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Retrospective Generational Accounts for Korea*

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This study addresses fiscal sustainability and generational equity of Korea by using generational accounting (GA). Unlike previous Korean GA studies, we compute retrospective GA, assessing the value of net taxes paid in the past combining this with traditional forward-looking GA, appraising the rest-of-life net tax burden to obtain full lifetime accounts (FLGA). FLGA cover the entire life for all the cohorts. We find that the fiscal policies of Korea bring about generational inequity. The net tax burden of future generations should be raised to an unbearable level, higher than 40% of lifetime income, to service government spending under the current policies. In addition, we show that parametric reforms to resolve the problem have only limited effects even under the demographic assumptions that subsidy to childbirth and childcare and open-door immigration policy substantially reverse population aging and reduction, which indicates the requirement of many fundamental reforms.

JEL Classification: H22, H53, H60
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I. Introduction

Lately, concern about the fiscal sustainability of Korean government has been growing. National debt has been rapidly increasing from 29.3% of GDP in 2006 to 38.3% in 2016, and it is expected to exceed 40% in 2020. The boost in the

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government liability is primarily due to the budget deficit of the last decade. The management-target budget (MTC), the consolidated budget (CB) net of the National Pension budget, was deficit for most of the period. The CB had been surplus since early 2000's, but the magnitude of the CB surplus decreased from 2011, and the budget turned deficit in 2015.

The state of the government finance is anticipated to worsen in the future. This pessimistic view is based on the structural change in the government budget as well as the declining tax revenue growth resulting from recent economic downturn. One of the most conspicuous changes in the government budget structure is the increase in non-discretionary expenditure proportion, which restricts the flexible public finance management. This change is the consequence of introduction and reinforcement of social welfare policies, such as introduction of National Pension System (NPS, 1988), Employment Insurance (EI, 1995), Minimum Living Standard Security (MLSS, 2000), Public Long-Term Care (LC, 2008), and Basic Pension (BP, 2008) and accretion of public health insurance benefits. The growth of these entitlement programs calls for revising the evaluation method on the fiscal sustainability. This change reduces the usefulness of CB balance and national debt adopted by most of countries for the assessment of soundness of public finance because the entitlement programs affect the present and future cash flow of government budget, whereas the CB balance and the national debt are the indices reflecting the past and present financial activities of the government. For example, although the benefit expenditure of NPS, which covers most of Korean population, is predicted to increase as the system matures in the future, its magnitude at present is not so large because few NPS participants have acquired the entitlement for pension benefits due to the short history of the system. The effects of the extension of public health insurance benefit coverage and the introduction of public long-term care and basic pension will be amplified as population ages.

The CB balance and the national debt also have limitation as measurement of intergenerational redistribution. The increase in budget deficit and national debt presumably indicates the redistribution of tax burden from current to future generations because it delays the timing when tax revenue rises. However, many incidences induce the shifts of tax burden across generations without affecting these two measurements. Introducing pure pay-as-you-go public pension system redistributes fund from the younger age groups to the elderly, but it does not change the budget balance. Public health insurance, which maintains balanced budget, brings about similar intergenerational redistribution. The insurance raises contribution revenue from the labor force, but the incidence of its benefits is skewed to the older age groups. A revenue-neutral tax regime that changed from income-tax-based to consumption-tax-based taxation has similar effects because of the difference in the tax base between the two regimes.

These problems were recognized, so the method of generational accounting (GA)

was suggested in the early 1990s. GA measures the present value of net tax payment for the remaining lifetime across generations. The net tax is defined as the tax payment to the government net of the transfers from the government. The budget balance and the national debt assess the financial outcome of the government activities of the present and the past, whereas GA takes a forward-looking approach. GA considers the present and future cash flow of the government finance. Therefore, the GA is appropriate to evaluate the effects of the entitlement programs on public finance.

Despite its merits, GA has been criticized in various aspects. Ironically, the limited capability of GA in the evaluation on the generational equity originated from its forward-looking nature. One of the important characteristics of recent fiscal policy revisions in Korea is the extension and reinforcement of transfers to the elderly. Examples are the introduction of public long-term care and basic pensions. Implementation of these policies reduces the net tax payment of the elderly. In traditional forward-looking GA (FGA), the tax payments and public transfers of the past are not considered. For the fair evaluation on the generational equity, the account must include the taxes and public transfers, which the elderly paid and received in the past. The generational equity should be assessed based on the value of net tax payment for the whole lifetime. Retrospective generational accounts (RGA), which measure the value of net taxes of the past, should be incorporated in the traditional FGA to present full lifetime generational accounts (FLGA), which pertain to the set of net payments for the entire lifetime of all the generations.

This study is the first attempt to compute the RGA, which cover the entire fiscal policy of Korea, to compare the lifetime net tax payment of current and future generations and assess the generational equity based on the FLGA. Except for a few cases, most of the studies on GA followed the forward-looking approach. Computing RGA requires detailed data containing the information of past government activities. The problem regarding the data is quite serious in Korea. The data deficiency is the most serious obstacle to RGA research even for developed countries such as the U.S., although the U.S. started household panel surveys much earlier than Korea. For the complete RGA computation, which covers the past life of the whole population, the data analysis must be extended back to the 1910s. If we assume that the oldest generation is aged 99 in 2016, then the information on the distribution of tax burden and social welfare benefits by age group should be gathered from 1917. The data should cover the Japanese colonial period (1910–1945) and the transitional period from liberation from Japanese occupation to establishment of the government of Republic of Korea. Another problem dealing with these periods is that including the analysis of the taxes and the transfers in these periods implies taking part in the historical and ideological debate on the socioeconomic significance of Japanese colonial occupation of the Korean peninsula. For the successful contribution to the academic debate, reliable research on the

controversial period should be accumulated. Recognizing this limitation, we focus on the period since the establishment of the South Korean government (1948). We compute the RGA, which cover the entire fiscal policy of South Korea since 1948, and incorporate this to FGA to present FLGA, which is necessary for the generational equity evaluation based on the measurement of full lifetime net tax payment for all the generations. Therefore, the accounts reported in this paper can be regarded as the generational accounts presenting the net tax payment to the government of Republic of Korea.

Our findings are summarized as follows. The net tax burden is larger for the future generations (younger age groups) than for the current generations (older age groups), even when we explicitly consider the taxes paid by the elderly in the past. This finding indicates that the fiscal policies since the establishment of the government of Republic of Korea in 1948 bring about the generational inequity. In addition, the FLGA shows that the current fiscal policies are unsustainable, and the tax and transfer adjustment on a large scale is required to recover the long-term budgetary balance of Korean government. As a result, the net tax burden of the younger age groups and the future generations will inevitably rise, and the absolute magnitude of their net tax burden should be lifted to an unbearable level, which is higher than 40% of lifetime income. Finally, we show that the parametric reforms to resolve the fiscal imbalance and the generational inequity, which Korean government considered, including the revisions of the NPS, the HI, the BP, and the LC, have only limited effects, even with optimistic assumptions on the fertility rate and immigration policies, which are expected to induce foreign labor force inflow. Many fundamental reforms are required for stabilizing the Korean public finance and mitigating the conflicts among generations.

The remainder of the paper is organized as follows. Section II summarizes the related literature. Section III and IV explain the concept of GA and the process of its computation, respectively. Section V presents the RGA, FGA, and FLGA of Korea as well as the policy simulation results. Finally, Section VI concludes our discussion.

II. Related Literature

Auerbach et al. (1991) first suggested GA to resolve the problems of budget balances and national debt as indices for fiscal sustainability and measurements of intergenerational redistributive effects of fiscal policies. In addition, they intended to provide a framework for analyzing the macroeconomic effects of intergenerational redistribution in pure life-cycle models. The study discusses how to incorporate the GA into life-cycle models.[1]

[1] Fehr and Kotlikoff (1999) attempted to integrate the GA into a general equilibrium model. Chun

GA has been widely used to evaluate the fiscal sustainability and intergenerational redistribution by government policies in many countries. Auerbach et al. (1999), European Commission (1999), and Raffelhuschen (1999) attempted international comparison of GA. These works assessed the fiscal sustainability of countries around the world on the same criterion, the generational accounts. European Commission (1999) computed the GA for European Union member countries and used the measures as references to enact the European Union countries' obligations for fiscal soundness. Auerbach and Chun (2006) computed GA for Korea, and Chun (2003, 2004) used the GA for assessment of fiscal stability of specific social welfare programs such as public pensions and public health insurance of Korea.

GA has also been used to address issues other than the fiscal sustainability and intergenerational redistribution. Auerbach et al. (2005) attempted to measure the Korean reunification cost, and Auerbach and Oreoploulos (2000) investigated the effects of the immigration to the U.S. on its public finance. Chun and Lee (2003) used GA to assess the impacts of public fund raising for restructuring of financial institutions, which faced bankruptcy risk during the economic crisis in 1997–1998. Chun and An (2007) used GA for the estimation of optimal tax burden from the utilitarian social welfare perspective. The studies listed follow FGA.

Gokhale et al. (1999) first computed the RGA. They computed the RGA and added it to the FGA to address the intergenerational equity based on the FLGA, which cover the entire lifetime of current and future generations. This approach was taken by Gal et al. (2001) to analyze the Hungarian public pension system. They evaluated the public pension benefits and contributions of the past as the value at 2000 using their historical age distribution, and they presented the FLGA for public pension system.

