4. Ageing and elderly care in an open economy

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> In order to go astray into the mountain sooner, I destroyed myself my teeth by rocks to look older. (Shichiro Fukasawa, *Narayamabushi-ko* (Elegy for the Old: The Tune of Narayama, 1968))

> We are told, in the future, two of young people have to take care of one old person. (Sawako Ariyoshi, *The Twilight Years*, 1972)

> You have begot me, bred me, lov'd me. I return those duties back as are right fit. (William Shakespeare, *King Lear*, Cordelia: Act 1, Scene 1, 95)[2]

1. INTRODUCTION

Care of the elderly presents a difficult challenge to the developed countries where the population is rapidly ageing. Costs of medical care of the elderly will grow more than proportionally as the ageing proceeds. To nurse the elderly, human labor services are essential and cannot easily be substituted by machines or tools. The medical cost and labor cost of elderly care can have strong macroeconomic effects on household savings and current account balances of an ageing economy such as Japan with rising life expectancy and a falling fertility rate. We present a prototype model of overlapping generations to study these macroeconomic effects under different assumptions about the substitutability of the present consumption of goods and the future consumption of nursing services, and about the substitutability of machines and human nurses in the elderly nursing sector. The model will shed light on the policy debate on whether to import foreign labor services or to invest capital abroad from the perspectives of elderly care in an ageing open economy.

More specifically, the chapter is driven by three motivations. First, as is illustrated in the opening extracts, caring for the elderly poses serious problems in society. According to *The Illustrated White Paper for the Elderly* (Miura, 1999), in 2000 about 17.2 per cent of the population in Japan consisted of people over 65 years old, and 7.0 per cent consisted of people over 75 years old. There are about four people in the active age group of 15 to 64 years are for every elderly person aged 65 years or over. In 2025, it is expected that more than 27.4 per cent of Japan's population will consist of elderly people aged 65 or more, and about 11.9 per cent of the population will be at least 75 years old. There will be about 2.5 people in the active population for every elderly person aged 65 or more and about 5 persons in the active population for every elderly person aged 75 or over. This trend goes to an extreme by the year 2050: slightly less than a third (32.3 per cent) of the population will be over 65 years old, and almost one fifth (18.8 per cent) of the population will be over 75 years old. That means there will be about 1.7 people in the active population for every elderly person aged 65 or more, and that about 3 people in the active population for every elderly person aged 75 or over.

Less conspicuous but similar patterns can be depicted in many developed countries. For instance, in the year 2025, the proportions of the population over 65 years of age are expected to be 18.8 per cent in the United States, 21.2 per cent in Great Britain, 23.4 per cent in Germany, 21.7 per cent in France and 24.3 per cent in Sweden (Miura, 1999). This means that the ageing pattern in Japan is not an isolated problem case. The ageing trend is being seen all over the world.

The second motivation for this chapter is the rising cost of elderly care. The cost of nursing as a proportion of national income is increasing more rapidly than the proportionate increase in the elderly population. Nursing requires human care which is difficult to substitute by medical instruments and robots. Thus the ageing of the population will necessitate a larger proportion of the labor force to be engaged in the elderly care sector.

Of course, not everyone older than 65 needs active care from others. As ageing progresses, however, more and more people will require intensive care. For instance, while only 2.5 per cent of people between the age of 65 and 69 need care either at home, in nursing facilities or in hospitals, the ratio of people who need such care climbs rapidly for older age groups, namely to 4.3 per cent for the age group 70–74, 8.0 per cent for the age group 75–79, 16.8 per cent for the age group 80–84, and as high as 35.3 per cent for the age group 85 or over. According to the Ministry of Welfare (1995), out of 850 000 households who needed elderly care, about 5.6 per cent are single households, about 16.9 per cent are households consisting of couples, and about 56 per cent are households consisting of three generations, namely, the adults, their parents and their children.

