e^s_{m,ft}\left(1-l_{s,t}-lc_{s,t,m,ft}-le_{s,t,m,ft}\right) \\ &+ \nu^s_{fe,ft}e^s_{fe,ft}\left(1-l_{s,t}-lc_{s,t,fe,ft}-le_{s,t,fe,ft}\right) \\ &+ \nu^s_{m,nf}e^s_{m,nf}\left(1-l_{s,t}-lc_{s,t,m,nt}-le_{s,t,m,nt}\right) \\ &+ \nu^s_{fe,nf}e^s_{fe,nt}\left(1-l_{s,t}-lc_{s,t,fe,nt}-le_{s,t,fe,nt}\right), \end{aligned} \tag{3}$$

where m, fe, ft, and nt denote male, female, full-time contract, and non full-time contract, respectively. Thus, $e^s_{k,n}$ denotes labor efficiency of gender k of contract type of n in age

[5] $\tau_{e,s,t}$ is different between an age group of 40 to 64 years old and an age group of over 65 years old in reality. This paper takes into account the difference, and the contribution rates to the long-term care insurance in this paper are calculated based on the actual data.

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 calculated from Rohdoryoku Chosa (2012) and Chinginkouzou Kihontoukei Chosa (2011). $lc_{s,t,k,n}$ and $le_{s,t,k,n}$ are time spent on child care 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 Shakai Seikatsu Kiso Chosa (2011).

$bq_{s,t}$ is the amount of accidental/unintended bequests inherited in age s at time t[6], and $\tau_{q,t}$ is the inheritance tax rate at time t. $b_{s,t}$ is the amount of public pension benefits in age s at time t. w_t and r_t are the wage rate per the efficiency unit and the interest rate, respectively. Public pension benefits are given by

$$b_t = \begin{Bmatrix} \epsilon_t H_t; & s \geq RH \\ 0; & s, < RH \end{Bmatrix},$$

where RH is the retirement age. Public pension benefits are taxed. ϵ_t and H_t denote the replacement rate, and the average annual amount, respectively. H_t is given by:

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

It is assumed that the representative household maximizes (1) with respect to $c_{s,t}$ and $l_{s,t}$ subject to (2), and the first order conditions yield the following optimal equations:

$$\begin{aligned} u'\left(c_{s,t}, l_{s,t}\right) u\left(c_{s,t}, l_{s,t}\right)^{-\rho} &= \frac{q_{s+1,g}\left[1 + \left(1 - \tau_{r,t+1}\right) r_{t+1}\right]}{1+\delta} \frac{1+\tau_{c,t}}{1+\tau_{c,t+1}} \\ &\quad \times u'\left(c_{s+1,t+1}, l_{s+1,t+1}\right) u\left(c_{s+1,t+1}, l_{s+1,t+1}\right)^{-\rho}, \\ l_{s,t} &= \left[\frac{\kappa\left(1+\tau_{c,t}\right)}{\left(1 - \tau_{w,t} - \tau_{p,t}\right) w_t e_s}\right]^{\xi} c_{s,t}, \end{aligned}$$

where

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

[6]For simplicity, it is assumed in this paper that each household receives bequests only when it becomes age 50.

4.2 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. The aggregate private production function is assumed to be Cobb-Douglas such that

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

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[7]. The fully competitive assumption of factor markets yields:

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

where φ is the depreciation rate.

4.3 The Government

The government sector consists of a general account, a public pension account, and a long-term care insurance account. The government issues government bonds. The budget constraint of the general account is such that:

$$D_{t+1} - D_t = AG_t + r_t D_t + P_t + E_t + CH_t - R_t, \tag{4}$$

[7]Annual technological progress is assumed to be 1% initially, and then to be diminishing gradually.As presented in Ihori et al (2006), the assumption on annual technological progress is very crucial for simulation results, and it is assumed in this paper to be diminishing gradually from 1 % in order to mimimize the impact of an ad-hoc assumption on technological progress on the simulation results.

where D_t denotes the amount of outstanding government debts at time t. AG_t is the total government expenditure. P_t and E_t denote the amount of transfers from the general account to the public pension account and to the long-term care insurance account at time t, respectively. CH_t denotes the total amount of child care benefits given to each household. Child benefits are assumed to be given to each household while it is between age 28 and 43.[8] Thus,

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

where $POP_{s,t}$ denotes the total population of age s at time t. R_t is the total tax revenue, which is given by:

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

where[9]

$$\begin{aligned} L_t &= \sum_{s=0}^{RH-1} e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t} \right) POP_{s,t} \\ &= \sum_{s=0}^{RH-1} \left[\nu^s_{m,ft} e^s_{m,,ft} + \nu^s_{fe,ft} e^s_{fe,ft} + \nu^s_{m,nf} e^s_{m,nf} + \nu^s_{fe,nf} e^s_{fe,nt} \right] \left(1 - l_{s,t} - lc_{s,t} - le_{s,t} \right) POP_{s,t}. \end{aligned} \tag{5}$$

[8]It is assumed that each household starts to have a child when it is in age 28. It is also assumed that the child receives child benefits until she/he becomes 15 years old. Thus, each household obtains child benefits between age 28 and 43.

[9]The labor market is assumed to be fully competitive, and (5) is also interpretted as an equilibrium condition of the labor market

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

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

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

$$F_{t+1} - F_t = r_t F_t + P_t + CP_t - AB_t, \tag{6}$$

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:

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

On the long-term care insurance account, the budget constraint is given by:

$$TLT_t = FIC_t + TIC_t + OIC_t + E_t, \tag{7}$$

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

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

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

such that:

$$FIC_t = \sum_{s=40}^{RH-2} \tau_{e,s,t} w_t e_s \left(1 - l_{s,t} - lc_{s,t} - le_{s,t}\right) POP_{s,t},$$

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

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. OIC_t is the total amount self-paid by the elderly when she/he receives services through the long-term care insurance at time t, which is given by:

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

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

4.4 Equilibrium

All markets are assumed to be fully competitive. The equilibrium condition of the capital market is given by:

$$AS_t + F_t = K_t + D_t,$$

and the equilibrium condition of the goods market is given by:

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

5 Numerical Analysis

5.1 Several Assumptions

5.1.1 The Future Demographic Structure

The future demographic structure is exogenously given to an economy. In order to make the model most realistic, the actual past population data and the latest Projection of Future Population in Japan by the National Institute of Population and Social Security Research (NIPSSR) (2012) are used for calculating P_s in (1). Until year 2010, the actual data is used, and from year 2011 the projection data is used. With the assumption of no uncertainty in the whole economy in terms of the size of each generation, this implies that the past and the future demographic structure can perfectly be re-produced in the model. The medium variant data for both the future fertility and death rates from the latest Projection are used in the model, and the population structure shown in Figure 1 is perfectly re-produced in the model.

5.1.2 The Future Government Expenditure and Deficits

The future government expenditure and future deficits are both exogenously given. The future government expenditure is assumed to increase according to population aging based on the latest Projection of Future Population in Japan by the NIPSSR (2012). Until year 2014, the actual data for government expenditure, deficits, and GDP are used. Figure 7 and 8 show the ratios to GDP. Both figures show the future trend of the ratios exogenously given to the model. In the following simulations, the consumption tax rate is endogenously calculated in order to satisfy (4) with the assumption of the future trend of government expenditure and deficits shown in Figure 7 and 8. In order to reflect reality, the consumption tax rate remains at 8% until year 2018, and from year 2019 the consumption tax rate is endogenously calculated[10]. Other tax rates are exogenously given to the model in (4). Note

[10]The wage income tax rate is endogenously calculated until year 2017 in order to satisfy (4).

that the purpose of this paper is to investigate how much the consumption tax rate should be modified to satisfy (4), taking the future government expenditure, government deficits, and other policy instruments as given.

5.1.3 The Future Public Pension Scheme

The past trend and the future amount of accumulated public pension fund is shown in Figure 9. Until 2014, the actual data is used. Note that since year 2003 the decreasing trend of the GDP ratio of accumulated public pension fund can be observed. According to the recent announcement by the Ministry of Health, Labor and Welfare (MHLW), the future scenario value is assumed to keep decreasing down to the level at which the annual amount of total benefits can be paid in year 2115. A half of the total amount of public pension benefits is transferred annually from the general account, which is P_t in (4) and (6).

Since the trend of accumulated public pension fund is taken as given in the simulations, the contribution rate ($\tau_{p,t}$) and the replacement rate (ϵ_t) are endogenously calculated in order to satisfy (6). In order to reflect the actual policy change, the contribution rate is endogenously calculated until year 2017 to satisfy the budget constraint of the public pension account with the fixed rate of the replacement. Until year 2017 the contribution rate is an endogenous policy instrument to satisfy (6). From year 2018, as the Ministry of Health, Labour and Welfare of Japan (MHLW) announced, the contribution rate is exogenously given at 18.3%, and the replacement rate becomes a new policy instrument to satisfy (6), so that the replacement rate is endogenously calculated from year 2018. The MHLW announced that the replacement rate will be reduced gradually to 50 - 51 % in the future, and it is reported that the replacement rate in year 2009 was 62.3 %. Thus in this paper the exogenous replacement rate is assumed to be fixed at 62.3 % until year 2017, while the contribution rate is endogenously calculated until year 2017 in order to satisfy the budget constraint of (6). From year 2018 the replacement rate is endogenously calculated, while the contribution rate is exogenously fixed at 18.3 % afterwards.

The actual policy change to use the replacement rate with the fixed level of the contribution rate at 18.3% from year 2018 reflects an argument that future generations will suffer from a very high contribution rate to maintain the current level of public pension benefits. A policy to modify the replacement rate rather than the contribution rate to satisfy the future budget constraint results in reducing financial burdens on future generations through the public pension scheme.

5.1.4 The Future long-term Care Insurance

The public long-term care insurance for the elderly was introduced in year 2000. The expenditure basically depends on the demographic structure and population aging, and the expenditure seems exogenous to the scheme. On the revenue side, a 10% of the total cost is paid by people as co-payments who receive services through the scheme. A half of the remaining cost (90% of the total cost) is covered by transfers from the general account (E_t). Other half of the remaining cost is paid by contributions. Currently, 22 % and 28% of the remaining cost are paid by people belonging to the first group (age 65 and over), and the second group (age 40 - 64), respectively. Note that the scheme is compulsory so that people between age 40 and 64 have to belong to the second group, and people in age 65 and over have to belong to the first group. While the current ratios between the first group and the second group are 22 % and 28 %, respectively, the ratios are modified every three years according to the relative population size of both groups in the actual scheme. This paper takes into account this fact. Table 1 shows the ratios calculated based on this fact, and the ratios in Table 1 are applied in the following simulations.

In the simulations, the future cost is calculated based on the future demographic structure and the financial cost of the scheme in year 2010 among different age groups given by Figure 2. This implies that the cost will increase according to population aging in the simulations, as shown in Figure 10. In Figure 10, the actual data is used until year 2014, and the future cost is exogenously given in the following simulations. The salary dependent contribution

rate ($\tau_{e,s,t}$) and the fixed amount of contributions ($IC_{s,t}$) are both endogenously calculated in order to satisfy (7).

5.2 Simulations

5.2.1 The Impact of Population Aging

Figure 1 shows that Japan will experience a drastic demographic change in the near future. Population aging in Japan is rapid and high. The total population already started to decline, and the negative impact of a shrinking labor force on future GDP is expected.

Figure 11 shows the future labor force measured in efficiency unit. In the figure several cases are shown: 'Labor force' shows the case if the household maintains the ratio of time spent on labor supply, child care, and elderly care. 'Labor force + no child care' shows the case if the household additionally spent more time on labor which is used for child care otherwise. 'Labor force + no elderly care' shows the case if the household additionally spent more time on labor which is used for elderly care otherwise. 'Labor force + no child care + no elderly care' shows the total labor supply if the household spent the time for labor which is used for both child care and elderly care. If the household used the all time for labor which is spent on child care and elderly care otherwise, then labor supply would increase approximately by 4 %.

In accordance with population aging, government expenditure of the general account is expected to increase. Based on the future scenario of government expenditure and deficits given by Figure 7 and 8, the consumption tax rate increases. In order to reflect reality, the consumption tax is assumed to be introduced in year 1989 with its tax rate of 3%, increased in year 1997 from 3 % to 5 %, and in year 2014 from 5 % to 8 %. It is also assumed that the consumption tax rate remains at 8 % until year 2018. The consumption tax rate is assumed to be exogenously given until year 2018, and it is endogenously determined from year 2019. The detailed consumption tax rate is given in Table 2.

Population aging directly affects the public pension account. In order to reflect reality

of the actual policy change, the replacement rate is used as a policy instrument to satisfy the budget constraint of the public pension account from year 2018, and the replacement rate is endogenously calculated with the exogenous value of the contribution rate from year 2018 and hereafter. As announced by the MHLW, the exogenous value of the contribution rate is fixed at 18.3 % from year 2018 to reflect the actual policy aspect. Table 3 shows the impact of population aging on the replacement rate. The MHLW announces that the replacement rate could remain over 50 % even in an aging Japan, but the simulation result shows it becomes below 50 % from year 2039, as shown in Table 3. Note that this situation cannot be avioded even if the currently accumulated public pension funds are used up for paying pension benefits by year 2115.

The long-term care insurance is also affected by population aging. The actual values of the fixed amount of contributions for the first group (age 65 and over) and the contribution rate for the second group (age 40 - 64) in year 2010 are 4.4 % and 1.2 %, respectively[11]. The fixed amount of contributions for the first group is normalized based on the annual income of male non-full-time workers in age 20 - 24 in year 2010. Table 4 and 5 show the impact of population aging on the long-term care insurance. As shown in the tables, both the fixed amount of contributions for the age group of 65 and over and the contribution rate for the age group between age 40 and 64 will drastically increase as Japan becomes aged. When Japan stably reaches the peak of population aging around year 2060, the fixed amount of contributions for the first group (age 65 and over) and the contribution rate for the second group (age 40 - 64) will be 9.87 % and 6.57 %, respectively. This implies that the amount of fixed amount of contributions for the first group (age 65 and over) and the contribution rate for the second group (age 40 - 64) become more than double and five times as much, respectively, even if the distribution ratio of the cost between two groups is adjusted according to the demographic distribution of the two groups every three years as shown in Table 1.

[11]The actual values were calculated by using the data of expenditure of the long-term care insurance in year 2010 by the author.

5.2.2 The Impact of Changes in the Elderly Care Cost

The Change in the financial cost As Figure 10 shows, population aging induces the increasing trend of the financial cost of the long-term care insurance, and the GDP ratio of the financial cost remains at nearly 3 % in the future. If the increasing trend is not avoidable in the future, then it could be argued; who should bear the cost?

There is a recent argument that the basis for collecting contributions should be widen. Under the current scheme, all age groups from age 40 should contribute to the scheme, but it could be possible to ask younger generations to start contributing to the scheme. If younger generations should contribute, then it is also possible to ask elder generations to contribute more to the scheme by paying higher co-payments. The elder generations currently pay 10% (the co-payment rate) of the total cost incurred when they obtain services through the long-term care insurance. Then, the following scenarios will be examined:

***Simulation*1 :** The co-payment rate increases from 10 % (the current level) to 20 % and 30 %, respectively. Indeed, since year 2015, 20 % of the co-payment rate has been applied to the elderly with high income in reality.

***Simulation*2 :** The impact of widening the basis of collecting contributions is explored. The starting age to contribute to the scheme is reduced from the current age (age 40) to a younger age group. In Simulation 2, it is reduced from age 40 to 35 and 30, respectively.

Table 6 and 7 show the impact of an increase in the co-payment rate (***Simulation*1**) on the fixed amount of contributions for the first group (age 65 and over) and the contribution rate for the second group (age 40 to 64), respectively. Note that the current co-payment rate is 10 %. Table 6 shows that an increase in the co-payment rate reduces the remaining cost covered by the long-term care insurance and that it induces the decrease in the fixed amount of contributions for the first group, while the magnitude of the impact is small. However, Table 7 shows a surprising result that an increase in the co-payment rate to 30 % induces a rise in the contribution rate for the second group. This surprising result can be explained as

follows: As Figure 12 shows, a rise in the co-payment rate stimulates private savings, thus resulting in an increase in capital per labor (K / L). Since each individual has to pay more financial cost on her/his own when she/he receives elderly care services through the long term care insurance in her/his old age, she/he will save more to prepare for an increased financial co-payments. This effect results in more saving, inducing the higher capital labor ratio[12]. Note that the higher capital labor ratio results in the higher wage rate. Since the financial cost of the elderly care is evaluated based on wage, a rise in the co-payment rate results in an increase in the financial cost of the elderly care through an increase in wage as well. Thus, the financial burdens for both groups increase. While the financial cost measured in wage increases, the increased capital labor ratio results in more income per labor. Indeed, welfare of future generations increases due to the increased capital labor ratio, as shown in Figure 13, in which the equivalent variation of each generation is normalized based on the equivalent variation of the generation born in year 2000. While elder generations suffer from a rise in the co-payment rate, future generations enjoy welfare gains. When the co-payment rate increases, elder generations have to pay more co-payments, while the fixed amount of contributions decreases. Since the former negative impact outweighs the latter positive impact, elder generations become worse off.

Table 8 and 9 (***Simulation2***) show the impact of an expansion of the contribution basis on the fixed amount of contributions by the first group (age 65 and over) and on the contribution rate for the second group (age 40 - 64), respectively. The current starting age for being in the second group is age 40. In Simulation 2, the starting age becomes earlier from age 40 to age 35 or age 30. The tables show that the annual fixed amount for the first group and the annual rate for the second group both decrease.

In particular, the annual contribution rate for the second group more decreases than the annual fixed amount for the first group. While the second group starts to contribute earlier in

[12]Ihori et al (2011) demonstrated the similar impact of an increase in the co-payments for the national health services in Japan. An increase in the co-payments stimulates savtings, thus resulting in higher economic growth.

Simulation 2, the annual amount of burdens on the second group becomes smaller. In terms of the impact on welfare, currently old generations can enjoy welfare gain, simply because they do not need to contribute to the scheme earlier. On the other hand, the impact on welfare of future generations depends on the starting age. Note that while an earlier starting age results in the reduction of the *annual* burden rate, it obviously implies that each generation has to contribute to the scheme earlier and thus in a longer period. While the former impact of a lower annual burden rate is positive, the latter impact of longer contribution is negative for future generations. When the starting age becomes age 35, the former positive impact outweighs the latter negative impact, thus resulting in future generations becoming better off. However, the starting age becomes age 30, the latter negative impact is stronger than the former positive impact, and future generations suffer from welfare loss, when the starting age becomes age 30, as shown in Figure 14.

Figure 15 combines Figure 13 and 14 to show the result of both simulations on welfare. When the co-payment rate increases to 30 %, the future generations receive the highest welfare gain, while such an increase results in the largest welfare loss of old generations. The largest welfare gain of future generations tributes to its stimulation effect on savings. Except for the case when the starting age for the second group becomes earlier from age 40 to age 30, future generations always receive welfare gain in all simulations. Regarding the impact on currently old generations, the impact depends on scenarios. When the starting age becomes earlier to age 30, old generations can become better off, while future generations most suffer from such a policy. The most interesting result is that when the starting age becomes age 35 all generations can enjoy welfare gain. When the starting age becomes earlier, old generations become better off. When the starting age becomes age 35, the positive impact to reduce the annual rate for the second group (age 35 to age 64) outweighs the negative impact to start to contribute to the scheme earlier, so that a such policy change induces Pareto improvement for all generations.

The Change in the Time Cost Figure 3 shows the time spent on elderly care. If the opportunity cost to spend time on elder care is eliminated and the household can use the time of elderly care for additionally supplying new labor, then it is expected that the total labor supply increases, thus resulting in higher economic growth. An expansion of nursing home services could contribute to the reduction of the opportunity time cost of elderly care. This section simulates the case when the time spent on elderly care can be used for additional labor supply (***Simulation*3**). When the available time increases, there are several channels to affect an economy. If the household uses newly generated available time for additional labor supply, then labor supply increases. More labor supply decreases the wage rate in the labor market. However, additional labor supply simply increases wage income if wage remains unchanged. Thus, whether the total labor income increases or not depends on to the extent which impacts outweighs the other. The impact on savings cannot be determined even if the total labor income increases. Furthermore, more available time affects decision making regarding the time for leisure. Even if leisure is normal, the substitution effect and the income effect affect decision making oppositely, and whether leisure increases or not depends on both effects. Since the interest rate is also affected in the capital market, the impact on savings is more complicated.

As shown in Figure 3, female non-full-time workers most spend time on elderly care. Kato and Kawade (2015) demonstrated that the wage profile of female non-full-time workers is the lowest as shown in Figure 16. Figure 3 and 16 indicate that the impact of elimination of time for elderly care spent by female non-full-time workers is limited. Indeed, Figure 17A and 18A show the very little impact on the capital labor ratio and welfare, respectively, when the time cost of elderly care by female non-full-time workers is eliminated.

While male full-time workers spend the least time on elderly care, their wage profile is the highest. Figure 17B and 18B show the impact when the time cost of elderly care of male full-time workers is completely eliminated so that they can enjoy more available time. In this case, savings are stimulated, thus resulting in the higher capital labor ratio. This

stimulation effect results in higher welfare of future generations. On the other hand, the generations born between in year 1951 and year 1999 suffer from the elimination of the time cost of elderly care. For these generations, the negative impact on leisure outweighs the positive impact of stimulating savings, and welfare of these generations decreases.

The wage profile of female full-time workers is the second highest, and the increasing trend of their time for elderly care is observed as they become aged. Figure 17C and 18C show the impact when the time spent on elderly care now becomes available for female full-time workers to spend on more leisure and work. In this case, while the future capital labor ratio increases by the stimulation effect on savings, the magnitude is not large enough to result in welfare gain for future generations, since the wage profile of female full-time workers is not high enough. The generations born only between in year 1978 and year 2000 can enjoy the welfare gain.

