Aging in OECD Countries and Capital Flows into Developing Countries: A Policy Analysis Using an Overlapping Generations Model.

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Abstract:

The pattern of demographic transitions in OCED and developing countries suggest that foreign capital flows from OECD countries to less developed countries can help ease the aging problems of OECD countries. In reality, however, very little capital flows to developing countries. In this paper, I investigate the reasons for this observed pattern of capital flows theoretically, and empirically using cross-country regressions. I use the parameter estimates of the regression models to calibrate an extended production function that incorporates the differences in infrastructure, human capital level and governance in the two regions. Using an overlapping generation model, I then numerically simulate the effects of various policies on capital flows into developing countries and on aging problems of the OECD countries.

Key words: Aging, Social Security, Capital flows.

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1. Introduction

In the last century the world has witnessed unprecedented demographic transitions. Japan and other OECD countries have achieved very high life expectancies and very low total fertility rates. For instance, the life expectancy at birth in Japan increased from 64 years in the 1950's to 83 years in the late 1990's, and the total fertility rate dropped from 2.75 in the 1950's to 1.43 in the late 1990's, which is much below the replacement total fertility rate, 2. The other OECD countries have similar experiences. These led to serious aging crises for the OECD countries. The potential support ratio in Japan, defined as the number of persons aged 15-64 per person aged 65 or older, has fallen from 12.06 in 1950 to 3.99 in 2000 and the UN projects it to drop to 1.71 by the year 2050 (see United Nations [2000] for details).

Japan and most other OECD countries have very generous publicly provided old-age pension programs, which transfer a large amount of resources from the young to the old, and generous publicly provided health care systems. In Japan, while higher life expectancy and lower fertility rate might have led to higher savings rate and current account surplus, these demographic events also led to aging crises involving high demand for labor services in the elderly care sector (see Sato [2001] for some estimates) and to heavy tax burdens on the young generation to provide for the promised pension benefits of the old. For instance, the social security benefits as percentage of national income was 17% in 1995 (9% pension, 6% medical care and 2% welfare) and it is expected to rise to 33.5% in 2025 (16% pension, 13% medical care, and 4.5% welfare). The above demographic transitions also have significant consequences on future population size. United Nations [2000] projects that in the absence of immigration after 1995, the total population in Japan will decline from the current level of 127 million to 105 million in 2050.

In contrast, the contemporary developing countries have much higher fertility rates and much lower life expectancies, and thus much higher potential support ratios. Furthermore, most developing countries do not have formal social security program or health care system that cover majority of their populations.

The aging crises in Japan and other OECD countries are very serious. The policy makers around the world have been debating on various ways to cope with the aging problems of OECD countries. The problems are in two areas – in resource requirements for elderly consumption including medical expenditure and in labor requirements for elderly care. Reforming the social security systems by reducing benefits, by increasing retirement age, and by privatizing the social security system are some of the highly debated and highly recommended policy suggestions. The long-term solution to the aging crises of the OECD countries, however, inevitably require tweaking the age-structure either by increasing fertility rate or by increasing immigration of foreign workers so that the potential support ratio is reasonably higher than what it would be otherwise. The general consensus is that it will be impossible to increase the fertility rate of the natives. United Nations [2000] and other practitioners recommend that Japan and other OECD countries should seriously consider "replacement migration" as a way to reduce the decline in population size and potential support ratio. United Nations [2000] estimates that Japan will require a yearly average net number of migrants in the order of 312 thousands to keep the population size constant, and 10 millions to keep the potential support ratio constant. It should be noted that there is no clear consensus on the concept of optimal population size in the literature. While it is not clear if Japan should try to increase its population size more than its projected size, it is, however, important to examine the role of replacement migration in easing the aging crises.

While immigration of labor is a viable solution to the aging crises, it is also important to seek other ways out of the crises. If capital can move across countries, the demographic mismatch between OECD countries and LDCs would open-up economic opportunities for both types of countries. For instance, demographic mismatch would lead to a higher rate of return from capital investment in LDC than in OECD country.

With more globalization of economies, capital of OECD countries can be invested in more productive LDCs, and thus leading to efficiency gain, and all countries can use the global capital market to smooth their consumption and thus leading to higher welfare gain. In particular, the demographic mismatch creates an opportunity for OECD countries to invest part of their capital in developing countries and then use the gains from capital incomes to pay for the old-age benefits. But even a cursory look at the foreign investment statistics of Japan would tell us that Japan has very little foreign investment in the less developed countries.

In this paper, I formulate an overlapping generations model to study the relevant policy issues surrounding Japan's aging crises. I will address the following issues:

- Could the aging problems in Japan be partly ameliorated by adopting suitable foreign investment policy vis-à-vis immigration policy?

- Why contrary to the prediction of the neoclassical theory, not much capital has been flowing from Japan into the less developed countries?

The rest of the paper is organized as follows. In section 2, I describe a few stylized facts about Japan. In section 3, I describe the basic theoretical framework. In section 4 I carry out cross country regression analysis to examine empirically the significant determinants of foreign capital flows. Section 5 uses the model to examine the role and prospects of foreign investment vis-à-vis immigration to cope with the aging crises in Japan.

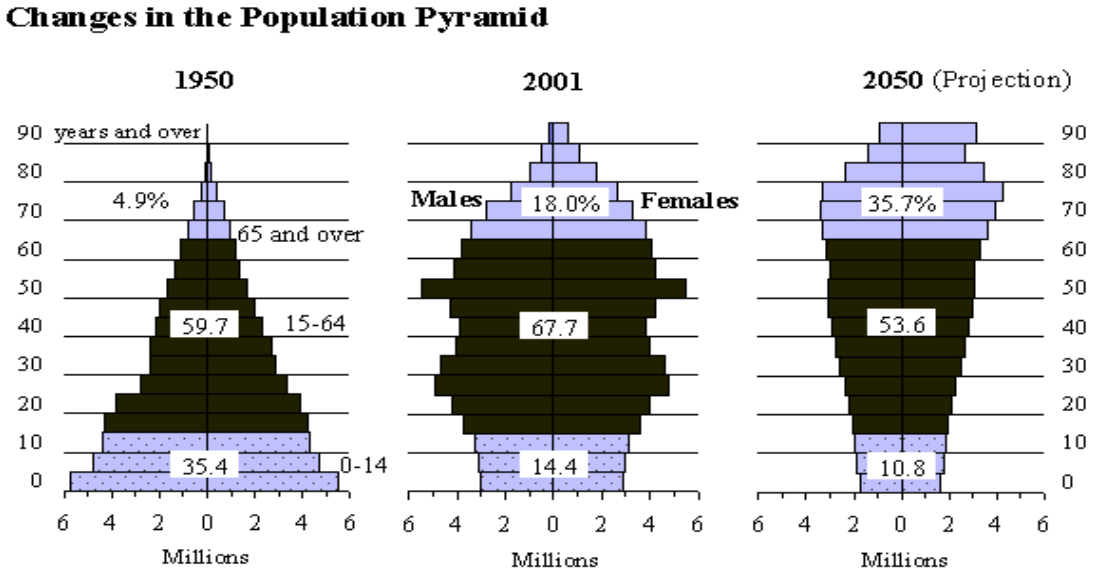
2. A Few Stylized Facts about Japan

Figure 1 depicts the population pyramid of Japan in 1950 and how it has changed in 50 years to the current age structure in 2001 and how it is expected to change in another 50 years as a result of the steady decline in fertility rate and increase in life expectancy. In the 1950's 100 adults had to take care of only 8 elderly people, currently 100 adults take care of 26 elderly persons, and in another 50 years 100 adults will have to

take care of 67 elderly persons. This will dwindle the labor that will be available for the production sector. Figure 2 compare Japan's scenario with other OECD countries and India. It is clear that in 1950 while all other OECD countries had much higher proportion of elderly population as compared to Japan. By the year 2000 Japan began to surpass all other OECD countries. This was due to the fact that while other OECD countries experienced their demographic transitions (low mortality and fertility rates) slowly over a longer period of time, Japan had a very rapid demographic transition.