In 1995, the Ministry of Welfare of Japan surveyed households with recently deceased family members to shed light on the caring arrangements of the dying family members. The findings of the survey are striking: about

66.8 per cent of such care was provided by direct family members, about 5.5 per cent of care was provided by other relatives, and about 16.4 per cent by professionals in the hospitals and clinics. The average age of caring family members and relatives was 60.4 years. About 30 per cent of those who took care of the old often resigned from jobs or took leave of absence. The majority of them were under heavy stress, and a substantial fraction of them were unable to have sufficient sleep or to leave the house.

Thus, although the average length of time during which old people must be nursed might not be too long, the anxiety of people in Japan over nursing expenses during old age has been tremendous and has significant macroeconomic consequences. Because of such strong anxieties over health and nursing care expenses, older people often refrain from consuming enough, which aggravates recession and deflation in Japan. There are some studies on these issues in the US. Alan Garber (1994) made a careful investigation of the rapid increase in costs and the uncertainty about the medical care of aged persons. He emphasized the need for alleviating the anxiety of the elderly and their family members and for better saving behavior to meet resource needs.

Incidentally, a few studies examined the link between rising elderly health care expenditures and the ageing pattern in the US. Fuchs (1990) notes that the health sector's share in GDP in the United States rose from under 4 per cent to more than 11 per cent in the 1980s. He attributed this to price factor – prices of medical services grew by 1.6 per cent per annum, much faster than other prices – and to quantity factor – the growth in the quantity of health care consumption was 0.9 per cent faster per annum than the other factors. He found that the speed of ageing, wage growth, technological change in the medical sector, and human factors like moral hazards were significant determinants of this rapid rise in the health care costs in the US. On the other hand, taking into account the effects of income, productivity and distribution of income on medical expenses, Karatzas (2000) finds that ageing has little to do with the medical costs. This is contrary to the common sense view.

The problem of rising medical expenditure is also present in Japan. Japan spent 21.5 billion yen on health care services in 1955. In 1995 this figure rose to 28.5 trillion yen. In the United States, however, the national expenditure on health care grew from 27 billion dollars in 1960 to 698 billion dollars in 1990. Sato (2001) puts Japanese medical expenditure in an international perspective. She points out that medical care as a proportion of GDP is as high as 14 per cent in the United States, but it is low, at the rate of 7.2 per cent in Japan. She classifies the causes of rising medical costs as follows: (1) the demand side factors such as better access to care, more use of care and the ageing population; (2) the supply side factors such as technological advances and moral hazards; and (3) the higher price of medical care.

Summing up, we note that for the intensive care of old people, human labor is essential and cannot easily be substituted by capital equipment. While technological progress in gerontology is greatly needed to find cheaper ways to provide for care of the elderly, its outcome at present is uncertain. In the meantime, the cost of caring for the elderly is rising steeply and it is hard to substitute nurses with robots and machines. Our second motivation in this chapter is to find alternative means of financing the elderly care expenses once the economy is open to exporting capital to and importing labor services from foreign countries.

The third motivation of this chapter is to examine theoretically the often-made claim that Japanese people saved too much and accumulated too great a balance of payments surplus because they had to spend a large amount when the population suddenly ages. The state of the debate involving Noguchi (1990), Horioka (1991, 1992), and EPA (1991) on the effect of ageing on the balance of payments of Japan is excellently summarized by Yashiro and Sato-Oishi (1997). An informal but lucid explanation is given by Lincoln (1993). A theoretical analysis incorporating ageing and care will shed light on this open-economy issue. It will be shown that, depending on the elasticity of substitution between the present consumption of goods and future consumption of nursing services, an ageing of the population may exhibit an increase in its saving rate.

We will also find conditions that support the claim by Goto (1998) that since trade and capital movements tend to equate with factor prices, migration is redundant for the adjustment. We show that this holds if the adjustment costs for capital movements and for international labor movements are not taken into account, and if the production function of the foreign country is identical to the home country.

