The Impact of Aging on Asian Development

David Canning
Harvard School of Public Health

May 2007

Seminar on Aging Asia. A New Challenge for the Region.
Kyoto, Japan, 7 May 2007 and Tokyo, Japan, 8th May 2007

Summary

The timing, speed, and dynamics of ageing in Asia.
The world is aging. A combination of longer life spans and low birth rates is producing a population distribution that is skewed towards the elderly. This phenomenon is well advanced in developed countries in the region such as Japan and Singapore, but is also occurring in developing countries. Low infant mortality rates have led to population surges in People's Republic of China and India, but rapid declines in fertility rates in People's Republic of China, and now in India are reducing youth dependency rates. Both People's Republic of China and India are enjoying a "demographic dividend" of low overall dependency rates. In the foreseeable future, however, the current work force will age, producing a high old age dependency rate.

In the world as a whole, falling fertility and low youth dependency has dominated age structure changes over the last 50 years. However dependency rates reached their minimum in 2005. Since then arising old age dependency has led to increases in total dependency rates. While the basic structure of the picture is the same worldwide the timing and amplitude of the age structure effects differs greatly across countries. Within People's Republic of China and India there is a great deal of regional variation with inland regions lagging behind in terms of timing. A common feature however is for longer life spans and falling fertility to spread to developing countries while their levels of income are still very low. Countries therefore face the prospect of population aging at low levels of income.

An important feature of population aging is the compression of morbidity. In developed countries, the period of sickness and disability near the end of life is falling, even as life spans are increasing; we are producing a new generation of healthy old people. This makes the economic prospects of population aging much less troublesome than if the aging were unhealthy. an important issue in developing countries in Asia is if aging in a low income setting will be similarly healthy.

Implications of population aging for regional development.

Population aging has enormous implications. Since labor supply and saving vary across the life cycle, changes in the age structure of the population will have effects on labor supply per capita and national savings rates. In addition to these "accounting" effects of population aging, age specific behavior will change. Lower fertility is associated with higher female labor supply. Longer healthy life spans can lead to longer working lives, or to additional saving for retirement. We must not simply project aging effects "as if" human behavior will remain the same; it will change.

In addition to these macro economic effects, there are also changes in the composition of consumption as people age. The elderly tend to consume a high level of labor intensive services. Shortages of working age population in aging societies may produce a demand for migrant workers that cannot be easily replaced by imports.

The "population pessimism" associated with the population explosion of the 20th centaury proved ill founded. Resources were found to cope with a massive increase in population and to allow for a much higher standard of living. The 1985 National Academy of sciences report on population pointed out that the "fixed resources" model of

population problem was wrong. Technological progress and highly elastic supply side effects as a response to population pressure, both by markets and institutions, allowed rapid economic growth despite rising population numbers. Population aging similarly has very negative effects in models where there is no behavioral feedback but may be much less threatening with appropriate responses.

Population aging and social security

The major reason population aging matters is that there is a mismatch between the timing of human productivity and human consumption. Children consume more than they produce. This phase now lasts into the late 20's in many countries as they continue in advanced education. Between 25 and 65 are the prime working years in which production exceeds consumption. After 65, consumption exceeds labor income. In almost most cases the young are supported by intra family transfers. Support for the elderly, who require normal consumption and medical care, is more complex, coming from family support, personal saving, and social security transfers. The mix of these support systems for the elderly differs greatly across countries. The ability of transfer systems to cope, wither family or state sponsored, is limited by the rising proportion of the elderly and implied high burden on the working age population. Generous state transfer systems undermine reduce labor supply of the elderly, increasing effective "dependency" rates. Real saving, however, requires robust institutions to ensure that savings for retirement are sufficient, secure, and productively employed.

1. The timing, speed, and dynamics of aging in Asia.

The world is aging. A combination of longer life spans and low birth rates is producing a population distribution that is skewed towards the elderly. This phenomenon is well advanced in developed countries in the region such as Japan and Singapore, but is also occurring in developing countries, particularly India and People's Republic of China.