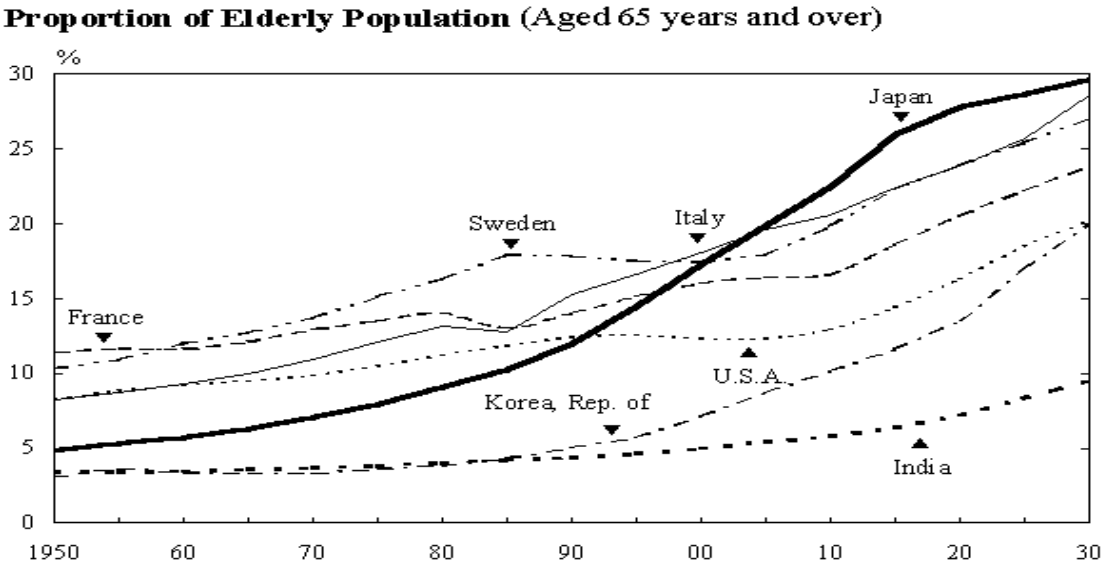
The figures 3-5 show some of the effects of Japan's demographic transitions on the resource and labor requirements for elderly care. Figure 3 shows that while in early 1980's only 10% of national income went for pension and medical care, by the year 2000 the share went up to more than 20% of national income. Figures 4 and 5 show that there is a sharp increase in the demand for female and homecare nurses. It is clear from these trends that in another 50 years a significantly high proportion of national income and the labor force need be devoted to elderly care sector.

Figure 1: Changes in population pyramid



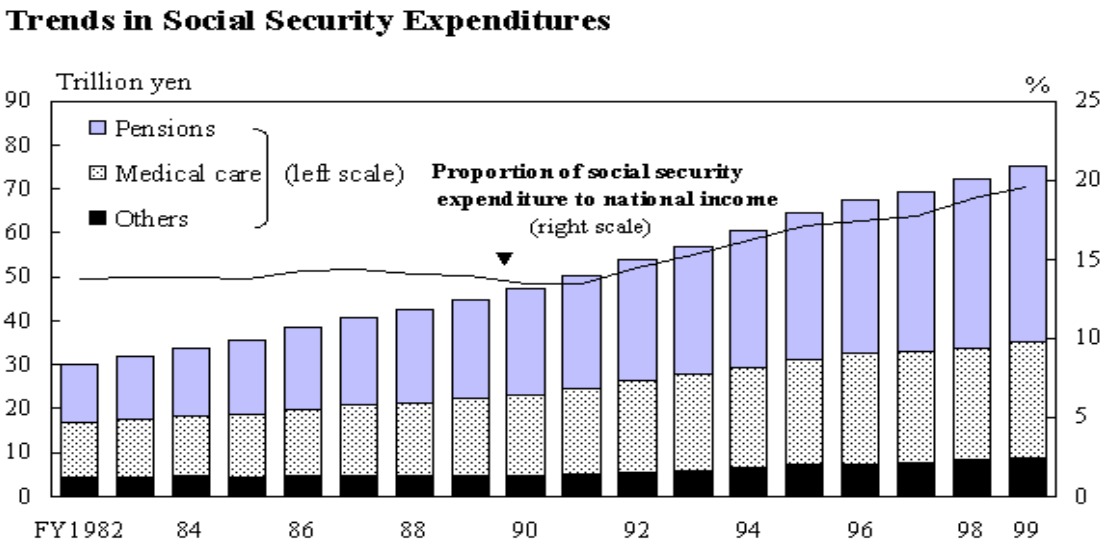
Source: Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications; Ministry of Health, Labour and Welfare.

Figure 2: Comparison of Japan's aging population with other countries



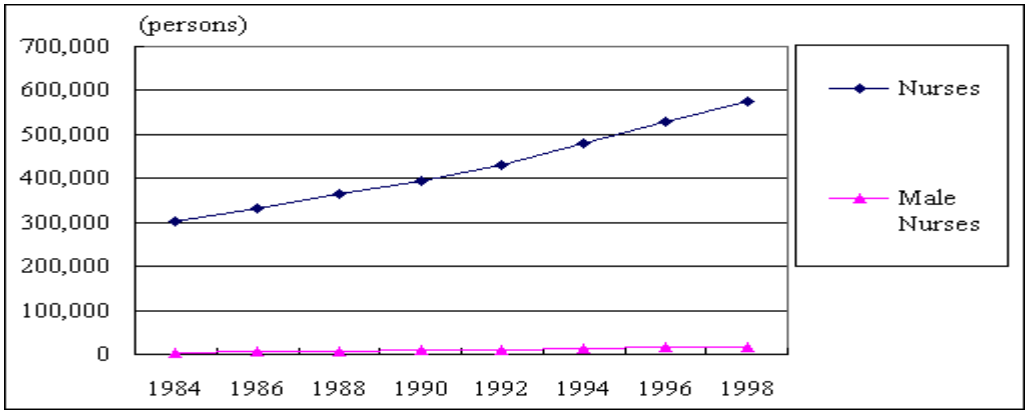
Source: United Nations; Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications; Ministry of Health, Labour and Welfare.

Figure 3: Trend in Social Security and Medical Care Expenditures



Source: Ministry of Health, Labour and Welfare.

