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INTERGENERATIONAL TRANSFERS, DEMOGRAPHIC TRANSITION, AND ALTRUISM: PROBLEMS IN DEVELOPING ASIA

Yoshitaka Koda,
Manachaya Uruyos, and
Siwapong Dheera-Aumpon

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Yoshitaka Koda is postdoctoral fellow of the Faculty of Economics at Chulalongkorn University. Manachaya Uruyos is assistant professor in the Faculty of Economics at Chulalongkorn University. Siwapong Dheera-Aumpon is assistant professor in the Department of Economics at Kasetsart University.

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Please contact the authors for information about this paper.

Email: yoshitaka.k@chula.ac.th, manachaya.u@chula.ac.th, fecospd@ku.ac.th

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Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

This paper develops a three-period overlapping-generations model where middle-aged agents care about not only their own lifetime utility but also their old parents' and children's well-being. The double altruistic agents choose amounts of intergenerational transfers to their old parents and children as well as private savings. The government specifies amounts of public transfers from working adults to the dependents. The model also takes the effects of demographic transition on the burdens of supporting elders and children into account. Using the 14 countries' data from the National Transfer Accounts (NTA), we estimate the degrees of filial and parental altruism and adjust them with their respective life expectancy and fertility rates. The findings suggest that the developed countries are more filially altruistic than the developing ones while the latter are more parentally altruistic than the former. Especially, people in developing Asia have notably lower adjusted degrees of filial altruism than those in the other countries. Our welfare analyses reveal that the developing Asian countries must introduce more comprehensive public welfare programs for the elderly in order to maximize social welfare. Moreover, their low adjusted degrees of filial altruism will trap the developing Asian countries at the current low levels of public old-age supports and social welfare as further demographic transition ensues.

Keywords: intergenerational transfers, altruism, education, social security, growth

JEL Classification: D14, D64, I25, J14, O15

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1. INTRODUCTION

As an economy develops, increasingly large amounts of resources are transferred from working adults, who produce more than they consume, to their elder parents and children, who consume more than they produce. The intergenerational transfers should have been less important in pre-modern societies, where both elders and children were counted as parts of their labor force. Because children stay in school for longer and elders spend more and more time in retirement, working adults' transfers to the dependent family members have inevitably increased in advanced nations. Nonetheless, the burdens of sustaining the dependents are shifting as a demographic transition takes place. The decreasing number of children raised by young parents eases the burden of sustaining their children's consumption, whereas improving longevity and the decreasing number of their siblings, with whom they are supposed to take care of their elderly parents collaboratively, intensify the burden of sustaining their old parents' consumption. Beside the increasing burden for young adults, private transfers to the elderly have a higher risk of defaults as the number of supporting children decreases. Consequently, the governments in developed nations have instituted various public welfare programs for the elderly (Ehrlich and Lui 1998). As it is well known that welfare programs for children should increase future productivity of the economy, the same governments have introduced public transfers to children to make sure that every child gets proper care and education. While these public transfers, especially ones to the elderly, have crowded out the private counterparts in the developed countries, it has to be noted that the governments' interventions do not absolve young adults from the burdens of supporting the dependents. As Nishimura and Zhang (1995) suggest, from the perspective of each young agent who makes contributions to the welfare programs, the public transfers are viewed as forced private transfers. Therefore, even if the shift from private to public transfers occurs, the continuing demographic transition makes the social burden of raising children smaller and that of supporting elder parents larger. If we take a look at the data compiled by the National Transfer Accounts (NTA), in 2004, each child from age zero to 29 in India, Japan, and Thailand received on average the income shares of 0.26, 0.40, and 0.34 from their parents and the respective governments.[1] In the same year, the same young parents and governments provided each old adult from age 60 to 89 with the average income shares of 0.08, 0.42, and 0.21, respectively.[2] This suggests that both of the per capita transfers to children and elders increase with the level of development albeit the differences in the latter are more pronounced. Once the previous and current total fertility rates and current life expectancy at birth are taken into account, for each of the young parents from age 30 to 59 in the above countries, the respective burdens of raising children are calculated to be 0.46, 0.29, and 0.32, and those of supporting elders are 0.002, 0.31, and 0.03.[3] This quick exercise clearly shows that the burden of supporting the elderly in Japan is particularly large compared to those in the developing Asian countries because young adults have fewer siblings to support their old parents, who are expected to live longer in retirement. In contrast, the burden of supporting

[1] As discussed in the following section, we develop a three-period overlapping generations model, in which one generation lasts 30 years. This is the reason why we categorize agents from age zero to 29 as children.

[2] See Table 1 below. Also, see Mason et al. (2009), who introduce the National Transfer Accounts.

[3] The burden of raising children is calculated as (private plus public transfers to a child agent)*(current total fertility rate)/2. That of supporting elders is given by (private plus public transfers to an elder agent)*(length of old-period)/((previous fertility rate)/2), where (length of old-period)=((current life expectancy)-59)/30. See our model in the following section.

children in Japan is relatively small due to the low current fertility rate. In Japan and the countries at advanced phases of demographic transition, the hefty burden of supporting the elderly is one of the most serious problems of population aging.

Why do individuals and societies take care of the elderly when the burden of doing so becomes unsustainably large? On the one hand, the motivations behind parental care toward children are discussed extensively in the economic literature. Young parents have children and educate them either because they care about their children's welfare out of love or because they expect to receive greater old-age supports from their children. In Barro and Becker (1989) and Becker, Murphy, and Tamura (1990), young agents procreate as their offspring's utility directly affects their own utility. Boldrin and Jones (2002) and Nishimura and Zhang (1995) suggest that young parents, whose utility function includes their old parents' consumption, have children only because they are going to receive old-age supports from their altruistic children.[4] On the other hand, the motivations behind filial care toward old parents have attracted far less attention. While Blackburn and Cipriani (2005) and Cigno and Rosati (1996) assume that altruistic young parents support the elders because they are concerned for their old parents' well-being, the family insurance mechanism in Ehrlich and Lui (1991) enables transfers between selfish agents. They postulate that, by implicit family contracts, old parents are entitled to receive supports from their children proportional to their past education investments. In short, there are two competing hypotheses explaining why agents make intergenerational transfers: the altruism and exchange hypotheses. Ioannides and Kan (2000), who study the nature of two-directional inter-vivos transfers, suggest that young adults and their old parents make transfers because they are mutually altruistic, and the exchange motive is absent. In his study of bequest motives, Horioka (2014) found that the Japanese and Chinese are more consistent with the exchange hypothesis, and Americans and Indians are following the altruism hypothesis. While the argument of which hypothesis is more applicable to a society is inconclusive in general, it has to be noted that the existing literature does not fully consider the relationship between the demographic parameters and the motivations behind transfers.[5] If inter-vivos transfers are motivated by the young parents' altruism toward their elder parents and children as Ioannides and Kan (2000) suggest, a society's degree of altruism must be related to its demographic parameters such as fertility rates and life expectancy because these parameters affect the burdens of sustaining elders and children substantially. Seen from the above exercise on intergenerational transfers, the degree of filial altruism toward elders in Japan adjusted with its demographic parameters must be greater than that in India or Thailand due to the significant difference in the burdens of supporting elders among these countries. Then, our main research questions are as follows: What are the degrees of filial and parental altruism in the countries at various levels of development and geographic locations? How should the degrees of altruism be adjusted using the respective country's demographic data? What happens to social welfare of a society if its government changes policies concerning welfare programs for the elderly?