1.1 Health improvements

Improvements in health and the related rise in life expectancy are among the most remarkable demographic changes of the past century. For the world as a whole, life expectancy more than doubled from around 30 years in 1900 to 65 years by 2000 (and is projected to rise to 81 by the end of this century; Lee 2003). Most of the historical rise reflects declines in infant and child mortality due to public health interventions related to improvements in nutrition, the provision of water and sanitation, and to medical interventions such as vaccine coverage and the use of antibiotics (Cutler, Deaton and Lleras-Muney, 2006) . By contrast, the life expectancy gains observed over the past few decades in developed countries (especially in high-income countries) and projected into the future are predominantly associated with reductions in age-specific death rates at the middle and older ages. These reductions are typically associated with improvements in medical technology, life-style changes, and income growth.

This pattern of declining death rates is common throughout Asia.[1] figure 1 shows life expectancy for 4 regions of Asia, Eastern, South –central, South –east and Western based on existing United Nations data and their projections out to 2050. The Eastern region saw large increases in life expectancy between 1950 and 1980, due to rapid health improvements in People's Republic of China. However all regions have seen sustained improvements and projected rises in the future. While there is undoubtedly a gradient between income and health with higher incomes leading to better health (Preston (1975), Pritchett and Summers (1996)), the most important component has been the upward movement of the whole relationship over time, with improvements in health at every income level. Along with gains in nutrition, relatively inexpensive public health

[1] One exception is the precipitous fall in life expectancy around the world is in Russia in the 1990's (see Bennett, Bloom, and Ivanov (1998)).

measures aimed at disease prevention initially, and medical interventions for the prevention and treatment of infectious disease later, were the basis for early improvements in health. Even poor countries in Asia have seen large health gains. More recently, improvements in health in countries with high life expectancy have relied on the treatment of non-infectious disease, such as cardiovascular disease and cancer, requiring medical interventions that are more costly. While the health trends in Asia look very promising they could be undone. The two factors that might undermine health gains are a rapid spread of HIV/AIDS or rapid increase in life style risk behaviors such as smoking and obesity.

An important feature of health improvements in developed countries is that long life spans have been associated with the compression of morbidity. Not only are people living longer, but they are staying healthy longer. Indeed, the period at the end of life when ill health produces substantial disabilities is being compressed (Murray and Chen 1992, Murray and Lopez, 1997, and Mathers et al. 2001). It seems reasonable that a similar process is occurring in developing countries, though population data on morbidity is developing Asian economies is scarce.

1.2 Falling fertility

In developing countries, the pattern has been for fertility to remain high for a considerable period of time, but when fertility rates start falling they tend to fall at a relatively rapid pace. Fertility remains high initially due to high desired family size. The causes of the fertility decline in low income countries can be ascribed to falling infant mortality rates, and high levels of female education and labor market opportunities that reduce desired fertility, together with the provision of family planning services (Schultz (1997)).

The historic pattern of the fertility transition has been repeated in many countries, with the declines in death occurring first followed at a later stage by declines in the birth rate. But the pace of these declines is occurring more rapidly in today's developing countries than it did historically. While the initial impetuous to fertility decline appears to having varying causes in different countries, once fertility decline gets underway it appears to proceed swiftly.

Figure 2 shows total fertility rates (the completed fertility of a women who experienced the current age specific fertility rates over her reproductive lifetime) for the four regions of Asia, with projections after 2005. We use the United Nations (2004) low fertility assumptions for projections – these have proved more reliable than high fertility assumptions in the past, and do not impose the assumption that fertility will converge to the replacement rate – which would impose rising fertility rates in the future. East Asia saw rapid declines in fertility after 1970 and fertility in the region is now below replacement levels. However, the other three regions have seen declines in fertility and are projected to converge with East Asia.

