Financing Consumption in an Aging Japan: The Role of Foreign Capital Inflows and Immigration

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1. Introduction.

Over the next several decades, Japan's population will be aging rapidly. In 1955, only 5.5 percent of the population was 65 years or older; by 1998, 16.2 percent were elderly. Projections imply large increases in the elderly in the next 20 years; by 2015, 25 percent of the population will be 65 or above. Declining fertility is the principal source of the changing demographic patterns (Takayama, 1998). In the years following the Second World War, the total fertility rate in Japan rose to about 4 by 1950. However, fertility declined sharply during the 1970s and 1980s. It was 2.1 per household in 1974, but 1.4 per household by 1997. The total fertility rate is projected to decline to about 1.2 over the next several decades. Moreover, Japan has typically allowed only a small number of immigrants, who, especially in English-speaking countries, have helped to keep the population young.

A key question is how domestic consumption can be maintained in a rapidly aging population. The elderly consume, but do not supply the labor that leads to higher output. Thus, as the population ages, the share of consumption in output increases. If domestic output is insufficient to maintain consumption in an aging population, capital must be imported. In this paper, we revisit the impact of demographic change on Japanese capital outflows and inflows. We show that the aging population will decrease both saving and investment rates, but the decline in saving rates will be more severe, leading to current account deficits and foreign capital inflows. In our baseline projections, we show that by 2015, about 25 percent of Japanese consumption will be maintained by foreign capital inflows.

We project the impact of demographic change on Japanese capital flows by simulating the impact of aging on Japanese saving and investment rates. In our simulations, we adopt the standard small-country, open capital markets, Ramsey optimal growth model. Specifically, we follow Cutler, Poterba, Sheiner, and Summers' (1990) modifications to the Ramsey model, in examining the impact of changing demographics on savings and investment. Our main innovation is that while Cutler, *et. al.'s* work focused on the closed-economy, we focus on the open-economy, so that capital inflows into Japan can be explicitly modeled.

Past work projecting the impact of demographic change on Japan's saving-investment balance are voluminous; see for example Horioka (1991, 1992), Oishi and Yashiro (1997), Auerbach *et. al*. (1989), Miles and Cerney (2001), McKibbin and Nguyen (2001) and many others. The distinguishing feature of our work is that in our projections, we compare the capital inflows that will occur without immigration, to the inflows that occur *with immigration*. Consistent with the United Nation's recommendations, we assume that from 2005 to 2040, Japan will allow 400,000 immigrants annually. With the larger labor force from immigration, output in 2020 will be 22 percent higher by 2020, and 50 percent higher by 2040. The higher output means that less capital needs to be imported. In our projections with immigration, by 2015, only 15 percent of Japanese consumption will be maintained by foreign capital inflows. To the best of our knowledge, our paper is the first paper to simulate the impact of increased immigration into Japan, on that country's saving-investment balances, and capital inflows.

The benefits of immigration into Japan are a hotly debated topic. While in recent centuries, Japan has virtually allowed no immigrants, immigration has been massive in some previous centuries. Some anthropologists believe that the import of wet-rice cultivation, and of iron and bronze tools and implements from China and Korea during the Yayoi period (400 B.C. to 300 A.D.) were accompanied by massive or at least modest immigration from those two countries (Seki, 2000). Japan's population at the beginning of the Yayoi period was estimated to be between 75 and 250 thousand; the population grew 70-fold during the Yayoi period. Some anthropologists also believe that during the Kofun period (300A.D. to 700 A.D.), Korean, but not Chinese, immigration was extensive (Diamond, 1998). These Korean immigrants brought Buddhism, writing, horseback riding, and new ceramic and metallurgical techniques.

Our simulation model also requires that we project government finances. We show that the aging of the population will worsen government finances, as healthcare and social security spending soar. In our baseline simulations, we show that Japanese taxes would need to increase from 28 percent of GDP to almost 50 percent of GDP by 2050 to cover the current Japanese government net debt, and the future government spending. With immigration, social security and healthcare spending as a percentage of GDP will be lower, meaning that future tax increases can be lower. We show that with immigration, the Japanese tax-GDP ratio would need to increase to only 45 percent by 2050.

This paper is organized as follows. In Section 2, we summarize the demographic changes undergoing in Japan, and present the Japanese government's demographic projections. We then show how Japan's future demographic profile would improve when 400,000 annual immigrants are allowed. In Sections 3 and 4, we digress briefly to describe the institutional characteristics of the Japanese social security system. We show that in practice, the Japanese social security accounts are inextricably intertwined with the general budget of the Japanese government; and that it is difficult to separate the Japanese social security accounts from the general government budget. This justifies the assumption in our model that there are no dedicated social security payroll taxes; and that all taxation can be captured by a lump-sum distortionary tax. In Section 5, we simulate the impact of demographic change on future Japanese saving and investment rates, government deficits, and net capital inflows, both without and with immigration. Section 6 concludes.

2. Aging, Immigration, and Support Ratios.

Figure 1 plots the Japanese government's projections of the country's population and the percentage of the total population that is elderly.[1] Japan's population is expected to peak at close to 130 million in 2005, then gradually decline to about 100 million by about 2050. The labor force (age 20-64) is projected to fall from 79 million in 2000 to 50 million in 2050.

The percentage of the population over the age of 65 has grown rapidly, especially since 1980, and now stands at about 15 per cent. By 2020, that percentage should approach 25 percent, and by 2050, 33 per cent. By 2030, the percentage of the very old (aged over 80) should exceed 10 per cent. These rates of population aging are much higher than in other countries. For example, in the U.S., only about 15 per cent of the population will be above the age of 65 by 2025.

Immigration into Japan.

Between 1970 and the mid-1980s, Japan annually allowed between 20 and 30 thousand immigrants. During the late 1980s and early 1990s, because of the severe shortage of labor,

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[1]The figures for 1955-99 were calculated from data presented in Japan's *Statistical Yearbook.* The figures from 2000-2050 were calculated from the medium projections of the population by age group presented in the Ministry of Health and Welfare (1998).

annual immigration increased to about 70 to 90 thousand, but that number declined in recent years. In terms of stocks, Japan's immigrant population numbered 1.5 million, or 1.2 percent of the population, with perhaps another 500 thousand in illegal immigrants in 1997. This is contrasted with the United States, which in the same year, had a stock of 26 million legal immigrants, or 9.7 percent of the population. Annual flows of legal immigrants to the U.S. is about 1 million (0.4 percent of the population), with an additional estimated illegal immigrant flow of 1 million.

The United Nations Population Division (1998) projects that to keep the size of the Japanese population constant at today's level of 127 million, Japan would need an average of 400,000 immigrants per year between 2005 and 2050. In our projections of the Japanese population structure *with immigration,* we assume that 200 thousand men and 200 thousand women immigrate annually. They are assumed to be equally divided between the age groups of 20-24 and 25-29. We also assume that all 20-24 year old immigrant couples have 2 children each within 5 years of their arrival in Japan.

