Population Aging, Fiscal Policies, and National Saving: Prediction for Korean Economy

Young Jun Chun

Department of Economics
University of Incheon
Dowha-Dong 177, Nam-Ku
Incheon, 402-749, Korea
e-mail: yjchun@incheon.ac.kr

June 2005

JEL classification: H3, H60, E21

Keywords: population aging, generational accounts, national savings

Abstract

This paper evaluates the effects of population aging and fiscal policies on national saving in Korean situation. For the prediction of the national savings rate of Korea for the next several decades, we employ a life-cycle model, which incorporates the generational accounting approach needed to assess the distribution of fiscal burden across generations. We found that the rapid population aging and long-term budgetary imbalance will substantially lower the national savings rate in Korea. In addition, the estimation results of consumption functions with respect to various kinds of wealth suggest that the annuitization of wealth due to maturing of public pensions and introduction of reverse annuity mortgage is likely to further decrease the savings rate in the future.

1. Introduction

While the current proportion of old-age population of Korea is lower than other OECD countries, the speed of population aging is very high. Even though the proportion of the population aged 65 and older was 7.2% as of 2000, much lower than the developed countries, the proportion is projected to increase to 23.1% in 2030, almost the same as the projected average. More old-age dependents relative to workers resulting from population aging suggest the likelihood of more consumption than relative to income and, therefore, less national saving. Increase in the old-age dependency ratio substantially affects the fiscal policies. The government expenditure such as public pension benefits and medical insurance benefits will increase rapidly as the population is aging. Public assistance program for the low-income classes is also expected to increase since the poverty rate for old-age population is higher than that of working ages in Korea. On the other hand, the decrease in working population will restrict the tax base of future. As a result, the population aging will increase the fiscal burden of future generations, therefore, decrease resource available for them, which suggests less saving in the future.

The long-term budgetary imbalance in Korea will also contribute to the future savings reduction through the increase in fiscal burden of future generations. Even though the consolidated budget balance at present maintains surplus, the budget balance will turn deficit in the near future and the magnitude of the deficit will rapidly rise in the future if Korean government maintains the current fiscal policies. In particular, long-term budgetary imbalance of public pensions due to too generous promised level of pension benefits compared with pension contributions, and prospective increase in Medical Insurance benefits, and the resistance to increase in social insurance contributions, will deteriorate the long-term budgetary imbalance. Therefore, the current fiscal stance of Korean government will shift the fiscal burden to the future generations, which will lower the national savings rate in the future.

The purpose of this paper is to evaluate the effects of population aging and fiscal policies on national savings in Korean situation. For the prediction of the national savings rate of Korea for the next several decades, we employ a life-cycle model, which incorporates the generational accounting approach needed to assess the distribution of fiscal burden across generations. Even though our main focus is on the effects of population aging and fiscal stance, we also study the effects of change in asset composition, such as annuitization of asset resulting from maturing of public pensions and introduction of reverse annuity mortgages through the estimation of consumption functions, which enables comparison of elasticity of consumption with respect to various kinds of wealth. We found that the rapid population aging and long-term budgetary imbalance will substantially lower the national savings rate in Korea. In addition, the estimation results of consumption functions with respect to various kinds of wealth suggest that the annuitization of wealth due to maturing of public pensions and introduction of reverse annuity mortgage is likely to further decrease the savings rate in the future.

The remainder of this paper is organized as follows. Section 2 briefly describes the demographic transition for the next several decades, based on our population projection. Section 3 explains our basic framework for the prediction of savings rate of the future, a life-cycle model in which the agents' consumption and savings is determined by the propensity to consume and the magnitude of resource available for the remaining lifetime, including human wealth, current asset holdings, and the value of net transfer income from the government. Section 4 explains the data source used to estimate the propensity to consume, which is used in the projection of consumption and savings, the method of imputation of human wealth and net transfer income from government. Section 5 presents our findings, and Section 6 summarizes and concludes the paper.

2. Demographic Transition in Korea

Figures 1-3 summarize the population projection based on the 2001 population projection model of National Statistics Office (NSO) of Korea. The 2001 NSO projection covers the period 2001-2050. We extend the population projection up to 2110 using the NSO's assumptions about fertility rates[1], mortality rates[2], and international mobility rates[3]. Baseline calculations are conducted under the assumption that the total fertility rate and age-sex mortality rates will remain constant at their 2050 levels until 2110.

The figures indicate that Korea will experience drastic change in demographic structure as well as total population. The total population is projected to reach maximum level around 2025 and then decrease rapidly. The proportion of the aged 65 and older will increase from 9% (as of 2005) up to 38% and that of the economically active population, aged 15-64, will decrease from 71% to 53%, which implies that while the current proportion of old-age population is smaller than other OECD countries (see Table 2), the speed of population aging

[1] We made 3 alternative fertility rate assumptions, high, medium, and low fertility rate assumption. Our base case result is based on the medium fertility assumption (see Table 3).

[2] The average life expectancy is projected to rise from currently 76 years to 83 years in 2050.

[3] International movement of population is limited in Korea. For example, net immigration in 2000 was 11 thousand (emigration 43 thousand, immigration 54 thousand). We assume that the international movement rates remain constant at their 2050 levels until 2110.

is very high, because of a low fertility rate and prolonged life expectancy. In particular, the fertility rate of Korea is much lower than many other OECD countries[4]. Moreover, National Statistics Office of Korea projects that the total fertility rate will decrease from 1.47 (2000) to 1.40 (2040), which will accelerate the process of population aging[5].

United Nations (1998) projection also shows that the proportion of the population aged 65 and older will increase from 7.2% (as of 2000), much lower than the average of developed countries (14.4%), to 23.1% (2030), almost the same as the projected average (22.6%). The time required for the old-age population proportion to increase from 7% (14%) to 14% (20%) is 19 years (7 years), which is much shorter than in other developed countries (France (115 years (41 years)), U.S. (71 years (15 years)), Japan (24 years (12 years))). Thus, Korea will age much faster than any other OECD countries.

3. Basic Framework

We adopt a life-cycle framework for the prediction of savings rates of the next several decades. The economy is populated with a large number of individuals who belongs to different cohorts indexed by the year of their birth. The individuals do not face mortality risks and live for D years. We assume that each agent in the economy makes decision on consumption flow and the magnitude of bequest to maximize the lifetime expected utility. The objective function and budget constraint of the agent aged a at period t are as follows:

$$(1)\qquad U_{a,t} = \sum_{i=a}^{D} \beta^{i-a} u(C_{i,t+i-a}, i) + \beta^{D+1-a} v(b_{D+1,t+D+1-a})$$

$$(2)\qquad \begin{aligned} &\sum_{i=a}^{D}\left(\prod_{s=t}^{t+i-a}\frac{1}{1+r_s}\right)C_{i,t+i-a} + \left(\prod_{s=t}^{t+D+1-a}\frac{1}{1+r_s}\right)b_{D+1,t+D+1-a} \le A_{a,t} + \sum_{i=a}^{D}\left(\prod_{s=t}^{t+i-a}\frac{1}{1+r_s}\right)\left(W_{a,t+i-a} + B_{a,t+i-a} - T_{a,t+i-a}\right) \\ &\equiv A_{a,t} + \sum_{i=a}^{D}\left(\prod_{s=t}^{t+i-a}\frac{1}{1+r_s}\right)W_{i,t+i-a} + \sum_{i=a}^{D}\left(\prod_{s=t}^{t+i-a}\frac{1}{1+r_s}\right)\left(B_{a,t+i-a} - T_{a,t+i-a}\right) \equiv A_{a,t} + HW_{a,t} + NB_{a,t} \end{aligned}$$

where $C, b, u(\cdot), v(\cdot)$ represent consumption and magnitude of bequest, differentiable strictly concave utility functions of consumption[6] and bequest, respectively. And, β, A, W, B, T are

[4] The fertility rate of Korea as of 2000 was 1.47. The rates for other OECD countries are 1.36 (Germany), 1.88 (France), 1.41 (Japan), 2.06 (U.S.), 1.64 (U.K.).

[5] The fertility rate has fallen up to 1.13 (as of 2003), lower than its assumed level in 2030 under the base case assumption. However, we do not reflect this drastic change in fertility in recent years, since the change might be temporary change resulting from economic crisis since 1997 triggered by foreign currency deficiency, which is followed by economic recession.

[6] We define the utility as function of age as well as consumption amount to reflect the difference in preference across ages.

discount rate, current asset holdings, non-capital income, transfer payment from the government, and tax payment to the government.

The lifetime budget constraint implies that the present value of consumption and bequest is not more than the total wealth available for the remaining lifetime, which is composed of asset holdings at present ($A_{a,t}$), human wealth, which is the present value of non-capital income earned for the remaining lifetime ($HW_{a,t}$), and the net government transfer wealth, which is defined as the present value of transfer income from the government minus tax payment ($NB_{a,t}$).