1.3 Dependency rates

The expansion in lifespans shown in figure 1, usually occurs prior to the reductions in fertility shown in figure 2. Insofar as the gap between the birth rate and the death rate in s the rate of population growth (assuming no net migration), one immediate consequence of the demographic transition, since death rates tend to decline prior to the birth rate, is a period of rapid population growth. On the strength of an annual growth rate of 1.7%, , mainly in developing countries where mortality fell while fertility remained high, world population more than doubled from 1950 to 2000, increasing from 2.6 to 6 billion. The population growth rate is projected by the United Nations Population Division to drop sharply during the next half century (to under 0.8 percent) as birth rates decline, but an additional 3 billion people will nevertheless be added to the planet. [2] People's Republic of China and India, the two most populous countries in the world, exemplify these trends. Health improvements and low infant mortality rates have led to population surges in both People's Republic of China and India, but rapid declines in

[2] It has been asserted in recent years that the world no longer faces a "population problem". This assertion has a variety of sources, including a series of downward revisions of global population projections by the United Nations over the past 10 years (from 10 billion to slightly under 9 billion by 2050). The assertion also reflects the toll of AIDS mortality and evidence that fertility decline has proceeded faster than previously assumed. While there is some truth to the view that world population has lost its "explosive" character, an increase of 3 billion in this half century is still exceedingly large by historical standards. It corresponds, for example, to total world population as recently as 1960. It also corresponds to adding nearly three populations the current size of India, or almost 5 populations the size of Sub-Saharan Africa.

fertility rates in People's Republic of China, and now in India are reducing youth dependency rates.

But population growth is not the only result of the demographic transition. Changes also occur in the age structure of the population. The initial fall in mortality rates creates a "boom generation," in which there are more people at the young ages than in earlier generations because survival rates – mainly infant and child survival -- are higher. After a period of time, fertility rates fall as people realize they do not need as many births to reach their desired family size, or as desired fertility abates as a result of some combination of educational development, income growth, and the expansion of women's opportunities to work outside the home. Improved access to family planning supplies and services may also be an important factor (Bongaarts, 1994, 1997; though Pritchett 1994 argues otherwise). At that point, the baby boom stops. But the age structure of the population then shows a "bulge" that is created by the non-synchronous falls in mortality and fertility. The bulge is particularly pronounced if the drops in mortality and fertility are large and if the period between mortality and fertility decline is short.[3] The bulge works its way through the age structure and, for a period of time, the share of the population that is of working age (generally taken to be 15-64) can be significantly higher than it was previously and than it will be in the future. Eventually the bulge will reach the older ages (as reflected in the UN population projections noted above).

This baby-boom effect can be seen in Figure 3, which represents a succession of cross-sectional population age distributions (e.g., the first slice represents the age distribution in 1950, the second slice represents the age distribution in 1960, etc.). In the absence of mortality and migration, the population aged *a* at time *t* will become the population aged *a+5* at time *t+5*. Thus, the diagonals in Figure 3 represent the path of birth cohorts through the age structure. In this connection, note that the diagonal ridges observed in Figure 3, starting in1970 represent East Asia's baby boom cohort. These ridge begins to reach retirement ages in 2035.

[3] The experience of different regions of the developing world in the latter half of the 20th century shows that the time lag between the onset of the fall in mortality rates and the corresponding decline in fertility rates can occur within widely different time frames, from 15 years upwards.

Figure 4 offers a two-dimensional view of this secular "age wave" process by plotting the ratio of the working-age population to the non-working-age population (i.e., the ratio of 15-64 years olds to the sum of those below age 15 and those ages 65 and over). Declining fertility in East Asia is associated with a sizable rise in the working age share (from 1.5 in 1970 to about 2.7 by 2010). But going forward, population aging will dominate and the working age share will recede steadily from its recent peak (falling to roughly 1.4 at mid-century.

