"The Demographic Transition and Economic Growth in the Pacific Rim"

Andrew Mason

University of Hawaii - Manoa and East-West Center

Ronald Lee

University of California - Berkeley

Sang-Hyop Lee

University of Hawaii - Manoa and East-West Center

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<A>Abstract

Declining mortality followed by declining fertility over the demographic transition initially produce decades of rising child dependency, then decades of improving support ratios as child dependency falls (the "first dividend" which raises per capita consumption, other things equal), and finally population aging. India and ASEAN are in the first dividend period; China and Korea are near its end; and Japan's population is aging.

Between 2008 and 2050, Japan's support ratio will decline by 25%; Korea's by 22%; China's by 14%; and India's and ASEAN's will rise. Population aging and the forces leading to it can produce not only frightening declines in support ratios, but also very substantial increases in productivity and per capita income by raising physical and human capital intensity. Longer life, lower fertility, and population aging all raise the demand for wealth to provide for old age consumption. This raises capital per worker (the "second dividend") despite declining aggregate saving rates, unless the increased demand for wealth is met through increased familial or public pension transfers for old age support: institutions and policies matter. Lower fertility and mortality are associated with higher human capital investment per child, also raising labor productivity. Together, these positive changes will likely outweigh the problems of declining support ratios as population ages.

Asian countries, like other countries around the world, are in the midst of a systematic series of demographic changes known as the demographic transition, driven by declining fertility and mortality. In addition to declining fertility and mortality, the demographic transition involves changes in population size, growth rate and age distribution. Populations start and end with similar total dependency ratios, but before the transition the dependents are primarily children and at the end they are primarily the elderly.

Although children and the elderly are both referred to as *dependents,* they differ in a very important way. Children rely almost exclusively on transfers to the fill the large gap between what they consume and what they earn. The elderly, in contrast, rely on a combination of transfers and lifecycle saving to fill the gap between what they consume and what they earn. Thus, aging – and the anticipation of aging – can lead to an enormous increase in transfers and/or assets.

For this reason, the shift in the structure of dependency from children to the elderly has large potential consequences for the accumulation of physical capital and human capital, as we shall consider in some detail as our main theme. Closely related to this theme is important role of institutional arrangements governing intergenerational transfers which interact with changing population age distributions and motivation for old age support. Depending on these institutions, population aging may either drive a vast accumulation of implicit debt in public transfer systems for health and retirement, or it may generate a greater accumulation of assets raising incomes and perhaps labor productivity depending on whether assets are accumulated domestically or abroad.

This is not the place to discuss the causes of changing fertility and mortality, but it will be helpful to begin by considering the general form of changes over a classic demographic transition, as done in Figure 1. The figure shows actual historical and projected data for India from 1890 to 2100 along with simulated outcomes based on

parameterized curves for fertility and mortality. The purpose of the simulated outcomes is to emphasize the systematic and regular aspect of the changes shown which result from the broad qualitative features of the transition and are not special to the Indian context. This stylized transition will then serve as a template for placing the transitions in Asia into a broader context.

<Figure 1 about here>

We see in Figure 1 that the mortality decline in India began early in the 19th Century while fertility did not begin to decline until around 1960. A lag of this sort between the inception of mortality and fertility decline is typical of demographic transitions, although the length of the lag is often shorter and there have been some exceptions. During the lag period the rate of population growth accelerates, here from less than a half percent per year to over two percent per year, and then decelerates after fertility begins its decline. Population size rises markedly, here by a factor of five or six from 1900 to the present, with substantially more increase yet to come.

The last panel in the figure summarizes the changes in the age distributions by plotting the youth and old age dependency ratios, defined conventionally as the ratio of the populations 0-14 or 65 and over to the working age population aged 15 to 65. The first notable change is the rise in the child dependency ratio as mortality declines while fertility remains high. As mortality declines, more children survive raising the ratio, much as would happen if fertility were to rise. The increase is evidently quite substantial. Only when fertility begins to decline after 1960 does the youth dependency and total dependency begin to fall, and this decline continues for fifty to sixty years. This phase of declining total dependency corresponds to a rising proportion of the population in the working ages which raises per capita income, other things equal, as we will discuss at length later. This boost to per capita income is called the first demographic dividend. Around 2015 this phase comes to an end as rising old age dependency first offsets and

then outweighs the decline in child dependency. Population aging now raises total dependency which continues its ascent until 2060 or so in this simulation, which assumes that fertility declines until replacement level at 2.1 births per woman and assumes that mortality decline ceases when a life expectancy of 80 is reached. It is entirely possible that fertility might continue to decline to the lower levels seen throughout much of East Asia, and that life expectancy may continue to rise, so that population aging continues to higher levels more similar to those expected for Japan and Korea.

We will be considering some of the consequences of this series of demographic changes for economic growth. To summarize, the first dividend stage presents an opportunity to convert the transient gains into long term progress through investment. Low and declining fertility has been widely associated with increased investments in human capital, which is one such investment. In various ways, the demographic changes driving the transition should greatly increase the aggregate demand for wealth, raising saving rates and leading to increased capital intensity in the aggregate economy. However, this response is not automatic. To the extent that old age consumption is funded through intergenerational transfers, either private, through the family, or public, through pension and health care systems, this boost to capital accumulation will be diminished. Each of these points provides leverage for policy intervention.

Whether countries will rely on transfers or assets to fund the needs of a growing elderly population will depend on policies, culture, and institutions. As compared with European and Latin American countries, Asia has relied less on public PAYGO pension programs, although the situation is somewhat different in Japan (Ogawa et al. this conference). But health care for the elderly is a large and increasing cost that is often heavily subsidized by the public sector. Moreover, familial transfers to the elderly may be very important in Asia, and these are similar to PAYGO pension programs in some

important respects. Thus, aging in Asia may lead to large implicit debts that are shared by taxpayers and the adult children of elderly.

If the needs of a growing elderly population are met through greater reliance on lifecycle saving, population aging will lead to an increase in assets with favorable implications for economic growth. Previous studies and the analysis presented below show that through this mechanism changes in age structure can lead to a second demographic dividend – higher standards of living that persist long after the favorable effects of the first dividend have ended.

The economic effects are not confined by national borders. Divergent demographic trends in the region are likely to generate international capital flows from those countries experiencing the most rapid increase in saving rates to countries which are aging more slowly (but have rapidly growing labor forces).

Some countries in Asia have experienced very rapid transitions. Japan, Korea, China and some members of ASEAN are examples of countries in which changes in age structure are particularly dramatic. Moreover, the timing of the demographic transitions varies across the region. Japan is furthest along, while India and some ASEAN countries are relatively early in the transition. As a consequence, the impact of age structure for any particular decade varies considerably from country to country. Moreover, the differences in the transition create the demographic divergence that leads to differences in factor ratios with implications for trade, foreign investment, and immigration.

The remainder of this paper addresses these issues in more detail. In keeping with the approach of this study, we contrast the experiences and prospects in Japan, Korea, India, ASEAN, and greater China – consisting of the PRC, Hong Kong, and Taiwan (also referred to as China+ below). Demographic trends are discussed in Section I.

The economic implications of demographic changes are addressed in section II following the broad outlines discussed in the introduction. We discuss research on the relationship between population and economics and we present a new analysis of how demographic change will influence key macroeconomic variables in ASEAN, greater China, India, Japan and Korea.

<A>I. Demographic Change in Asia

<B>Demographic Transition and Population Growth

In the middle of the 20th Century birth rates were high in every Asian country but Japan. Death rates had begun to decline in a number of Asian countries leading to more rapid population growth and to increasing proportions of children because the declines in mortality were concentrated at young ages. In terms of the transition shown in Figure 1, some of these countries in 1950 were in the late stages of rising youth dependency and others were in the stage of fertility decline and the first dividend.

Except in Japan birth rates were generally around 40 births per 1000 population in 1950-55 while death rates as low as 10 per 1000 population in Japan and as high as 25 per 1000 in China and India (United Nations, 2007). The rate of natural increase (RNI), the difference between the birth rate and the death rate, is the rate at which the population would grow with no net immigration. The RNI was high in 1950-55, varying from around 20 to 25, that is, 2 to 2.5% per year (see Figure 2).

<Figure 2 about here>

During the next 50 years death rates declined very substantially. By 2000-05, the death rate was near or below 10 per 1000 in every country, while birth rates also declined. In some countries the birth rate declined by more than the death rate slowing population growth, but growth rates remained near 2 percent per year or more in many countries in 1975-80. By 2000-05, however, further declines in the birth rate are

apparent in Figure 2. In Japan, births and deaths were nearly equal during this period. In other countries population growth ranged from near 0 to almost 2 percent per year.

Figure 2 also shows UN Medium projections through 2050 which assume that in countries with very low fertility, e.g., Japan, South Korea, Taiwan, Hong Kong, China, and Singapore, it will rise in the future and that in countries with relatively high fertility, e.g., the Philippines and India, it will decline further (UN 2007). The implied variation in population growth rates lies between minus and plus one percent per year. Death rates will rise moderately in many countries as their populations age, reflecting the deficiencies in the Crude Death Rate as a measure of mortality.

The broad outlines of the demographic transition are similar across Asia, but speed and timing vary. The transition began first in Japan, then in other East and Southeast Asian countries, and more recently in some ASEAN countries and India. It has been very rapid in Korea and China as compared with countries elsewhere in Asia, other parts of the developing world, or in Western countries.

Population growth rates are reported for ASEAN, greater China, India, Japan, and Korea in Table 1. For 2000-05, Japan's population growth was almost zero. The PRC and Taiwan had population growth rates well below one percent per annum. Among the ASEAN countries only Thailand and Myanmar were growing at less than 1 percent per annum. Two Asian countries had birth rates that would have been well below 10 were it not for substantial rates of immigration – Singapore and Hong Kong, China. The population growth rates for 2000-05 of other ASEAN countries vary from 1.3 percent in Indonesia to 2.3 percent in Brunei. India's growth rate is moderately high at 1.6 percent per year for 2000-05.

<Table 1 about here>

Because of differences in population growth rates, the populations of ASEAN and India are increasing relative to China, Japan, and South Korea. India's population is projected to exceed greater China's population by 2030 (Figures 3 and 4).

<Figure 3 about here>

<Figure 4 about here>

<B>Population Age Structure

Population age structure changes in a very predictable way over the demographic transition. Early in the transition, the percent children increases as infant and child mortality declines, as we saw in Figure 1. Later the child share declines and the percent in the working ages increases. In the final stages the share of the working age population declines while the share at old ages increases.

The rise in the child share of the population occurred in ASEAN, China, and India between 1950 and 1975. In ASEAN, for example, the percent under age 20 increased from 49.0% to 53.0% (Table 2). The decline in the proportion under age 20 has been extraordinarily rapid in some Asian countries such as greater China and South Korea. In 1975, just over 50 percent of South Korea's population consisted of children under the age of 20. The projected value for 2025 is 16.8 percent.

<Table 2 about here>

The low level reflects the fact that South Korea has among the lowest total fertility rates of any country in the world. Other countries in which the child share is expected to drop to very low levels over the coming decades are Singapore, China, Hong Kong, China, Taiwan, and Japan.

The percentage of the population in the working ages, defined here as those between age 20 and 64 inclusive, increased between 1975 and 2000 in every member of greater China, India, Japan, Korea, and every ASEAN country but Cambodia and Lao PDR. The percentage reached 60 percent or more in Singapore, Thailand, greater

China, Japan, and Korea. These countries are at or near the peak and will not experience any substantial change in the share of their working age population between 2000 and 2025. Japan is an exception and it will experience a significant decline in the working-age share and size (Table 3).

<Table 3 about here>

The largest increases in the working-age populations are occurring in ASEAN and India. Between 2000 and 2025 the working-age share will increase 7 percentage points in ASEAN and almost 9 percentage points in India. Within ASEAN, the gains will be dramatic in Cambodia (13 points), Lao PDR (14 points), and Viet Nam (11 points).

Population aging is coming very rapidly to the countries of East Asia. Japan, with the percentage 65 and older increasing from 17.2 in 2000 to 29.5 in 2025, has the oldest population in the world. The percentage 65 and older will double between 2000 and 2025 in greater China, from 6.9 percent to 13.8 percent, and in Thailand, from 6.7 percent to 14.9 percent. Even more rapid aging will occur in Singapore and Korea where 22.8 percent and 19.6 percent of the populations are projected to be 65 and older by 2025 (Table 4).

<Table 4 about here>

Elsewhere the share of the population 65 and older will not reach 10 percent until after 2025. By 2050, however, the ASEAN share is projected to reach 17.7 percent and India's share 14.5 percent. At first glance demographic characteristics in 2050 may appear to be remote to the economic concerns of today. Nothing could be further from the truth, however. The elderly population of 2050 is the working population of today. The prospect of old-age and retirement will influence current behavior – with respect to saving, for example. Moreover, policies implemented by governments today will determine the success with which the working population of today can adequately prepare for an extended period of old age, and the ways in which they prepare.