The optimization of the agent aged a at period t yields the following path of consumption and bequest.

(3) $$\frac{C_{i+1,t+i+1-a}}{C_{i,t+i-a}} = f^{-1}\left(\beta\left(1+r_{t+i+1-a}\right), i\right) = \varsigma_{i,t+i-a}, \quad f\left(\frac{c'}{c}, i\right) = \frac{u_{c'}(c', i+1)}{u_c(c,i)}, \quad i = a,\Lambda\ , D-1.$$

(4) $$\frac{b_{D+1,t+D+1-a}}{C_{D,t+D-a}} = g^{-1}\left(\beta\left(1+r_{t+D+1-a}\right), D\right) = \varsigma_{D,t+D-a}, \qquad g\left(\frac{b}{c}, i\right) = \frac{v'(b)}{u_c(c,i)}$$

Using equation (3) and (4) together with lifetime budget constraint, we solve for the consumption of the aged a.

(5) $$C_{a,t} = \left[\sum_{i=a}^{D+1}\left(\prod_{s=a}^{i}\varsigma_{i,t+i-a}\right)\right]^{-1}\left(A_{a,t} + HW_{a,t} + NB_{a,t}\right) = PC_{a,t}\left(A_{a,t} + HW_{a,t} + NB_{a,t}\right)$$

The equation (5) shows that an individual's consumption at the age of a is the product of total asset available for the remaining lifetime and this age's average propensity to consumption out of the total asset ($PC_{a,t}$). The equation (5) is our basic framework to project the consumption rate for the next several decades.

We follow several steps for the projection. We first estimate the average propensity to consume, by age and sex, out of total asset using micro data set. Then we project the magnitude of total assets by age and sex, including current asset holdings, human wealth, and the net government transfer wealth, for the next several decades. Finally, we compute the consumption amount by age and sex for each year and savings rate.

The national savings are composed of the private saving and the government savings. The private savings are the difference of the total income, the sum of wage income, capital income and net transfer from government, and consumption (see equation (6)). The current asset holdings evolve following the equation (7).

(6) $$S_{a,t} = W_{a,t} + r_t A_{a,t} + B_{a,t} - T_{a,t} - C_{a,t}$$

(7) $$A_{a+1,t+1} = A_{a,t} + S_{a,t}$$

The government saving is defined as the budget surplus of the government: i.e. tax revenue-transfer payment-government consumption (GC_t) (see equation (8)), and the national income (Y_t) is the sum of labor income and capital income (see equation (9)).

(8) $$GS_t = \sum_{a=0}^{D} (T_{a,t} - B_{a,t})\mu_{a,t} - GC_t$$

(9) $$Y_t = \sum_{a=0}^{D} \left(W_{a,t} + r_t A_{a,t}\right)\mu_{a,t}$$

where $\mu_{a,t}$ is the population of the aged a at period t .

4. Data and Imputations

To predict future savings rates, we need to estimate the average propensity to consume, and predict the magnitude of human wealth, and the net government transfer wealth by age for the future, in addition to each year's Gross National Product (GNP), government consumption, and private consumption which we discuss in section 3. In this section we discuss the procedures of estimating the average propensity to consume, and projection of the magnitude of human wealth, and the net government transfer wealth for the future period.

4. 1. Estimating the average propensity to consume

We use Korea Labor and Income Panel Study (KLIPS)[7] to estimate the average propensity to consume. KLIPS consists of household survey and individual survey. The household survey contains information about the income, consumption, and asset holdings, including real estate and financial asset, of households. The individual survey contains information about the current employment status, current level of wage and income of the self-employed, job experience of the past, public pension participation status, and current pension benefits amount.

[7] The KLIPS stated to survey from 1998 and its most recent survey is 2002 survey. We use the 1999-2002 survey for the estimation of the average propensity to consume.

As mentioned in section 3, total asset consists of current asset holdings, human wealth, and net government transfer wealth. We assume that total asset holdings of each household are equally distributed among the household head and his/her spouse.

We compute individuals' human wealth, the present value of non-capital income for the remaining lifetime, $\sum_{i=a}^{D}\left(\prod_{s=t}^{t+i-a}\frac{1}{1+r_s}\right)W_{i,t+i-a}$, using the age-sex profile of average income and employment rate[8]. We assume that the average wage growth rate and discount rate are 1.5% and 3.5%[9] per annum in real term.

To compute the government transfer wealth, we first compute the net public pension wealth from the KLIPS sample. For the retired people, we use the reported public pension benefit amount. For the people currently working, we use pension benefit formula and contribution rules of public pensions. In that process, we explicitly take into account the value of each individual's already acquired pension benefit wealth, which is reflected in his/her job experience of the past, as well as the expected value of net pension wealth, which will be acquired by the contributions in the future. The value of the latter is dependent upon the expectations about the future employment status and government policy change. We assume that each individual's employment status of the future follows the same path of the employment rate by age and sex. We assume that the individuals in the sample maintain myopic expectations about the future government fiscal policies, since we do not have any consensus about the public pension reform. As for the other components of the government transfer wealth, related with social insurance, means-test public aid programs, and taxes, the KLIPS does not contain enough information to impute their value. Therefore, we take an alternative approach, which uses the generational accounts separated across the components of fiscal policies[10]. We compute the ratio of the negative value of the whole generational accounts to that of public pensions, reported in Table 10, and multiply this ratio with net public pension wealth computed using KLIPS sample to get the value of the net government transfer wealth. Table 5 reports the value of net public pension wealth and the net government transfer wealth by age and sex. The value of the net public pension wealth shows an irregular age profiles, since Korean public pension consists of two different plans: occupational pensions (OCP) which covers government employees, private school employees and military personnel; and national pension (NPS) which covers the rest of Korean residents. Since the

---

[8] Table 4 shows the population distribution, employment rate, average income by age and sex in 5th year (2002) sample of KLIPS as an example.

[9] This value is based on the real interest rate of government bonds in recent years.

[10] Section 4.3 explains the procedure of GA calculations and the GA values for the components of fiscal policies.

NPS, which covers most of Korean residents, was introduced in 1988, most of NPS participants have not acquired entitlement of pension benefits. The OCP was first introduced in 1960 to cover the government employees and military personnel, and expanded the coverage to private school employees in 1975. Since the OCP's are relatively mature plans, they have produced many pension benefit recipients. However, the net pension wealth reported in Table 5 shows that pension wealth of the aged 75 and older is 0, since the KLIPS sample does not cover many occupational pension recipients. The imputed value of the net government transfer wealth shows negative for most of cohorts, because the value does not reflect the value of government consumption. It is also because the transfer payment from government is not large at present due to immature public pension systems and small magnitude of expenditure of public aid programs[11].

To impute the individual's consumption, we need assumption on the distribution of consumption within family. We use Besanger et al. (2000)'s estimate of age-profile of consumption within family in Australia[12]. The average propensity to consumption is defined as ratio of consumption level to total wealth. We compute the average propensity to consume, using 1999-2002 KLIPS samples, and will use the average level for the period in the projection of the savings rate for the next decades.

4. 2. Projecting human wealth and current asset-holdings

The magnitude of human wealth and current asset holdings are computed based on the assumption that the productivity growth rate and interest rate remain constant: i.e. we adopt a partial equilibrium approach. The productivity growth rate and interest rate are assumed 1.5% and 3.5% per annum in real term. The projection begins with imputation of aggregate value of asset and human capital stock at the benchmark year. The aggregate labor income is assumed 60% of GDP based on the record of labor income share for the period 1990-2003. We compute the distribution of wage income by age and sex, by allocating the aggregate value based on the age-sex profile of wage income estimated by the Ministry of Labor (2001). Then we use the definition of human capital (see equation (2)), to compute the stock value of human capital for the next several decades.

The aggregate value of asset holdings is assumed to be aggregate capital income, 40% of GDP, divided by the interest rate. We impute the age-sex distribution of asset holdings in the

[11] Table 10 shows that the generational accounts for most of cohorts are positive, which implies that most of taxpayers pay more taxes than they receive from the government.

[12] Besanger et al. (2000) also estimated the distribution of consumption among family members for the case of U.S..

benchmark year using the asset holding profile by age and sex using the 1999-2002 KLIPS survey. The distribution following the benchmark year is computed using equations (6)-(7).

4. 3. Projecting net government transfer wealth

The net government transfer wealth is the present value of the transfer income from the government minus tax payment to the government for the remaining lifetime, which is the negative value of generational accounts.