In this chapter, we will construct a simple, prototype model of overlapping generations in which a person works when young and consumes elderly and nursing care during old age. The model may seem too simple, but it clarifies the basic nature of the nursing problem of the aged. We show that the individuals with utility functions that limit substitution between the present consumption of goods and the future consumption of nursing services will be forced to save more during their working years. The decline of the labor growth rate implies a decrease in the transformation possibility from present consumption to the nursing care in the next period. We also argue that when the nursing services cannot be substituted by capital expenditures, it is desirable to import foreign labor services as well as to encourage outflow of capital. We also show that in spite of the extreme emphasis on the need for nursing care during old age in our model, the neoclassical property of the overlapping generation model is kept intact.

The rest of the chapter is organized as follows. In section 2, we set out our theoretical apparatus, and examine the theoretical issues. In section 3 we use the theoretical apparatus of section 2 to address the policy issues that we mentioned above.

2. THEORETICAL APPARATUS

The welfare of the elderly depends on the level of care. Elderly care includes medical care and nursing services. The welfare of an individual in a society depends also on their material well-being during their lifetime. In this chapter we consider only nursing services during old age, and we identify all material well-being with consumption of an aggregate good during the first period. More specifically, we assume an overlapping generations economy in which each agent lives for two periods – young and old. Each adult is endowed with 1 unit of labor that he/she supplies to the labor market inelastically and earns wage rate w_t out of which he/she consumes c_t and saves s_t. In the second period, he/she retires, and consumes nursing services n_{t+1}. Let the agent of the tth generation have the lifetime utility $u(c_t) + v(n_{t+1})$, where $u(c_t)$ is the present utility of the tth generation defined on the present consumption of goods and $v(n_{t+1})$ is the utility derived from the nursing service n_{t+1}which we assume as hours of nursing time and provided by the future generation. The consumption good is the numeraire and the total available time of a young person is normalized to 1.

Household's Choice Problem

The choice problem of an adult of tth generation is: maximize: $u(c_t, \ell_t) + v(n_{t+1})$. Subject to:

$$c_t^{+} + \frac{w_{t+1} n_{t+1}}{1 + r_{t+1}} \leq w_t \tag{4.1}$$

Note that $s_t = w_t - c_t$. Denote by $\rho_{t+1} = w_{t+1}/(1 + r_{t+1})$ the wage–rental ratio in period $t+1$. The optimal solution for s_t and n_{t+1} depend on the wage rate w_t and the wage–rental rate ρ_{t+1} in period $t+1$. We denote the optimal solution by

$$s_t = s(w_t, \rho_{t+1}), \quad \text{and} \quad n_{t+1} = n(w_t, \rho_{t+1}) \tag{4.2}$$

Suppose there is a drop in fertility rate in period t. To examine the effect of this fertility decline on savings, consumption of nursing services and the welfare of various generations, notice that the effect in our set-up is percolated through the income w_t and the price of the nursing services ρ_{t+1} for any generation t. The agents take these as given. In a closed economy, the effect of fertility decline in period t will affect the wage rate w_{t+1} and the rental rate $1+r_{t+1}$ and hence the wage–rental ratio ρ_{t+1} but the wage rate w_t will be unaffected. Let us assume that a fertility decline in period t increases the wage rate w_{t+1} and decreases the interest rate r_{t+1}, and thus increases the wage–rental rate ρ_{t+1} (we shall show that this will be the case in most situations). As shown in Figure 4.1a, this will shift inward the budget line of a representative adult of period t (the dotted budget line with a slope of $-1/\rho'_{t+1}$. We use x' to denote the variable x after demographic shock, and x to denote the variable before the demographic shock in Figure 4.1). The effect on savings and consumption of nursing services will depend on the income and substitution effects, but there will be a fall in the welfare level of generation t.

Could the outflow of capital or the immigration of labor improve the welfare of generation t? Either of the two will lower the wage–rental ratio ρ_{t+1} and hence will improve welfare of generation t and can even attain a higher level of autarky welfare level than the level that the representative adult of generation t would have achieved if there were no drop in fertility.