[4] Boldrin and Jones (2002), who employ the filial altruism model in their study on endogenous fertility, point out that Barro and Becker (1989) fail to replicate the process of demographic transition as the latter's parental altruism model predicts rising fertility when infant mortality declines.

[5] While Blackburn and Cipriani (2005) discuss and endogenize the representative agent's fertility decision, they assume the fixed life span in their two-period overlapping generations set-up.

In this study, we develop a three-period overlapping-generations model of the joint determination of intergenerational transfers and private savings by a utility maximizing household, which cares about not only utility from young parent's lifetime consumption but also utility from his or her elder parents' and children's consumption. Our theoretical framework is close to that of Blackburn and Cipriani (2005), whose two-sided altruism model suggests that individuals eventually switch their type of behavior from filial altruism toward parents to parental altruism toward children as the economy develops. However, in their two-period overlapping-generations setup, dependent old agents do not exist, and the two-way transfers are conducted between young parents and their children, who work albeit with lower earning capacity than their parents. Koda and Uruyos (2015) employ the three-period-lived model under four hypotheses of self-interest, filial altruism toward old parents, parental altruism toward children, and two-sided altruism combining filial and parental altruism.[6] They show that the effects of government policies on household choices are quite different depending on the hypotheses of family relationships. Whereas Koda and Uruyos (2015) set the degrees of filial and parental altruism to be either zero or one to characterize the four hypotheses, in this study, we use the actual data from the NTA and succeed in estimating the degrees of altruism in the 14 countries at various stages of development.

The estimated degrees of per capita and per unit period altruism are adjusted by using the demographic data of the respective countries, and the resulting adjusted degrees of altruism toward children and elders are the weights on utilities from child-age and old-age consumption, respectively. Our results suggest the opposite of the ones in Blackburn and Cipriani (2005). Namely, the adjusted degrees of filial altruism are higher in the developed countries, which are at the advanced stages of demographic transition, whereas those of parental altruism are higher in the developing countries.[7] It deserves special attention that people in the developing Asian countries such as India, Indonesia, and Thailand have markedly lower adjusted degrees of filial altruism than those in any other country in the NTA system. The following simulation analyses reveal that the current levels of welfare programs supporting the elders, e.g., public pensions and health insurance programs, are significantly below their respective welfare maximizing levels in the developing Asian countries. Contrastingly, those programs in the developed countries attain nearly maximum social welfare. By assuming that the adjusted degrees of altruism are specific to a country and time-invariant, we also simulate what would happen to the welfare maximizing levels of public transfers to the elderly when the demographic transition continues. The simulation results suggest that one generation later, social welfare will be maximized at slightly lower levels of public transfers to elders than the current levels in all countries except the developing Asian countries, where the welfare maximizing levels of the transfers will significantly decrease during the same period. Therefore, the window of opportunity to introduce

[6] In contrast to Blackburn and Cipriani (2005), Koda and Uruyos (2015) endogenize longevity of agents but assume zero population growth.

[7] Family relationship might have moved from the one with filial altruism, where people spent a significant amount of time to take care of their cohabiting old parents, to the other with parental altruism, where young parents carefully raised their sole child in nuclear family setups. However, considering the current high old-age dependency rates in the developed economies, family relationship may be moving back to the one with filial altruism. As Ehrlich and Lui (1991) suggest, if we take agents' contributions to public welfare programs into account, their total financial supports for elderly parents do not decline during the post war period.

proper welfare programs for the elderly in developing Asia becomes narrower as further demographic transition ensues.[8]

The rest of paper is organized as follows: Section 2 develops the model which specifies the relationship among intergenerational transfers, demographic parameters, and degrees of altruism. In Section 3, we introduce the NTA system, which provides us with the detailed data on private and public transfers. In Section 4, we estimate the degrees of altruism in the 14 countries and perform the welfare analyses. Section 5 provides concluding remarks.

2. THE MODEL

The continuing demographic transition suggests that, in order to maintain a certain level of old-age consumption, each young agent must provide his or her elder parents with greater transfers than previous generations because he or she has fewer siblings to share the burden of supporting elder parents who spend more time in retirement. Whereas, the same transition that reduces the current fertility rate enables the young agent to increase resources spent for each of his or her children while reducing total transfers to children. As the motivation for the sizable and increasing transfers to elders, we introduce the less examined filial altruism in addition to the more common parental altruism, which motivates the transfers to children.

2.1 Preferences

The economy consists of infinite generations of agents with perfect foresight. Each agent goes through three periods in a lifetime: child, young parent, and old parent, and the first two periods last for 30 years while the old-age period lasts for a fraction of 30 years. A representative agent derives utility from his or her own young-age and old-age consumption and from old-age consumption of his or her parent and child-period consumption of his or her child. We disregard the agent's own child-period consumption because it is irrelevant to his or her decisions. Utility depends also on the length of the old-age period, and the past and current fertility rates. For simplicity, we assume that survival is complete until agents reach their old-period, and every agent retires when he or she is old. We also assume that the single agent procreates without marriage. Let c_t^c, c_t^y, and c_t^o be consumption flows of a child born in period t, a young parent born in period $t-1$, and an old parent born in period $t-2$, respectively. For the representative agent born in period $t-1$, his or her utility function is given by:[9]

$$U^{t-1} = \ln c_t^y + \beta\theta_{t+1} \ln c_{t+1}^o + \alpha^F \frac{\theta_t}{1+n_{t-1}} \ln c_t^o + \alpha^P (1+n_t) \ln c_t^c, \quad (1)$$

$$0 < \beta < 1, 0 \leq \alpha^F, 0 \leq \alpha^P,$$

[8] While Chomik and Piggott (2015) suggest the narrowing windows of opportunity for pension reforms in developing Asia based on the region's demographic trends, this study discusses the problem via welfare analyses of the countries in the NTA system.