Computing generational accounts is based on the government's intertemporal budget constraint. This constraint, written as equation (10), requires that the future net tax payments of current and future generations be sufficient, in present value, to cover the present value of future government consumption as well as service the government's initial net debt.

$$\text{(10)} \qquad \sum_{s=0}^{D} N_{t,t-s} + \sum_{s=t}^{\infty} N_{t,t+s} = \sum_{s=t}^{\infty} G_s (1+r)^{-(s-t)} - W_t^g$$

The first summation on the left-hand side of (10) adds together the generational accounts of existing generations. The term $N_{t,t-s}$ stands for the account of the generation born in year *t-s*. The index *s* in this summation runs from age 0 to age *D*, the maximum length of life. The second summation on the left-hand side of (10) adds together the present value of remaining net payments of future generations, with *s* representing the number of years after year *t* that each future generation is born. The first term on the right-hand side of (10) is the present value of government consumption. In this summation the values of government consumption, G_s in year *s*, are discounted by the pre-tax real interest rate, *r*. The remaining term on the right-hand side, W_t^g, denotes the government's net wealth in year *t* – its assets minus its explicit debt.

Equation (10) indicates the zero sum nature of intergenerational fiscal policy. Holding the present value of government consumption fixed, a reduction in the present value of net taxes extracted from current generations (a decline in the first summation on the left side of (10)) necessitates an increase in the present value of net tax payment of future generations.

The term $N_{t,k}$ in (10) is defined by:

$$\text{(11)} \qquad N_{t,k} = \sum_{s=\max(t,k)}^{k+D} T_{s,k} P_{s,k} (1+r)^{-(s-t)}$$

In expression (11), $T_{s,k}$ stands for the projected average net tax payments to the government made in year s by the generation born in year k. The term $P_{s,k}$ stands for the number of surviving members of the cohort in year s who were born in year k. For the generations who are born in year k, where $k>t$, the summation begins in year k. Regardless of the generation's year of birth, the discounting is always back to year t. A set of generational accounts is simply a set of values of $N_{t,k}$, one for each existing and future generation, with the property that the combined present value adds up to the right-hand side of equation (10).

The traditional Generational Accounts are calculated in two steps. The first step involves calculation of the net tax payments of current generations (the first term on the left-hand-side of equation (10)). This is done on the basis of current fiscal rules without being constrained by the intertemporal budget constraint of the government. In the second step, given the right-hand-side of equation (10) and the first term on the left-hand-side of equation (10), we determine, as a residual, the value of the second term on the left-hand side of equation (10), which is the collective payment, measured as a time-t present value, required of future generations. Accordingly, whereas the fiscal burdens for current generations are based entirely on current fiscal rules, the government budget constraint fully determines the fiscal burdens for future generations.

Based on the collective amount required of future generations, we determine the average present value of lifetime net tax payments for each member of each future generation under the assumption that the average lifetime tax payments of successive generations rise at the economy's rate of productivity growth. Leaving out this growth adjustment, the lifetime net tax payments of future generations are directly comparable with those of current newborns, since the generational accounts of both newborns and future generations take into account net tax payments over these generations' entire lifetimes. Measuring the generational imbalance as the difference between two lifetime tax burdens provides a measure for the sustainability of the public finances. If future generations bear a heavier tax burden than the newly born do, current fiscal rules will have to be adjusted in the future to meet the budget constraint.

We modify the presentation of generational accounts to make the generational accounts appropriate for calculation of consumption level of generations who will survive for the next several decades. We compute the generational accounts by age and sex at every year for the next several decades, because the consumption by age and sex at each year is dependent upon the net government transfer wealth, the negative value of generational accounts, at the year. The standard approach estimates the fiscal gap between current and future generations, assuming existing policy for current generations. It is also customary to express this fiscal gap using other measures, such as the required changes in taxes and or transfer payments for current and future generations together. Because it is likely that some of the burden will be placed on current generations and there are differing effects of required changes in taxes and transfer payment across future generations, we take this latter approach one step further and actually present alternative estimates of the accounts for current generations and future generations, taking such projected increases in their fiscal burden into account. In addition we also renew the generational accounts for non-zero age groups. For example, we renew the accounts the cohort aged *a* every year, who were *a*-1 years old in the previous year, and this process continues until this cohorts reaches the age *D*, the maximum length of life. The renewal of the accounts is necessary, because the consumption of the aged *a* is dependent upon the renewed accounts. We denote as GA1 the accounts as conventionally presented, and refer to the accounts incorporating the added taxes to restore fiscal balance as GA2.[13]

Table 10 reports standard generational accounts (GA1) for Korea[14], under the base case assumptions for the productivity growth rate (1.5 percent) and the real discount rate (3.5 percent).[15] The table shows positive values of net payments for most cohorts alive in our benchmark year 2000 for GA calculation, except for cohorts aged 90 or older, indicating that most generations will, on balance, pay more in present value than they receive. One reason for positive burdens even among the elderly is the high taxes on consumption, capital income and assets, relative to taxes on labor income.[16] The age profile of the average tax burden on capital is more skewed to older age groups than that of labor income taxes, and the consumption tax burden for older age groups is quite high.

The more important reason that even older generations have positive net payments is that social welfare benefits such as public pension benefits, Medical Insurance (MI) benefits, Minimum Living Standards Security (MLSS) Benefits and other social welfare services (OSTP) were quite small in the aggregate as of 2000. Aggregate public pension and MI benefits were 1.1 percent and 1.7 percent of GDP respectively as of 2000 and those for the MLSS and the OSTP were 0.5 percent and 0.6 percent of GDP respectively. However, maturation of the public pension system and the projected increase in social welfare expenditures will increase transfer payments to old-age groups. This maturation is shown in Figure 4, which displays the relative (to age-40 males) benefit profile in 2000 along with the

[13] Similar presentation method to this one has been used by others in the past, including Auerbach and Oreopoulos (2000) and Bovenberg and ter Rele (2000).

[14] The data source and calculation procedure is explained in detail in Auerbach and Chun (2005) and Auerbach et al (2005).

[15] The accounts are expressed in thousands of won, the domestic currency of Korea. As of May 2005, 1,000 won were worth about US$1.

[16] Revenues from consumption tax, capital income tax, taxes on asset holding, and labor income tax in South Korea as of 2000 were 9.1 percent, 5.1 percent, 1.3 percent, and 2.2 percent of GDP respectively.

corresponding profiles projected at other dates through 2080. As a result, the accounts for a wider range of old-age groups will turn negative in the future, given current policy.

The row labeled "Future Gen." indicates the present value of amounts that those born in 2001 will, on average, pay, assuming that subsequent generations pay this same amount except for the adjustment for growth. The account for future generations is about 118 percent larger than those for those aged 0, which implies that the current fiscal policies are not sustainable and that a substantial fiscal burden is shifted to future generations.

Table 10 also reports the present value, rest-of-life transfer benefits and tax burdens by category. The substantial negative entries for public pensions and Medical Insurance play a key role in the large overall generational imbalance. On the tax side, three important characteristics of the Korean tax system are: (i) the large share of consumption taxes; (ii) the relative unimportance of labor income taxes; and (iii) the large proportion accounted for by taxes on asset transactions. The largest present value (for ages 0 and age 30) is the consumption tax, followed by the capital income tax, the tax on asset transactions, labor income tax, other taxes, and taxes on asset holdings. The present value of the tax burden on older age groups, relative to that on younger age groups, is heaviest for consumption taxes, followed by capital income taxes, taxes on asset holding, taxes on asset transactions, and labor income taxes.

Figure 5 reports the GA2[17], omitting the accounts for the non-zero aged in the future, under alternative scenarios to attainment long-term fiscal balance of government budget: (i) no change in fiscal policies; (ii) increasing tax burden of the cohorts alive in 2010 and thereafter by 23.1% of tax burden under current policies; and (iii) maintaining budget balance every year (pay-as-you-go scheme). The case (i) is a hypothetical situation where the government does not intend to attain long-term budgetary balance, thus, this should be treated as a benchmark case to evaluate the effects of policy changes to attain long-term budgetary balance. The Case (ii) is a scheme of prefunding, since under this scheme the government budget maintains surplus around 2025 and thereafter the budget turns deficit. Comparison of the case (i) with the case (ii) or the case (iii) shows that the current fiscal policies are not sustainable and to maintain the current policies related with government consumption and transfer payments the net tax burden for future generations as well as current generations should be substantially raised. The profile of fiscal burden across generations is crucially dependent upon the method to attain the long-term budgetary balance.

[17] The index for the generations specified in x-axis is according to the year of birth of each cohort, with the 2000 newborns being generation 0. The generations indexed below zero are current generations and those indexed higher then 0 are future generations. The accounts for the future generations are evaluated at the productivity value as of 2000 to make the accounts for future generations comparable with those of current generations.

The pay-as-you-go scheme (case (iii)) further shifts the fiscal burden to the future generations than the prefunding scheme (case (ii)).