The welfare effects on the future generations are more complicated to determine since there is a wealth effect from the fertility decline because generation $t+1$ will have a higher wage rate w_{t+1}, which shifts his budget

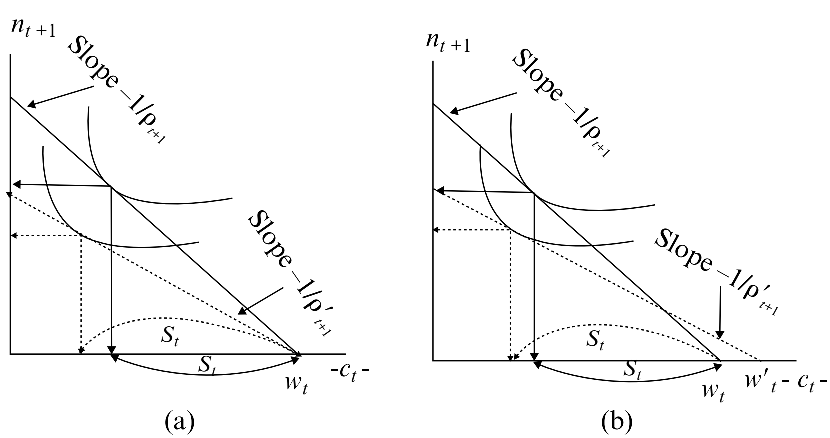

Figure 4.1

constraint along the consumption axis as shown by the dotted lines in Figure 4.1b. In this case we cannot even determine the welfare effect. To determine these effects we shall consider the constant elasticity of substitution (CES) utility function, which assumes constant inter-temporal rate of substitution, beginning with the case of the Cobb–Douglas utility function, that is, with the unit elasticity of substitution case. To that end, we describe the autarky equilibrium.

Autarky Equilibrium

Let L_t be the number of young agents in period t. We assume that population is growing exogenously at the rate of g, that is, $L_{t+1} = (1+g)L_t$. Denote by $\hat{L}_{t+1}$ the labor in the productive sector. Then in equilibrium we must have,

$$\hat{L}_{t+1} = L_{t+1} - n_{t+1}L_t = \left[1 - \frac{n_{t+1}}{1+g}\right]L_{t+1}. \tag{4.3}$$

Denote by e_t the fraction of labor in the productive sector in period t. It then follows from the above that

$$e_{t+1} = \frac{\hat{L}_{t+1}}{L_{t+1}} = 1 - \frac{n_{t+1}}{1+g} \tag{4.4}$$

Assume that capital fully depreciates in one period and it takes one period to gestate. This also means that rental rate and interest rate are identical. The aggregate capital K_{t+1} in period $t+1$ is given by

$$K_{t+1} = L_t s_t \tag{4.5}$$

We assume that the nursing sector does not require any capital. The productive sector uses capital and labor to produce output using a constant return to scale production function $Y_t = F(K_t, \hat{L}_t)$. Denote the capital–labor ratio in the productive sector in period $t+1$ by $\hat{k}_{t+1} = (K_{t+1})/(\hat{L}_{t+1})$. Utilizing (4.3) and (4.5) we have,

$$\hat{k}_{t+1} = \frac{s_t}{(1+g) - n_{t+1}} \tag{4.6}$$

In autarky, the competitive wage rate and interest rate between period t and $t+1$ are determined in the productive sector as follows

$$1 + r_t = f'(\hat{k}_t) \tag{4.7}$$

$$w_t = f(\hat{k}_t) - \hat{k}_t \cdot f'(\hat{k}_t) \equiv \omega(\hat{k}_t) \tag{4.8}$$

where, $f(k) \equiv F(k, 1)$. We assume that production function is concave. Notice that the wage rental rate $\rho_t(\hat{k}_t) = (f(\hat{k}_t) - \hat{k}_t f'(\hat{k}_t))/f'(\hat{k}_t)$, which as a function of $\hat{k}_t$ is an increasing function.[3] Substituting (4.7), (4.8) and (4.2) in (4.6), we have the following non-linear difference equation in the capital–labor ratio $\hat{k}_t$ of the productive sector.