Figure 17D and 18D show the impact when the time spent on elderly care by all types of workers becomes available for them. In this case, the capital labor ratio increases after year 2042[13]. Note that when male full-time workers use the time spent on elderly care for additional labor and leisure the capital labor ratio increases even before year 2042. However, when all other types of workers also have more available time which was used for elderly care before, then savings decrease. This effect is larger, and thus savings decrease when all types of workers have more available time which was used for elderly care before year 2042. In this case, except for the generations born between year 2001 and year 2039, all other generations can enjoy welfare gain. Note that in reality it seems difficult to differentiate workers based on gender and job contract types in terms of elimination of the time cost of elderly care. Thus, this case most captures reality. Note also that elimination of the time cost of elderly care does necessarily not result in welfare gain of all generations. This is because elimination of the time cost changes optimal savings level and the optimal labor supply, which also change all prices in all relevant markets. The price change thus affects welfare of all generations,

[13]More presicely speaking, the capital labor ratio very slightly increases between year 1978 and year 1986.

and the generations born between year 2001 and year 2039 suffer from welfare loss due to price changes in the markets.

5.2.3 The Impact of Changes in the Child Care Cost

The Change in the financial cost Figure 19 shows the total financial cost of child care per household in each year. According to Figure 6, it is assumed in this paper that it costs to care a child until a child becomes age 22 after his/her birth. It is also assumed that each household starts caring its child when it becomes age 28. These two assumptions imply that each household has to care its child between age 28 (its child is age 0) and age 50 (its child is age 22). The total financial cost per household in each year is the summed cost of all generations between age 28 and age 50 in Figure 19. Note that the total financial cost of child care decreases since the total number of children decreases according to the actual and the forecasted future demographic change.

This section simulates the case when the financial cost of child care decreases (***Simulation*4**). In this section the impact of an increase in the child benefits is explored. In order to reflect reality, it is assumed in this paper that child benefits are given to each household while its child is between age 0 and age 15, so that each household keeps receiving child benefits between age 28 and age 43.

It has been so far assumed in the above simulations that the GDP ratio of child benefits remains unchanged at the level of year 2014 in the future. Then, Simulation 4 examines the case when the amount of child benefits increases from the level of year 2014 by 10 %, and 30 %, respectively, and the increased level remains unchanged from year 2015 and thereafter. Note that a 10 % and 30 % increases are the amount of child benefits, but not the GDP ratio of child benefits, since such increases in the GDP ratio imply a huge increase in the amount of child benefits, which seem unrealistic.

Figure 20 and 21 show the impact of an increase in the amount of child benefits from the year 2014 level by 10 % and 30 %, respectively. An increase in child benefits stimulates

savings, and the capital labor ratio increases. This positive impact increases wage, and all generations receive welfare gain. An expanded economy with increased wage induces the reduction of the consumption tax rate, so that not only the generations which receive child benefits but also old generations can enjoy welfare gain. However, increased child benefits need more tax revenue in order to satisfy the budget constraint of the government, and this negative impact on the consumption tax rate induces an increase in the consumption tax rate. When child benefits increase by 10 %, this negative impact is smaller than the case when child benefits increases by 30 %, and welfare gain of old generations is relatively larger when child benefits increase only by 10 %.

The Change in the Time Cost Figure 5 shows the time spent on child care. If the government improves public facilities such as child nursery facilities, then the time spent on child care could be reduced. This section simulates the case when the time on child care becomes available for self-consumption so that each household can use the time for additional labor supply and more leisure (***Simulation*5**).

As Figure 5 shows, female non-full-time workers spend the most time on child care, and they spend more than 12 % on child care relative to their working time around age 30. Figure 22A and 23A show the impact when female non-full-time workers do not need spend their own time on child care, so that they can now have additional time for more labor supply and leisure. Since the time spent on child care is longer than that on elderly care by female non-full-time workers when their wage profile is relatively high over their work period, the impact on an economy is larger in comparison with Simulation 3 (Figure 17A and 18A). The capital labor ratio decreases first, but it starts increasing after year 2040. The generations of approximately current age 30 to 40 directly receive welfare gain, but future generations suffer from welfare loss. Since the capital labor ratio increases in the future, the wage rate also increases. However, labor supply depends on the substitution and income effects, and the total wage income does necessarily not increase. Furthermore, the change in wage income

affects demand for goods. Welfare of future generations depend on all effects, and future generations suffer from welfare loss when female non-full-time workers have more available time which was used for child care before.

Female full-time workers also spend much time on child care. Figure 22B and 23B show the impact when female full-time workers have more available time which was used for child care. In this case, the impact on the capital labor ratio is opposite to the case when female non-full-time workers can have more available time. Except for a very beginning period, the capital labor ratio decreases. On the impact on welfare, except for some old generations, which can enjoy a positive impact on the capital labor ratio, and also some young generations, many generations suffer from welfare loss.

Figure 22C and 23C show the case when male full-time workers enjoy more available time which was used for child care. In this case, the capital labor ratio decreases until year 2046. On the impact on welfare, old generations enjoy welfare gain, but future generations suffer from welfare loss. The reduction of the time on child care does directly not affect old generations. However, the reduced capital labor ratio induces an increase in the interest rate, and the increase in the interest rate induces an increase in income of old generations.

When the available time for all workers increases due to the reduction of the time spent on child care, the impact on the capital labor ratio is small, since the direction of the impact on savings is different depending on the gender and the types of work contracts. On the impact on welfare, except for some old generations, almost all generations suffer from welfare loss. The overall impact on welfare depends on several channels. More available time is used for more leisure and additional labor supply. More leisure time directly increases welfare. More labor supply reduces the wage rate in the labor market. The change in the wage rate affects labor supply decision, and the total wage income does necessarily not increase. The change in the wage rate also induces the change in the interest rate, which also affects optimal savings decision. A change in the available time affects a whole economy through price changes in all markets. When the time spent on child care is reduced for all workers

and thus all workers change their optimal behavior, then almost all generations suffer from welfare loss except for relatively elder generations. Relatively elder generations do not spend time on child care, and thus they are not affected directly by the reduction of time on child care. However, by indirect effects such as the impact on the interest rate, they can enjoy the positive impact, thus resulting in them having welfare gain.

6 Concluding Remarks

This paper has presented a computable general equilibrium (CGE) framework to numerically examine the impact of the financial and time cost of child as well as elderly care in an aging Japan. The difference in the contract condition such as full-time (Seiki) and non-full-time (Hi Seiki) for both genders has also been taken into account explicitly in the simulations.

Not only the public pension account but also the account of the public long-term care insurance have been taken into account with several realistic assumptions when the impact of population aging is examined. Several simulation results have shown that the financial burdens of population aging are more severe than what has been recognized. In particular, the replacement rate of the public pension scheme becomes below 50 % from year 2039, even if the currently accumulated public pension funds are used up for paying pension benefits by year 2115. Note that the Ministry of Health, Labor and Welfare (MHLW) announces that the replacement rate would not be below 50 % even in an aging Japan.

On the impact of increased co-payment rate of the long-term care insurance, future generations can surprisingly enjoy welfare gain, while old generations suffer from welfare loss. Improvement in welfare of future generations comes from stimulated savings by an increase in the co-payment rate, since future generations increases their savings to prepare for more private payments when they need elderly care services through the scheme in their old age. This positive effect on savings results in higher economic growth and welfare gain of future generations.

When the basis of contributions to the public long-term care insurance is widen by making the household start to contribute to the scheme in its earlier age, then the overall impact on welfare depends on when the household starts to contribute. When the starting age becomes earlier, then annual rate of contribution decreases, while the household has to contribute to the scheme for a longer period. When the starting age becomes age 35 from the current age of 40, the former positive effect outweighs the latter negative effect, thus resulting in future generations becoming better off. However, the starting age becomes age 30, the latter negative effect is stronger than the former positive effect, and future generations suffer from welfare loss.

While increased child benefits stimulate savings and thus they improve welfare, the impact of elimination of the time cost of child care and elderly care is quite mixed, depending on the gender and job contract types of workers within the household. When the time cost of *elderly* care spent by all workers irrespective of gender and job contract types is eliminated, many generations enjoy welfare gain. However, when the time cost of *child* care by all workers is eliminated, then almost all generations, except for relatively elder generations, reversely suffer from welfare loss.

References :

Abe, Y(2009), 'The Effects of the 1.03 million yen ceiling in a dynamic labor supply model,' Contemporary Economic Policy, Vol. **27**, No. 2, 147 - 163

Asai, Yukiko, Ryo Kambayashi, and Shintaro Yamaguchi (2015), ' Childcare Availability, Household Structure, and Maternal Employment,' Journal of the Japanese and International Economies, Vol. 28, 172 - 192

Auerbach, A and L J Kotlikoff (1987), *Dynamic Fiscal Policy*, Cambridge University

Press

Auerbach, A, L J Kotlikoff, and J Skinner (1983), 'The efficiency gains from dynamic tax reform,' International Economic Review, Vol. 24, 81 - 100

Hatta, T, and T Oguchi (1999), *Nenkin Kaikakuron*, Nohon Keizai Shinbunsya (in Japanese)

Higuchi, Yoshio (1994), 'Empirical Analysis on Leave for Child Care,' in Family in a Modern Society and Social Security, University of Tokyo (in Japanese)

Homma, M, N Atoda, Y Iwamoto, and F Ohtake (1987), 'Pension: Aging society and public pension scheme,' in *Macroeconomic analysis of the Japanese economy*, Hamada, K, A Horiuchi, and M Kuroda eds, Tokyo University Press, 149 - 175 (in Japanese)

Ihori, T, R R Kato, M Kawade, and S Bessho (2006), 'Public Debt and Economic Growth in an Aging Japan,' Chapter 3, in *Tackling Japan's Fiscal Challenges: Strategies to Cope with High Public Debt and Population Aging*, Kaizuka K and A O Krueger eds., Palgrave

Ihori, T, R R Kato, M Kawade, and S Bessho (2011), 'Health Insurance Reform and Economic Growth: Simulation Analysis in Japan,' Japan and the World Economy, Vol. 23, No. 4, 227-239

Iwamoto, Y, M Kohara, and M Saito (2001), 'Deadweight loss of households by caring long term elderly patients,' Kikan Shakai Hosyo Kenkyu, Vol. 36m Bi, 4, 547- 560 (in Japanese)

Ishida, Ryo, K Oguro, and J Takahata (2012), 'Child Benefit and Fiscal Burden in the Endogenous Fertility Setting,' Economic Modelling, Vol. 44

Iwazaki, Chie, A Kinsei, and M Yoshida (2006), 'Long Term Estimation of the Long-term Care Insurance,' University of Tokyo (in Japanese)

Jinno, M. (2010), 'Aging of the Population and Employment among the Young: A Reconsideration of the Relationship,' NIRA Report 2010.5, Chapter 5, 72-87

Kato, R R (1998), 'Transition to an Aging Japan: Public Pension, Savings and Capital Taxation,' Journal of the Japanese and International Economies Vol. 12, 204-231

Kato, R R (2002), 'Government Deficit, Public Investment, and Public Capital in the Transition to an Aging Japan,' Journal of the Japanese and International Economies, Vol. 16, No. 4, 462-491

Kato, R R, and M Kawade (2015), 'Female Labor Supply, Social Security, and Fiscal Consolidation,' Chapter 3 in Ihori T and K Terai eds., *The Political Economy of Fiscal Consolidation in Japan*, Springer

Kawade, M (2007), 'Welfare Comparison among Generations on Public Expenditure and Pension.', Chapter 6 in T. Tachibanaki ed., *Scale of Government and Social Security*, Tokyo University Press (in Japanese)

Kawade, M (2009), 'The Revaluation of the Fiscal Reconstruction in Japan: Incorporating Intra-generational Income Gap,' Keizai Ronsyu, Niigata University, Vol. 87, 185 - 204 (in Japanese)

Kitaura, Masatoshi, and S Kyotani (2007), 'On the Long Term Estimation of the Long-term Care Insurance,' Discussion Paper No. 0704, University of Kyoto (in Japanese)

Kuroda, S, and I Yamamoto (2007), 'How much do people change their labor supply by responding to the change in wage? : Survey on labor supply elasticities and estimation in Japan,' Kinyuu Kenkyu April 2007 (in Japanese)

Nagase, Nobuko (2007), 'How much have Fertility Policies been Implemented? Issues on Policies for Child Care,' Financial Review, Vol. 87, 3 - 22 (in Japanese)

Nakazawa, Masahiko, S Sakai, and J Sato (2014), 'Long Term Estimation of the Cost of the Long-term Care Insurance,' Ministry of Finance, Japan

Oguro, Kazumasa, J Takahata, and M Shimasawa (2011), 'Child Benefit and Fiscal Burden: OLG Model with Endogenous Fertility,' Modern Economy Vol. 2, 602 - 613

Oguro, Kazumasa, and J Takahata (2013), 'Child Benefits and Macroeconomic Simulation Analyses: An Overlapping-Generations Model with Endogenous Fertility,' Public Policy Review, Vol. 9 (4), Policy Research Institute, Ministry of Finance, Japan

Oguro, Kazumasa, and M Yasuoka (2016), 'Stress, Child Care and Fertility,' presented at the annual conference of Japan Institute of Public Finance, Kyoto, Japan

Okamoto, Akira (2016), 'Child Allowances and Public Pension: Welfare Effects and Political Feasibility of Reforms in a Silver Democracy,' presented at the annual conference of Japanese Economic Association, Tokyo, Japan

Shigeno, Yukiko, and Y Ohkusa (1998), 'The Impact of Leave for Child Care on Female's Marriage and Successive Labor Supply,' Nihon Rodo Kenkyu Zasshi, No. 459, 44 - 49 (in Japanese)

——————-, and ————-(1999), 'The Impact of Child Care Policy on Fertility Decision and Labor Supply,' Kikan Shakai Hosyo Kenkyu, Vol. 35 (2), 192 - 207 (in Japanese)

Suruga, Terukazu, and M Nishimoto (2002), 'The Impact of Child Care Policy on Fertiliy Decision,' Kikan Shakai Hosyo Kenkyu, Vol. 37 (4), 372 - 380 (in Japanese)

Tajika and Kikuchi (2004), 'The Estimation of the Total Cost of the Long-term Care Insurance and the Benefits-Cost Ratio,' Financial Review, Vol. 74, Ministry of Finance, Japan (in Japapnese)

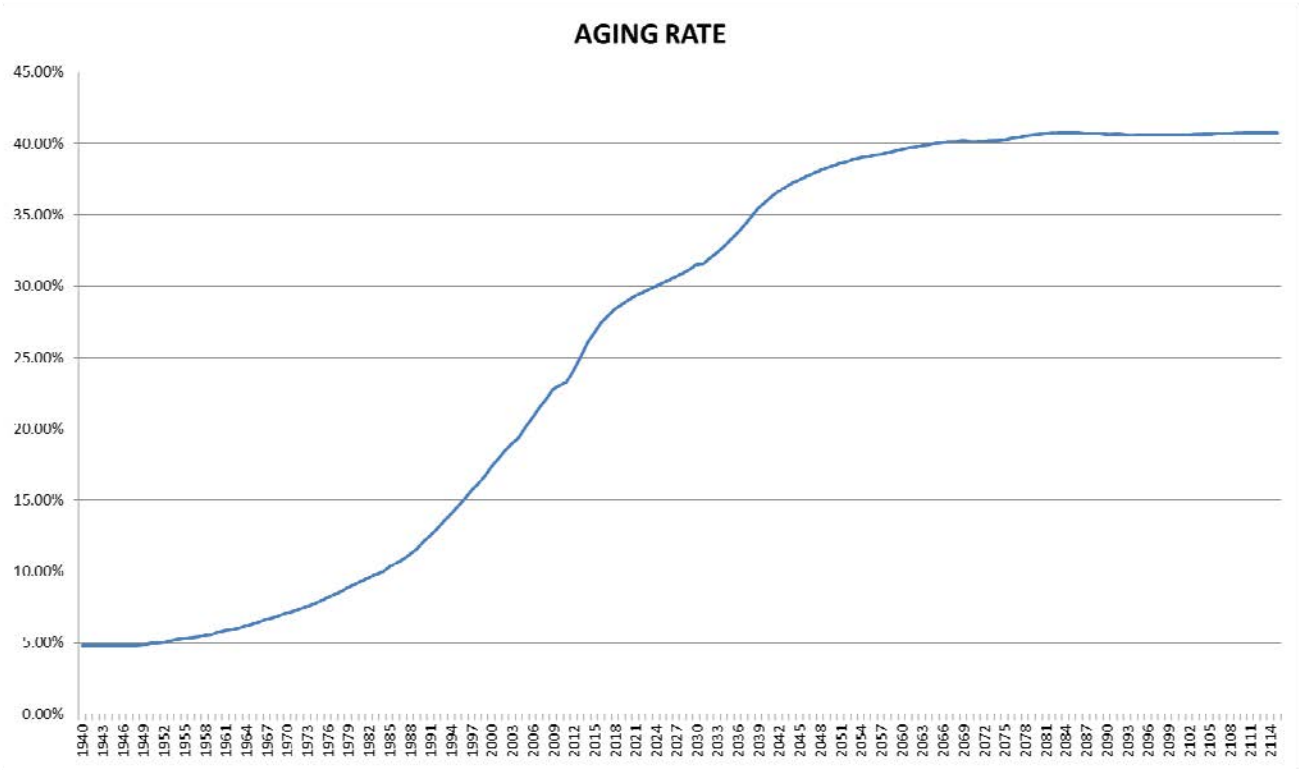
Ueda, Junji, Y Horiuchi, and T Tsutsui (2011), 'The Necessary Size of Adjustment for the Japanese Fiscal Policy: An Empirical Analysis on Dynamic Fiscal Disequilibrium,' Financial Review, Vol. 117, Ministry of Finance, Japan (in Japanese)

Unayama, S (2011), 'A Possibility for both Marriage and Giving-birth, and Improvement in Nurery Services, ' Nihon Keizai Kenkyu, No. 65, 1 - 22 (in Japanese)

——————(2013), 'Female Labor Market, Distribution within a Household, and Single Life,' RIETI Discussion Paper 14-J-048 (in Japanese)

Unayama, Suguru, and M Yamamoto (2015), 'Improvement in Nursery Services, and Female Labor Force Rate and Fertility Rate,' PRI Discussion Paper Series, No. 15A-2, Ministry of Finance, Japan (in Japanese)

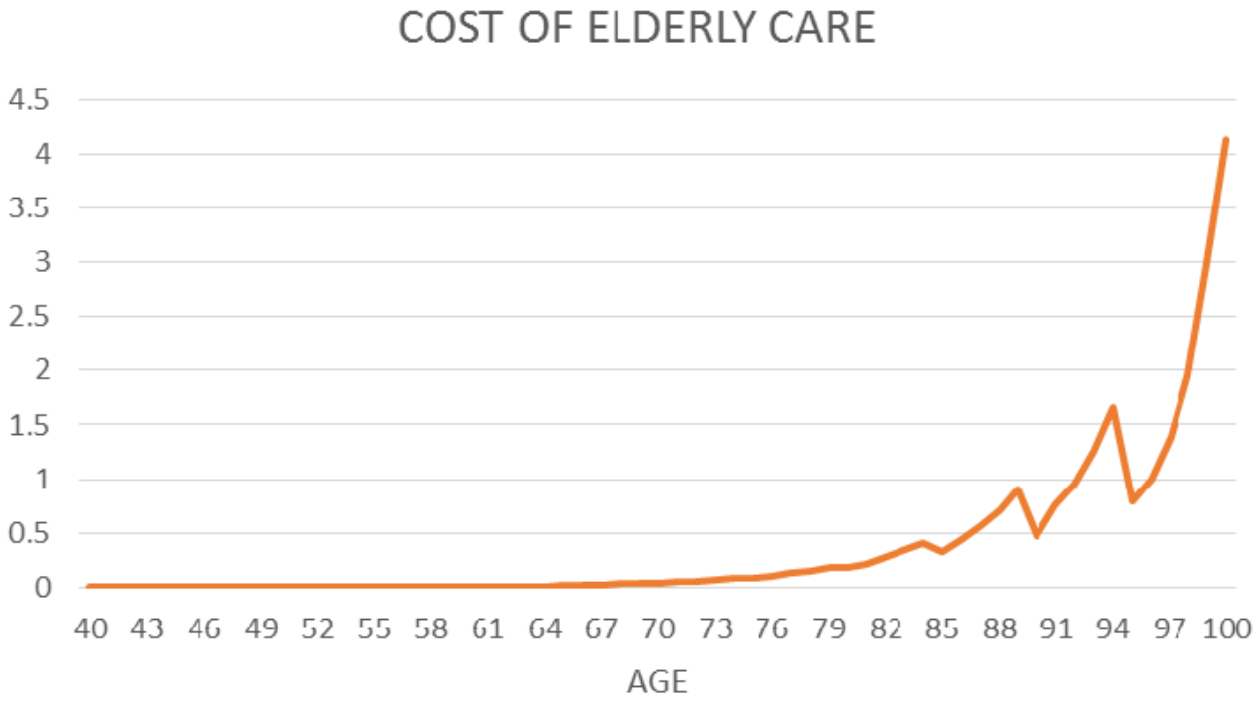
Figure 1: Population Aging of Japan



Until year 2010 the actual data has been used. From 2011 the future forecast by National Institute of Population and Social Security Research (NIPSSR) has been used, where the figures of medium variant for both fertility and death rates are assumed.

The aging rate is defined by the ratio of the total population of elderly people of age 65 and over to the total population of age 18 and over.