Figure 4: Demand for nurses during 1984-1998

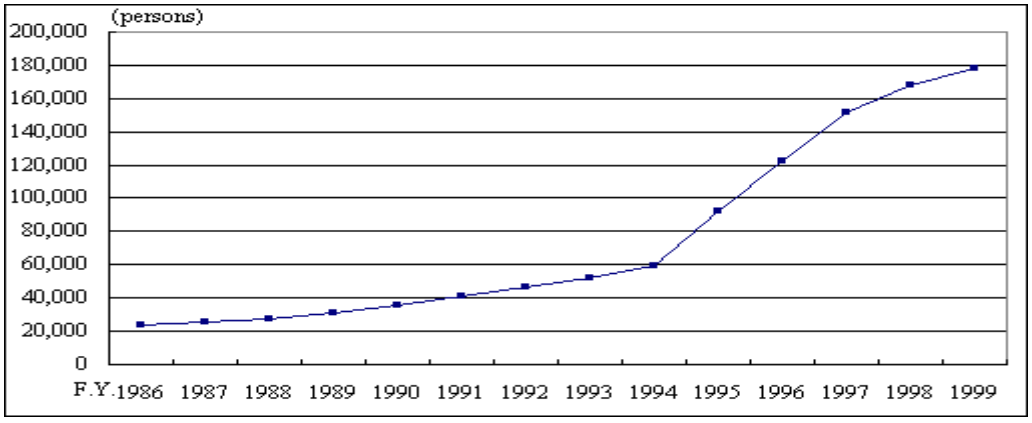


Source: Summary of Vital Statistics

The Statistics and Information Department,

Minister's Secretariat, Ministry of Health and Welfare

Figure 5: The demand for home care nurses during 1986-1999.



Source: Summary of Vital Statistics

The Statistics and Information Department,

Minister's Secretariat, Ministry of Health and Welfare

Another important development in Japan has been its persistent current account surplus over the past several years (see figure 6). That means Japan persistently invested abroad more than foreigners invested in Japan. International Investment Position (IIP) is the stock variable consisting of the capital and financial accounts plus the reserve assets in the balance of payments. Table 1 shows Japan's investment position and the composition of Japan's foreign investment in the second half of the nineties. From Table 1, it is clear that Japan's stock of foreign assets, which went down a

bit during the Asian crisis years, has been growing over a long period of time at a high positive rate. Table 1 also shows three components of the stock of total foreign assets – (1) direct foreign investment, which is 9.25% of total assets, (2) portfolio foreign investment, which is 41.44% of total assets, and (3) other investment, which is 37.33% of total stock of foreign assets at the end of Year 2000.

Two sources of private capital flows – direct foreign investment and portfolio foreign investment - have grown substantially over the past several years. But where did most of these investments go? From table 2 it is clear that much of Japanese direct foreign investment went to Europe and to the US, and very little went to less developed countries. Furthermore, much of Japanese foreign investment for less developed countries went to East Asia.

Figure 6: Japan's current account surplus during 1986-2000.

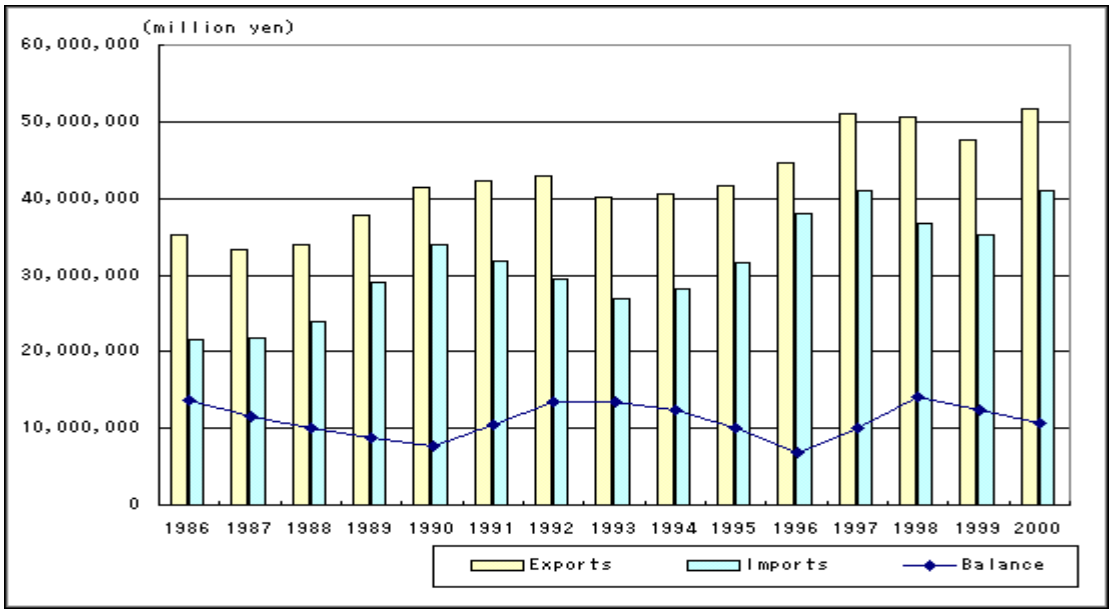


Table 1: International Investment Position of Japan (Asset in Billion Yen)

End of Year	Assets Total	1. Direct Investment	2. Portfolio Investment	(1) Equity Securities	(2) Debt Securities	3. Other Investment
1995	270,738	24,520	88,257	15,040	73,217	139,129
1996	307,703	29,999	108,711	17,968	90,743	143,751
1997	355,731	35,334	117,821	20,632	97,188	173,884
1998	345,132	31,216	122,719	24,205	98,515	166,335
1999	307,989	25,425	127,426	29,161	98,265	125,740
2000	346,099	31,993	143,420	30,130	113,290	129,208

Source: The Bank of Japan

Table 2: Percentage Distribution of Japan's Foreign Direct Investment

FY	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
North America	50.35	47.84	45.31	42.81	42.37	43.27	45.18	47.94	39.63	26.86	37.14	25.26
Latin America	7.74	6.33	8.00	7.95	9.37	12.85	7.55	9.26	11.74	15.86	11.15	10.77
Asia	12.18	12.38	14.26	18.77	18.48	23.56	24.05	24.19	22.57	16.02	10.74	12.21
Europe	21.84	25.11	22.57	20.71	22.17	15.24	16.71	15.35	20.76	34.38	38.69	50.24
Rest of the World	7.90	8.33	9.87	9.76	7.60	5.08	6.52	3.26	5.30	6.88	2.28	1.52

Source: The Bank of Japan

3. The Basic Framework

I consider a simple OLG model in which agents live for two periods, adulthood and old-age. To incorporate variations in life expectancy among countries, and to keep the analysis analytically manageable, I assume that agents survive the first period with probability one, but the probability of surviving to the second period is π, $0 < \pi \leq 1$. A period in our model would typically mean about 40 years. Assuming that adulthood,

i.e., period 1 of the life-cycle in our model, starts at age 20, the life expectancy in our model is given by 60 +40π. I assume that Japan has higher π than the less developed countries. While gender does not play any role in this paper, I will address everyone in this paper as he instead of she or (s)he.

Denote by c_t^t and c_{t+1}^t respectively the consumption in period *t* and *t* +1 of an adult of period *t*. I further assume that when an agent survived to be old, he does not work and he needs a fixed γ hours of nursing services, $0 < \gamma < 1$. For simplicity of exposition, I assume that it is fixed and not a choice variable. A young worker has one unit of labor which he supplies inelastically either to the nursing/medical sector or to the production sector.

Let w_t be the wage rate in period *t*. A young worker earns w_t, pays social security taxes $\tau_t w_t$ and chooses to consume c_t^t and to save s_t. His savings are immediately put into annuity market which promises to pay $1+\rho_t$ for each unit of annuity until the agent dies.