Only a few attempts to compute the RGA despite its necessity exist because of the data requirement. The age distributions of taxes and transfers, in addition to their historical aggregate values, must be estimated. Even Gokhale et al. (1999) used the historical values of aggregates, but they did not estimate the age profiles of taxes and transfers for the entire period of analysis. Instead, they assumed that the age profiles are the same as those for a benchmark year. Bommier et al. (2010) attempted to estimate the age distribution of taxes and transfers for each year to compute FLGA. They assessed the full lifetime net benefits from the public policies of the U.S. government. They covered the generations from 1850 to 2090 newborns. For the estimation of age profiles since 1850, they used household panel surveys of the U.S. However, they focused only on social security (public pensions), Medicare, transfers

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(2007) used the GA to investigate the effects of population aging on the national savings in a partial equilibrium model. The model estimated the marginal propensity to consume with respect to the net tax payments, which is the generational account for each generation, and used it to project national savings and public savings over time.

though public education, and related tax burden. The household surveys they used did not cover the entire period since 1850. An example of computing FLGA for Korea is Choi (2013). He computed the consolidated accounts for Korean NPS, which was introduced in 1988, using the National Pension Corporation database, to address the generational equity related with NPS.

Our work is the first attempt to compute the FLGA for Korea, which covers all government fiscal activities. This study is similar to that of Gokhale et al. (1999) in that the RGA is computed for all fiscal policies. This research focuses on the policies since the establishment of the government of Republic of Korea, whereas Gokhale et al. (1999) covered those for a much longer period. However, the present study uses more detailed historical age distributions of taxes and transfers or their estimates for a longer period, whereas Gokhale et al. (1999) assumed constant age distributions. Unlike Gal et al. (2001) and Choi (2013), which confined their analysis to public pensions, our study covers all fiscal policies. Except for Bommier (2010) and Auerbach et al. (2005), all studies mentioned in this section presented accounts in a traditional manner: the future generations, who are born after the benchmark year, are regarded as one cohort, and the average value of the accounts across future generations is presented as their account. This paper reports the accounts in two alternative ways. One follows the traditional method, and the other classifies the cohorts according to the year of birth. This paper reports one account for each cohort, which enables the investigation of the heterogeneous effects of policy reforms with different contents and the timing of implementation on the fiscal burden across generations.

III. Concept of Generational Accounting

GA reports the value of the net tax payment of each generation's representative individual. Net tax is the tax payment to the government net of public transfers to the individual, and generation is the group of people of the same gender and age. The traditional FGA pertain to the set of the present values, discounted with interest rate r, of each generation's net tax for the remaining lifetime ($N^F_{t,k}$ in Equation (1)). FGA do not count taxes and transfers of the past but include only those of the present and the future. The accounts for the cohorts born before the benchmark year are the sum of the net tax values from the benchmark year (t), instead of the year of birth (k), to the maximum age (D). On the contrary, RGA evaluate the net tax of the past ($N^R_{t,k}$ in Equation (2)). The net taxes ($T_{s,k}$) are converted at compound interest into the value as of the benchmark year.

$$N_{t,k}^{F} = \sum_{s=\max(t,k)}^{k+D} T_{s,k} \left(\prod_{j=t+1}^{s} \frac{1}{1+r_j} \right) \tag{1}$$

$$N_{t,k}^{R} = \sum_{s=k}^{t-1} T_{s,k} \prod_{j=s+1}^{t} (1+r_j) \tag{2}$$

RGA are assessed using the information on the aggregates and the age distributions of past taxes and transfers. Computing FGA begins with the following intertemporal budget constraint of the government (Equation (3)):

$$\sum_{s=0}^{D} N_{t,t-s}^{F} P_{t,t-s} + \sum_{s=1}^{\infty} N_{t,t+s} P_{t+s,t+s} + W_t = \sum_{s=t}^{\infty} G_s \left(\prod_{j=t+1}^{s} \left(1+r_j\right)^{-1} \right), \tag{3}$$

where $P_{t,k}$ refers to the year-k-newborn population at t, W is the government net wealth, and G is the government purchase (spending). $N_{t,k}$ is the FLGA for the cohort born in year k, evaluated as a value as of year t. The accounts cover the entire lifetime of future generations born after the benchmark year.

Budget constraint is that the value of the government purchase of the present and the future is not more than the sum of the government net wealth, the net taxes of current generations alive in the benchmark year, and the net taxes of future generations. This reveals that the zero-sum nature of the public finance decreases in current generations' accounts, which is the first term of the left-hand side of Equation (3), and should be compensated by an increase in the future generations' net tax payment, which is the second term, to satisfy the government budget constraint.

We use the following procedure to compute FGA. First, we compute the current generations' accounts by applying the current policy of taxation and public transfer to the current generations. Second, we project future government spending to assess the value of the right-hand side of Equation (3). Given the sum of accounts for current generations, the value of government purchase, and the government net wealth, W, the sum of future generations' accounts is determined as a residual. Fiscal imbalance is absorbed entirely by future generations. In this traditional approach, future generations are treated as one cohort, and their account is presented with the value of the net tax, which is converted into a productivity level as of the benchmark year to compare with that of current generations.

Assessed FGA are used to evaluate fiscal sustainability. We compare the account for the newborns at the benchmark year with those of future generations because both accounts cover an entire lifetime. The account for benchmark-year newborns reflects the current fiscal policies, and that for future generations shows the magnitude of their fiscal burden to prevent government insolvency. We use

generational imbalance (GI) to measure the degree of the instability of government finance.

$$GI = \frac{\sum_{s=1}^{\infty} N_{t,t+s} P_{t+s,t+s} \Big/ \sum_{s=1}^{\infty} P_{t+s,t+s} - N_{t,t}}{N_{t,t}} \times 100 \tag{4}$$

$GI > 0$ means that the current fiscal policy is unsustainable, in that the government cannot maintain the current policy, and the government must raise the net tax burden sometime in the future. GI can be used to assess the generational inequity between the benchmark-year newborns and future generations; however, the fair comparison of the net tax burden among current generations is impossible. Except for the account for the newborns at the benchmark year, the FGA does not reflect the taxes and transfers of the whole lifetime. The FGA ignores those of the past for the cohorts born before the benchmark year. For the unbiased assessment of generational equity among cohorts, FLGA, which cover the entire lifetime for all the generations, should be computed by incorporating RGA into FGA.

IV. Generational Accounts Computing Process

This section explains the process of computing RGA and FGA. The taxes and transfer programs for the analysis are public pensions,[2] National Health Insurance (HI, 1977–), EI (1995–), Worker's Compensation (WC, 1964–), Public LC (2008–), BP (2008–), MLSS (2000–), earned income tax credit (EITC, 2008–), labor income tax (LabT), capital income tax (CapT), consumption tax (ConT), asset-holding tax (AHT), asset transaction tax (ATT), other taxes 1, other taxes 2 (OT2), and defense tax (DFT).

4.1. Retrospective Generational Accounts

The following steps are taken to compute RGA. First, we gather the historical data of the aggregates and the age distributions of taxes and transfers of the past. We categorize the taxes since 1948 according to our classification to obtain the aggregates of the tax revenue by the type of taxes.[3] Total tax revenue as a percentage

[2] Public pensions include National Pension (NPS, 1988–), Pension for Civil Servants (PCS, 1960–), and Pension for Private School Employees (PPS). Pension for Military Personnel, which was separated from the PCS in 1963, is not reflected in Public Pensions because of lack of information on the age distribution of benefits and pension contribution. Instead its aggregate value of the net benefit payment, benefit minus pension contribution, is reflected in government spending.

[3] For the classification of the taxes, see Table A-1 of the Online Appendix (https://drive.google.

of GDP has increased from the level a little higher than 10% in the 1950s to approximately 18% in recent years.[4] Throughout the period, Cont has taken the largest proportion, followed by Capt, Labt, asset-transaction tax, and AHT. DFT was the third largest tax in revenue between the mid-1970s and early-1990s. We make a simplifying assumption regarding the distribution of tax burden by gender and age: the distributions are the same through the period between 1949 and 2000. The age distributions should be estimated for every year, if possible. However, the micro data sets in Korea must estimate the distributions that do not cover a substantial part of the period. Therefore, we estimate the distributions using the survey data sets for the late 1990s and use the age distributions estimated for 1949–2000.[5] For 2008–2013, we use the 1–8 wave survey of the National Survey of Taxes and Benefits to estimate the distributions. We assume interpolated distributions from 2000 to 2008.

In the case of public transfers and social insurance contributions, we use highly detailed information reported in relevant statistical yearbooks and reports.[6] For the social insurance programs, such as public pensions, HI, EI, and WC, we compute the-gender-age profiles of benefits and contributions for every year since the implementation of each program using their aggregates and distributions reported in the statistical yearbooks and the reports. For MLSS, LC, and EITC, we follow the same procedure to obtain the profiles. The total social welfare expenditure has continuously increased to the level over 6% of GDP in 2013[7] since the expenditure of the welfare system started in 1960 (PCS), 1964 (WC), 1975 (PPS), 1977 (HI), 1988 (NPS), 1997 (EI), 2001 (MLSS), and 2008 (LC, BP, and EITC). The social insurance contribution revenue reached the level a little higher than 6.5% in 2013.[8] In recent years, the HI contribution took the largest proportion because its contribution rates have continuously risen, whereas those of public pensions were slightly adjusted despite the warning of their fiscal instability.

Using the aggregates and the gender-age profiles, we compute the values of public transfer benefits, tax, and social insurance contribution burdens of a representative for each cohort that belongs to each gender-age group for each year since 1948. We compute RGA, which is the total value of the net taxes, which are converted at compound interest to those of the benchmark year (2013), of a representative individual of each living cohort in 2013. No single series of interest rates covers the entire period of the analysis. Therefore, we connect several series of

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com/file/d/1ZYm06DK0Vy0WbmqNlRpmc7_DSgyJSdub/view).

[4] See Figure A-1 of the Online Appendix.