<B>Role of Immigration[1]

Immigration plays a relatively modest role in determining population growth and age structure in Asia as compared with births and deaths. Immigrant flows are heavily regulated and limited – mostly by receiving countries. With a few exceptions the countries of Asia have not opened their borders to immigrants and there is little to suggest that will change soon irrespective of economic or demographic pressures that may emerge in the coming years.

Asia's largest countries are net sending countries. Net migration from India, China, Indonesia, and the Philippines has consistently been negative (outward). The rate of net migration is quite small in India and China and, thus, has little effect on the size of their national populations. In 2000-2005, for example, China lost 0.03 percent per year of its population and India lost 0.02 percent per year of its population due to immigration. The rate of out-migration from Indonesia and the Philippines is relatively great as compared with most other countries - .09 percent per year in Indonesia and 0.23 percent per year in the Philippines. But even in these two countries, the impact on the growth of the population in any year is modest (Table 5).

<Table 5 about here>

These four countries do contribute relatively large shares to global migration flows because their populations are so large. For 2000-2005 the annual net numbers of immigrants were 390,000 from China, 280,000 from India, 200,000 from Indonesia, and 180,000 from the Philippines. Combined they contributed just over 1 million net immigrants a year to the global flow. This compares with a total outflow of 2.6 million per year from the less developed regions to the more developed regions of the world during the same period.

[1] Estimates presented in this section are all drawn from two sources: United Nations 2006. *International Migration 2006;* and United Nations 2006. *World Population Prospects 2006.*

For the most part these immigrants were not moving to other Asian countries. Total net inflows, including immigrants from outside Asia, were approximately 100,000 immigrants per year to the net receiving countries of ASEAN, 60,000 per year for Hong Kong, and only 54,000 per year for Japan.

For a few countries in the region migration is significant relative to their domestic populations. The Philippines has sustained immigrant outflows at a significant level for many years. As a consequence, remittances are currently about 13% of GDP. Hong Kong, Brunei, and Singapore have actively encouraged immigration to their countries. Over 40 percent of Hong Kong's and Singapore's populations and one-third of Brunei's population are immigrants.

Japan falls at the other end of the immigration spectrum with its relatively closed borders. Given the high wages of its workers relative to those of its neighbors and the declining numbers in the working ages, one might well expect substantial immigration into Japan. Currently about 2 million immigrants live in Japan or 1.6% of its population. This compares with an immigrant share for the "more developed regions" of the world of 9.5% and a figure of 12.9% for the US population.

<A>II. Economic and Social Implications

Demographic change in general, and the demographic transition in particular, has three broad kinds of economic consequence. First, the support ratio is altered, such that output produced by the working age population must be shared with differing numbers of children and elderly. During the phase of the transition when fertility is falling, rising support ratios boost the growth rate of per capita income or consumption, other things equal, and this is called the "first demographic dividend". Second, the process of capital accumulation is affected, since both longer life and fewer children lead to higher savings in preparation for retirement, while population aging increases the relative number of wealth-holding elderly in the population. The combined effect raises the aggregate

capital-labor ratio and therefore labor productivity, generating the so-called "second demographic dividend". However, the extent to which this happens depends on the extent to which income of the elderly is derived from public or familial transfers rather than private saving, and the degree of openness of the economy influences the extent to which labor productivity is raised domestically or in other countries. In any event, although the capital-labor ratio increases, the rate of saving out of GDP may decrease as populations age. Third, both lower fertility and higher survival lead to increased human capital investment per child. While the support ratio falls, rises, and then falls again over the demographic transition, the accumulation of physical and human capital per capita rises permanently, at least once fertility begins to fall. We will consider each of these three kinds of effect in more detail drawing on information about the economic life cycle for various Asian countries from the National Transfer Accounts project.[2]

Population change has important implications for individual countries, but also for regional economies and regional integration. First, national and regional populations are growing at very different rates, with India and ASEAN increasing relative to greater China, Japan, and Korea. Inevitably changes in the size of populations influence the size of regional economies. More people means more consumers, more workers, and more savers and investors. The extent to which larger populations result in greater aggregate consumption, aggregate earners, aggregate saving and investment will be influenced by a host of factors beyond the size of national and regional populations. None the less, population size is an important consideration.

National and regional differences in the growth of consumer demand, labor forces, and aggregate saving and investment will influence international flows of workers,

[2] The National Transfer Accounts (NTA) project uses new methods to construct measures of the flows of resources across ages through the public sector and through the private sector, including within families. Estimates are consistent with National Income and Product Accounts. Currently 25 countries in Asia, the Americas, Europe and Africa are participating in the project. More information is available at www.ntaccounts.org.

goods and services, and capital. The classic approach to this issue is that international flows arise in response to international differences in relative factor endowments (Deardorff 1987). In this context a key issue is whether divergent population trends lead to divergent factor endowments.

The impact of divergent factor endowments will depend to a great extent on the institutional context. Divergent capital-labor ratios can lead to immigration, capital flows, and/or trade depending on the policy context. As should be clear from the brief description in the preceding section, international labor flows are relatively limited in Asia. In the absence of radical changes in policy, population aging is more likely to influence international capital flows and trade than immigration.

<B>The Economic Lifecycle

The economic lifecycle is fundamental to understanding the relationship between population age structure and the economy. In all populations there are extended periods of dependency. Children consume more resources than they produce through their own labor and must rely heavily on intergenerational transfers from their parents (and grandparents) and from taxpayers. The elderly also consume more than they produce. They rely on intergenerational familial and public transfers, but also on personal assets to fill the gap between what they consume and what they produce through their own labors.

Figure 5 is an estimate of the economic lifecycle based on analysis of consumption and labor income data for four developing economies. The figure is a cross-sectional profile constructed from per capita measures of labor income and consumption by single year of age. The values are normalized on average labor income of adults aged 30-49. Labor income includes all pretax returns to labor: earnings, benefits, and self-employment income, estimated as a proportion of the operating surplus or mixed income of the household sector. The age profiles are based on

nationally representative household surveys of income and adjusted to match National Income Account data.

Labor income is a composite. It includes the labor income of both men and women. It is influenced by labor force participation rates, by variation in hours worked, and by variation in wages for employees and productivity for the self-employed. Earnings, which can be measured with relative accuracy, is a dominant share of labor income in developed countries, However, self-employment income, which is poorly measured, is a substantially large share of labor income in low-income countries.

Consumption includes both public and private consumption. Private consumption of health, education, and other goods and services has been estimated separately from nationally representative surveys of consumption. Public consumption has also been estimated separately for education, health, and other publicly provided goods and services. Private and public consumption have also been adjusted to match NIPA values.[3]

One must avoid interpreting these figures as longitudinal or cohort profiles rather than as cross-sectional profiles. In a growing economy with these cross-sectional profiles, labor income will rise more steeply for young cohorts, peak at a later age, and decline more slowly for the elderly. Consumption will not be flat for a cohort – rather it will rise with age at a rate roughly equal to the rate of aggregate per capita consumption growth.

The age at which children become economically independent is surprisingly old. Children under age 25 are producing less than they consume. Likewise, old age dependency occurs at a surprisingly early age. Those 60 and older are producing less

[3] Detailed information about the methodology is available in Lee, R. D., S.-H. Lee, et al. (2007). Charting the Economic Lifecycle. Population Aging, Human Capital Accumulation, and Productivity Growth, a supplement to Population and Development Review 33. A. Prskawetz, D. E. Bloom and W. Lutz. New York, Population Council and at www.ntaccounts.org.

from their labor than they consume. The lifecycle surplus is confined to 34 years – from ages 25 to 59.

The extent of dependency varies across the dependent ages, however. Those in their early twenties are producing almost as much as they consume as are those in their early sixties. Young children produce nothing, but they also consume much less than a teenager or someone over the age of 60.

An important issue is whether the economic lifecycle is changing over time, and how, and whether it is susceptible to policy. The potential for policy intervention is discussed in the conclusions to the paper. An important possibility that is widely discussed is that the age at retirement will increase as health improves and lifecycle expectancy rises. This may happen and in a few industrial countries including the US, labor force participation rates have risen slightly at older ages in recent years. For the most part, however, the age at retirement has declined dramatically around the world. For example, the median age at retirement of US men was above 74 in 1900 and is now around 63. This is a typical kind of change for industrial nations, although Japan has been different. The labor income profile for the US and Taiwan have become increasingly concentrated declining for both the young and the old relative to prime age adults. Another possibility is that the consumption side of the economic lifecycle will change. Our preliminary analysis suggests that this may be occurring – consumption is rising most steeply at older ages in the industrial countries and particularly in the US consumption of the elderly has increased very sharply. In the analysis presented below we abstract from these changes. If we were to incorporate them, however, they would reinforce our conclusions.

The subsequent sections will make extensive use of the economic lifecycle to provide a more refined measure of how changes in population age structure will influence trends in consumption, labor, and their magnitudes relative to one another.

<B>The First Dividend

Recent studies on the macroeconomic effects of population age structure are based on growth models that explicitly incorporate population age structure. The simplest form for these models distinguishes two components of per capita income:

$$\frac{Y}{N} = \frac{L}{N}\frac{Y}{L}. \qquad (1)$$

The exact definitions of the terms vary across studies, but broadly speaking Y/N is per capita income, L/N is the share of the population in the working ages – also called the support ratio, and Y/L is income per worker or working age person. Letting *gr*, represent the growth rate, equation (1) can also be expressed as:

$$gr\left[\frac{Y}{N}\right] = gr\left[\frac{L}{N}\right] + gr\left[\frac{Y}{L}\right] \qquad (2)$$

Equation (2) identifies two channels through which population can influence per capita income. First, the support ratio varies with changes in the population age structure. Given the rate of growth in Y/L, a one percentage point increase in the support ratio yields a one percentage point increase in per capita income. This effect is referred to as the accounting effect or the first dividend. Note that equation (2) is an identity and, hence, given output per effective consumer, changes in the support ratio must produce point-for-point changes in output per effective consumer. A comprehensive understanding requires that we explore the second channel, as well, how changes in population age structure, other population changes, and non-demographic factors influence productivity growth, i.e., the growth of Y/L.

Elaborations on this simple formulation have been used to study population and economic growth using three approaches. First, aggregate panel data have been used to estimate growth models, usually adapting equation (2) to a Barro-type growth framework (Kelley and Schmidt 1995; Bloom and Williamson 1998; Bloom and Canning

2001; Kelley and Schmidt 2001; Kelley and Schmidt 2007). A second approach relies on growth accounting methods (Mason 2001). A third method uses simulation modeling (Cutler, Poterba et al. 1990; Mason 2005; Attanasio, Kitao et al. 2006; Mason and Lee 2006; Mason 2007).

A simple refinement of this formulation incorporates the age variation in the economic lifecycle into the calculation of the support ratio. In this formulation, L is the effective labor force calculated using the age-profile of labor income to weight the population age distribution. The effective labor force then incorporates age variation in labor force participation, hours worked, and productivity. The denominator N should also incorporate age variation in consumption to measure the effective number of consumers. Thus, if income per effective consumer, Y/N, increases by 1 percent the per capita age profile of consumption in Figure 5 can increase by 1 percent holding the consumption ratio (the ratio of aggregate consumption to national income) constant. To be explicit, the effective number of producers, L, and the effective number of consumers, N, are defined to be:

$$L(t) = \sum_x \gamma(x) P(x,t)$$
$$N(t) = \sum_x \alpha(x) P(x,t) \qquad (3)$$

where P(x,t) is the population aged x in year t, $\gamma(x)$ is the age-profile of labor income, and $\alpha(x)$ is the age-profile of consumption. Both age-profiles are held constant over time.[4] The support ratio is defined as the ratio *L(t)/N(t)*.

<Figure 5 about here>

The economic support ratio for five countries/groups from 1950 to 2050 is plotted in Figure 6. Japan's support ratio has peaked and is beginning to decline, but for all

[4] An interesting and important question is how the economic lifecycle changes over time and how that will influence the analysis presented here.

others in Asia the economic support ratio is rising and thus contributing to more rapid growth in income per effective consumer. The impact of the economic support ratio does not depend on its level; its effect on income per effective consumer – the first dividend - is determined by the growth rate of the support ratio (Figure 7).

<Figure 6 about here>

<Figure 7 about here>

Figure 7 presents the first dividend for 1990 to 2025. In the early 1990s the first dividend was turning negative in Japan, increasingly so as time progressed. By 2025 the decline in the economic support ratio will be depressing growth in income per effective consumer by 0.5% per year.