$$\hat{k}_{t+1} = \frac{s(w_t, \rho_{t+1})}{(1+g) - n(w_t, \rho_{t+1})} \equiv \varphi(\hat{k}_t, \hat{k}_{t+1}) \tag{4.9}$$

for an appropriately defined function φ. Equation (4.9) provides the fundamental difference equation of our growth model. Once we obtain $\{\hat{k}_t\}_0^\infty$ we can derive all other equilibrium quantities. Thus the dynamic properties of our economy could be studied from the properties of (4.9).

The implicitly defined second order difference equation in (4.9) is, however, hard to study. We shall consider two examples to study the dynamic properties of our economy when there is exogenous shock in the fertility rate: one with Cobb–Douglas utility and production functions, and the other with constant elasticity of substitution (CES) utility function and Cobb–Douglas production function.

Cobb–Douglas Economy

Assume Cobb–Douglas utility function $u(c_t) = \alpha \ln c_t$ and $v(n_{t+1}) = (1-\alpha)\ln n_{t+1}$, $\alpha > 0$. Assume Cobb–Douglas production function as $f(k) = k^\theta$, $0 < \theta < 1$. We then have the following optimal solutions:

$$c_t = \alpha w_t$$

$$n_{t+1} = (1-\alpha)(1+r_{t+1})\frac{w_t}{w_{t+1}} \tag{4.10}$$

Thus we have

$$s_t = (1-\alpha)w_t \tag{4.11}$$

Notice that a rise in wage rate in the next period only due to a fall in the fertility rate in this period will have no effect on consumption and savings in this period, but the demand for nursing services will fall to the level such that the share of current income spent on nursing will remain constant. However, if both w_t and w_{t+1} change due to a constant fertility decline over time which started in the past, there will be an increase in savings. The effect on demand for nursing services will depend on how the ratio of the wage rates w_t/w_{t+1} and the interest rate r_{t+1} are affected by such fertility decline. To that end, we study the difference equation (4.9) which for this specific economy becomes,

$$\hat{k}_{t+1} = \frac{(1-\alpha)}{(1+g)}\hat{k}_t^{\theta}, \quad \hat{k}_0 \quad \text{given}, \quad t \geq 0. \tag{4.12}$$

The above is a first order difference equation in the capital–labor ratio which has a stable steady-state given by

$$\hat{k}^* = \left[\frac{(1-\alpha)}{(1+g)}\right]^{\frac{1}{1-\theta}} \tag{4.13}$$

and the phase diagram is as shown in Figure 4.2. It is clear from the phase diagram that if there is a constant fertility decline beginning in time period t, the capital–labor ratio in all subsequent periods will be higher than the levels without the fertility decline,[4] and hence the economy will have higher wage rates w_{t+1}, w_{t+2} … and higher wage rental rates ρ_{t+1}, ρ_{t+2} …

