The Fiscal Burden of Korean Reunification:

A Generational Accounting Approach

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Abstract

This paper uses Generational Accounting to assess the fiscal impacts of Korean reunification. Our findings suggest that early reunification will result in a large increase in the fiscal burden for most current and future generations of South Koreans. The Korean reunification's fiscal impact appears much larger than that of German reunification, due to a wider gap in productivity between the two Koreas and North Korea's much larger share of the unified country's population. The projected large-scale fiscal burden on South Korea is attributable primarily to the rapid increase in social welfare expenditure for North Korean residents, rather than to the direct reconstruction cost of the North Korean economic system after the disintegration of its old economic regime.

1. Introduction

The relationship between South and North Korea in many fields, including politics, economics, and social affairs, has substantially improved over the past decade. Even though recent international developments surrounding North Korea do not presage a closer relationship between the two Koreas in the near future, the majority of South Koreans views these developments as transitory and expects that the two Koreas will be reunified eventually.

A key issue of Korean reunification will be its cost. The reunification cost will depend on the political process of reunification, the political, economic, and social structure of North Korea after the reunification, the productivity gap between the two Korean regions, and the fiscal policies that will be implemented in a reunified Korea. As to the first two aspects, there is little one can say at present, so we will work with simple assumptions and focus on the last two aspects. We consider a hypothetical situation where the economic system of North Korea will make the transition from central planning and the current fiscal policies of South Korea will be implanted in the North Korean region of the newly unified country. We assess the cost of reconstruction of the North Korean economic system after the disintegration of its old regime, and estimate the taxes and transfers for North Korean residents and the cost of additional government provision of public goods to the North Korean region.

Previous research on the subject has focused mainly on reconstruction cost, producing a wide range estimates, from 6% (Lee 1993) to 25% (Park 1997) of South Korea's GDP for 10 years after reunification[1]. This past research, though, did not attempt a thorough investigation of the costs associated with other fiscal policy changes, even though the productivity gap between South and North Korea will inevitably increase expenditures on public goods and social welfare and limit the collection of taxes from the North Korean region for a considerable period after reunification.

The purpose of this paper is to assess the fiscal impact of the reunification of South and North Korea, by taking explicit account of projected changes in social welfare expenditures, government consumption, and the North Korean region's tax bases, as well as direct reconstruction costs. We use Generational Accounting (GA) to do so, as GA is a natural tool for investigating how the costs of fiscal changes are distributed among different population cohorts. GA covers all relevant government fiscal policies, and its forward-looking properties allow us to explore how Korea's public finances will be affected by future reunification.

Our findings suggest that early reunification will result in a large increase in fiscal burden for most current and future generations of South Koreans, assuming that the productivity gap between the two Koreas does not substantially decrease before reunification. The overall magnitude of this added fiscal burden is much larger than that of German reunification, because (i) the productivity gap between South and North Korea is much larger than that between East and West Germany before reunification and (ii) North Korea's population is much larger, relative to the South, than was the case for East Germany relative to West Germany. The findings also suggest that increased spending on social welfare is much more important than direct reconstruction costs as a determinant of the added fiscal burden.

The remainder of this paper is organized as follows. Section 2 explains the basic concept of GA and the GA calculation methods. Section 3 explains the GA calculation procedure and data used to measure the fiscal impacts of reunification. Section 4 presents the accounts and

[1] Other previous research focusing on reconstruction cost includes An (1997) and Bae (1996).

discusses their implications. Section 5 summarizes findings and draws conclusions.

2. GA Calculation Method

2.1. Basic Framework[2]

Generational Accounting is based on the government's intertemporal budget constraint. This constraint, written as equation (1), 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 consumptions as well as service the government's initial net indebtedness.

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

The first summation on the left-hand side of (1) adds together the generational accounts (the present value of the remaining lifetime net payments) 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 (1) 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 (1) 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 (1) 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 (1)) necessitates an increase in the present value of net tax payment of future generations.

The term $N_{t,k}$ in (1) is defined by:

$$(2) \qquad N_{t,k} = \sum_{s=\max(t,k)}^{k+D} T_{s,k} P_{s,k} (1+r)^{-(s-t)}$$

In expression (2), $T_{s,k}$ 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 (1).

Note that generational accounts reflect only taxes and social insurance contributions (taxes henceforth) paid less transfers received. The accounts do not impute to particular generations

[2] See Auerbach, Gokhale, and Kotlikoff (1991, 1992a, 1992b, 1994) and Kotlikoff (1992) for further discussion.

the value of government's purchases of goods and services because it is difficult to attribute the benefits of such purchases[3]. Therefore, the accounts do not show the full net benefit or burden that any generation receives from government policy as whole, although they can show a generation's net benefit or burden from a particular policy change that affects only taxes and transfers. Thus, generational accounting tells us which generations will pay for government spending, rather than telling us which generations will benefit from that spending. Another characteristic of generational accounting that should be understood at the outset is that, as its name suggests, it is an accounting exercise that, like deficit accounting, does not incorporate induced behavioral effects or macroeconomics responses of policy changes. As a corollary, it does not incorporate the deadweight loss of taxation in its measure of fiscal burden, again following the tradition of budget incidence analysis.

2.2. The Standard Method

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 (1)). 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 (1) and the first term on the left-hand-side of equation (1), we determine, as a residual, the value of the second term on the left-hand side of equation (1), 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. Future generations are thus assumed to absorb the entire adjustment that is required to make the claims of various generations consistent with the intertemporal budget constraint.

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.

The computation of the total net payment across generations requires information about average tax burdens and transfer payments by age and sex. The standard calculation method used to project the average values of particular taxes and transfer payments by age and sex starts with government forecasts of the aggregate amounts of each type of tax and transfer payment in future years. These aggregate amounts are then distributed by age and sex based on cross-sectional relative age-sex-tax and age-sex-transfer profiles derived from cross-sectional micro-data sets. For years beyond those for which government forecasts are

[3] Bovenberg and ter Rele (2000) tried to incorporate the incidence of government consumption into generational accounts, assuming that all current generations enjoy the same (per capita) benefits from both government consumption and the public capital stock, with the latter benefits set at the imputed rent on the public capital stock. However, their approach does not attempt to deal with the "public" nature of government-provided goods.

available, age- and sex-specific average tax and transfer amounts are set equal to those for the latest year for which forecasts are available, with an adjustment for growth.

This procedure is based on the assumption that the age-sex-profiles of transfer payments and tax burdens do not change over time. The standard procedure also assumes that government purchases, transfer payments and tax revenues grow at the same rate as GDP, although in some cases they are broken down into age-specific components, with the assumption that each component remains constant per member of the relevant population, adjusted for the overall growth of GDP per capita.

2.3. Extending the Standard Method

To reflect important characteristics of the Korean fiscal situation, we modify the approach just described, by incorporating prospective changes in the age profiles of transfer payments and tax burden. There are two sets of factors underlying these prospective changes. The first set would be present in South Korea even without reunification, while the other relates to changes associated with reunification.

First, the maturation of the National Pension system (NPS) will change the age profiles and aggregate levels of benefits and contributions in South Korea. The average National Pension benefit per member of cohorts aged 70 and older is low compared with that for the aged between 55 and 70 at present, since the NPS does not cover a large proportion of the older age groups. In addition, the number of beneficiaries and the aggregate benefit amounts are limited, since most of those covered by the NPS, in older age cohorts, have not acquired entitlement to full benefits because of its short history. However, maturation of the system will increase the average benefit payments to old-age groups, which will flatten the age profile of benefits and increase the number of pension recipients and the aggregate pension benefit amount. We expect to observe a similar trend of maturation of the National Pension system for North Korean residents after the reunification.

Also, one can reasonably anticipate changes in social welfare expenditures, even if South Korea remains separate. Even though the aggregate amount of transfer payments by Medical Insurance and social welfare services and public assistance for South Koreans was limited in the past, its amount has been increasing rapidly for the past decade due to the recent structural changes in social welfare policies. Even the current level of social welfare expenditure in South Korea, though, remains well below the OECD average. Therefore, we project that social welfare expenditure will increase more rapidly than other components of government expenditure for a considerable period. In particular, we assume that the per capita amount of social welfare expenditure will increase more rapidly than per capita GDP until they reach the OECD average[4].

Turning to factors associated with reunification, the National Pension benefit levels of South Korean participants will be affected, since pension benefits consist of two parts, an

[4] The income elasticity of government expenditure on health care is based on estimates by Newhouse (1997), Leu (1983, 1986), Gertham et al. (1998, 1992) and the OECD (1993), whose values range between 1.2 and 1.4. Exceptionally low or high estimates are produced by Gerdtham (1991, 1992) (0.74), Moon (2000) (1.75) and the OECD (1993) (1.6). In the case of government expenditure on social security and welfare services, Moon (2000) produced a high income elasticity estimate (1.54). We make a very conservative assumption about the income elasticity (1.2) in order to avoid over-projection of government expenditure in these sectors. The upper bounds for expenditures on social security and welfare, and health care are assumed to be 4.12% and 5.94% respectively of GDP, based on the OECD averages as of 1995. For detailed information about the future path of social welfare expenditure, see Auerbach and Chun (2003).

income-related part and flat part. The latter is computed based on the average income of all NPS participants. The participation of North Korean residents, whose average income is currently less than 10% of that of South Koreans, will lower the flat part of the NPS benefit substantially.