The experiences of greater China and South Korea are similar with the first dividend marginally larger in greater China in each year. In the early 1990s, the first dividend added about 1 percent per year to growth in income per effective consumer. The impact has declined steadily. It is still positive, but will soon disappear and after 2020 will depress growth by 0.5% per year. In India and ASEAN the dividend is positive for the entire 35 year period. Currently, the increase in the economic support ratio is adding approximately 0.5 percent per year to growth in income per effective consumer. Over the period 1990 to 2025, the first dividend has raised income per effective consumer in total by 21 percent in ASEAN and by 18 percent in India.

Changes in the economic support ratio emphasize the implications of population age structure for per capita values. The changes in total number of effective consumers and producers are also of interest because of their implications for trade, capital flows, and immigration. The most rapid growth in the effective number of consumers is in ASEAN and India. For the period 2005-10, the annual growth rate in the effective number of consumers is 1.4 percent per annum in ASEAN and 1.7 percent per annum in

India. The effective number of consumers is growing much more slowly in China and Korea and declining slowly in Japan (Table 6).

<Table 6 about here>

Currently the effective number of producers is growing more rapidly than the effective number of consumers except in Japan. The growth rate is about 2 percent per annum in ASEAN and India, 1 percent in greater China, 0.7 percent per annum in Korea, and declining by 0.4 percent per annum in Japan.

The regional differences in growth rates may seem small but their cumulative effect is not because they are persistent. The coming decades will see a significant shift to the West and to the South. India will supplant China as the largest country in terms of effective number of consumers and effective number of producers. ASEAN's share will grow to approach about 20 percent by 2050. Japan and Korea will shrink relative to their neighbors. Korea's share of effective producers will be cut in half by 2050 and Japan's by over 60 percent (Table 7).

<Table 7 about here>

The first dividend depends entirely on changes in the size of the effective work force relative to the population (or the effective number of consumers). Output and income per working-age adult are held constant and, hence, the possible effects of population growth or changing age structure on the second component in the basic growth identity, equation (2), are set aside. In the next sections we explore the possibility that demographic trends are influencing income per effective worker.

There are many potentially important channels through which productivity may be influenced by population. We will consider two important ones, the accumulation of human capital and the accumulation of physical capital, with our emphasis on the latter.

<B>Human capital formation

In Becker's quantity-quality tradeoff theory (Becker, 1991), one possible explanation for fertility decline is that rising incomes lead couples to choose to invest so much more per child that they also choose to have fewer children. But within that theory there are also other possibilities. Newly available contraceptives raise the price of quantity by disconnecting fertility from sex, and could thereby reduce fertility and raise investments per child through a complex interaction. New public education or cheaper transportation to existing schools could reduce the price of quality, raising investments and reducing numbers of children. Mortality decline or economic development would both raise rates of return to education and thereby could lead couples to choose quality over quantity. In all these cases we would expect to observe an inverse relationship between quantity and quality reflecting movements along the hyperbolic budget constraint, although the causal forces at work would be quite different.

Some theories assign a central role to human capital. For example, Becker, Murphy and Tamura (1990) make output of consumption goods proportional to the stock of human capital (constant returns), and human capital per child proportional to the human capital of the parent generation. If this growth model escapes a Malthusian trap, then it converges to a steady state growth path with constant fertility, growing human capital per person, and a growing rate of return to human capital.

Using data from National Transfer Accounts, we have constructed a measure of investment in children's human capital. We begin with measures of public and private spending on children's health and education at each age. We then sum these across age up to 18 years for health and up to 26 years for education. This sum measures total human capital investment per child, in a cross-sectional synthetic cohort sense. To normalize these measures to facilitate comparison across countries, we then divide by the average level of labor income from ages 30 to 49, as before. The natural logarithm of

this ratio is then compared to the logarithm of the Total Fertility Rate, which is also a cross-sectional synthetic cohort measure.

The result is plotted in Figure 8 which shows a strong inverse association across countries between human capital investment per child and the level of fertility. The elasticity is -1.3 indicating that couples in countries with lower fertility actually spend a higher proportion of their labor income on human capital investments than do couples in the countries with higher fertility. When countries outside of Asia are included, however, this elasticity is indistinguishable from unity (Lee and Mason, 2008). The inverse association displayed in Figure 8 can be viewed as a kind of meta budget constraint for quantity-quality, an interpretation developed in Lee and Mason (2008).

<Figure 8 about here>

Although Figure 8 shows a cross-sectional rather than a longitudinal relationship, it suggests that fertility decline in Asia has been accompanied by a sharp increase in investment per child relative to family resources. We would expect an increase of this sort to raise labor productivity and contribute powerfully to economic growth, a process that is modeled and explored in Lee and Mason (2008). Here, however, we will simply note that this rising level of investment may have been rooted in declining fertility and must surely have contributed importantly rising labor productivity and economic growth.

<B>Physical capital accumulation and the second dividend

A fundamental result that follows from the neo-classical growth model is that for a given saving rate, slower population growth or slower growth in the effective labor force leads to capital deepening and an increase in output per worker (Solow 1956). When the workforce grows more rapidly, a larger share of current investment must be devoted to providing capital to new workers (capital widening). Less is available for increasing capital per worker (capital deepening). The steady state capital output ratio (K/Y) depends only on the saving rate and the rate of population growth (n) and technological

change (λ) (if we ignore depreciation): $K/Y = s/(n+\lambda)$. Any decline in the population growth rate leads to a rise in the capital output ratio.

This is an important point because the decline in the economic support ratio at the end of the demographic transition is a direct result of slower growth in the labor force. The first dividend turns negative, but, given a constant saving rate, output per worker will rise. Hence, population aging may lead to higher not lower per capita income. Indeed, this was the conclusion reached by Cutler et al. in their analysis of US aging (Cutler, Poterba et al. 1990).

Given the objective of this analysis two assumptions underlying the simple neo-classical growth model are unattractive: that the saving rate is exogenous and that the economy is closed.

The lifecycle saving model is widely used to analyze the effects of population and other factors on saving (Modigliani and Brumberg 1954; Modigliani 1988) and capital (Tobin 1967). In the classic lifecycle model, individuals save when they are young and dis-save during their retirement years. Thus, given the age profile of saving, an increase in the old-age population leads to lower aggregate saving. A lower saving rate does not unambiguously lead to a decline in capital because of the capital deepening effect. If n and s both decline K/Y may increase or fall.

The validity of the lifecycle model is widely debated. Factors other than the desire to provide for old age may motivate saving. The bequest motive may influence saving, in addition to lifecycle saving, but neither we nor others know how the motivation to bequeath varies with fertility or other demographic factors. Hurd (1987) finds that the bequest behavior of individuals with and without children is similar, suggesting either that bequests are mainly unintended or that saving for bequests may be motivated by a others besides ones own children (Michael Kuehlwein (1993). Old age support may be

provided through public or through familial support. Models estimated using aggregate data support very large effects of age structure (Kelley and Schmidt 1996; Higgins and Williamson 1997; Williamson and Higgins 2001). Models based on survey data suggest more modest influences from age structure (Deaton and Paxson 2000). Simulation models imply that age structure has an important effect, but one that is smaller than found in aggregate empirical work (Lee, Mason et al. 2000).

A potentially important elaboration on the life cycle model incorporates the effects of life expectancy on the age profile of saving in addition to the composition of the population. People are living longer and, hence, the duration of their retirement is longer. Although a possible response would be to retire at a later age, this has not occurred for reasons that are not entirely understood. Several recent studies have found support for a strong positive life expectancy effect on aggregate saving rates (Bloom, Canning et al. 2003; Kinugasa 2004; Kinugasa and Mason 2007). Fertility decline may also have a significant effect on saving. A number of studies have concluded that populations with high child dependency have lower saving rates (Mason 1987; Higgins 1994; Kelley and Schmidt 1996).

Transfers also play an important role. In principal, old age consumption can be financed entirely through intergenerational transfers as in Samuelson's consumption-loan economy (Samuelson 1958). More realistically intergenerational transfers vary in their importance from country to country. Some countries rely heavily on PAYGO public pension programs. Other countries rely heavily on familial support systems, although much less is known about this form of intergenerational transfer and its implication for saving.

A high percentage of elderly and adult children live together in most Asian countries. In Japan and Korea the extent of co-residence has declined substantially in recent decades. Moreover, young adults have much lower expectations about receiving

old-age support in the future than was previously the case (Ogawa and Retherford 1993). Co-residence, however, does not provide a clear guide to the magnitude or direction of familial transfers.

National Transfer Accounts provide comprehensive estimates of the importance of assets and intergenerational transfers, both public and familial, for a few countries. Figure 9 provides estimates for Japan, Taiwan, Thailand and the US of the fraction of the lifecycle deficit (consumption less labor income) of those 65 and older funded by familial transfers, public transfers, and assets (asset income and dis-saving combined). The elderly in Taiwan and Japan are both depend heavily on transfers – covering almost two-thirds of their lifecycle deficits. Taiwan is much more heavily dependent on family transfers and Japan on public transfers, but in total they rely heavily on combined transfers. They rely on assets to cover roughly one-third of their lifecycle deficits. In contrast, the US and Thailand depend on transfers for roughly one-third of their lifecycle deficit. Thailand depends more on family transfers and the US on public transfers, but their total dependence on combined transfers is similar. Thailand and the US rely much more on assets to cover their lifecycle deficits than do Japan and Taiwan.

<Figure 9 about here>

That US elderly depend more on assets for their retirement than Japanese elderly may seem surprising given that Japanese saving rates are higher than US saving rates. The estimates are constructed to insure consistency with NIPA estimates of saving. There are many possible explanations of the seeming inconsistency, however. This is a snapshot of the use of assets to support retirement by the elderly. Aggregate saving rates also depend on the saving behavior of non-elderly adults. Moreover, the estimates presented in Figure 9 address only the lifecycle use of saving and not other motives, e.g., the bequest motive.

Because comprehensive measures of familial transfers are just becoming available, there are no empirical studies of their effect on aggregate saving rates. But Lee, Mason, and Miller (Lee, Mason et al. 2000; Lee, Mason et al. 2002; Lee, Mason et al. 2003) use a simulation model to explore their potential effect on aggregate saving. In their analysis of Taiwan, they find that changes in age structure and life expectancy alone can account for only a portion of the rise in aggregate saving rates that accompanied its demographic transition. However, demographic change combined with a widespread abandonment of familial support systems can explain the boom in saving that occurred there.

The results presented here make use of a similar simulation model to assess the implications of population change for wealth and income. The details of the model are described in Mason and Lee (2007) and only its key features are sketched out here.

The economy is assumed to be completely open to international capital flows and interest rates so domestic wages and interest rates are unaffected by the supply of capital by residents. The age profile of labor income is fixed, i.e., relative productivity and labor force participation rates do not change over time, but the labor income profile shifts upward in response to technological growth which is exogenously determined. These aspects of the model are relatively conventional. However, the treatment of consumption and saving in the model is distinctive.

The model used here implicitly assumes that intergenerational altruism is a pervasive feature of the society. We assume that the cross-sectional age-consumption profile incorporates those preferences for the well-being, for example, of children and the elderly. The shape of this age profile is assumed not to change over time but it shifts upward (or downward) depending on the accumulation of assets, technological progress, and changes in the support ratio driven by changing population age structure. Individual consumption is determined only indirectly by the individual's economic success, since

there is extensive sharing of income through public and private intergenerational transfers. Likewise total consumption by a cohort at each age is only indirectly influenced by the lifetime economic success of that cohort. This approach is far more consistent with the consumption patterns observed in Asia which in each year are quite constant across all adult ages, regardless of the income histories of each generation.[5]

Consumption at older ages is realized through a combination of intergenerational transfers and lifecycle saving. The importance of transfers relative to lifecycle saving is exogenously determined and treated in this model as a policy variable or a feature of each society. The economy is subject to an aggregate budget constraint on flows that, along with other features of the model, determines the time path of assets, transfer wealth and implicit debt, and income.

In each period t aggregate wealth is equal to the present value of current and future consumption of all individuals who are adults in year t less the present value of current and future labor income of all individuals who are adults in year t. Wealth (W) defined in this way is a broad measure of wealth that includes both real assets (A) and the present value of current and future net transfers to year t adults, called transfer wealth (T). Transfer wealth consists of two components: child transfer wealth and pension transfer wealth. Child transfer wealth is the present value of transfers from year t adults to living dependent children and to children who will be born in the future. Child transfer wealth is negative and it is equal to the present value of the future cost of children to those who are adults in year t.

Pension transfer wealth is the present value of net transfers that year t adults will receive from year t children and from future generations. These transfers may be familial transfers or public transfers. Pension transfer wealth is the counterpart of implicit

[5] Models based on the standard lifecycle theory or the Ramsey approach produce broadly similar results.

debt – the transfer wealth of those who are adults today is equal in magnitude to the implicit debt of future generations. Implicit debt as calculated here is not limited to public transfers programs, e.g., PAYGO pension programs. It includes all intergenerational transfers whether public or private (familial).