[5] For the data source of the estimation, see Table A-2 of the Online Appendix.

[6] For the data source for estimation, see Table A-3 of the Online Appendix.

[7] See Figure A-2 of the Online Appendix.

[8] See Figure A-3 of the Online Appendix.

interest rates[9] and covert those to the value equivalent to the one-year treasury bond rate of Korea by considering the difference in the level of interest rates with the benchmark rate.

4.2. Forward-looking Generational Accounts

Although the computing process of the FGA is similar to that for the RGA, several differences are found. FGA excludes OT2 and DFT, which were repealed, and include government spending instead, which is G in Equation (3). In addition, FGA computing demands the assessment of the cash flow of government finance for the future periods, whereas RGA requires its historical records. The projection of government spending is needed because it affects the required tax revenue which must be raised in the future period.[10]

The aggregates and the gender-age distributions of taxes and transfers of the future should be assessed to compute FGA. We take an alternative approach given that the information for the estimation of the distributions is limited. The distribution of the items of government revenue and expenditure, except for the public pensions, do not change over time. The gender-age profiles are the same as those in the benchmark year. The constant gender-age profiles indicate that the current policies are assumed maintained. This assumption is relevant for the traditional GA, in that the accounts for the current generations, the first term of the left-hand side of Equation (3), are assessed using the profiles of taxes and transfers projected based on current fiscal policies.

We take a few steps to compute FGA for the programs with constant gender-age profiles. First, we project their aggregate values. The aggregates are then allocated using the profiles for each year. Finally, we compute the present value of each item for the remaining lifetime.[11]

The projection of the cash flow overtime begins with the classification of the benefits and taxes into two categories: non-age-specific items, the aggregates of

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[9] We gather the interests from several sources: Economic Statistics System of Bank of Korea (ECOS), Cho and Kim. (1997), and Bank of Korea (BOK, 2005). The series we use are deposit interest rates (1948–1963, from BOK, 2005), general bank loan interest rates (1964–1975, from Cho and Kim, 1997), corporate bond rates (pit tranding, 1976–1991, from ECOS), corporate bond rates (over-the-counter, AA-, 1992–1994, from ECOS), 3-year treasury bond rate (1995–1999, from ECOS), and 1-year treasury bond rate (2000–, from ECOS). See Figure A-4 of the Online Appendix.

[10] The scope of the government should be determined for government spending projection. We follow the definition of the general government of national accounts (NA). The exceptions are the occupational pensions, which include PCS and PPS, which belong to the financial corporation group in NA. The expenditure of these public pensions is reflected in the projection for transfer payments. Therefore, the total government spending is the total expenditure of the general government net of the transfer payments in the form of the benefits of NPS, HI, EI, WC, MLSS, LC, and BP.

[11] For the assumptions of macroeconomic variables needed for the projection and the discount rates, see Table A-4 of the Online Appendix.

which do not depend on the age structure of the population, and age-specific items,[12] whose total values are affected by the demographic structure. For the non-age-specific items, we assume that the total values increase at GDP growth rate. For the age-specific items, we assume that the average level for the relevant age groups grows with labor productivity improvement.

For public pensions, the assumption of time-varying gender-age profiles is inevitable because their distribution of benefits and contributions are expected to change over time. Owing to its short history, few NPS participants have acquired the entitlement for pension benefits. However, the number and the distribution of benefits recipients are expected to change over time. In addition, a series of revision of pension policy affects the benefit level differentially across cohorts. Therefore, we construct separate pension benefit and contribution projection models for public pensions.

We use 2008 NPS Finance Recalculation Report by NPS Corporation (NPC) to project NPS benefits and contributions by year-gender-age. We adjust NPC projection in two ways: we recalculate the distributions of NPS insurants and pension benefit recipients based on the 2010 Statistics Korea (SK) population projection because NPC projection is based on the 2006 population projection; we also recalculate the average income of pension participants and the average benefit amount because our assumptions about macroeconomic variables, such as growth and inflation rates, are different from projected values of NPC.

We construct projection models for the benefits and contributions of PCS and PPS. The distribution of participants and benefit recipients and their aggregates and the profiles of average levels of contributions and benefits by year-gender-age are imputed based on the statistical yearbooks published by their administrative organizations, such as the *Statistical Yearbook for the PCS* and the *Statistical Yearbook for the PPS*.

The total social welfare expenditure is expected to increase from 6% of the GDP in 2013 to 15% (17%) of the GDP in 2060 (2100).[13] The NPS benefit expenditure is predicted to take the largest proportion, followed by HI expenditure. The expenditure of the occupational pensions (PCS, PPS) reaches 1.4% of GDP in the long-run, and that of MLSS is expected to show a slight increase if the current policy is maintained. However, BP and LC expenditure are projected to increase substantially over time from 0.25% and 0.3% in 2013 to 1.4% and 1%, respectively.

The projection of the government consumption shows the maintenance of the current level or its slight decrease because of the decrease in expenditure for public education, which results from school-age population reduction due to low fertility

[12] They include the benefits and contributions of public pensions, HI, EI, WC, the benefits of MLSS, LC, BP, and EITC, taxes, such as labor income tax, Capt, government consumption and investment for education, and health and social welfare.

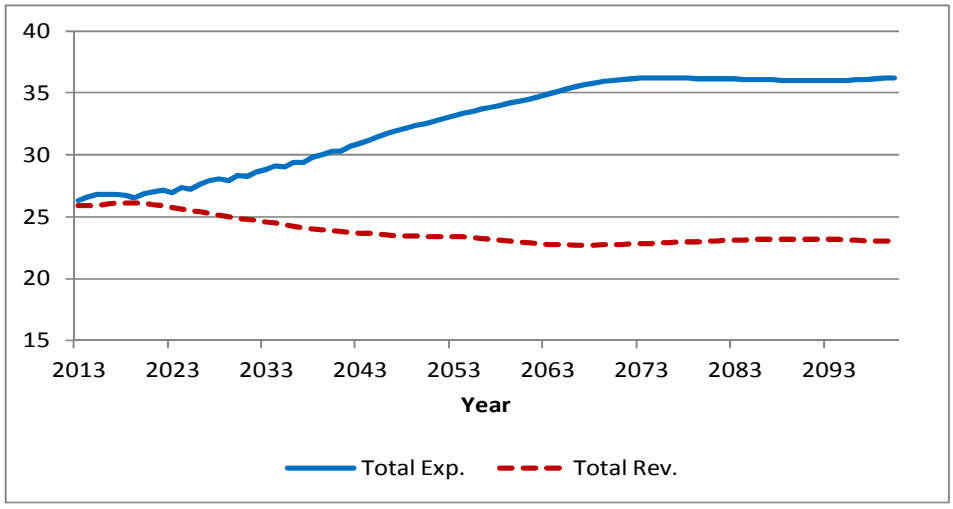
[13] See Figure A-5 of the Online Appendix.

rate. The government spending for health and welfare, as a percentage of GDP, is expected to increase, but the magnitude of increase is not large.[14]

The social insurance contribution revenue is expected to slightly increase from 6.5% in the benchmark year to 6.9% for the next 10 years and to decrease to 6% in the long run. The tax revenue is projected to decrease from approximately 19% at present to 17% around 2100.[15]

Total government expenditure, which is the sum of government consumption and social welfare expenditure, is expected to increase from 26.3%[16] in 2013 to 34.3% in 2060 to reach 36.2% in 2100. Total government revenue, which is the sum of tax revenue and social insurance contribution revenue, is projected to decrease from 25.9% currently to 23.0% in 2060 and stay at almost at the same level (Figure 1). The projection results indicate that the basic government deficit reaches 11.3% of GDP in 2060 and 13.2% in 2100, unless the policy revisions for the improvement of fiscal sustainability are implemented.

[Figure 1] Total Revenue and Expenditure (% of GDP)



Source: Author's calculation.

[14] See Figure A-6 of the Online Appendix.

[15] See Figure A-7 and A-8 of the Online Appendix.

[16] The expenditure of the general government reported in NA in 2013 is 31.6% of GDP, which is 5.3% larger than our aggregate value. For the correct comparison of government expenditure with total government revenue, which is the sum of tax and social insurance revenues, we make a few adjustments. First, we remove property income (use) and property income (source) from expenditure and revenue to obtain the basic government budget balance. Second, we reflect only net (current and capital) transfer to non-government sectors by subtracting the transfers from private sectors and foreign countries from the revenue and expenditure sides of the general government. Finally, we remove the value of the production of the public sector for market sales and self-consumption from revenue and expenditure sides because these two items are included in the two sides of government finance.

V. Findings

5.1. Benchmark Case

Tables 1, 2, and 3 report RGA, FGA, and FLGA, respectively. The net payment of each cohort is converted to the value of the productivity level as of the benchmark year (2013). RGA shows that the net payment of the past is the highest for the aged 60 in the benchmark year, and it is lower for older age groups because (i) the labor participation periods for those aged 65 and older overlap those until 1970s, when the ratio of total tax burden to GDP is lower than that of succeeding years and (ii) their transfer income in the form of social welfare benefits is larger than that in other age groups. The magnitude of the net benefit from HI, LC, MLSS, and BP is quite large. The net benefits from public pensions are significant. The pension benefit payments of NPS for the elderly are not large because few NPS participants have acquired such payments because of NPS's short history. However, the net benefits from PCS and PPS, which started to pay pension benefits much earlier than NPS, are quite large, because of relatively large pension benefits compared with the pension contribution burden. The tax burden of the past could be under-evaluated for some age groups, as our analysis covers since 1949. Those aged 99 (90) as of 2013 was 35 (24) years old in 1949, and approximately 20 (10) years of labor participation period is excluded. Nevertheless, the truncation of analysis period does not cause a serious problem because the analysis includes the entire working period of most age groups, except for the super senior groups.