Analyzing reunification also requires another extension of the standard methodology, to account for the heterogeneity of the two populations. Rather than just separating each age cohort by sex, we also separate it by region, specifying different profiles for North and South Koreans. This will have important effects, not only on the tax side, but also on the expenditure side. For example, the Minimum Living Standard Security (MLSS) benefit, a social transfer program to aid low-income households, will initially apply to many more North Korean residents under current rules. Thus, we require not only distinct profiles for North and South Koreans, but also changing profiles over time for North Koreans, as they make the assumed transition over time to income parity with South Koreans.

Finally, we also modify the presentation of generational accounts. 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, we take this latter approach one step further and actually present alternative estimates of the accounts for current generations, taking such projected increases in their fiscal burden into account. We denote as GA1 the accounts as conventionally presented, and refer to the accounts incorporating the added taxes to restore fiscal balance as GA2[5].

3. Calculation Procedure and Underlying Assumptions[6]

To produce generational accounts for North Korea, we require projections of population, taxes, transfers, government expenditures, initial government debt, and a discount rate. We also need to project the age-sex profiles of average income of North Koreans, since taxes and transfer payments of individuals are dependent upon their income level. We ignore the current fiscal policies of North Korea, based on the assumption that North Korean policies will be repealed. Therefore, we consider a hypothetical situation where the current fiscal policies in South Korea are implanted in North Korea after the reunification.

The current fiscal policies in South Korea are classified into following groups: social welfare policies, tax system, seigniorage, and government consumption. The social welfare policies are composed of public pensions, Medical Insurance (MI), Employment Insurance (EI), Industrial Accident Compensation Insurance (IACI), and social welfare services and public assistance (Minimum Living Standards Security System, MLSS, and other social transfer programs, OSTP). Taxes are classified as labor income taxes, capital income taxes, consumption taxes, taxes on asset-holdings, taxes on asset-transactions and other taxes. Government consumption is broken down into expenditure on education and other government consumption.

Except for public pensions (NPS), MLSS, and EI[7], we follow standard procedure to

[5] This presentation method has been used by others in the past, including Auerbach and Oreopoulos (2000) and Bovenberg and ter Rele (2000).

[6] For the detailed information about the GA calculation procedure for South Korea and its underlying assumptions, see Auerbach and Chun (2003).

compute the age-sex distribution of most of the components of fiscal policies: we start by projecting the aggregate of each component, and then distribute the aggregate by age and sex based on cross-sectional relative age-sex-tax and age-sex-transfer profiles derived from cross-sectional micro-data sets.

3.1. Population Projection (North Korea)

We employ the 2001 population projection model of the National Statistics Office (NSO) for South Korea's population projections. We project current and future populations of North Korea using information about base-year age-sex distributions, death rates, and fertility rates, since neither the South Korean nor the North Korean government has published projections of the future North Korean population. The baseline year for our projection is 1993, the most recent year for which a North Korean government report is available. We convert the population distribution of 5-year-age intervals into one with 1-year-age intervals by assuming that, within each 5-year-age interval, the population is evenly distributed across ages.

We impute the age-sex-year profile of death rates based on the NSO projections of life expectancy in North Korea, since the age-sex profiles have not been published. For the imputation of age-sex profiles of North Korean death rates in a given year, we search for the 'equivalent year' when the life expectancy of South Korea is the closest to that of North Korea, and then assume that the profiles for North Korea are the same as those in South Korea's equivalent year.

The total fertility rate in North Korea as of 1993 is 2.16, much higher than that in South Korea (1.67 in 1993, 1.47 in 2000). We assume that the fertility rates as of 1993 are maintained until the reunification and that after reunification they will approach those of South Korea. Since the total fertility rate of North Korea in 1993 is quite close to that of South Korea in 1983 (2.08), we assume that the fertility rates of North Korea after reunification follow the same path for South Korea since 1983. The assumed sex ratio of newborns is 106, which is standard in population projections.

3.2. Projection of Average Income Profile (North Korea)

We impute the age-sex-year profiles of average income of North Koreans based on the information about the difference in per capita GDP between South and North Korea. We assume that the average labor productivity of North Korea is about 11% of that of South Korea in 1993 based on the projection of Bank of Korea. To impute the productivity growth path, we divide the period after 1993 into 5 sub-periods: (i) 1994-2001; (ii) 2002-the year of reunification; (iii) stagnation period (for 5 years after the reunification); (iv) a period of rapid growth (for 45 years after the stagnation period); and (v) a period of balanced growth. For period (i) we used historical data on the productivity growth reported by the NSO[8]. The labor productivity growth in period (ii) is assumed 1% per annum, which is slightly lower than that of South Korea (1.5%). For period (iii), we assume that the labor productivity will not grow, since in the process of disintegration of the old North Korean economic system the stagnation will be inevitable. After the stagnation period, we expect a period of rapid growth, so that

[7] In the case of NPS contributions and benefits and MLSS benefits, the age-sex profiles as well as the growth rates of the aggregate amounts are assumed to change over time while in the case of EI only the growth rate of the aggregate benefit amount is assumed to change over time with the age-sex profiles fixed.

[8] The labor productivity growth rates for the period 1993-2001 are –5.2% ('93), -3.1% ('94), -5.1% ('95), -4.6% ('96), -7.3% ('97), -2.1% ('98), 5.2% ('99), 0.3% (2000), and 2.7% (2001).

after the 45 years of period (iv) the labor productivity of North Korea converges to that of South Korea, i.e., the productivity of North Korean residents will catch up with that of South Koreans 50 years after reunification[9]. For period (v), we assume that labor productivity grows at the same rate as in South Korea. Given the path of labor productivity, we impute the age-sex profile of labor income under the assumption that the profiles are the same as that of South Korea, except for the gap of the absolute level of labor income.

Beginning with reunification, we require estimates of North Korea's unemployment rates to project expenditures on EI benefits. In period (iii), we assume that the unemployment rate is 20%, since immediately after the reunification, the skill of North Korean residents will become obsolete and we will experience a massive unemployment in the North Korean area[10]. During period (iv) the unemployment rate is assumed to gradually decrease to reach the current unemployment rate of South Korea (3%), and this level is assumed to be maintained in period (v).

The age-sex profile of capital income is the same as those of South Korea, except for the gap in the absolute level between the two Koreas. The gap is assumed the same as that in labor productivity. The resulting path of capital income share in the North Korean region for period (iii) and after shows that the capital income share gradually rises from 38% to 40%[11].

3.3. Projecting National Pension Contributions and Benefits (South and North Korea)

The public pensions in South Korea consist of two different plans: National Pension (NPS) and Occupational Pensions. Since the Occupational Pensions cover a small portion of the whole population, we assume that the North Korean residents will be covered by the NPS after the reunification. We project the NPS for South and North Korea in two steps. The first step is to project the distribution of insurants and benefit recipients in North Korea; in the second step, we recalculate the contribution and benefit amounts by age-sex-year for both South and North Korean residents.

In the first step, we assume that the distributions of insurants and benefit recipients of North Korea follows the same trend as the distributions of South Korea since the NPS's introduction in 1988. In other words, we assume that the maturation of the NPS in North Korean area follows the same path as in South Korea with the time lag between 1988 and the year of reunification. Therefore, we compute the ratio of South Korean insurants and benefit recipients by age and sex to the population of the same cohorts for the period since 1988; we then project the distribution of insurants and benefit recipients in North Korea by multiplying the ratio by the North Korean population by age and sex in the years after reunification.

In addition, we adjust the distributions by taking into account the difference in unemployment rates between South and North Korea, since we assume that the unemployment rates will be much higher in the North Korean area for a considerable time

[9] The period assumed necessary for full integration of the two Koreas is much longer than that assumed by Raffelhüschen and Walliser (1999) for the German unification (20 years), based on the much larger productivity gap between the two Koreas (North Korea's level is 8% of South Korea's as of 2000, whereas East Germany's was 37% of West Germany's) and the fact that the ratio of North Korea's population to South Korea's (47% as of 2000) is much larger than that of East to West Germany's (26% as of 1989).

[10] The unemployment in the East German area after Germany's reunification was about 15%. We expect the unemployment rate of the North Korean area after reunification to be much higher, since the productivity gap between South and North Korea is much larger than that between East and West Germany when they joined.

[11] The capital income share of South Korea for the past decade is about 40%.

post-reunification. This adjustment is needed since the unemployment rates affect the contribution and benefit amount of each cohort[12]. Instead of average income and benefit amount by age and sex, we adjust the distribution of insurants and benefit recipients. The distribution of insurants is adjusted by assuming that the number of insurants by age and sex in a given year is proportional to the employment rate. For the distribution of new benefit recipients, we assume that the number of new recipients by age and sex in a particular year is proportional to the average employment rate during each cohort's economically active period.

In the second step, we recalculate the contribution and benefit amounts of South and North Korea. We compute the contribution amount by taking into account the average income levels, number of insurants by age and sex and the unemployment rates. Given the distribution of benefit recipients and profiles of average benefit levels, the benefit amount of each cohort in South and North Korea is recalculated based on the pension benefit formula. Note that the level of pension benefits of South Korean recipients needs to be recalculated, since the level of the benefits will substantially fall with the decrease in the flat part of the benefits resulting from the decrease in the average income due to the extension of coverage to North Korean residents, whose income is much lower than that of South Korean residents.