The impact of demographic change on capital accumulation and economic growth depends on the extent to which the economy in question relies on pension transfer wealth versus capital accumulation to support consumption in old age. We treat this as an exogenous variable rooted in each country's institutions, but changeable through policy. Thus we specify the relative shares of assets and pension transfer wealth. Two sets of results are presented below. In one a very low percentage of pension wealth is transfer wealth (35%) with assets accounting for the other 65%. In the alternative simulation, transfer wealth is 65% of pension wealth and assets are 35%.

Before we turn to the results it should be clearly stated that the model is not intended to be a complete and comprehensive model of the economy. Its purpose is quite specific to showing how demographic changes are likely to influence wealth and assets, and with what implication for economic growth. There are three ways in which demographic change will influence wealth in our model. First, changes in the support ratio influence consumption at each age. If the support ratio is high, perhaps due to low fertility, then higher consumption at every age is possible. Anticipated higher consumption at old ages means that more wealth (assets plus pension transfer wealth) must be held at every age to finance that consumption. Second, people are living longer. To support consumption over an extended period of retirement, they must accumulate more wealth during their working years. Third, given the age profile of wealth holdings, changes in the population age structure influence aggregate wealth. Up to a point wealth rises with age and, hence, a population concentrated in the late working years and early retirement years has greater wealth, in one form or the other.

<B>Simulation Results for ASEAN

Simulated net saving rates in ASEAN for 1950 to 2050 are shown in Figure 10. Comparative results will be presented in the next section. Productivity growth is assumed to be 2 percent per annum here and in all other results presented. The high IG transfer simulation gives the saving rate if 65% of the wealth required to support consumption in old age is provided through public and familial transfer programs. The low IG transfer simulation gives the saving rate if intergenerational transfers cover only 35% of the consumption needed during retirement.

<Figure 10 about here>

Changes in age structure lead to a rise and then to a decline in net saving rates. One might incorrectly infer from the pattern that population aging is leading to a decline in saving rates, but this is not correct. Saving rates are rising in anticipation of population aging. The change in saving rates is transitory, however. As the population stabilizes at an older age structure, saving rates decline to levels closer to their pre-transition level.

Saving rates are strongly influenced by the size of intergenerational transfers. If transfers play a modest role in supporting the consumption of older adults, changes in age structure have a very substantial effect on net saving rates which rise from about 3 percent of national income in 1950 to peak at 23 percent of national income in 2010.

If intergenerational transfers play a dominant role in providing support to the elderly, then the effect of age structure on saving is moderate. Net national saving rates rise from 2 percent in 1950 to peak at around 8 percent in 1985 before gradually declining.

The impact of age structure on assets is substantial (Figure 11). In 1950 the ratio of total assets to total labor income is about 0.3 for both intergenerational transfer systems. By 1990 assets have increased to 1.5 times labor income for the low IG

transfer case and to 1.2 time labor income in the high IG transfer case. After 1990 the systems diverge with assets relative to labor income increasing to 7 in 2050 for the low IG transfer case, but only to 2 in 2050 for the high IG transfer case. Total wealth in 2050 in the low IG transfer case is also 350% greater than in the high IG transfer case in 2050.[6]

<Figure 11 about here>

As compared with 1950, changes in age structure lead to about a 30% increase in consumption per equivalent consumer in 2030 given the high IG transfer policy (Figure 12). Using the low IG transfer policy, changes in age structure lead to an increase in consumption per equivalent consumer of about 50% in 2050. Note that the higher consumption after 2025 for the low IG transfer policy comes with a cost. The higher saving rates and lower consumption rates necessary lead to lower consumption between 1995 and 2020 under the low IG transfer policy than under the high IG transfer policy. Consumption remains permanently higher under the low IG transfer policy. Over the next 100 years (not shown) consumption is 20 percent higher on average given the low IG transfer policy. In a closed economy these differences would be larger.

<Figure 12 about here>

The simulations presume that the economic lifecycle itself does not respond to changes in age structure and, hence, the gains (or losses) in consumption are equally shared by all age groups. Of course, other outcomes are possible. The elderly might flex its political power and increase its consumption relative to younger generations. Or young generations may rebel if IG transfers are too burdensome to the detriment of the elderly.

<B>Comparative Results

[6] Because a small open economy assumption is used labor income growth is the same in either case. The greater wealth is accumulated as foreign assets in the low IG transfer economy.

The results presented in this section focus more narrowly on two periods: 1995-2005 and 2005-2020. The effects of changes in age structure on saving rates depend on the importance of intergenerational transfers to the elderly (Table 8). Given low reliance on intergenerational transfers, net national saving rates reach very high peaks in 1995 in greater China, Japan, and Korea. In these countries saving rates decline to intermediate levels in 2005 and to much lower levels in 2025. In India and ASEAN, the saving effects are somewhat more modest and are delayed reflecting the slower and later changes in age structure.

<Table 8 about here>

If intergenerational transfers play a very important role, the effects of age structure on saving are muted.

Accumulated assets are reported in Table 9. Age structure has a substantial influence on the lifecycle demand for assets if intergenerational transfers are low. In this case, the ratio of assets to labor income in 1995 ranges from 1.1 given the demography of India to 10.2 given the demography of Japan. The demand for lifecycle assets grows in all cases between 1995 and 2005 and between 2005 and 2025. By 2025, Korea is approaching the simulated level of assets for Japan. Percentage growth rates are very strong in ASEAN and India. Between 1995 and 2025, assets relative to labor income increase three-fold in both cases.

<Table 9 about here>

The complexities of the relationship between age structure and consumption growth are apparent in Table 10. Consumption growth changes because of changes in income per effective consumer and changes in the ratio of consumption to national income that underlie the second dividend. If the consumption ratio changes very little, the trend in consumption is dominated by changes in the support ratio, i.e., the first

dividend. Thus, consumption per equivalent consumer will grow more rapidly during the dividend period and then decline as population aging dominates the support ratio.

<Table 10 about here>

However, if there is a strong response in the consumption ratio the outcome is more complex. Rapid accumulation of capital is realized through a decline in the consumption ratio and slow growth in consumption per effective consumer. As the consumption ratio rises from low levels, however, consumption growth can be very rapid.

Consumption growth in ASEAN shows this pattern. Given a strong saving response (low intergenerational transfers), consumption growth is slow in 1995-2005, but very substantial in 2005-2025. In contrast, given a modest saving response (high intergenerational transfers), consumption growth is more rapid in 1995-2005 and dissipates in 2005-2025.

The situation in India is somewhat different. In 1995-2005 consumption is actually declining modestly (relative to productivity gains) as a result of a decline in the share of national income consumed. Consumption rebounds after 2005. For the two decades taken as a whole consumption growth rates are the same given either policy, but more detailed results show that consumption growth is substantially more rapid given the high saving scenario after 2015.

Greater China, Japan, and Korea are in similar situations given a low level of intergenerational transfers. For 1995-2005 consumption growth is very rapid – ranging from 3 percent to nearly 6 percent above the assumed rate of productivity growth of 2 percent per year. During this period saving rates are declining from the high levels of 1995 and earlier and income growth is strong leading to rapid growth in consumption. After 2005, consumption growth rates are well above those possible in the absence of a strong saving response.

A note of caution is in order here. The very large simulated effects are conditioned on low intergenerational transfers. The evidence from Japan, Taiwan, and preliminary estimates for Korea not presented here indicates that intergenerational transfers to the elderly were closer to the high IG transfer scenario than the low IG transfer scenario. Hence, the second dividends realized in East Asia were probably well below the possible gains that could have been realized. Estimates of the contribution of changes in age structure to growth in per capita income in East Asian range from about one-third to one-quarter of actual growth (Bloom 1998; Mason 2001). The simulated impact on consumption is substantially greater than the simulated effect on per capita income, because of the rapid increase in consumption rates for Korea, Japan, and greater China.

<A>IV. Discussion and Conclusions

Declining mortality followed by declining fertility leads to a roller-coaster of changes in dependency, with initial increases in child dependency, then a period of improving support ratios spanning about 50 years and generating the first dividend, and finally population aging. Asian countries have all entered the first dividend phase, with India and ASEAN midway through it, China and Korea near its end, and Japan well past it and into population aging.

Population aging is the inevitable last stage of the demographic transition, and the costs of supporting the consumption of a large dependent elderly population, reflected in falling support ratios, lead to concerns by policy makers, the media and the public. The declining support ratios due to population aging are a predictable and very concrete aspect of the complex constellation of economically important changes occurring over the course of the demographic transition, and it is therefore tempting to view population aging separately from these other changes that result from the same basic causes. Earlier we have highlighted the relation of the demographic transition and

population aging to increased investment in human capital and physical capital. Both raise productivity and incomes far more significantly than declining support ratios diminish them.

The changes in age structure that accompany the demographic transition are emphasized here because of their importance particularly in countries which have experienced rapid fertility decline in East Asia and elsewhere. The post-World War II baby booms of the US and other Western countries have also produced significant changes in age structure and demographic dividends. These are qualitatively similar to those experienced in East Asia but smaller in scale. Although Japan experienced its own post-war baby boom, it was short-lived with little discernable effect.

We will now briefly consider some policy issues related to these themes.

As noted, population aging will lead to substantial declines in support ratios from their peaks at the culmination of the first dividend phase of the transition. Assuming that the shapes of the age profiles of consumption and labor income do not change, we can calculate the size of these declines. In Japan, the support ratio will decline by 25% between 2008 and 2050, or at .7% per year. In Korea the decline will be by 22%, or .6% per year. In China the decline will be only 14%, and in India and ASEAN the support ratio will rise.

The projected declines in support ratios have occasioned deep concerns in many countries, since they imply an increased dependency burden on the working age population and threaten fiscal instability. They depend on both demographic trends and on the age patterns of consumption and labor income. Some governments have considered policies to reduce the pace and depth of future population aging by raising fertility. The past experience of European nations with pronatalist policies has not been encouraging in this regard, however. Another possibility is immigration, but this seems unlikely to play a significant role in ameliorating population aging in the Asian context,

since Asia is a major net supplier of migrants to other parts of the world, and the more highly industrialized countries like Japan and Korea have a history of highly restrictive immigration policies (Mason et al, 2008).

Another way to reduce the projected declines in support ratios is to modify the age patterns of consumption and labor income in a way that raises support ratios for a given demographic structure. Policies to encourage later retirement have not drawn much attention in Asia; indeed many countries have mandatory retirement laws (see Mason et al, 2008), but later retirement could moderate the decline in support ratios, as could increases in female labor supply. The incentive structure created by public pension programs can have an important effect on retirement behavior (Gruber and Wise, 1999) and the design of any new pension programs could be shaped accordingly. Turning to the consumption age profiles, Japan (Ogawa et al, in this conference) and Western industrial countries have experienced disproportional increases in consumption by the elderly relative to younger adults in recent decades, and such changes exacerbate the costs of population aging and its effects on support ratios. Some of this increase in old age consumption appears to be driven directly by the structure of public transfers to the elderly for pensions and health care. It is possible that declines in elder co-residence with adult children are an in part an indirect consequence of these public transfers, and this decline may also have contributed to the increases in old age consumption by reducing family level income pooling.

The great increase in human capital investment over the course of the demographic transition has surely played an important role in economic development. Both theory and empirical analysis suggest that the increased human capital investment is closely tied to fertility decline and to a lesser degree to mortality decline. However, the direction of causality is not entirely clear, leaving some uncertainty about whether policy

driven changes in fertility, for example through pronatalist policies, would lead to opposite changes in human capital.

In the global context, East Asia stands out as investing particularly heavily in children's human capital, but in our analysis (Lee and Mason, 2008) the level of investment is to be expected, given the exceptionally low fertility in East Asia. The strong role for private spending on education, complementing public education, is also distinctive in East Asia. Given this already strong pattern of human capital investment, the main policy concern appears to be that new policies not interfere with this existing tendency. It is also possible that the demand for a high level of human capital investment is itself a driving force behind the very low levels of fertility in East Asia.

Our final point is the need for governments and societies to consider carefully the arrangements supporting consumption by the elderly, and potential changes in these arrangements. Should continuation of familial support for the elderly be encouraged by policy? Or should governments move toward public pension programs, and should any new pension programs be funded or PAYGO?

A switch from familial support to public PAYGO pensions may entail less change than it appears, since both accumulate implicit debt as the population ages, and both entail increasing dependency burdens on the working age adult. However, public sector pension programs spread the support costs more evenly across the population while altering the incentives of the elderly and adult children in various ways. In either case, it should be kept in mind that the transfer wealth generated by familial support or PAYGO pensions is likely to substitute for capital in individual's retirement plans. Transfer programs of these kinds likely diminish the promotion of capital accumulation by population aging, the second dividend. Policies that encourage life cycle saving and personal retirement accounts, whether public or private, would enable countries to harness the power of population aging to generate increased capital per worker.