Figure 2: The Financial Cost of Elderly Care through the Long-Term Care Insurance

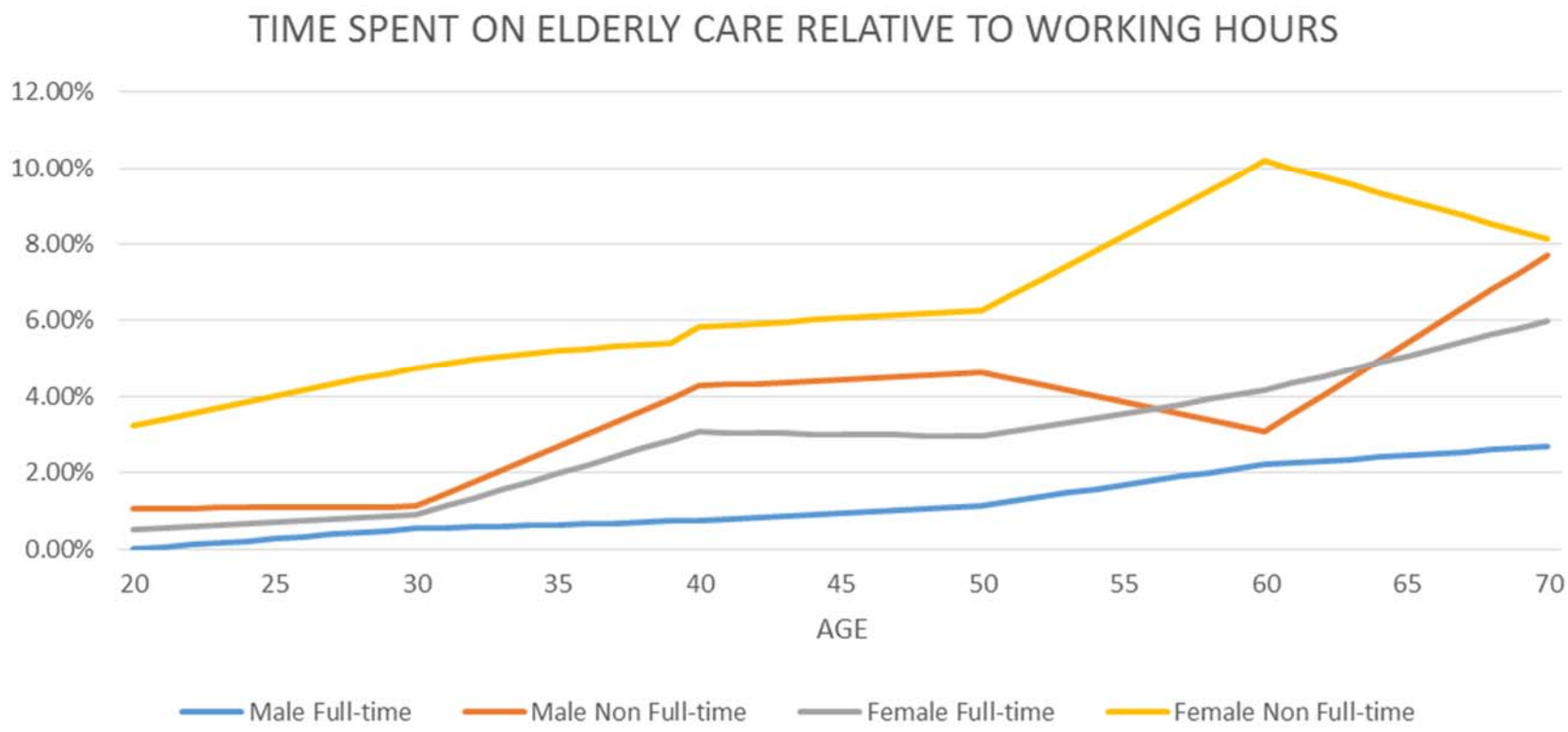


Annual amount of benefits per capita through the public long-term care insurance including Yo-shien 1 to Yo-kaigo 5)

The annual income of male non-full-time worker of age 20 – 24 in year 2010 is normalized to be unity, and the above figures are relative amount to the normalized amount.

Data: Kaigo-kyufu-hi Jittai Chosa Houkoku (year 2010)

Figure 3: The Time Spent on Elderly Care



The relative time to working hours in each age
Data: Shakai Seikatsu Kiso Chosa (year 2011)

Figure 4: The Amount of Child Care Benefits relative to GDP

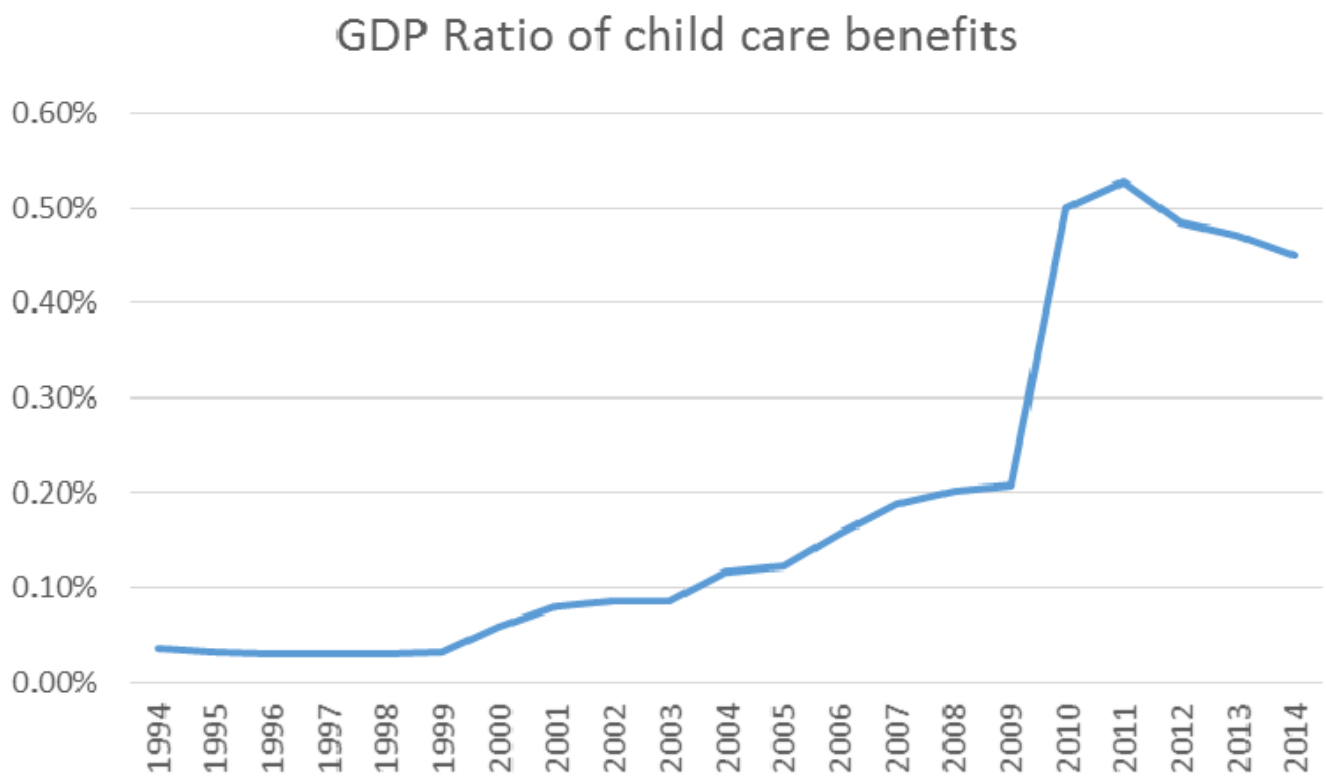
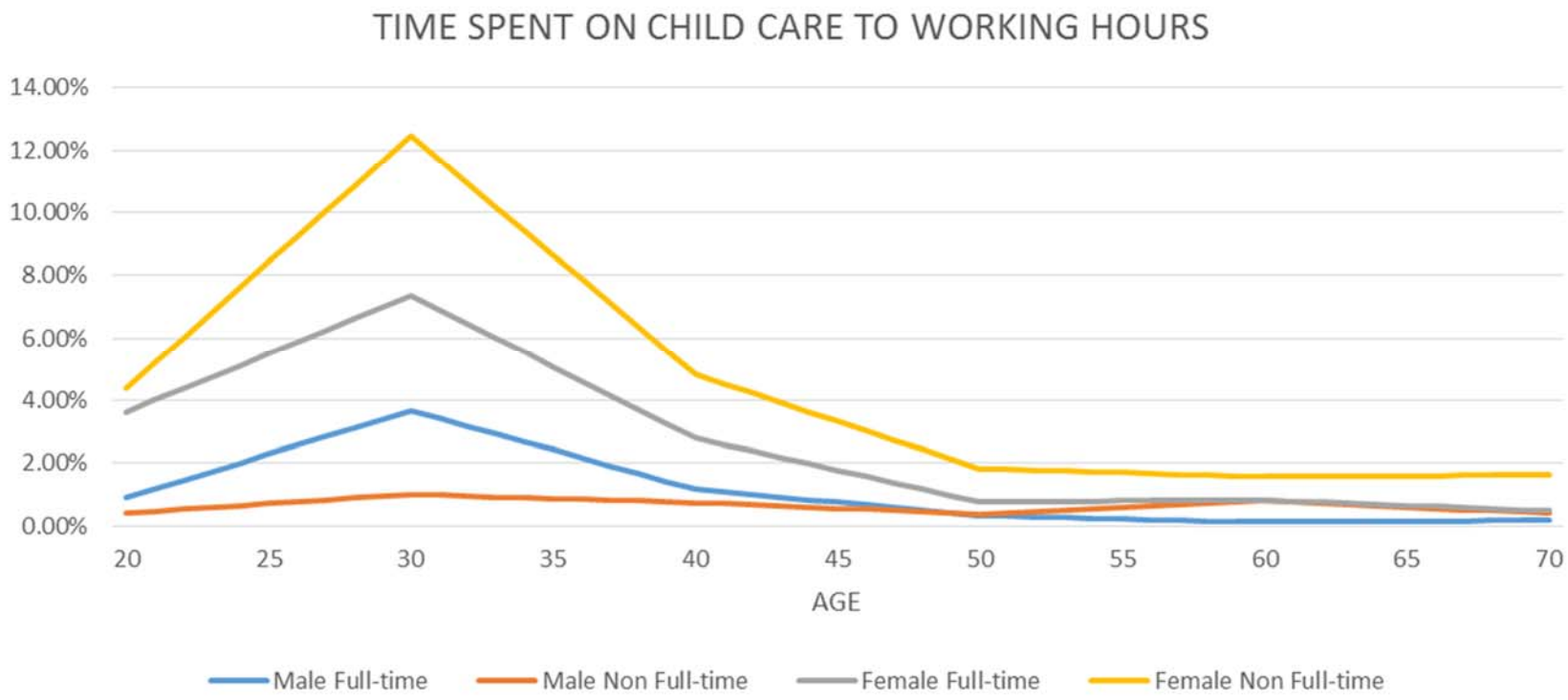
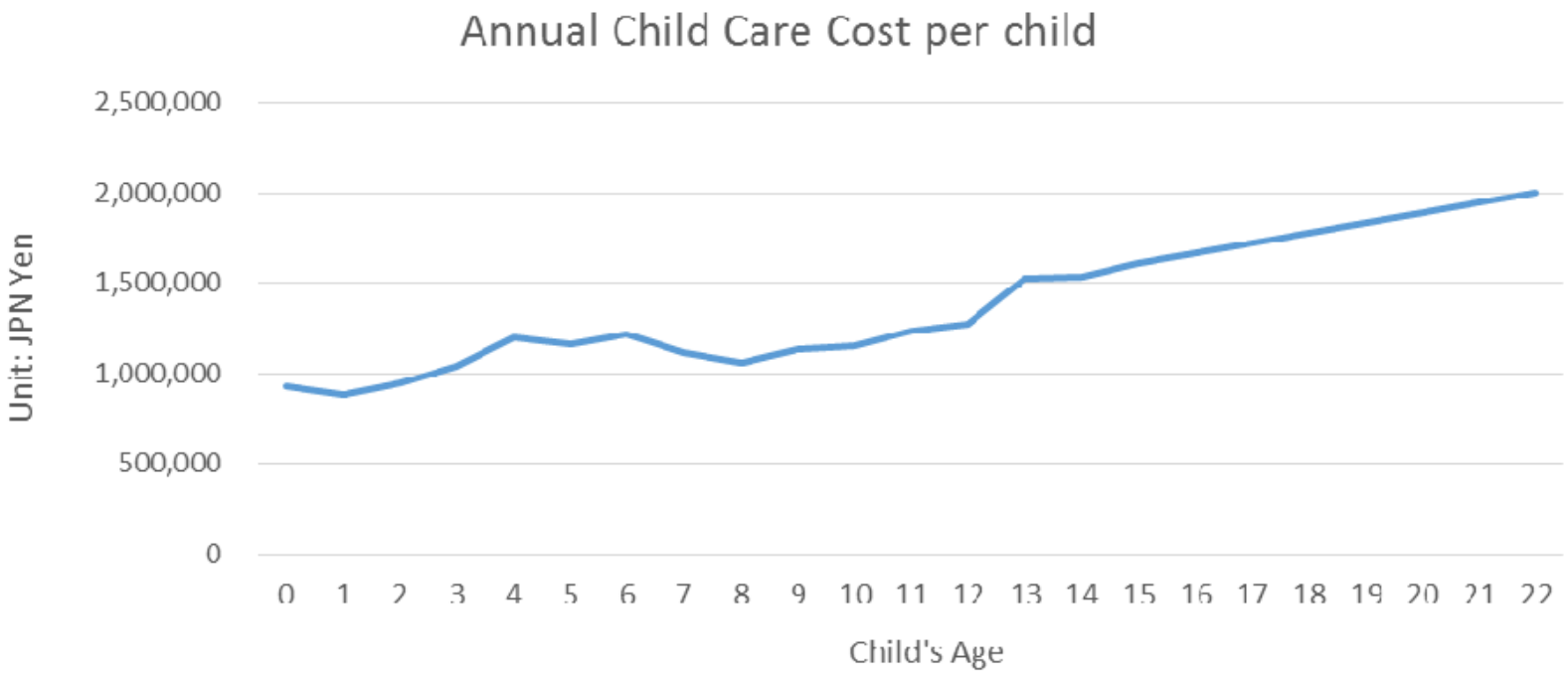


Figure 5: Time Spent on Child Care



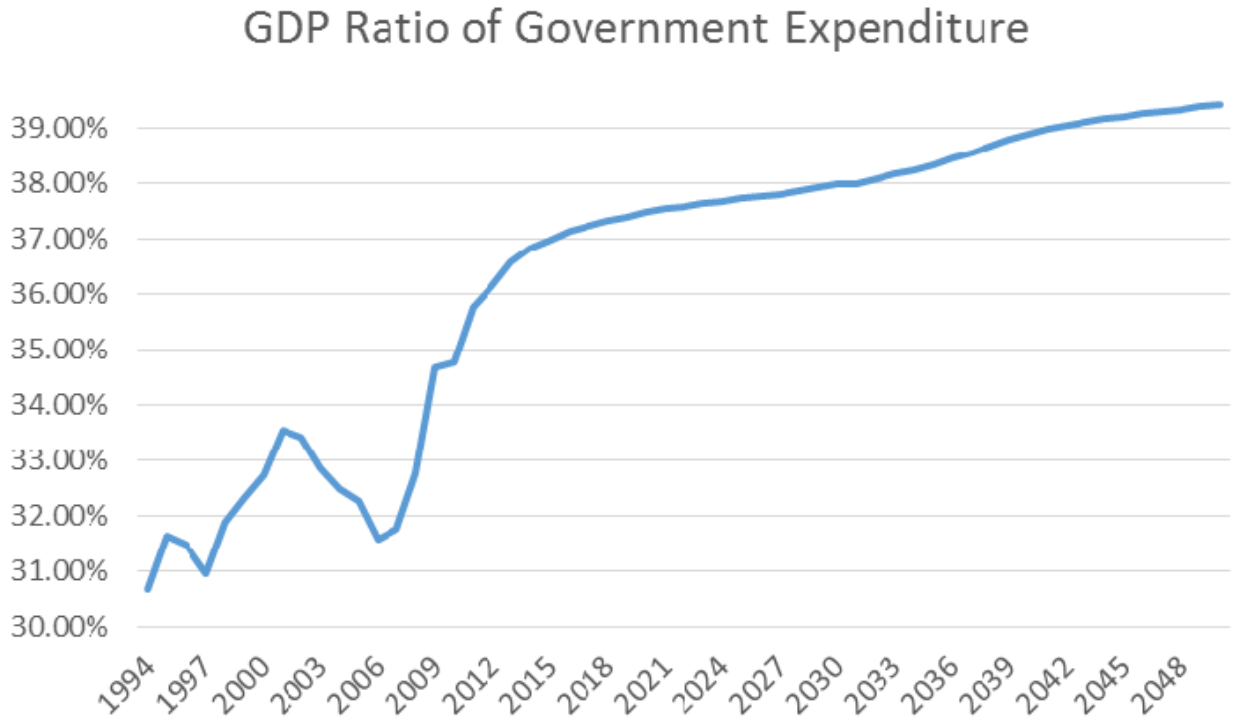
The relative time to working hours in each age
Data: Shakai Seikatsu Kiso Chosa (year 2011)

Figure 6: Child Care Cost



Data: The child care cost by internet, Cabinet Office (2009)

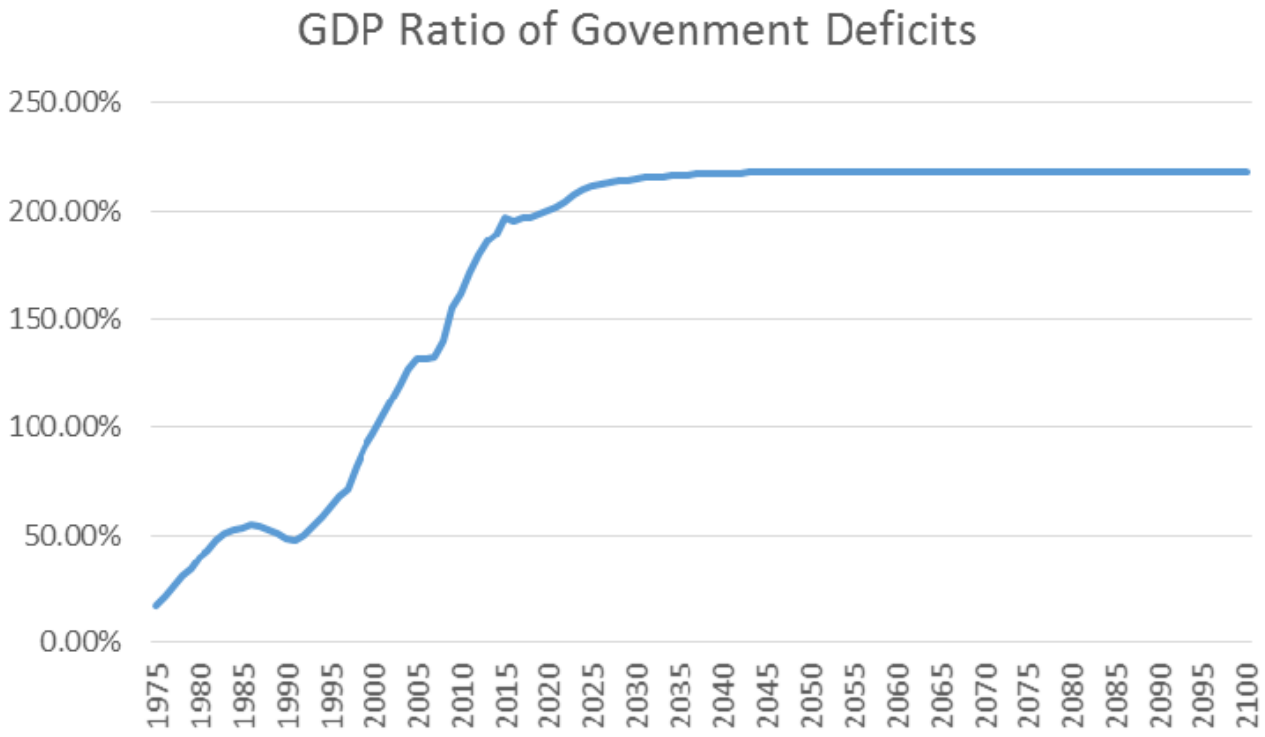
Figure 7: The GDP Ratio of Government Expenditure



Government transfers are also included.

The actual data is used until 2014.

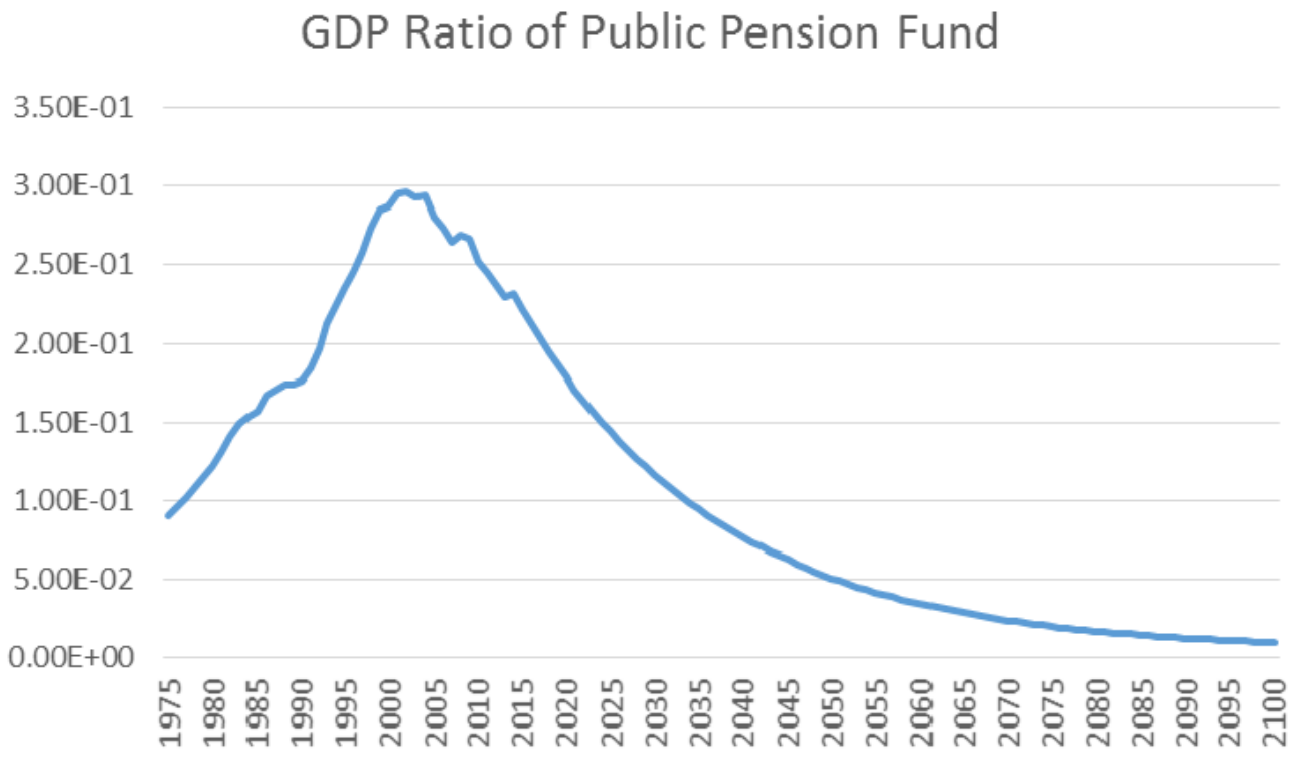
Figure 8: The GDP Ratio of Government Deficits



Both central and local governments deficits are included.