FGA (Table 2), which does not include the past taxes and public transfers, shows a typical pattern of the traditional GA: (i) the net taxes for the younger age groups are positive because their tax-paying period is long, and (ii) the net taxes for the elderly are negative because the period is short and the benefits from the government, in the form of public pension benefits and medical insurance benefits, are large for the older age groups.

The comparison of the accounts among social welfare policies reveals that the net benefits from public pensions are the largest for most of age groups, followed by HI. The accounts for public pensions are negative for all the age groups of current generations despite recent pension policy revisions, which implies that, under the current policies, every cohort alive in the benchmark year gains from public pensions. The NPS pension contribution rate, currently at 9%, remains lower than that required to finance the benefits for future periods. In the case of PCS and PPS, the promised benefit level is higher than the expected contribution revenue. The absolute value of the net benefits from HI is smaller than that of the public pensions but the HI accounts are negative for all the current generations. The benefits from LC and BP are significant. The value of LC benefits is more skewed to older age groups than to the value of BP benefits because the target population groups for LC is super seniors aged 80 and older, whereas BP is a universal program for the elderly. The absolute level of LC benefit value is quite high and almost half the level of HI.

[Table 1] Generational Accounts (RGA, Total, unit: 1,000 won)

age	Public Pen.	HI	LC	EITC	MLSS	BP	EI	WC	LabT	CapT	ConT	AHT	ATT	OT1	OT2	DF	Total
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	-1	-3,762	0	0	-174	0	0	0	0	0	6,591	0	0	251	0	0	2,905
10	-9	-5,272	0	0	-514	0	0	-2	0	0	13,001	0	0	525	0	0	7,729
15	-25	-5,354	0	0	-996	0	0	-6	0	0	18,959	0	0	646	0	0	13,223
20	90	-4,860	0	-58	-1,415	0	-112	28	402	5	25,497	23	0	684	0	2	20,285
25	1,194	-3,020	0	-78	-1,069	0	-701	292	2,244	1,537	35,026	789	3,526	1,868	0	243	41,851
30	5,650	399	0	-78	-502	0	-1,172	731	5,293	6,106	47,155	2,269	7,193	3,885	0	723	77,650
35	10,886	3,251	0	-149	-262	0	-636	1,001	9,070	13,364	61,737	4,214	10,284	6,707	0	1,258	120,725
40	16,097	5,965	0	-149	-380	0	251	1,302	13,425	23,880	73,272	6,790	13,551	8,180	235	1,456	163,874
45	19,505	7,952	0	-171	-678	0	772	1,475	17,753	34,030	82,928	9,310	18,146	9,426	353	3,246	204,048
50	21,331	8,362	0	-170	-906	0	948	1,555	21,602	41,222	90,690	11,744	20,879	11,500	353	6,065	235,175
55	21,818	6,550	0	-226	-1,005	0	953	1,409	25,863	50,076	99,052	14,120	24,786	14,297	898	10,041	268,633
60	17,427	3,300	0	-228	-940	0	912	689	28,439	57,812	104,515	16,358	27,735	16,675	905	12,084	285,684
65	-3,270	-1,284	-302	-113	-982	0	749	14	28,564	62,256	106,005	18,699	28,127	17,324	910	12,922	269,619
70	-16,917	-8,853	-469	-111	-1,480	-3,425	1,375	-229	26,472	62,466	105,535	19,455	22,117	16,544	910	13,445	236,836
75	-18,124	-15,466	-983	-55	-2,147	-3,425	829	-811	22,088	57,803	103,162	18,964	15,331	15,569	910	12,461	206,105
80	-16,293	-19,006	-2,030	-52	-2,804	-3,425	344	-1,500	15,429	51,210	101,894	17,005	10,705	14,431	910	12,894	179,711
85	-17,871	-22,499	-3,784	0	-3,361	-3,425	-161	-2,357	12,503	47,297	100,022	16,215	8,255	13,683	910	12,237	157,663
90	-17,111	-25,688	-8,013	0	-3,643	-3,425	-329	-3,117	9,504	45,076	96,830	15,820	5,829	12,367	910	11,404	136,414
95	-15,858	-25,469	-8,013	0	-3,766	-3,425	-329	-3,712	6,954	39,325	85,369	14,186	3,954	10,361	910	10,241	110,728
99	-15,745	-25,933	-8,013	0	-3,766	-3,425	-329	-3,897	4,978	32,890	76,285	12,063	2,803	8,908	910	9,291	87,021

Source: Author's calculation.

[Table 2] Generational Accounts (FGA, Total, unit: 1,000 won)

age	Public pen.	HI	LC	EITC	MLSS	BP	EI	WC	LabT	CapT	ConT	AHT	ATT	OT1	Total
	-47,043	-30,587	-17,728	-1,318	-7,491	-13,823	1,740	1,730	46,223	65,683	168,666	37,361	45,031	22,886	271,331
0	-57,937	-27,357	-18,467	-1,367	-7,569	-14,374	1,807	1,786	47,781	68,443	165,835	38,370	45,184	22,958	265,094
5	-77,557	-25,926	-18,986	-1,406	-7,473	-14,863	1,950	1,822	49,375	71,325	161,843	39,218	44,996	22,930	247,249
10	-62,660	-25,578	-19,540	-1,441	-7,167	-15,329	2,116	1,837	50,631	74,267	156,977	39,804	44,126	22,709	260,752
15	-59,207	-25,056	-19,704	-1,454	-6,583	-15,623	2,364	1,767	51,107	76,888	150,265	40,010	43,314	22,279	260,368
20	-65,796	-26,922	-20,082	-1,435	-6,332	-15,762	2,882	1,413	48,144	76,811	138,135	38,557	38,401	20,777	228,790
25	-86,800	-29,731	-20,474	-1,417	-6,289	-15,912	3,532	836	43,432	75,191	124,037	36,175	32,639	18,687	173,908
30	-89,498	-32,914	-20,872	-1,338	-6,289	-16,226	3,665	308	38,477	73,092	110,803	33,655	26,895	16,425	136,183
35	-88,634	-36,491	-21,068	-1,253	-6,188	-16,451	3,416	-185	32,543	68,169	97,326	30,425	21,807	14,227	97,644
40	-84,191	-39,641	-20,834	-1,106	-5,885	-16,524	2,908	-633	26,087	61,230	83,654	26,730	17,299	12,116	61,210
45	-95,102	-41,823	-20,122	-949	-5,394	-16,476	2,359	-1,018	19,528	53,345	70,556	22,608	13,925	10,014	11,452
50	-72,837	-42,747	-19,541	-699	-4,891	-16,525	1,773	-1,211	13,051	43,089	57,715	18,226	9,289	7,714	-7,593
55	-60,477	-42,212	-19,051	-452	-4,402	-16,921	1,300	-1,124	7,724	32,282	45,974	13,871	4,628	5,682	-33,177
60	-44,199	-39,972	-18,348	-308	-3,934	-17,436	898	-907	4,387	23,272	35,373	9,913	811	4,010	-46,439
65	-27,458	-36,476	-18,253	-167	-3,358	-13,942	0	-908	2,365	16,005	26,499	6,691	46	2,711	-46,244
70	-12,493	-31,257	-18,138	-84	-2,593	-10,742	0	0	1,050	10,739	19,961	4,193	0	1,844	-37,520
75	-5,460	-26,002	-18,304	0	-1,809	-7,991	0	0	376	6,395	12,771	2,223	0	1,154	-36,647
80	-1,297	-21,816	-19,252	0	0	-5,784	0	0	88	3,507	7,013	955	0	597	-35,988
85	-1,120	-15,310	-13,714	0	0	-4,028	0	0	8	699	217	282	0	77	-32,889
90	-2,437	-10,055	-9,061	0	0	-2,506	0	0	0	33	139	51	0	33	-23,803
95	-4,489	-3,340	-3,023	0	0	-678	0	0	0	1	46	2	0	11	-11,472
99															
Future Gen.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	732,768

Source: Author's calculation.

The value of BP benefit is not small despite the low level of per capita value, 100–200 USD per month as of 2016, because this program covers a large proportion of the elderly. The benefit from MLSS is smaller than that of BP despite its high per capita benefits for program beneficiaries because the eligibility condition for the benefit is restrictive.

Table 2 reports the present value, rest-of-life tax burdens by category. The largest present value (for ages 0 and 30) is Cont, followed by Capt, the tax on asset transactions, Labt, other taxes, and taxes on asset holdings. The three important characteristics of the Korean tax system are (i) the large share of Conts, (ii) the relative unimportance of Labts, and (iii) the large proportion accounted for by taxes on asset-holdings and asset transactions. Among Conts, value-added tax raises the largest revenue of all Conts, and special excise tax and transportation tax also contribute substantially to the tax revenue. Although labor-tax progressivity is quite high, the average effective Labt rate is quite low due to the large proportion of tax-exempt workers.[17] The accounts for ATT was reported much larger than those for AHT in previous studies. However, the difference in the accounts between the two taxes has been reduced due to the recent real estate market slowdown, which reduced housing transactions.

FLGA (Table 3), which is the sum of RGA and FGA, indicates that the net payments of the aged 65 and older are much smaller than those of other age groups. The accounts for younger age groups are also larger than those of older age groups. This tendency is observed even when the accounts are presented as ratios to the lifetime income,[18] which is the value of non-capital income for the entire lifetime (Figure 2). The division of FLGA by gender reveals that the net payments of females are much smaller than those of males. This conspicuous difference between genders is due to the low labor participation rate, the resulting low income, and the longer life expectancy of females. The tax burden of females is small, and their benefits from the social welfare system are large because of their low income. Moreover, their long life expectancy adds to the benefits from HI, LC, BP, and MLSS.