[9] The first term in the right-hand side of Equation (1) is utility from consumption of a young parent (superscript y) at time t (subscript t), and, analogously, the second term is utility from consumption of an old parent (superscript o) at time $t+1$ (subscript $t+1$).

where α^F and α^P denote the degrees of filial and parental altruism. The logarithmic utility function is used here in order to guarantee interior solutions. Utility from the representative agent's own old-age consumption, the second term, is discounted for the subjective rate of time preference ρ, where $\beta = \left(1/(1+\rho)\right)^{30}$. The third term represents an emotional benefit to the agent from concurrent old-age consumption of his or her old parent c_t^o, which is divided by the past fertility rate $1+n_{t-1}$ assuming that his or her siblings share utility from their old parent's consumption equally.[10] The fourth term represents an emotional benefit from consumption of his or her child c_t^c, which is multiplied by the current fertility rate $1+n_t$. Both the second and third terms are multiplied by the respective lengths of old-age periods θ_{t+1} and θ_t while the lengths of child and young periods are regarded as a unity because we assume agents in these periods are perfectly healthy.

2.2 Human Capital Accumulation

We introduce endogenous growth through education (human) capital investments in children by their altruistic parent. A young parent's education capital E_{t+1}^y increases with the income shares of private and public downward transfers, b_t/w_t and b_p/w_t, which he or she has received from his or her parent and the government during childhood, respectively. Accordingly, the technology of imparting education capital to the child is given by:

$$E_{t+1}^y = \gamma \frac{b_t + b_p}{w_t} E_t^y, \gamma > 0, \tag{1}$$

where γ is the constant parameter measuring the productivity of education capital investments.

2.3 Resource Allocation

The young parent combines his or her earning capacity E_t^y with the contemporary wage rate per effective labor w_t and earns income $E_t^y w_t$. To provide his or her old parent and each child with upward and downward transfers, $E_t^y g_t$ and $E_t^y b_t$, respectively, he or she chooses the flows of transfers to his or her old parent $E_t^y \theta_t g_t / (1+n_{t-1})$, taking into account the length of current retirement period and the number of supporting children, transfers to his or her children $(1+n_t)E_t^y b_t$, and private savings $E_t^y s_t$. The public transfers considered in this study include those from various welfare programs such as public pensions, health insurance, education subsidies, and child care. As the first two programs involve intergenerational transfers from the young to the old, the young agent's contributions to these programs can be viewed as forced upward transfers, and the flow of contributions $E_t^y \theta_t g_p/(1+n_{t-1})$ is collected from the young parent. As for the last two programs facilitating transfer from the young to children, the young agent's contributions to the programs can be modeled as forced downward transfers, and the government collects the flow of contributions $(1+n_t)E_t^y b_p$ from the young agent. Then, the young parent's consumption flow at time t is determined by:[11]

[10] See Equation (3) for a similar argument.

[11] See Appendix, *Flows of Private Intergenerational Transfers and Savings*.

$$c_t^y = E_t^y \left[w_t - \frac{\theta_t}{1+n_{t-1}} \left(g_t + g_p \right) - (1+n_t)\left(b_t + b_p \right) - s_t \right]. \quad (2)$$

Upon reaching his or her old parenthood at time $t+1$, the same agent, who lives for θ_{t+1} in retirement and has $1+n_t$ children, receives private transfers from each of his or her grown-up children $E_{t+1}^y \theta_{t+1} g_{t+1}/(1+n_t)$ and also his or her savings with earned interests $(1+r_{t+1})E_t^y s_t$. Likewise, public transfers paid to the old parent equal the contributions collected from each of his or her children $E_{t+1}^y \theta_{t+1} g_p/(1+n_t)$ multiplied by the number of his or her children $1+n_t$ assuming that g_p is constant. The old-age consumption for the duration of θ_{t+1} is stated as:

$$\theta_{t+1} c_{t+1}^o = (1+n_t)\frac{\theta_{t+1}}{1+n_t} E_{t+1}^y \left(g_{t+1} + g_p \right) + (1+r_{t+1}) E_t^y s_t. \quad (3)$$

Because the representative agent born in time $t-1$ fails to recognize that the public transfers depend on his or her own education investments in children, with Equation (2), we set $E_{t+1}^y g_p = \gamma\left(\bar{b_t} + b_p\right) E_t^y g_p / w_t$, where $\bar{b_t}$ is the average education investments. By dividing both sides by θ_{t+1} and using Equation (2), the consumption flow of the old parent at time $t+1$ is given by:[12]

$$c_{t+1}^o = \frac{\gamma\left(b_t + b_p\right)}{w_t} E_t^y g_{t+1} + \frac{\gamma\left(\bar{b_t} + b_p\right)}{w_t} E_t^y g_p + \frac{1+r_{t+1}}{\theta_{t+1}} E_t^y s_t. \quad (4)$$

By lagging one period and using Equation (2) again, we can derive the old parent's consumption flow at time t as:

$$c_t^o = E_t^y \left(g_t + g_p \right) + \frac{1+r_t}{\theta_t} \frac{w_{t-1}}{\gamma\left(b_{t-1} + b_p\right)} E_t^y s_{t-1}, \quad (5)$$

The agent and the government provide each of his or her children with private and public downward transfers $E_t^y \left(b_t + b_p \right)$, respectively, and the child's consumption flow at time t is stated as:[13]

$$c_t^c = E_t^y \left(b_t + b_p \right). \quad (6)$$

[12] It has to be noted that the total (actual) old age consumption at time $t+1$ is given by $\theta_{t+1} c_{t+1}^o$ as the old-age period lasts θ_{t+1}. The flow of old-age consumption c_{t+1}^o is a hypothetical value when the old agent could live for the same length as the child and young agents (see Sheshinski and Weiss 1981).