The actual data is used until year 2014.

Figure 9: The GDP Ratio of Accumulated Public Pension Fund



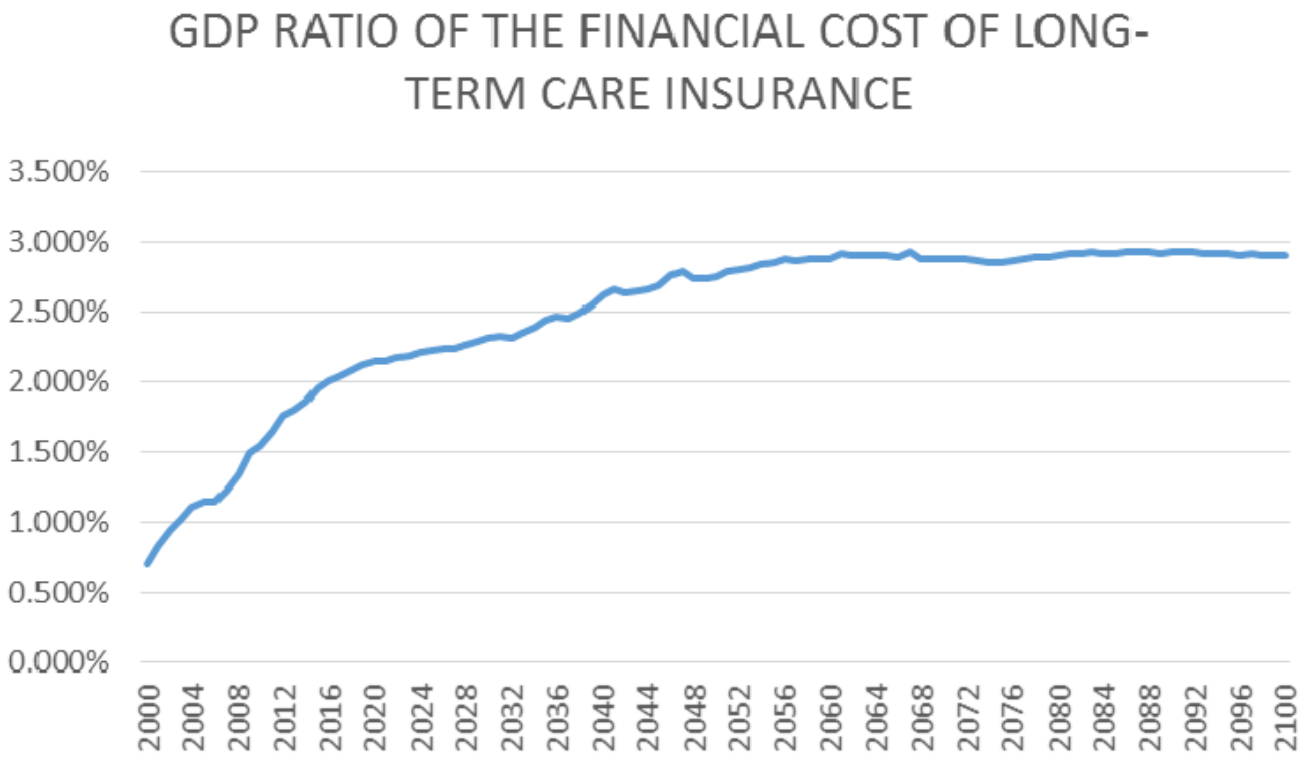
The actual data is used until year 2014.

Table 1: The Distribution of the Cost of the Long Term Care Insurance

Year	Contributins by 1st group	Contributins by 2nd group	Tax
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%

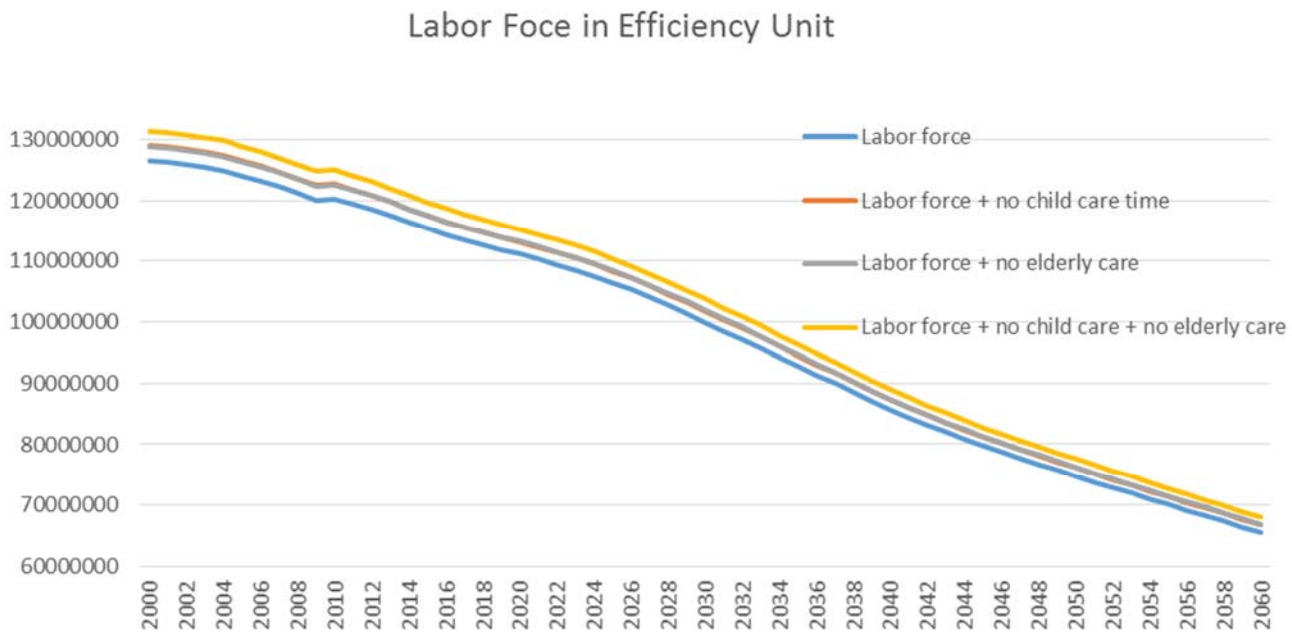
1st Group: Age 65 and Over
2nd Group: Age 40 – 64
The above cost refers to the remaining cost of the long term care insurance, so that the cost paid by the elderly as co-payments is not included.

Figure 10: The GDP Ratio of the Expenditure of the Long-Term Care Insurance



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

Figure 11: Labor Force in Efficiency Unit



Labor force + no child care time: The total labor force if time spent on child care were also used as labor as well
Labor force + no elderly care time: The total labor force if time spent on elderly care were also used as labor as well
Labor force + no child care time + elderly care: The total labor force if time spent on child care and elderly care were also used as labor as well

Table 2: The Consumption Tax Rate

Year	Tax Rate
2016	8.00%
2017	8.00%
2018	8.00%
2019	8.44%
2020	8.46%
2021	8.54%
2022	8.37%
2023	8.38%
2024	8.39%
2025	10.38%
2026	10.66%
2027	11.00%
2028	11.29%
2029	11.57%
2030	11.84%
2031	12.19%
2032	12.40%
2033	12.65%
2034	12.94%
2035	13.27%
2036	13.76%
2037	14.05%
2038	14.50%
2039	14.85%
2040	15.27%
2041	15.69%
2042	15.97%
2043	16.20%
2044	16.42%
2045	16.62%
2046	16.90%
2047	17.22%
2048	17.71%
2049	17.86%
2050	17.99%
2051	18.16%
2052	18.31%
2053	18.50%
2054	18.65%
2055	18.80%
2056	19.05%
2057	19.20%
2058	19.30%
2059	19.49%
2060	19.65%

Table 3: The Replacement Rate

Year	Replacement Rate
2016	62.30%
2017	62.30%
2018	60.96%
2019	64.64%
2020	63.92%
2021	63.25%
2022	62.76%
2023	62.42%
2024	61.99%
2025	61.31%
2026	60.90%
2027	60.50%
2028	60.05%
2029	59.49%
2030	58.83%
2031	57.95%
2032	57.74%
2033	56.75%
2034	55.75%
2035	54.69%
2036	53.57%
2037	52.39%
2038	51.14%
2039	49.85%
2040	48.65%
2041	47.66%
2042	46.83%
2043	46.15%
2044	45.54%
2045	45.03%
2046	44.54%
2047	44.14%
2048	43.77%
2049	43.43%
2050	43.08%
2051	42.76%
2052	42.49%
2053	42.22%
2054	41.98%
2055	41.77%
2056	41.58%
2057	41.41%
2058	41.19%
2059	40.96%
2060	40.68%

Table 4: The Fixed Amount of Contributions by the First Group (age 65 and over of the Long Term Care Insurance

Year	Contributions for the first group
2016	5.42%
2017	5.52%
2018	5.64%
2019	5.77%
2020	5.91%
2021	6.01%
2022	6.13%
2023	6.26%
2024	6.42%
2025	6.56%
2026	6.68%
2027	6.80%
2028	6.94%
2029	7.10%
2030	7.26%
2031	7.38%
2032	7.51%
2033	7.62%
2034	7.74%
2035	7.91%
2036	8.10%
2037	8.13%
2038	8.18%
2039	8.22%
2040	8.36%
2041	8.53%
2042	8.56%
2043	8.54%
2044	8.53%
2045	8.53%
2046	8.66%
2047	8.85%
2048	8.88%
2049	8.86%
2050	8.82%
2051	8.85%
2052	8.90%
2053	8.96%
2054	9.04%
2055	9.13%
2056	9.32%
2057	9.44%
2058	9.60%
2059	9.75%
2060	9.87%

Table 5: Contribution Rate for the Second Group (age 40 – 64) of the Long Term Care Insurance

Year	Contribution rate for the second goup
2016	2.32%
2017	2.40%
2018	2.49%
2019	2.59%
2020	2.70%
2021	2.79%
2022	2.89%
2023	3.01%
2024	3.13%
2025	3.25%
2026	3.38%
2027	3.48%
2028	3.60%
2029	3.76%
2030	3.90%
2031	4.05%
2032	4.15%
2033	4.26%
2034	4.38%
2035	4.54%
2036	4.68%
2037	4.70%
2038	4.73%
2039	4.77%
2040	4.89%
2041	5.04%
2042	5.08%
2043	5.08%
2044	5.08%
2045	5.09%
2046	5.22%
2047	5.39%
2048	5.40%
2049	5.40%
2050	5.38%
2051	5.43%
2052	5.49%
2053	5.57%
2054	5.66%
2055	5.78%
2056	5.97%
2057	6.11%
2058	6.28%
2059	6.44%
2060	6.57%

Table 6 Simulation 1: The Impact of an Increase in the Co-Payment Rate on the Fixed Amount of Contributions by the First Group (Age 65 and Over) of the Long-term Care Insurance

	Co-payment rate		
Year	10%	20%	30%
2016	5.42%	5.42%	5.42%
2017	5.52%	5.52%	5.52%
2018	5.64%	5.63%	5.63%
2019	5.77%	5.76%	5.77%
2020	5.91%	5.90%	5.90%
2021	6.01%	6.01%	6.01%
2022	6.13%	6.13%	6.13%
2023	6.26%	6.26%	6.26%
2024	6.42%	6.41%	6.41%
2025	6.56%	6.55%	6.54%
2026	6.68%	6.67%	6.67%
2027	6.80%	6.80%	6.80%
2028	6.94%	6.93%	6.93%
2029	7.10%	7.09%	7.08%
2030	7.26%	7.25%	7.24%
2031	7.38%	7.36%	7.35%
2032	7.51%	7.50%	7.50%
2033	7.62%	7.60%	7.60%
2034	7.74%	7.73%	7.72%
2035	7.91%	7.90%	7.89%
2036	8.10%	8.07%	8.06%
2037	8.13%	8.10%	8.10%
2038	8.18%	8.15%	8.14%
2039	8.22%	8.19%	8.18%
2040	8.36%	8.33%	8.32%
2041	8.53%	8.51%	8.49%
2042	8.56%	8.53%	8.51%
2043	8.54%	8.52%	8.50%
2044	8.53%	8.50%	8.48%
2045	8.53%	8.50%	8.48%
2046	8.66%	8.63%	8.62%
2047	8.85%	8.82%	8.80%
2048	8.88%	8.83%	8.81%
2049	8.86%	8.81%	8.80%
2050	8.82%	8.78%	8.76%
2051	8.85%	8.80%	8.79%
2052	8.90%	8.86%	8.84%
2053	8.96%	8.92%	8.90%
2054	9.04%	9.00%	8.97%
2055	9.13%	9.09%	9.07%
2056	9.32%	9.27%	9.25%
2057	9.44%	9.40%	9.37%
2058	9.60%	9.56%	9.53%
2059	9.75%	9.71%	9.67%
2060	9.87%	9.82%	9.79%

Table 7 Simulation 1: The Impact of an Increase in the Co-Payment Rate on the Contribution Rate for the Second Group (Age 40 to 64) of the Long Term Care Insurance

	Co-payment rate		
Year	10%	20%	30%
2016	2.32%	2.32%	2.32%
2017	2.40%	2.39%	2.40%
2018	2.49%	2.48%	2.49%
2019	2.59%	2.59%	2.60%
2020	2.70%	2.70%	2.70%
2021	2.79%	2.78%	2.79%
2022	2.89%	2.89%	2.90%
2023	3.01%	3.00%	3.01%
2024	3.13%	3.12%	3.14%
2025	3.25%	3.25%	3.26%
2026	3.38%	3.37%	3.39%
2027	3.48%	3.47%	3.49%
2028	3.60%	3.60%	3.61%
2029	3.76%	3.75%	3.77%
2030	3.90%	3.89%	3.91%
2031	4.05%	4.04%	4.06%
2032	4.15%	4.14%	4.16%
2033	4.26%	4.26%	4.28%
2034	4.38%	4.38%	4.40%
2035	4.54%	4.53%	4.56%
2036	4.68%	4.68%	4.71%
2037	4.70%	4.70%	4.73%
2038	4.73%	4.74%	4.76%
2039	4.77%	4.77%	4.80%
2040	4.89%	4.90%	4.93%
2041	5.04%	5.04%	5.08%
2042	5.08%	5.08%	5.12%
2043	5.08%	5.08%	5.12%
2044	5.08%	5.08%	5.12%
2045	5.09%	5.09%	5.14%
2046	5.22%	5.23%	5.26%
2047	5.39%	5.40%	5.43%
2048	5.40%	5.42%	5.45%
2049	5.40%	5.42%	5.45%
2050	5.38%	5.40%	5.44%
2051	5.43%	5.45%	5.48%
2052	5.49%	5.50%	5.55%
2053	5.57%	5.58%	5.63%
2054	5.66%	5.67%	5.72%
2055	5.78%	5.79%	5.84%
2056	5.97%	5.98%	6.03%
2057	6.11%	6.12%	6.17%
2058	6.28%	6.29%	6.35%
2059	6.44%	6.45%	6.50%
2060	6.57%	6.59%	6.64%

Figure 12 Simulation 1: The Impact of an Increase in the Co-payment Rate on K/L

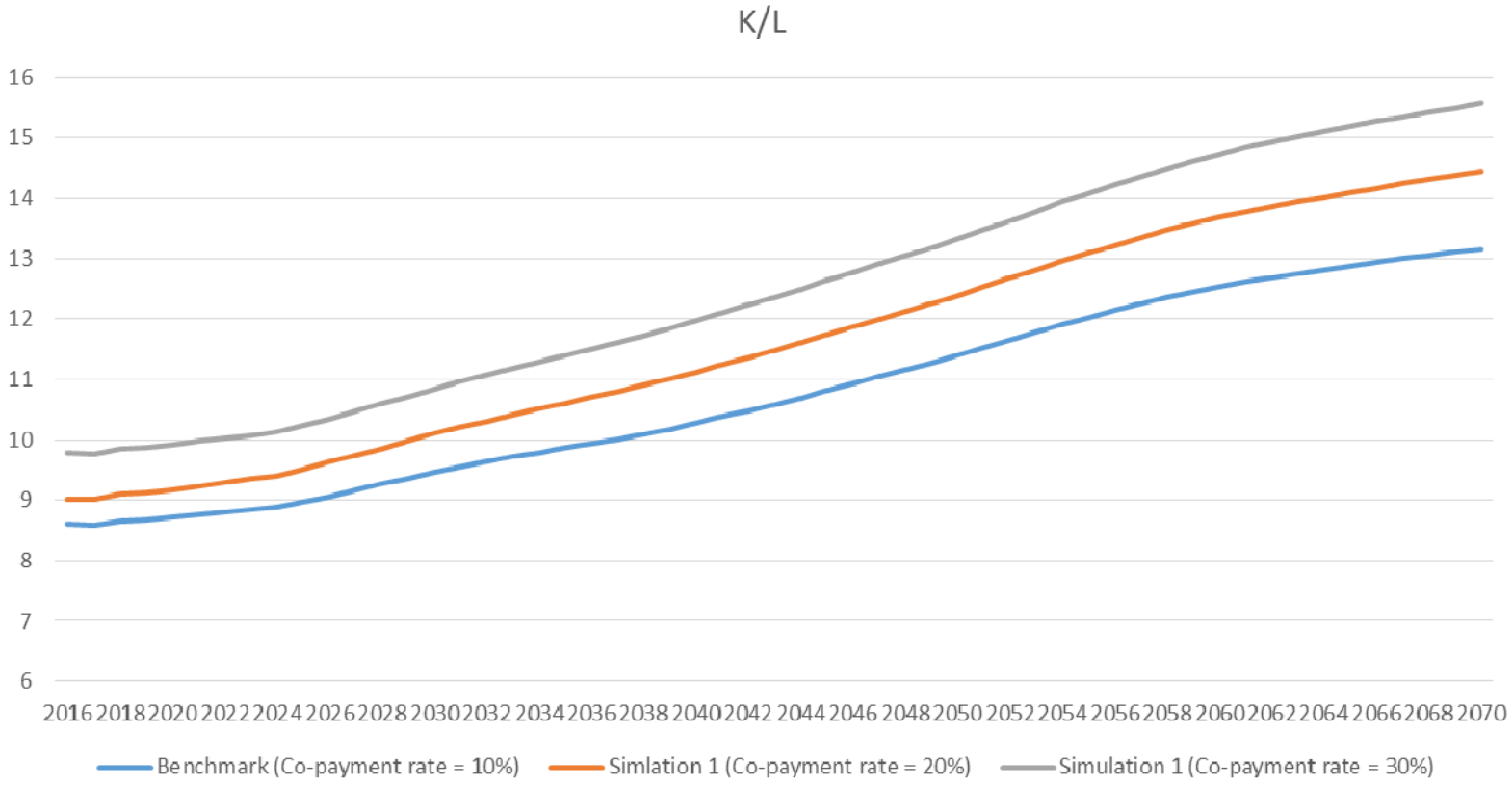
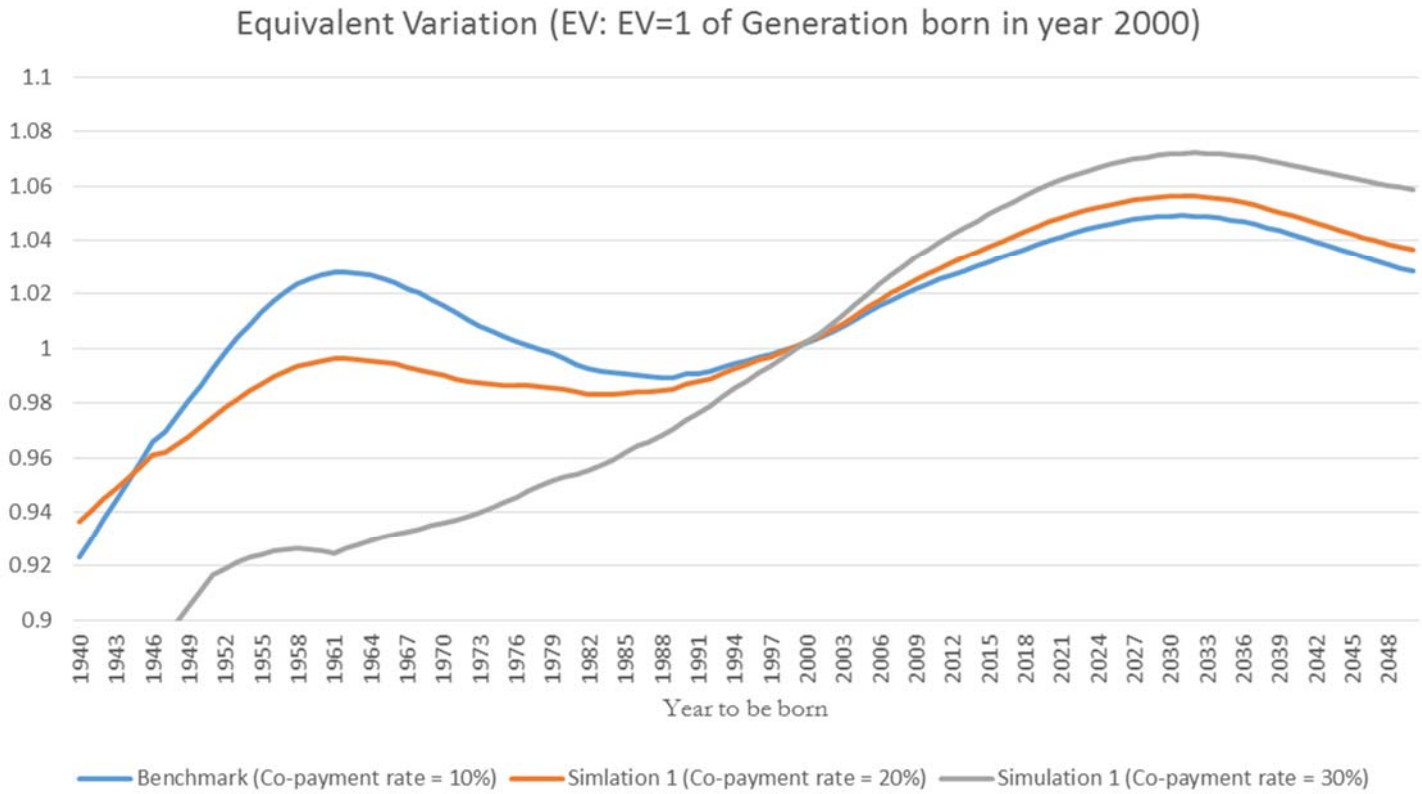