5. Findings

5. 1. Projected Savings Rates, 2002-2090

We predict the savings rates for the period 2002-2090, based on the life-cycle framework described in section 3, and using the imputed value of current asset holdings, the projected value of human wealth, transfer wealth explained in section 4. Before our prediction, we adjust the average propensity to consume to reproduce the level of aggregate consumption in our benchmark year 2002. We adjust the average propensity in two steps. First, we reduce the propensity to consume for the aged 75 and older by 50%, since their estimated value is extremely high, more than 200% of the value for the aged 70-74. It is also due to the fact that the number of observation of the aged 75 and older is very small, thus, the estimated value of the average propensity to consume is not reliable. The predicted value of aggregate consumption in our benchmark year, using the adjusted propensity to consume, is 401 trillion won, 3.1% higher than its actual value. Therefore, we reduce the overall level of the average propensity to consume by 3.1%, maintaining its profile by age and sex.

Tables 11-13 summarize the prediction results. Table 11 shows the predicted value, evaluated at fixed price as of 2002, of the wealth and annual values related with the wealth and government budget balance. The non-capital income grows faster than the productivity growth rate (1.5% per annum) until late 2010's despite the population aging, since the total population increase until it reaches a peak around 2025. The growth rate of non-capital income falls rapidly, which induces the decrease in growth rate of human capital, which is defined as the present value of non-capital income earned for the remaining lifetime. The growth rate of the human wealth is lower than that of non-capital income, because the former reflects the decrease in the growth rate of the latter in the future. The human wealth has largest proportion of total wealth.

The transfer wealth, which is defined as the present value of net transfer income from the government for the remaining lifetime, is negative for the next several decades under the current policies. However, its value becomes positive around 2055, which reflects the fact that the government transfer payments will increase much faster than the tax revenue due to the population aging, maturing of public pensions, and increasing demand for social welfare expenditure. Table 10, which summarizes generational accounts for Korea (GA1), shows that the accounts for most of current generations are positive, reflecting the fact that the current level of government transfer payment is low due to the short history of public pensions and low level of social welfare expenditure at present. Despite the positive accounts for most of current generations, the generational imbalance of the net payment is very high (118%), since the forward-looking property of the generational accounting reflects the rapid increase in government transfer payments in the future due to maturing of public pensions, and prospective increase in social welfare expenditure resulting from population aging and increasing demand for social welfare expenditure[18]. The negative accounts of public pensions and medical insurance and social welfare expenditure (MLSS, OSTP) explains substantial part of the generational imbalance. While the growth rate of tax revenue is lower than that of government transfer payment because of reduction in economically active population due to population aging, the government consumption grows faster than tax revenues, which further deteriorates the government budget balance.

The growth rate of aggregate consumption is higher than the GDP growth rate, due to the population aging and increasing age profile of the average propensity to consume, which raises the ratio of private consumption to GDP[19]. The increasing ratio of consumption to GDP results in decrease in the value of asset holdings. The absolute level of the asset holdings falls after the early 2010's, which decreases capital income and the GDP growth rate[20].

Table 13 shows the predicted savings rates under the alternative assumptions about the fiscal policies and fertility rates. We simulate 3 cases: (i) a hypothetical situation where current fiscal policies are maintained disregarding the long-term budget imbalance; (ii) an economy where the government proportionally adjusts the tax burden of cohorts alive in 2010 and thereafter to match the present value of tax revenue of the present and the future to that of government transfer payment and government consumption (prefunding); and (iii) an economy where the government maintains the budget balance every year (budget balance).

The private and government savings, defined as the government budget surplus, depend crucially upon the method to restore the long-term budgetary balance. Compared with the case (i), national savings rates, the sum of private and government savings rates, in the case of prefunding is higher, since higher level of transfer wealth in case (i) induces higher level of consumption and the government budget in case (i) is more imbalanced. Comparison of case

[18] Auerbach and Chun (2003) projected that aggregate public pension benefits will increase from 1.1% of GDP as of 2000 to 16% in 2080. Benefits of Medical Insurance and public aid programs are projected to increase from 1.7% and 1.1% of GDP, respectively, to 5.1%, 2.1% during the same period. The projected level of the Medical Insurance benefits and public aid to low-income families is based on very conservative income elasticity (1.2). Therefore, the projected levels should be interpreted as their minimum level under current policies.

[19] The ratio rises from 56.8% as of 2002 to 72.5% in 2050.

[20] The effects on the asset holdings might be exaggerated, since our approach is a partial equilibrium approach. Under the general equilibrium approach the effects will be mitigated, since the increase in the rate of return to capital will be a buffer to mitigate the reduction in asset holdings.

(ii) and case (iii) shows the effects of intergenerational redistribution of net tax burden. Figure 5 shows that transition from the prefunding scheme to the balanced budget scheme redistributes the fiscal burden, defined as net payment to the government, from current generations to future generations. This redistrtibution of resource from the future generations to the current generations raises the savings rates of current generations. Therefore, the private savings rates of the near future are higher in case (iii)[21]. However, the private savings rates after 2050 are higher in case (ii), because under the prefunding scheme, the resource for the future generations is much larger than that under the pay-as-you-go scheme. The government savings rate of the future is lower in the case (ii), since the case (ii) allows the budget deficit in the future while this case accumulates the budget surplus in the government fund in preparation for the budget deficit in the future.

We try a sensitivity analysis on the fertility rates. Changing the fertility rates substantially affects the savings rate in the long run. However, the national savings rate of the next several decades are not affected much, because we assume gradual change in fertility rate. It is also because it takes time for the change in the fertility rates, which changes the number of newborns, to affect the age structure of population, which affects the aggregate value of consumption and savings.

5. 2. Further Consideration: the effects of annuitization of wealth

The prediction of savings rate in this paper is based on the life-cycle framework, under which we implicitly assume that the propensity to consume does not change overtime and is the same regardless of the kind of wealth. However, the previous researches, such as Auerbach and Kotlikoff (1992) and Kotlikoff et al. (1996), suggested the possibility of decline in the propensity to consume resulting from the annuitization of wealth. The investigation of the effect of the annuitization of wealth in Korean context is very suggestive, since the proportion of asset holding including house and real estate is projected to decrease (see Table 11). In addition, the increase in the old age population and maturing of public pensions, and introduction of reverse annuity mortgages imply that the household wealth will be substantially annuitized.

In order to investigate the effects of the annuitization of household wealth, we estimate the consumption functions, which include current asset holdings, human wealth, and net pension wealth as explanatory variables. For the estimation, we use 1999-2002 KLIPS sample, which is used to estimate the average propensity to consume (see section 4.1). For the estimation of

[21] The reditribution of resource to the current generations increases the consumption level of current generations. However, the private savings rates also rise since the marginal (also average) propensity to consume is lower than 1.

consumption functions, we include the individuals, who belong to the age group 15-64, and have positive non-capital income. We use log values of consumption and those of explanatory variables as well as their absolute level for the estimation. We include the age and age squared as explanatory variables to control the differing preference across age groups.

Table 14 shows mixed implication of annitization of wealth. When we use the 1999-2002 samples separately or use pooled sample, the elasticity of consumption with respect to net pension wealth is smaller than that with respect to current asset holdings[22], which implies that the annuitization of wealth does not decrease the savings rate and moreover it raises the savings rate. However, using fixed-effect panel equations produces larger elasticity of consumption with respect to net pension wealth than that with respect to current asset holdings. Considering the fact that the fixed effect panel equation approach reflects the characteristics of the individuals in the sample better than the pooled sample approach or the estimation using a single-year sample, the result suggests that the annuitization of wealth in the future in Korea, due to the population aging, maturing of public pensions, and introduction of reverse annuity mortgages, will further reduce the savings rate in the future.

6. Conclusion

This paper has investigated the effects of population aging and fiscal policies on the national savings rate of the future. For the prediction of the national savings rate of Korea for the next several decades, we employ a life-cycle model, which incorporates the generational accounting approach needed to assess the distribution of fiscal burden across generations. We also study the effects of change in asset composition, such as annuitization of asset resulting from maturing of public pensions and introduction of reverse annuity mortgages by estimating consumption functions, which enables comparison of elasticity of consumption with respect to the magnitude of various kinds of wealth. We found that the rapid population aging and long-term budgetary imbalance will substantially lower the national savings rate in Korea. In addition, the estimation results of consumption functions with respect to various kinds of wealth suggest that the annuitization of wealth due to maturing of public pensions and introduction of reverse annuity mortgage is likely to further decrease the savings rate in the future.

In addition to the population aging and the generational imbalance of fiscal burden, premature reunification of South and North Korea will be a large burden of South Korean taxpayers. Auerbach et al. (2005) showed that to finance the reunification cost, tax burden of

[22] This result may be partly due to the measurement error incurred in computing the value of the net pension wealth.

cohorts alive in 2010 and thereafter should be raised by about 30% of tax burden under current fiscal policies, which will further reduce national savings of the future. In order to restore the sustainability of fiscal policies as well as to prevent a drastic decrease in the savings rate, fundamental reforms of fiscal policies, such as public pension reform, Medical Insurance reform, and restructuring of government consumption policies, are necessary.