Under these assumptions, Figure 2 depicts the total population and the population over age 65, *with immigration*. Instead of peaking in 2005 at 128 million, with immigration, the population peaks at 2015 at 135 million and stays at about that level.[2] The labor force is kept robust with immigration. The labor force is projected to slightly dip from 79 million in 2005 to about 74 million in 2050.

By 2050, the immigrants and their decedents will comprise about 18 percent of the total population of the country. As immigrants reach age 65 after 2040, the elderly population

[2]Our population projections are somewhat higher than the United Nations projections, because we assume higher immigrant fertility rates.

increases somewhat. The proportion of those over the age of 65 reaches 25 percent in 2020, and 29 percent in 2050. Thus, even with this immigration, the population of Japan will be considerably older than in the United States.

The Support Ratio.

Demographic shifts affect the economy's consumption opportunities because they change the relative sizes of the self-supporting and dependent populations. Following Cutler, Poterba, Sheiner, and Summers (1990), we summarize these changes by the *support ratio,* denoted by α, which we define as the effective labor force, LF, divided by the number of consumers, CON,

$$\alpha = LF / CON.$$

The first issue in measuring the support ratio concerns the relative consumption needs of people at different ages. We assume that all people have identical resource needs so that:

$$CON = \sum_{i=1}^{99} N_{i,}$$

where N_i is the number of people of age i.

The second issue concerns the effective labor force. We assume simply that all people aged 20-64 are in the labor force, while individuals 19 and under or 65 and over are not:

$$LF1 = \sum_{i=20}^{64} N_i .$$

This measure is used by the Japanese government in projecting the future labor force.

Figure 3 plots the support ratios without (LF) and with immigration (LFIM). As the population falls, the support ratio declines under both scenarios, but the decline in the support ratio is much steeper without immigration. Without immigration, the support ratio falls from 1.0 in 2000 to 0.86 in 2025 and 0.80 in 2050. With immigration, the support ratio falls from 1.0 in 2000 to 0.89 in 2025 and 0.86 in 2050.

3. Aging and the Japanese Social Security System.

The Japanese social security system is two-tiered. The first-tier is the universal pension, which provides a flat basic pension, currently averaging about 50 thousand yen. Enrollment is mandatory for all Japanese residents, including immigrants, between the ages of 20 and 60. An interesting feature of the universal pension plan is that 1/3 (½ by 2004) of the benefits are paid from the general budget of the government. The second-tier covers most employees, and contributions are wage related. Presently, contributions are 13.6 percent of annual income, shared equally between employee and employer. Average monthly benefits are about 180,000 yen. The Japanese social security system has built up a sizable trust fund–about 30 percent of GDP–but is essentially a "pay-as-you-go" system.

Problems with the Japanese Social Security System.

*Intergenerational Inequality***.**

One characteristic of "pay-as-you-go" social security systems is that when the population ages, the elderly receive more from the system than they pay into the system. In turn, younger generations pay more into the system than they receive from the system. The main reason why pay-as-you-go social security leads to intergenerational inequality is that when population growth rates decline, taxes must increase or benefits must decline to keep social security receipts approximately equal to payouts. Thus, in the face of an aging population, the Japanese government has repeatedly raised payroll taxes and cut social security payout ratios in an attempt to keep the future system intact.[3]

These policy changes have hurt future generations. Takayama and Kitamura (1999) identified large intergenerational imbalances in Japan, with future generations expected to pay about 3-4 times more in net taxes and social security contributions than the generation currently in retirement. Hatta and Oguchi (1999, p. 5) calculate that people born in 1935 receive about 3.8 times what they paid; and people born in 2010 receive only about 60 percent of what they paid.

Unfunded Social Security Liabilities.

Another consequence of slowing population growth under pay-as-you-go social security is the accumulation of unfunded government liabilities. Although the government has in recent years--especially in 1999-- raised payroll taxes and reduced future benefits, unfunded liabilities have continued to accumulate. The government bases its future projections of the social security balance on assumptions regarding future demographics, income growth, and interest rates. Based on these assumptions, the government determines its projected payroll taxes and benefits; so as to keep the annual flows of social security receipts and payouts approximately equal.

[3]For example, social security payroll taxes as a percentage of income was 3 percent in 1979, and 17.4 percent in 2002. It is projected to be 26.2 percent of income in 2035.

However, some analysts have argued that the government's assumptions are over-optimistic, and that the projected payroll taxes and benefits will lead to annual deficits (Nishizawa, 2003; Chand and Jaeger, 1996).

The present value of these annual deficits do not appear on the government's balance sheets, and are called unfunded social security liabilities. Chand and Jaeger (1996) estimate the present (2000) value of Japan's unfunded social security liabilities as 110 percent of GDP. Hatta and Oguchi (1999) estimate the present value of unfunded liabilities as 140 percent of GDP. On an optimistic note, the IMF estimates that the 1999 social security reforms have reduced government unfunded social security liabilities to about 30 percent of GDP (IMF, 2000).

There are several reasons for the continued accumulation of unfunded liabilities. First, the government's demographic projections have consistently underestimated the pace of future population aging; because of rapidly declining fertility rates, and lengthening life-spans. The total fertility rate has declined from 2.1 per household in 1975 to 1.33 per household in 2001. Meanwhile, male life expectancies have increased from 72 in 1975 to 78 in 2001. Since demographic projections are based on current fertility rates and life-spans, adverse movements in these variables make demographic projections over-optimistic. Based on these demographic projections, tax rates have turned out to be too low, and benefits, too high, resulting in large unfunded liabilities.

Second, is government's inability to get a good interest rate on the social security trust fund. The government's projections assume a 4.5 percent interest rate on the social security trust fund. Since there were relatively few aged until now, the social security system ran persistent surpluses, and the trust fund reached 150 trillion yen (30 percent of GDP) by end-2002. Until 2001, these funds were by law invested in government investment projects through the fiscal investment and loan program; and earned the interest rate on government bonds, which recently yielded about 0.7 percent. Since 2001, the social security trust fund has been allowed to invest in financial markets, although asset allocations have been legally prescribed.[4] Given the weakness of Japanese financial markets, the fund earned a *minus* 2.5 percent in 2001 (Nishizawa, 2003). It appears unlikely that the government will be able to earn rates of return approaching 4.5 percent, which means less income from the social security trust fund; and larger unfunded liabilities.