There are tradeoffs between the benefits and drawbacks of familial, PAYGO, and funded old age support programs, and each society may choose a different mix. The key point is that most but not all of the countries of Asia are still at an early enough stage in the transition that they have options that are no longer open to Japan and the other industrial nations. For these countries to transit from their PAYGO programs to funded programs would entail very heavy costs amounting to a year or several years worth of GDP. For countries earlier in the transition, that do not yet have comprehensive PAYGO programs, steps to encourage individual responsibility for own retirement are much more feasible and less painful.

Population aging and the forces leading to it produce not only frightening declines in support ratios, but also very substantial increases in productivity and per capita income. Low fertility and low mortality are associated with large increases in human capital investment in children, and they also cause large increases in the accumulation of physical capital. Together, these positive changes will likely outweigh the problems of declining support ratios. Population aging brings economic benefits as well as costs, and we should view this package of consequences as a whole while developing policies to minimize the costs and amplify the benefits.

<A>References

Attanasio, O. P., S. Kitao, et al. (2006). “Quantifying the Effects of the Demographic Transition in Developing Economies.” Advances in Macroeconomics 6(1): Article 2.

Bhat, P.N. Mari (1989). “Mortality and Fertility in India, 1881-1961: A Reassessment” in Tim Dyson, ed., India’s Historical Demography: Studies in Famine, Disease and Society (Curzon Press, London) pp.73-118.

Bauer, J. (2001). Demographic Change, Development, and the Economic Status of Women in East Asia. Population Change and Economic Development in East Asia: Challenges Met, Opportunities Seized. A. Mason. Stanford, Stanford University Press.

Becker, G. (1991). A Treatise on the Family, enlarged edition. Cambridge, MA, Harvard University Press.

Becker, G. S., Kevin M. Murphy, and Robert Tamura (1990). ”Human Capital, Fertility, and Economic Growth.” Journal of Political Economy, 98 (October), part II, S12-37.

Bloom, D. E. and J. G. Williamson (1998). "Demographic Transitions and Economic Miracles in Emerging Asia." World Bank Economic Review 12(3): 419-56.

Bloom, D. E. and D. Canning (2001). Cumulative Causality, Economic Growth, and the Demographic Transition. Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World. N. Birdsall, A. C. Kelley and S. W. Sinding. Oxford, Oxford University Press: 165-200.

Bloom, D. E., D. Canning, et al. (2003). “Longevity and Life-cycle Savings.” Scandinavian Journal of Economics 105(3): 319-338.

Cutler, D. M., J. M. Poterba, et al. (1990). “An Aging Society: Opportunity or Challenge?” Brookings Papers on Economic Activity 1990(1): 1-56.

Deardorff, A. V. (1987). Trade and Capital Mobility in a World of Diverging Populations. Population growth and economic development: Issues and evidence. D.-G. Johnson, ed., and R.-D. Lee, ed., Social Demography series, Madison, Wis., University of Wisconsin Press: 523-60.

Deaton, A. and C. H. Paxson (2000). Growth, Demographic Structure, and National Saving in Taiwan. Population and Economic Change in East Asia, A Supplement to Population and Development Review. R. Lee and C. Y. C. Chu. New York, Population Council. 26: 141-173.

Gruber, J. and D. A. Wise (1999). Introduction and Summary. Social Security and Retirement around the World. J. Gruber and D. A. Wise. Chicago, The University of Chicago Press: 437-474.

Higgins, M. (1994). The demographic determinants of savings, investment and international capital flows. Department of Economics. Cambridge, MA, Harvard University.

Higgins, M. and J. G. Williamson (1997). “Age Structure Dynamics in Asia and Dependence on Foreign Capital.” Population and Development Review 23(2): 261-93.

Hurd, Michael (1987). "Savings of the Elderly and Desired Bequests," American Economic Review 77: 298-312.

Kelley, A. C. and R. M. Schmidt (1996). “Saving, Dependency and Development.” Journal of Population Economics 9(4): 365-86.

Kinugasa, T. (2004). Life Expectancy, Labor Force, and Saving, Ph.D. Dissertation. University of Hawaii at Manoa.

Kinugasa, T. and A. Mason (2007). “Why Nations Become Wealthy: The Effects of Adult Longevity on Saving.” World Development 35(1): 1-23.

Kuehlwein, Michael (1993). “Life-Cycle and Altruistic Theories of Saving with Lifetime Uncertainty” The Review of Economics and Statistics 75(1)(Feb.): 38-47.

Lee, R. and A. Mason (2007). “Population Aging, Wealth, and Economic Growth: Demographic Dividends and Public Policy.” UN World Economic and Social Survey Background Paper.

Lee, R., A. Mason, et al. (2000). “Life Cycle Saving and the Demographic Transition in East Asia.” Population and Development Review 26(Supplement).

Lee, R., A. Mason, et al. (2002). Saving, Wealth, and the Transition from Transfers to Individual Responsibility: The Cases of Taiwan and the United States. under review.

Lee, R., A. Mason, et al. (2003). “From Transfers to Individual Responsibility: Implications for Savings and Capital Accumulation in Taiwan and the United States.” Scandinavian Journal of Economics 105(3): 339-357.

Lee, R., A. Mason (2008). "Fertility, Human Capital, and Economic Growth over the Demographic Transition" paper presented at the 2008 Annual Meetings of the Population Association of America.

Lee, R. D., S.-H. Lee, et al. (2007 forthcoming). Charting the Economic Lifecycle. Population Aging, Human Capital Accumulation, and Productivity Growth, a supplement to Population and Development Review 33. A. Prskawetz, D. E. Bloom and W. Lutz. New York, Population Council.

Mason, A. (1987). National Saving Rates and Population Growth: A New Model and New Evidence. Population growth and economic development: Issues and evidence. D. G. Johnson and R. D. Lee. Social Demography series, Madison, Wis., University of Wisconsin Press: 523-60.

------. (2001). Population and Economic Growth in East Asia. Population Change and Economic Development in East Asia: Challenges Met, Opportunities Seized. A. Mason. Stanford, Stanford University Press: 1-30.

------. (2005). Demographic Transition and Demographic Dividends in Developed and Developing Countries. United Nations Expert Group Meeting on Social and Economic Implications of Changing Population Age Structures, Mexico City.

------. (2007). Demographic Dividends: The Past, the Present, and the Future. Population Change, Labor Markets and Sustainable Growth: Towards a New Economic Paradigm. A. Mason and M. Yamaguchi, Elsevier Press.

Mason, A. and R. Lee (2006). "Reform and support systems for the elderly in developing countries: capturing the second demographic dividend." GENUS LXII(2): 11-35.

Mason, A. and R. Lee (2007). Transfers, Capital, and Consumption over the Demographic Transition. Population Aging, Intergenerational Transfers and the Macroeconomy. R. Clark, N. Ogawa and A. Mason, Elgar Press.

Mason, A., S-H Lee, and R. Lee (2008). "Asian Demographic Change: Its Economic and Social Implications" written for a volume: Emerging Asian Regionalism: Ten Years after the Crisis– *A Study by the Asian Development Bank.*

Modigliani, F. (1988). Measuring the Contribution of Intergenerational Transfers to Total Wealth: Conceptual Issues and Empirical Findings. Modeling the Accumulation and Distribution of Wealth. D. Kessler and A. Masson. Oxford, Oxford University Press: 21-52.

Modigliani, F. and R. Brumberg (1954). Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data. Post-Keynesian Economics. K. K. Kurihara. New Brunswick, N.J., Rutgers University Press.

Ogawa, N. and R. D. Retherford (1993). "Care of the Elderly in Japan: Changing Norms and Expectations." Journal of Marriage and the Family 55(3): 585-97.

Samuelson, P. (1958). “An Exact Consumption Loan Model of Interest with or without the Social Contrivance of Money.” Journal of Political Economy 66: 467-82.

Solow, R. M. (1956). “A Contribution to the Theory of Economic Growth.” Quarterly Journal of Economics 70(1): 65-94.

Tobin, J. (1967). Life Cycle Saving and Balanced Economic Growth. Ten Economic Studies in the Tradition of Irving Fisher. W. Fellner. New York, Wiley: 231-56.

United Nations, Population Division (2001). World Population Prospects: The 2000 Revision. Disk 2: Extensive Set. CDROM. New York, February.

------. (2007). World Population Prospects: The 2006 Revision. New York, United Nations.

Williamson, J. G. and M. Higgins (2001). The Accumulation and Demography Connection in East Asia. Population Change and Economic Development in East Asia: Challenges Met, Opportunities Seized. A. Mason. Stanford, Stanford University Press: 123-54.

World Bank (1994). Averting the Old Age Crisis, World Bank, Washington D.C.

Table 1. Population Growth Rates (%), 1950-2050.

	1950-55	1975-80	2000-05	2025-10	2045-50
ASEAN	2.10	2.14	1.39	0.69	0.19
Brunei Darussalam	5.56	3.65	2.29	1.28	0.78
Cambodia	2.15	-1.01	1.76	1.26	0.77
Indonesia	1.67	2.20	1.31	0.61	0.10
Lao PDR	2.73	1.30	1.62	1.08	0.50
Malaysia	2.72	2.32	1.95	0.87	0.41
Myanmar	1.96	2.19	0.89	0.47	0.01
Philippines	2.99	2.70	2.08	1.09	0.50
Singapore	4.90	1.30	1.49	0.38	-0.37
Thailand	2.84	2.08	0.76	0.12	-0.27
Viet Nam	1.87	1.99	1.45	0.75	0.21
CHINA +	1.90	1.49	0.67	0.17	-0.32
China, People's Rep. of	1.87	1.48	0.67	0.17	-0.32
Hong Kong, China	4.64	2.73	1.15	0.54	0.11
Taiwan	3.63	1.95	0.54	-0.06	-0.89
India	1.73	2.30	1.62	0.79	0.32
Japan	1.43	0.93	0.14	-0.56	-0.78
Korea, Rep. of	2.55	1.55	0.46	-0.25	-0.89

Note: Values for ASEAN and China + are for the combined populations not simple average across the group members. Source: United Nations Population Prospects, 2006. Taiwan: see text.

Table 2. Percentage of Population Under Age 20, 1950-2050.

	1950	1975	2000	2025	2050
ASEAN	49.0	53.0	41.8	30.3	24.1
Brunei Darussalam	46.0	50.5	40.0	29.6	24.7
Cambodia	52.6	52.8	54.3	39.0	29.4
Indonesia	50.0	52.3	40.6	28.9	23.6
Lao PDR	49.5	54.3	54.1	38.7	26.9
Malaysia	50.4	53.2	43.6	31.7	24.5
Myanmar	44.3	51.7	40.4	27.9	23.0
Philippines	53.7	55.4	48.4	37.3	26.6
Singapore	50.0	45.7	28.1	16.4	15.5
Thailand	53.0	53.3	32.1	24.4	21.4
Viet Nam	41.9	53.8	44.1	29.4	23.1
CHINA +	43.4	48.8	32.8	23.7	20.5
China, People's Rep. of	43.3	48.9	32.9	23.8	20.5
Hong Kong, China	41.2	42.3	23.7	15.7	15.2
Taiwan	52.5	47.4	29.7	20.6	18.6
India	47.7	50.6	45.1	33.3	24.4
Japan	45.8	31.5	20.5	15.5	15.3
Korea, Rep. of	51.7	50.3	28.9	16.8	14.2

Source: United Nations Population Prospects, 2006. Taiwan: see text.

Table 3. Percentage of Population Age 20-64, 1950-2050.

	1950	1975	2000	2025	2050
ASEAN	47.2	43.4	53.3	60.6	58.3
Brunei Darussalam	49.2	46.0	57.0	62.8	60.5
Cambodia	44.7	44.4	42.7	56.0	60.9
Indonesia	46.1	44.4	54.5	62.1	57.8
Lao PDR	48.4	42.7	42.5	56.5	62.5
Malaysia	44.6	43.0	52.5	59.6	59.2
Myanmar	52.3	44.0	54.1	62.9	58.1
Philippines	42.7	41.6	48.0	56.3	60.4
Singapore	47.6	50.1	64.8	60.8	51.7
Thailand	43.8	43.1	61.2	60.7	55.3
Viet Nam	53.9	41.3	50.5	61.9	57.7
CHINA +	52.1	46.8	60.3	62.5	55.7
China, People's Rep. of	52.2	46.7	60.3	62.5	55.8
Hong Kong, China	56.3	52.3	65.4	62.6	52.1
Taiwan	45.0	49.2	62.1	62.3	55.5
India	49.2	46.0	50.3	58.9	61.1
Japan	49.3	60.6	62.2	55.1	47.0
Korea, Rep. of	45.2	46.1	63.7	63.6	50.6

Source: United Nations Population Prospects, 2006. Taiwan: see text.