3.4. Projecting the Distribution of MLSS Benefits (North Korea)

We compute the MLSS benefit level by age-sex-year by subtracting the average income of each group, including labor income and capital income, from the minimum living expense guaranteed by the Korean government. The minimum living expense guaranteed is computed by using the distribution of households and profiles of the minimum living expense guaranteed by the number of household members, and the resulting value is about 230,000 won per month as of 2000 (see Table 4). We assume that the minimum living expense guaranteed grows at the productivity growth rate of South Korea, and allow the profiles for North Koreans to change over time, consistent with their rising relative incomes.

3.5. Projection of Other Fiscal Components (North Korea)

Determining Generational Profiles

The profiles of taxes and transfers for North Korean residents, except for the NPS contributions and benefits and the MLSS benefits, are assumed to the same as those for South Koreans, except for their absolute levels[13].

Projection of Aggregates

The procedure for projecting aggregates of taxes, transfers and government consumption for North Korean residents after the reunification is basically the same as that for South Koreans described in Auerbach and Chun (2003). We assume the same scope of government activities, and follow the same procedure of decomposing government consumption, contributions and benefits of social insurance into (1) age-specific components and (2) non-

[12] The benefits of a particular individual are affected by the employment rates over his lifetime, since the NPS benefit amount is proportional to the period of his contribution to the NPS.

[13] For the age and sex profiles for South Korea, see Auerbach and Chun (2003).

age-specific components. The scope of the government covers the central government, local government, public education institutions, social insurance programs, and non-profit organizations financed by the government and providing services such as research on the economy, science and public administration. The government consumption classified as age-specific includes government expenditure on education, health, and social security and welfare services[14]. Social insurance contributions and benefits, and government non-contributory transfer programs such as OSTP are age-specific, and labor income taxes and capital income taxes are classified as age-specific.

The non-age-specific components of taxes, transfers and government consumption are assumed to increase at the rate of productivity growth. In the case of the components classified as age-specific, the amount per member of the relevant population grows at the rate of productivity growth. The only exceptions are expenditure on health and social welfare, whose amounts per member of the relevant age groups grows at a higher rate than productivity growth until reaching the OECD average[15].

A difference in the procedure of projecting aggregates of components of fiscal policies for North Korea from that for South Korea is that we further classify the fiscal policy components as applied to North Koreans into two groups: one in which the value per member of the relevant population grows at the productivity growth rate of South Korea and the other in which the value grows at the productivity growth rate of North Korea after the reunification. The former group includes MI benefits and all components of government consumption. The latter group includes IACI benefits, OSTP benefits, all taxes and social insurance contributions, and seigniorage. Components of the latter group have benefit or tax formulae based on income or assets. Components of the former group, on the other hand, are not determined so mechanically, and we would not expect government to discriminate against North Koreans in these areas. Not covered by this two-way classification is the EI benefit, since we expect high unemployment rates during the transition period after reunification. We project the aggregate EI benefit expenditure under the assumption that the average benefit is proportional to the average income of North Korean workers and the number of the recipients of EI benefits is proportional to the unemployment rate.

We also must add to government expenditure the reconstruction cost of North Korea, since after reunification the government and private sector of South Korea will inevitably transfer resources to the North Korean region in order to economically cushion the North Korean transition. Since the estimates of the reconstruction cost by previous researchers show a wide range, from 6% (Lee 1993) to 25% (Park 1997) of the GDP of South Korea for 10 years after reunification[16], we derive our own estimate of the value following the procedure described in the appendix. Our estimate of the reconstruction cost is 10% of the GDP of South Korea for 20 years after the reunification. In the base case, we assume that 50% of the reconstruction cost is paid by the government and the other half by the private sector. Therefore, government expenditure on the reconstruction of the North Korean economy amounts to 5% of South

[14] Government consumption is classified as: general public service, defense, public order and safety, education, health, social security and welfare services, housing and community amenities, recreation-culture-religion, fuel and energy, agriculture-forestry-fishing, mining-manufacture-construction, transportation and communication, and other.

[15] See footnote 4.

[16] The difference relates primarily to differences in the assumed speed of convergence of North Korean productivity to that of South Korea.

Korean GDP for 20 years after reunification.

3.6. Government Net Wealth and Discount Rate (North Korea)

The North Korean government debt is assumed to be 14.9 trillion won as of 2000, based on the projection by the Bank of Korea (The Bank of Korea (2001)). We also assume that the debt, evaluated in present value, does not change until the reunification.

We assume the same discount rate for government finance for the North Korean region as for the South Korean region. The nominal discount rate is assumed to be 6.5%, based on the values of the assumed real interest rate (3.5%) and the assumed inflation rate (3%).

4. Findings

The benchmark year in the GA calculation is 2000. We regard the generations alive in the benchmark year as current generations and classify cohorts by the age. We treat cohorts born in 2001 and later as future generations. For the computation of the net payments of North Korean residents, we include the taxes and transfers from the time of reunification onward, i.e., we completely ignore the fiscal burden under the current North Korean regime, which is difficult to calculate. We consider a hypothetical situation where Korea is reunified in 2010[17].

4.1. Generational Accounts Disregarding Reunification

Table 5 reports standard generational accounts (GA1) for South Korea, assuming no reunification, under the base case assumptions for the productivity growth rate (1.5%) and the nominal discount rate (6.5%)[18]. Following past studies, we report two variants of the accounts: Net Payment I (NP I) which treats educational expenditures as government consumption; and Net Payment II (NP II), which treats educational expenditures as transfer payments.

The table shows positive values of net payments for most cohorts alive in 2000 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[19]. 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 for the result is that the aggregate amounts of social welfare benefits such as public pension benefits, Medical Insurance (MI) benefits, Minimum Living Standards Security (MLSS) Benefits and other social welfare services (OSTP) are quite small as of 2000. Aggregate public pension and MI benefits are 1.1% and 1.7% of GDP respectively as of 2000 and those for the MLSS and the OSTP are 0.5% and 0.6% of GDP respectively. However, maturation of the public pension system and the projected increase in social welfare

[17] There is much uncertainty about the timing of reunification. Changing the date does not change qualitative results, except for some redistribution of fiscal burdens across generations. The results of the sensitivity analysis on the time of reunification can be provided upon request.

[18] The accounts are expressed in thousands of won, the domestic currency of South Korea. As of March, 2004, 1,000 won were worth about US$0.85.

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

expenditures will increase transfer payments to old-age groups. As a result, the accounts for a wider range of old-age groups will turn to negative. For example, net taxes for groups aged 65 or more as of 2050 are negative (see Figure 2).

Among current generations, net payments are largest around age 20, when people tend to join the labor market and start work. Therefore, they will experience the longest economic participation periods from this age. For example, the age-20 NP I (NPII) account is about 37% (124%) higher than the age-0 account. There is a sharp decrease in net payments between ages 50 and 60, since around age 55 many workers tend to retire and acquire eligibility for social welfare benefits, including public pension benefits. However, the net payments of many older age groups are still positive because they pay substantial amounts of consumption tax and tax on capital and because the amount of social welfare benefits is limited as of 2000.

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 NP I (NP II) account for future generations is about 117% (195%) 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 9 reports the magnitude of the adjustment of tax and social insurance contributions (tax, henceforth) and transfer payments required to attain long-run government budget balance[20]. The results for the base case simulation, given in column [1], indicate that a substantial adjustment is required, even without reunification. The required adjustment is a 58.7% increase in tax burden if the adjustment is made only for generations born in 2001 and thereafter. If the adjustment is made to all cohorts alive in 2004 and later, the required tax adjustment represents a 19.8% increase in tax burden. If we delay the tax adjustment until 2010 (the reunification year under base case assumption), the required tax adjustment reaches 22.8%. If the proportional increase in the tax burden is accompanied by the same percentage decrease in transfer payments to attain long-run government budget balance, the magnitude of the required adjustment decreases to 34-39% (if the adjustment is made only for the generations born in 2001 and later years), 12-13% (if the adjustment is made to all the cohorts alive in 2004 and later) and 13-14% (if we delay the tax adjustment until 2010).

Table 5 shows that a substantial part of the fiscal burden on the future generations is accounted for by the long-run budgetary imbalance of public pensions and the Medical Insurance. The account of the public pension system for future generations explains 34% (42%) of Net Payment I (Net Payment II), and the account for MI accounts for 11.7% (14.5%) of Net Payment I (Net Payment II). The fiscal burden caused by social welfare programs such as the Minimum Living Standards Security (MLSS) system and other social welfare services and public assistance (OSTP) will not be very heavy, since in the projection of their aggregates we make a very conservative assumption about the income elasticity of social welfare expenditure (1.2).

Table 5 also reports the present value, rest-of-life tax burdens by category. 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

[20] Long-run budget balance is defined as the situation where the summation of current government net wealth and the present value of present and future flows of taxes and social insurance contributions is equal to that of transfer payments and government consumption.

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 in the case of consumption taxes, followed by capital income taxes, taxes on asset holding, taxes on asset transactions, and labor income taxes.

4.2. Incidence of the Fiscal Burden of Reunification

Tables 6-8 report the standard Generational Accounts for South and North Korean residents by taking into account the fiscal impacts of the reunification. The accounts for South Korean residents indicate that the reunification will substantially increase the fiscal burden on South Korean future generations, unless the current fiscal policies of South Korea are substantially altered[21]. The Net Payment I (Net Payment II) of South Koreans, born 2001 and later, increases by 16.1% (22.7%) due to the reunification, if the additional burden is completely shifted to cohorts born in 2001 and later. The increase in the fiscal burden is primarily due to the increase in transfer payments to North Korean residents. Table 8, which reports the accounts for North Korean residents, shows that the net transfers to existing generations of North Koreans are accounted for primarily by public pensions, MI, EI, and MLSS. The present values of lifetime net transfers from MI, EI and MLSS for most existing North Korean generations are higher than those for South Koreans. In particular, MLSS benefits for the cohort born in 2000 in North Korea is about five times as large as that for the same generation in South Korea. Even though the absolute level of net transfer from NPS to most existing North Koreans is lower than that to current South Koreans, its ratio to income is much higher for North Koreans.