[13] In this study, all transfers are monetary ones, and agents' time spent taking care of their elder parents and children is not considered. This is partly for simplicity and partly because the data in the NTA system do not include the time transfers. As the omission of the time transfers leads to underestimations of the degrees of altruism, the future extensions of this study should address the above issues. We are indebted to Shoshana Grossbard for a helpful discussion of the time transfers and their gender inequality aspects.

2.4 Production Function

Assuming that the economy in this study produces a single good, the production function is given by:

$$Y_t = AK_t^{\sigma}\left(L_t E_t^{y}\right)^{1-\sigma}, 0 < \sigma < 1, \tag{7}$$

where A is the constant productivity parameter, K_t is the aggregate physical capital, $L_t E_t^{y}$ is the aggregate effective labor, and σ is the share parameter associated with physical capital. As one period in this model spans 30 years, we assume that physical capital depreciates fully within each period. Provided that the markets are perfectly competitive, the firms' optimal conditions for maximizing profits are given by:

$$w_t = (1-\sigma)AK_t^{\sigma}\left(L_t E_t^{y}\right)^{-\sigma} = (1-\sigma)Ak_t^{\sigma}E_t^{y-\sigma}, \tag{8}$$

$$1 + r_t = \sigma AK_t^{\sigma-1}\left(L_t E_t^{y}\right)^{1-\sigma} = \sigma Ak_t^{\sigma-1}E_t^{y1-\sigma}, \tag{9}$$

where $k_t = K_t/L_t$ is per capita physical capital. The condition for clearing physical capital and labor markets is stated as:

$$K_{t+1} = k_{t+1}L_{t+1} = L_t s_t E_t^{y}. \tag{10}$$

Using the law of motion of population $L_{t+1} = (1+n_t)L_t$, Equations (8), (9), and (10) are combined to yield the equation below:

$$\frac{1+r_{t+1}}{w_{t+1}} = \frac{\sigma}{1-\sigma}\frac{\gamma\left(b_t + b_p\right)}{w_t}\frac{1+n_t}{s_t}. \tag{11}$$

2.5 The Optimization Problem

The agent born in period $t-1$ maximizes his or her utility function (1) with respect to private upward transfers to his or her parent $g_{t,}$ private downward transfers to each of his or her children $b_{t,}$ and private savings s_t, subject to the budget constraints (3), (4), (5), and (6). The necessary optimal conditions are as follows:

g_t: $$\frac{1}{c_t^{y}} = \frac{\alpha^{F}}{c_t^{o}}, \tag{12}$$

b_t: $$\frac{1+n_t}{c_t^{y}} = \frac{\beta\theta_{t+1}}{c_{t+1}^{o}}\frac{\gamma}{w_t}g_{t+1} + \frac{\alpha^{P}(1+n_t)}{c_t^{c}}, \tag{13}$$

$$s_t: \qquad \frac{1}{c_t^y} = \frac{\beta}{c_{t+1}^o}(1 + r_{t+1}). \tag{14}$$

Equation (12) states that the loss in utility from consuming less and providing his or her parent with more old-age supports is compensated by the utility gained from higher old-age consumption of his or her parent via filial altruism. Equation (13) implies that the utility foregone due to reducing one more unit of the young parent's consumption for investing in education capital of his or her children equals the utility obtained from the larger amount of old-age supports from his or her children and higher consumption of his or her child via parental altruism. Equation (14) shows the rate of return from savings. Our analysis focuses on the balanced steady-state growth path and ignores transitional dynamics. On the balanced steady-growth path, the ratios of private upward and downward transfers and savings to total income are constant, and hence the economy's growth rate is also constant. With Equation (11), the three first-order conditions (12), (13), and (14) yield the analytical solutions for g, b, and s as follows:

$$g + g_p = \frac{\alpha^F w - [1 + \beta\theta + \alpha^P(1+n)]\frac{\alpha^F}{\beta\theta}s + \beta\theta g_p}{1 + \beta\theta + \frac{\alpha^F\theta}{1+n} + \alpha^P(1+n)}, \tag{15}$$

$$b + b_p = \frac{\left(\frac{\beta\theta}{1+n} + \alpha^P\right)\left[w + \frac{\alpha^F}{\beta(1+n)}s\right] - \left(1 + \frac{\alpha^F\theta}{1+n}\right)\frac{\beta\theta}{\alpha^F(1+n)}g_p}{1 + \beta\theta + \frac{\alpha^F\theta}{1+n} + \alpha^P(1+n)} - \frac{s}{1+n}, \tag{16}$$

$$s = \frac{\sigma}{1-\sigma}\frac{\beta(1+n)}{\alpha^F}w. \tag{17}$$

Due to the moral hazard problem inherent in welfare programs aiming at the elders, when the public upward transfers g_p exist, total upward transfers are higher than the optimal level, and total downward transfers are lower than optimal. Consequently, taking Equation (2) into account, the growth rate of the economy should be lower as g_p increases. With Equation (17), private savings are substituted out from Equations (15) and (16), and these equations are modified to:

$$\frac{g + g_p}{w} = \frac{\alpha^F\frac{1}{1-\sigma} + \beta\theta\frac{g_p}{w}}{1 + \beta\theta + \frac{\alpha^F\theta}{1+n} + \alpha^P(1+n)} - \frac{\sigma}{1-\sigma}\frac{1+n}{\theta}, \tag{18}$$

$$\frac{b + b_p}{w} = \frac{\left(\frac{\beta\theta}{1+n} + \alpha^P\right)\frac{1}{1-\sigma} - \left(1 + \frac{\alpha^F\theta}{1+n}\right)\frac{\beta\theta}{\alpha^F(1+n)}\frac{g_p}{w}}{1 + \beta\theta + \frac{\alpha^F\theta}{1+n} + \alpha^P(1+n)} - \frac{\sigma}{1-\sigma}\frac{\beta}{\alpha^F}, \tag{19}$$

where the private and public transfers in both directions are given as income shares. In order to perform simulation analyses, we are going to estimate the degrees of altruism toward old parents α^F and children α^P in the following section.