Figure 13 Simulation 1: The Impact of an Increase in the Co-payment Rate on Welfare



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

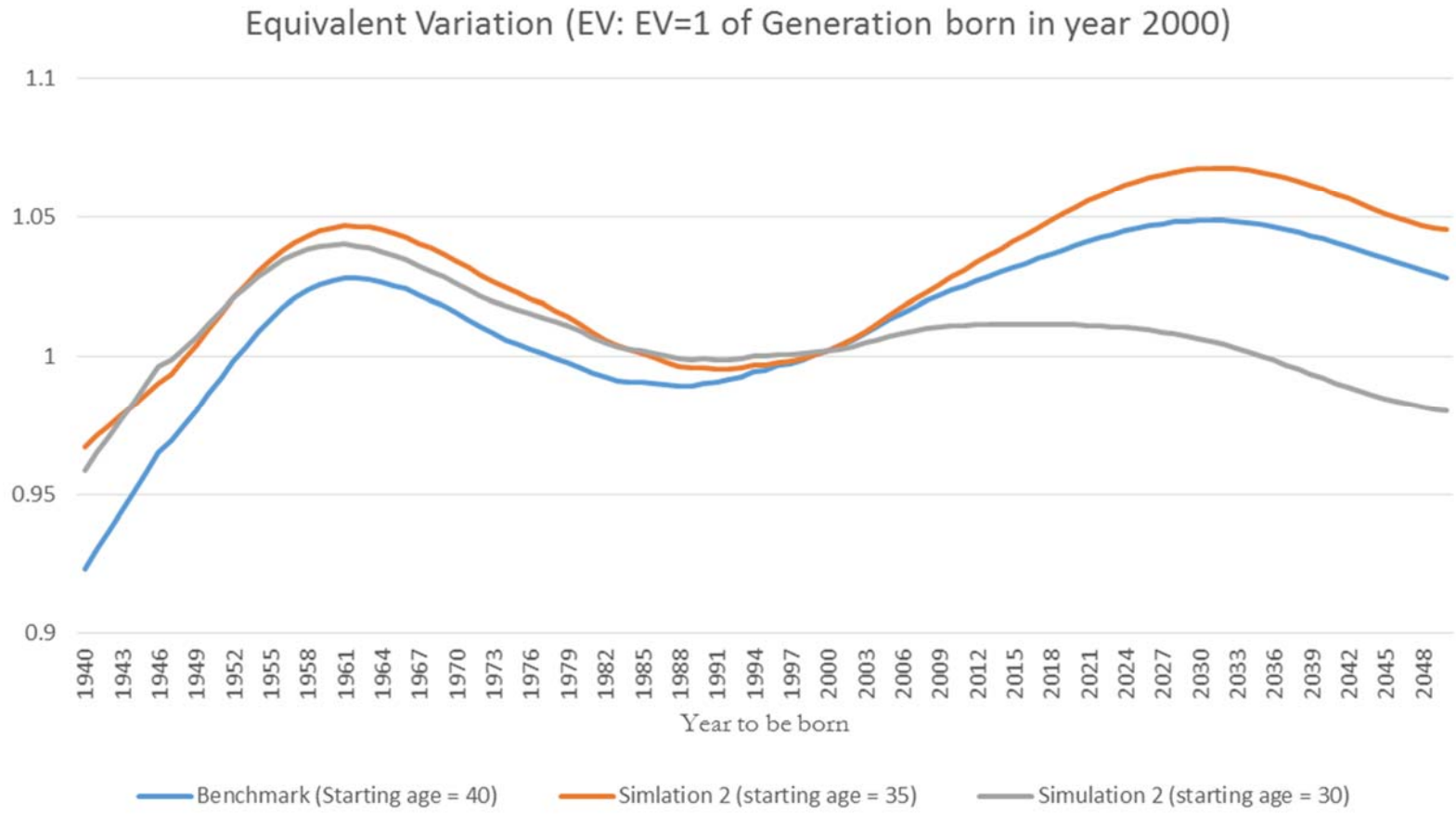
Table 8 Simulation 2: The Impact of an Expansion of the Contribution Basis on the Fixed Amount of Contributions by the First Group (Age 65 and Over) of the Long Term Care Insurance

	Starting Age of the second group		
Year	40	35	30
2016	5.42%	5.09%	4.88%
2017	5.52%	5.19%	4.97%
2018	5.64%	5.30%	5.08%
2019	5.77%	5.43%	5.21%
2020	5.91%	5.56%	5.34%
2021	6.01%	5.67%	5.44%
2022	6.13%	5.78%	5.54%
2023	6.26%	5.91%	5.66%
2024	6.42%	6.05%	5.80%
2025	6.56%	6.18%	5.92%
2026	6.68%	6.32%	6.03%
2027	6.80%	6.43%	6.15%
2028	6.94%	6.55%	6.26%
2029	7.10%	6.71%	6.40%
2030	7.26%	6.85%	6.54%
2031	7.38%	6.95%	6.63%
2032	7.51%	7.07%	6.75%
2033	7.62%	7.18%	6.84%
2034	7.74%	7.29%	6.95%
2035	7.91%	7.45%	7.11%
2036	8.10%	7.61%	7.26%
2037	8.13%	7.63%	7.28%
2038	8.18%	7.68%	7.33%
2039	8.22%	7.72%	7.37%
2040	8.36%	7.86%	7.50%
2041	8.53%	8.01%	7.65%
2042	8.56%	8.04%	7.66%
2043	8.54%	8.02%	7.65%
2044	8.53%	8.01%	7.64%
2045	8.53%	8.02%	7.63%
2046	8.66%	8.14%	7.76%
2047	8.85%	8.32%	7.94%
2048	8.88%	8.34%	7.96%
2049	8.86%	8.32%	7.95%
2050	8.82%	8.29%	7.93%
2051	8.85%	8.33%	7.97%
2052	8.90%	8.38%	8.03%
2053	8.96%	8.45%	8.09%
2054	9.04%	8.53%	8.17%
2055	9.13%	8.62%	8.26%
2056	9.32%	8.80%	8.42%
2057	9.44%	8.92%	8.54%
2058	9.60%	9.07%	8.68%
2059	9.75%	9.21%	8.81%
2060	9.87%	9.32%	8.91%

Table 9 Simulation 2: The Impact of an Expansion of the Contribution Basis on the Contribution Rate for the Second Group (Age 40 to 64) of the Long Term Care Insurance

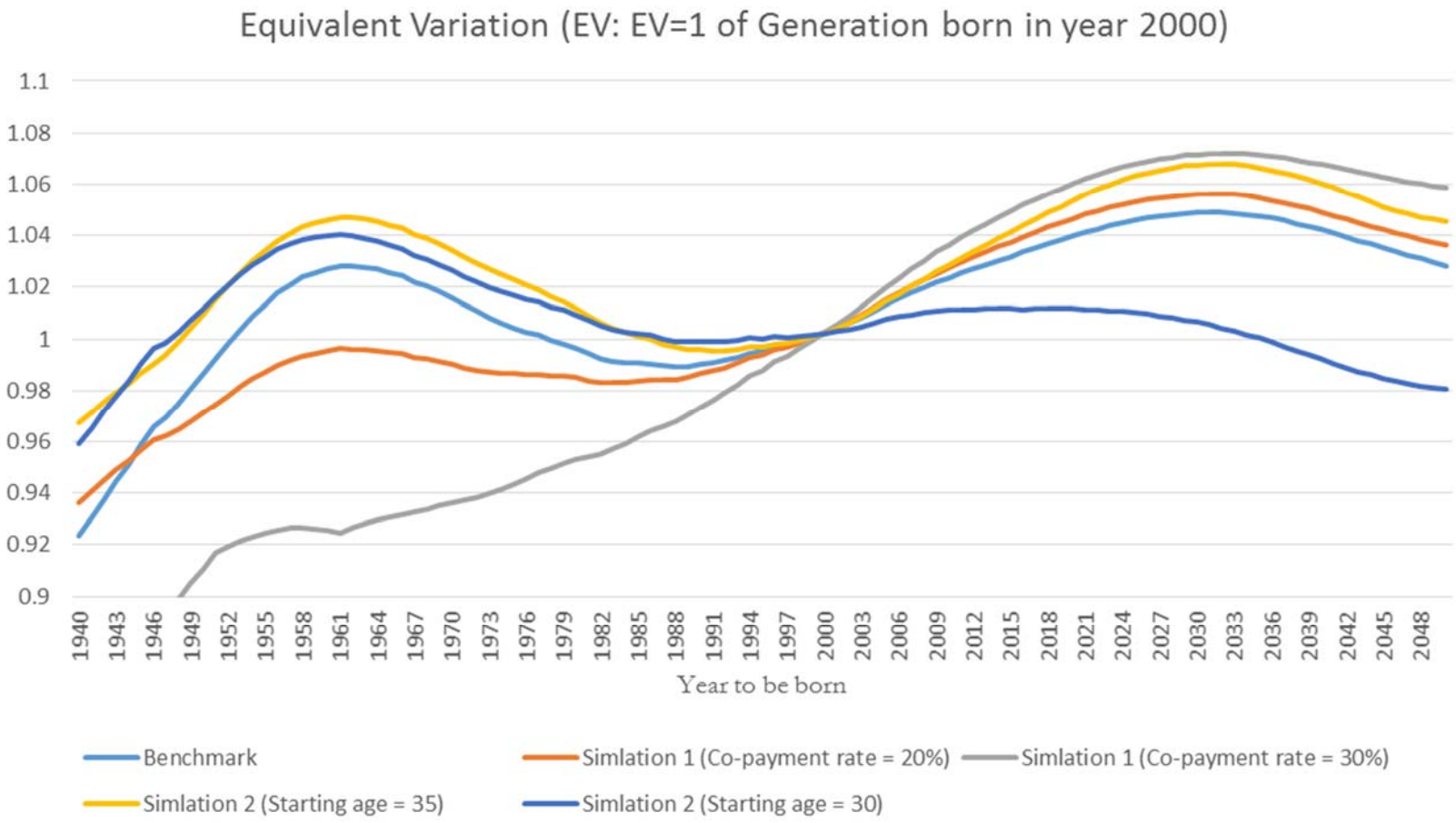
	Starting Age of the second group		
Year	40	35	30
2016	2.32%	2.06%	1.91%
2017	2.40%	2.14%	1.98%
2018	2.49%	2.23%	2.07%
2019	2.59%	2.32%	2.16%
2020	2.70%	2.42%	2.26%
2021	2.79%	2.51%	2.34%
2022	2.89%	2.60%	2.43%
2023	3.01%	2.71%	2.53%
2024	3.13%	2.83%	2.64%
2025	3.25%	2.95%	2.75%
2026	3.38%	3.05%	2.85%
2027	3.48%	3.15%	2.94%
2028	3.60%	3.26%	3.04%
2029	3.76%	3.39%	3.16%
2030	3.90%	3.51%	3.27%
2031	4.05%	3.64%	3.39%
2032	4.15%	3.73%	3.47%
2033	4.26%	3.82%	3.55%
2034	4.38%	3.92%	3.65%
2035	4.54%	4.06%	3.78%
2036	4.68%	4.19%	3.90%
2037	4.70%	4.21%	3.93%
2038	4.73%	4.25%	3.95%
2039	4.77%	4.28%	3.99%
2040	4.89%	4.40%	4.10%
2041	5.04%	4.54%	4.23%
2042	5.08%	4.55%	4.25%
2043	5.08%	4.55%	4.24%
2044	5.08%	4.55%	4.24%
2045	5.09%	4.56%	4.26%
2046	5.22%	4.68%	4.36%
2047	5.39%	4.83%	4.52%
2048	5.40%	4.85%	4.55%
2049	5.40%	4.85%	4.55%
2050	5.38%	4.84%	4.55%
2051	5.43%	4.89%	4.59%
2052	5.49%	4.95%	4.66%
2053	5.57%	5.03%	4.73%
2054	5.66%	5.12%	4.82%
2055	5.78%	5.23%	4.92%
2056	5.97%	5.41%	5.09%
2057	6.11%	5.54%	5.21%
2058	6.28%	5.70%	5.35%
2059	6.44%	5.84%	5.48%
2060	6.57%	5.96%	5.60%

Figure 14 Simulation 2: The Impact of an Expansion of the Contribution Basis on Welfare



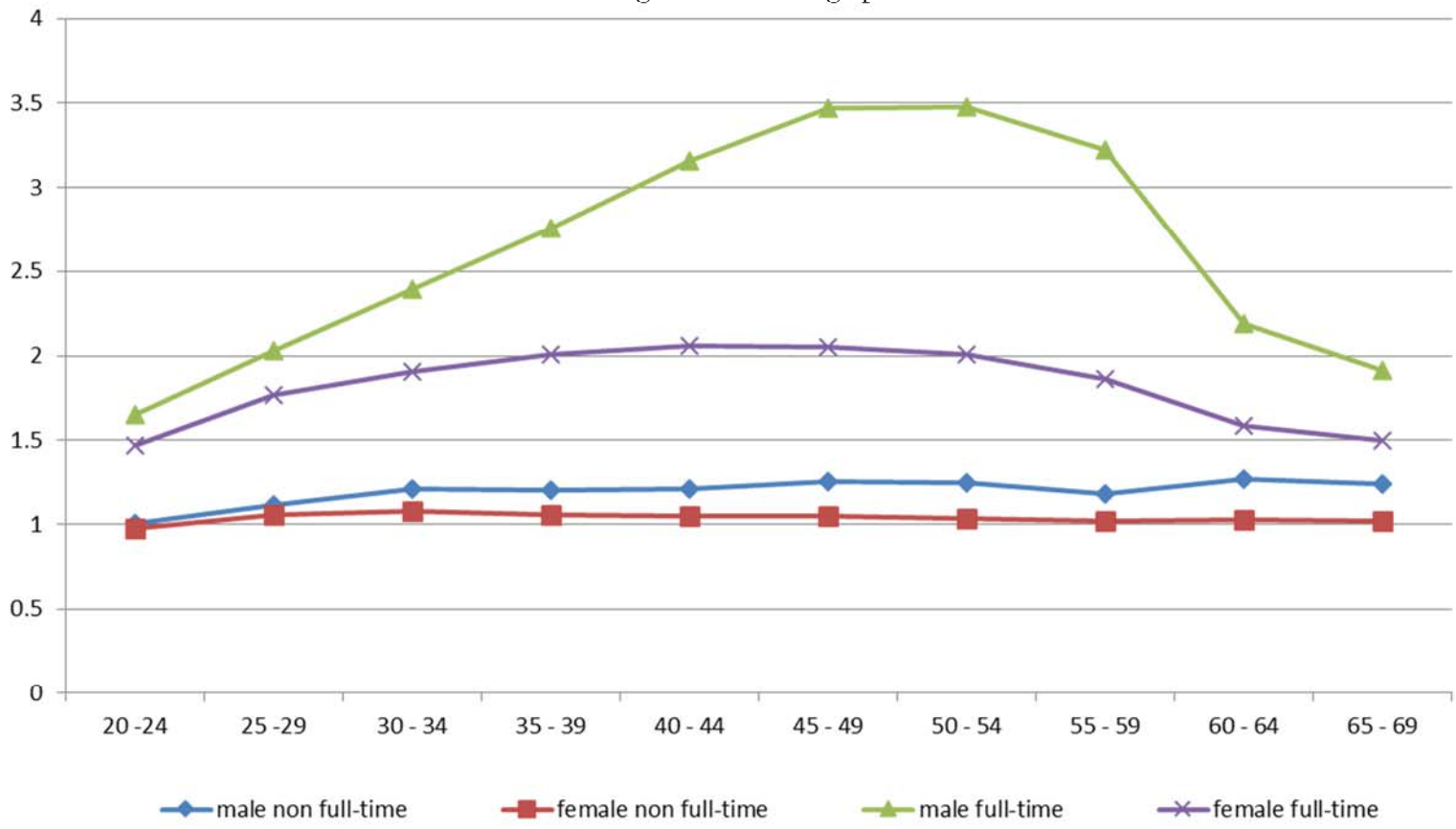
The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 15 Simulation 1 and 2: The Impact on Welfare



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 16: The wage profiles



The above figures are normalized by the wage of male non full-time workers of age 20 – 24 in year 2010. The wage of male non full-time workers of age 20 – 24 is 1.
Obtained from Kato and Kawade (2015)

Figure 17A Simulation 3: The Impact of additional labor supply by ***female non-full-time*** workers on K/L when the time cost of elderly care is eliminated

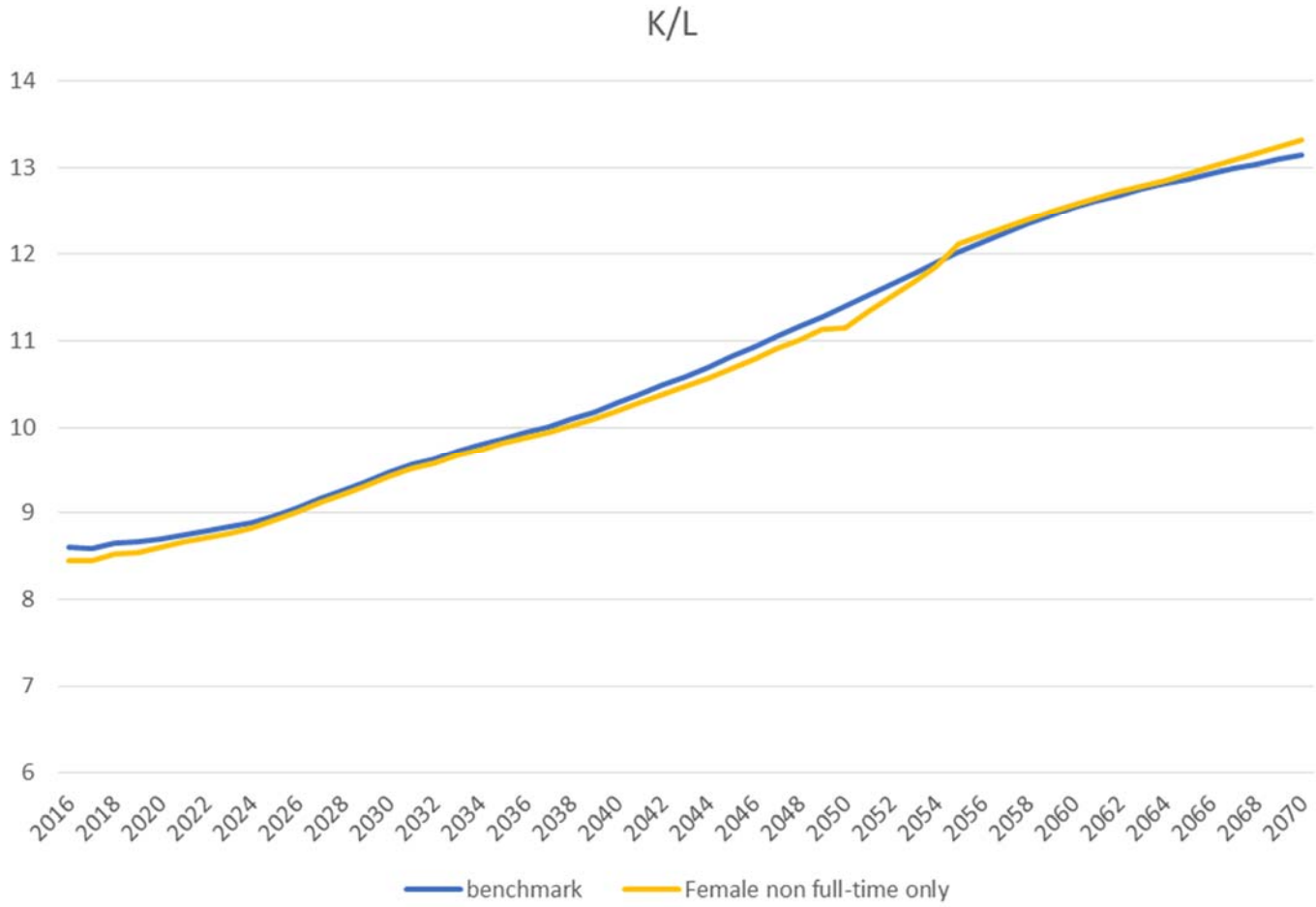
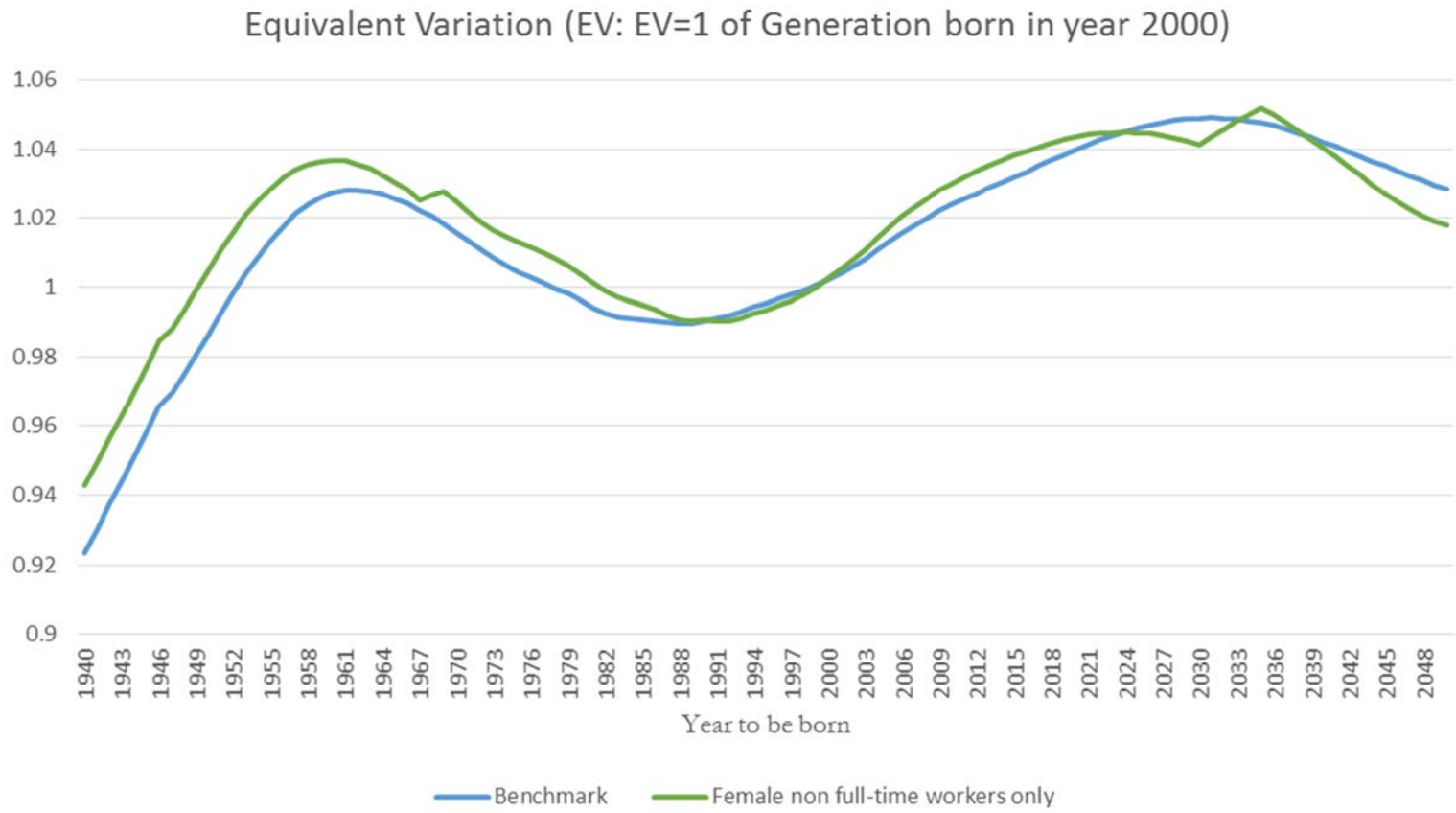


