Very Low Fertility and the High Costs of Children and the Elderly in Japan and Selected Asian Countries: An NTA Approach

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1. Introduction

In the recent past, we have attempted to (1) examine, on the basis of a pool of time-series data primarily from three low-fertility East Asian economies (Japan, South Korea and Taiwan), the nexus between the direct public and private costs of children and the number of children that parents would raise during their reproductive span; and (2) investigate whether or not there exists a competing relationship between the young and the aged in the allocation of private and public financial resources to these two age groups in the three East Asian economies (Ogawa et al., forthcoming). Here, along a similar line of interest, we expand the scope of our analysis by adding to our data set the following three Asian countries: China, Thailand and the Philippines.

The structure of this paper is as follows. In the next section, some of the basic features of the National Transfer Accounts (NTA) system, which serves as the basic analytical framework of the present study, are succinctly presented. On the basis of the NTA approach, we then analyze, for illustrative purposes, Japan's changing pattern of intergenerational transfers, both public and familial, over the past two decades, especially from the angle of the cost of children but also from the standpoint of the cost of the elderly. By combining computational results for Japan with those for South Korea, Taiwan, China, the Philippines, and Thailand, we estimate the relationship between the cost of children and the fertility rate in these six economies. In addition, we test, by employing a pooled data set on the cost of children and the cost of the elderly, the applicability of the "crowding out" effect to East and South East Asia. The final section summarizes some of the major findings in the present study.

2. What Can the NTA System Do?

Several years ago, an international collaborative research project called "NTA" was initiated under the leadership of the East-West Center (Andrew Mason) and the Center for the Economics and Demography of Aging at the University of California, Berkeley (Ronald Lee). A number of collaborating institutions from various parts of the world are included in the project.

As of July 1, 2012, a total of 37 countries constitute the NTA membership, and 10 of them are situated in the Asian region. The purpose of NTA is to measure at the aggregate level how much persons at each age acquire and use economic resources. NTA is constructed in a manner consistent with the National Income and Product

Accounts（NIPA）and provides a comprehensive and coherent treatment of economic flows by age.

The following two principal components comprise the NTA system. One is a detailed accounting of the economic lifecycle, consisting of consumption, labor income, and their major constituent elements. As people move through their lives, there are periods when their material needs are not matched by their ability to produce goods and services. In childhood and old-age people consume far more than they produce, thereby generating lifecycle deficits, while during the prime working ages they produce considerably more than they consume, thereby generating lifecycle surpluses.

The other component of NTA measures the flows of economic resources from lifecycle surplus to lifecycle deficit ages. These economic flows are mediated by both the public and private sectors. Age reallocations come in two forms: transfers and asset-based reallocations. A defining feature of transfers is that they involve no explicit *quid pro quo*. Resources flow from one party to another either voluntarily in the case of most private transfers, or involuntarily in the case of public transfers. Asset-based reallocations rely on inter-temporal exchange. An asset acquired in one period can be used to support consumption, either from asset income or by disposing of the asset, in subsequent periods. When individuals accumulate pension funds or personal savings during their working years and rely on asset income and/or dis-saving of those assets during their retirement, they are relying on asset-based reallocations. Or when individuals borrow to finance their education or to buy a car or a home, they are relying on asset-based reallocations to consume more than their current labor income allows.

A fuller explanation of the NTA's basic concepts, the crucial computational assumptions utilized, and definitions of other key variables are available on the NTA website（http://www.ntaccounts.org）. Moreover, a volume containing many NTA country reports together with several chapters on the foundations of NTA and inter-country comparative analysis on selected topics has been published recently（Lee and Mason, 2011）.

3. Computing Private and Public Costs of Children and the Elderly

3.1　The interrelationship between the direct costs of children and the elderly

According to an essential idea of the Becker model, the psychological satisfaction that parents obtain from children is directly related to the number of children they have and the amount of resources they spend on them. If parents spend a greater amount of resources on a child, they derive greater satisfaction if the child is of "higher quality." In Becker's fertility model, to increase the amount of satisfaction in the conditions where there is a higher private cost for having children, the parents opt for the substitution of quality for quantity of children, thus operating to decrease fertility. Consequently, Becker's model suggests that there exists a trade-off between the number of children in the family and the quality of children. It should be also stressed that beside private costs of children, public spending on children may also play an important role in determining the quality and quantity of children parents have. For example, subsidizing the quality of children reduces the private costs of acquiring high quality children, thus leading to higher fertility.