3. DATA

The data compiled from the NTA provide us with important insights into intergenerational transfers of the 14 countries in the system. Working adults transfer a substantial amount of resources to dependent children and elders to satisfy their expanding needs. For each of the countries, the NTA system constructs the data set on an aggregate level for intergenerational transfers by itemizing private and public transfers received at every age from zero to 90. Together with the age distribution data of respective countries, the aggregated values are converted to per capita terms. The resultant annual flows of transfers per person are presented in the nominal values expressed in each country's currency, the values expressed in US dollars using purchasing power parity to convert local currency, and the normalized values as shares of working adults' average labor income. In this study, we are working on the normalized per capita terms because the intergenerational transfers in Equations (18) and (19) are also expressed in income shares. As one generation lasts for 30 years in the model presented above, we take the income shares of private and public transfers received by children (0-29) and old parents (60-89) and find their averages, which are the equivalents of b/w, b_p/w, g/w, and g_p/w, respectively.[14] The normalized per capita transfers of the countries in the NTA system are presented in Table 1.

Table 1: Per Capita Private and Public Transfers

Countries	g/w	g_p/w	b/w	b_p/w
Brazil, 1996	–0.2723351	0.8266236	0.3242447	0.0195016
Costa Rica, 2004	–0.0066658	0.386519	0.2559778	0.0463883
Germany, 2003	–0.0531102	0.495526	0.2078021	0.1009523
India, 2004	0.0559424	0.0240517	0.2439221	0.01412
Indonesia, 2005	–0.1267947	0.0063413	0.3103428	0.0423572
Japan, 2004	0.0202247	0.4004373	0.2561795	0.1450664
Republic of Korea, 2000	0.0921924	0.1377078	0.3249721	0.0844076
Mexico, 2004	–0.1536718	0.217302	0.3246817	0.0611194
Philippines, 1999	0.073622	–0.0133568	0.292821	0.0392878
Slovenia, 2004	0.0136512	0.4550758	0.2215856	0.1018652
Spain, 2000	–0.0493797	0.3200069	0.2469515	0.108877
Sweden, 2003	–0.0730482	0.6627168	0.2067662	0.0930048
Thailand, 2004	0.2262911	–0.0169675	0.2516557	0.0873865
US, 2003	–0.065374	0.247738	0.1919361	0.1359456

Note: Per capita values normalized as shares of average labor income.

Source: The National Transfer Accounts.

In all countries in the NTA system, young adults provide similar amounts of private downward transfers for each of their children b/w. Even though young parents in the less developed countries have a larger number of offspring, they tend to transfer more resources to each child than those in the developed nations. Public transfers to each

[14] We also derived the average values of private and public transfers received by young parents (30–59), which are negative, and found that these corresponded generally well with their theoretical values given by $-[\theta g/(1+n)w + (1+n)b/w]$ and $-\left[\theta g_p/(1+n)w + (1+n)b_p/w\right]$ when these terms were calculated using the values in Table 1 and demographic data of respective countries.

child b_p/w such as education subsidies and child care programs are smaller in the developing countries and larger in the developed ones. Private upward transfers to each of the elderly parents g/w are either positive or negative but very small in absolute values in the developed nations. In Brazil, Indonesia, and Mexico, g/w are negative and large in absolute values. This suggests that the elders in these countries make significant private transfers to their children or grandchildren as labor force participation of the elders is high in Indonesia, and retirees in Brazil benefit from generous public welfare programs.[15] Public transfers to the elderly g_p/w such as public pensions and health insurance programs are greater than the counterparts to children b_p/w in all countries except the developing Asian countries, where g_p/w is very small, and the elders may rely on their own family's supports, own savings, or labor incomes.

4. NUMERICAL ANALYSES

4.1 Calibrating the Model

In order to perform welfare analyses of the 14 countries in the NTA system, the parameters of our theoretical model are calibrated using the values presented in Table 1, demographic data in respective countries, and consensus estimates from the existing literature. Following Blackburn and Cipriani (2005), the time preference parameter ρ is set to be 0.023, so the discount factor is $\beta = (1/1.023)^{30} \cong 0.5$ as one period in this study spans 30 years. The share parameter associated with physical capital σ is set to be 0.3 following Zhang, Zhang, and Lee (2001). As for the demographic parameters of each country, we use the data from the World Development Indicators (2016). The length of the old-age period θ is given by $(\overline{le} - 59)/30$, where $\overline{le}$ are the average values of life expectancy at birth from 1985 to 2009 in the 14 countries. During the following analyses, we distinguish the numbers of children of the current generation from those of the previous one because we find that in the developing countries the former are far smaller than the latter. Accordingly, Equations (18) and (19) are modified as:

$$\frac{g + g_p}{w} = \frac{\alpha^F \frac{1}{1-\sigma} + \beta\theta\frac{g_p}{w}}{1 + \beta\theta + \frac{\alpha^F\theta}{n1} + \alpha^P n2} - \frac{\sigma}{1-\sigma}\frac{n1}{\theta},$$

$$\frac{b + b_p}{w} = \frac{\left(\frac{\beta\theta}{n2} + \alpha^P\right)\frac{1}{1-\sigma} - \left(1 + \frac{\alpha^F\theta}{n1}\right)\frac{\beta\theta}{\alpha^F n2}\frac{g_p}{w}}{1 + \beta\theta + \frac{\alpha^F\theta}{n1} + \alpha^P n2} - \frac{\sigma}{1-\sigma}\frac{\beta n1}{\alpha^F n2},$$

where $n1$ are the numbers of children of old parents, and $n2$ are those of young parents. $n1$ are given as the average values of total fertility rates from 1960 to 1984 divided by two because our model does not distinguish females from males.[16] Likewise, $n2$ are given as the average values from 1985 to 2009 divided by two. The remaining

[15] The value of $g_p/w \cong 0.83$ in Brazil seems too high to be accurate, so we do not include the country in the following welfare analyses.

[16] By definition, the total fertility rate is the average number of children a female has in her lifetime. That is to say, a couple has as many children as the total fertility rate on average.

preference parameters α^F and α^p, which are the degrees of altruism toward elders and children, respectively, are derived as solutions to the system of equations above by substituting in the values of g/w, g_p/w, b/w, and b_p/w in Table 1 and the other parameter values discussed in this section. The calibrated degrees of filial and parental altruism in the 14 countries are presented in Table 2. The adjusted degrees of filial and parental altruism, which are the equivalents of weights on utility from the flows of old-age and child-period consumption in Equation (1), are defined as α^F multiplied by the length of the old-age period θ and divided by the number of the old agent's children $n1$ and as α^P multiplied by the number of the young parent's children $n2$. For example, the very large value of $\alpha^F \cong 31.5$ in India turns out to be a rather small value of $\alpha^F\theta/n1 \cong 0.82$ because the old-age period $\theta = (61.1 - 59)/30$ is short, and the number of children $n1 = 5.36/2$ is large in the country.