Finally, there has recently been a sharp increase in non-payments of social security payroll taxes and other social security contributions. As in other countries, participation in the social security system in Japan is mandatory. However, Nishizawa (2003, p. 63) calculates that nearly 40 percent of those required to participate in the social security system fail to pay taxes or contributions. These non-payers include the unemployed, the self-employed refusing to pay contributions, and those with incomes so low that they are excused from paying contributions. Since under current law, all residents of Japan are eligible to receive social security benefits, non-payments result in an increase in unfunded liabilities.

Recently Enacted or Proposed Social Security Reform Measures.

Recent social security reform measures have focused on reducing the intergenerational inequality, and unfunded social security liabilities. In 1999, the Japanese government enacted

[4]The prescribed asset allocations are 68 percent domestic bonds; 12 percent domestic stocks; 7 percent foreign bonds; 8 percent foreign stocks; and 5 percent domestic deposits.

their latest social security reform measures. These reforms: 1) cut the future level of benefits across the board by 5 percent in real terms ; 2) scheduled a gradual increase in the age of eligibility of social security benefits from 60 today to 61 in 2013 and 65 by 2030; and 3) eliminated the automatic indexing of social security benefits to increases in the real wage. Japanese authorities have claimed that without these reforms, payroll taxes would need to increase to 35 percent by 2025; but with the reforms, payroll taxes would need to increase to only 28 percent.

Many private sector analysts have argued that these measures do not fundamentally resolve the problems of the social security system. As pointed out above, the government's demographic assumptions appear over-optimistic; with more realistic assumptions, payroll taxes will have to increase substantially, leading to greater intergenerational inequality, and larger unfunded social security liabilities. Overwhelmingly, private sector analysts recommend a shift from the current pay-as-you-go system to a fully-funded system.

Hatta and Oguchi (1999) are perhaps the strongest proponents of this shift to a fully-funded system. In shifting from the current pay-as-you-go system to the fully-funded system, they recommend the following process. They first recommend that the government fully fund the amount of unfunded social security liabilities by issuing bonds. Their reasoning is that the funding of these liabilities are not just the responsibility of future wage earners, but also the responsibility of all citizens. In fact, they recommend that these bonds be paid for by increased consumption taxes, which would be levied on the elderly as well. Next they recommend that the benefits of future retirees be cut by 20 percent; and that future payroll taxes be lowered to make the system actuarily fair. The portion of the benefits of the current retirees that should have been covered by payroll taxes on the currently working are thus unfunded and should be covered by increased consumption taxes.

4. Social Security and Overall Government Spending in Our Model.

Our approach differs from the traditional approach in modeling the Japanese social security system. First, unlike in Hatta and Oguchi (1999), Nishizawa (2003), and others, we do not estimate the amount of unfunded social security liabilities. To do so would require separately projecting social security benefits, and in particular, dedicated social security payroll taxes. Thus, in our model, we do not differentiate between dedicated social security payroll taxes and other forms of taxation. Our view is that in practice, Japanese social security accounts cannot be separated from the overall Japanese government budget.

Some of the social security benefits, and much of the excess social security payroll taxes (i.e., social security trust fund) are today inextricably intertwined with the general government budget. As noted, as much as 50 percent of the benefits of the basic pension will be (from 2004) subsidized from the general government budget. In addition, most analysts expect that as unfunded liabilities mount, the rate of subsidy will increase. For example, as mentioned, Hatta and Oguchi (1999) recommend that all of the currently projected unfunded social security liabilities should be paid for by the general government budget (consumption taxes).

Moreover, part of the social security trust fund (about 80 percent) is mixed in with other government borrowing-- like postal saving deposits--to finance the massive Fiscal Investment and Loan Program. Hoshi and Doi (2003) estimate that over 50 percent of government funds in FILP are irrecoverable, which means that some of the social security trust fund is irrecoverable.

Money to replace these irrecoverable loans must come from the general government budget.

Second, unlike in Hatta and Oguchi (1999) and Takayama and Kitamura (1999), we will not be concerned with the redistributive effects of the social security system, and the intergenerational inequality that arises from the system. In our model, we assume that Japanese households are Ricardian. If the elderly raise their bequests to completely offset the costs to the young of the higher burden of social security, then the higher burden of social security has no redistributive effects.[5]

Our model only requires that we project overall government spending patterns by age group. In our projections, we focus on the three largest social expenditures: social security, healthcare, and education. For social security, we divide average social security expenditures in 1996-99 by the population over age 60. For healthcare, we allocate average healthcare spending in 1996-99 to different ages, using the age-specific expenditure patterns reported in Ishi (2000). For education, we divide total education spending in 2000 by the population between the ages 5 and 20.

For healthcare and education, we assume that age-specific expenditure patterns remain at the same real level between 2000 and 2040. For social security, we assume that the age of eligibility gradually increases from 60 to 65 in 2030, but once eligible, the age-specific benefits remain the same as today in real terms (in accordance with the 1999 reforms). That is, if the

[5]There is a large literature testing whether the Ricardian model is applicable for Japan (for a review, see Horioka, 2001). The Ricardian model can be contrasted with the life-cycle model, in which households do not care about their children. Thus, in the life-cycle model, households bring down their wealth (dissave) in old age. On the whole, the empirical tests support the Ricardian model, and reject the life-cycle model. The Japanese elderly, on average, leave large bequests to their children, and this appears to be motivated by altruism towards the next generation.

average 67 year old receives 180 thousand yen in social security benefits in 2000, an average 67 year old receives the same inflation adjusted amount in 2035. Other government spending, mainly defense, policing, and administration, are assumed to always equal the average 1996-99 ratio to GDP of 5.6 percent.

Demographic shifts can significantly alter the patterns and overall levels of government spending. Tables 1 and 2 depict the projections of total government spending in 1995 yen and as a share of projected GDP *without and with immigration*. Without immigration (Table 1), government spending rises from 25 percent of GDP in 2000 to 28 percent in 2015, and 33 percent in 2035. While education spending is projected to decline (as the number of children fall), healthcare, and especially social security spending, are projected to increase sharply, as the population ages. In particular, in 2035, the population over 65 increases significantly, leading to sharp increases in social security and healthcare spending.

With 400,000 annual immigrants (Table 2), government spending rises from 25 percent of GDP in 2000 to 27 percent in 2015, but falls thereafter to 22 percent in 2040. Government spending as a proportion of GDP falls, because while immigration raises the level of government spending somewhat, immigration sharply boosts the level of Japanese GDP, resulting in a fall in the ratio of government spending to GDP. The immigration-induced increase in the labor force raises the projected Japanese annual real GDP growth rate between 2000 and 2040 from 0 percent without immigration to 1.1 percent with immigration. These growth rates mean that output in 2020 will be 22 percent higher by 2020, and 50 percent higher by 2040 with immigration.

With immigration, the absolute levels of health care and education spending increase, as immigrants also require healthcare and especially, education services for their children. The absolute level of social security spending increases after 2035, as the population over 65 increases significantly, and some of the immigrants start to retire.