The trade-off between spending and the number of children is important for other reasons too. One of them is related to generational equity. Preston（1984）has raised the possibility that population aging will lead to a decline in the welfare of children relative to the welfare of the elderly. In Japan, the cost of the elderly has been rising alongside with the cost of children, partly owing to the maturity of the pension programs（Ogawa and Retherford,

1997; Ogawa, Chawla, and Matsukura, 2010). In addition, the argument has been advanced with respect to the allocation of public resources that, as a consequence of the increased political power of the elderly induced by rapid population aging and because Japanese government's budgetary resources are severely constrained, it is conceivable that a "crowding out" effect between the resources directed to the young and to the elderly might be occurring. Another important macroeconomic consideration pertaining to the cost of children is related to the trade-off between the number of children and human capital spending per child (Becker, Murphy, and Tamura, 1990).

3.2 Per capita private and public consumption profiles for children and the elderly

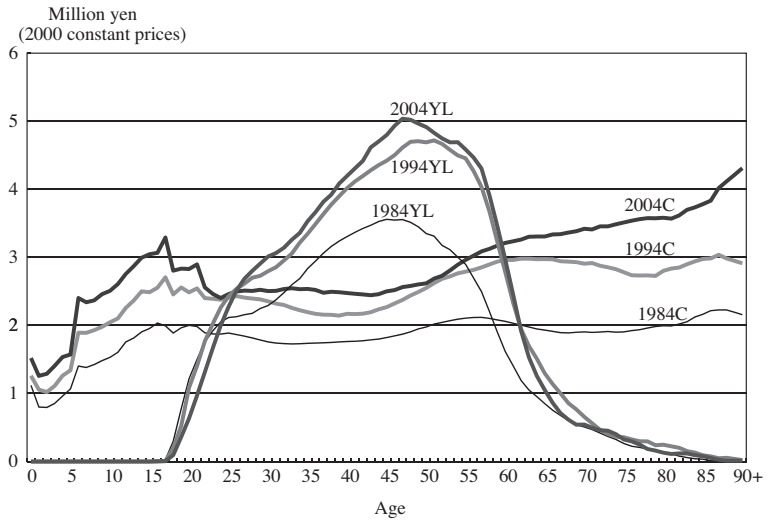
Because the direct cost of raising children up to adulthood and supporting elderly persons in retirement is one of the key variables in this paper, it is worthwhile to discuss how the direct public and private costs of rearing children and supporting the elderly are computed. In the NTA system, consumption, both private and public, is comprised of education, health, and other consumption (food, clothing, housing, durables, etc.). Moreover, because the young population, particularly at school going ages, has little or no labor income, its consumption is virtually equal to the direct costs of raising children. In contrast, the direct costs of living of the elderly need to be calculated as a difference between their consumption and labor income. It should be noted that although the foregone income is an important part of costs to be incurred in raising children and taking care of elderly persons, it falls outside the scope of this paper.

Let us now discuss the computational procedure of per capita public costs of children and the elderly per year. The age-specific profile of the per capita public education cost has been computed by utilizing the published data on the government expenditure for each level of education and the number of pupils and students at each level of education. The age-specific profile of the per capita health care cost has been estimated on the basis of government published data concerning age-specific outpatient and inpatient costs per case and age-specific incidence of receiving such medical treatments. In the case of the per capita cost of public consumption in general (e.g., government employees' salaries, road maintenance costs, national defense, etc.), we have assumed that every person consumes equally, and have simply divided the total annual expenditure for each component of public consumption, except for education and health, by the total population.

Using these computed results of age-specific profiles of various components of consumption, we have estimated the age-specific profile of per capita consumption for 1984, 1989, 1994, 1999, and 2004, private and public sectors combined. In Figure 1, we have plotted for illustrative purposes the estimated results of per capita total consumption only for three selected years (1984, 1994, and 2004). For comparative purposes, we have also plotted the corresponding age-specific profiles of per capita production (labor income) for the three selected years (For a more detailed methodological explanation pertaining to the per capita production profiles, see Ogawa et al., 2010). The estimated results are expressed in terms of 2000 constant prices.

A few points of interest can be derived from this graphical exposition. First, by drawing upon information contained in Figure 1, we can calculate the size of income-consumption deficits by age in 1984, 1994, and 2004. Throughout the time period under review, there are sizeable income-consumption deficits at both young and older lifecycle stages. Obviously, these lifecycle deficits (LCD) must be covered, with reallocations coming largely from the surplus of income generated at the lifecycle surplus stage during the current period or from assets accumulated during previous periods.