Contrary to the high transfer payments to North Koreans, their tax burdens are very low. Comparing the accounts for the cohorts born in 2000, the labor income tax burden of North Koreans is 41.8% of that of South Koreans, the capital income tax 64.4%, the consumption tax 33.3%, asset holding tax 54.3%, and the asset transactions tax 36.8%. As result, the accounts for most existing North Koreans, except for cohorts aged 90 and older, are negative. This implies, not surprisingly, that reunification will transfer resources to current North Koreans, unless fiscal policies toward existing generations are substantially altered; most of the fiscal burden will be shifted to the future generations of South Korea. The magnitude of adjustment needed to attain long run budgetary balance will substantially rise. The required tax adjustment (see Table 9, column [2]) rises from 23% to 49-50% due to reunification, if we adjust the tax burden from the year of reunification (2010). The required magnitude of increase in tax burden accompanied by the same decrease in transfers also rises from 13-14% to 29-30% because of reunification.

It is interesting that reunification will decrease the fiscal burden of future South Korean generations attributable to the NPS. In addition, net transfers from NPS for existing South Koreans will also decrease. As discussed above, this is due to the sharp decrease in the flat part of the pension benefit, which is computed based on the average income of all insurants. Therefore, without an adjustment to prevent the sharp decrease in the NPS benefits of South Koreans, the government will face strong resistance from current South Korean participants.

[21] The typical method to allocate the fiscal burden between subgroups of future generations is to assume the same increase in the fiscal burden relative to age-0 individuals of each subgroup. We cannot adopt this method, since the age-0 North Koreans have a negative account. Therefore, we allocate the net payments among future generations of South and North Koreans based on relative present values of lifetime earnings. That is, we assume that each future generation's burden is the same as a share of the present value of its lifetime earnings.

Tables 10-11 show the alternative (GA2) generational accounts (for variant NP I) under the assumption that the tax adjustment that we estimate is necessary for long-run budget balance is actually distributed to current and future cohorts in South and North Korea. These tables reflect the scenario in which the government increases the tax burden on all cohorts alive in the reunification year and later[22]. The increase for South Koreans without reunification (column [1] of Table 10) is by 22.8% of net payments under current fiscal policies; under reunification (column [2]), the corresponding increase in net payments is 49.4%. Using these tables, we can compute the magnitude of changes in net payments due to the reunification under the assumption that the fiscal policy needed to maintain long-run budget balance will be imposed on all generations starting from the time of reunification, not just future generations. (Also see Figures 3-5). Under this scenario, the fiscal burden of reunification is still substantially shifted to future generations of South Koreans. Yet generations aged less then 75 as of 2000 would still bear a significant burden, experiencing a more than 10% increase in lifetime net tax burden; thus, under this realistic scenario, most of the generations alive in 2000 and thereafter will be much affected by the economic cost of reunification. The magnitude of the increase in the fiscal burden will increase up to 21.7% of lifetime net payments, relative to the economy with no reunification, for South Koreans born after 2010.

The fiscal burdens of North Koreans after reunification are much lower than those of South Korean residents, since the productivity gap between the two regions is still very large for a considerable time, and for the same period North Koreans will receive large amounts of transfer payments from such benefits as MLSS, EI, and MI. However, the gap will decrease with the convergence in the productivity of North Korean residents to that of South Koreans, increasing the tax burden and decreasing transfers for North Koreans.

4.3. Policy Experiments and Sensitivity Analysis

We consider several other situations to investigate the relative importance of policy and economic variables in determining the fiscal burdens of reunification: [3] MLSS benefit reduction; [4] EI benefit reduction; [5] separate operation of NPS; and [6] higher cost of reconstruction of North Korea. In situation [3] we assume that the government specifies an upper limit (300% of average wage of North Koreans) for MLSS benefits for North Korean residents in order to prevent an excessively rapid increase in MLSS expenditures. In situation [4], we assume that aggregate EI expenditure does not depend on the unemployment rate, under the assumption that a substantial part of the unemployed will be covered by the MLSS system. Scenario [5] assumes that the government maintains separate NPS systems in the two Korean regions, in order to prevent a decrease in the benefit levels of South Korean residents. Except for the separation, the same NPS system is assumed for the two regions. Case [6] assumes that the reconstruction cost incurred by the government is 10% of GDP for 20 years after the reunification instead of 5%, i.e., that government pays the whole cost of reconstruction of North Korean economy.

Figures 4-5 indicate that the reduction in MLSS benefits for North Koreans has a substantial impact on the fiscal burden. The fiscal impact of the adjustment of EI is much smaller than that of MLSS. The changes in the fiscal burdens associated with these reductions in MLSS and EI are reductions of 2.6% and 0.2%, respectively (relative to the base case [2]) in the net payments of generations of both South and North Koreans born after 2010. Imposing the restriction on MLSS benefits reduces the required tax adjustment to attain long-

[22] See the corresponding columns of Table 9, in the row labeled “NPI, Reunif. Year (2010).”

term fiscal balance from 49-50% of the current tax burden to 45-46%.

Separate operation of the NPS raises overall fiscal burdens, since the benefit level of the NPS for South Korean participants is not affected by the reunification, while under the incorporated system, the benefit levels fall considerably due to North Korean participation. The fiscal burden of future generations of South Korea (North Korea), born after 2010 increases by about 3% (4%) of that under the base case [2]. (The fact that the additional fiscal burden, evaluated as a proportional change, is larger for North Koreans reflects the intragenerational redistribution from South to North under the combined system.) The required tax adjustment for long-term fiscal balance increases from 49-50% of current tax burden to 53-54%.

Doubling the assumed reconstruction cost from 5% to 10% of GDP for 20 years after reunification substantially increases fiscal burdens. For generations of both South and North Korea born after 2010, net payments increase by 3.8% relative to our base case [2]. The required tax adjustment for long-term fiscal balance increases from 49-50% of the current tax burden to 55-56%. But the impact of this increase in reconstruction cost, equal in magnitude to the entire reconstruction cost initially assumed, is small relative to the overall impact of reunification on the required long-run tax adjustment, from 23% in case [2] to 49-50% in case [3]. Indeed, simply changing the pension benefit calculation (case [5], just discussed) has almost as large an impact on the long-run cost of reunification.

Table 12 summarizes the sensitivity of our results to variations in key parameters (productivity growth of South Korea[23] and the interest rate[24]) and prolonged adjustment paths for North Korea. The generational imbalance is increasing with the interest rate, while the pattern of the generational imbalance is irregular with respect to growth rate[25]. The percentage difference is quite sensitive to the variations in the growth rate and the interest rate, while the qualitative result that post-reunification fiscal policy in Korea is imbalanced is sustained for a realistic range of growth and discount rates. The variation of the adjustment of tax (or tax and transfer) required for fiscal balance, if imposed on cohorts born at the year of reunification and later, spans a relatively narrow range, from 42% to 55% (or from 25% to 31%).

Lower speed of convergence between South and North Korean productivity levels will increase generational imbalance and the fiscal burden of reunification. Table 12 indicates the quantitative impacts of more pessimistic assumptions concerning the adjustment process[26]. The generational imbalance increases to 324.5% if the adjustment process is completed in 70 years after the reunification instead of within 50 years. The required tax (or tax and transfer) adjustment for long-term fiscal balance increases to 54-56% (31-33%) because of the delay. A higher speed of convergence thus significantly reduces the fiscal burden of reunification.

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[23] A higher growth rate in South Korea raises the reconstruction cost, since the required investment for the productivity of North Korea to catch up becomes larger. In the case where South Korean productivity growth is 2% (1%), we assume that the reconstruction cost is 5.5% (4.5%) of South Korean GDP for 20 years after reunification, instead of the value of our base case (5%).

[24] We try sensitivity analysis for higher interest rates than in the base case, since our base case interest rate is quite low compared with values typically assumed in previous research.

[25] The irregular pattern is due to the fact that there are two conflicting forces affecting fiscal burden. Increasing productivity increases government transfers and consumption as well as the tax bases of future generations.

[26] The base case [2] assumes 50 years for the period of complete convergence between two Koreas. The 50 years of complete convergence is generally regarded as optimistic. Therefore, we try sensitivity analysis under more pessimistic assumptions about the speed of convergence.

4.4. Comparison with the Case of German Reunification

Tables 13-14 indicate that the fiscal burden of reunification will be much heavier for Korea than for Germany. The generational imbalance for the base case of Raffelhüschen and Walliser (1999) is 156.1%, while that of the Korean case under the same assumptions about the productivity growth rate and the discount rate (g=1.5%, r=5% (real)) is 669.5%[27]. The required tax adjustment for long-term fiscal balance is much smaller for the German case. Korean reunification requires a 48.2% increase in the overall tax burden, while German reunification was estimated to require only a 9.5% increase.