This paper needs some methodological revisions. Since we adopted a life-cycle framework, under which we implicitly assume that the propensity to consume is the same across various kinds of wealth. However, the estimated consumption functions suggest that change in the composition of wealth induce drifts of the propensity to consume. Construction of the model, which enables the analysis of the effects of asset composition changes, will be an important agenda for our future research.

Our projection suggests a drastic decrease in asset holdings due to population aging and fiscal policies. The prediction may exaggerate the decreasing trend of asset holdings and savings rate, since our approach is a partial equilibrium approach. A general equilibrium approach needs to be considered, because the general equilibrium change in factor prices (i.e. rise in rate of return to capital) resulting from decrease in capital stock, mitigates the drastic downward trend of asset holdings.

References

Auerbach, Alan J. and Young Jun Chun (2005), "Generational Accounting in Korea," *Journal of Japanese and International Economies*, forth-coming, earlier version in NBER Working Paper No. 9983.

Auerbach, Alan J., Young Jun Chun, and Ilho Yoo (2005), "The Fiscal Burden of Korean Reunification: A Generational Accounting Approach", *FinanzArchiv*, Vol. 61, March 2005 pp.62-97.

Auerbach, Alan J., and Laurence J. Kotlikoff (1992), "The Impact of the Demographic Transition on Capital Formation", *Scandinavian Journal of Economics* 84(2), pp.281-295.

Auerbach, Alan J. and Philip Oreopoulos (2000), "The Fiscal Impacts of U.S. Immigration: A Generational-Accounting Perspective," *Tax Policy and the Economy* 14, pp.123-156.

Besanger, Serge, Ross S. Guest and Ian McDonald (2000), "Demographic Changes in Asia: The Impact on Optimal National Saving, Investment, and the Current Account", IMF Working Paper 00/115.

Bovenberg, A. Lans, and Harry ter Rele (2000), "Generational Accounts for the Netherlands: an Update," *International Tax and Public Finance* 7, pp.411-430.

Kotlikoff, Laurence, Jagadeesh Gokhale and John Sabelhaus (1996), "Understanding the Postwar Decline in U.S. Saving: A Cohort Analysis", NBER working paper NO. 5571.

Ministry of Labor, Republic of Korea (2001), *Survey Report on Wage Structure*.

National Statistics Office, Republic of Korea (2001), *2001 Population Projection of the Future.*

United Nations(1998), *World Population Projections.*

United Nations, *The Sex and Age distribution of World Population*, each year

Table 1. Demographic Structure and Dependency Ratios of Selected Countries (%)

Country	Demographic Structure						Total Dependency Ratio	
	2000			2030			2000	2030
	0-14	15-64	65+	0-14	15-64	65+		
World	29.7	63.4	6.9	22.4	65.8	11.8	57.7	52.0
Developed Countries	18.2	67.4	14.4	15.4	62.0	22.6	48.4	61.3
Developing Countries	32.5	62.4	5.1	23.6	66.5	9.9	60.3	50.4
Japan	14.7	68.1	17.2	12.7	59.3	28.0	46.8	68.6
U.S.A	21.5	66.0	12.5	17.8	61.6	20.6	51.5	62.3
Italy	14.3	67.5	18.2	11.6	59.3	29.1	48.1	68.6
France	18.7	65.4	15.9	16.9	59.9	23.2	52.9	66.9
China	24.9	68.3	6.8	17.3	67.0	15.7	46.4	49.3
India	33.3	61.7	5.0	22.3	68.0	9.7	62.1	47.1
Korea	**21.1**	**71.7**	**7.2**	**12.4**	**64.6**	**23.1**	**39.5**	**54.9**

Source: United Nations, *World Population Projections*, 1998

Table 2. Speed of Population Aging of Selected Countries

	Year Attained			Number of Years Required for Transition	
Proportion of Old Population[1)]	7%	14%	20%	7%→14%	14%→20%
Japan	1970	1994	2006	24	12
France	1864	1979	2020	115	41
Germany	1932	1972	2012	40	40
U.K.	1929	1976	2021	47	45
Italy	1927	1988	2007	61	19
U.S.A	1942	2013	2028	71	15
Korea	**2000**	**2019**	**2026**	**19**	**7**

Source: United Nations, *The Sex and Age distribution of World Population*, each year
Note: 1) Proportion of the population aged 65 and older.

Table 3. Fertility Assumptions (unit: persons / 1,000 women)

Year	Low Fertility	Medium Fertility (base case)	High Fertility
2000	1.47	1.47	1.47
2005	1.35	1.38	1.43
2010	1.32	1.37	1.45
2015	1.31	1.37	1.50
2020	1.27	1.37	1.54
2025	1.21	1.38	1.61
2030	1.15	1.39	1.69
2040-	1.10	1.40	1.80

Table 4. Characteristics of KLIPS sample (2002 KLIPS sample)

	Population distribution		Employment rate		Average annual income (1,000 won)	
Age	Male	female	Male	female	Male	Female
15-19	380	358	0.047	0.078	6,687	7,423
20-24	293	415	0.314	0.482	10,143	12,076
25-29	418	403	0.687	0.526	15,963	13,536
30-34	454	376	0.874	0.436	20,942	14,737
35-39	419	379	0.902	0.475	24,807	13,075
40-44	445	381	0.892	0.528	24,491	13,876
45-49	374	332	0.874	0.482	25,756	11,843
50-54	299	266	0.866	0.474	26,436	11,927
55-59	219	208	0.772	0.288	19,336	8,354
60-64	142	227	0.754	0.233	13,203	7,617
65-69	100	178	0.640	0.135	13,013	6,940
70-74	53	130	0.472	0.100	8,981	2,714
75-79	24	105	0.250	0.019	4,260	4,800
80-84	12	50	0.333	0.020	12,060	2,400
85-90	5	26	0.000	0.000	0	0
90+	0	8	0.000	0.000	0	0

Table 5. Net government transfer wealth

	Net public pension wealth (1,000 won)		Ratio of net government transfer to net pension wealth		Net government transfer wealth (1,000 won)	
Age	male	Female	Male	Female	Male	Female
15-19	12,278	8,903	-6.90	-4.80	-72,443	-42,736
20-24	18,545	12,888	-6.18	-4.08	-114,611	-52,585
25-29	19,169	12,418	-5.49	-3.02	-105,239	-37,504
30-34	27,819	14,487	-4.77	-1.89	-77,059	-27,381
35-39	37,734	19,461	-1.32	-1.17	-49,808	-22,769
40-44	43,760	20,212	-1.32	-1.25	-57,763	-25,265
45-49	48,933	16,789	-1.28	-1.03	-62,635	-17,293
50-54	53,597	13,334	-0.81	-0.29	-43,413	-3,867
55-59	27,843	3,608	-0.37	-0.19	-10,302	-685
60-64	6,514	2,262	-1.15	-1.49	-7,491	-3,370
65-69	10,088	1,671	-1.37	-2.17	-13,820	-3,626
70-74	2,090	934	-2.47	-5.89	-5,161	-5,499
75-79	0	348	-2.70	-6.90	0	-2,403
80-84	0	0	-1.39	-4.18	0	0
85-89	0	0	0.46	1.19	0	0
90-94	0	0	2.80	13.94	0	0
95+	0	0	5.82	27.18	0	0

Table 6. Composition of Wealth (2002 KLIPS sample, 1,000 won)

	Current asset holdings		Human wealth		Net government transfer wealth	
Age	Male	Female	Male	Female	Male	Female
15-19	101	149	464,594	167,397	-72,443	-42,736
20-24	7,621	2,889	939,007	245,191	-114,611	-52,585
25-29	13,694	22,580	642,279	165,532	-105,239	-37,504
30-34	30,600	32,602	577,780	135,736	-77,059	-27,381
35-39	50,813	57,365	496,524	117,653	-49,808	-22,769
40-44	54,826	57,409	408,858	100,467	-57,763	-25,265
45-49	62,701	69,142	338,279	65,565	-62,635	-17,293
50-54	77,351	62,850	254,270	45,048	-43,413	-3,867
55-59	80,646	70,791	143,281	19,177	-10,302	-685
60-64	75,828	66,876	91,515	11,990	-7,491	-3,370
65-69	78,817	61,860	58,933	5,232	-13,820	-3,626
70-74	92,685	49,102	18,077	1,327	-5,161	-5,499
75-79	47,469	26,347	2,715	278	0	-2,403
80-84	42,306	29,215	2,020	0	0	0
85-89	62,100	18,300	0	0	0	0
90-94	0	7,500	0	0	0	0
95+	0	0	0	0	0	0