5. Demographic Change, Government Deficits, and Optimal Capital Flows.

Here we simulate the impact of aging and of immigration on future Japanese private and government saving and investment rates, and capital inflows. In our simulations, we adopt the standard small-country, open capital markets, Ramsey optimal-growth model (Barro and Sali-i-Martin, 1995, Ch. 3). With the model, we can examine how a society can adjust its saving, investment, capital inflows, and government deficits, in response to changes in demographic variables, summarized by the support ratios.

(i). Behavior of Firms.

We begin with the production function of a representative firm that uses both private and public capital as inputs:

$$y_t = \hat{k}_t^{\gamma} \hat{m}_t^{\gamma} \alpha^{1-\lambda} e^{ht} \tag{1}$$

where y_t is gross output per population (capita), $\hat{k}_t$ is the private capital stock per effective population, $\hat{m}_t$ is the public capital stock per effective population, and h is the constant rate of labor augmenting technical progress. We assume constant returns to scale in private and public capital, so that $(1-\lambda) = 2\gamma$. In the above production function, public capital is essential for the productivity of private capital–ie., public capital is not wasteful. This goes against conventional wisdom regarding the wastefulness of recent public investment in Japan. In our production function, we are mostly concerned with the productivity of public capital over the long run (over decades), and public investment was certainly productive in Japan in the past (1960s and '70s), and may be productive again in the future.

Note that when $\hat{k}_t$, $\hat{m}_t$ and the support ratios are constant, output per capita also grows at a constant rate h. When the support ratio is falling, however, output per capita grows at a slower rate than h.

The supply of private capital available to the firm depends on the global capital market; the marginal product of capital must equal $r + \delta$, where r is the gross international real interest rates, and δ is the rate of depreciation. We have:

$$\hat{k}_t = (r + \delta)(av\alpha_t^{1-\lambda})^{-1}\hat{m}_t^{\frac{v}{1-v}}, \tag{2}$$

and thus private investment per capita is:

$$\hat{i}_t = \dot{\hat{k}}_t + (n_t + h + \delta)\hat{k}_t . \tag{3}$$

where n_t is the population growth rate Thus, the paths of private capital and private investment are solely determined by the real interest rate, the rates of growth of the labor force and population, technical progress, and the path of public capital.

The government adjusts the level of public capital by changing the public investment rate, $\hat{j}_t$:

$$\hat{j}_t = \dot{\hat{m}}_t + \hat{m}_t(n_t + h + \delta) \qquad (4)$$

(ii) Behavior of Consumers.

The consumption rate is determined from "forward-looking" household behavior. Assume that households wish to maximize their lifetime utility, U, given by:

$$U = \int_0^\infty \frac{c^{1-\theta}}{(1-\theta)} e^{nt} e^{-\rho t} dt \qquad (5)$$

where c is consumption per capita, $1/\theta$ is the intertemporal elasticity of substitution, and ρ is the pure rate of time preference.

The budget constraint for households (in per-capita terms) is:

$$\dot{a}_t = \alpha_t w_t + (r - n_t)a_t - \tau_t - \frac{q\tau_t^2}{2} \qquad (6)$$

where a_t is total assets per capita, which is comprised of private capital, government bonds, and foreign assets, which are perfect substitutes in international portfolios; w_t are wages; and τ_t is the lump-sum tax imposed on each person each period by the government. This lump-sum tax also imposes a "deadweight" welfare loss of $\frac{q\tau_t^2}{2}$ per person.

It can be shown (see Appendix) that consumption per capita also always grows at h. Thus, while consumption per capita grows at h, when the support ratio is declining, output per capita tends to grow at less than h (see ii). The consumption rate, $\frac{c_t}{y_t}$ is rising, lowering the private saving rate.

(iii) The Government Budget Constraint and Government Behavior.

Each period, the government issues government bonds of, $\dot{b}$ to cover shortfalls in tax revenues:

$$\dot{b}_t = (r - n_t)b_t - \tau_t + g_t + j_t \qquad (7)$$

where b_t is government bonds outstanding per capita. The increase in government bonds per capita is higher, the larger is the primary fiscal deficit, which is the difference between tax revenues per capita, and the sum of government consumption g_t and public investment j_t per capita. As in Cutler, *et. al.* (1990), we assume that g_t is determined by age-specific patterns of government consumption, as presented in Tables 1 (without immigration) and 2 (with immigration).[6]

It can be shown (see Appendix) that the government will choose to levy a per capita

[6]We also assume that g_t either yields no utility to households, or that government benefits do not affect the household's optimal choice of private consumption.

lump-sum tax of τ_t that grows at the rate of consumption per capita growth, h. The government must then satisfy the following intertemporal budget constraint:

$$\tau_0 \int_0^\infty e^{ht} R_t dt = b_0 + \int_0^\infty (g_t + j_t) R_t dt \qquad (8)$$

where b_0 is the government debt outstanding per person today, and R_t is a discount factor. This budget constraint says that the present value of tax revenues must equal the present value of government consumption plus public investment. If government tax revenues are insufficient to cover government spending today, then in the future, tax revenues must exceed government spending for the government to satisfy its intertemporal budget constraint.

As in Clarida (1993), we assume that the government maximizes lifetime household utility (5), with respect to c_t and $\hat{j}_t$ subject to the constraints. We simulate the model using plausible parameter values, projected future support ratios without immigration, LF, and with immigration, LFIM, and future rates of population and labor force growth without and with immigration.

In the simulations, we allow support ratios and rates of population and labor force growth to change every five years. Details of the simulation are given in the Appendix. For comparability with actual National Accounts Data, we express our simulations in terms of ratios to GDP. We calibrate our model so that the starting year (2000) corresponds to the average of the actual data between 1996-99. For the initial government debt-GDP ratio, we use the ratio of *net* debt-GDP, *inclusive* of the social security net assets (=45 percent of GDP). We account for future social security liabilities by explicitly incorporating future social security benefits into our model.

(iv) Projections of Optimal Government Deficits and Capital Flows: Without Immigration.

Table 3 presents our projections without immigration. Private saving rates decline about 10 percentage points until 2010, and then declines rapidly from 2010 to 2040. This pattern is a result of shifts in the support ratio and increases in tax rates, which reduces disposable income. Although consumption per capita always grows at a constant rate of h (=1.2 percent), as the support ratio falls, output per capita growth is lower. This raises the consumption rate and lowers the private saving rate. Essentially, consumers are seeking to smooth their consumption when income is growing very slowly by lowering their saving rates.