The difference in the reunification cost is mainly due to differences in the productivity gap and in relative population magnitudes. Productivity in North Korea relative to that of South Korea (8% of the South Korean level as of 2000) is much lower than that of East Germany relative to West Germany before unification (37% of the West German level). The population ratio of North to South Korea (47% as of 2000) is much larger than that of East to West Germany the year before German unification (26% as of 1989). Therefore, a much longer transition period for complete convergence will be needed in the Korean case, and the Korean government will inevitably pay much more during the transition for social welfare benefits and government consumption.

5. Conclusion

This paper has reevaluated the fiscal impacts of Korean reunification using Generational Accounting, considering the inter- and intra-generational redistribution of fiscal burdens among current and future generations of South and North Koreans that could result from reunification. Our findings suggest that early reunification will result in large increases in the fiscal burden for most current and future generations of South Korea, assuming that the productivity gap between the two Koreas does not substantially decrease before reunification. The magnitude of the fiscal impact of Korean reunification appears much larger than that of German unification, as the productivity gap between South and North Korea is much larger than existed between East and West Germany, and because North Korea has a much larger population, relative to South Korea, than was true of East Germany relative to West Germany. The findings also suggest that the fiscal burden due to increased social welfare expenditure for the North Koreans is much more important than the reconstruction of the North Korean economic system in determining the fiscal burden of reunification.

Economic cooperation between the two Koreas, to help speed the growth of productivity in North Korea, could alleviate some of the projected burdens. Reforms of South Korea's fiscal policies, needed to help restore fiscal balance even without reunification, take on added importance in light of the large added burdens of reunification. Without such reforms, the total fiscal burdens faced by South Koreans in the future will be substantially higher than at present, making it likely that the government will face strong resistance from South Korean residents and a difficult road to convergence of the two Korean economies.

[27] We compare the generational imbalances of Korea and Germany based on NP II, since that is the variant reported by Raffelhüschen and Walliser (1999).

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Table 1. Population Distribution of North Korea (1993)

Age	Total	Male	Female
0 - 15	6,045,975	3,100,141	2,945,834
16 - 24	3,067,515	1,308,429	1,759,086
25 - 29	2,019,525	987,095	1,032,430
30 - 34	1,607,929	791,117	816,812
35 - 39	1,386,454	682,990	703,464
40 - 44	990,787	482,309	508,478
45 - 49	1,243,077	603,230	639,847
50 - 54	1,208,802	582,990	625,812
55 - 59	1,063,657	487,276	576,381
60 - 64	748,594	301,764	446,830
65 -	1,140,036	350,322	789,714
Total Population	20,522,351	9,677,663	10,844,688

Source: Korea Institute for Health and Social Affairs

Table 2. Life Expectancy (North Korea)

	Male[1)]	South Korea's Equivalent Year[2)]	Female[1)]	South Korea's Equivalent Year[2)]
1993	63.6	1983	69.3	1979
1995	59.8	1973	64.7	1971
1997	59.8	1973	64.5	1971
2000	62.9	1983	67.4	1973
2005	-	1987	-	1979
2010	67.9	1991	72.4	1985
2015	-	1995	-	1989
2020	71.7	1999	76.1	1991
2025	-	2000	-	1991
2030	73.4	2005	77.9	1997
2035	-	2010	-	2000
2040	-	2015	-	2005
2045	-	2020	-	2010
2050	-	2025	-	2015
2055	-	2030	-	2020
2060	-	2035	-	2025
2065	-	2040	-	2030
2070	-	2045	-	2035
2075	-	2050	-	2040
2080	-	2055	-	2045
2085	-	2060	-	2050
2090	-	2065	-	2055
2095	-	2070	-	2060
2100	-	2075	-	2065
2105	-	2080	-	2070
2110	-	2085	-	2075

Notes: 1) Historical data and projection by NSO (NSO (2000).
2) The year where life expectancy of South Korea is closest to that of North Korea in the respective year.

Table 3. Fertility Rates (North Korea, 1993)

Age	Fertility Rate (%)
22	0.2
23	0.65
24	1.5
25	2.4
26	2.65
27	2.7
28	2.8
29	2.6
30	2.5
31	1.55
32	1.35
34	0.6

Source: Korea Institute of Health and Social Affairs

Table 4. Distribution of Households

Number of household members	Number of households	Proportion (%)	Minimum Living Expense Guaranteed per month (won)
1	1,642,406	12.67	320,000
2	2,184,626	16.86	540,000
3	2,636,254	20.34	740,000
4	4,110,359	31.72	930,000
5	1,666,981	12.86	1,060,000
6	496,861	3.83	1,200,000
7	158,886	1.23	1,200,000
8	44,609	0.34	1,200,000
9	12,207	0.09	1,200,000
10	3,774	0.03	1,200,000
11	1,218	0.01	1,200,000
Average per household	-	-	780,000
Per capita amount	-	-	233,370

Source: National Statistics Office, Korean Statistics Information System (KOSIS).

Table 5. Generational Accounts (GA1)
(No Reunification, S. Korea, 1,000 won)

Age	Net Payment I[1)]	Net Payment II[2)]	Public Pensions	Medical Ins.	Employ. Ins.	IACI	MLSS	OSTP
0	56,355	33,476	-9,216	-5,187	-608	217	-2,542	-3,342
5	62,733	37,260	-8,819	-4,167	-696	254	-2,490	-3,334
10	67,695	48,202	-9,072	-3,748	-786	278	-2,419	-3,215
15	67,811	56,936	-14,461	-3,614	-885	295	-2,353	-3,146
20	77,244	74,977	-11,311	-3,659	-920	295	-2,268	-3,118
25	73,719	73,655	-15,128	-4,335	-791	271	-2,169	-3,085
30	64,716	64,683	-17,993	-5,145	-685	198	-2,131	-3,034
35	39,299	39,268	-35,155	-5,828	-611	174	-2,089	-2,904
40	36,728	36,699	-27,779	-6,723	-580	43	-2,083	-2,807
45	32,384	32,357	-23,461	-7,399	-504	11	-2,060	-2,690
50	22,158	22,134	-22,865	-7,914	-443	-6	-1,978	-2,564
55	12,705	12,684	-21,361	-8,097	-404	99	-1,939	-2,445
60	14,277	14,259	-8,367	-7,647	-318	18	-1,876	-2,351
65	8,374	8,359	-6,314	-6,753	-239	21	-1,724	-2,257
70	6,356	6,344	-3,754	-5,374	-228	-52	-1,452	-1,860
75	5,813	5,803	-1,367	-4,098	-176	-41	-966	-1,465
80	2,831	2,823	-991	-3,174	-132	-32	-656	-1,122
85	569	563	-647	-2,323	-95	-24	-335	-846
90	-2,491	-2,494	-341	-1,579	-64	-17	-257	-593
95	-1,281	-1,284	-33	-985	-40	-11	0	-383
99	-486	-487	-10	-381	-15	-4	0	-150
Future Gen.	122,280	98,899	41,676	14,316	1,478	-487	-	-
	Labor Income Tax	Capital Income Tax	Con-sump-tion Tax	Tax on Asset Holding	Tax on Asset Transact	Other Taxes	Seign-iorage	Edu. Exp
0	7,288	12,806	37,755	3,926	8,727	6,224	172	-22878
5	8,168	14,778	38,382	4,378	9,488	6,522	193	-25473
10	8,975	16,839	38,830	4,829	10,148	6,785	216	-19493
15	9,810	19,155	39,481	5,342	10,846	7,087	244	-10875
20	10,610	22,389	40,010	5,922	11,632	7,387	274	-2268
25	10,777	23,464	38,951	6,177	11,860	7,465	262	-64
30	9,941	23,022	36,284	6,156	10,802	7,046	256	-33
35	9,527	21,937	32,915	5,910	8,873	6,314	237	-31
40	7,756	20,814	29,451	5,541	7,253	5,609	234	-29
45	6,165	19,963	25,987	5,291	5,909	4,962	209	-26
50	4,031	17,185	22,701	4,662	4,883	4,271	196	-24
55	1,983	15,111	19,115	3,803	3,235	3,432	173	-21
60	587	11,226	15,681	2,934	1,597	2,630	161	-18
65	54	8,523	12,538	2,062	392	1,941	128	-15
70	0	6,276	9,767	1,502	38	1,386	107	-13
75	0	4,069	7,878	898	0	1,009	73	-10
80	0	2,223	5,395	560	0	698	61	-8
85	0	969	3,179	231	0	417	41	-6
90	0	126	51	31	0	121	32	-4
95	0	42	33	3	0	74	18	-3
99	0	25	20	1	0	29	6	-1

Notes: 1) Educational expenditure treated as government consumption
2) Educational expenditure treated as government transfers

Table 6. Generational Accounts (GA 1)

(Unit: 1,000 won, %)