The world as a whole is also in the midst of a period of change in its age structure. The world's population aged 60 and over, which currently represents slightly more than half the number of 15-24 year olds (over 1 billion people), is rising sharply and projected to surpass 1 billion within two decades (and to overtake the 15-24 age group). The population aged 80 and over is projected to increase at an annual rate of 3.4% from 2000 to 2050, corresponding to an increase from 1 to 4 percent in the global population share of the "oldest old". Moreover, the process of population aging is accelerating. During the last 50 years, the number of people aged 60 or over in the world rose by 350 million (to 550 million); in the next 50 years a 1.5 billion increase is projected. Figure 5 shows, for the world as a whole, the overall dependency ratio: the ratio of the young (0- 14 years old) and the old (65 years old or more) to those of working age (15 to 64 year olds). From around 1970 the overall dependency rate has being falling due to falling fertility and youth dependency. However, old age dependency has being rising and from 2010 onwards we see a projected upward trend in the overall dependency rate for the world as increasing numbers of elderly outweigh the decline in the number of children.

Cross-country heterogeneity is among the most salient features of the global demographic profile. For example, virtually all of the increase projected in world population to 2050 will occur among today's low and middle income countries. By contrast, population aging will be most rapid in Western Europe, the United States, and, in particular, Japan, where 42% of the population is projected to be aged 60 or over by 2050, with 16% aged 80+. Japan has recently become the first country in history with an average age of over 40. Japan is projected to have nearly one million centenarians (1% of the population) by 2050.

Demographic heterogeneity is considerable not just between, but also within, country income groups. For example, fertility rates are well below replacement in Europe, whereas they have been hovering at replacement levels in the United States since 1990. Net migration to Europe has been relatively slow in the past decade, whereas net migration to United States has given a sizable boost to its population (including the echo effect of above-average fertility among migrants and their children). According to current projections, which reflect the implications of recent fertility and net migration differences, the population of the United States will overtake that of Europe by 2040.

Figure 6 shows the ratio of working age to non working age population in East Asia, South Asia, Europe, Sub-Saharan Africa, and the United States. It shows that the working-age to non-working-age population ratio rose fastest in East Asia, a consequence of its rapid and pronounced demographic transition. But it also shows that East Asia, which experienced the most rapid declines in fertility, will exhibit the most sizable drop in this ratio given its projected age structure dynamics in the decades ahead. Europe will follow a path similar to that of East Asia as a consequence of rapid population aging, while the trajectory of the United States will be qualitatively similar but far less dramatic, with the ratio being supported by somewhat higher fertility and by immigration. Fertility decline is well under way in South Central Asia, most notably in India and Bangladesh, and its working age ratio already shows signs of increase. Similarly, North Africa and the Middle East are now well into the fertility reduction phase of the demographic transition.

At the other end of the demographic spectrum, Sub-Saharan Africa continues to experience an extremely sluggish demographic transition. In most countries of Sub-Saharan Africa, children continue to be viewed as a valuable source of labor and insurance for old age. As a result, traditionally high fertility rates and large family sizes have persisted in the face of improvements in infant and child mortality, and now the ravages of HIV/AIDS are depleting the working-age population.[4] As a result, the

[4]With respect to mortality, nearly one fourth of all deaths in Sub-Saharan Africa are now due to HIV/AIDS, a rate that is overwhelmingly in excess of the corresponding rate in all other developing regions (UNAIDS 2004). This has a potentially large effect on these economies, given the fact that deaths from AIDS are concentrated among prime age workers, and insofar as the rise in orphans, and decline in prospective longevity, may reduce investments in human capital.

average age of the population has remained low, as has the proportion of working-age people.[5] The projection of a rise in the working age ratio in Figure 7 for Sub-Saharan Africa is contingent on the projections of fertility decline in the region actually taking place.