Figure 1.　Age-specific profiles of per capita consumption and production in Japan: 1984, 1994, and 2004



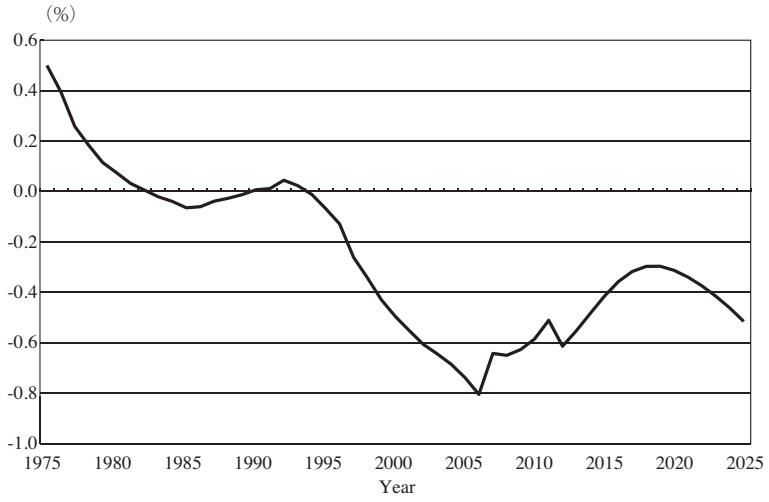
Note: YL denotes labor income, while C denotes consumption.
Source: Author's calculation.

Second, it is also worth noting in Figure 1 that the age at which an average individual shifts from a net consumer to a net producer gradually increased from 23 years old in 1984 to 25 in 1994, and 26 in 2004. At the other end of the lifecycle, the age transition from a net producer to a net consumer was postponed only marginally from 58 years old in 1984 to 60 in 2004. These results indicate that the length of time during which an average individual is financially self-supporting ranges from 34 to 35 years, which is relatively short, corresponding only to two-fifths of the average life span in contemporary Japan.

Third, unlike per capita production, the age-profiles of per capita consumption were rising almost continuously over time. The 1984 and 1994 age-profiles show a mildly-shaped double hump, being high at both young and older ages. The first peak corresponds to the high costs of the young, while the second peak is related to the high costs to be placed upon household heads under multigenerational living arrangements. In addition, it is worth noting that the amount of per capita consumption rose distinctly among those aged 65 and over in 2004. This seems to be accounted for by the implementation of Long-term Care Insurance（LTCI）starting from the year 2000. In-home care for the frail elderly, which had until then been informally provided by their family members, became formalized as a part of the market economy. As a result, Japan's per capita consumption profiles have, over time, started to look increasingly similar to those of the United States, Sweden, and Costa Rica, among the NTA member countries（Tung, 2011）.

Fourth, as widely discussed elsewhere（Mason, 2001, 2007; Mason and Lee, 2006）, one of the important linkages between demographic structural transformations and economic growth is the role of demographic dividends in the process of economic development. When a country's fertility begins to fall, the first demographic dividend arises if changes in the population age structure lead to an increase in the working ages relative to non-working ages. That is, the first demographic dividend is the rate of growth of the economic support ratio（ratio of

Figure 2. First demographic dividend in Japan, 1975-2025



Source: Author's calculation.

effective workers to effective consumers), which rises or falls, subject to the age compositional transformation in the process of the demographic transition. During a demographic transition, when the economic support ratio rises, income per effective consumer increases, given that there is no change in productivity. As the economic support ratio declines, however, income per effective consumer falls and the first demographic dividend disappears, which means that the increase in income per effective consumer is transitory.

With a view to identifying the timing and duration of the first demographic dividend for Japan, we have calculated the change in the economic support ratio over the period 1975-2025, by applying the age-specific profiles of per capita consumption and production observed in the year 2004 as statistical weights to adjust the entire population. This implies that the computational results solely reflect the effect of age structural change on the economic support ratio. In addition, we have used the 2010 United Nations population projection as the source of demographic data for the computation. The results are shown in Figure 2. As can be observed in this graph, Japan's first demographic dividend comes to an end over the period 1982-1995, after which Japan enters the phase of population aging, where it is expected to stay during the rest of the projected period [1)].

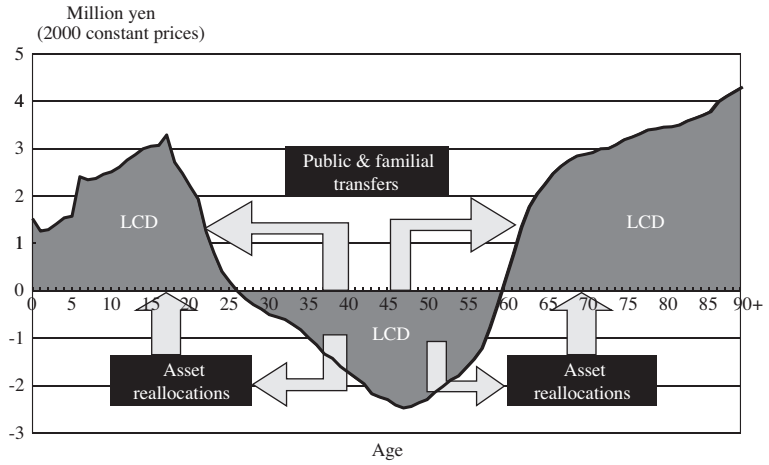
3.3 Pattern of lifecycle deficits and lifecycle allocations