Age	No Reunification		Unified Korea					
	S. Korea		S. and N. Korea combined		S. Korea		N. Korea	
	Net Payment I[1)]	Net Payment II[2)]	Net Payment I	Net Payment II	Net Payment I	Net Payment II	Net Payment I	Net Payment II
0	56,355	33,476	33,283	13,364	56,505	33,627	-1,120	-16,655
5	62,733	37,260	40,476	20,955	63,374	37,900	-271	-9,201
10	67,695	48,202	41,865	29,211	69,311	49,818	-1,454	-3,313
15	67,811	56,936	44,921	37,876	70,729	59,853	-2,197	-2,248
20	77,244	74,977	55,203	53,605	80,195	77,927	-3,464	-3,490
25	73,719	73,655	53,018	52,966	77,436	77,372	-7,098	-7,122
30	64,716	64,683	46,208	46,178	68,390	68,357	-10,743	-10,765
35	39,299	39,268	26,104	26,077	44,280	44,249	-11,682	-11,702
40	36,728	36,699	25,718	25,692	39,032	39,003	-11,221	-11,238
45	32,384	32,357	20,310	20,286	33,241	33,215	-13,598	-13,613
50	22,158	22,134	12,041	12,021	22,465	22,441	-14,944	-14,956
55	12,705	12,684	2,283	2,266	12,965	12,944	-15,406	-15,416
60	14,277	14,259	4,653	4,639	14,287	14,269	-12,023	-12,030
65	8,374	8,359	2,179	2,168	8,382	8,366	-8,565	-8,570
70	6,356	6,344	3,720	3,712	6,360	6,347	-858	-859
75	5,813	5,803	3,918	3,911	5,813	5,803	-6	-6
80	2,831	2,823	1,787	1,783	2,828	2,820	-1	-1
85	569	563	564	559	569	563	-63	-63
90	-2,491	-2,494	-2,489	-2,493	-2,491	-2,494	0	0
95	-1,281	-1,284	-1,280	-1,283	-1,281	-1,284	0	0
99	-486	-487	-485	-486	-486	-487	0	0
Future Gen.	122,280	98,899	63,733	54,468	141,998	121,355	39,642	33,879
Generational Imbalance(%)	117	195	91	308	151	261	-	-

Notes: 1) Educational expenditure treated as government consumption
2) Educational expenditure treated as government transfers

Table 7. Composition of Generational Accounts
(base case, S. Korea, 1,000 won)

Age	Net Payment I[1)]	Net Payment II[2)]	Public Pensions	Medical Ins.	Employ. Ins.	IACI	MLSS	OSTP
0	56,505	33,627	-9,065	-5,187	-608	217	-2,542	-3,342
5	63,374	37,900	-8,178	-4,167	-696	254	-2,490	-3,334
10	69,311	49,818	-7,456	-3,748	-786	278	-2,419	-3,215
15	70,729	59,853	-11,544	-3,614	-885	295	-2,353	-3,146
20	80,195	77,927	-8,360	-3,659	-920	295	-2,268	-3,118
25	77,436	77,372	-11,411	-4,335	-791	271	-2,169	-3,085
30	68,390	68,357	-14,319	-5,145	-685	198	-2,131	-3,034
35	44,280	44,249	-30,175	-5,828	-611	174	-2,089	-2,904
40	39,032	39,003	-25,475	-6,723	-580	43	-2,083	-2,807
45	33,241	33,215	-22,604	-7,399	-504	11	-2,060	-2,690
50	22,465	22,441	-22,558	-7,914	-443	-6	-1,978	-2,564
55	12,965	12,944	-21,101	-8,097	-404	99	-1,939	-2,445
60	14,287	14,269	-8,357	-7,647	-318	18	-1,876	-2,351
65	8,382	8,366	-6,307	-6,753	-239	21	-1,724	-2,257
70	6,360	6,347	-3,750	-5,374	-228	-52	-1,452	-1,860
75	5,813	5,803	-1,367	-4,098	-176	-41	-966	-1,465
80	2,828	2,820	-994	-3,174	-132	-32	-656	-1,122
85	569	563	-647	-2,323	-95	-24	-335	-846
90	-2,491	-2,494	-341	-1,579	-64	-17	-257	-593
95	-1,281	-1,284	-33	-985	-40	-11	0	-383
99	-486	-487	-10	-381	-15	-4	0	-150
Future Gen.	141,998	121,355	22,311	11,197	1,234	-265	-	-
	Labor Income Tax	Capital Income Tax	Con-sump-tion Tax	Tax on Asset Holding	Tax on Asset Transact	Other Taxes	Seign-iorage	Edu. Exp
0	7,288	12,806	37,755	3,926	8,727	6,224	172	-22,878
5	8,168	14,778	38,382	4,378	9,488	6,522	193	-25,473
10	8,975	16,839	38,830	4,829	10,148	6,785	216	-19,493
15	9,810	19,155	39,481	5,342	10,846	7,087	244	-10,875
20	10,610	22,389	40,010	5,922	11,632	7,387	274	-2,268
25	10,777	23,464	38,951	6,177	11,860	7,465	262	-64
30	9,941	23,022	36,284	6,156	10,802	7,046	256	-33
35	9,527	21,937	32,915	5,910	8,873	6,314	237	-31
40	7,756	20,814	29,451	5,541	7,253	5,609	234	-29
45	6,165	19,963	25,987	5,291	5,909	4,962	209	-26
50	4,031	17,185	22,701	4,662	4,883	4,271	196	-24
55	1,983	15,111	19,115	3,803	3,235	3,432	173	-21
60	587	11,226	15,681	2,934	1,597	2,630	161	-18
65	54	8,523	12,538	2,062	392	1,941	128	-15
70	0	6,276	9,767	1,502	38	1,386	107	-13
75	0	4,069	7,878	898	0	1,009	73	-10
80	0	2,223	5,395	560	0	698	61	-8
85	0	969	3,179	231	0	417	41	-6
90	0	126	51	31	0	121	32	-4
95	0	42	33	3	0	74	18	-3
99	0	25	13	1	0	29	6	-1

Notes: 1) Educational expenditure treated as government consumption
2) Educational expenditure treated as government transfers

Table 8. Composition of Generational Accounts
(base case, N. Korea, 1,000 won)

Age	Net Payment I[1)]	Net Payment II[2)]	Public Pensions	Medical Ins.	Employ. Ins.	IACI	MLSS	OSTP
0	-1,120	-16,655	-12,501	-5,173	-1,157	64	-12,748	-1,591
5	-271	-9,201	-11,405	-5,787	-1,260	56	-9,925	-1,563
10	-1,454	-3,313	-10,376	-6,190	-1,262	46	-8,312	-1,458
15	-2,197	-2,248	-8,061	-6,500	-1,130	30	-7,424	-1,312
20	-3,464	-3,490	-5,701	-6,633	-989	19	-7,332	-1,135
25	-7,098	-7,122	-4,132	-6,824	-830	-5	-8,421	-970
30	-10,743	-10,765	-4,518	-6,893	-696	-10	-8,692	-773
35	-11,682	-11,702	-3,578	-6,855	-571	0	-8,478	-574
40	-11,221	-11,238	-254	-6,636	-429	-1	-9,547	-424
45	-13,598	-13,613	-231	-6,222	-310	5	-10,778	-311
50	-14,944	-14,956	-80	-5,496	-206	0	-11,749	-230
55	-15,406	-15,416	-63	-4,512	-125	0	-12,339	-166
60	-12,023	-12,030	-43	-3,328	-89	-3	-9,557	-109
65	-8,565	-8,570	-14	-2,116	-58	-2	-6,953	-69
70	-858	-859	0	-331	-8	0	-601	-9
75	-6	-6	0	-2	0	0	-4	0
80	-1	-1	0	0	0	0	-1	0
85	-63	-63	0	-14	0	0	-49	0
90	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0
99	0	0	0	0	0	0	0	0
Future Gen.	39,642	33,879	6,229	3,126	344	-74	-	-
	Labor Income Tax	Capital Income Tax	Con sump-tion Tax	Tax on Asset Holding	Tax on Asset Transact	Other Taxes	Seign-iorage	Edu. Exp
0	3,048	8,254	12,561	2,133	3,210	2,347	90	-15,535
5	2,621	7,863	11,699	2,025	2,800	2,171	88	-8,930
10	2,170	7,113	10,350	1,822	2,327	1,906	82	-1,859
15	1,741	6,124	8,894	1,572	1,877	1,622	72	-51
20	1,361	5,096	7,405	1,320	1,470	1,338	62	-26
25	947	3,831	5,997	1,004	1,002	1,036	52	-24
30	669	3,015	4,634	789	728	799	42	-22
35	508	2,472	3,440	650	544	612	32	-20
40	295	1,819	2,533	487	384	449	25	-17
45	132	1,335	1,822	346	228	315	18	-15
50	38	890	1,282	238	105	213	14	-12
55	3	591	860	150	25	136	9	-10
60	0	355	552	94	2	83	6	-7
65	0	178	360	47	0	49	3	-5
70	0	23	53	7	0	7	1	-1
75	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0
99	0	0	0	0	0	0	0	0

Notes: 1) Educational expenditure treated as government consumption
2) Educational expenditure treated as government transfers

Table 9. Required Adjustments for Long-Term Budgetary Balance
(unit: %)