Table 4. Percentage of Population 65 and Older, 1950-2050.

	1950	1975	2000	2025	2050
ASEAN	3.8	3.6	4.9	9.1	17.7
Brunei Darussalam	4.9	3.5	2.9	7.6	14.8
Cambodia	2.7	2.8	2.9	5.0	9.8
Indonesia	4.0	3.3	4.9	9.0	18.6
Lao PDR	2.2	3.1	3.4	4.7	10.6
Malaysia	5.1	3.7	3.9	8.7	16.3
Myanmar	3.4	4.2	5.5	9.3	18.9
Philippines	3.6	3.1	3.5	6.5	12.9
Singapore	2.4	4.1	7.2	22.8	32.8
Thailand	3.2	3.6	6.7	14.9	23.3
Viet Nam	4.2	4.9	5.5	8.7	19.2
CHINA +	4.4	4.4	6.9	13.8	23.8
China, People's Rep. of	4.5	4.4	6.8	13.7	23.7
Hong Kong, China	2.5	5.4	11.0	21.7	32.6
Taiwan	2.4	3.4	8.1	17.2	25.9
India	3.1	3.4	4.6	7.7	14.5
Japan	4.9	7.9	17.2	29.5	37.7
Korea, Rep. of	3.0	3.6	7.4	19.6	35.1

Source: United Nations Population Prospects, 2006. Taiwan: see text.

Table 5. Annual net migration rate (net migrants per thousand population)

	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000	2000-2005
ASEAN											
Brunei Darussalam	18.0	13.6	11.0	17.3	13.6	10.9	2.5	4.7	2.6	2.2	2.0
Cambodia	-0.0	-0.0	-0.0	-0.1	-12.8	-3.6	—	3.4	2.8	1.3	0.2
Indonesia	-0.0	-0.0	-0.1	-0.1	-0.0	-0.1	-0.1	-0.5	-0.8	-0.9	-0.9
Lao PDR	-0.0	0.0	0.0	0.0	0.0	-13.2	-2.1	0.0	-1.4	-3.5	-4.2
Malaysia	1.9	1.3	1.0	-1.5	-1.6	1.5	-0.3	1.8	3.0	4.5	1.2
Myanmar	—	—	—	—	—	—	-0.3	-0.7	-0.6	0.0	-0.4
Philippines	—	—	—	-0.7	-1.1	-1.6	-3.0	-2.7	-2.8	-2.5	-2.2
Singapore	15.0	11.6	1.1	0.4	1.3	0.9	11.7	9.7	15.4	19.6	9.6
Thailand	—	—	—	—	0.4	0.9	0.0	0.0	0.6	1.7	0.7
Viet Nam	—	—	—	—	—	-3.2	-0.9	-0.8	-0.7	-0.5	-0.5
China +											
China	-0.1	-0.1	-0.2	—	-0.2	-0.1	-0.0	-0.1	-0.2	-0.2	-0.3
China, Hong Kong SAR	17.4	13.0	9.5	-5.0	7.3	15.1	5.1	0.9	10.1	9.3	8.7
Taiwan	—	—	0.1	-0.0	-0.5	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2
Japan	-0.0	-0.1	-0.0	-0.1	-0.1	-0.0	0.0	0.3	0.4	0.4	0.4
Republic of Korea	5.4	-0.0	-0.2	-0.2	-0.8	-1.0	-1.0	-0.9	-0.5	-0.3	-0.3
India	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2

Sources: UN 2007 World Population Prospects; Taiwan-Fuchien Demographic Fact Book, various years.

Table 6. Annual Growth Rates (%), Effective Numbers of Consumers and Producers

	1990	1995	2000	2005	2010	2015	2020
Effective Consumers							
ASEAN	2.0	1.8	1.6	1.4	1.2	1.1	0.9
China +	1.3	1.1	0.9	0.7	0.6	0.5	0.3
India	2.2	2.0	1.8	1.7	1.5	1.3	1.1
Japan	0.5	0.3	0.1	-0.1	-0.2	-0.3	-0.5
Korea	1.1	0.9	0.7	0.5	0.3	0.1	-0.1
Effective Producers							
ASEAN	2.8	2.7	2.3	2.1	1.7	1.3	1.0
China +	2.4	1.9	1.4	1.1	0.7	0.3	-0.2
India	2.5	2.4	2.3	2.2	2.0	1.8	1.6
Japan	0.5	0.2	-0.1	-0.4	-0.6	-0.7	-0.8
Korea	2.2	1.6	1.2	0.7	0.2	-0.2	-0.7

Table 7. Distribution of Effective Consumers and Producers.

	1990	2025	2050
Effective Consumers			
ASEAN	16.4	18.0	19.0
China +	45.3	39.5	36.0
India	31.7	37.8	41.4
Japan	4.9	3.3	2.6
Korea	1.7	1.3	1.1
Total	100.0	100.0	100.0
Effective Producers			
ASEAN	15.4	18.1	19.1
China +	47.2	40.5	34.3
India	29.9	37.0	43.5
Japan	5.7	3.0	2.2
Korea	1.8	1.4	0.9
Total	100.0	100.0	100.0

Table 8. Net Saving/National Income (%), Country Groupings.

	IG trans share low (0.35)			IG trans share high (0.65)		
	1995	2005	2025	1995	2005	2025
ASEAN	13.6	21.5	18.5	7.5	7.3	4.9
China +	32.4	21.6	6.5	7.6	5.3	2.8
India	7.0	15.0	21.6	7.1	7.6	5.7
Japan	38.6	15.9	3.5	4.5	2.9	1.4
Korea	52.9	32.4	2.6	7.9	4.7	1.4

Table 9. Assets/Labor Income, Country Groupings.

	IG trans share low (0.35)			IG trans share high (0.65)		
	1995	2005	2025	1995	2005	2025
ASEAN	1.6	2.4	5.0	1.3	1.5	1.8
China +	2.6	4.4	7.1	1.5	1.7	2.0
India	1.1	1.5	3.9	1.0	1.2	1.7
Japan	10.2	13.6	14.9	2.5	2.6	2.8
Korea	5.2	8.9	12.7	2.1	2.2	2.3

Table 10. Annual Growth in Consumption Due to Age Structure (%), Country Groupings.

	IG trans share low (0.35)		IG trans share high (0.65)	
	1995-2005	2005-2025	1995-2005	2005-2025
ASEAN	0.3	1.2	0.9	0.6
China +	3.0	1.4	1.0	0.1
India	-0.2	0.7	0.6	0.7
Japan	4.1	0.5	0.0	-0.3
Korea	5.9	2.6	1.0	0.0

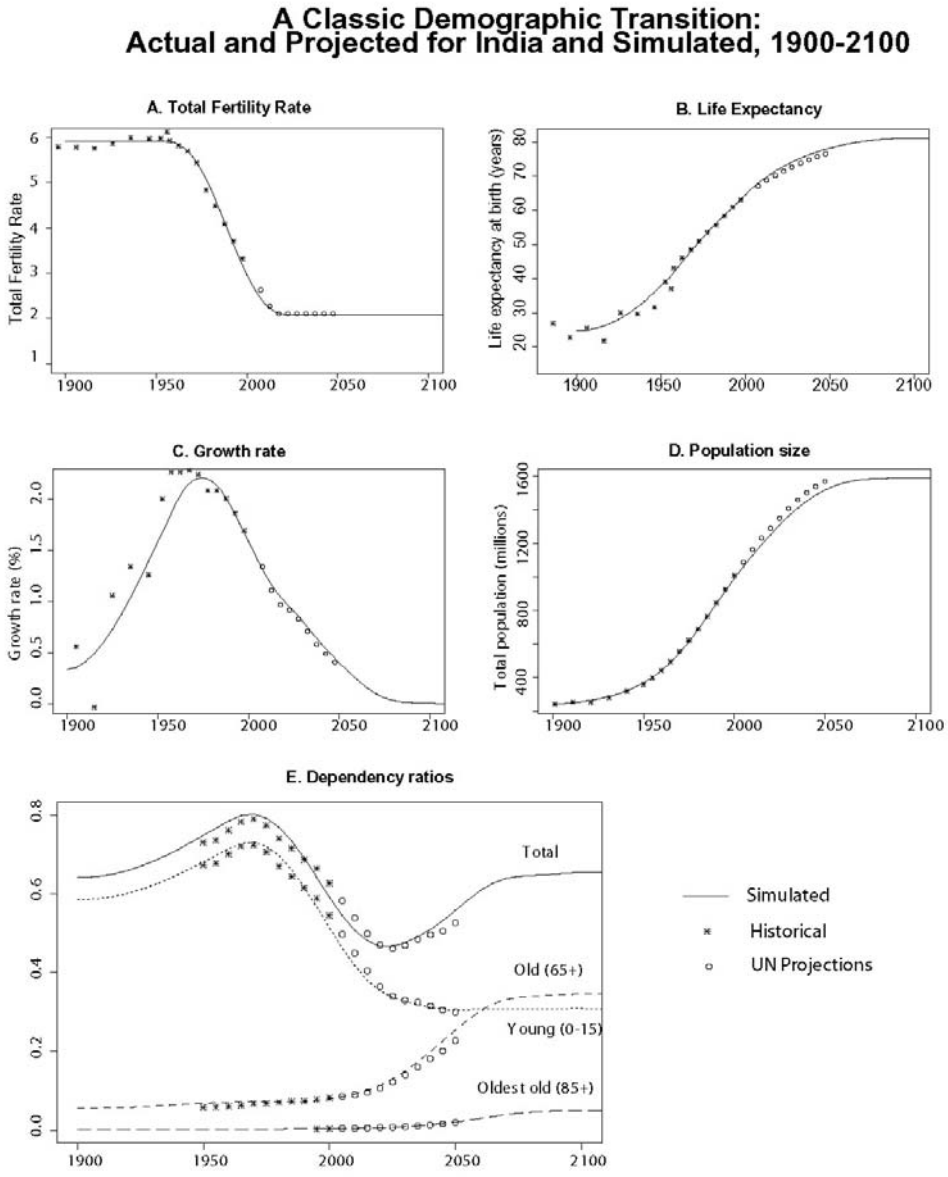

Figure 1. A Classic Demographic Transition, India 1890 to 2100, Historical, Projected and Simulated

Note: The simulation is based on a fertility transition in which the total fertility rate follows a quintic path declining from 5.9 in 1953 to 2.1 in 2025 and a mortality transition in which a Lee-Carter mortality index follows a sinusoidal path as e(0) increases from 24.7 in 1900 to 80.0 in 2100. Actual India data for the period 1891-1901 to 1941-1951 are taken from Bhat (1989). Actual and projected data are taken from UN (2001).

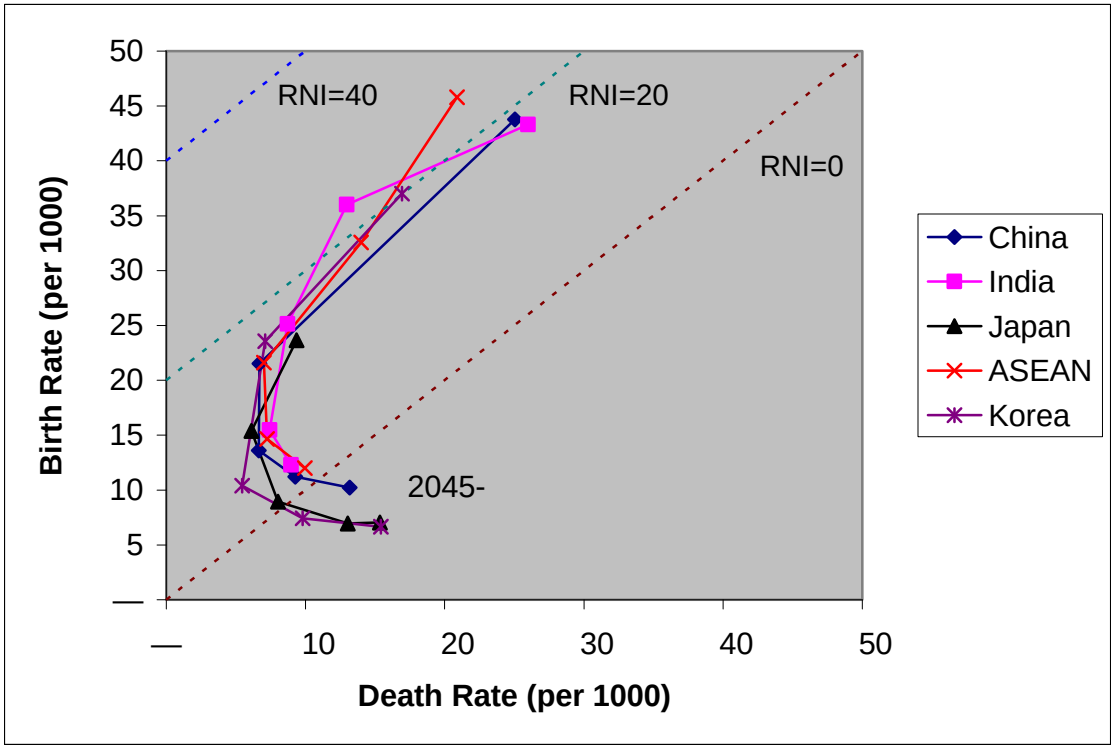

Figure 2. Birth Rates and Death Rates for Selected Asian Countries, 1950-55, 1975-80, 2000-05, 2025-30, and 2045-50. RNI is rate of natural increase per 1000 persons. ASEAN is a simple average of country values. Source: Based on data from United Nations Population Division 2007.