Table 7. Age profile of consumption within family

	0-15	16-24	25-39	40-49	50-59	60-64	65-69	70-74	75+
Australia	0.68	0.89	1.00	0.98	1.00	1.05	0.87	0.95	1.19
U.S.A	0.72	0.72	1.00	1.00	1.00	1.00	1.27	1.27	1.27

Source: Besanger et al. (2000)

Table 8. Average propensity to consume (2002 KLIPS sample)

	Average wealth (A)		Average consumption (B)		Average propensity to consume (A/B)	
Age	Male	female	Male	female	male	female
15-19	476,974	176,449	4,915	4,956	0.013	0.040
20-24	965,173	260,969	4,578	4,937	0.006	0.025
25-29	675,142	200,530	6,101	5,715	0.011	0.038
30-34	636,199	182,826	8,779	7,104	0.017	0.050
35-39	585,070	194,479	10,769	7,245	0.022	0.048
40-44	507,444	178,089	10,628	6,908	0.026	0.052
45-49	449,913	151,496	9,379	6,061	0.028	0.052
50-54	385,218	121,232	9,031	5,699	0.031	0.055
55-59	251,770	93,575	7,960	5,329	0.037	0.060
60-64	173,858	81,128	6,737	6,073	0.042	0.080
65-69	147,838	68,763	6,139	4,912	0.050	0.077
70-74	112,851	51,363	5,062	4,774	0.048	0.106
75-79	50,184	26,973	3,897	4,879	0.077[1)]	0.214[1)]
80-84	44,326	29,215	3,480	5,331	0.077[1)]	0.214[1)]
85-89	62,100	18,300	4,354	6,076	0.077[1)]	0.214[1)]
90-94	0	7,500	0	4,294	0.077[1)]	0.214[1)]
95+	0	0	0	4,460	0.077[1)]	0.214[1)]

Note: 1) we assume that the average propensity to consume is same for the cohorts aged 75 and older.

Table 9. Average propensity to consume (1999-2002 KLIPS sample)

	1999		2000		2001		2002		Average (1999-2002)	
age	Male	female	male	female	male	female	male	female	male	female
15-19	0.013	0.044	0.012	0.042	0.012	0.041	0.013	0.040	0.012	0.042
20-24	0.008	0.027	0.006	0.027	0.007	0.017	0.006	0.025	0.007	0.024
25-29	0.012	0.044	0.011	0.047	0.009	0.043	0.011	0.038	0.011	0.043
30-34	0.017	0.050	0.017	0.052	0.015	0.048	0.017	0.050	0.016	0.050
35-39	0.024	0.053	0.024	0.055	0.021	0.047	0.022	0.048	0.022	0.051
40-44	0.028	0.047	0.029	0.051	0.027	0.045	0.026	0.052	0.028	0.049
45-49	0.029	0.041	0.030	0.049	0.026	0.046	0.028	0.052	0.028	0.047
50-54	0.032	0.043	0.033	0.049	0.030	0.046	0.031	0.055	0.032	0.048
55-59	0.037	0.057	0.039	0.059	0.030	0.051	0.037	0.060	0.036	0.056
60-64	0.042	0.061	0.043	0.061	0.039	0.058	0.042	0.080	0.041	0.065
65-69	0.048	0.072	0.054	0.075	0.039	0.086	0.050	0.077	0.048	0.078
70-74	0.057	0.089	0.046	0.086	0.034	0.084	0.048	0.106	0.046	0.091
75+	0.092	0.235	0.138	0.242	0.094	0.207	0.077	0.214	0.100 (0.05)[1)]	0.225 (0.123)[1)]

Note: 1) adjusted value used in predictions of savings rate

Table 10. Generational Accounts (GA1, 1,000 won**)**

Age	Net Payment	Public Pensions	Medical Ins.	Employ. Ins.	IACI[1)]	MLSS[2)]	OSTP[3)]
0	56,025	-9,349	-5,100	-684	186	-2,544	-3,344
5	62,689	-8,914	-4,164	-765	220	-2,501	-3,349
10	67,649	-9,174	-3,793	-844	244	-2,431	-3,231
15	67,707	-14,596	-3,687	-933	260	-2,364	-3,162
20	77,218	-11,430	-3,746	-958	261	-2,281	-3,136
25	73,675	-15,271	-4,433	-819	238	-2,183	-3,106
30	64,700	-18,117	-5,248	-706	166	-2,145	-3,056
35	39,226	-35,332	-5,936	-625	143	-2,104	-2,927
40	36,720	-27,882	-6,834	-590	15	-2,098	-2,832
45	32,425	-23,520	-7,514	-512	-9	-2,076	-2,716
50	22,226	-22,910	-8,034	-450	-16	-1,995	-2,593
55	12,788	-21,396	-8,219	-411	95	-1,958	-2,475
60	14,370	-8,371	-7,764	-324	17	-1,894	-2,381
65	8,448	-6,317	-6,864	-245	19	-1,742	-2,287
70	6,407	-3,756	-5,476	-233	-54	-1,468	-1,889
75	5,837	-1,366	-4,185	-181	-43	-979	-1,491
80	2,818	-990	-3,243	-136	-33	-665	-1,144
85	541	-626	-2,376	-98	-25	-340	-864
90	-2,543	-324	-1,635	-67	-18	-260	-612
95	-1,508	-223	-1,022	-42	-11	0	-392
99	-485	-10	-384	-16	-4	0	-149
Future Gen.	122,341						
	Labor Income Tax	Capital Income Tax	Con-sumption Tax	Tax on Asset Holding	Asset Transac-tions Tax	Other Taxes	Seign-iorage
0	7,265	12,769	37,745	3,935	8,745	6,227	172
5	8,174	14,788	38,513	4,404	9,540	6,549	194
10	8,982	16,849	38,963	4,856	10,199	6,813	217
15	9,815	19,160	39,601	5,368	10,889	7,113	244
20	10,624	22,412	40,150	5,952	11,680	7,417	275
25	10,788	23,492	39,102	6,207	11,901	7,495	264
30	9,951	23,057	36,440	6,186	10,837	7,077	258
35	9,535	21,978	33,071	5,939	8,902	6,344	239
40	7,761	20,860	29,603	5,569	7,275	5,638	236
45	6,169	20,016	26,144	5,318	5,925	4,989	211
50	4,033	17,248	22,862	4,689	4,895	4,299	198
55	1,985	15,181	19,278	3,830	3,243	3,459	175
60	588	11,291	15,834	2,957	1,601	2,655	163
65	54	8,582	12,681	2,082	393	1,963	130
70	0	6,323	9,893	1,517	38	1,404	108
75	0	4,101	7,975	908	0	1,023	74
80	0	2,239	5,453	566	0	708	63
85	0	974	3,198	233	0	422	42
90	0	131	52	31	0	125	33
95	0	49	33	3	0	76	19
99	0	28	13	1	0	29	6

Note: 1) LACI represents Labor's Accident Compensation Insurance, which is Korean version of Worker's Compensation.
2) MLSS represents Minimum Living Standards Security System, which is public aid program to low income classes
3) OSTP represents the other social transfer programs.

Table 11. Predicted Values (current policy, medium fertility)

(unit: 1 trillion won, 2002-fixed price)

Year	Wealth				Annual values							
	Total	Asset-holdings	Human wealth	Transfer Wealth	Non-capital income	Taxes and government transfer			Gov't Consump.	Budget deficit	Private consump.	GDP
						Net transfer	Transfer payment	taxes				
2002	15,408	4,213	13,564	-2,369	411	-122	29	153	109	-13	389	685
2005	16,083	4,261	14,148	-2,326	444	-131	34	167	115	-16	417	720
2010	17,115	4,301	15,001	-2,187	500	-141	45	187	126	-14	467	779
2015	18,019	4,292	15,695	-1,967	550	-147	57	206	136	-12	511	829
2020	18,783	4,235	16,228	-1,679	594	-147	74	223	145	-2	553	869
2025	19,441	4,131	16,677	-1,367	635	-139	96	237	155	16	592	903
2030	19,953	3,994	17,017	-1,058	670	-127	120	250	165	38	625	930
2035	20,290	3,816	17,232	-759	697	-113	144	260	174	61	650	945
2040	20,452	3,578	17,353	-479	712	-98	167	268	183	86	665	944
2045	20,473	3,284	17,420	-230	721	-82	190	275	190	108	669	934
2050	20,406	2,970	17,450	-13	726	-68	211	281	196	128	665	919
2055	20,331	2,650	17,506	175	726	-58	225	287	199	141	657	898
2060	20,298	2,351	17,602	345	728	-48	238	290	202	155	649	881
2065	20,340	2,112	17,739	489	728	-37	251	292	205	169	643	865
2070	20,476	1,965	17,897	613	735	-29	261	294	208	179	641	863
2075	20,708	1,894	18,087	728	734	-24	268	297	210	186	642	857
2080	21,039	1,831	18,366	842	733	-22	272	299	211	189	646	852
2085	21,474	1,755	18,757	963	735	-21	275	301	212	192	653	849
2090	22,016	1,649	19,277	1,091	738	-18	279	302	214	196	662	845