The high level of the generational imbalance (*GI*), the difference between the net tax of the aged 0 cohort, and the future generations as a percentage of the former account indicate that the current fiscal policy of Korea is unsustainable and causes serious generational inequity (Table 3). The magnitude of tax and transfer adjustment required to restore the long-term fiscal balance is large. The tax adjustment required to equalize the present value of government expenditure with

[17] The proportion of tax-exempt workers has declined from 52.9% in 2005 to 31.3% in 2013. Nevertheless, it remains higher than other OECD countries: 15.8% (Japan), 22.6% (Canada), 19.8% (Germany), and 23.1% (Austria) as of 2012.

[18] We include the non-capital income since the establishment of Korean government (1948) when computing the lifetime income because we do not cover the period prior to the Independence Day of Korea.

[Table 3] Generational Accounts (FLGA, Total, unit: 1,000 won)

age	Public pen.	HI	LC	EITC	MLSS	BP	EI	WC	LabT	CapT	ConT	AHT	ATT	OT1	OT2	DF	Total
0	-47,043	-30,587	-17,728	-1,318	-7,491	-13,823	1,740	1,730	46,223	65,683	168,666	37,361	45,031	22,886	0	0	271,331
5	-57,938	-31,119	-18,467	-1,367	-7,742	-14,374	1,807	1,786	47,781	68,443	172,426	38,370	45,184	23,209	0	0	267,999
10	-77,566	-31,197	-18,986	-1,406	-7,987	-14,863	1,950	1,820	49,375	71,325	174,844	39,218	44,996	23,454	0	0	254,978
15	-62,685	-30,932	-19,540	-1,441	-8,164	-15,329	2,116	1,831	50,631	74,267	175,936	39,804	44,126	23,355	0	0	273,976
20	-59,117	-29,916	-19,704	-1,511	-7,998	-15,623	2,253	1,795	51,509	76,893	175,762	40,032	43,314	22,963	0	2	280,653
25	-64,602	-29,943	-20,082	-1,514	-7,401	-15,762	2,180	1,705	50,388	78,348	173,161	39,346	41,927	22,645	0	243	270,641
30	-81,150	-29,332	-20,474	-1,495	-6,791	-15,912	2,361	1,567	48,725	81,298	171,192	38,444	39,831	22,572	0	723	251,558
35	-78,612	-29,663	-20,872	-1,487	-6,551	-16,226	3,028	1,309	47,548	86,456	172,539	37,869	37,179	23,132	0	1,258	256,908
40	-72,537	-30,526	-21,068	-1,402	-6,568	-16,451	3,667	1,117	45,968	92,049	170,597	37,215	35,357	22,407	235	1,456	261,517
45	-64,687	-31,689	-20,834	-1,276	-6,563	-16,524	3,680	841	43,840	95,261	166,582	36,040	35,445	21,542	353	3,246	265,258
50	-73,770	-33,461	-20,122	-1,120	-6,300	-16,476	3,307	538	41,130	94,567	161,246	34,352	34,804	21,513	353	6,065	246,627
55	-51,020	-36,196	-19,541	-925	-5,896	-16,525	2,726	198	38,914	93,166	156,767	32,346	34,076	22,011	898	10,041	261,039
60	-43,050	-38,911	-19,051	-681	-5,342	-16,921	2,212	-435	36,163	90,094	150,489	30,230	32,364	22,357	905	12,084	252,507
65	-47,469	-41,256	-18,650	-420	-4,915	-17,436	1,647	-892	32,951	85,529	141,377	28,612	28,938	21,334	910	12,922	223,180
70	-44,375	-45,329	-18,722	-278	-4,838	-17,367	1,375	-1,138	28,838	78,471	132,034	26,147	22,163	19,255	910	13,445	190,592
75	-30,617	-46,723	-19,120	-140	-4,740	-14,167	829	-811	23,138	68,542	123,123	23,157	15,331	17,413	910	12,461	168,585
80	-21,753	-45,008	-20,334	-52	-4,614	-11,416	344	-1,500	15,805	57,605	114,666	19,227	10,705	15,585	910	12,894	143,064
85	-19,168	-44,315	-23,036	0	-3,361	-9,209	-161	-2,357	12,591	50,805	107,035	17,170	8,255	14,279	910	12,237	121,675
90	-18,231	-40,999	-21,727	0	-3,643	-7,453	-329	-3,117	9,511	45,774	97,047	16,102	5,829	12,444	910	11,404	103,524
95	-18,295	-35,524	-17,074	0	-3,766	-5,931	-329	-3,712	6,954	39,358	85,509	14,236	3,954	10,394	910	10,241	86,925
99	-20,234	-29,273	-11,036	0	-3,766	-4,104	-329	-3,897	4,978	32,891	76,331	12,065	2,803	8,918	910	9,291	75,549
Future Gen.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	732,768

Generational Imbalance (*GI*, %)[1]		Required Tax Adjustment (%)[2]	Required Tax-Transfer Adjustment (%)[3]
170.1	2020	50.0	29.5
	2030	55.5	32.0
	2040	62.2	35.0
	2050	69.8	38.7

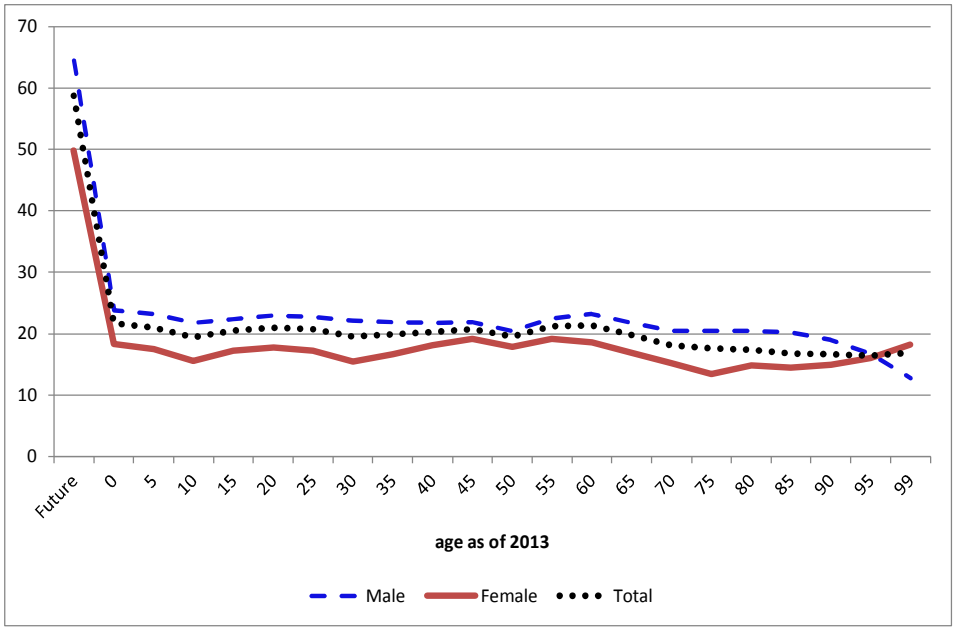
Note: 1) *GI*=(Account for future generation - account for the aged 0) ÷ account for the aged 0 x 100

2) Tax increase (as percentage of tax burden under the current policy) required to restore long-term budgetary balance in the year specified and thereafter

3) Tax increase accompanied by transfer reduction by the same ratio required to restore long-term budgetary balance in the year specified and thereafter.

Source: Author's calculation

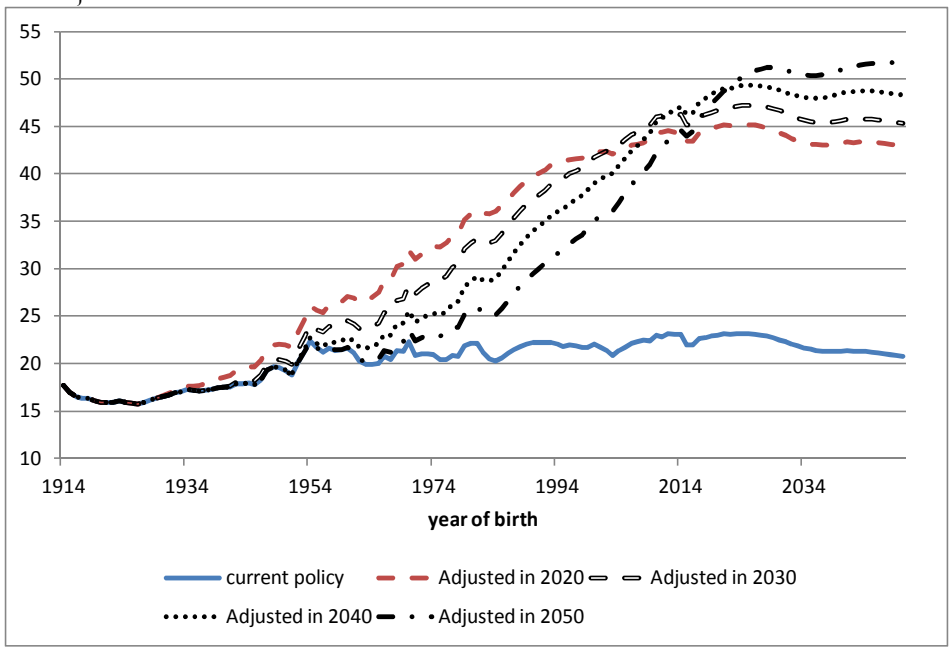
[Figure 2] FLGA by Gender (% of Lifetime Income)



Source: Author's calculation.