While population aging is occurring in developed countries, it is also likely to come about in developing countries over the next 50 years. Indeed, given the pace of advances in health and lower mortality, and declines in fertility (particularly in People's Republic of China, due to the one child policy), large scale population aging is likely in developing countries before they reach high levels of income. The window of opportunity created by the potential demographic dividend that occurs when birth rates and youth dependency rates fall is temporary, and is replaced by old age dependency as the baby boom cohort ages.

Table 1 shows the current demographic situation in Asian countries. The countries are ranked by the current old age dependency rate. The countries at the top of the list have long life expectancies and low fertility. they are at or dear the peak in terms of working age people per dependent, being in the phase where fertility and youth dependency have declined but old age dependency have not yet risen excessively. These countries are looking forward to substantial population aging in the future. Near the bottom of the table we have countries where life spans have risen but where fertility remains high. These countries have very high youth dependency rates and can look forward to a decline in dependency as fertility declines.

Demographic projections are fairly reliable. In five years time we will be five years older. Mortality and fertility rates change fairly steadily over time. In the long run it is unclear at what level, or even if, fertility decline will halt. However projections for life expectancy and fertility over the next fifty years are probably quite reliable for most developing countries that are following in the well trodden footsteps of the developed countries. The one caveat to this reliability is migration. Most migrants are young people who migrate for education and employment. Figure 8 shows they age structure of migrants into the United States showing it to be concentrated mainly among young

[5] Some African nations —notably those in southern Africa, including Namibia, Botswana, South Africa, and Zimbabwe—are beginning to show reductions in fertility.

working age people. Figure 9 shows historical flows of population from developing to developed countries with projections for the future.

International migration from developing to developed countries has been rising. The United Nations forecast a stabilization of these flows in the future (figure 9). However it seems likely that international migration will continue to grow. Aging populations in developed countries will generate labor shortages, particular in the health and care service sectors. These shortages will increase the economic incentives to allow inward migration (Hatton and Williamson, 2001, 2002). The fact that the demographic transitions of different regions are occurring sequentially gives rise to labor booms in some regions while others face labor shortages openness the opportunity for large flows to occur. While these flows would enhance welfare overall there are large issues around ensuring that everyone gains from migration including people left behind in the sending country. .

2. Implications of population aging for regional development.

2.1 The effects of demographic change

The "population pessimism" associated with the population explosion of the 20th centaury proved ill founded. Resources were found to cope with a massive increase in population and to allow for a much higher standard of living. The 1985 National Academy of sciences report on population pointed out that the "fixed resources" model of population problem was wrong. Technological progress and highly elastic supply side effects as a response to population pressure, both by markets and institutions, allowed rapid economic growth despite rising population numbers. Population aging similarly has very negative effects in models where there is no behavioral feedback but may be much less threatening with appropriate responses.

Although it is often argued that rapid population growth has a negative effect on the growth rate of income per capita, compelling evidence on this point has been rather elusive and counterarguments abound. Most studies find little cross-country evidence of a significant effect, holding constant myriad other influences on the rate of economic growth. Whether this result reflects the true unimportance of population growth, offsetting negative and positive influences of population growth on economic growth,

inadequate control variables or other model specification errors, poor data, or reverse causality, continue to be open questions. Nonetheless, this body of empirical research has tended to support what has come to be known as the population neutralist view: population growth neither systematically impedes nor promotes economic growth. This view has been the dominant academic belief in this area since the early 1980s and contributed to the marginalization of population and reproductive health as an instrument of economic development among key development agencies like the World Bank. (See Ahlburg (2002), Birdsall, Kelley, and Sinding (2001), Bloom, Canning, and Sevilla (2003), Kelley (1988, 2001), and Kelley and Schmidt (2001)).