Table 12. Annual Growth Rate of Predicted Values (current policy, medium fertility, %)

Year	Wealth				Annual values							
	Total	Asset-holdings	Human wealth	Transfer Wealth	Non-capital income	Taxes and government transfer			Gov't Cons.	Budget deficit	Private cons..	GDP
						Net transfer	Transfer payment	taxes				
2002	1.5	0.4	1.5	-[1)]	2.7	-[1)]	5.4	3.1	1.9	-[1)]	2.4	1.8
2005	1.4	0.3	1.3	-	2.6	-	6.1	2.6	1.9	-	2.6	1.7
2010	1.2	0.1	1.1	-	2.2	-	5.0	2.3	1.6	-	2.1	1.5
2015	0.9	-0.2	0.8	-	1.7	-	5.9	1.8	1.4	-	1.7	1.1
2020	0.8	-0.4	0.6	-	1.4	-	5.7	1.4	1.3	-	1.5	0.9
2025	0.6	-0.6	0.5	-	1.3	-	5.2	1.1	1.3	28.1	1.3	0.7
2030	0.4	-0.8	0.3	-	1.0	-	4.2	0.9	1.2	12.7	0.9	0.5
2035	0.2	-1.1	0.2	-	0.5	-	3.3	0.7	1.1	8.3	0.6	0.1
2040	0.1	-1.6	0.1	-	0.3	-	2.9	0.6	0.9	5.8	0.3	-0.2
2045	0.0	-2.0	0.0	-	0.3	-	2.3	0.5	0.6	4.0	0.0	-0.3
2050	-0.1	-2.2	0.0	-	0.0	-	1.7	0.4	0.5	2.5	-0.2	-0.5
2055	-0.1	-2.5	0.1	20.9	0.1	-	1.2	0.3	0.3	1.8	-0.2	-0.4
2060	0.0	-2.3	0.1	9.3	-0.1	-	1.2	0.2	0.3	2.0	-0.2	-0.5
2065	0.1	-1.8	0.2	5.5	0.2	-	0.9	0.2	0.3	1.4	-0.1	-0.1
2070	0.2	-0.9	0.2	3.9	0.1	-	0.7	0.2	0.2	1.0	0.0	-0.1
2075	0.3	-0.7	0.3	3.2	0.3	-	0.3	0.1	0.1	0.5	0.1	-0.2
2080	0.4	-0.7	0.4	2.9	0.4	-	0.2	0.1	0.1	0.2	0.2	-0.1
2085	0.5	-1.1	0.5	2.7	0.5	-	0.2	0.1	0.1	0.3	0.3	-0.1
2090	0.6	-1.5	0.7	2.4	0.7	-	0.3	0.1	0.2	0.6	0.3	-0.1

Note: 1) The growth rates of these components are not reported because their absolute level is negative.

Table 13. Predicted Savings Rates (% of GDP)

Year	Low fertility						Medium fertility						High fertility					
	Current policy		Prefunding		Balanced budget		Current policy		Prefunding		Balanced budget		Current policy		Prefunding		Balanced budget	
	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't	Privat	Gov't
2002	25.3	1.8	27.6	1.8	27.4	0	25.3	1.8	27.6	1.8	27.5	0	25.4	1.8	27.7	1.8	27.5	0
2005	23.9	2.1	26.6	2.1	26.6	0	23.9	2.1	26.6	2.1	26.7	0	23.9	2.1	26.7	2.1	26.8	0
2010	21.9	1.8	20.2	7.3	25.4	0	21.9	1.8	20.3	7.3	25.4	0	22.0	1.8	20.3	7.3	25.5	0
2015	20.5	1.4	18.4	7.1	24.6	0	20.5	1.4	18.4	7.1	24.6	0	20.6	1.3	18.5	7.0	24.7	0
2020	19.5	0.3	17.0	6.2	23.7	0	19.5	0.2	17.0	6.2	23.7	0	19.5	0.1	17.0	6.1	23.6	0
2025	19.1	-1.6	16.4	4.5	22.8	0	19.1	-1.7	16.3	4.4	22.7	0	19.0	-1.9	16.2	4.2	22.5	0
2030	19.2	-3.9	16.2	2.3	21.9	0	19.1	-4.0	16.1	2.2	21.7	0	19.0	-4.3	15.9	2.1	21.3	0
2035	19.4	-6.2	16.2	0.1	20.9	0	19.2	-6.5	16.0	-0.1	20.4	0	18.9	-6.8	15.6	-0.3	19.8	0
2040	19.6	-8.8	16.2	-2.4	19.6	0	19.3	-9.1	15.8	-2.6	18.9	0	18.8	-9.4	15.3	-2.8	17.9	0
2045	20.1	-11.3	16.4	-4.7	18.6	0	19.6	-11.6	15.9	-5.0	17.5	0	19.0	-11.9	15.2	-5.1	16.3	0
2050	20.9	-13.7	17.1	-7.1	17.8	0	20.3	-13.9	16.4	-7.1	16.5	0	19.5	-14.1	15.4	-7.1	14.9	0
2055	21.1	-15.8	17.0	-9.0	16.7	0	20.4	-15.7	16.2	-8.8	15.2	0	19.4	-15.6	15.1	-8.4	13.5	0
2060	21.7	-18.1	17.4	-11.2	15.7	0	20.8	-17.6	16.5	-10.5	14.2	0	19.8	-17.0	15.3	-9.7	12.5	0
2065	22.3	-20.5	17.9	-13.6	14.4	0	21.4	-19.5	16.9	-12.4	13.0	0	20.3	-18.3	15.7	-10.9	11.5	0
2070	23.3	-22.3	18.8	-15.5	13.8	0	22.3	-20.8	17.9	-13.7	12.6	0	21.1	-19.0	16.5	-11.6	11.3	0
2075	22.8	-23.9	18.3	-17.0	12.1	0	22.2	-21.7	17.6	-14.6	11.3	0	21.1	-19.3	16.5	-11.8	10.5	0
2080	21.8	-25.4	17.1	-18.4	9.9	0	21.6	-22.2	16.9	-15.1	9.9	0	21.0	-19.2	16.3	-11.8	10.0	0
2085	20.2	-26.9	15.3	-19.9	7.1	0	20.6	-22.6	15.8	-15.4	8.5	0	20.7	-18.9	16.0	-11.5	9.7	0
2090	18.4	-28.8	13.2	-21.8	3.8	0	19.4	-23.2	14.6	-16.0	6.8	0	20.4	-18.7	15.7	-11.2	9.4	0

Table 14. Consumption Functions

	Dependent variable: consumption					
	1999 sample	2000 sample	2001 sample	2002 sample	Pooled sample	Fixed effect
constant	-652.3 (54.4)[1]	-623.7 (61.4)	-543.7 (69.8)	-726.6 (80.1)	-562.2 (34.62)	-641.476 (77.121)
age	42.48 (2.80)	42.93 (3.12)	50.23 (3.55)	53.17 (4.036)	44.04 (7.762)	46.316 (3.910)
age^2	-0.442 (0.034)	-0.443 (0.037)	-0.571 (0.042)	-0.552 (0.047)	-0.470 (0.021)	-0.4587 (0.046)
asset holdings(x_1)	0.011 (0.0008) <0.071>[2]	0.012 (0.0009) <0.069>	0.017 (0.0009) <0.101>	0.018 (0.0009) <0.102>	0.016 (0.0004) <0.095>	0.011 (0.007) <0.065>
human wealth (x_2)	0.006 (0.0002) <0.364>	0.006 (0.0002) <0.344>	0.002 (0.0001) <0.120>	0.005 (0.0002) <0.267>	0.004 (0.0009) <0.23>	0.003 (0.0001) <0.17>
net pen. wealth (x_3)	0.012 (0.002) <0.053>	0.012 (0.002) <0.055>	0.013 (0.002) <0.062>	0.013 (0.002) <0.057>	0.016 (0.001) <0.073>	0.029 (0.0019) <0.132>
	Dependent variable: log(consumption)					
constant	-5.641 (0.442)	-5.365 (0.422)	-4.937 (0.360)	-5.214 (0.322)	-6.146 (0.188)	-7.354 (0.358)
age	0.090 (0.0048)	0.075 (0.0049)	0.080 (0.0046)	0.064 (0.0043)	0.071 (0.002)	0.063 (0.0052)
age^2	-0.0008 (0.00006)	-0.0007 (0.0006)	-0.0007 (0.00005)	-0.0005 (0.0005)	-0.0006 (0.00002)	-0.0004 (0.00006)
$\log(x_1)$[3]	0.224 (0.021)	0.312 (0.025)	0.2310 (0.017)	0.327 (0.019)	0.268 (0.010)	0.1601 (0.016)
$\log(x_2)$[3]	0.596 (0.020)	0.529 (0.021)	0.548 (0.017)	0.533 (0.016)	0.577 (0.009)	0.524 (0.014)
$\log(x_3)$[3]	0.148 (0.049)	0.150 (0.045)	0.151 (0.038)	0.153 (0.034)	0.231 (0.020)	0.540 (0.0404)

Note: 1) represents standard error.
2) represents the elasticity evaluated at the mean of the explanatory variable.
3) We use $\log(-\min(x_1)+1+x_i)$ (i=1,2,3) to avoid negative value for the argument of log function.