The resolution of uncertainty and the savings decisions happen in the following sequence: first the agent decides his savings, which he immediately puts in the annuity market. Then, the uncertainty about his death is resolved. If he survives, he receives $(1+\rho_t)s_t$ when he is old. If he dies, he receives nothing. I assume the existence of an annuity market as a modeling simplification. Other more realistic institutions could be introduced at the cost of extra complications. The agent's expected utility function is given by

(1) $E(U^t) = u(c_t^t) + \beta\pi u(c_{t+1}^t)$,

He maximizes (1) subject to the following budget constraints:

(2) $c_t^t + s_t = (1-\tau_t)w_t$

and

(3) $c_{t+1}^t + \gamma w_{t+1} = (1+\rho_{t+1})s_t + B_{t+1}$,

where B_{t+1} is the old-age security benefits he receives at his old age. Optimal savings s_t depends on the wage rates w_t and w_{t+1}, on the rate of returns from capital ρ_{t+1} on the social security benefits B_{t+1} and on the survival probability π.

I assume that Japan has a defined benefits pay-as-you-go public pension program with the replacement rate μ, which means that a worker is promised by the social security administration to be paid a fraction μ of his adult age wage earnings when he retires. For the less developed countries, I assume that there is no formal social security program. The old-age pension related intergenerational transfers from young to old are, however, performed within the family. More specifically, I assume that the adults of generation t transfer a fraction a_t, $0 < a_t < 1$, of their wage earnings to their elderly parents. The fraction a_t is determined by social norms.[1] Informal transfers are generally lower than the formal transfers, and thus, economies with informal system of old-age transfers results in higher fertility rate. I will not make fertility endogenous, but assume that it is higher in less developed countries than in Japan and other OECD countries. Assume population is growing exogenously at the rate of n, i.e., $(1+n)$ is the fertility rate. Assume that the private annuity markets are actuarially fair. Denote the interest rate between periods t and $t+1$ by r_{t+1}. Then the following holds for Japan,

(4J) $$B_{t+1} = \mu w_t = (1+n)\tau_{t+1} w_{t+1} / \pi$$

and the following for the less developed countries,

(4L) $$B_{t+1} = (1+n) a_{t+1} w_{t+1} / \pi.$$

Notice that equation (4J) for Japan implies that the social security tax rate is given by $\tau_{t+1} = \dfrac{\mu\pi}{(1+n)(1+g_{t+1})}$, where $1+g_{t+1} = w_{t+1}/w_t$ is the growth in wages between period t and $t+1$. This implies that when fertility rate, $1+n$, goes down as in Japan, unless it

[1] See Raut [1991], Raut and Srinivasan [1994], for details of this line of modeling and Raut[1995] for an extended model in which a_t is endogenized by introducing two-sided altruism in a similar overlapping generations framework.

maintains high growth rate in productivity, g_{t+1}, the social security tax rate will be very high to provide the promised replacement rate μ. Notice also that the actuarially fair tax rate τ_{t+1} becomes higher, the higher is the life expectancy, i.e., higher is the survival probability π in our case. Thus, two critical elements of Japan's social security problems are drop in fertility rate *1+n*, and increase in life expectancy or survival probability π. We have assumed π and *n* to be exogenously given and fixed over time. An immediate policy implication for aging crises is that Japan must maintain high growth rate of productivity and increase its fertility rate in order to keep the social security tax rate within a viable limit. Higher wage growth has also effect on savings s_t because it increases the relative cost of nursing cost γw_{t+1} relative to w_t.

The assumption about actuarially fair annuity market implies the following:

$$(5) \quad (1+\rho_{t+1})s_t\pi_t L_t = (1+r_{t+1})L_t s_t \Rightarrow 1+\rho_{t+1} = \frac{1+r_{t+1}}{\pi}$$

I assume that capital lasts for one period and savings take one period to gestate. The annuity firm invests all its receipts $L_t s_t$, in the capital market. Thus the next period capital stock is given by $K_{t+1} = L_t s_t$. The amount of labor in the productive sector is given by

$$(6) \quad \bar{L}_{t+1} = (1+n)L_t - \pi\gamma L_t,$$

where, the second term in the above represents labor needed to meet nursing/medical care of the surviving olds.

Note that the capital labor ratio k_{t+1} in period *t + 1* is then given by

$$(7) \quad k_{t+1} = \frac{K_{t+1}}{\bar{L}_{t+1}} = \frac{s_t}{\left[(1+n)-\pi\gamma\right]}.$$

3.1 Household Decisions

A representative adult of time period *t* maximizes the expected utility (1) subject to budget constraints, (2) and (3).

From the budget set, it can be seen that higher π has income and substitution effects. Furthermore, the marginal rate of substitution of the expected utility function is also affected by π. I consider here the Cobb-Douglas utility function, $u(c) = \ln c$, to derive explicit solutions. Thus we are assuming unit elasticity of inter-temporal substitution. It should be noted that many of the properties that I derive from this specific utility function also holds for general class of utility functions and production functions. For this specification of the utility function, the optimal savings of a representative Japanese adult is given by

$$(8J) \quad s_t = w_t \cdot \left[\frac{\beta\pi}{1+\beta\pi}\left(1 - \frac{\mu\pi}{(1+n)(1+g_{t+1})}\right) - \frac{\pi\left[\mu - \gamma(1+g_{t+1})\right]}{(1+\beta\pi)(1+r_{t+1})} \right]$$

and for a representative adult in less developed countries is given by

$$(8L) \quad s_t = w_t \left[\frac{\beta\pi}{1+\beta\pi}(1-a_t) - \frac{\left[(1+n)a_{t+1} - \pi\gamma\right](1+g_{t+1})}{(1+\beta\pi)(1+r_{t+1})} \right].$$

It is clear from the above optimal solutions that household savings is higher for economies that have higher survival probability π or higher needs for nursing services γ. An economy with a lower fertility rate also has higher savings rate. An economy that transfers a higher amount of resources from young to old, (i.e., has a higher value for a_{t+1}), has lower savings rate.

3.2 Predicted savings rate in the calibrated model.

There has been a long-standing controversy over Japan's high savings rate. Most studies find Japan's household savings rate to be around 12% (see, for instance, Horioka [1997]), and the national savings rate to be a little less than 30% in the eighties. Some argue that these savings figures are too high as compared to other OECD countries including USA, and that the saving rate would be much smaller when depreciation and government expenditures are properly taken into account, see, for instance, Hayashi [1986, 1989]. I use our highly aggregative model to compute the predicted household

savings rate and national savings rate for Japan and for a typical LDC after calibrating the model as follows:

Since not much is known empirically about the savings motive (and the magnitude) for the purpose of providing for one's own elderly nursing care services, I first assume that $\gamma = 0$. As I pointed out earlier, I take each period to be 40 years, and 20 years for young-age. Taking Japan's life expectancy to be about 80 years, and noting that life expectancy in our model is given by $60+40\pi$, I calibrate the parameter π for Japan to be $\pi = 0.5$. Assuming an average annual growth rate of wages and per capita income to be 2.5% and the real interest rate to be also 2.5% per annum, it is easy to see that the corresponding linear growth rate and the simple interest rate over a 40 years period become 168%.