Under tax smoothing, taxes per capita increase at a constant rate, while output per capita grows at a slower rate; thus the tax-GDP ratio rises over time. However, the actual tax rate in the starting year (average, 1996-99) at 28 percent of GDP, is lower than what is necessitated by tax smoothing (33 percent) and the satisfaction of the government's intertemporal budget constraint. That is, unless current tax rates are increased, the government will not be able to satisfy its intertemporal budget constraint. We allow taxes per capita to increase more rapidly between 2000 to 2015, and then smooth increases in taxes per capita from 2015 onwards. The sharp increases in tax rates between 2000 and 2015 also contributes to the decline in private saving rates, by lowering disposable income. By 2040, tax rates need to increase to almost 50 percent of GDP, for the government to recoup its current outstanding net debt of 45 percent of

GDP, and to cover its increased future spending.

Government saving rates rise from about 1-2 percent of GDP in 2000 to about 11 percent in 2040, owing to increased tax receipts. Private and public investment rates gradually fall over time, as the need to equip workers with capital equipment declines. Because of high government saving and falling public investment, the fiscal surplus (government saving minus public investment) turns positive after 2020. Consequently, the government net debt-GDP ratio increases until 2020, and falls thereafter.

The decrease in private saving is sharper than the increase in government saving, resulting in a fall in total saving between 2000 and 2040. The total saving rate declines from about 30 percent in 2000 to 10 percent in 2015, and then rises to 15 percent in 2040, as the government saving rate increases. The total investment rate declines from 28 percent in 2000 to 25 percent in 2015, 23 percent in 2030, and 22 percent in 2040. Thus, the decline in total saving is sharper than the decline in total investment, leading to larger current account deficits. Japan's current account surplus is projected to become negative in 2005, and sharply negative from then onwards. Part of Japan's domestic consumption will be financed from international capital *inflows* from about 2005. By 2015, about 25 percent of Japanese consumption will be financed from foreign capital inflows.[7] The ratio of consumption financed from foreign capital inflows, however, declines to about 18 percent by 2040, as government saving increases.

(v) Projections of Optimal Government Deficits and Capital Flows: With Immigration.

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[7]In 2015, the Japanese consumption-GDP ratio is projected to be 0.61. Given Japan's projected capital inflow-GDP ratio of 0.15 in 2015, capital inflows are about 25 percent of Japanese consumption.

Table 4 presents our projections *with* immigration of 400,000 people a year. Private saving rates decline about 10 percentage points until 2010. The decline in private saving between 2010 and 2040, however, is much milder with immigration than without, owing to improvements in the support ratio, especially after 2015. By 2040, private saving rates decline to about 8 percent of GDP.

With immigration, the growth in GDP is higher, and projected government spending as a percentage of GDP is smaller, meaning that tax rates can be lower. However, even with lower tax rates, the actual tax rate in the starting year (average, 1996-99) at 28 percent of GDP, is below what is necessitated by tax smoothing (33 percent), and the satisfaction of the government's intertemporal budget constraint. Thus, again, we allow taxes per capita to increase more rapidly between 2000 to 2015, and then smooth increases in taxes per capita from 2015 onwards. By 2040, tax rates need to increase to only 45 percent of GDP-- instead of almost 50 percent without immigration--for the government to satisfy its intertemporal budget constraint.

Government saving rates rise from about 1-2 percent of GDP in 2000 to about 17 percent in 2040, owing to increased tax receipts. Private and public investment rates gradually fall over time, but the decline is less rapid with immigration, as the labor force stays roughly constant from 2005. The government net debt-GDP ratio increases until 2020-25, and falls rapidly thereafter.

The decrease in the private saving rate is somewhat larger than the increase in the government saving rate, resulting in a slight fall in the total saving rate between 2000 and 2040. The total saving rate declines from about 30 percent in 2000 to 17 percent in 2020; rises to 19 percent by 2030, and bounces back to 25 percent by 2040. Total investment declines from 28 percent in 2000 to 25 percent in 2030-40. The current account deficit, while worsening to 10 percent of GDP in 2020, improves to rough balance by 2040, as the government saving rate increases. While in 2015, 15 percent of Japanese consumption will be financed from foreign capital inflows, by 2040, foreign capital inflows are negligible.

6. Conclusion.

Many previous papers (Horioka (1991, 1992), Oishi and Yashiro (1997), Auerbach *et. al*. (1989), Miles and Cerney (2001), McKibbin and Nguyen (2001) and others) have projected the impact of demographic change on the Japanese saving-investment balance and on capital inflows, although papers projecting future Japanese government budget balances are fewer. Despite the variety of methodologies and modeling assumptions, most earlier papers–like our paper–project declining saving and investment rates, with saving rates declining faster than investment rates, leading to current account deficits and capital inflows. On the whole, the previous papers predict deteriorating government budget balances, unless there is drastic fiscal reform. The proposed fiscal reforms in the previous papers range from tax increases to cuts in social security benefits and public investment. In our paper, we have focused on tax increases.

A unique feature of our work is that we also examine scenarios in which the government allows sizable immigration (400,000 immigrants per year from 2005 to 2040) into Japan. We show that with this immigration, Japan's projected capital inflows as a percentage of consumption will be much smaller, since the higher labor force will be able to raise Japan's GDP, to help sustain its growing elderly population. With the larger labor force from immigration, Japanese output (GDP) in 2020 will be 22 percent higher by 2020, and 50 percent higher by 2040. Finally, with immigration, social security and healthcare spending as a percentage of GDP will be lower, meaning that future tax increases can be smaller.

Appendix:

For convenience, we carry out the analysis in terms of effective population. The data for the population, n_t and the labor force, z_t (and therefore, α_t) are available only every 5 years. Thus, we assume that n_t and z_t discretely change only every five years; within any 5-year interval, say 2005 to 2010, n_t and z_t are assumed to be constant. From 2050 onwards, we assume that the values for 2050 hold.

From (1), real wages per effective population are:

$$\hat{w}_t = (1-\gamma)\hat{y}_t$$

In addition, we assume that there are adjustment costs to adjusting public capital, reflecting political lobbying costs, and bureaucratic implementation lags,

$$\text{adjcosts} = \hat{j}_t(1+\frac{\chi}{2}(\frac{\hat{j}_t}{\hat{m}_t})), \qquad \text{(A1)}$$

where χ reflects the costs of adjustment.

The government (or optimal planner) maximizes (5), in terms of effective population, with respect to (4), (6), (7), (8), and (A1).

Optimal Consumption.