Table 2: Degrees of Altruism and Adjusted Degrees of Altruism

Countries	α^F	$\alpha^F\theta/n1$	α^P	$\alpha^P n2$
Brazil, 1996	8.8266565	1.1385368	0.7915265	0.9894081
Costa Rica, 2004	5.0685581	1.3018807	0.7489055	0.9922998
Germany, 2003	2.58303	1.6487425	0.7372003	0.4976102
India, 2004	31.528454	0.8235044	0.4933579	0.8732435
Indonesia, 2005	11.036294	0.8944447	0.7550739	1.0533281
Japan, 2004	3.0283573	2.2156187	1.197451	0.868152
Republic of Korea, 2000	3.5985709	0.9227105	0.757298	0.5414681
Mexico, 2004	8.5615786	1.3207945	1.1707157	1.7677807
Philippines, 1999	17.862718	1.4219079	1.0888447	2.1450241
Slovenia, 2004	2.8851942	1.4028926	0.6873237	0.4742534
Spain, 2000	2.2532633	1.1095615	0.7240335	0.4778621
Sweden, 2003	4.3734735	3.0058237	1.1029108	0.9926197
Thailand, 2004	5.2457179	0.8401766	0.6000819	0.5610766
US, 2003	2.2503338	1.1044191	0.7167417	0.7203254

Note: We call the values in the second and fourth columns as the adjusted degrees.
Source: The authors' calibration.

The degrees of filial altruism per old parent and per unit period α^F are negatively related to the levels of economic development except for Sweden, where quite generous public welfare programs are instituted as seen in Table 1. However, once α^F are adjusted for each country's demographic parameters, we find that the adjusted degrees of filial altruism are higher in the developed countries than in the developing ones. It deserves special attention that those adjusted values are less than one only in developing Asia. That is, in India, Indonesia, the Republic of Korea, and Thailand, people weigh their old parents' old-age consumption less than their own young-age consumption whereas the opposite is true in the other countries in the NTA system. While the degrees of parental altruism per child α^P show no clear pattern against the levels of development, the adjusted degrees of parental altruism are higher in the developing economies than the developed ones with the exception of Thailand, where its current fertility rate $n2$ is as low as those in the developed countries. Young adults

in Indonesia, Mexico, and the Philippines alone weigh their children's child-age consumption more than their own young-age consumption.[17]

4.2 Welfare Analyses

The derivation of the preference parameter values enables us to perform welfare analyses of the countries in the NTA system. For this purpose, we first define social welfare of an economy. Letting $\overline{U}^{t-1}$ denote the utility level of the agent born in $t-1$ evaluated at the steady-state values of the choice variables, the social welfare Ω is the weighted sum of $\overline{U}^{t-1}$ as t goes from one to infinity. Then, the social welfare function is expressed as:

$$\Omega = \frac{1}{1-\omega}\sum_{t=1}^{\infty} \omega^{t-1}\overline{U}^{t-1}, 0 < \omega < 1, \tag{20}$$

where ω is the generational discounting factor and is set to be equal to $\beta \cong 0.5$. Initial levels of young agents' earning capacity E_1^y are set to be the average per capita GDP values from 1995 to 2014 expressed in US Dollars using purchasing power parity to convert the local currencies. For each country, the parameter values of γ, the constant parameter measuring the productivity of education capital investment in Equation (2), are derived by using the values of b/w and b_p/w presented in Table 1 and the average per capita GDP growth rates from 1995 to 2014.[18] We then conduct comparative statics analyses numerically by changing the income shares of public transfers to the elders g_p/w from -0.2 to 0.8, and the results for six selected countries are reported in Figure 1.[19] Social welfare is non-linearly related to the level of public transfers g_p/w, and the graphs of the six countries have varied hump-shapes. Generally speaking, the higher the level of $\alpha^F\theta/n1$ is in a country, the more its agents care about their elder parents' old-age consumption. Therefore, its social welfare Ω is maximized at a greater level of public transfers aiming at the elderly g_p/w. The current levels of public transfers to elders, which are indicated by the vertical lines, attain the nearly maximum social welfare in Germany, Japan, and the United States.[20] On the contrary, the governments of Indonesia and Thailand have failed to introduce desirable levels of public welfare programs for their elders. While social welfare is maximized at $g_p/w \cong 0.3$ in both of these countries, their actual public transfers to elders are next to zero. Moreover, because the adjusted degrees of filial altruism $\alpha^F\theta/n1$ are less than unity in Indonesia and Thailand, their welfare maximizing levels of $g_p/w \cong 0.3$ are lower than those in the other countries in Figure 1, which fall in a range between 0.35

[17] Becker et al. (1990) assumed that the degree of parental altruism per child $a(n_t)$ decreases with the fertility rate n_t and specified their utility function as: $V_t = u(c_t) + a(n_t)n_tV_{t+1}$, where V_t and V_{t+1} are utilities of the parent and each of his or her children. As far as we can see from the third column of Table 2, α^P are negatively but only insignificantly related to the current fertility rates of the respective countries.