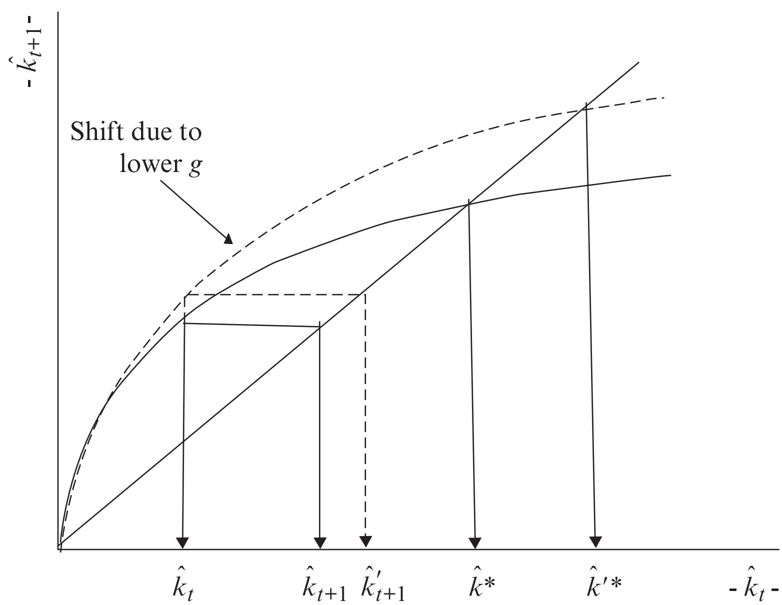

Figure 4.2 Phase diagram before and after fertility decline

compared to the rates when there was no fertility decline. We now examine the general equilibrium effect of fertility decline on other variables.

From equation (4.4) it follows that

$$\begin{aligned} e_t &= 1 - \frac{(1-\alpha)(1+r_t)w_{t-1}/w_t}{1+g} \\ &= 1 - \frac{(1-\alpha)}{1+g} \cdot \frac{\theta}{1-\theta} \frac{\omega(\hat{k}_{t-1})}{\hat{k}_t} \\ &= 1-\theta \end{aligned} \tag{4.14}$$

The last equality follows after substituting equation (4.12) in the denominator in the previous step and then simplifying. Thus in this economy the fraction of labor in the nursing sector is independent of the population growth rate in all periods.

From the second line of equation (4.10) we have

$$\begin{aligned} n_{t+1} &= (1-\alpha)w_t/\rho_{t+1} \\ &= (1-\alpha)\theta\hat{k}_t^{\theta}/\hat{k}_{t+1} \\ &= \theta(1+g) \end{aligned} \tag{4.15}$$

In the above, we derived the last equality after substituting $\hat{k}_{t+1}$ from equation (4.12) and then simplifying. It is clear from (4.15) that all generations will have the same level of consumption of nursing services, the level of which becomes lower, the lower is the population growth rate.

Since wage rates in all future periods are higher, it follows that there will be higher savings due to a fall in fertility rate. The savings rate, defined as s_t/w_t will, however, remain unaffected by a drop in fertility.

Constant Elasticity of Substitution Economy

We consider now a more general CES utility function to shed light on the effect of fertility decline on savings rate and other variables. We assume the following forms for the CES utility function:

$$u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}, \quad \text{and} \quad v(n_{t+1}) = \frac{n_{t+1}^{1-\sigma}}{1-\sigma}, \quad \sigma > 0, \sigma \neq 1. \tag{4.16}$$

After algebraic manipulations, we have the optimal solution for n_{t+1} and s_t as follows:

$$n_{t+1} = \frac{w_t}{\rho_{t+1} + \rho_{t+1}^{1/\sigma}} \tag{4.17}$$

and

$$\begin{aligned} s_t &= \rho_{t+1} n_{t+1} \\ &= \frac{w_t}{1 + \rho_{t+1}^{1/\sigma - 1}} \end{aligned} \tag{4.18}$$

Notice that in this case the effect on savings rate of generation t from a constant fertility decline over time beginning in time period t depends on whether $\sigma > 1$ or $\sigma < 1$. We know that an increase in interest rate has a negative income effect and a positive substitution effect on savings and the net effect depends on which effect is dominant. It is well known that when $\sigma > 1$, the income effect dominates the substitution effect and the net effect of an increase in interest rate on savings is negative. The opposite is the case when $\sigma < 1$. The empirical estimates of σ in macroeconomics and public finance literature vary anywhere from 1 to 4 for the US during the post world war period. Assuming similar estimates hold for Japan, we can see that a decline in fertility rate will increase the savings rate s_t/w_t. The economic interpretation of this result is that the households save more so that they can afford more costly nursing services when they become old.