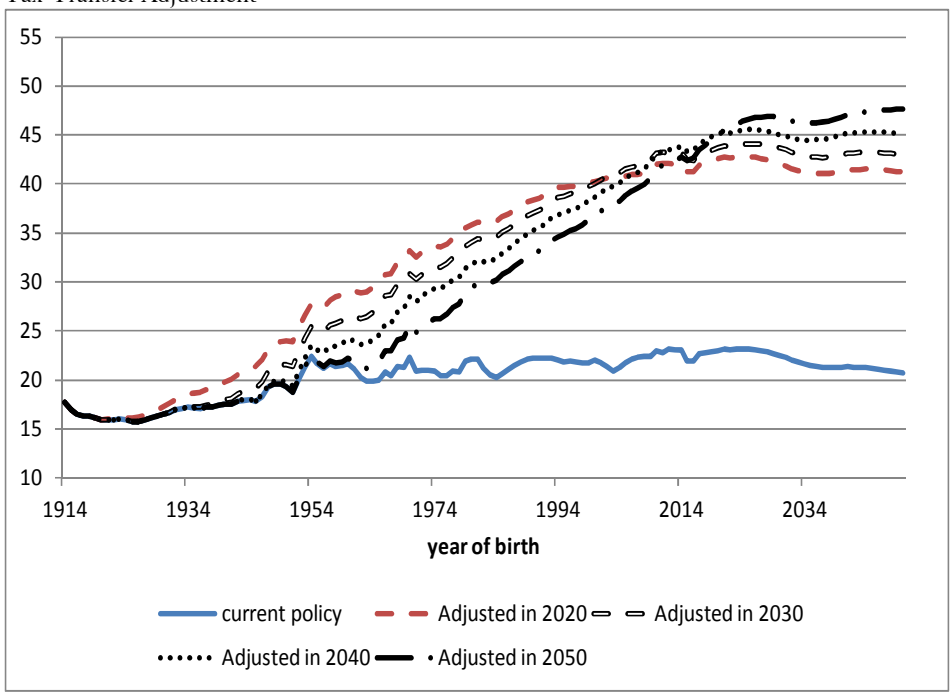
[Figure 3] Generational Accounts (FLGA, % of Lifetime Income)

Tax Adjustment[1)]



[Figure 3] continued

Tax-Transfer Adjustment[2)]



Note: 1) Tax increase (as the percentage of tax burden under the current policy) required to restore long-term budgetary balance in the year specified and thereafter;
2) Tax increase accompanied by transfer reduction by the same ratio required to restore long-term budgetary balance in the year specified and thereafter.

Source: Author's calculation.

that of its revenue is approximately 50.0% of the tax burden under the current tax policies if tax revision is implemented in 2020. If the revision is delayed until 2030 (2040, 2050), the adjustment scale is expected to increase to 55.5% (62.2%, 69.8%). If the tax increase is accompanied with the same percentage decrease in transfer payment, the required adjustment is reduced to 29.5% (32.0%, 35.0%, 38.7%) if the revision plan is implemented in 2020 (2030, 2040, 2050).

The division of future generations by the year of birth provides a clear picture of the generational inequity. FLGA by this classification (Figure 3) shows that the future generations have heavier fiscal burden than the current generations even under the hypothetical situation where the current fiscal policies are maintained. The implementation of revision plans to recover the fiscal sustainability worsens the inequality between generations. The tax adjustment, which raises the tax burden proportionally in 2020 (2030, 2040, 2050) and thereafter, boosts the lifetime net tax burden of the future generations up to the level higher than 40% of their lifetime income. The proportional tax increase accompanied by the decrease in the transfer

payment by the same percentage as that of the tax increase[19] also raises the fiscal burden to an unbearable level.

5.2. Effects of Demographic Transition

The generational accounts reported in Section 5.1 is computed under the baseline assumptions of Statistics Korea (SK) population projection on fertility rates, life expectancy, and international mobility rates. The total fertility rate gradually rises from 1.23 (2010) to 1.42 (2060); life expectancy is prolonged from 77.20 (84.07) for males (females) to 86.59 (90.30); net population inflow rate, which is the number of net inflows from abroad per 1,000 inhabitants, falls from 1.67 to 0.53 (Table 4). The fiscal sustainability and generational equity in net tax burden critically depend on the demographic structure. We generate eight alternative demographic transition paths based on the following assumptions: the optimistic assumptions of SK projection (optimistic), its pessimistic assumptions (pessimistic), high fertility assumptions (HF1, HF2), lower fertility assumptions (LF1, LF2), and the implementation of immigration policies (Imm1[20], Imm2[21]) (Table 4). All the scenarios generate the paths of population aging; the paths are combinations of increasing elderly population proportion and decreasing labor force population ratio; the total population declines in most cases except for Imm2, which assumes an extremely high net international population inflow rate (Figure 4).

The index for fiscal sustainability and generational equity varies depending on the demographic assumptions (Table 5). The generational imbalance (*GI*) ranges from 295.3 (under Pessimistic SK assumption) to 101.0% (under Optimistic SK assumption). The required tax (and transfer) adjustment is small under more demographically favorable assumptions. However, drastic fiscal reforms are needed even when the most hopeful population structure is assumed: *GI* is higher than 100% even under the "optimistic" SK population assumptions, and tax should be raised by more than 40% of that under the current policies to attain long-term

[19] For the required magnitude of tax and transfer adjustment to restore the long-term government finance balance, see Table 3.

[20] The net immigration rate, which is defined as the net migration per 1,000 inhabitants, of Canada from 2007 to 2012 was 33.84 (Wikipedia, https://en.wikipedia.org/wiki/List_of_countries_by_net_migration_rate). It is higher than that of other developed countries, which adopt open-door immigration policies, such as Germany (15.54), the United Kingdom (14.13), and the US (15.94). The assumption, Imm2, is an example of an extremely aggressive (and probably unrealistic) immigration policy to induce foreign labor force inflows.

[21] We adjust the age profile of net international inflow and the absolute level of the inflow rate in the scenario Imm1 and Imm2. The profiles under the baseline assumption show the outflow of males aged 20–25 and females aged 17–19. We assume that immigration policies implemented in near future prevent the outflow and induces the inflow of labor force population aged 15–50. In addition, the net outflow of the children aged under 15 is assumed at most 0. The productivity of the immigrants is assumed as high as that of natives. See Figure A-9 of the Online Appendix.

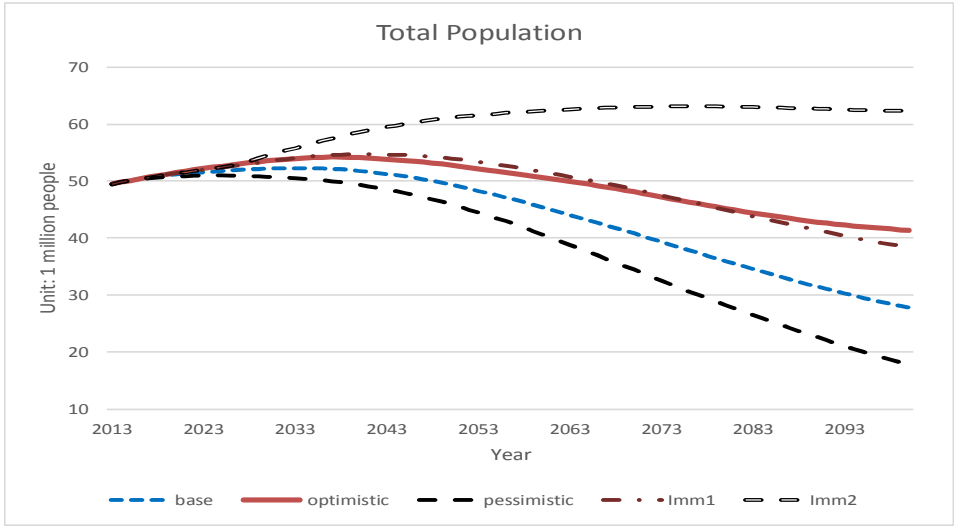
government budgetary balance. Even when the transfer payment is reduced with the same rate of tax increase, tax and transfer should be adjusted more than 20% of those under the current policies. These findings indicate that the most important source of the fiscal imbalance and the generational inequity is the fiscal policies, which promise large government transfer payment and government consumption that can be financed under the current tax policies. Moreover, the effects of