Figure1. Totoal Population (Unit: 1 million persons)

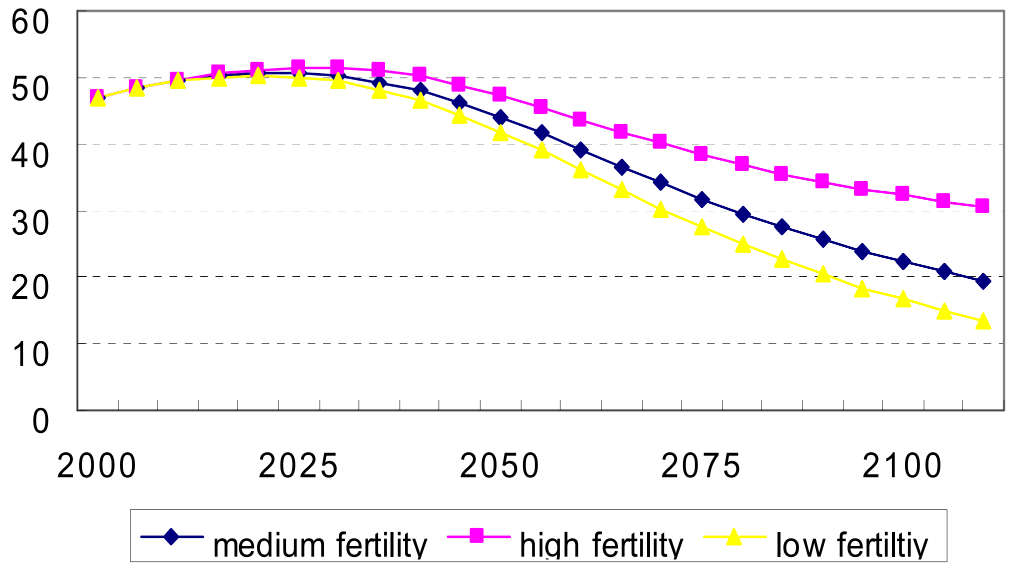

Figure 2. Proportion by age group (base case)

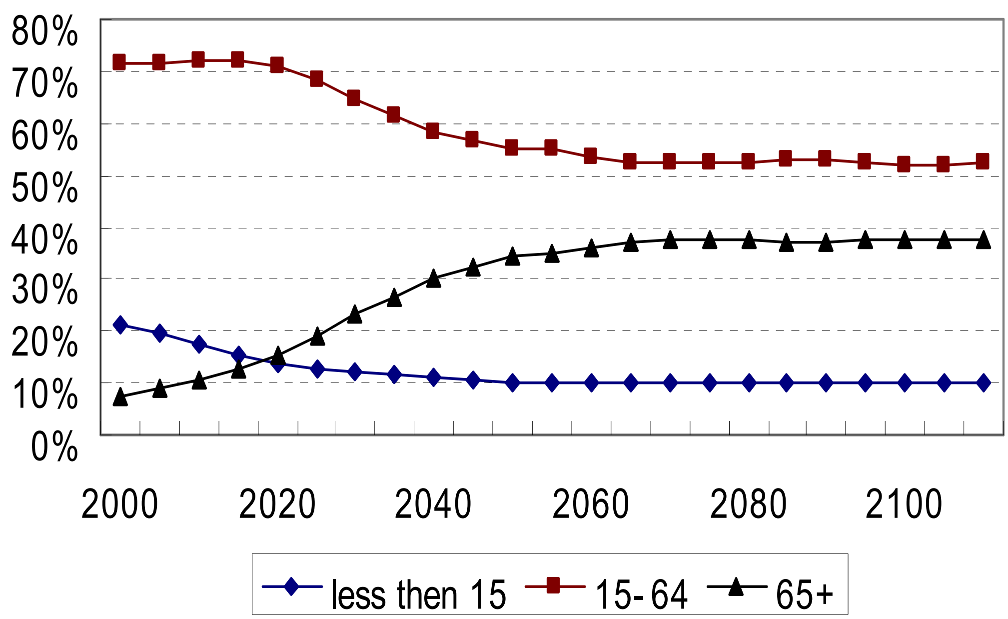

Figure 3. Proportion of the aged 65 and older under altertnative fertility rate assumptions

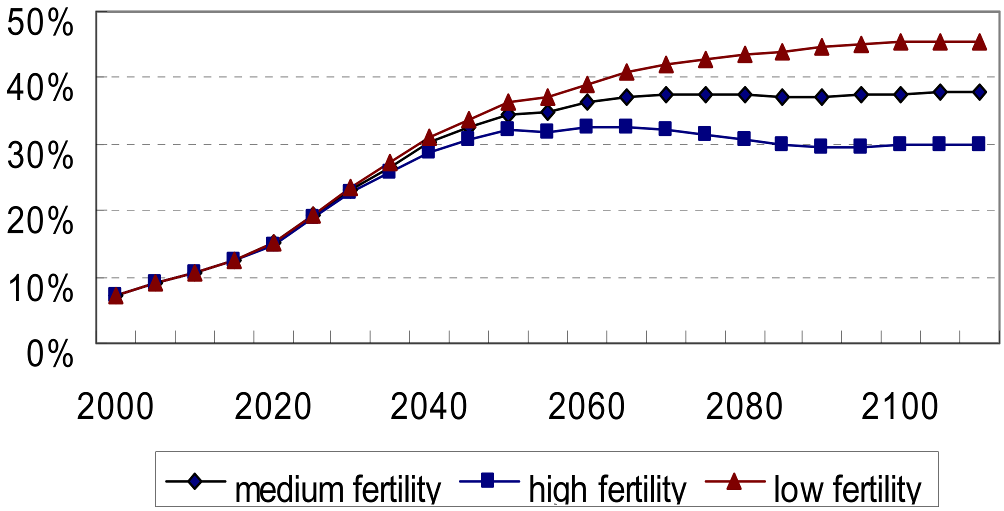

Figure 4. Public Pension Benefit Profile

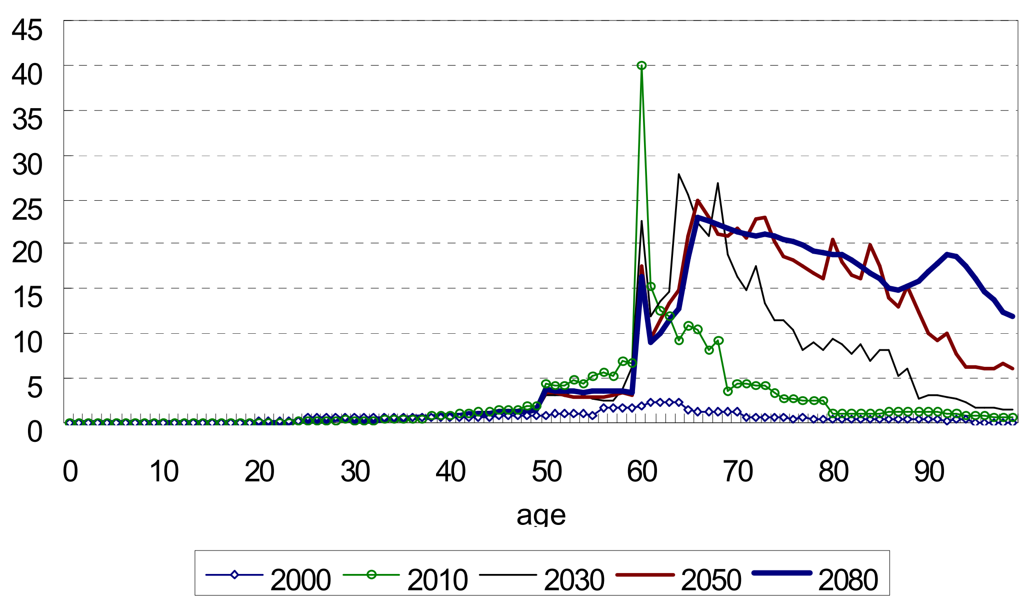

Figure 5. Generational Accounts (GA2, 1 million won)