The two-tier social security program in Japan does not have an explicit replacement rule. But the benefits are estimated to be equivalent to a replacement ratio of around 70% (see Horlacher [undated]). So I take $\mu = 0.70$, and the population growth rate to be -0.1%. I take the payroll tax rate to be 15%. Substituting these in equation (8J) gives a household savings rate of 10.12%, and assuming σ in the Cobb-Douglas production function to be 0.33, the domestic savings rate is computed to be 30.66%. Both figures look close to the observed figures.

Under the assumption that an elderly requires on the average an hour of nursing services a day which is about 5% of the 18 hour day of an adult, i.e. $\gamma = 0.05$, the calibrated model predicts the household savings rate in Japan to be 11.94% and the domestic savings rate to be 36.17%.

For a representative developing country, I take pay-roll tax rate to be 5%, the social security replacement rate to be 30%, the annual growth rate of wages and per capita income and the annual interest rate to be 3.33%, and the life expectancy to be 65 years. When $\gamma = 0$, the calibrated model predicts the household savings rate to be 7.12% and the domestic savings rate to be 21.59%, both of which are also reasonable figures for a representative developing country. Later I will use these parameter values to carry out

policy exercises. Under the assumption that $\gamma = 0.05$, the calibrated model predicts the household savings rate to be 7.7% and the domestic savings rate to be 23.32%.

It is clear from the simulated results that savings rate is higher, higher is the life expectancy, or higher is the nursing care requirement γ or lower is the fertility rate. Since Japan and other OECD countries have higher life expectancy, higher value for γ, and lower population growth rate compared to a representative LDC, the savings rate in Japan is predicted to be higher than in LDC. This is consistent with the observed differences in savings rate of Japan and LDCs.

3.3 Autarky Equilibrium

Assume for both economies the neoclassical constant returns to scale technology in production of GDP, which uses capital and labor as inputs. Let the aggregate production of GDP be represented by the following production function,

(9) $$Y_t = A_t F\left(K_t, b_t L_t\right),$$

where A_t represents factor neutral productivity level. I assume it to depend on infrastructure and other social factors that affect the productivity of both capital and labor equally. The variable b_t denotes the efficiency level of a unit of labor in period t. I assume that b_t grows over time at the rate of φ per period, and the growth rate depends on the average education level of the work force of an economy. Notice that the difference in the level of b_t for Japan and a representative LDC determines the wage differences of the economies, and the difference in the level of A_t determines the difference in interest rates between countries in the free world capital market equilibrium. In this section, however, I assume that $A_t \equiv 1$ for all *t* and for all countries.

Denote by $\hat{x}_t$ the variable x_t in efficiency unit, i.e., $\hat{x}_t = x_t / b_t$. Let $\hat{y}_t = f\left(\hat{k}_t\right)$ be the output per unit of labor in efficiency unit when capital labor ratio in efficiency unit is $\hat{k}_t$. Under the assumption that all markets are competitive, it follows that

(10) $$\hat{w}_t = f(\hat{k}_t) - \hat{k}_t f'\left(\hat{k}_t\right) \equiv \omega\left(\hat{k}_t\right),$$

and

(11) $1+r_t = f'(\hat{k}_t).$

The solution of Equation (11) for $\hat{k}_{t+1}$ as a function of $1+r_{t+1}$, denoted as, $\hat{k}_{t+1} = \kappa(r_{t+1})$ determines the demand for capital per unit of efficiency labor, and it is a standard downward slopping curve as shown in figure 10 below.

The supply of capital labor ratio in efficiency unit can easily be derived, by substituting equation (8J) in equation (7). I have shown the supply curves for Japan and a representative LDC in figure 10.

The dynamics of the economy is determined by the following difference equation for capital labor ratio in efficiency unit:

(12) $$\hat{k}_{t+1} = \frac{\beta\pi}{1+\beta\pi}(1-a)\omega(\hat{k}_t) - \frac{[(1+n)a - \pi\gamma](1+\varphi)R(\hat{k}_{t+1})}{(1+n)-\pi\gamma},$$

where, $R(\hat{k}) = \left[f(\hat{k}) - \hat{k}f'(\hat{k})\right] / f'(\hat{k})$, the efficiency wage-rental ratio as a function of capital labor ratio in efficiency unit. For Cobb-Douglas production function, the above simplifies to,

(13) $$\hat{k}_{t+1} = \frac{\beta\pi(1-a)(1-\sigma)}{1+\beta\pi}\cdot\frac{\sigma}{1+\varphi(1-\sigma)}\cdot\hat{k}_t^{\sigma}.$$

The steady-state capital-labor ratio $\hat{k}^*$ for the above Cobb-Douglas case is given by

(14) $$\hat{k}^* = \left[\frac{\beta\pi(1-a)(1-\sigma)}{1+\beta\pi}\cdot\frac{\sigma}{1+\varphi(1-\sigma)}\right]^{\frac{1}{1-\sigma}}.$$

Figure 7 shows the autarky equilibrium dynamics and the steady-state capital-labor ratio in efficiency unit for a general neoclassical production function of an economy.

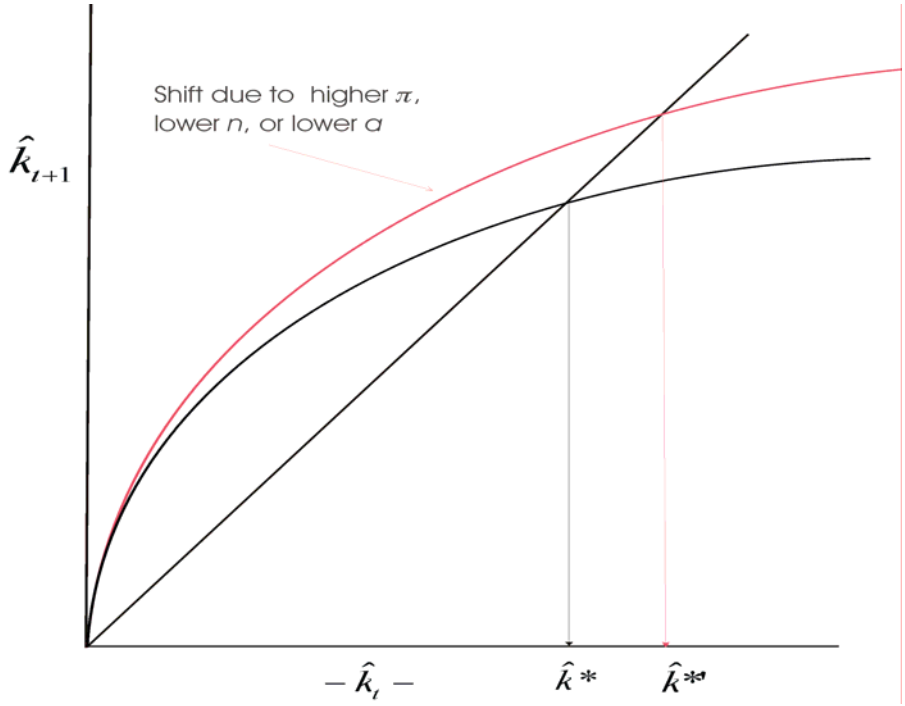


Figure 7: Phase diagram for the autarky capital-labor ratio in efficiency unit.