[Table 4] Demographic Assumptions

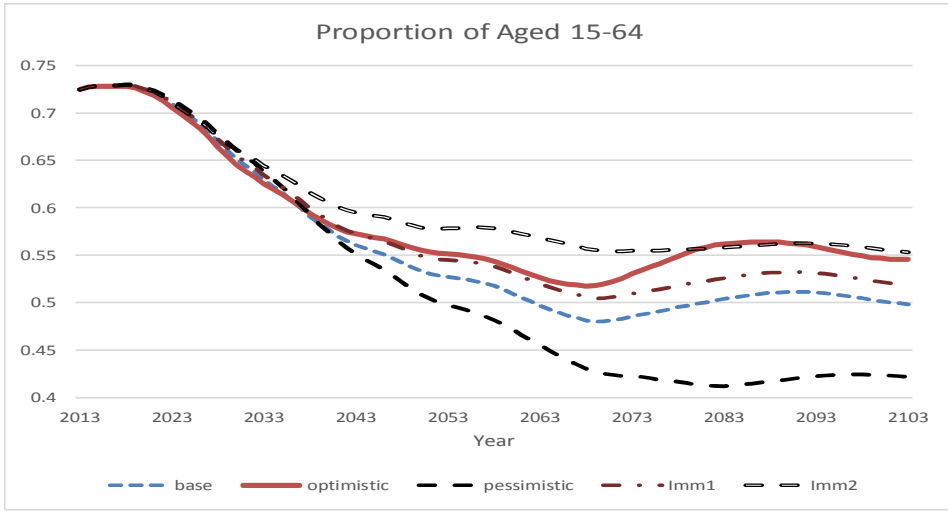
	Total Fertility Rate	Life Expectancy	Net Immigration Rate[1)]
Baseline	1.23 (2010) to 1.43 (2060)	77.20 to 86.59 for males 84.07 to 90.30 for females	1.67 to 0.53
Optimistic	1.23 to 1.79	77.20 to 83.64 for males 84.07 to 87.81 for females	1.67 to 1.50
Pessimistic	1.23 to 1.01	77.20 to 89.09 for males 84.07 to 92.53 for females	1.67 to -0.07
HF1	1.23 to 1.61	the same as Baseline	the same as Baseline
HF2	1.23 to 1.79 (Optimistic)	the same as Baseline	the same as Baseline
LF1	the same as Baseline	77.20 to 87.84 for males 84.07 to 91.41 for females	the same as Baseline
LF2	the same as Baseline	77.20 to 86.59 for males 84.07 to 90.30 for females (Pessimistic)	the same as Baseline
Imm1	the same as Baseline	the same as Baseline	1.67 to 30 (Canada level)
Imm2	the same as Baseline	the same as Baseline	1.67 to 70

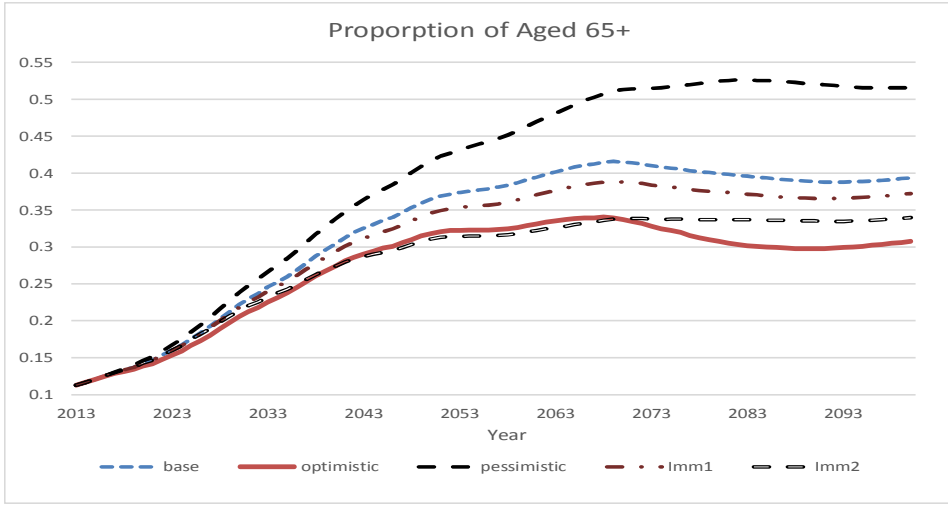
Note: 1) Number of net immigration per 1,000 inhabitants.

[Figure 4] Demographic Structure



[Figure 4] continued





Source: Author's Calculation.

demographic changes that result from fertility-boosting policies may be exaggerated. Recent empirical studies on their effectiveness have not provided a consensus on this issue.[22] Therefore, substantial increase in the fertility rates in assumptions

[22] Song and Choi (2010) presented empirical result that subsidy to childbirth has positive influence on the decision-making on childbirth. But their focus was the planning of having children, not the realized fertility rate change due to the policy. On the other hand, Choi and Lee (2017) showed that the subsidy to childbirth and childcare from local government does not have significant effects on childbirth. Kim and Hong (2013) suggested that child birth and care related government policies do not affect households' plan for two or more childbirth. Song and Woo (2015) demonstrated that the policy has significant effects on fertility rate, but their magnitude is small. Overall results on this issue

"optimistic," "HF1," and "HF2" may not be realized. Moreover, the effects of immigration policy revisions (Imm1, Imm2) in Table 5 should be interpreted with reservation because the productivity of the new immigrants is assumed as high as that of Korean natives. The maintenance of the current trend of the immigration policy, which aims to reduce the shortage of the unskilled workers in low-productive industries, will increase the welfare expenditure for the low-income foreign-origin workers and deteriorates government finance.

[Table 5] Effects of Demographic Transition (%)

	Pessimistic	LF2	LF1	**Baseline**	HF1	HF2	**Optimistic**	Imm1	Imm2
	Generational Imbalance (*GI*)								
	295.3	271.6	207.7	**170.1**	143.3	120.3	101.0	147.9	102.1
	Required Tax Adjustment								
2020	57.6	53.1	51.9	**50.0**	48.0	45.7	41.1	47.5	40.1
2030	67.8	62.1	59.1	**55.5**	52.3	49.0	43.7	51.1	41.6
2040	81.8	74.2	68.2	**62.2**	57.3	52.7	46.6	55.3	43.4
2050	100.0	89.8	79.2	**69.8**	62.8	56.7	49.8	60.0	45.4
	Required Tax-Transfer Adjustment								
2020	32.5	30.5	30.2	**29.5**	28.8	27.9	25.6	28.2	24.3
2030	36.7	34.3	33.3	**32.0**	30.8	29.5	26.9	29.9	25.1
2040	42.3	39.4	37.3	**35.0**	33.2	31.3	28.5	31.8	26.0
2050	49.8	45.9	42.2	**38.7**	36.0	33.5	30.2	34.2	27.0

Source: Author's calculation.

5.3. Policy Simulation

This section simulates the six revision plans to improve fiscal soundness and generational equity. Plans S1–S3 are regarding the NPS policy: the adjustment of normal pension age, replacement ratio of pension benefits, and NPS contribution rates. Plans 4, 5, and 6 raise the BP pension age, the HI contribution rates,[23] and the entitlement age for the LC, respectively (Table 6).

The parametric revision plans show only limited effects on fiscal sustainability and generational inequity under the baseline demographic assumption of SK population projection. Enforcing all six plans reduces *GI* and the required tax (and transfer) adjustment for fiscal soundness on a small scale: *GI* is still over 100%, and the required adjustment remains at a level that is higher than 30% and 20%. Among the six plans, S5 is most effectively achieves the policy objectives. However, the

indicate the risk of ineffectiveness of the fertility-promoting policies.

[23] The S5 revision plan assumes larger change in the HI contribution rate (4.11%P between 2014 and 2008) than that predicted by Lim (2016) (0.7%P between 2015 and 2060) because S5 considers the fact that the HI contribution revenue is used to partially finance LC expenditure, whereas Lim (2016) focused only on HI finance.

comparison of the effects among the plans should be made with reservations by considering their heterogeneous welfare effects.

We compute the indices for the fiscal sustainability and the generational equity by assuming hopeful demographic scenarios. The fertility rates are raised due to the subsidies to childbirth and childcare (HF1, HF2), and productive labor forces inflowed as a result of aggressive immigration policies (Imm1, Imm2). Even when

[Table 6] Simulation Plan

<table>
<tr><td>Current</td><td>S1</td><td>Current</td><td>S2</td></tr>
<tr><td>
<table>
<tr><td>Birth Year</td><td>Entitlement Year</td></tr>
<tr><td>-’52</td><td>60</td></tr>
<tr><td>’53-’56</td><td>61</td></tr>
<tr><td>’57-’60</td><td>62</td></tr>
<tr><td>’61-’64</td><td>63</td></tr>
<tr><td>’65-’68</td><td>64</td></tr>
<tr><td>’69-</td><td>65</td></tr>
</table>
</td><td>
<table>
<tr><td>Birth Year</td><td>Entitlement Year</td></tr>
<tr><td>-’52</td><td>60</td></tr>
<tr><td>’53-’55</td><td>61</td></tr>
<tr><td>’56-’57</td><td>62</td></tr>
<tr><td>’58-’59</td><td>63</td></tr>
<tr><td>’60-’61</td><td>64</td></tr>
<tr><td>’62-’63</td><td>65</td></tr>
<tr><td>’64-’65</td><td>66</td></tr>
<tr><td>’66-’67</td><td>67</td></tr>
<tr><td>’68-’69</td><td>67</td></tr>
<tr><td>’70-’71</td><td>67</td></tr>
<tr><td>’72-</td><td>67</td></tr>
</table>
</td><td>
<table>
<tr><td>Year</td><td>Replacement Ratio</td></tr>
<tr><td>2008</td><td>50%</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td>2015</td><td>46.5%</td></tr>
<tr><td>2016</td><td>46.0%</td></tr>
<tr><td>2017</td><td>45.5%</td></tr>
<tr><td>2018</td><td>45.0%</td></tr>
<tr><td>2019</td><td>44.5%</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td>2027</td><td>40.5%</td></tr>
<tr><td>2028-</td><td>45.0%</td></tr>
</table>
</td><td>
<table>
<tr><td>Year</td><td>Replacement Ratio</td></tr>
<tr><td>2008</td><td>50%</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td>2015</td><td>46.5%</td></tr>
<tr><td>2016</td><td>46.0%</td></tr>
<tr><td>2017</td><td>45.333%</td></tr>
<tr><td>2018</td><td>44.666%</td></tr>
<tr><td>2019</td><td>44.0%</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td>2027</td><td>38.666%</td></tr>
<tr><td>2028-</td><td>38.0%</td></tr>
</table>
</td></tr>
<tr><td>Current</td><td>S3</td><td>Current</td><td>S4</td></tr>
<tr><td>NPS Contribution Rate 9%</td><td>Contribution rate raised from 2017</td><td>-</td><td>Basic Pension’s entitlement age raised as in S1</td></tr>
<tr><td>Current</td><td>S5</td><td>Current</td><td>S6</td></tr>
<tr><td>
HI contribution Rate Adjustment
<table>
<tr><td>2014</td><td>5.99%</td></tr>
<tr><td>2015</td><td>6.07%</td></tr>
<tr><td>2016</td><td>6.12%</td></tr>
<tr><td>2017</td><td>Not determined</td></tr>
</table>
</td><td>
<table>
<tr><td>2014</td><td>5.99%</td></tr>
<tr><td>2015</td><td>6.07%</td></tr>
<tr><td>2016</td><td>6.12%</td></tr>
<tr><td>2017</td><td>6.38%</td></tr>
<tr><td>2018</td><td>6.73%</td></tr>
<tr><td>2019</td><td>7.08%</td></tr>
<tr><td>2020</td><td>7.42%</td></tr>
<tr><td>2021</td><td>7.75%</td></tr>
<tr><td>2022</td><td>8.08%</td></tr>
<tr><td>2023</td><td>8.41%</td></tr>
<tr><td>2024</td><td>8.74%</td></tr>
<tr><td>2025</td><td>9.07%</td></tr>
<tr><td>2026</td><td>9.41%</td></tr>
<tr><td>2027</td><td>9.75%</td></tr>
<tr><td>2028-</td><td>10.10%</td></tr>
</table>
</td><td>LC Entitlement Age: 65</td><td>
<table>
<tr><td>2015</td><td rowspan="2">65</td></tr>
<tr><td>2016</td></tr>
<tr><td>2017</td><td rowspan="2">66</td></tr>
<tr><td>2018</td></tr>
<tr><td>2019-</td><td>67</td></tr>
</table>
</td></tr>
</table>