		[1] [9]	[2]	[3]	[4]	[5]	[6]
Generational Imbalance[1]							
NPI[2]	S. and N. Korea combined	-	91.5	63.4	88.9	117.5	106.9
NPII[3]		-	307.6	194.3	295.6	454.7	346.0
NPI	S. Korea only	117.0	151.3	142.8	150.6	158.1	171.5
NP II		195.4	260.9	246.7	259.7	272.9	294.9
Required Tax Adjustment for Long-Term Budgetary Balance[4]							
NPI	Current[5]	26.4	69.3	63.8	68.9	75.4	77.2
	Future[6]	58.7	102.8	94.7	102.2	111.6	114.5
	2004[7]	19.8	-	-	-	-	-
	Reunif. Year (2010) [7]	22.8	49.4	45.5	49.1	53.7	55.0
NPII	Current	26.4	70.3	64.8	69.9	76.4	78.2
	Future	58.7	104.3	96.2	103.7	113.1	116.0
	2004	19.8	-	-	-	-	-
	Reunif. Year (2010)	22.8	50.1	46.2	49.8	54.4	55.7
Required Tax and Transfer Adjustment for Long-Term Budgetary Balance[8]							
NPI	Current	17.5	44.6	42.0	44.4	47.8	49.7
	Future	38.8	65.7	61.8	65.4	68.8	73.2
	2004	12.9	-	-	-	-	-
	Reunif. Year (2010)	14.4	30.4	28.7	30.2	32.1	33.8
NPII	Current	16.9	43.6	41.0	43.4	46.7	48.5
	Future	34.3	58.2	54.7	58.0	61.2	64.8
	2004	12.1	-	-	-	-	-
	Reunif. Year (2010)	13.6	28.6	27.0	28.5	30.3	31.8

Notes: 1) Percentage difference in net payment between 2000 newborns and future generations
2) Net Payment I
3) Net Payment II
4) Percentage increase in tax burden to attain long-run budgetary balance
5) Tax burden and benefits of current generations (as of 2000) are adjusted, while those of future generations not changed.
6) Tax burden and benefits of future generations are adjusted, while those of current generations not changed.
7) Adjust tax burden and benefits for all the age groups from the respective year.
8) Percentage increase in tax burden and (the same) percentage decrease in benefits to attain long-run budgetary balance
9) [1] No unification; [2] Base case; [3] MLSS benefit reduction; [4] EI benefit reduction; [5] Separate operation of NPS; [6] Higher cost of reconstruction of North Korea

Table 10. GA 2 for South Korea (Tax Adjustment[1)], unit: 1,000 won)

	[1][2)]	[2]	[3]	[4]	[5]	[6]
Age	Current Generations (as of 2000)					
0	121,644	147,219	143,490	146,949	151,350	152,625
5	131,142	158,575	154,572	158,285	163,037	164,378
10	140,108	169,265	165,003	168,957	174,072	175,443
15	147,430	176,467	172,212	176,159	181,358	182,635
20	150,510	177,324	173,399	177,040	181,806	183,014
25	148,556	173,161	169,564	172,900	177,219	178,374
30	135,770	156,987	153,889	156,763	160,459	161,478
35	122,205	140,490	137,816	140,297	143,519	144,367
40	103,632	118,211	116,083	118,057	120,587	121,296
45	85,086	96,048	94,449	95,932	97,822	98,366
50	63,364	70,980	69,870	70,900	72,210	72,590
55	41,137	46,575	45,782	46,518	47,454	47,725
60	29,638	33,407	32,858	33,367	34,016	34,204
65	18,639	21,073	20,718	21,047	21,466	21,587
70	12,272	13,581	13,390	13,567	13,793	13,858
75	8,505	9,034	8,957	9,028	9,119	9,146
80	3,859	3,885	3,881	3,885	3,889	3,890
85	818	823	822	823	824	824
90	-2,491	-2,491	-2,491	-2,491	-2,491	-2,491
95	-1,281	-1,281	-1,281	-1,281	-1,281	-1,281
99	-486	-486	-486	-486	-486	-486
Year of birth	Future Generations (born after 2000)					
2001	117,996	142,891	139,261	142,628	146,911	148,152
2006	109,097	132,502	129,089	132,255	136,283	137,449
2011	102,437	124,634	121,397	124,399	128,223	129,326
2016	93,568	113,843	110,886	113,629	117,121	118,129
2021	87,957	107,018	104,238	106,817	110,098	111,047
2026	79,598	96,847	94,332	96,665	99,634	100,493
2031	72,350	88,029	85,742	87,863	90,562	91,343
2036	66,458	80,860	78,760	80,708	83,187	83,905
2041	61,062	74,294	72,365	74,155	76,433	77,092
2046	56,281	68,477	66,698	68,348	70,448	71,055
2051	52,181	63,488	61,839	63,369	65,315	65,878
2056	47,811	58,171	56,660	58,062	59,846	60,361
2061	44,067	53,616	52,223	53,515	55,159	55,634
2066	41,380	50,346	49,039	50,252	51,796	52,242
2071	39,416	47,958	46,712	47,867	49,338	49,763
2076	37,906	46,120	44,922	46,034	47,448	47,857
2081	36,349	44,226	43,078	44,143	45,499	45,891
2086	34,493	41,967	40,877	41,888	43,175	43,547
2091	32,989	40,137	39,095	40,062	41,292	41,648
2096	32,137	39,101	38,086	39,028	40,227	40,574
2100	31,769	38,653	37,649	38,580	39,766	40,108
2106	31,377	38,176	37,184	38,104	39,275	39,613
2111	30,516	37,128	36,164	37,059	38,197	38,526

Notes: 1) Tax adjusted proportionally to attain long-run budgetary balance
2) [1] No unification; [2] Base case; [3] MLSS benefit reduction;
[4] EI benefit reduction; [5] Separate operation of NPS;
[6] Higher cost of reconstruction of North Korea

Table 11. GA 2 for North Korea (Tax Adjustment[1)], unit: 1,000 won)

	[2] [2)]	[3]	[4]	[5]	[6]
age	Current Generations (as of 2000)				
0	57,785	56,285	57,677	60,191	59,961
5	52,234	50,878	52,136	54,399	54,201
10	45,230	44,055	45,145	46,731	46,933
15	37,776	36,795	37,705	38,874	39,199
20	30,620	29,825	30,562	31,505	31,773
25	23,123	22,523	23,080	23,789	23,994
30	17,503	17,048	17,470	18,006	18,162
35	13,417	13,069	13,392	13,803	13,922
40	9,596	9,347	9,578	9,872	9,958
45	6,604	6,432	6,591	6,794	6,852
50	4,313	4,201	4,304	4,437	4,475
55	2,734	2,663	2,728	2,812	2,836
60	1,676	1,632	1,673	1,724	1,739
65	962	937	960	990	998
70	136	133	136	140	142
75	1	1	1	1	1
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0
95	0	0	0	0	0
99	0	0	0	0	0
Year of birth	Future Generations (born after 2000)				
2001	58,481	56,962	58,371	60,873	60,683
2006	65,091	63,400	64,969	67,780	67,541
2011	71,495	69,638	71,361	74,372	74,187
2016	76,255	74,275	76,112	79,229	79,126
2021	77,688	75,670	77,542	80,589	80,613
2026	73,582	71,671	73,444	76,316	76,352
2031	75,270	73,315	75,128	78,016	78,104
2036	73,561	71,650	73,423	76,217	76,330
2041	67,767	66,006	67,639	70,231	70,318
2046	64,305	62,635	64,185	66,654	66,726
2051	59,879	58,324	59,767	62,070	62,133
2056	55,879	54,427	55,774	57,956	57,982
2061	53,361	51,975	53,261	55,373	55,370
2066	50,080	48,779	49,986	51,978	51,965
2071	46,891	45,673	46,803	48,676	48,656
2076	44,253	43,103	44,169	45,942	45,919
2081	41,792	40,707	41,713	43,391	43,365
2086	40,639	39,583	40,563	42,198	42,169
2091	40,284	39,238	40,208	41,832	41,801
2096	39,111	38,095	39,037	40,615	40,583
2100	37,759	36,778	37,688	39,211	39,180
2106	36,051	35,115	35,983	37,439	37,408
2111	34,246	33,356	34,181	35,564	35,535

Notes: 1) Tax adjusted proportionally to attain long-run budgetary balance
2) [1] No unification; [2] Base case; [3] MLSS benefit reduction;
[4] EI benefit reduction; [5] Separate operation of NPS;
[6] Higher cost of reconstruction of North Korea

Table 12. Sensitivity Analysis

(Unit: %)

	Growth Rate	*g*=1			*g* =1.5			*G* =2			Length of Transition		
	Discount Rate[1)]	*r*=3.5(6.5)	*r* =5(8)	*r* =7(10)	*r* =3.5(6.5)	*r* =5(8)	*r* =7(10)	*r* =3.5(6.5)	*r* =5(8)	*r* =7(10)	50 years	60 years	70 years
Generational Imbalance													
NP I	S. and N. Korea combined	111.1	173.1	274.2	91.5	161.0	276.6	76.0	148.9	276.7	91.5	121.5	148.1
NP II		302.7	612.4	4897.8	307.6	669.5	12343.1	362.2	790.8	-[2)]	307.6	408.9	501.8
NP I	S. Korea only	189.5	246.4	312.6	151.3	230.8	317.3	105.1	206.0	317.1	151.3	179.0	202.3
NP II		303.2	440.1	754.0	260.9	428.1	782.4	209.1	403.5	798.3	260.9	295.5	324.5
Required Tax Adjustment for Long-Term Budgetary Balance													
NP I	Current Future Reunif. Year (2010)	63.2 96.2 45.6	43.5 136.7 44.4	30.3 193.9 41.5	69.3 102.8 49.4	46.7 144.2 47.4	32.4 205.5 44.4	77.1 110.9 54.1	50.5 152.5 50.9	34.8 217.2 47.5	69.3 102.8 49.4	72.3 110.0 52.3	74.5 116.6 54.7
NP II	Current Future Reunif. Year (2010)	64.2 97.6 46.3	44.2 139.0 45.2	30.9 197.8 42.4	70.3 104.3 50.1	47.4 146.6 48.2	33.0 209.4 45.3	78.1 112.3 54.8	51.3 154.8 51.7	35.4 221.0 48.3	70.3 104.3 50.1	73.3 111.5 53.0	75.5 118.1 55.4
Required Tax and Transfer Adjustment for Long-Term Budgetary Balance													
NP I	Current Future Reunif. Year (2010)	41.1 64.0 28.7	29.9 94.0 28.8	21.9 130.9 27.6	44.6 65.7 30.4	31.8 96.3 30.3	23.3 135.6 29.1	48.8 67.4 32.1	34.0 98.3 31.7	24.8 139.5 30.6	44.6 65.7 30.4	46.5 69.6 32.0	47.8 73.3 33.3
NP II	Current Future Reunif. Year (2010)	40.2 56.3 27.1	29.0 76.7 26.9	21.1 97.0 25.5	43.6 58.2 28.6	30.9 79.2 28.2	22.4 101.2 27.0	47.6 60.2 30.4	33.0 81.7 29.7	23.8 105.3 28.4	43.6 58.2 28.6	45.4 61.5 30.1	46.7 64.4 31.2

Notes: 1) real value (nominal value)

2) We do not report the measure of generational imbalance since the age-0 account is negative in this case.