The optimal path of consumption per effective population is:

$$\frac{\dot{\hat{c}}}{\hat{c}} = \frac{1}{\theta}*(r-\rho-\theta g) \ .$$

To prevent consumption per effective labor from approaching zero asymptotically, we assume that $r = \rho + \theta g$, so that consumption per effective population is flat, or that consumption per capita grows at rate h. For h, we take, 0.012 (from Jorgenson and Nishimizu, 1978). Consumption per effective population at time 0, $\hat{c}(0)$, (in our case, the year 2000), depends in a complicated way on the parameters of the lifetime utility function, and the entire future paths of $n_t, \alpha_t, \hat{\tau}_t, \hat{g}_t, \hat{j}_t, \hat{w}_t$, the parameters r, h, and the starting values, $\hat{a}_0$, and $\hat{b}_0$. Rather than calculating $\hat{c}(0)$, we assume that the actual level of consumption per capita between 1996 and 1999 (in the data) was at or near the optimal level. (Of course, we are not assuming that the Japanese economy was in steady-state between 1990-1999; we are only assuming that consumers were optimizing in 1996-1999).

Optimal public and private investment, output.

The optimal path of public capital per effective population is:

$$\frac{\dot{\hat{m}}_t}{\hat{m}_t} = \left(\frac{1}{\chi}\left(\frac{\phi_t}{\mu_t} - 1\right) - (n_t + h + \delta)\right), \qquad \text{(A2)}$$

where μ_t is the marginal utility of total assets, and ϕ_t is the marginal utility of public capital. Investment in public capital raises utility by raising output; on the other hand, investment in public capital lowers utility because total assets decline. Thus, $\frac{\phi_t}{\mu_t}$ represents the shadow value of public investment. μ_t and ϕ_t evolve according to:

$$\dot{\mu}_t = (r - n_t - h)\mu_t \qquad \text{(A3)}$$

$$\dot{\phi} = (h + \delta + n_t)\phi_t - \left(\frac{d\hat{y}_t}{d\hat{m}_t} + \frac{(\frac{\phi_t}{\mu_t} - 1)^2}{2\chi}\right)\mu_t \qquad \text{(A4)}$$

where $\frac{d\hat{y}_t}{d\hat{m}_t}$, after substituting the expression for $\hat{k}_t$, (2), is a function of only $\hat{m}_t$. To determine the optimal path of $\hat{m}_t$, we discretize (A2), (A3), and (A4), and simulate the path of $\hat{\mu}_t$, $\hat{\phi}_t$, and $\hat{m}_t$ forward, for plausible parameter values. For the parameters used in the simulations, we take values culled from the literature. For γ, h, δ, r, and χ, we use 0.20, 0.012, 0.13,0.05, and 6. These values are fairly standard, except that since we have no empirical data for the adjustment speed of public capital, we took the value 6 from the private capital adjustment cost literature (Hayashi, 1982).

Our simulation strategy is to start from 2000 (from the actual values in the data, 1996-99), and simulate forward using the values of n_t and α_t. We imposed the condition that $\phi(0) = \mu(0)$, and chose a value of $\phi(0)$ so that the path of $\hat{m}_t$ did not vary much from

$\hat{m}(0)$. As mentioned, we assume that the demographic variables change discretely only every 5 years. As it turned out, given our parameter values, new steady states for $\hat{m}_t$, ϕ_t , and μ_t were reached in about 5 years for all n_t and α_t .

Finally, from the path of $\hat{m}_t$; $\hat{j}_t$ (from (4)), $\hat{k}_t$ (from (2)), $\hat{i}_t$ (from (3)) and $\hat{y}_t$ (from (1)) can be calculated . Thus, we can calculate the private and public investment rates, which are depicted in Tables 3 and 4.

Optimal Government Taxes.

It can be shown that $\hat{c}(0)$ is maximized when $\hat{\tau}_t$ is constant (Barro, 1979). That, is, the government maximizes the path of consumption (and of utility) when lump-sum tax taxes per effective population are constant, or that taxes per capita are growing at the rate h.

Satisfaction of the government's intertemporal budget constraint (8) means that the present value of lump-sum taxes per effective population is equal to the present value of government spending per effective population:

$$\hat{\tau} = \frac{\hat{b}_0 + \int_0^\infty \hat{g}_t R_t dt + \int_0^\infty \hat{j}_t R_t dt}{\int_0^\infty R_t dt}, \qquad \text{(A5)}$$

where the discount rate, $R_t = \exp(-\int_0^t (r - h - n_v)dv)$. From (A5), we calculate the optimal value of $\hat{\tau}$, from our estimated (exogenous) path of $\hat{g}_t$ (from Tables 1 and 2), and our simulated path of $\hat{j}_t$ (from above). In practice, we truncate the integral at 2050, since beyond that, $\hat{g}_t$ and $\hat{j}_t$ are discounted to the extent that they are negligibly small. By dividing $\hat{\tau}_t$ by $\hat{y}_t$, we obtain the tax rate. Finally, from $\hat{c}_t$ (above), $\hat{g}_t$, $\hat{j}_t$, $\hat{y}_t$ and $\hat{\tau}_t$, we can calculate the private and public saving rates that are depicted in Tables 3 and 4.

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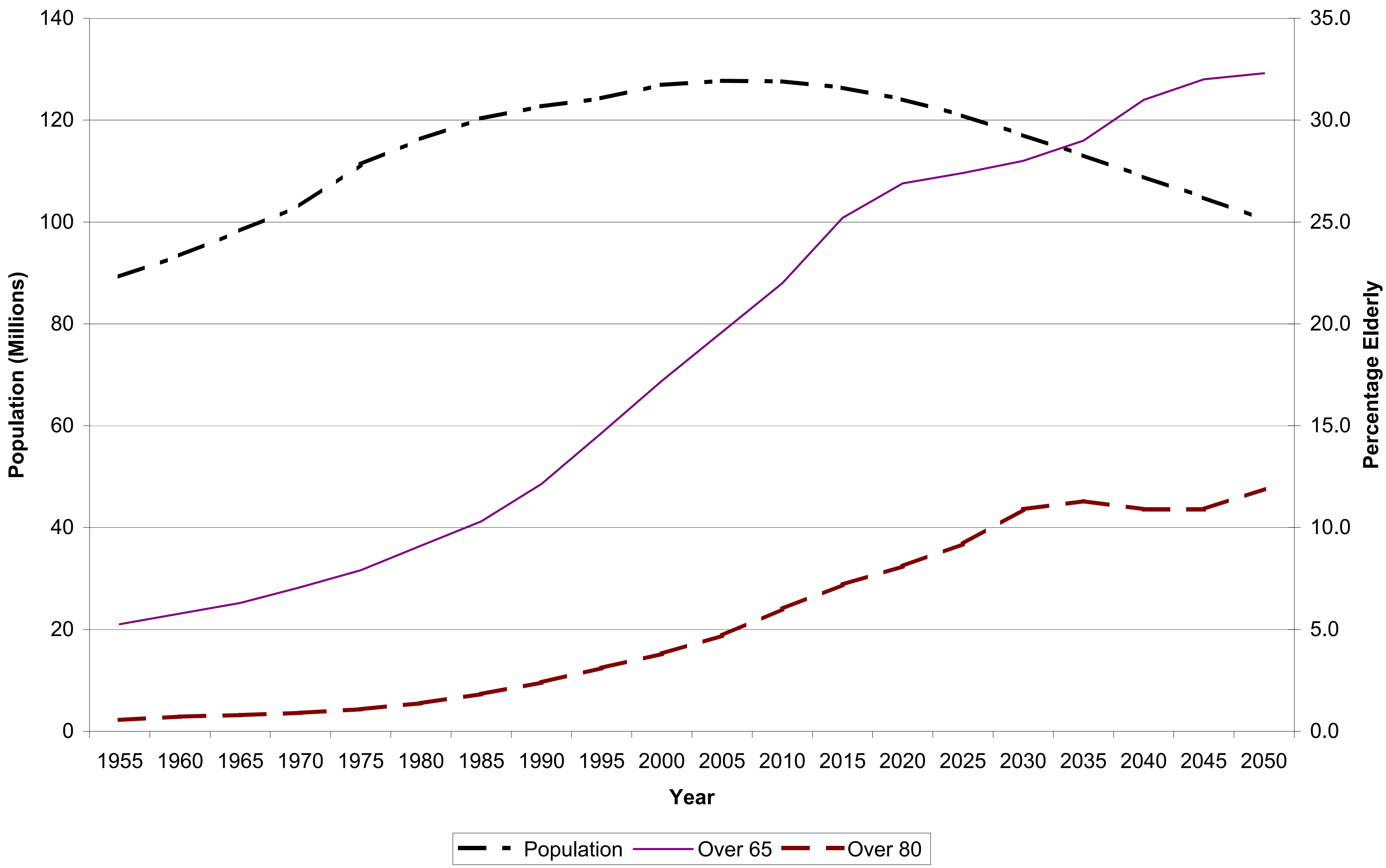
Figure 1: Population and Elderly Projections