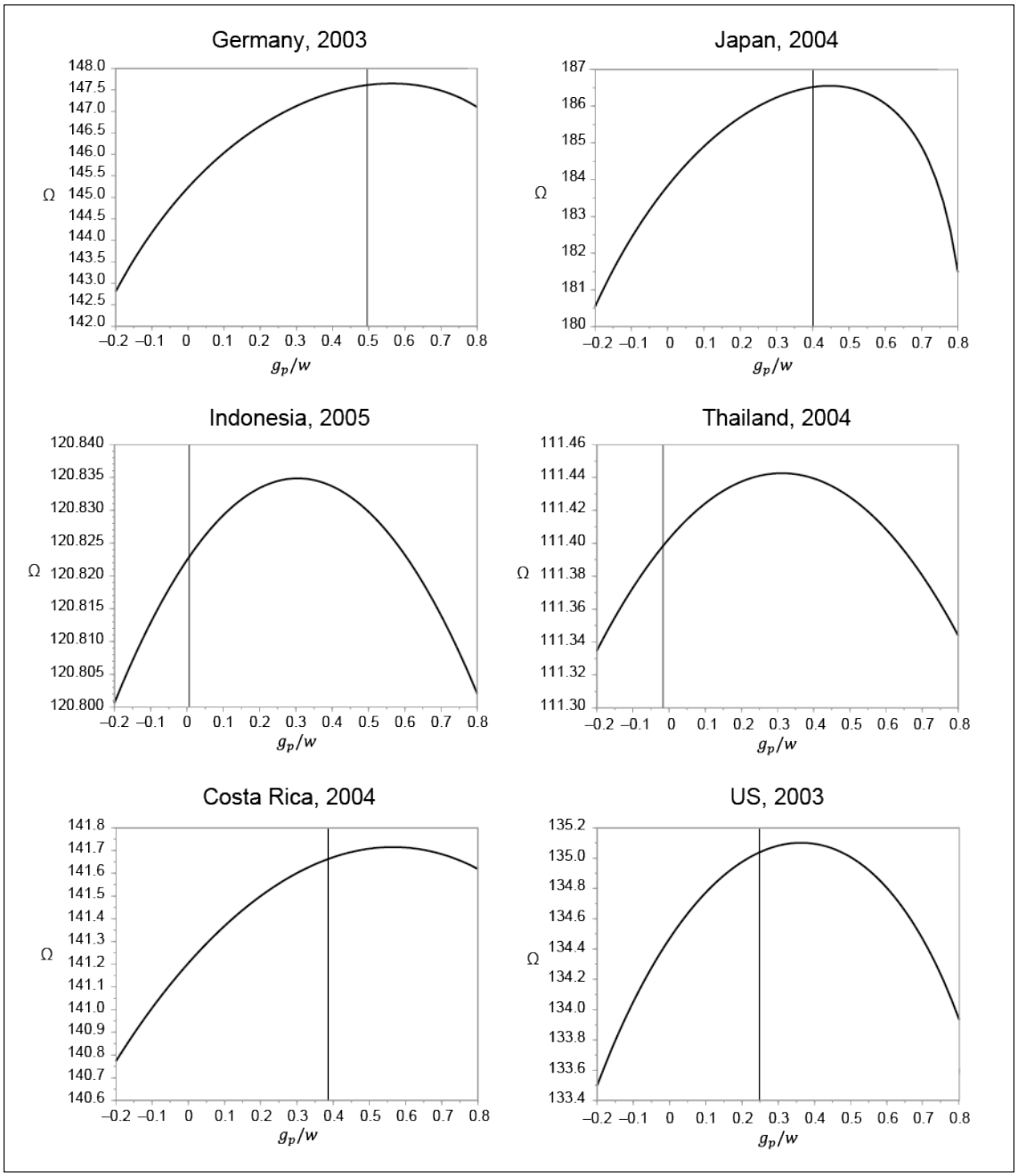
[18] To find the per capita GDP growth rates, we use the data from the World Development Indicators (2016).

[19] Though we have conducted an analogical analysis by changing the income shares of public transfers to children b_p/w, the resulting graphs do not differ significantly among the all countries in the NTA system.

[20] The United States still keeps its total fertility rate above the replacement level and its old-age dependency rate below the ones in most of the developed countries (World Development Indicators, 2016). The above demographic characteristics of the US make its graph in Figure 1 resemble those of Indonesia and Thailand rather than those of Germany and Japan.

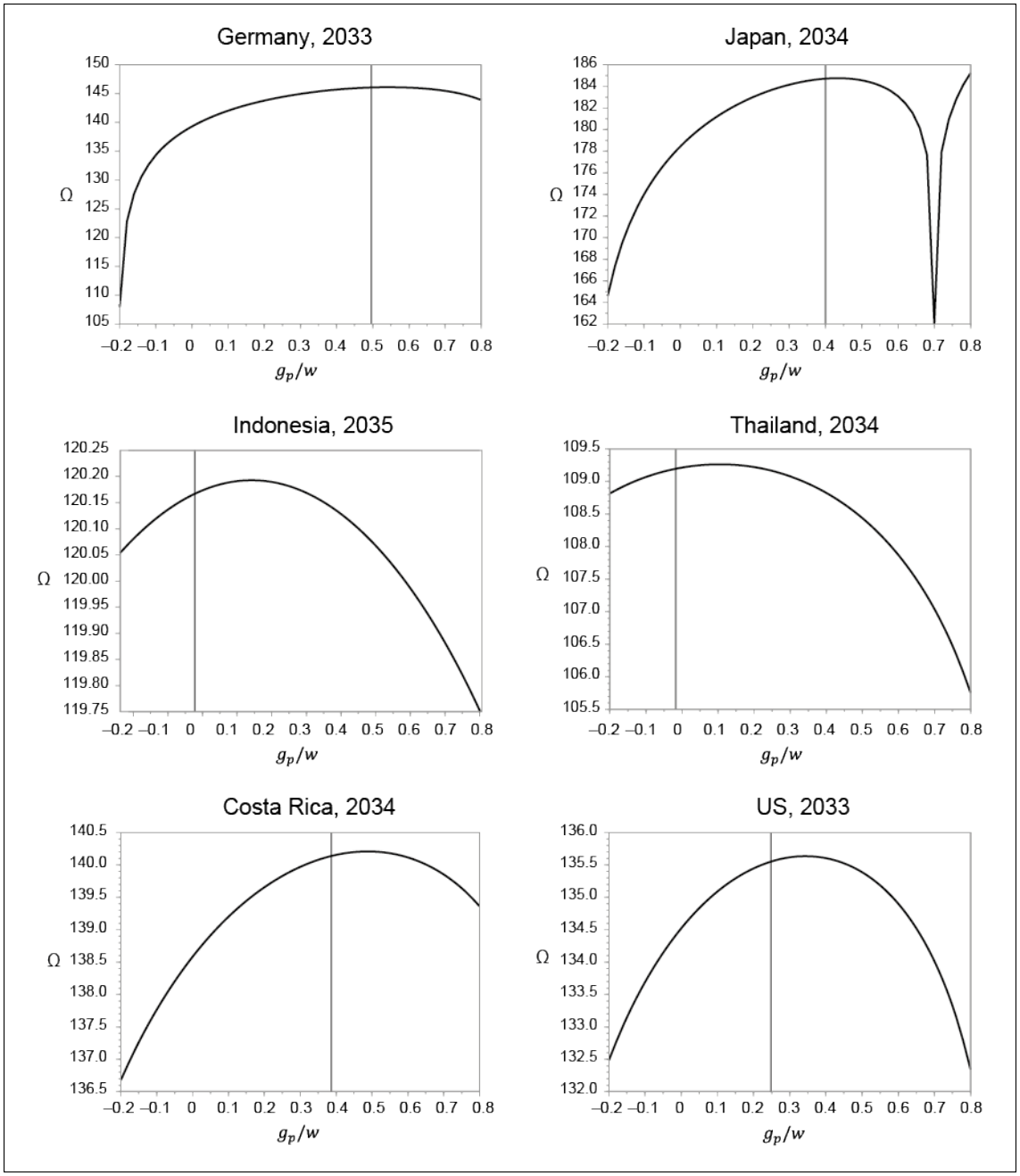
and 0.55. As for Costa Rica, its level of $\alpha^F\theta/n1 \cong 1.3$ is comparable to those in the developed countries, and the maximizing value of its social welfare is as high as $g_p/w \cong 0.55$. The country has instituted a decent amount of public transfers to the elders albeit it must increase the level of g_p/w a little more to attain the maximum social welfare.