New evidence and thinking has emerged in the past few years that challenges, and is beginning to unseat, this longstanding view. This new evidence relates to the importance of population age distribution in the determination of macroeconomic performance. There are two main ideas here. The first, as detailed in the preceding section, is that population growth and changes in the age structure of the population are both consequences of the demographic transition. The second is that people's economic needs and contributions vary over the life cycle. For example, young people tend to be net consumers, while working-age people tend to be net producers and savers, with the elderly falling somewhere in between. Figure 7 shows labor income and consumption by age based on data for Costa Rica, Indonesia, Taipei,China, and Thailand from Mason et al (2006). Lee (2000) argues that this pattern is pervasive.

The mis-match between the time paths of earnings and consumption is universal. People need a mechanism for shifting labor income to young and old ages when they are consuming but not earning. This can be done by saving and borrowing, or more commonly by transfer system. Governments and families are the mechanisms for such transfers. These age specific behaviors mean that the age structure of a population may be very consequential for its economic performance – as measured by income per capita. Large youth and elderly cohorts might slow the pace of economic growth, while large working-age cohorts might speed it. Contrary to the neutralist view, the emerging evidence indicates that population does matter to economic growth, with age structure playing a central role. As the dependency ratio falls, opportunities for economic growth tend to rise, creating what is now referred to as a "demographic dividend".

2.2 Labor Supply and Savings

Population aging will have enormous implications. Since labor supply and saving vary across the life cycle, changes in the age structure of the population will have effects on labor supply per capita and national savings rates. In addition to these "accounting" effects of population aging, age specific behavior will change. Lower fertility is associated with higher female labor supply. Longer healthy life spans can lead to longer working lives, or to additional saving for retirement. We must not simply project aging effects "as if" human behavior will remain the same; it will change.

In addition to these macro economic effects, there are also changes in the composition of consumption as people age. The elderly tend to consume a high level of labor intensive services. Shortages of working age population in aging societies may produce a demand for migrant workers that cannot be easily replaced by imports.

East Asia's macroeconomic performance is tracked very closely by its demographic transition and resulting changes in age structure. Estimates indicate that as much as one-third of its "economic miracle" can be accounted for as a "demographic dividend (Bloom and Williamson (1998), Bloom, Canning, and Malaney (2000), and Mason (2001)). By contrast, the absence of demographic change also accounts for a large portion of Africa's economic debacle (Bloom, Canning, and Sevilla (2003) and Bloom and Sachs (1998)). In addition, the introduction of demographics has reduced the need for the argument that there was something exceptional about East Asia or idiosyncratic to Africa. Most models of economic growth have significant region dummies, usually negative for Sub-Saharan Africa and positive for East Asia, indicating that the poor performance of Africa and the exceptionally good growth performance of East Asia cannot be explained within the models. Once age structure dynamics are introduced into an economic growth model, these regions are much closer to obeying common principles of economic growth (Bloom and Canning (2001), Bloom, Canning, and Malaney (2000)) and the statistical significance of the region dummy variables disappears.

It is also clear, both theoretically and empirically, that there is nothing automatic about the link from demographic change to economic growth (Bloom and Canning (2001), Bloom, Canning, and Sevilla (2003)). Age distribution changes merely create

potential for economic growth. Whether or not this potential is captured depends on the policy environment, as reflected, for example, by the quality of governmental institutions, labor legislation, macroeconomic management, openness to trade, and education policy. This realm is where Latin America seems to have stumbled. During 1965 to 1990, its demographics resembled those of East Asia, but its economic performance lagged well behind. Episodes of high inflation, political instability, adversarial labor relations, and an inward orientation with respect to trade through much of the period appear to have prevented many Latin American countries from exploiting its demographic window of opportunity, at least in its early phases.[6]

The three mechanisms on which we focus on relate to the effects of demography on labor supply per capita, on savings, and on education. Given well-established life-cycle variations in behavior, it is reasonable to suppose that changes in age structure will have effects on aggregate outcomes. For example, since labor supply tends to follow an inverted U-shaped pattern with respect to age, changes in the age composition of the population are likely to have effects on aggregate labor supply. Savings rates also vary with age, with the highest rates occurring for 40 to 70 year olds, implying that changes in the age structure will affect aggregate savings rates.