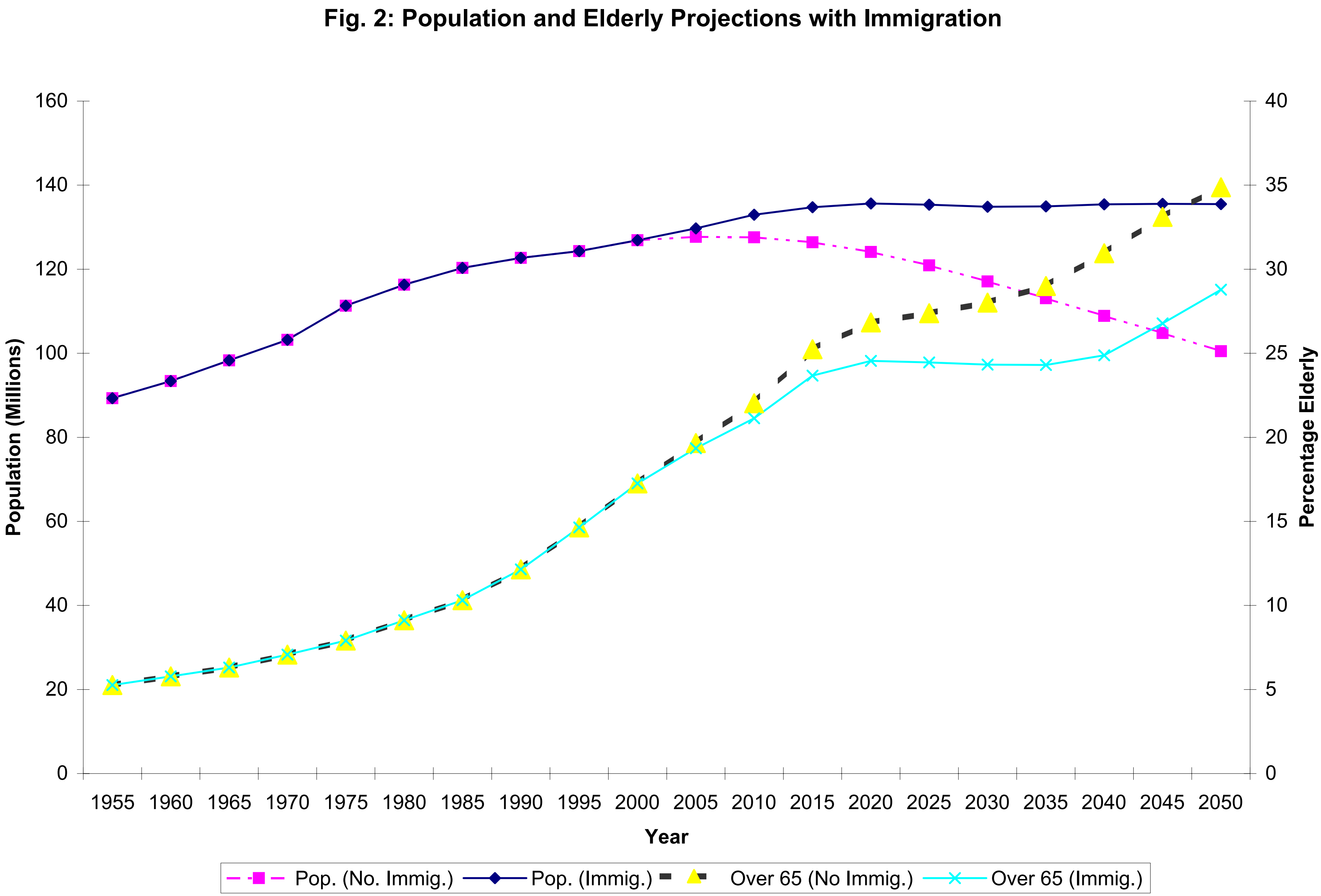


Fig. 2: Population and Elderly Projections with Immigration
Population (Millions)
Percentage Elderly
Year
0
20
40
60
80
100
120
140
160
0
5
10
15
20
25
30
35
40
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Pop. (No. Immig.)
Pop. (Immig.)
Over 65 (No Immig.)
Over 65 (Immig.)