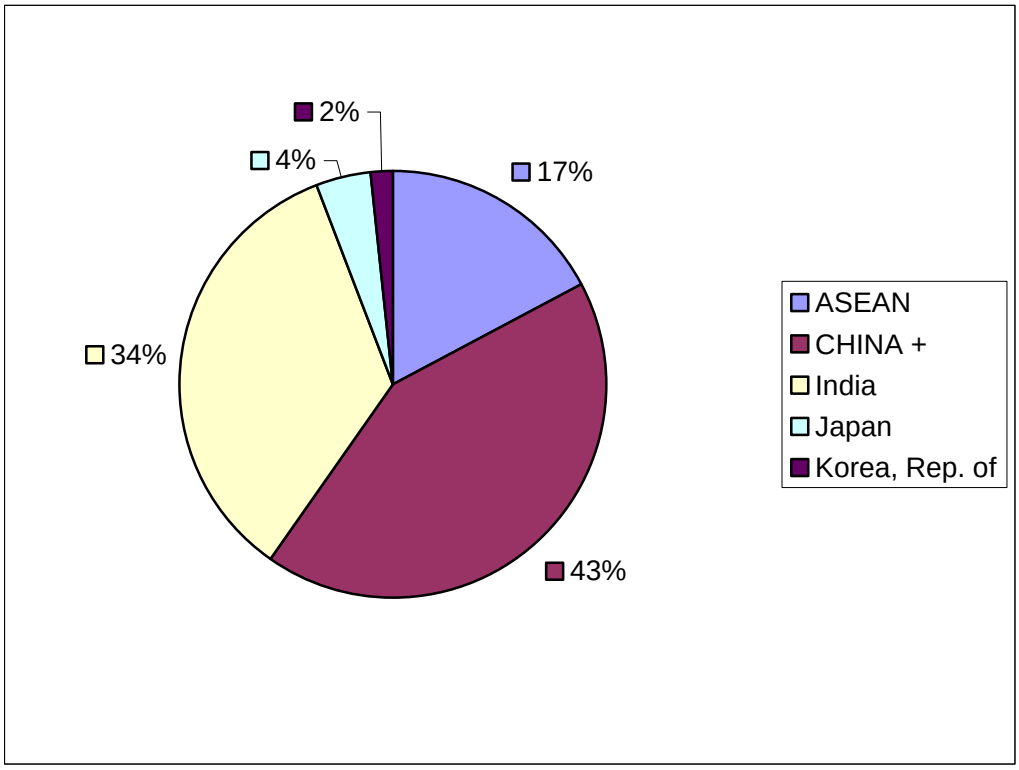

Figure 3. Regional Distribution of Population for Major Country Groupings, 2000.
Source: See text.

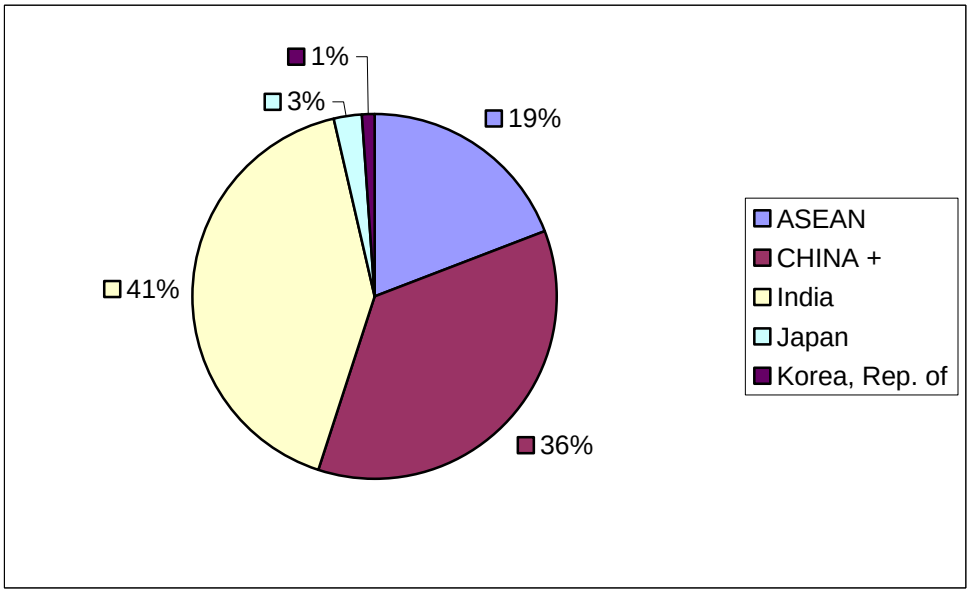

Figure 4. Regional Distribution of Population for Major Country Groupings, 2050.
Source: See text.

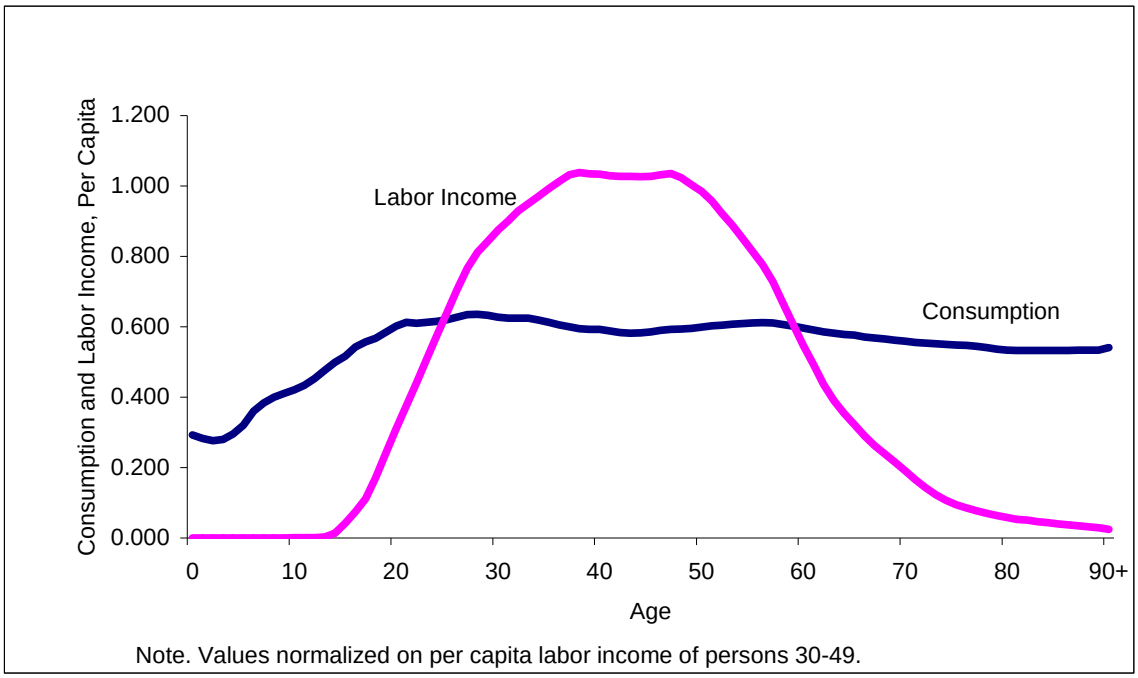

Figure 5. The Economic Lifecycle, Developing World Profile. Source: (Lee and Mason 2007).

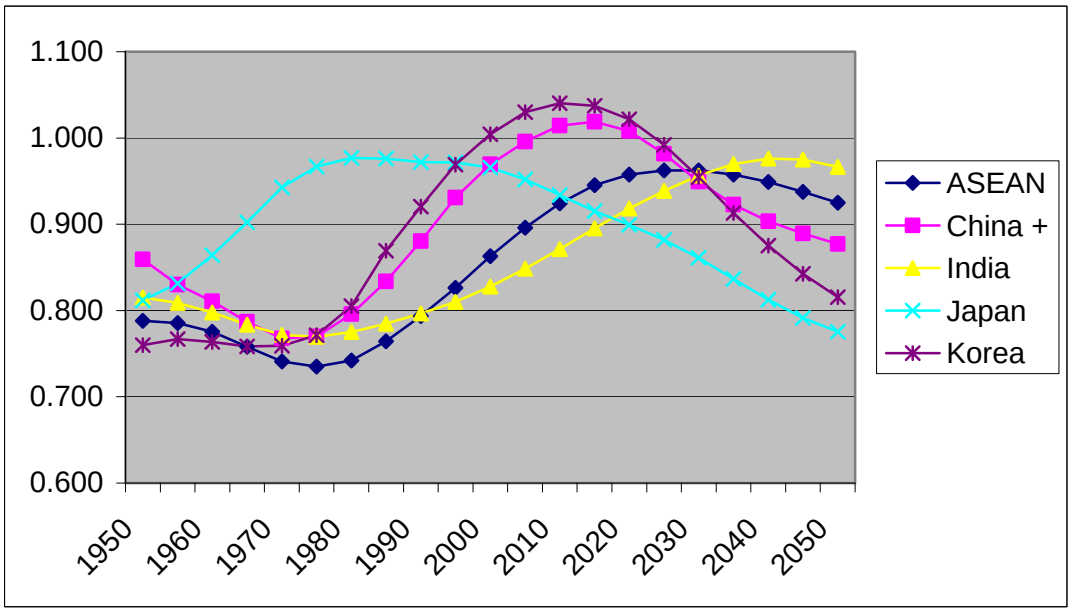

Figure 6. Economic Support Ratio, Country Groupings, 1950-2050. Source: Calculated by authors.

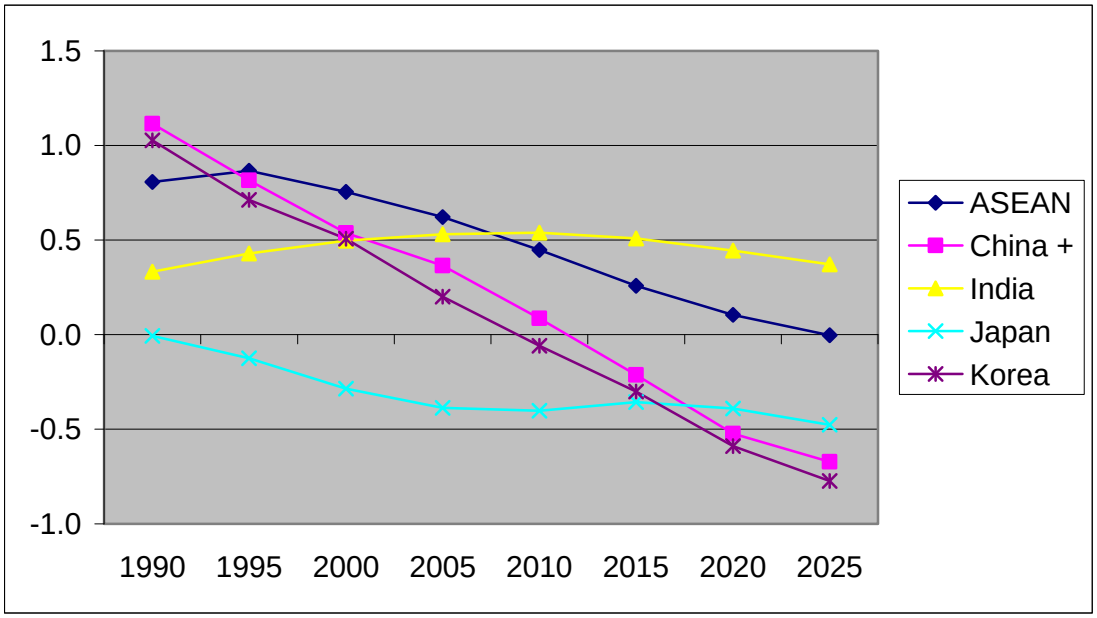

Figure 7. The First Demographic Dividend (%), 1990-2025, Country Groupings. Source: Calculated by authors.