Figure 18A Simulation 3: The Impact of additional labor supply by ***female non-full-time*** workers on Welfare when the time cost of elderly care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 17B Simulation 3: The Impact of additional labor supply by ***male full-time*** workers on K/L when the time cost of elderly care is eliminated

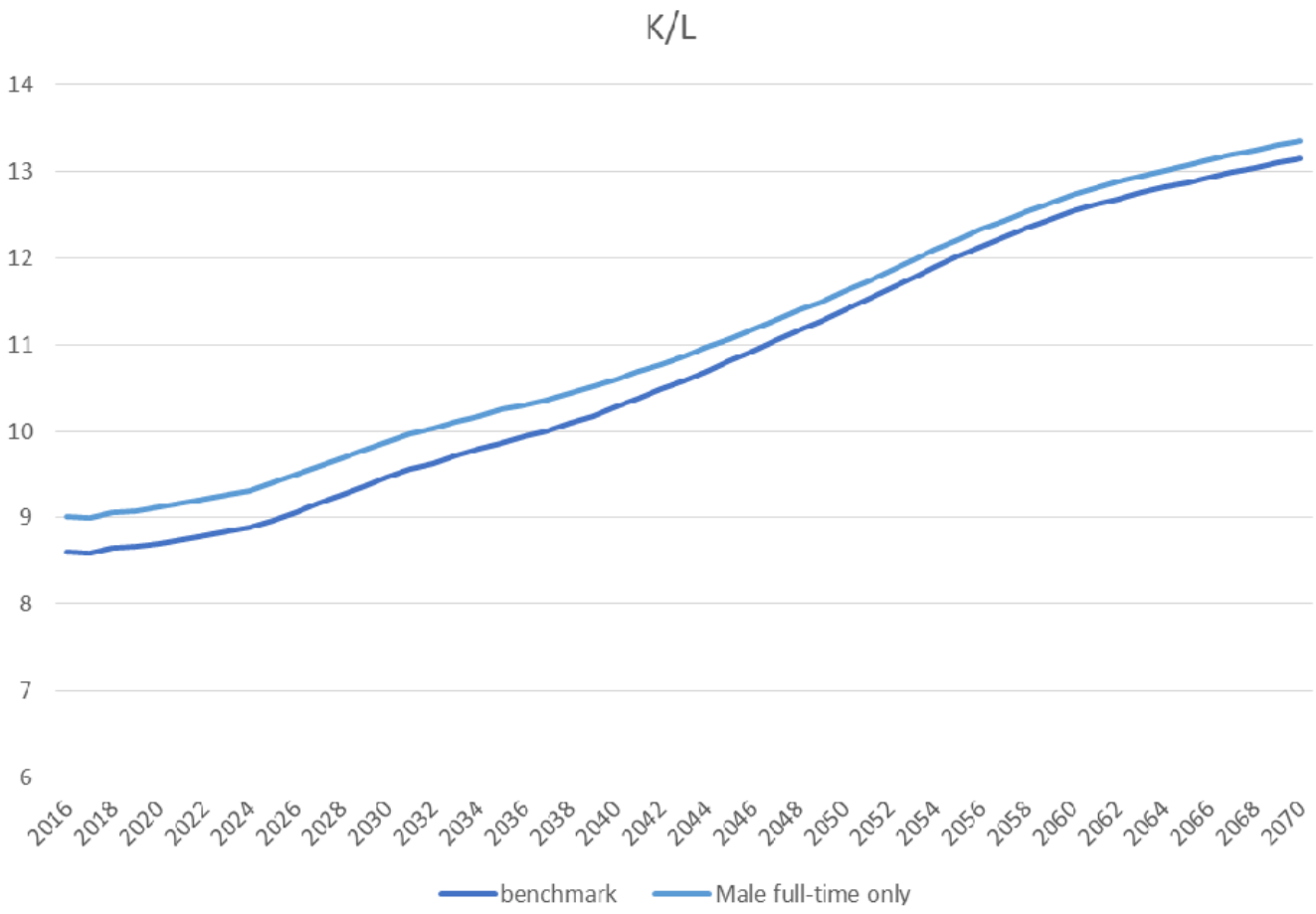
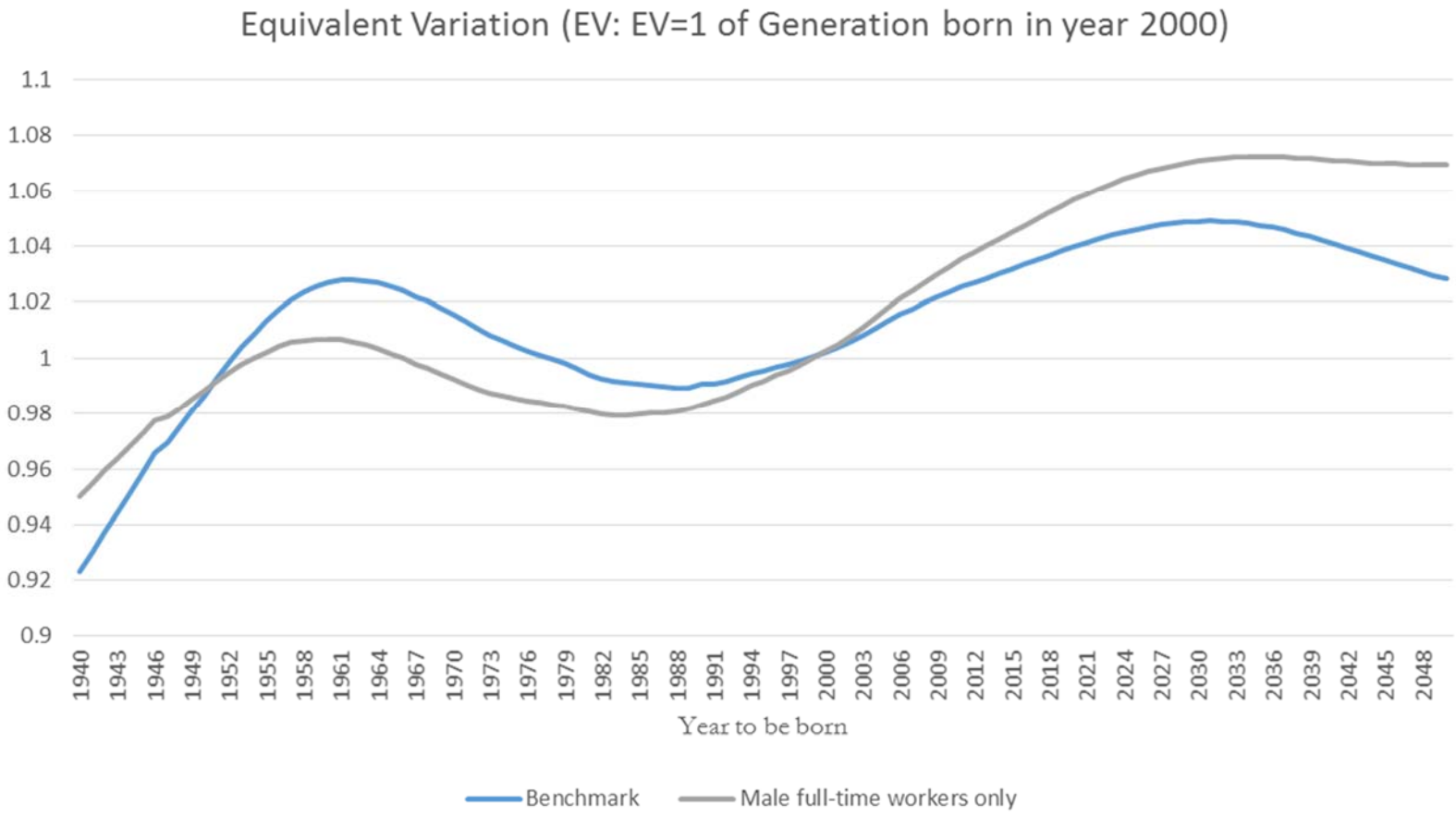


Figure 18B Simulation 3: The Impact of additional labor supply by ***male full-time*** workers on Welfare when the time cost of elderly care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 17C Simulation 3: The Impact of additional labor supply by ***female full-time*** workers on K/L when the time cost of elderly care is eliminated

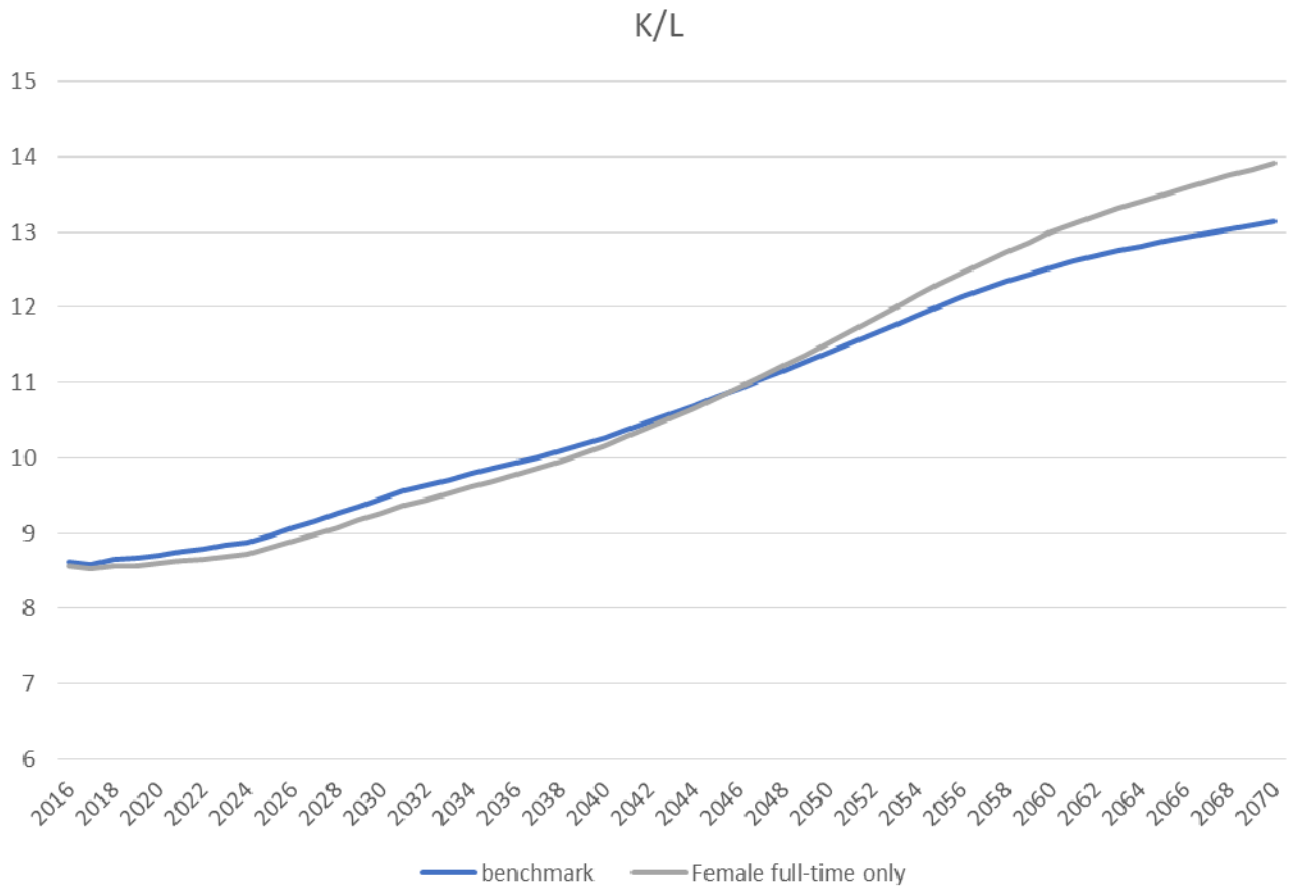
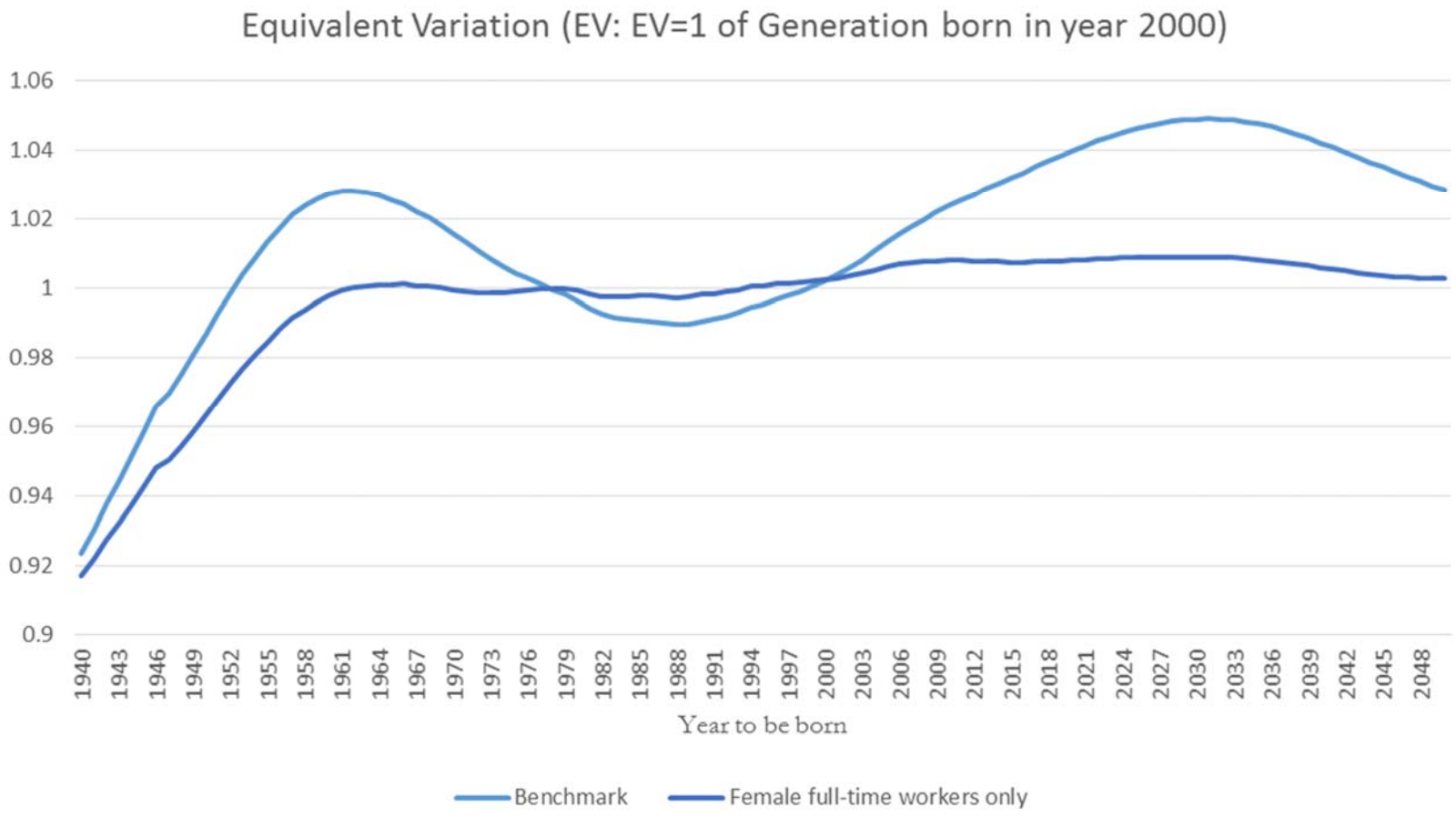


Figure 18C Simulation 3: The Impact of additional labor supply by ***female full-time*** workers on Welfare when the time cost of elderly care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 17D Simulation 3: The Impact of additional labor supply by ***All*** workers on K/L when the time cost of elderly care is eliminated