It follows that the lower the population growth rate, n, or the higher the life expectancy, π, or the higher the social security transfers rate, a, the higher is the balanced growth capital-labor ratio in efficiency unit, $\hat{k}^*$. Thus Japan, expecting higher life-expectancy and lower fertility rate saved relatively more than the less developed countries, even though, Japanese expected a higher rate of social security tax transfers, a, as compared to residents in less developed countries and thus resulting in higher capital-labor ratio in efficiency unit both in the short-run and in the long-run. Since the autarky interest rate for Japan is higher than in the less developed countries in all periods, there should be a drive for capital to flow from Japan to less developed countries. See figure 8 for details.

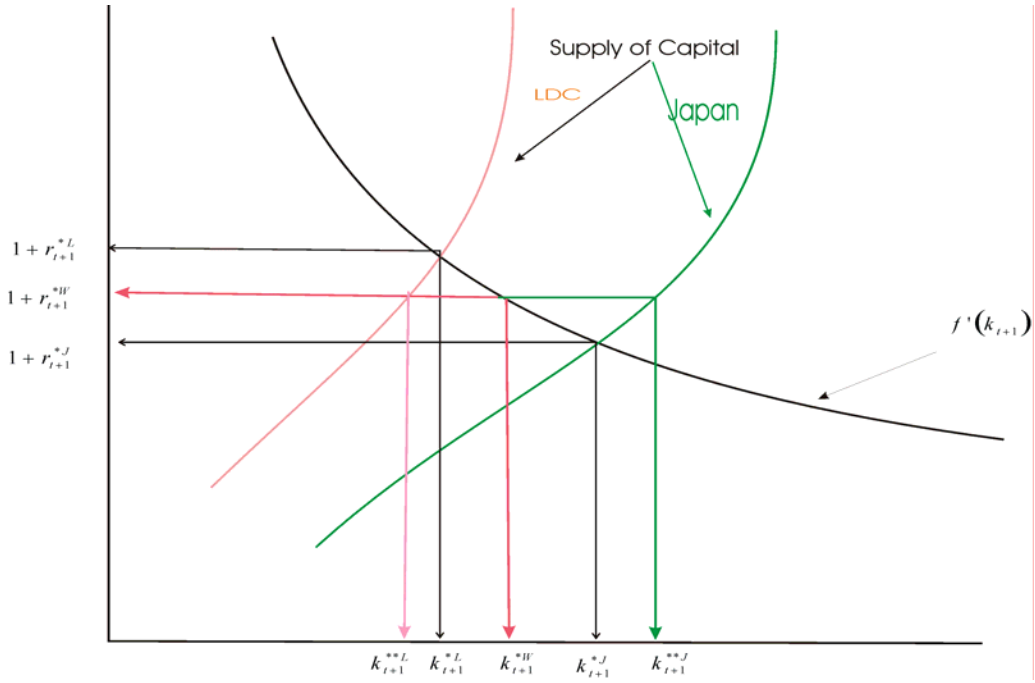


Figure 8: Determination of world interest rate and the direction of capital flow.

If the total factor productivity level A is different for Japan and the less developed countries, then the marginal product curve for LDCs will be a different one and will be to the left of the marginal product curve of Japan. So long as it is not too far to the left so that the autarky interest rate of LDCs becomes lower than that of Japan, the above predictions will hold. It is, however, possible that some less developed countries may have such high level of corruption and low level of infrastructure that the autarky interest of the LDCs is lower than that of Japan. Private capital will very rarely flow to such LDCs.

3.4 World capital market equilibrium and the direction of capital flows

From equations (7) and (8) it is clear that Japan with a higher π and a lower fertility rate n will have a higher capital-labor ratio in autarky as compared to the rest of the world. That means, Japan's autarky interest rate is lower and the wage rate is higher than the rest of the world.

Suppose the world interest rate between period t and $t+1$ is r_{t+1}^{*}. Let $w\left(r_{t+1}^{*}\right) \equiv \omega\left(\kappa\left(r_{t+1}^{*}\right)\right)$ be the corresponding wage rate (in the wage-rental rate frontier).

The current account balance CA_t in period t is the net change in the value of its net claims on the rest of the world, which in our case is the total export after domestic absorption. The capital account balance in the balance of payment statistics is the net sale of assets to foreigners. Each dollar surplus of current account is a dollar negative sale (i.e., purchase) of foreign asset. In the one good case, which is used for both consumption and investment, exports of the good is same as the investment abroad, i.e., the payment for obtaining equal amount of foreign asset, measured in the unit of the good. Thus, in the simple one good case, it is enough to work with current account. The current account balance at time t is given by,

$$(15) \qquad \frac{CA_t\left(r^*_{t+1}\right)}{L_t} = \left[\frac{\beta\pi}{1+\beta\pi}(1-a_t)\hat{w}_t - \frac{\left[(1+n)a_{t+1} - \pi\gamma\right]\hat{\omega}\left(r^*_{t+1}\right)}{(1+\beta\pi)(1+r^*_{t+1})}\right] - (1+n)\hat{\kappa}(r^*_{t+1})$$

It is clear from the above that the current account balance over a long period of time and hence the international investment position over a long period of time is affected by the demographic factors such as fertility rate and life expectancy.

The world equilibrium interest rate between period t and t+1 is r^*_{t+1} that solves

$$(16) \qquad CA^J_t\left(r^*_{t+1}\right) + CA^L_t\left(r^*_{t+1}\right) = 0.$$

In the world equilibrium with free capital flows, capital would flow from Japan to the rest of the world. Let the world interest rate be r^*_{t+1} between period t and t+1. Figure 8 shows the potential amount of capital outflow in this period.

Note that under free capital mobility or free labor mobility or both, and under the assumption that there is no difference in technology or in infrastructure between countries, capital labor ratio in efficiency unit is going to be the same in all economies, and this common capital labor ratio in efficiency unit in period t+1 is given by

$$(17) \qquad \hat{k}_{t+1} = \frac{L^J_t \cdot s^J_t + L^L_t \cdot s^L_t}{\hat{\bar{L}}^J_{t+1} + \hat{\bar{L}}^L_{t+1}},$$

which after some algebraic manipulations becomes,

$$(18) \qquad \hat{k}_{t+1} = \frac{\hat{s}^J_t + \hat{\theta}_t \cdot \hat{s}^L_t}{\left(1+\varphi^J\right)\left[\left(1+n^J\right) - \pi^J\gamma\right] + \hat{\theta}_t \cdot \left(1+\varphi^L\right)\left[\left(1+n^L\right) - \pi^L\gamma\right]},$$

where $\hat{\theta}_t = \frac{b_t^L}{b_t^J} \cdot \frac{L_t^L}{L_t^J}$. The first term in $\hat{\theta}_t$ also represents the ratio of wages between the representative LDC and Japan, and the second term represents the ratio of working population sizes of a representative LDC and Japan.

Substituting the values of $\hat{s}_t$ for Japan and the representative LDC from equation (8) in equation (18), and assuming Cobb-Douglas production function $f(k) = k^\sigma$, one obtains the following first order difference equation for capital labor ratio in efficiency unit,

$$(19) \qquad \hat{k}_{t+1} = \frac{\left[\frac{\beta\pi^J}{1+\beta\pi^J}\left(1-a^J\right) + \hat{\theta}_t \frac{\beta\pi^L}{1+\beta\pi^L}\left(1-a^L\right)\right](1-\sigma)}{\frac{\left[\left(1+n^J\right)a^J - \gamma\pi^j\right]\left(1+\varphi^J\right)}{\sigma\left(1+\beta\pi^J\right)/\left(1+\beta\pi^J\sigma\right)} + \hat{\theta}_t \frac{\left[\left(1+n^L\right)a^L - \gamma\pi^L\right]\left(1+\varphi^L\right)}{\sigma\left(1+\beta\pi^L\right)/\left(1+\beta\pi^L\sigma\right)}} \cdot \hat{k}_t^\sigma .$$

The dynamics depend on the exogenous dynamics of $\hat{\theta}_t$. If we assume that $\hat{\theta}_t$ is constant over time, then the dynamics of the world capital labor ratio has the same standard properties of the neoclassical growth models.