Substituting the first part of equation (4.18) in equation (4.6) we have,

$$\hat{k}_{t+1} = \frac{\rho_{t+1}}{(1+g)/n_{t+1} - 1} \tag{4.19}$$

For the Cobb–Douglas production function we have, $\rho_{t+1} = ((1-\theta)/\theta) \cdot \hat{k}_{t+1}$. Substituting this in equation (4.19) we have

$$n_{t+1} = \theta(1+g). \tag{4.20}$$

Thus, the equilibrium consumption of nursing services does not depend on elasticity of substitution, σ, and its level is constant over time. The equilibrium consumption of nursing services is, however, lower if there is a decline in the fertility rate g. From equation (4.4) it also follows that

$$e_t = 1 - \theta \tag{4.21}$$

Substituting equation (4.17) in equation (4.20) and after simplification, we have the following non-linear difference equation for $\hat{k}_t$,

$$\left[\frac{1-\theta}{\theta}\right]^{(1-\sigma)/\sigma}\hat{k}_{t+1}^{1/\sigma}+\hat{k}_{t+1}=\frac{1}{(1+g)}\hat{k}_t^{\theta} \tag{4.22}$$

The above defines implicitly $\hat{k}_{t+1}$ as a function of $\hat{k}_t$. This is an increasing function of $\hat{k}_t$ and its derivative at $\hat{k}_t = 0$ is ∞. It will have a phase diagram similar to the one shown in Figure 4.2. Thus the dynamic properties of this model will be similar to those of a standard neoclassical growth model.

3. FOREIGN CAPITAL INVESTMENT AND INTERNATIONAL LABOR MIGRATION

If this country is opened to the world market, then certainly immigration from abroad will help the welfare of the country as long as the foreign technology and population growth rate are initially identical to those in the home country. This proposition can be seen easily by looking at the wage-rental frontiers of the two countries. The wage-rental frontier of a country depicts the relationship between the present wage rate and the rate of return to savings for the future. Initially, the foreign wage-rental frontier is given. The home country's wage-rental frontier shrinks downward because the same amount of saving will be less effective in obtaining care in the future. Therefore, the inflow of foreign workers will recover the labor growth rate and improve the consumption possibility of the home country. In the simplest case assume that the foreign country is a large country, so that its wage-rental frontier does not change because of migration of its labor to the other country. Then it is clear that the home country can enjoy the same welfare level as the foreign country.

Incidentally, in Kageyu spa of the (mid-mainland) Nagano prefecture in Japan, there were 21 nurses (or carers) from Brazil in the year 2000. Before World War II, many Japanese migrated to Brazil and their descendants still speak Japanese. Probably because of that, Brazilian citizens are under less strict regulations for immigration into Japan. Patients as well as the aged in Japan welcome these carers from abroad.

According to the Asahi Newspaper (14 January, 2000), the Japanese Government started a debate on whether foreigners should be admitted to provide nursing services. In the year 2025, the numbers of elderly who will require intensive care will increase to 5.2 million from the present level of 2.8 million. Presently there are only 170 000 in-home carers, but Japan will need more than a million nurses including their administrative support in the future. There are different opinions about letting immigrants provide this service. For instance, the nursing service organizations are hardly welcoming such a policy. Some economists admit that this trend is inevitable. The aged and the patients often say that they are happier to be taken care of by kind foreigners than by busy natives.

On the other hand, we could achieve the same goal by exporting capital. Instead of accumulating capital in the home country where the rate of return will be lower because of a fall in the labor force due to a fall in the fertility level and decreasing utility from nursing, the home country can invest capital abroad, earning a higher rate of return, and pay for the nursing care in the next period utilizing the higher returns from foreign investment. This provides a theoretical explanation for the commonly made observation that the Japanese save a large percentage of their income in order to consume in old age. This analysis is also consistent with the claim by Goto (1998) that Japan can avoid the social problems involved with immigrant workers by trading with foreign countries first and then investing capital in foreign countries.

We live, however, in a world where technological levels differ from one part of the world to the other. There are two conceivable cases. One case is where the labor force in Northern countries possesses a higher level of human capital, so that a worker in the North is as effective as, say, two workers in the rest of the world. Then if the production function in terms of the effective labor unit is identical, the neoclassical theory of capital movements and migration hold true. A worker in the South will have a wage rate equal to only half of the wage rate in the North after migration.