As has been widely accounted for in numerous publications pertaining to the NTA system, the accounts measure intergenerational flows for a certain period of time (usually a calendar or fiscal year), and are governed by the following relationship:

$$y^l + y^A + \tau_g^+ + \tau_f^+ = C + S + \tau_g^- + \tau_f^- \qquad (1)$$

where y^l = labor income; y^A = asset income; τ_g^+ = public transfer inflows; τ_f^+ = private transfer inflows; C = consumption; S = saving; τ_g^- = public transfer outflows to the government; and τ_f^- = private transfer outflows. Rearranging terms in Equation (1), the LCD, which is the difference between consumption and production, is matched by age reallocations consisting of reallocations through assets and net transfers, as expressed below:

Figure 3.　Total reallocations and lifecycle deficits（LCD）



Source: Author's calculation.

$$\underbrace{C - y^{l}}_{\text{Lifecycle deficit}} = \underbrace{y^{A} - S}_{\text{Asset reallocations}} + \underbrace{\underbrace{\tau_{g}^{+} - \tau_{g}^{-}}_{\text{Net public transfers}} + \underbrace{\tau_{f}^{+} - \tau_{f}^{-}}_{\text{Net private ransfers}}}_{\text{Net transfers}} \qquad (2)$$

Age reallocations

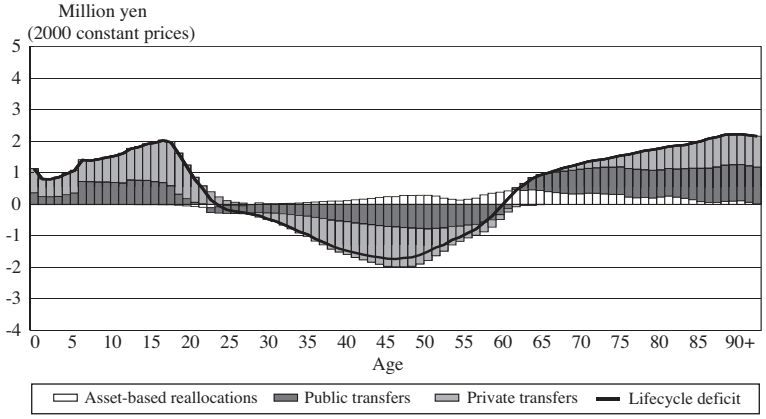
Furthermore, to gain further insight into Equation（2）, we can express the mathematical relationship by using the relevant data for 2004 as illustrated in Figure 3.

At this point, caution should be exercised with regard to the following two remarks. First, both 'familial transfers' and 'private transfers' are used interchangeably in this paper. Second, although net private transfers are comprised of bequests and *inter vivo* transfers, the computation of the bequest component has not been completed at the time of writing this paper. For this reason, bequests are excluded from the computational results reported in this paper.

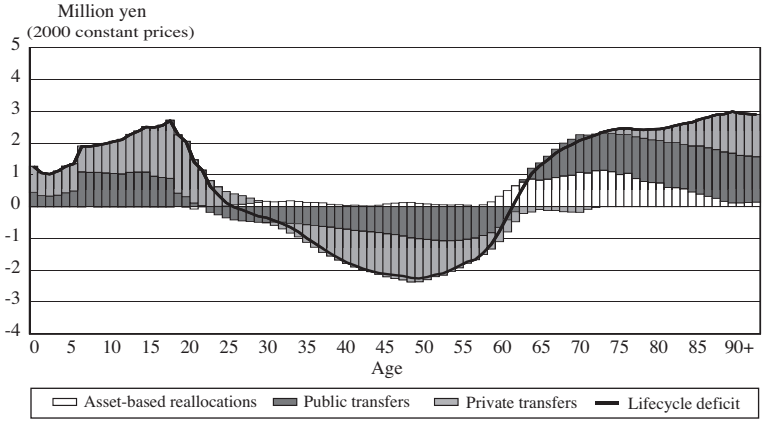
In Figure 3, the vertical scale represents age-specific per capita deficit, which corresponds to the difference between per capita consumption and per capita production at each age. It should be further noted that the graph of age-specific aggregate-level deficit takes into consideration the number of persons at each age, thus showing a pattern substantially different from the one displayed in Figure 3.

By applying the time-series data for Japan to Figure 3, we have produced Figure 4 which shows how the pattern of three components of reallocation of the LCD changed in Japan over two decades beginning from 1984. The three components are reallocations through assets, public transfers, and private transfers, measured on an annual basis. Panels A, B and C illustrate annual reallocations of the LCD observed in 1984, 1994 and 2004.