It is clear from figure 8 that Japan and other OECD countries would benefit from foreign investment or immigration of labor from less developed countries. Which of these are better options for Japan? In section 2, we saw that not much capital flows from Japan to LDCs nor is it the case that Japan has much immigrants from LDCs. In the next section I explore empirically the factors in the host countries that affect foreign capital inflowt. In a later section I explore the role of immigration vis-à-vis foreign capital investment to cope with aging crises in Japan and other OECD countries.

4. Why too little capital flows into less developed countries?

From figure 8 and the discussions in the previous section it is clear that demographic mismatch between Japan and LDCs creates an environment in which Japan would benefit from investing in less developed countries. In section 2 we saw, however, that not much capital from Japan flow into LDCs. **Why?** Could it be due to lack of demand in LDCs?

Even though many developing countries had misgivings about foreign capital, because of their past colonial bad experiences or some other internal vested interests, in recent years most developing countries welcome foreign capital since foreign capital if invested properly enhances economic growth. Direct foreign investment is more likely to enhance economic growth than portfolio foreign investment. To find empirical support for these claims, I used cross country regressions to estimate the effect of two types of foreign investments and a few other standard variables on economic growth. Table 3 shows the parameter estimates of determinants of growth in per capita income for two sets of countries: for all LDCs with per capita income less than US$12000 (measured in constant 1995 US dollars) in 1997, which also includes the NICs, and the second sample consists of these countries together with the OECD countries. The estimates are based on the three years averages of all the variables from 1988 to 1997. In the calculations the countries with inadequate data were dropped. I ended up with 96 countries in the first group and 111 countries in the second group. I included direct foreign investment as percent of GDP, private capital flow as percentage of GDP together with the standard variables such as savings rate, population growth rate, public spending on education as percentage of GNP to measure investment in human capital in the right hand side variables as would be prescribed by the standard Solow model. As a measure of infrastructure I used the variable telecommunication which measures the number of telephone mainlines per 1,000 population of each country.

It has been argued that governance plays a significant role in the growth process and in attracting foreign investment. There are many aspects of governance. The world Bank collected data on five aspects – (1) Voice Accountability (2) Political Stability (3) Government Effectiveness (4) Rule of Law and (5) Control of Corruption (see Kaufmann, Kraay and Zoido-Lobaton [2002] for details on how these variables were created). Since the standard socio-economic indicators that are generally used in cross country growth regressions might be correlated with these governance variables, I modify these variables by purging out the effects of the standard socio-economic indicators.

Table 3 shows the regression estimates for growth in per capita income. The parameter estimates show that direct foreign investment has positive effect on growth in per capital income growth but not the other form of private capital flows. Direct foreign investment is preferred over the other forms of private capital flow especially by the less developed countries since FDI brings better technology and management of the host country, and since the risk of the capital is borne by the source country, whereas in the other forms of private capital flows the risk is borne by the host country and there are greater risks of financial crisis with the other forms of capital flows.

Out of the five aspects of governance only the rule of law has significant positive effect on growth in per capita income in both sets of countries and control of corruption has positive effect in less developed countries.

Table 3: Determinants of Growth in Per Capita Income

Variables	Only LDCs	All countries
Intercept	2.420	3.043
	(2.05)	(3.09)
Foreign Direct Investment	1.123	0.527
	(4.03)	(2.83)
Private Capital Flow	-0.052	-0.015
	(1.20)	(0.49)
Savings Rate	0.0004	0.034
	(0.02)	(1.39)
Population Growth Rate	0.306	0.057
	(0.86)	(0.198)
Expenditure on Education	-0.711	-0.679
	(4.39)	(4.77)
Telecommunication	-0.005	0.001
	(0.77)	(0.30)
Per Capita Income	0.4E-3	-0.8E-5
	(1.76)	(0.38)
Voice Accountability	-0.311	-0.008
	(0.47)	(0.01)
Political Stability	0.038	-0.101
	(0.05)	(0.16)
Government Effectiveness	-0.109	-0.009
	(0.10)	(0.01)
Rule of Law	1.707	1.959
	(1.73)	(2.29)
Control of Corruption	2.236	1.433
	(1.76)	(1.34)
No. of countries	96	111
R^2	0.2272	0.1887

Note: Absolute value of the t-statistic is in parenthesis under a parameter estimate.

Based on this finding that foreign direct investment has significant positive effect on growth of per capita income after controlling for other standard determinants of growth, we would expect that much of the private capital flows, especially direct foreign investment would flow from Japan into less developed countries. But we saw in section 2 that the bulk of the Japanese DFI flew into other developed countries, and very little into less developed countries.

What determines private foreign capital inflow into a host country? The main determinants of any private investment are the rate of returns and the riskiness of the investment. In the international context, there is also empirical evidence for home bias. We saw in the previous section that the rate of returns in less developed countries would be higher than in Japan. But I derived this conclusion under the assumption that all countries share the same technology, infrastructure and technological capability. These are generally poor in LDCs and we will examine how they affect foreign capital inflow to a host country. An important source risk for foreign investors is political instability and corruption and other forms of bad governance. We also examine how these factors affected the foreign capital inflow into a host country.

There are several ways economists looked for determinants of capital flows. For instance, Higgins [1998] used cross country regression to examine how age structure affects savings, and the savings investment gap, i.e., foreign capital inflow. Obstfeld and Rogoff [1996] employed a present value model of current account, Lane and Milesi-Ferretti [2001] used an error correction model (ECM) to empirically determine capital flows and some of the economic and demographic variables that are related to each other in the long-run and some other factors that determine the short-run fluctuations, and Urata [1998] used a survey of Japanese enterprises to determine statistically the most effective practices of the Japanese firms that lead to higher DFI of Japanese enterprises.

I used the same two sets of countries as mentioned earlier and ran regression on the three year averages during 1988-1997 to examine the determinants of

direct foreign investments and other forms of private capital flows. The results are shown in table 4. The theory of the previous section predicted that higher is the population growth rate, the higher should be the amount of foreign capital inflow into a country, and the opposite is the case with life expectancy. The parameter estimates, however, show that only the effect of population growth is significant and its sign is consistent with the prediction of the theory. The effect of life expectancy is, however, not significant in any of the regression estimates. The effects of other variables are discussed in the following subsections.