Figure 1: Social Welfare and Public Transfers to the Elders



Source: The authors' simulation.

Figure 2: Social Welfare and Public Transfers to the Elders, Next Generation



Source: The authors' simulation.

If a set of adjusted degrees of altruism toward elders and children is specific to an economy and does not change over time, what would happen to social welfare of the next generation as further demographic transition ensues?[21] For this simulation analysis, we also assume that the governments keep the current levels of public transfers to elders and children, and future agents, who face exogenous changes in demographic parameter values described below, optimally choose amounts of private transfers. For the duration of one generation, life expectancy at birth is expected to increase by three years, hence θ increases by 0.1 in all six countries. Future fertility rates $n1$ are replaced by the current $n2$, and future $n2$ are chosen following the actual demographic trends in the respective countries. As in the case of the previous analysis, the graphs in Figure 2 present the changes in social welfare of the next generation as public transfers to the elderly vary between -0.2 and 0.8. The vertical lines indicate the time-invariant income shares of public transfers to elders g_p/w. If we compare the graphs of the current and next generation, Figure 1 and Figure 2, the levels of public transfers g_p/w that maximize social welfare only slightly shift to the left in Germany, Japan, and the US because their relevant demographic parameter values are not changing sharply in one generation. While Costa Rica experiences a small leftward shift, more pronounced changes in the welfare maximizing levels of g_p/w take place in developing Asia. The welfare maximizing g_p/w decline from 0.3 to 0.15 in Indonesia and to 0.1 in Thailand as drastic demographic transitions are expected within one generation. For example, if life expectancy in Indonesia increases by three years from 65.2 to 68.2, the length of its old-age period θ increases from 0.2 to 0.3. As the number of siblings of each young adult decreases from 2.6 to 1.4, the burden of supporting an old parent in Indonesia increases three times assuming that the future elders receive the same level of supports as the current ones. When the adjusted degrees of altruism toward elders do not increase accordingly, the desirable levels of public transfers to elders decline as seen in Figure 2. Our results suggest that the windows of opportunity to introduce comprehensive welfare programs for the elderly would become narrower as further demographic transition ensues in the developing Asian countries.

5. CONCLUSION

Due to the rise of retirement and the declining fertility rates, the increasing burden of supporting the elderly becomes one of the most serious problems of population aging. As urbanization in the advanced nations dismantled traditional extended families, the resulting nuclear family set-up was suitable for carefully bringing up a small number of children, and this contributed to faster economic growth. However, within a couple of generations, the same nuclear family set-up is found to be inappropriate for taking care of old parents, and family insurance mechanisms are exposed to high default risks. This induces governments to introduce public welfare programs to provide sufficient old-age supports with every elder. While the public transfers to elder people have mostly crowded out the private counterparts in the developed countries, the data from the NTA suggest that as further demographic transition ensues the greater the total burden of supporting the elderly becomes. In order to investigate the motivation behind the substantial intergenerational transfers, this study develops a three-period

[21] In contrast, the degrees of altruism α^F and α^P must be varied when a demographic transition takes place. If we had assumed that the degrees did not change over time, in India, where α^F was about 31.5, the adjusted degree of altruism toward the elders $\alpha^F\theta/n1$ turned out to be as high as 23 when the country reached the advanced stage of demographic transition currently observed in Japan. However, it is highly unlikely that any people weigh their elder parent's old-age consumption 23 times more than their own young-age consumption.

overlapping generations model and derives degrees of altruism towards elders and children. Contrary to Blackburn and Cipriani (2005), who suggest that people become more parentally altruistic as the economy develops, we find that the adjusted degrees of parental altruism decrease with the level of development, whereas those of filial altruism increase. The low adjusted degrees of filial altruism in the developing Asian countries deserve special attention. Our numerical analysis reveals that the developing Asian countries, where old-age supports are privately provided, must introduce comprehensive public old-age support programs to attain maximum social welfare. Furthermore, important policy changes should be implemented as soon as possible because the windows of opportunity to do so are narrowing as developing Asia undergoes unprecedentedly rapid demographic transitions.

Our estimation of the degrees of altruism is based on the data in the NTA system, where only a specific year's data are available for each of the 14 countries. In order to analyze whether the adjusted degrees of altruism are actually time-invariant or not, we need data from multiple years. Once the NTA publishes data in more counties and from multiple years as well as those on time transfers, our estimation of the degrees of altruism and simulation analyses must be updated accordingly.

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APPENDIX

Names and Definitions of Variables/Parameters

U^{t-1}	Instantaneous utility of "quality of life" of agent born in time $t-1$
c_t^y, c_{t+1}^o	Consumption of young parent at time t and old parent at time $t+1$, respectively
c_t^c, c_t^o	Consumption of children and old parent at time t, respectively
ρ	The rate of time preference: $\beta = \left(1/(1+\rho)\right)^{30}$
α^F	The parameter measuring the intensity of utility from filial altruism
α^P	The parameter measuring the intensity of utility from parental altruism
θ_t	The length of old-age period at time t
$1+n_t$	The number of children born at time t
E_t^y	The stock of education capital of young parent at time t
w_t	The wage rate per effective labor at time t
g_t	Private transfers to elders at time t
g_p	Public transfers to elders at time t
γ	The parameter measuring the productivity of education capital investment
b_t	Private transfers to children at time t
b_p	Public transfers to children at time t
s_t	Private savings at time t
$1+r_t$	The interest rate at time t
Ω	Social welfare
ω	The rate of generational discount

Flows of Private Intergenerational Transfers and Savings