On the other hand, suppose instead that the technological level of the North is higher than that in the South. If the two regions have the same shape for production isoquants in terms of capital and labor, and if the levels of total factor productivity between the two regions are different, what will the pattern of international factor movements be? The exodus of capital from the North to the South is not the solution in this situation. The flow of both capital and labor from the South to the North will enhance world welfare.[5] This would mean that there will be a higher concentration of production in the North. But after a while there will be congestion in the North, especially when the northern country is geographically small, such as Japan or a Europen country. To see this formally we consider a variation of the congestion model of Raut and Srinivasan (1994). Assume that population density affects total factor productivity of inputs. Assume further that very high population density has a negative effect on total factor productivity level due to congestion. More precisely, we assume that the output per unit of labor in the productive sector of the North is given by

$$y^N = A^N(L_t)f(\hat{k}_t) \tag{4.23}$$

where $A^N(L_t)$ denotes the total factor productivity level as a function of population density in period t. Assume that the South does not have a congestion effect on productivity and assume its output per unit of labor in the production sector is represented by the same production function as described in the previous section. Suppose that at a very high level of L_t, the total factor productivity level $A^N(L_t)$ becomes less than 1. Then it is clear that the wage rate in the North $w_t^N = A^N(L_t)[f(\hat{k}_t) - \hat{k}_t f'(\hat{k}_t)]$ will be higher than that in the South initially. There will be labor migration to the North up to the point when the congestion effect of labor makes the productivity level $A^N(L_t)$ in the North less than or equal to 1. After that there will be no more labor mobility to the North.

4. CONCLUDING REMARKS

In order to focus on the problem associated with the caring of the aged, we have built an overlapping generation model that takes full account of the nursing cost of an economy facing rapid ageing. Rapid ageing presents a challenge to society because the present generation will face a less favorable trade-off in transforming the saving into nursing services when it becomes old. If the elasticity of substitution between the present consumption and the future nursing consumption is less than unity, the saving of the current generation will be increased.

In such a case the increased saving may find an outlet to foreign markets. We found that immigration and capital outflow are alternative remedies to a country's rapid ageing problems.

Needless to say, the ageing and nursing problems also have much wider dimensions, such as ethical, sociological and medical aspects. Transportation costs for migration and foreign investments also vary depending on the situation. The Gastarbeiter (guest workers) issues in Europe pose social problems of adjustment even a generation afterwards. The 'hollowing out' of capital exports presents another serious problem to the home country. Conclusions given in this chapter should be qualified in the light of these elements if they are to be applied to policy-making.

NOTES

1. Lakshmi Raut is an Economist at the Social Security Administration (SSA). This chapter was prepared prior to his joining SSA and the analyses and conclusions expressed are those of the authors and not necessarily those of the organizations with which they are affiliated.
2. Literature describes the depth of emotion attached to caring for an ageing generation, which is often a hard and sublime duty for mankind. In medieval villages in the highlands

of Japan, a legend told of old people who sacrificed themselves by straying into the mountains to spare the young from caring for them and to save food for them. Fukasawa writes that a woman even prepared herself for this sacrifice by destroying her own still young teeth so that she would look old. In the best-selling novel about modern Japan, Sawako Ariyoshi describes a process of how a middle class family was disrupted by an elderly man who was losing his memory as well as control of his physical faculties. A housewife had to give up her full-time job to become a part-timer so that she could take care of her elderly father-in-law. In Shakespeare's classical drama, one sees a prototype of generational conflicts and even implicit strategic negotiations.

3. To see this, note that $\rho_t'() = -[f''(k_t)f(k_t)]/[f'(k_t)]^2$, which is positive for the concave production function.
4. In the figure we used x' to denote the variable x after the fertility shock.
5. See Raut (2007) for further discussions.

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