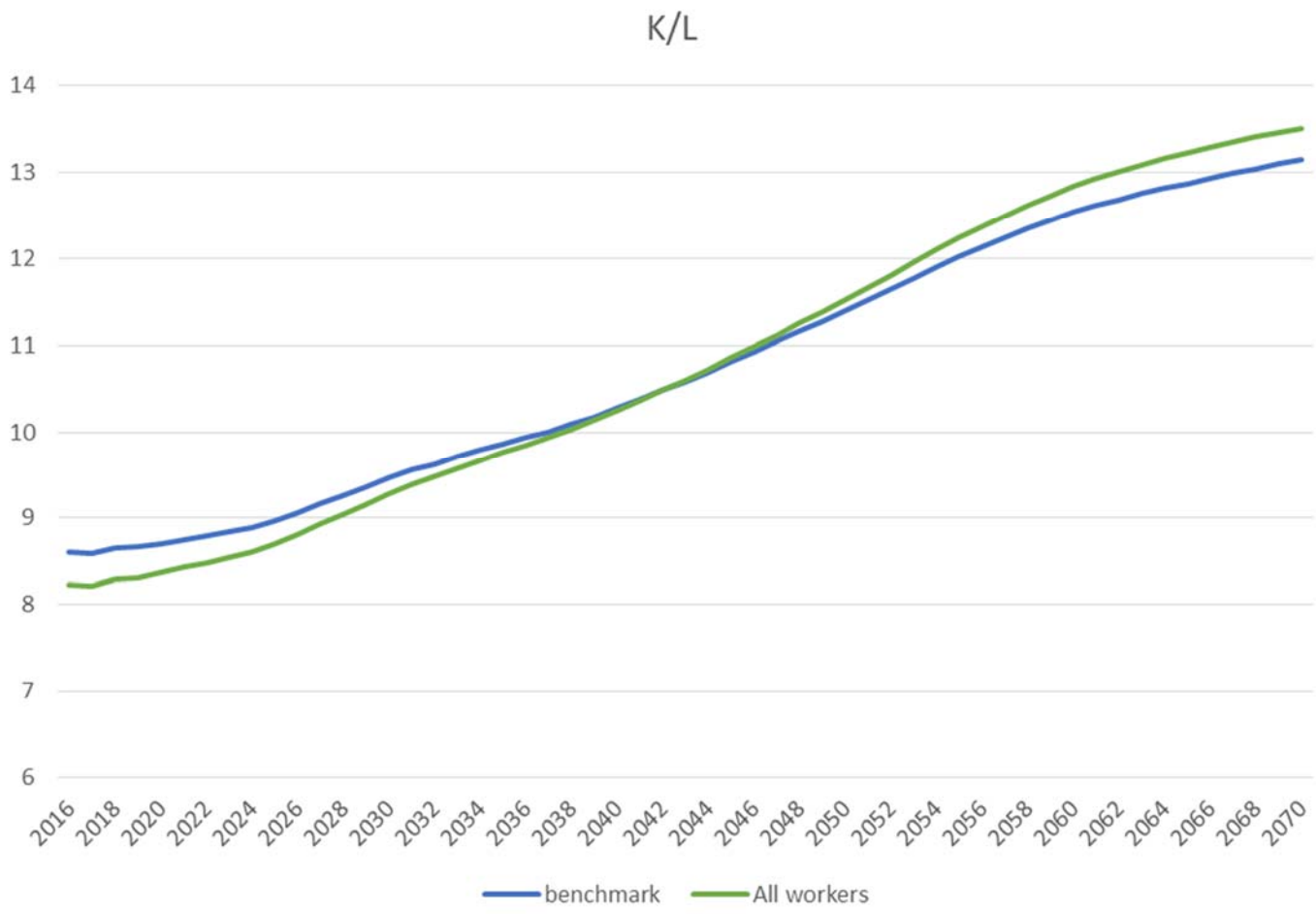
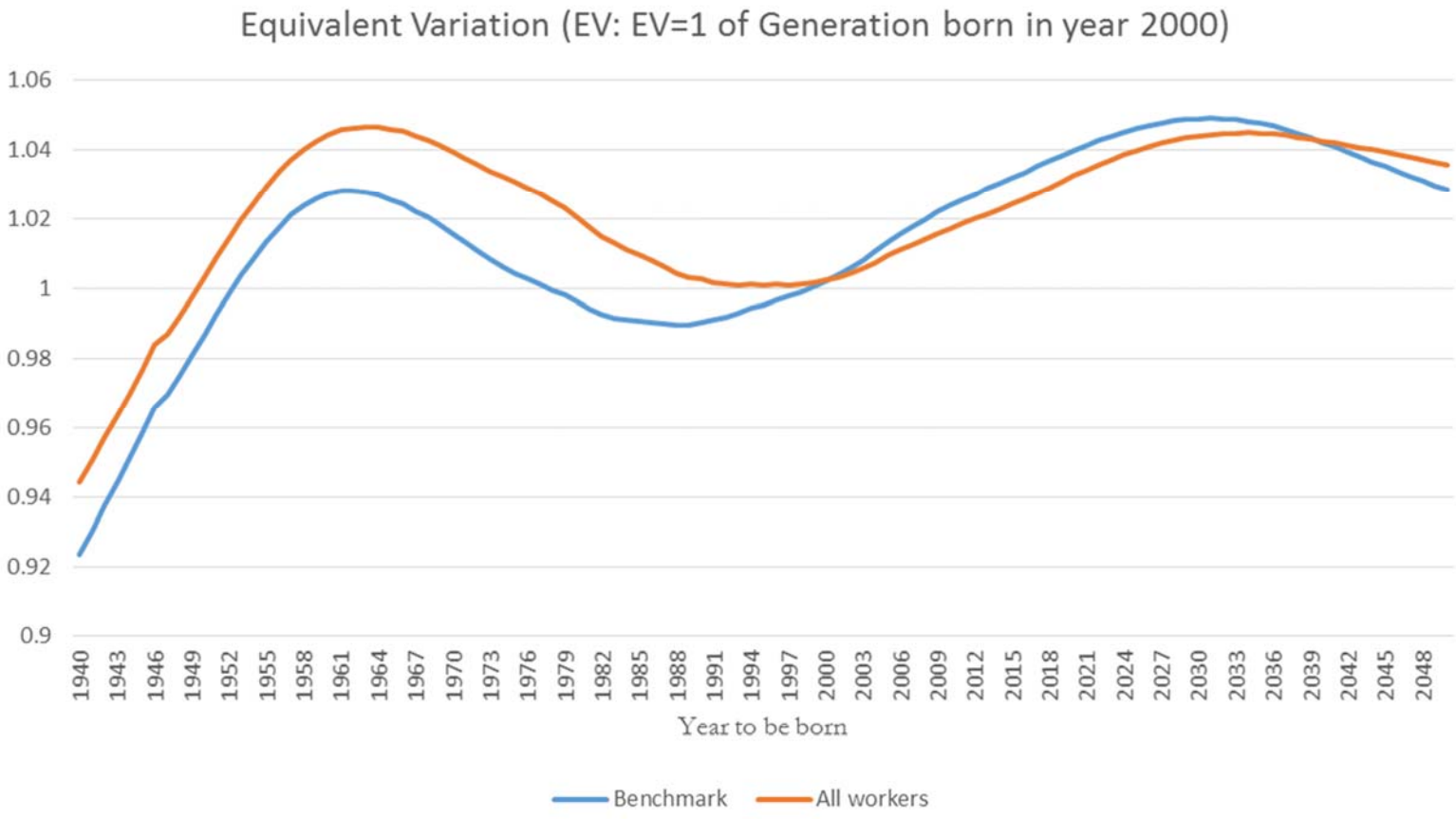
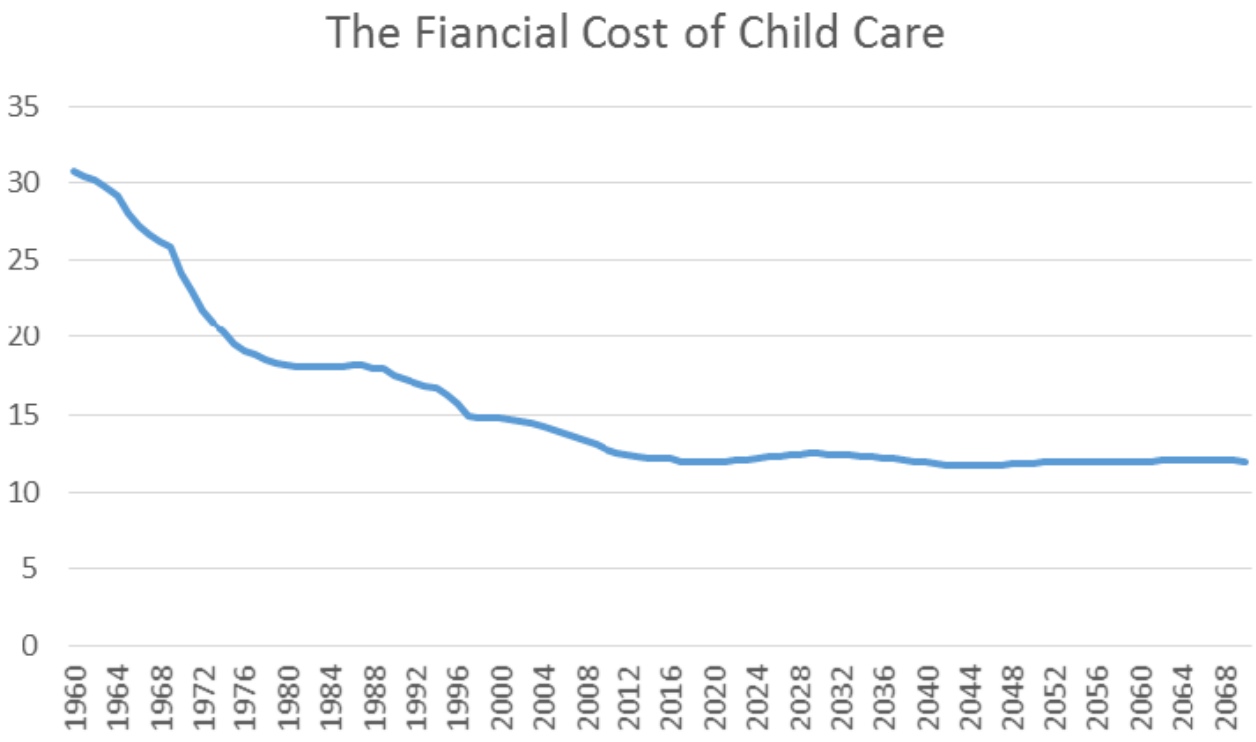


Figure 18D Simulation 3: The Impact of additional labor supply by ***All*** workers on Welfare when the time cost of elderly care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 19: The financial cost of child care



The financial cost of child care is normalized based on the annual income of male non full-time worker in age 20 – 24 in year 2010

Figure 20 Simulation 4: The Impact of an increase in the child care benefits on K/L

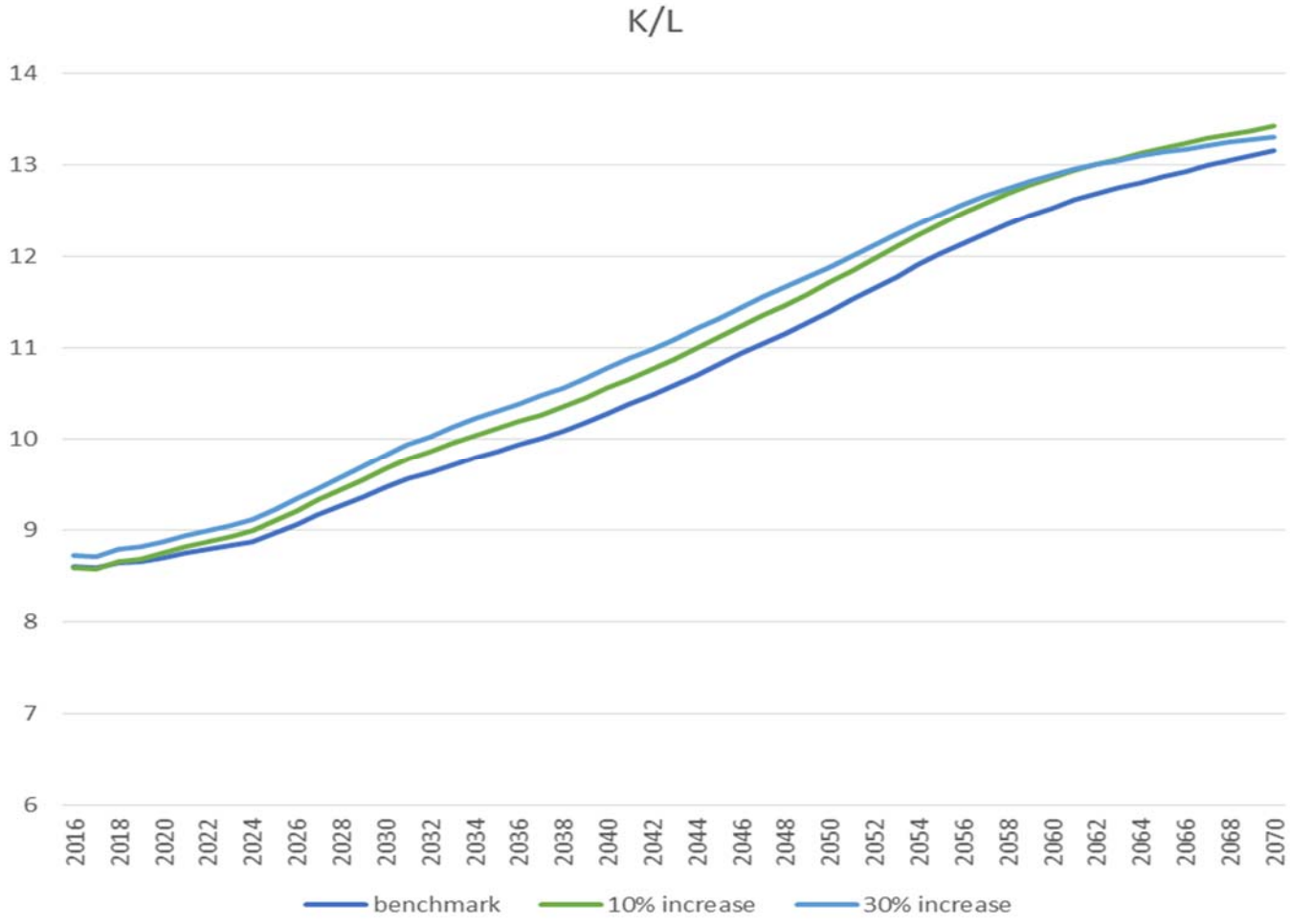
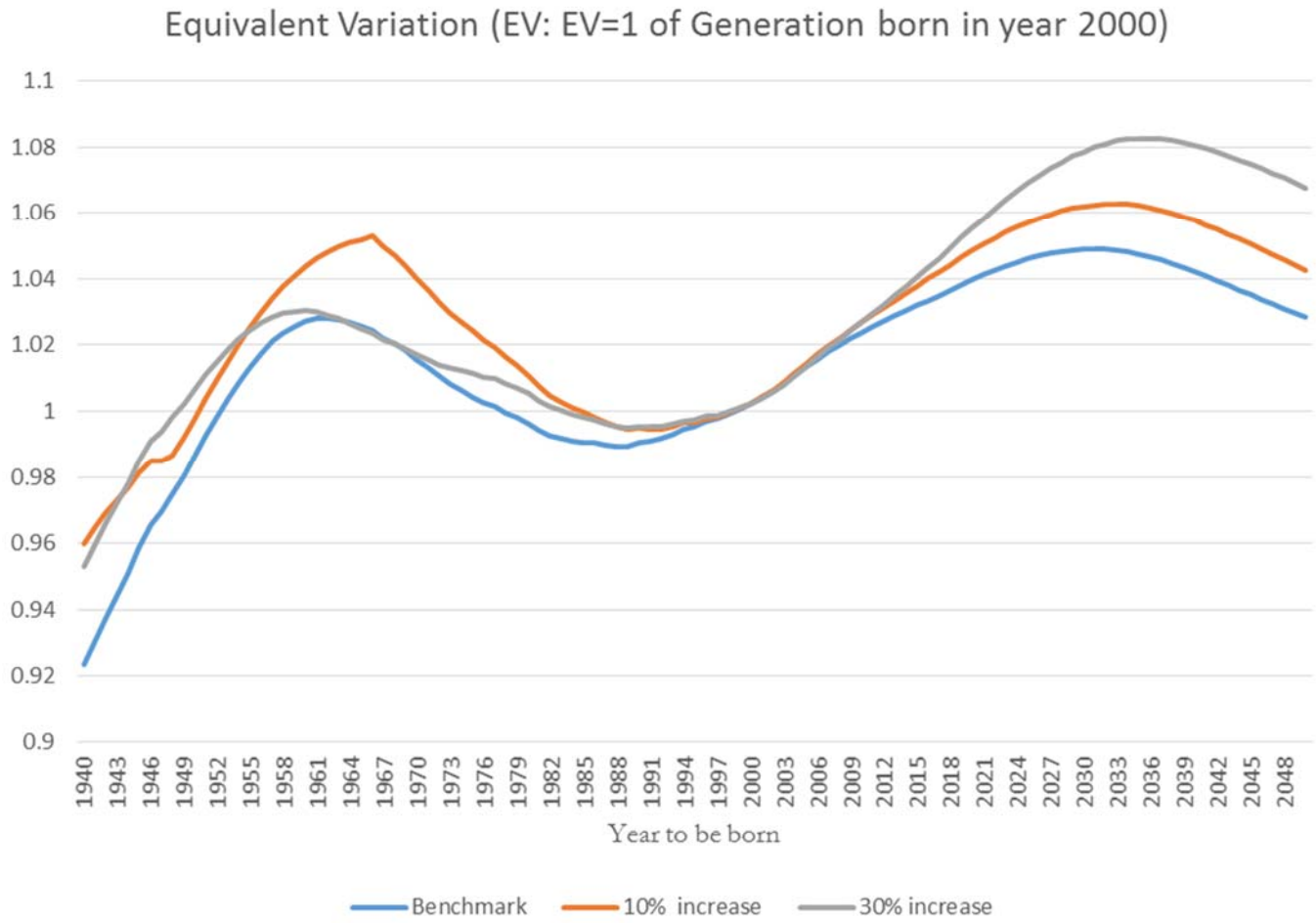


Figure 21 Simulation 4: The Impact of an increase in the child care benefits on welfare



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 22A Simulation 5: The Impact of additional labor supply by ***female non-full-time*** workers on K/L when the time cost of child care is eliminated

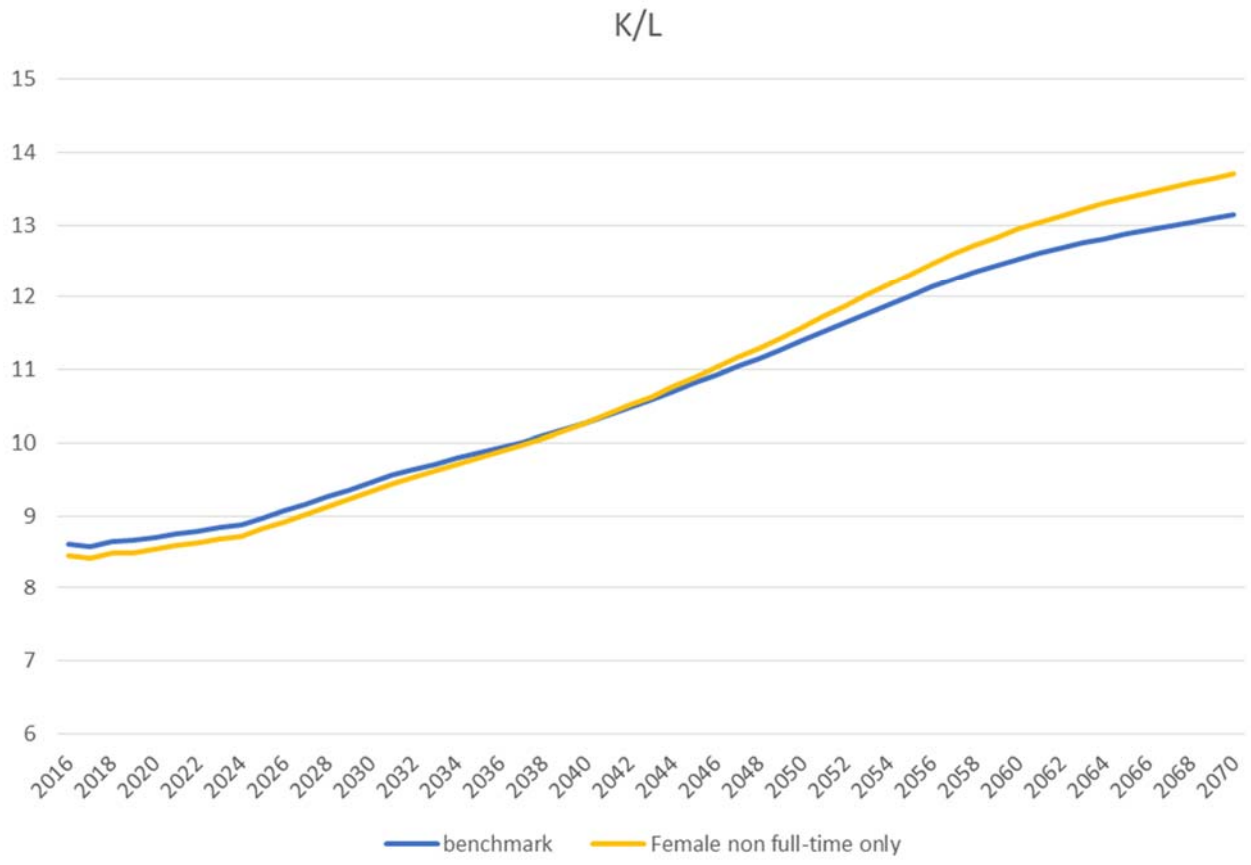
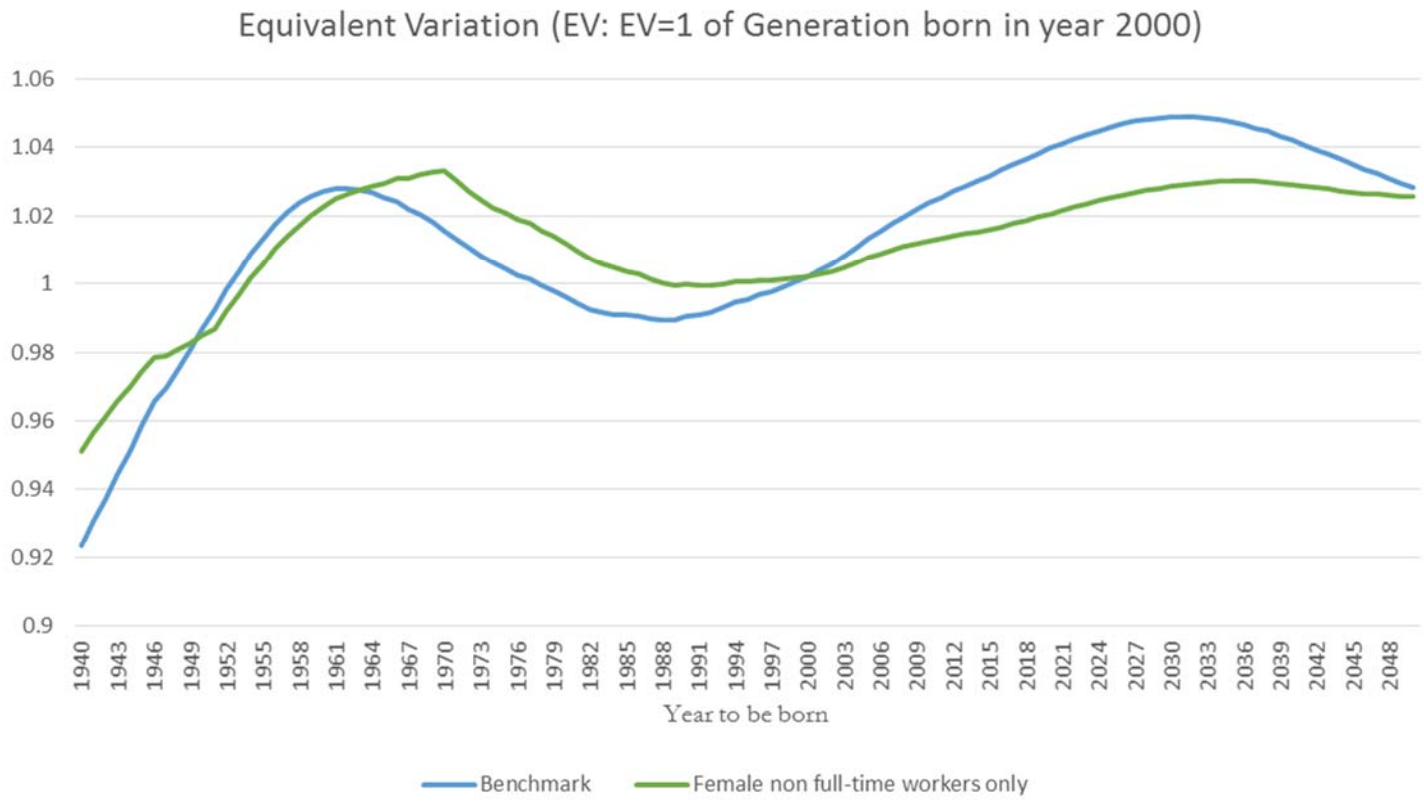


Figure 23A Simulation 5: The Impact of additional labor supply by ***female non-full-time*** workers on welfare
When the time cost of child care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 22B Simulation 5: The Impact of additional labor supply by ***female full-time*** workers on K/L when the time cost of child care is eliminated