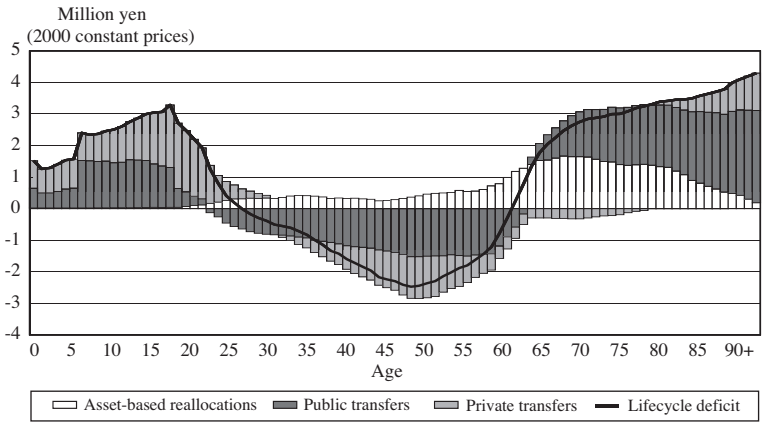
Figure 4. Changing pattern of three components of per capita reallocation of lifecycle deficits in Japan



Panel A. 1984



Panel B. 1994



Panel C. 2004

Source: Author's calculation.

4. The Rising Costs of Children and the Elderly over Time in Asia

To facilitate the analysis to be made in this section, we define the following two new variables: "the child LCD" and "the elderly LCD". The former represents the per capita direct cost of raising children up to their self-sufficient ages, i. e., the age at which the age-specific LCD shifts from positive to negative, based upon the NTA system. The latter represents the per capita direct cost of the elderly from the age in which they cease to be self-sufficient up to the age of their death. The per capita direct cost of the elderly corresponds to the sum of the age-specific LCD, computed as consumption minus production.

4.1 Spending per child and the number of children in the selected Asian countries

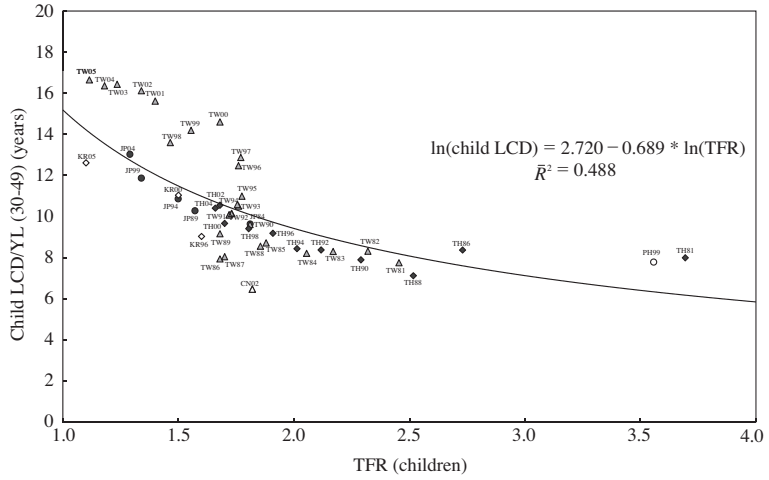
As briefly discussed in an earlier section of this paper and fully described elsewhere（Ogawa et al., 2009, forthcoming）, one of the most essential concepts in the economics of fertility is the trade-off between the spending per child and the number of children, and this idea is fully embedded in Becker's model of fertility decision-making（Becker, 1960, 1981）. In its simplest form, Becker's theory states that higher income leads to an increase in the demand for higher quality in children and a more modest increase in the demand for the number of children（quantity）. But because higher quality children are costly, this leads couples to substitute away from quantity. In other words, the basic trade-off has to do with private costs of children, i. e., costs borne by the fertility decision-makers（parents）. Moreover, public spending on children may play an important role as well. For instance, with the provision of government subsidies for improving the quality of children, the private cost of acquiring high quality children is reduced, which consequently boosts fertility.

As briefly described above, the child LCD is the consumption of children（both public and private）minus the value of labor by children, i. e., the cost that children themselves cover. The child LCD is calculated for single years of age and can be used to construct a synthetic cohort measure of the cost of children. It represents the direct cost of children, assuming that they were raised from birth to adulthood consuming and producing at the same age-specific rates that prevailed in the year in question.

We normalize the child LCD by dividing it by the mean labor income of prime-age adults aged 30-49. This facilitates comparison across countries but also indirectly controls for the effects of income on child spending. In order to allow for mortality risks in childhood, we have also adjusted the normalized child LCD, by using appropriate life table values. Thus, the computed values can be interpreted as the years of prime-age adult labor income devoted to rearing a child from birth to economic independence, or to the child's death, should that occur during childhood.