Table 13. Generational Imbalance between Current and Future Generations[1)]
(Unified Germany, %)

g [2)]=1			g =1.5			g =2		
r[2)]=3	r=5	r=7	r=3	r=5	r=7	r=3	r=5	r=7
101.9	188.3	563.4	89.9	156.1	387.5	79.3	132.6	288.0
Population Projection						Year East Germany Catches Up (Length of Transition Period)		
Constant Population Structure		Baseline Assumptions		Constant Fertility (1994)		2010 (20)	2020 (30)	2030 (40)
-7.6		156.1		161.4		156.1	170.2	181.8

Source: Raffelhüschen and Walliser (1999)
Notes: 1) Evaluated based on Net Payment II.
2) g is the productivity growth rate (%): r is the discount rate (%). All values for these parameters are real.

Table 14. Four Alternatives to Restore Generational Balance
(difference from base-year revenue/expenditures)

Option	Change (%)
Increase in Income Tax Revenues	29.5%
Cut in Government Purchases	25.9%
Cut in Transfer payments	14.1%
Increase in All Tax Revenues	9.5%

Source: Raffelhüschen and Walliser (1999).

Fig 1. Labor productivity of N. Korea
(relative to S. Korea)

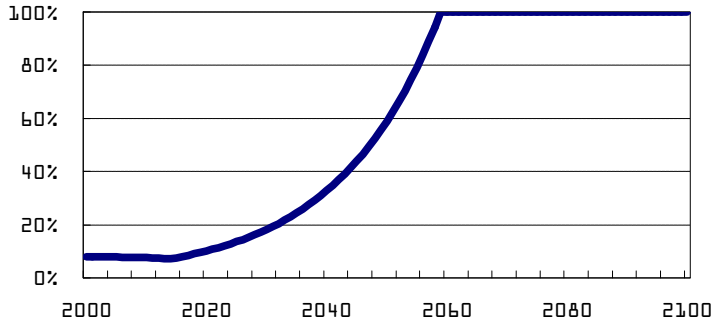


Fig 2. Public Pension Benefit Profile
(case [1])

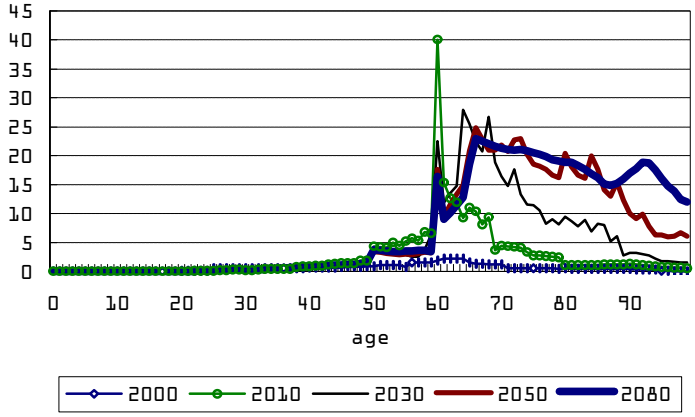


Fig 3. Change in Net Payment due to Reunification
(S. Korea, NPL, Tax Adjustment, %)

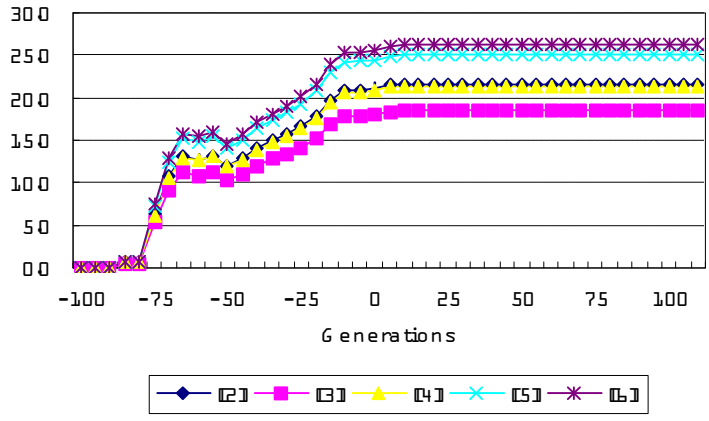


Fig 4. Change in Net Payment (NPI, S. Korea)
(Compared with [2], Tax Adjustment, %)

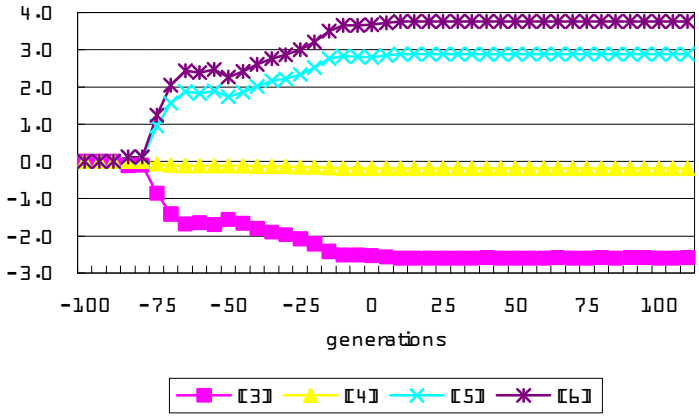
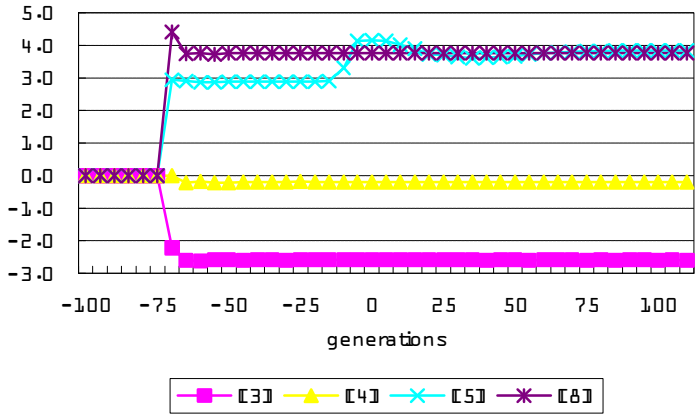


Fig 5. Change in Net Payment (NPI, N. Korea)
(Compared with [2], Tax Adjustment, %)



Appendix. Estimation of the Reconstruction Cost

We assume that the production technology is represented by a Cobb-Douglas function:

(A1) $$Y = F(K, eN) = K^{q}\left(eN\right)^{1-q}$$

where Y, K, N, and q are GDP, the aggregate capital stock, aggregate labor (represented by the economically active population) and the capital income share. The term e accounts for the level of multifactor productivity, expressed in labor-augmenting units.

Under the assumption of a competitive labor market, the South-North wage ratio is:

(A2) $$\frac{w_S}{w_N} = \left(\frac{e_S}{e_N}\right)\left(\frac{K_S/\left(e_S N_S\right)}{K_N/\left(e_N N_N\right)}\right)^{q} = \left(\frac{e_S}{e_N}\right)^{1-q}\left(\left(\frac{K_S}{K_N}\right)\left(\frac{N_N}{N_S}\right)\right)^{q}$$

(A2) indicates that the wage gap results from differences in multifactor productivity as well as in capital intensity. We assume that, along path of convergence, the multifactor productivity gap is reduced by technology spillovers from South Korea to North Korea, i.e., that the reconstruction cost comes from paying for part of North Korea's capital accumulation.

By assuming a balanced growth path, i.e., $\frac{w_S}{w_N} = \frac{e_S}{e_N}$, and solving (A2) for the ratio of aggregate capital stocks, we get:

(A3) $$\frac{K_S}{K_N} = \left(\frac{w_S}{w_N}\right)\left(\frac{N_S}{N_N}\right)$$

Using (A3), the paths assumed for the ratios of labor productivity (w_S/w_N) and economically active populations (N_S/N_N), and the assumed capital-output ratio of 3 (which pins down capital stock levels), we compute the path of North Korea's aggregate capital stock required for its labor productivity to reach South Korea's by the end of the transition. We then compute the corresponding path of (gross) investment in North Korea, under the additional assumption that the annual economic depreciation rate is 5%. We assume that the rate of investment by North Korea itself is the same as that of South Korea, and that the residual investment must be financed by South Korean residents for a period of 20 years after reunification.