[Table 7] Policy Simulation (%)

		Base case	S1	S2	S3	S1-3	S4	S5	S6	S1-6
Generational Imbalance (*GI*)[1]										
Baseline Demo		170.1	156.9	164.0	161.8	144.5	168.4	128.7	169.4	107.2
HP1		143.3	132.6	138.3	136.5	122.2	142.0	108.3	142.8	90.4
HP2		120.3	111.5	116.1	114.7	102.8	119.2	90.4	119.9	75.4
Imm1		147.9	135.7	142.0	140.4	124.2	146.4	110.4	147.3	90.8
Imm2		102.1	89.4	94.2	93.4	80.0	98.1	69.6	98.9	53.9
Required Tax Adjustment (%)[2]										
Baseline Demo.	2020	50.0	47.4	49.6	48.0	45.0	49.8	40.2	49.9	35.3
	2030	55.5	52.6	55.1	53.2	49.9	55.2	44.6	55.4	39.1
	2040	62.2	58.9	61.7	59.6	55.9	61.8	49.9	62.0	43.8
	2050	69.8	66.1	69.3	66.9	62.8	69.5	56.1	69.7	49.2
HP1	2020	48.0	45.4	47.7	45.9	43.0	47.8	38.5	47.9	33.6
	2030	52.3	49.4	51.9	50.0	46.8	52.0	41.9	52.2	36.5
	2040	57.3	54.1	56.8	54.8	51.3	57.0	45.9	57.2	40.0
	2050	62.8	59.4	62.4	60.1	56.2	62.5	50.4	62.7	43.9
HP2	2020	45.7	43.1	45.4	43.6	40.8	45.5	36.6	45.6	31.7
	2030	49.0	46.2	48.7	46.7	43.7	48.7	39.1	48.9	33.9
	2040	52.7	49.6	52.3	50.2	46.9	52.4	42.1	52.6	36.5
	2050	56.7	53.4	56.3	54.1	50.5	56.4	45.3	56.6	39.3
Imm1	2020	47.5	44.7	47.1	45.4	42.3	47.2	37.8	47.4	32.2
	2030	51.1	48.1	50.7	48.8	45.5	50.8	40.7	51.0	35.2
	2040	55.3	52.0	54.9	52.8	49.2	55.0	44.0	55.2	38.1
	2050	60.0	56.5	59.6	57.3	53.4	59.7	47.8	59.9	41.3
Imm2	2020	40.1	37.1	39.7	37.8	34.7	39.7	30.8	39.9	25.7
	2030	41.6	38.5	41.3	39.3	36.1	41.3	32.0	41.5	26.7
	2040	43.4	40.2	43.1	41.0	37.6	43.1	33.4	43.3	27.8
	2050	45.4	42.1	45.1	42.9	39.4	45.1	35.0	45.3	29.1
Required Tax-Transfer Adjustment (%)[3]										
Baseline Demo.	2020	29.5	28.4	29.3	28.5	27.2	29.4	24.4	29.5	21.9
	2030	32.0	30.8	31.8	30.8	29.5	31.9	26.4	31.9	23.8
	2040	35.0	33.7	34.8	33.8	32.3	34.9	29.0	35.0	26.1
	2050	38.7	37.3	38.5	37.3	35.7	38.5	32.0	38.6	28.8
HP1	2020	28.8	27.6	28.6	27.7	26.4	28.7	23.7	28.7	21.2
	2030	30.8	29.5	30.6	29.6	28.2	30.6	25.3	30.7	22.7
	2040	33.2	31.9	33.0	31.9	30.4	33.0	27.3	33.1	24.4
	2050	36.0	34.6	35.8	34.6	33.0	35.8	29.6	35.9	26.5
HP2	2020	27.9	26.7	27.8	26.8	25.5	27.8	22.9	27.9	20.3
	2030	29.5	28.3	29.4	28.3	26.9	29.4	24.2	29.4	21.5
	2040	31.3	30.0	31.2	30.1	28.6	31.2	25.7	31.3	22.8
	2050	33.5	32.1	33.3	32.1	30.6	33.3	27.5	33.4	24.4

[Table 7] continued

Imm1	2020	28.2	27.0	28.1	27.1	25.7	28.1	23.1	28.2	20.5
	2030	29.9	28.6	29.7	28.7	27.3	29.7	24.4	29.8	21.7
	2040	31.8	30.5	31.7	30.6	29.1	31.7	26.1	31.8	23.2
	2050	34.2	32.7	34.0	32.8	31.2	34.0	28.0	34.1	24.9
Imm2	2020	24.3	23.0	24.2	23.1	21.7	24.2	19.3	24.3	16.5
	2030	25.1	23.7	25.0	23.9	22.3	25.0	19.8	25.0	17.0
	2040	26.0	24.5	25.9	24.7	23.1	25.9	20.6	25.9	17.6
	2050	27.0	25.5	26.9	25.7	24.1	26.9	21.4	27.0	18.3

Note: 1) GI=(account for future generation − account for the aged 0) ÷ account for the aged 0 x 100.

2) Tax increase (as the percentage of tax burden under the current policy) required to restore long-term budgetary balance in the year specified and thereafter.

3) Tax increase accompanied by transfer reduction by the same ratio required to restore long-term budgetary balance in the year specified and thereafter.

Source: Author's calculation.

we assume the successful functioning of fertility promoting and immigration policies, the parametric reforms do not completely solve the problem of fiscal imbalance and generational equity. Even in the most successful case (Imm2), *GI* is larger than 50%, and the required tax (and transfer) adjustment is higher than 25% (15%). Therefore, more fundamental fiscal reforms are needed to recover generational equity and fiscal balance.

VI. Conclusion

In this study, we attempt to evaluate the fiscal sustainability of the current policies and address their effects on the generational equity, using generational accounting (GA). Unlike previous studies that apply GA to Korean fiscal policies, we compute retrospective generational accounts (RGA), which assess the value of the net taxes paid in the past period since the establishment of the government of Republic of Korea (South Korea) in 1948, and combine this with the traditional FGA, which appraise the rest-of-life net tax burden, to obtain FLGA, which covers the entire lifetime for all the cohorts.

Our findings are summarized as follows. The net tax burden is larger for the future generations (younger age groups) than for the current generations (older age groups), even when we take explicit consideration of the taxes paid by the elderly in the past. This finding indicates that the fiscal policies of South Korea bring about generational inequity. In addition, FLGA shows that the current fiscal policies are unsustainable and that tax and transfer adjustment on a large scale is required to recover the long-term budgetary balance of the Korean government. This inevitably

raises the net tax burden of the younger age groups and future generations, and its absolute magnitude should be lifted to an unbearable level, which is higher than 40% of the lifetime income. This is an important source of generational conflicts. Finally, we show that the parametric reforms to resolve the fiscal imbalance and generational inequity, which the Korean government considered and included the revisions of NPS, HI, BP, and LC, have only limited effects, even under the demographic assumptions that subsidizes child birth and care, and the open-door immigration policy substantially (but not completely) reverses the process of population aging and population reduction in the future. This finding indicates the requirement of more fundamental reforms for stabilizing the Korean public finance and mitigating the conflicts among generations.

For complete RGA computation, our analysis should be extended back to the 1910s. The assessment of net tax burden needs to cover the Japanese colonial period (1910–1945) and the transitional period from the liberalization from Japanese occupation to the establishment of the government of the Republic of Korea. The attempt to evaluate the fiscal burden for these periods does not simply imply the extension of the period subject to the analysis but also the participation into the historical and ideological debate on the socioeconomic significance of the Japanese colonial occupation of the Korean peninsula. Reliable research on the controversial period should be accumulated to successfully contribute to the academic debate. We recognize this limitation and leave this for future work.

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Online Appendix:
https://drive.google.com/file/d/1ZYm06DK0Vy0WbmqNlRpmc_7DSgyJSdub/view

Wikipedia, https://en.wikipedia.org/wiki/List_of_countries_by_net_migration_rate