Using the computed results of the child LCD per person below a self-sufficient age and the mean labor income of adults aged 30-49 for Japan, we have calculated the normalized per capita child LCD adjusted for survivorship up from birth to the self-supporting age in 1984, 1989, 1994, 1999, and 2004. The calculated values increased monotonically over time, namely, 9.6 years of labor income in 1984, 10.3 years in 1989, 10.9 years in 1994, 11.9 years in 1999, and 13.0 years in 2004. In addition, we have carried out the same computation for the other Asian countries for different time periods, subject to the availability of data, as follows: Taiwan（1981-2005）, South Korea（1996-2005）, China（2002）, Thailand（1981-2004）, and the Philippines（1999）. In the case of Taiwan, the normalized per capita child LCD adjusted for survivorship increased almost continuously from 7.7 years in 1981

Figure 5. TFR versus normalized per capita LCD for children in the selected Asian economies



Source: Author's calculation.

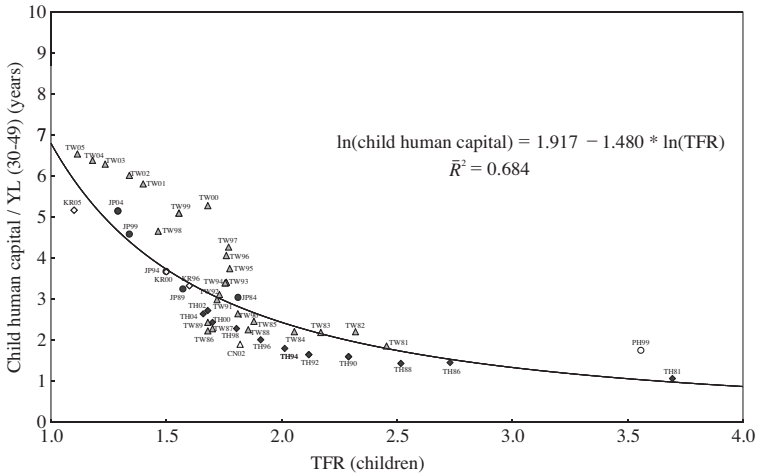
to 16.6 years in 2005. As regards South Korea, the corresponding value rose linearly from 9.0 years in 1996 to 12.6 years in 2005. In the case of Thailand, the value rose almost continuously from 8.0 years in 1981 to 10.4 years in 2004. China's value for 2002 was 6.5 years, while the Philippines' value for 1999 was 7.8 years.

With a view to quantitatively examining the trade-off between spending on children and the number of children, we have pooled the results on the child LCD derived from the six countries, and have linked them to the time-series data on TFR for each country under investigation. In the case of Japan, TFR declined continuously from 1.81 in 1984 to 1.29 in 2004. Taiwan experienced a sharp TFR decline from 2.46 in 1981 to 1.12 in 2005, while South Korea's TFR fell from 1.60 to 1.10 during the period 1996-2005. The corresponding drop in Thailand was from 3.69 in 1981 to 1.66 in 2004. Furthermore, China's TFR for 2002 was 1.82, and the Philippines' TFR for 1999 was 3.56.

In Figure 5, a total of 46 data points of the normalized per capita child LCD for the six economies for various years are plotted, coupled with the TFR for the corresponding years. As displayed in this graph, we have fitted the data by regressing the natural logarithm of the normalized per capita child LCD onto the natural logarithm of the TFR and, hence, the coefficient is the elasticity of the quality-quantity trade-off. As presented in Figure 5, the estimated elasticity for the six selected Asian countries combined is -0.69, implying that a decrease in the TFR leads to a considerable decrease in the total cost of childrearing per adult [2].

Furthermore, we have also undertaken a regression analysis, as displayed in Figure 6, by focusing on the relationship between the human capital component (education and health costs) of per capita child LCD and the TFR. It should be noted that except for the fact that we have used the human capital component of the per capita child LCD in place of the per capita child LCD as a whole, all the data points plotted in Figure 6 have been constructed in the same manner as in Figure 5. The regression result indicates that the computed elasticity (-1.48) is considerably larger than the one shown in Figure 5 for the total cost of children. This elasticity is also much larger than the cross-sectional elasticity reported by Lee and Mason (2010). In addition, the goodness of fit, as measured by adjusted R^2, is better in the case of the computed result shown in Figure 6 than that in Figure 5.

Figure 6.　TFR versus normalized per capita human capital spending for children in the selected Asian economies



Source: Author's calculation.

Hence, the health and education component of per capita child LCD are more closely linked to fertility change than other components of child LCD. This finding is consistent with the widely-held view that human capital factors have been playing an important role in the relationship between economic growth and fertility change in Asian countries [3)].