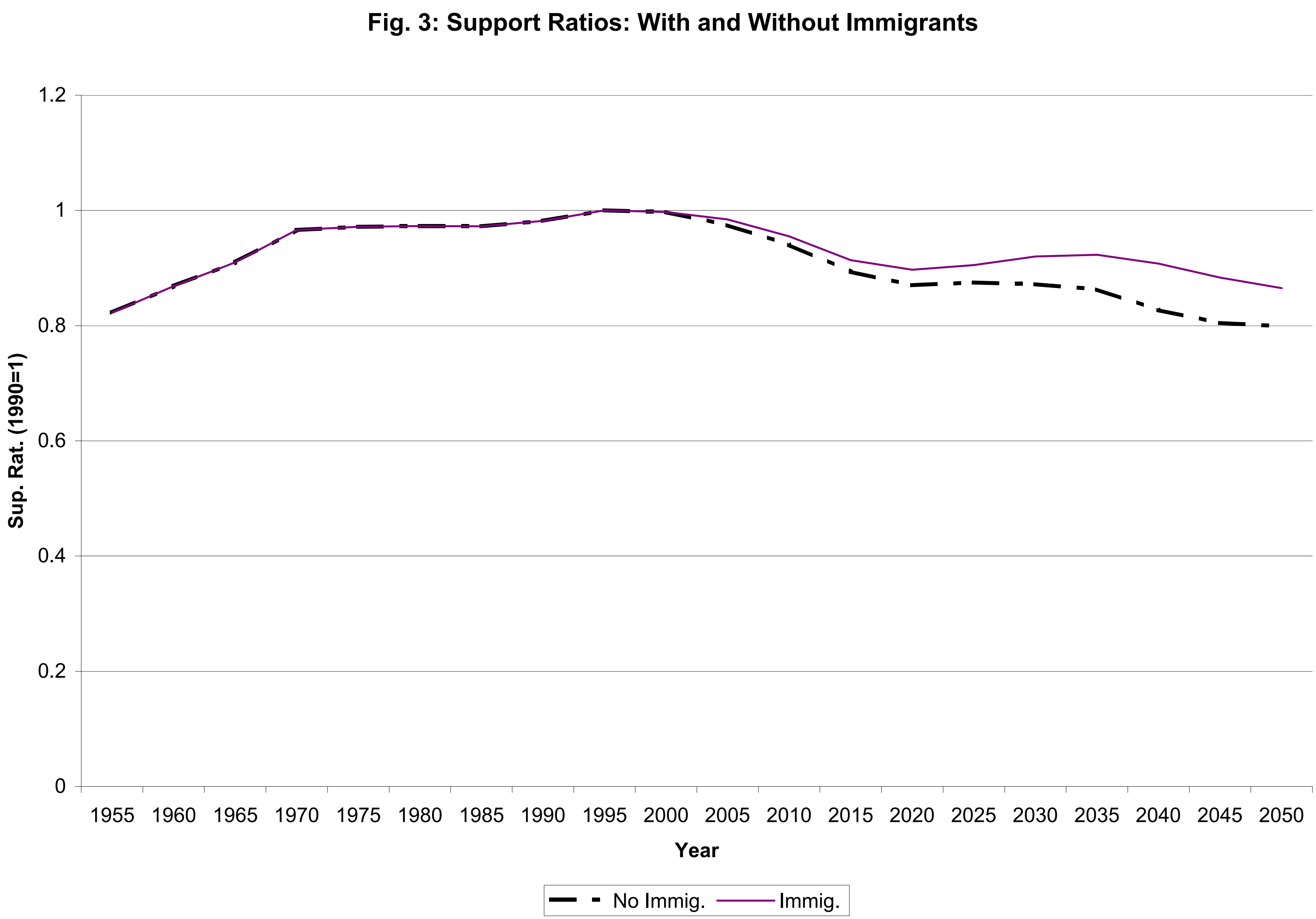


Fig. 3: Support Ratios: With and Without Immigrants
Sup. Rat. (1990=1)
1.2
1
0.8
0.6
0.4
0.2
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
No Immig.
Immig.

Table 1: Projected Government Spending, 2000-2040

(No Immigration)

	Social Security	Health Care	Education	Social Security	Health Care	Education	Other Spending 2/	Total
	(in billions of 1995 yen)			(in percent of GDP)/1				
2000	57667	27271	16327	11	5.3	3.2	5.6	25.1
2005	65265	28471	15634	12	5.4	2.9	5.6	25.9
2010	74032	29462	15445	14	5.7	3.1	5.6	28.4
2015	78318	30550	15067	14	5.7	2.8	5.6	28.1
2020	78903	30659	14689	13	5.1	2.4	5.6	26.1
2025	79098	30089	13680	14	5.2	2.3	5.6	27.1
2030	79683	29392	12923	14	5.2	2.3	5.6	27.1
2035	81630	28764	12167	18	6.3	2.7	5.6	32.6
2040	81046	28407	11915	16	5.7	2.4	5.6	29.7

1/ GDP projections are from the simulation model in the text.

2/ Defence, policing, administration, etc.

Table 2: Projected Government Spending, 2000-2040
(With Immigration)

	Social Security	Health Care	Education	Social Security	Health Care	Education	Other Spending 2/	Total
	(in billions of 1995 yen)			(in percent of GDP)/1				
2000	50662	27271	16328	11.0	5.3	3.2	5.6	25.1
2005	65266	28785	15634	11.9	5.2	2.8	5.6	25.6
2010	74033	30302	16075	12.8	5.3	2.8	5.6	26.5
2015	78319	31861	16328	13.2	5.4	2.8	5.6	27.0
2020	78903	32472	16580	12.7	5.2	2.7	5.6	26.2
2025	79098	32358	16202	12.0	4.9	2.5	5.6	24.9
2030	79683	32179	15445	11.2	4.5	2.2	5.6	23.6
2035	81631	32194	15319	10.8	4.3	2.0	5.6	22.7
2040	84164	32575	15697	10.7	4.1	2.0	5.6	22.4

1/ GDP projections with immigration of 400,000 a year.
2/ Defence, policing, administration, etc.

Table 3: Projection of Saving and Investment Rates, Government Debt, Current Account
(No Immigration)
(in percent of GDP)

	Private Saving	Tax Rate	Government Saving	Private Investment	Public Investment	Net Gov. Debt/GDP	Curr. Acc./ GDP
2000	28	28	1	20	8	45	2
2005	26	31	−3	20	8	91	−5
2010	19	38	−4	19	8	138	−12
2015	10	43	0	18	7	171	−15
2020	6	45	6	18	7	182	−13
2025	6	45	7	17	6	178	−10
2030	5	46	8	17	6	170	−10
2035	8	47	7	16	6	153	−7
2040	3	49	11	16	6	141	−8

Table 4: Projection of Saving and Investment Rates, Government Debt, Current Account
(With Immigration)
(in percent of GDP)

	Private Saving	Tax Rate	Government Saving	Private Investment	Public Investment	Net Gov. Debt/GDP	Curr. Acc./ GDP
2000	28	28	2	20	8	45	2
2005	27	31	1	20	8	87	−1
2010	19	37	3	19	8	125	−5
2015	11	42	6	18	8	149	−9
2020	9	44	8	19	8	156	−10
2025	8	44	9	18	8	156	−9
2030	8	44	11	18	7	142	−6
2035	8	44	14	17	7	115	−2
2040	8	45	17	18	7	74	0