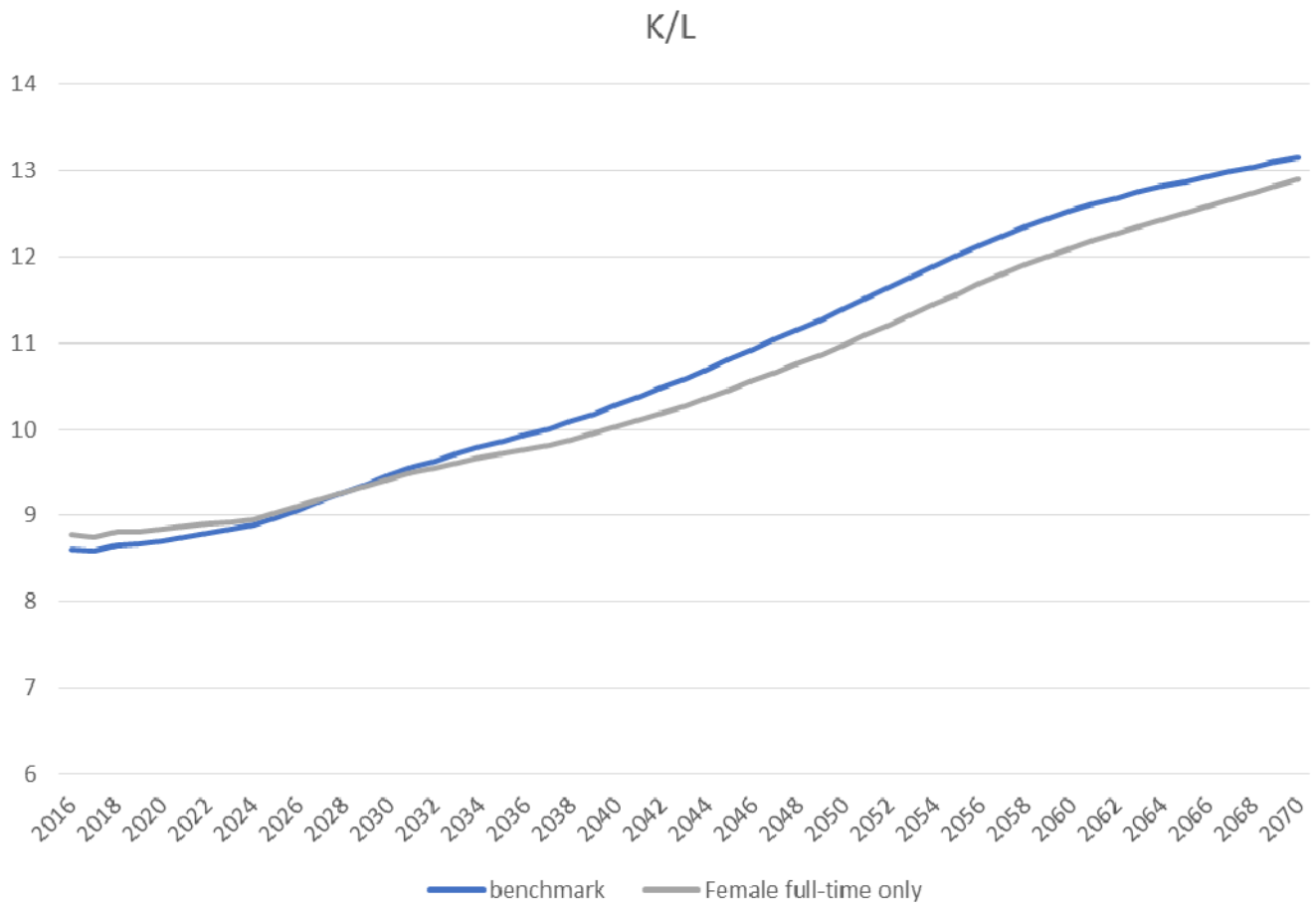
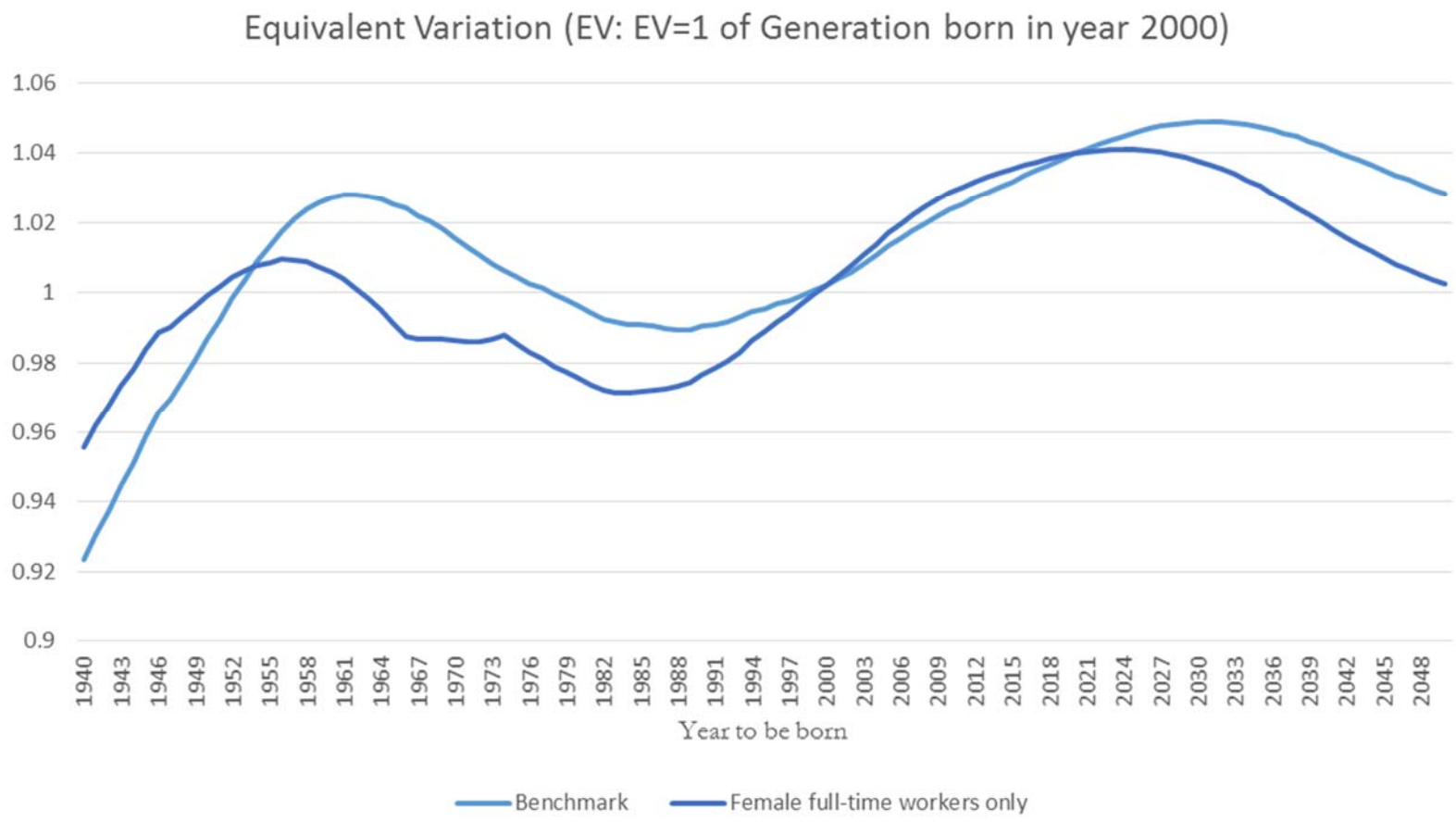


Figure 23B Simulation 5: The Impact of additional labor supply by ***female full-time*** workers on welfare
When the time cost of child care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 22C Simulation 5: The Impact of additional labor supply by ***male full-time*** workers on K/L when the time cost of child care is eliminated

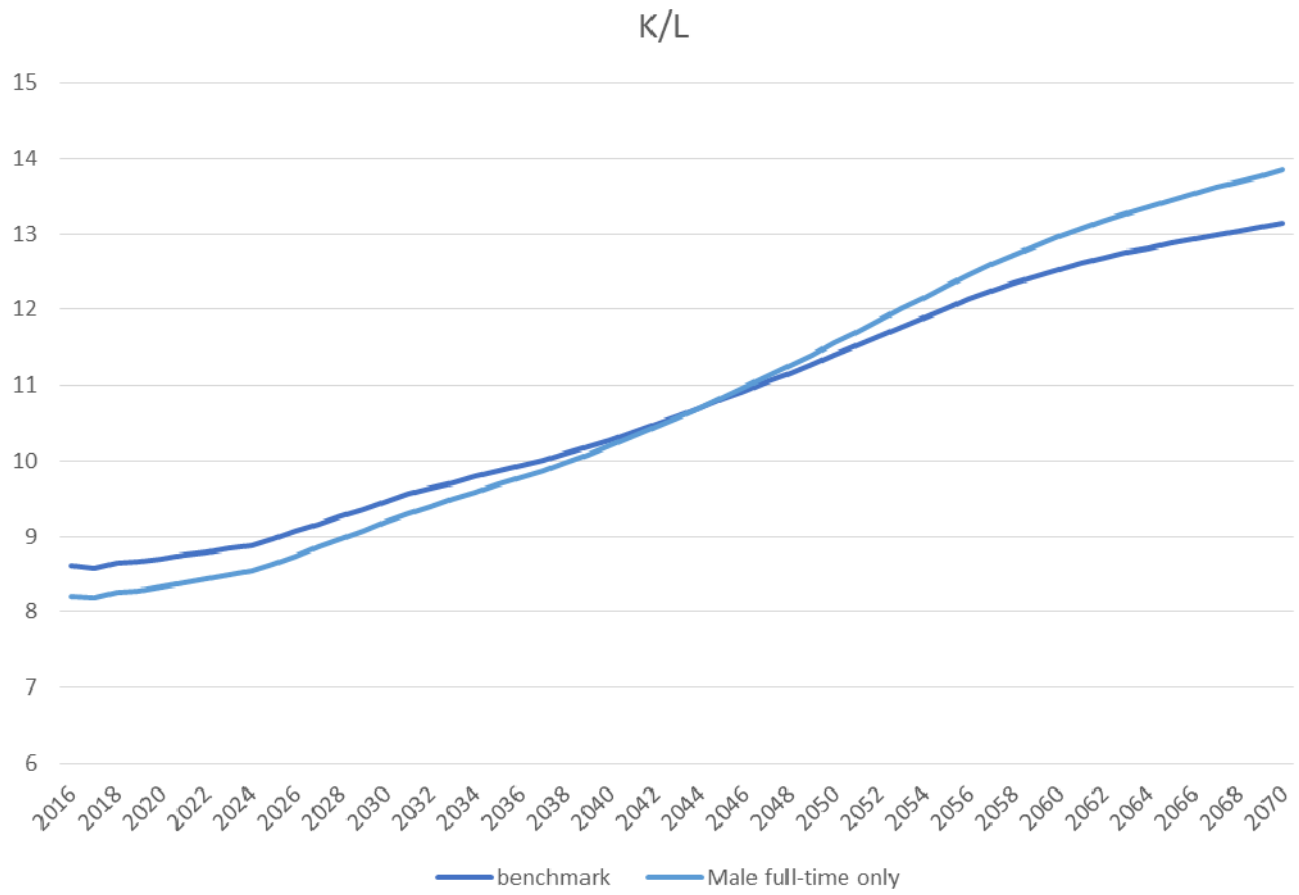
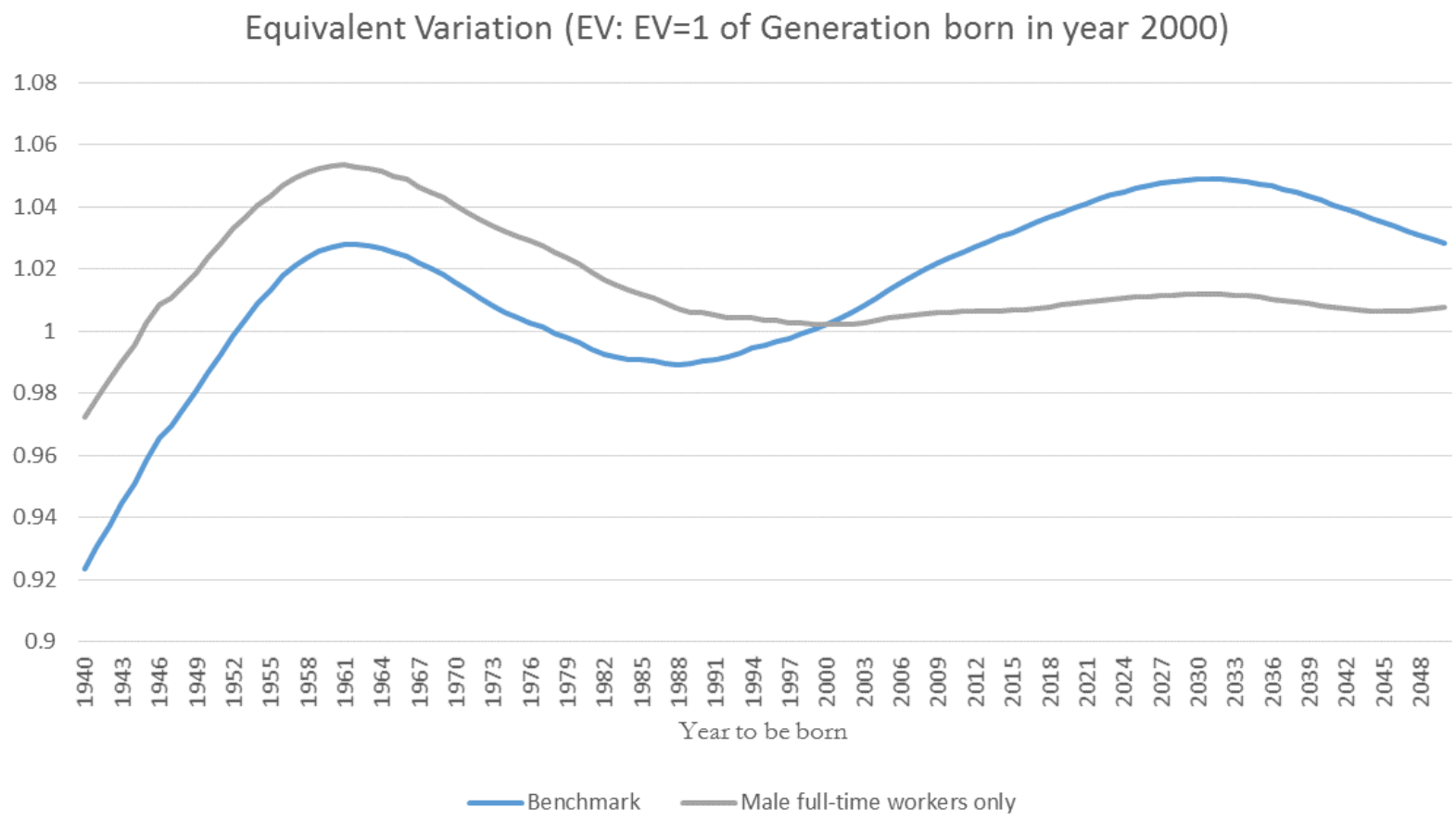


Figure 23C Simulation 5: The Impact of additional labor supply by ***male full-time*** workers on welfare
When the time cost of child care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.

Figure 22D Simulation 5: The Impact of additional labor supply by ***All*** workers on K/L when the time cost of child care is eliminated

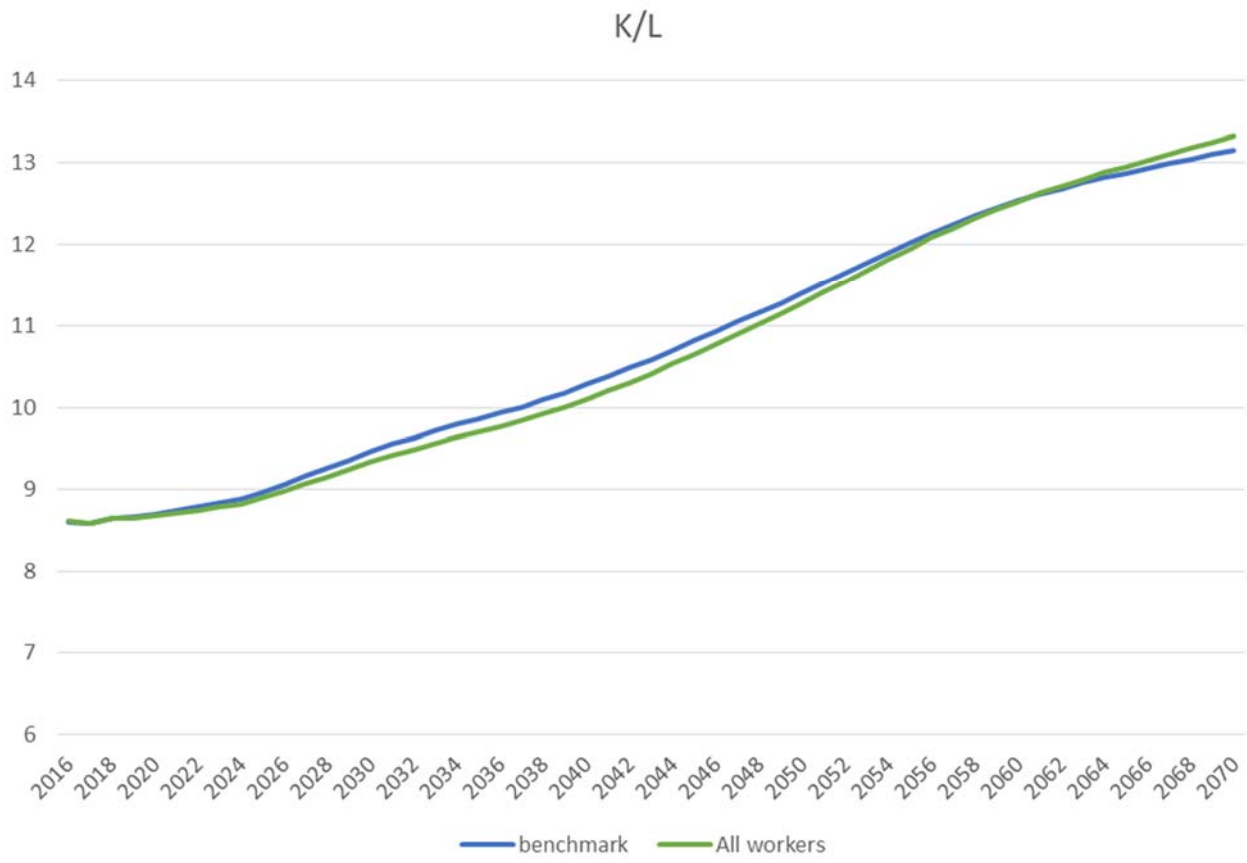
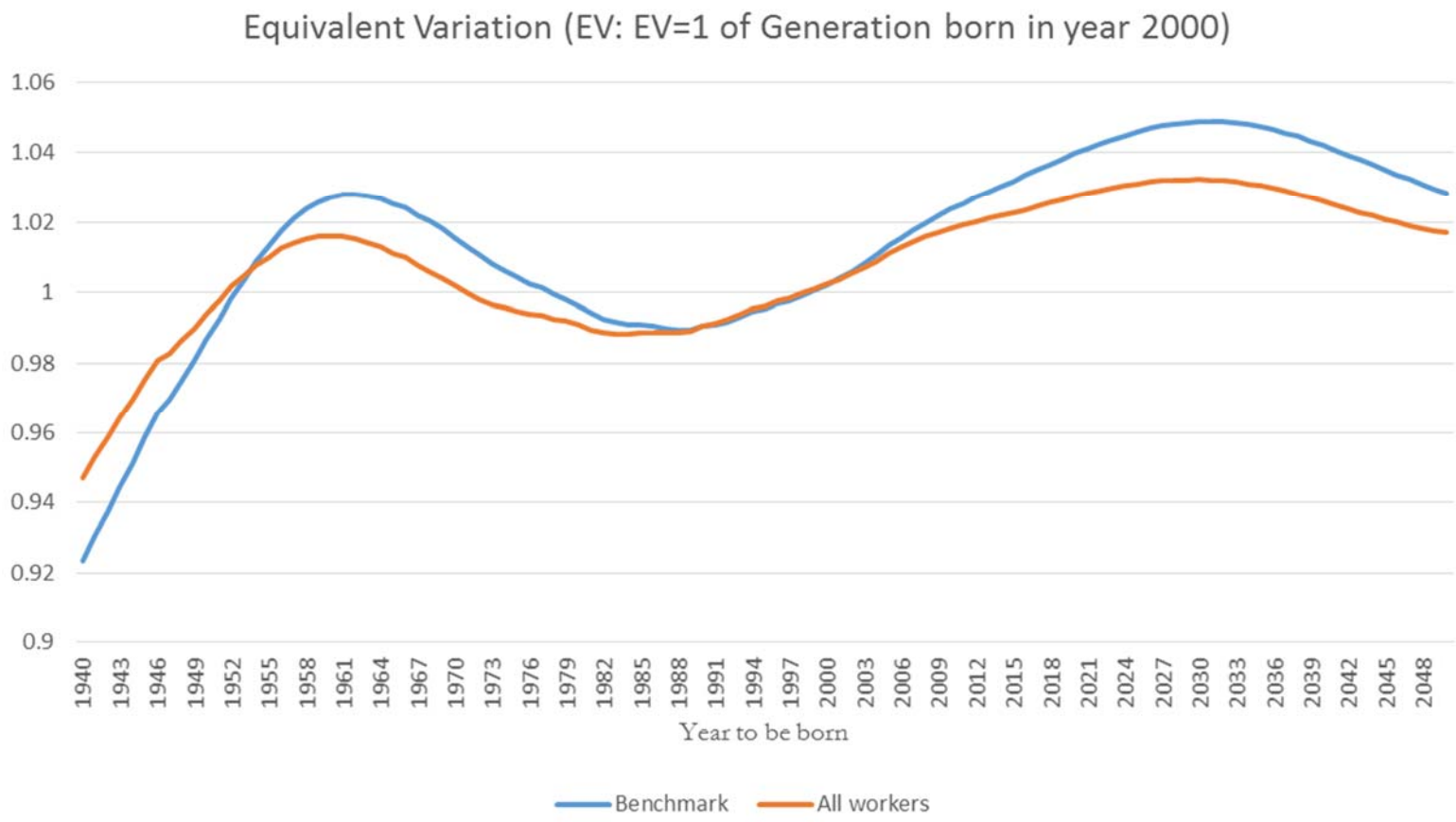


Figure 23D Simulation 5: The Impact of additional labor supply by ***All*** workers on welfare
When the time cost of child care is eliminated



The equivalent variation of all generations is normalized by that of the generation born in year 2000.