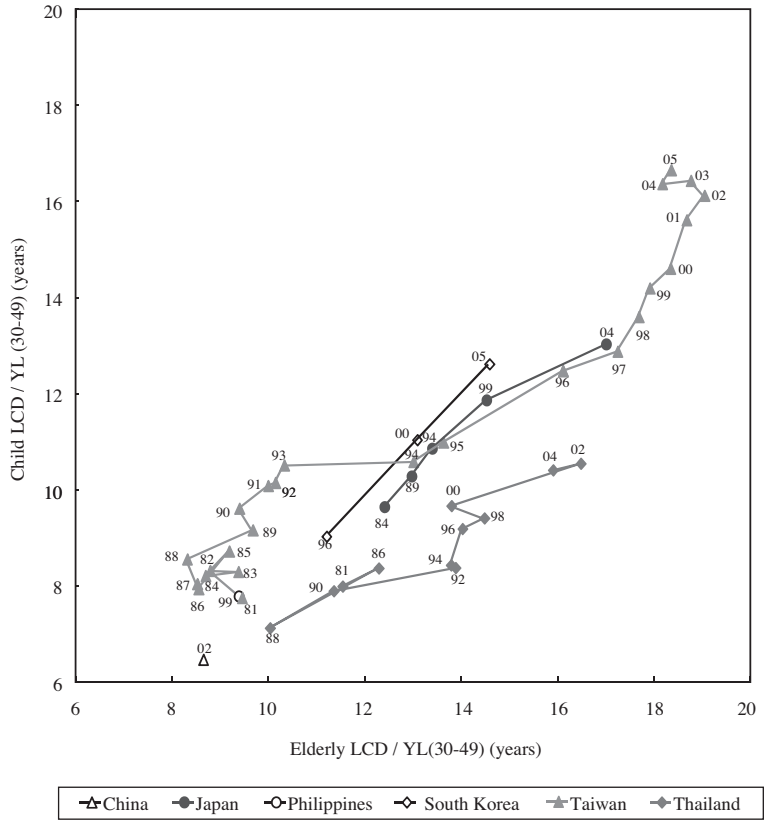
For the purpose of shedding more light on the nexus between human capital factors and fertility, we have conducted the following two additional regressions for the six Asian economies. In one of them, we have fitted the data by regressing the natural logarithm of normalized per capita *public* human capital spending onto the natural logarithm of the TFR. In the other regression, the natural logarithm of normalized per capita *private* human capital spending has been regressed on the natural logarithm of the TFR. The results of these regressions, not detailed here, indicate that both the *public* and *private* components of human capital spending have strong association with fertility, with the elasticity for *public* human capital spending standing at -1.19 and for *private* human capital spending at -1.70. It should be stressed, however, that the *private* component of human capital spending is substantially more strongly related to fertility than the *public* component.

The regression results presented thus far appear to conform to the view that there is a distinctive trade-off between the number of children and the combined（familial and public）spending per child in East and Southeast Asia. Caution should be exercised, however, in interpreting these fitted results, since all the regressions for the Asian economies examined are based upon a mix of cross-section and time-series data heavily dominated by Taiwan. Given such limitations of the data, the fixes that are usually employed to deal with well-known statistical problems that limit the value of aggregate regression estimates are not practical in this case. Furthermore, these regression results do not represent causal relationships.

4.2　The interrelationship between the per capita child LCD and the per capita elderly LCD

In recent years, numerous studies（e. g., Takegawa, 2005）have shown that the cost of the elderly has also been

Figure 7. Relationship between cost of children and cost of the elderly in the selected Asian economies



Source: Author's calculation.

rising in aging Asia, particularly in East Asia. A question therefore arises: is there a "crowding out" effect between the resources going to the young and those allotted to the elderly? To shed some light on this question, we have calculated, on a time-series basis, (1) how many years of the mean labor income of prime-age adults aged 30-49 is needed to finance the per capita LCD for a child, and (2) how many years of prime-age mean labor income is required to finance the per capita LCD for an elderly person. For the six Asian economies under study, the data for the computation have been prepared in the same manner as in our foregoing analysis pertaining to the cost of children and fertility.

The computed results are plotted in Figure 7. The pattern emerging from this graph indicates that both the cost of a child and the cost of an elderly person grow in the same direction, thus suggesting that there is no "crowding-out" effect in these six Asian economies [4]. This result therefore suggests that in these economies, working-age adults are sandwiched by their elderly parents and their children, heavily relying on assets to meet their own material needs as well as their familial and social obligations to other generations.

Beside these six Asian economies, we have calculated the cost of a child and the cost of an elderly person for NTA member countries in other regions. Although relevant graphs are omitted, the following two observations can be made safely. First, in both Latin America and Africa, we found virtually the same pattern as the one prevailing

in the Asian economies. Second, European countries show a totally different pattern from these developing countries, and the cross-sectional data gleaned from the European countries involved in the NTA project indicates that there is no significant relationship between the costs of the two age groups [5)].