Table 4: Regression Estimates of the determinants of FDI and Private Capital flows

Variables	Direct Foreign Investment		Private Capital Flows	
	Only LDCs	All countries	Only LDCs	All countries
Intercept	0.270	-0.203	-6.816	-4.227
	(0.34)	(0.20)	(1.34)	(0.66)
Population growth rate	0.035	0.209	1.219	0.823
	(0.37)	(1.92)	(2.03)	(1.18)
Life Expectancy	-0.001	-0.005	0.067	0.026
	(0.13)	(0.39)	(0.91)	(0.28)
Expenditure on Education	0.081	0.125	0.637	0.765
	(2.00)	(2.52)	(2.45)	(2.40)
Telecommunication	0.002	0.006	0.024	0.026
	(1.40)	(4.66)	(2.41)	(3.03)
Per Capita Income	0.7E-4	0.3E-4	0.2E-3	0.0003
	(1.33)	(1.46)	(0.62)	(1.91)
Voice Accountability	0.179	-0.014	1.677	1.150
	(1.06)	(0.07)	(1.56)	(0.86)
Political Stability	-0.079	-0.03	1.188	1.392
	(0.42)	(0.14)	(1.00)	(0.94)
Government Effectiveness	-0.026	0.174	0.653	2.514
	(0.09)	(0.50)	(0.36)	(1.13)
Rule of Law	-0.126	-0.420	-1.978	-2.891
	(0.50)	(1.37)	(1.23)	(1.48)
Control of Corruption	0.622	1.071	-2.134	-0.975
	(1.93)	(2.80)	(1.03)	(0.40)
No. of countries	96	111	96	111
R^2	0.158	0.516	0.177	0.416

Note: Absolute value of the t-statistic is in parenthesis under a parameter estimate.

4.1 Corruptions and Poor Governance in the Host LDC

We used five revised measures of governance after purging out the effects of other right hand side variables that are listed in table 4. Out of the five aspects of governance, control of corruption has only significant positive effect on direct foreign investment for both sets of countries. None of these variables has significant effect on private portfolio capital investment.

4.2 Low human capital level of less developed countries

Assume that there are no barriers to free capital movement, and that both Japan and the representative LDC have the same level of infrastructure capital, and normalize this common level of infrastructure capital to $A_t = 1$ in all periods. Assume that the representative LDC and Japan, however, differ in their level of human capital b_t. Japan with much higher average education level has a higher growth rate of b_t and thus a much higher level of human capital in all periods. As shown in the previous section, when capital moves freely, the interest rates and hence capital labor ratio in efficiency units must equate between LDCs and Japan. If the human capital level of the representative LDC is very low relative to the human capital level of Japan, Japan will have substantially high number of effective labor, and the capital will rather flow from the representative LDC to Japan in that case, or at least it will reduce Japanese capital flow into the representative LDC. In this case, Japanese wage rate will also be substantially higher than that of the representative LDC. Thus, this explanation is also consistent with the observed wage differentials between Japan and LDCs. If this is the case, then the choice between immigration of workers and exporting capital is clear: It is beneficial to bring skilled workers, preferably temporary guest workers such as IT (Information Technology) specialists into Japan.

The parameter estimates show that the level of human capital has positive effect on both types of capital flows for both sets of countries.

4.3 Poor Infrastructure in less developed countries

In contrast to the previous two subsections, assume now that there is no difference in human capital level of Japan and the representative LDC, and without loss of generality normalize $b_t = 1$ for all t. Assume also that there are no barriers to capital flow but the infrastructure capital stock A_t is low in less developed country. Infrastructure in our set-up includes transportation system, telecommunication system, and legal system to enforce contacts. It follows then that the autarky interest rate and the wage rate in the representative LDC will be lower than those in Japan. This is consistent with the pattern of capital flow we saw in section 2 and the observed wage differentials between LDCs and OECD countries.

I did not readily find a good measure of infrastructure in the World Development Indicators database of the World Bank. I used a simple measure, namely the variable telecommunication, which measures the telephone mainlines (per 1,000 people). It appears that better infrastructure of a host country attracts higher level of foreign capital of both types.

In this case what will be the right kind of policy for Japanese aging problem? The policy prescription would be that instead of investing only in manufacturing sector, as Japan has generally done so far, Japan should increase its capital flow into LDCs and allocate the investment funds appropriately between the manufacturing and the infrastructure sectors. This strategy can be shared with other official international investments or private investments from other countries. This strategy can produce a higher rate of returns from foreign investment in LDCs than the existing low rate. Moreover, it will ease the resource requirements of Japanese social security system. The populations of the less developed countries will benefit from such foreign investment. This policy might be hard to implement since it involves another sovereign government.

5 Is It Immigration or Foreign Investment?

Until the post World War II periods Japan had mostly out migration of labor. After the war, and because of rapid demographic transitions, Japan faced labor shortages, and allowed limited immigration of the foreign workers. The relative size of the immigrant works in Japan is much lower than most OECD countries. There are many social factors and political factors that determine labor migration. We will not get into these in this paper. We use our model to examine if immigration is a better option vis-à-vis foreign capital investment to cope with the aging crises.

Suppose the labor union and the Japanese government prevent much capital to flow out of Japan so that domestic unemployment rate is reduced, the wage rate is prevented from falling, and the industrial base is kept strong. Let us assume for the moment that labor productivity level b_t and the general efficiency level or the level of infrastructure capital A_t are identical for all countries. Without loss of generality let us normalize A_t and b_t to be identically equal to 1 in all periods. It follows then that Japan will have a higher capital labor ratio than a representative LDC, and the wage rate will be higher in Japan relative to the representative LDC's wage rate. If we invest a dollar in the representative LDC, we will have the rate of return r^L. But if we import a unit of labor and invest the required capital k^J in Japan instead, it will yield a lower return r^J. Could one use the difference in rates of returns $r^L - r^J$ to finance social security benefits? The answer depends on whether the worker is a temporary guest worker or a permanent immigrant. While ether type of workers will contribute to the social security revenues and payroll tax revenues during the current period, in future, however, the permanent worker will put a claim on the social security benefits. If the rate of returns from the pay-as-you-go social security system is higher than the market interest rate, the migrant worker does not help at all. There are, however, other positive benefits from either type of migrant workers. For instance, the immigrants generally have higher

fertility rate and over time it can help to tilt the age structure and improve the potential support ratio of the host country.

Alternatively, the government can invest that k^J unit of capital abroad instead of bringing an immigrant to Japan, and this earns a higher rate of returns in LDCs. The government can use the difference to pay for old-age benefits. Which option is better? I used our calibrated model's autarky steady-state equilibrium to numerically examine these benefits in the case of a temporary guest worker. Let k^J be the steady level of capital-labor ratio in Japan and let ◎ be the combined social security and payroll tax rate in Japan. Let r^L and r^J be the steady-state rental rates respectively in LDC and Japan. Investing k^J units of capital in LDC brings a maximum tax revenue $\left(r^L - r^J\right)k^J$. Investing k^J units of capital in Japan instead by bringing a unit of guest worker from LDC to work on the capital produces the tax revenue $\tau \cdot \omega\left(k^J\right)$. I found that the latter produces more revenue than the former. Thus immigration of guest workers stands out a better option. This calculation, however, does not take into account social costs and other economic costs and benefits of bringing in a guest worker.

In an extreme case, however, our model has unambiguous preference for immigration over foreign capital investment. With a lower population growth rate, and a higher life expectancy in Japan, there is a higher demand for labor in the elderly care sector, and thus a huge shift of labor from industries to health and elderly care service sector is going to manifest. Consider the extreme case within our framework by supposing that $\gamma\pi L_t > (1 + n) L_t$, *i.e.*, hours needed to nurse the survived old is greater than the total hours available from all young adult population. In this extreme case it is obvious that immigration of workers is essential.

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