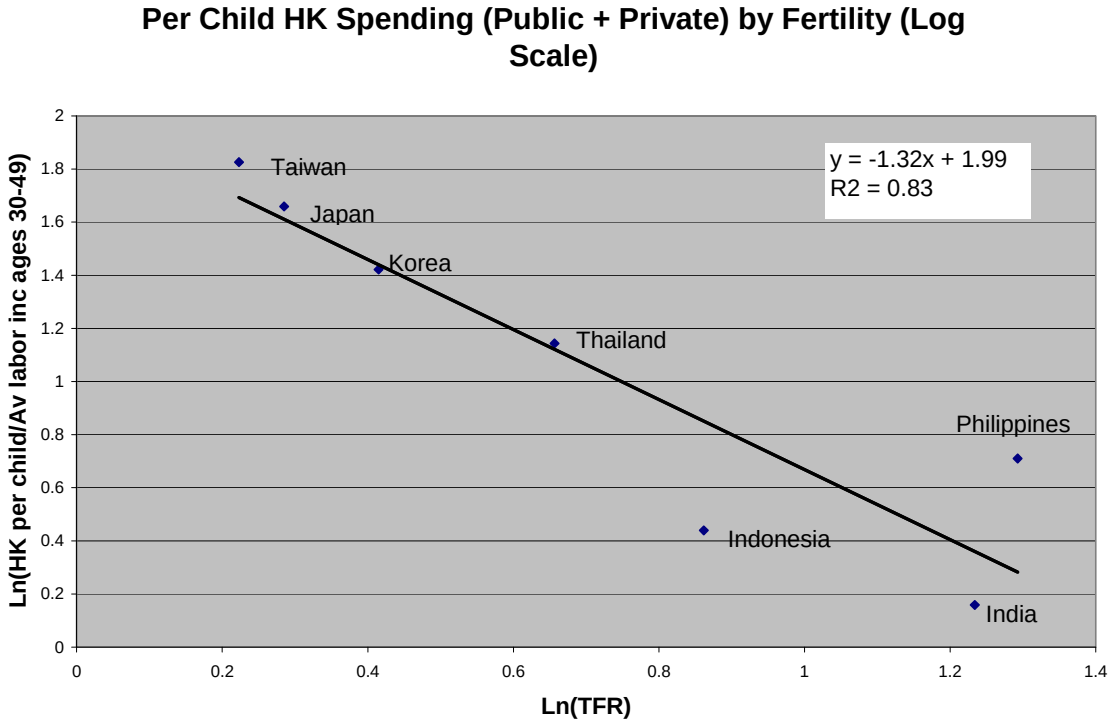

Figure 8. Total Human Capital Spending per Child on Health up to 18 and Education up to 26, Public and Private, Divided by Average Labor Income Ages 30-49.

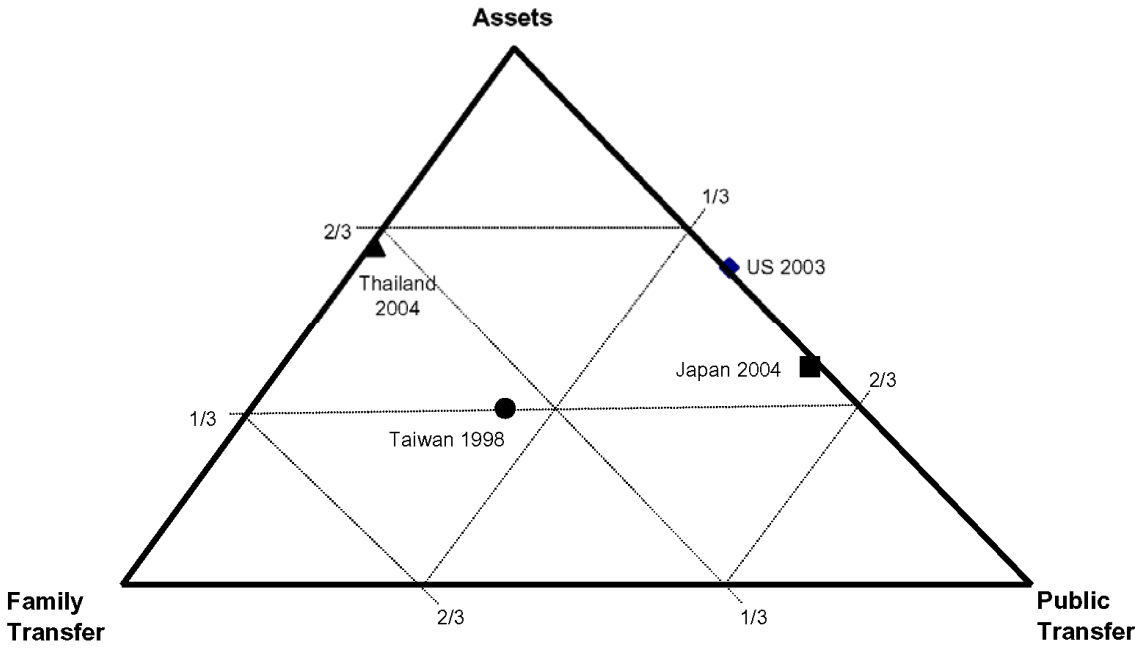

Figure 9. Proportion of lifecycle deficit of those 65 and older funded through familial transfers, public transfers, and asset-based reallocations (asset income and dis-saving). Selected Asian countries and the US. Computational details available at www.ntaccounts.org. Estimates from the National Transfer Accounts Project. Japan estimates constructed by Naohiro Ogawa, Rikiya Matsukura, and Chawla Amonthep. Thai estimates constructed by Amonthep. Information about Taiwan and US estimates available in Mason, Lee, et al. (forthcoming).

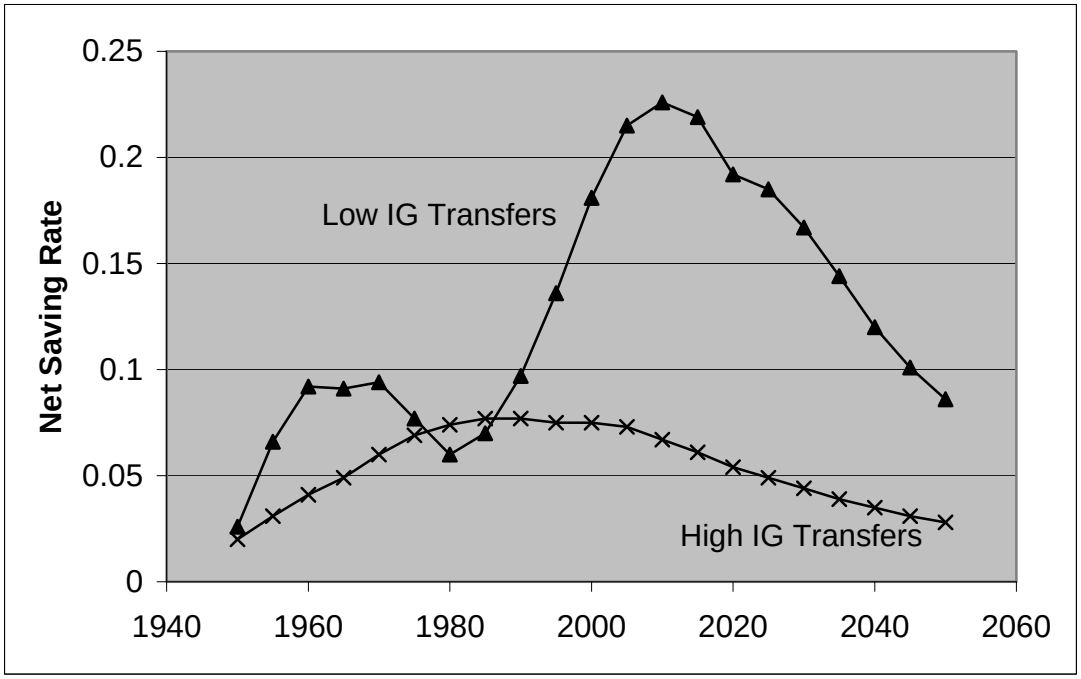

Figure 10. Net Saving Rate Simulations, ASEAN population, 1950-2050. Low (high) IG transfer assumes that transfer wealth is 35% (65%) of pension wealth.

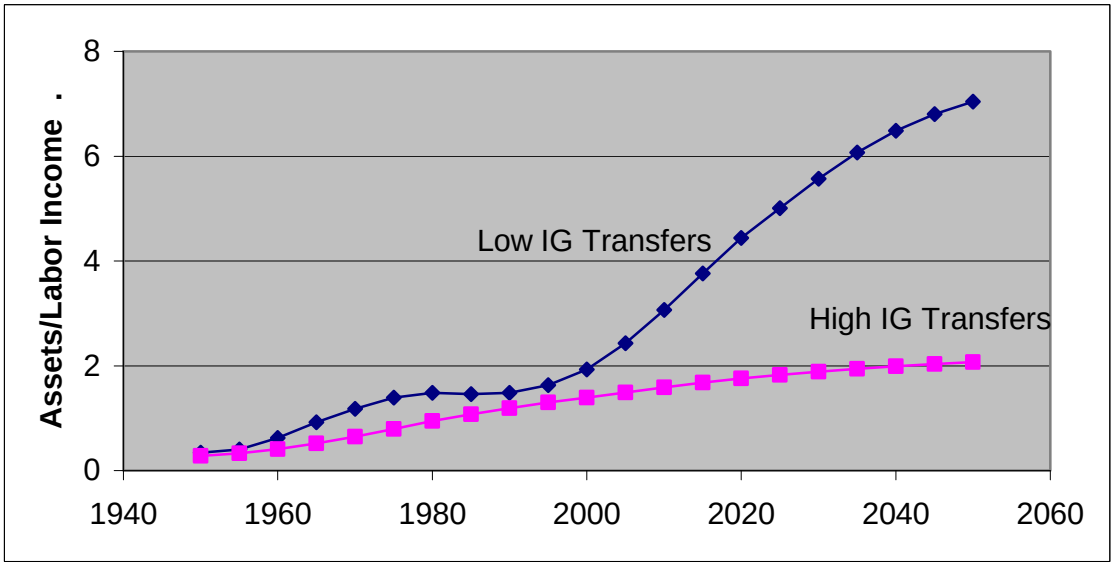

Figure 11. Assets/Labor Income, ASEAN population, 1950-2050. Low (high) IG transfer assumes that transfer wealth is 35% (65%) of lifecycle pension wealth.

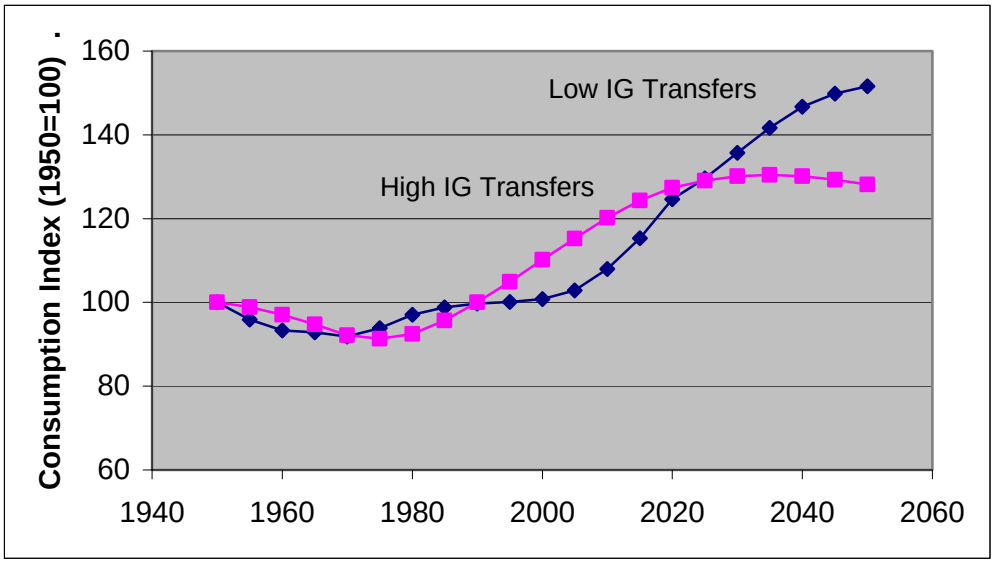

Figure 12. Consumption index, ASEAN, 1950-2050, Low (high) IG transfer assumes that transfer wealth is 35% (65%) of lifecycle pension wealth. Consumption index equals 100 in 1950. Effect of age structure only; effect of productivity increases not included.