5. Concluding Remarks

In this paper we have examined the relationship between the cost of raising children up to self-supporting ages and the number of children parents have, by drawing heavily upon the computed results for Japan, Taiwan, South Korea, China, Thailand, and the Philippines. The results suggest that the two variables in question have a negative association in the case of the six Asian economies, and that the calculated elasticity is -0.69, which implies that lower fertility has been accompanied by a slight decrease in the total cost of childrearing per adult. More importantly, as regards the per capita child human capital costs and the TFR, the calculated elasticity amounts to -1.48, which suggests that, in the six economies under examination, the health and education component of the per capita child LCD is more closely linked to fertility change than the other components of the per capita child LCD.

So, what can these six Asian economies do to restore their fertility levels in the years to come? The fact that higher quality children are costly leads couples to substitute away from quantity. This basic trade-off relationship between the quality and quantity of children plays a crucial role in determining the private cost of children defrayed by parents. Moreover, *public* spending on children also plays an essential role in this respect. By subsidizing the quality of children through public resources, the cost of acquiring high quality children can be reduced, and consequently higher fertility can be encouraged.

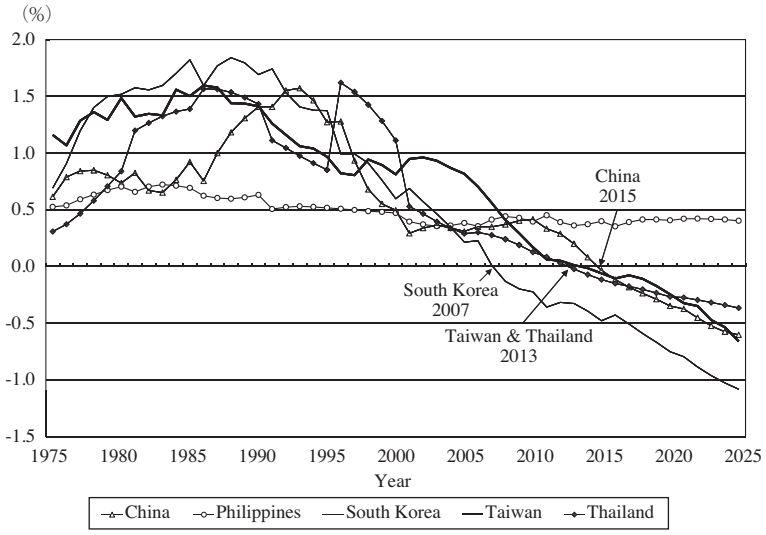
Apart from the provision of government subsidies for pronatalist purposes, the child LCD can also be reduced by lowering the self-supporting ages. One of the possible policy measures for this purpose is creating more stable full-time job opportunities for young workers. In the case of a shrinking population such as that of Japan, hourly labor productivity can be raised through better vocational and on-the-job training. In addition, greater women's labor force participation is another option, but methods for ameliorating the potential impact of female paid employment on fertility need to be carefully considered before implementing this policy option.

The trade-off between the cost of children and the number of children is important not only in terms of formulating effective fertility policies but also from the standpoint of generational equity. As hypothesized by Preston（1984）, population aging induced by reduced fertility and extended longevity should lead to a decline in the welfare of children relative to the elderly. However, contrary to this, one of the conclusions derived from our study is that, in the six Asian economies examined, the "crowding out" phenomenon between children and the elderly cannot be observed.

Acknowledgements

Research for this paper was partially funded by two grants from Nihon University: the Nihon University Multidisciplinary Research Grant for 2011-12, and the Collaborative Research Grant of the Research Institute of Economic Science, College of Economics, for 2010-11.

Appendix figure. First demographic dividend in the selected Asian economies: 1975-2025



Source: Author's calculation.

Note

1） By applying the same computational procedure to each country's data, we have computed the timing and duration of the first demographic dividend for Taiwan, South Korea, China, the Philippines, and Thailand. As shown in the Appendix figure, in South Korea the first demographic dividend phase ends in 2007, in Taiwan and Thailand in 2013, in China in 2015, while the Philippines continues to enjoy the first dividend during the projection period.

2） In addition, we have estimated the elasticity of the quality-quantity substitution for four East Asian economies（Japan, Taiwan, South Korea, and China）, which is -0.75: a value fairly comparable to that shown in Figure 5.

3） This observation is particularly applicable to the East Asian context（Ogawa *et al*., 2009; McDonald, 2009）.

4） The simple correlation coefficient between the two variables shown in Figure 7 is 0.87.

5） We should reassess this statistical result when the data for NTA's European countries become available on a time-series basis.

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