However, in addition to these "accounting" effects (assuming age-specific behavior remains unchanged we can simply calculate the consequences of age structure change mechanically) there are also behavioral effects. Generational crowding (i.e., being born into a large cohort) may have effects on relative wages and individual labor supply (Easterlin 1980, Bloom, Freeman, and Korenman 1987; Korenman and Neumark 2000). In addition, the decision to reduce fertility and youth dependency rates may be linked to labor market participation, particularly among women.

The effect of life expectancy that we find can be due to a number of mechanisms. One is that higher life expectancy goes hand in hand with better health, and better health may improve worker productivity (Bloom, Canning, and Sevilla 2004). However, there may also be a demographic effect as a longer prospective life span can change life-cycle

[6] As discussed below, Ireland is, like much of East Asia, an example of a country whose policy environment enabled it to take advantage of its demographic dividend.

behavior, leading to a longer working life or higher savings for retirement (Bloom, Canning, and Graham 2003; Bloom, Canning, and Moore 2004).

Central to our understanding of the East Asian "miracle" has been Alwyn Young's work (Young 1994; Young 1995) showing that rapid economic growth in the region was mainly due to increases in factor inputs-- notably labor, capital, and education-- and not to improvements in total factor productivity. In order to understand the rise in income levels in East Asia we must therefore understand the driving forces behind the growth in these inputs. All of the Asian "Tiger" economies enjoyed a surge in savings and investment during their period of rapid economic growth. We focus here on Taipei,China, for which there are fairly good data on household savings. The private savings rate in Taipei,China rose from around 5% in the 1950's to well over 20% in the 1980's and 1990's. Savings rates vary by age, being highest in Taipei,China for households with heads in the 50-60 year old range. We would therefore expect changing age structure to be a possible explanation of this increase in aggregate saving. Studies that examine the link between demographic structure and national savings rates do find a strong connection (Fry and Mason (1982), Higgins (1998), Higgins and Williamson (1997) , Kelley and Schmidt (1996), Leff (1969), Mason (1987, 1988)) and suggest that a large part of the savings boom in East Asia can be explained by the age structure in the population.

However, Deaton and Paxson (2000) show that based on household saving data for Taipei,China, changes in age structure account for only a modest increase in the overall savings rate, perhaps 4 percentage points. They show that the rise in the aggregate savings rate has not been mainly due to changes in the age composition of the population but, rather, to a secular rise in the savings rates of all age groups.

The question then arises as to why savings rates rose at each age. One possible explanation, proposed by Lee, Mason, and Miller (2000) is that increased savings rates are due to rising life expectancy and an increasing need to fund retirement income. Tsai, Chu, and Chung (2000) show that the timing of the rise in household savings rates matches the increases in life expectancy of the population.

With a fixed retirement age we would expect such a savings effect. However, Deaton and Paxson (2000) argue that in a flexible economy, without mandatory

retirement, the main effect of a rise in longevity will be on the span of the working life, with no obvious prediction for the rate of saving. Bloom, Canning, and Moore (2004) formalize this argument to show that under reasonable assumptions the optimal response to an improvement in health and a rise in life expectancy is to increase the length of working life, though less than proportionately, with no need to raise saving rates at all (due to the gains from enjoying compound interest over a longer life span).

While in theory a longer life span should be associated with a longer working life, in practice this may not be the case. Bloom, Canning, and Graham (2003) find that, even allowing for age structure effects, longer life expectancy is strongly associated with higher national savings rates across countries, which suggests that there is a savings effect.[7] This savings effect could of course be due to mandatory retirement systems, which prevent workers from lengthening their working lives. Even in the absence of mandatory retirement, Gruber and Wise (1998) argue that many national social security systems produce strong financial incentives to retire at particular ages and that workers respond to these incentives. For example, the social security system in Taipei,China takes 5.85% of earnings (jointly from employers and workers), pays a lump sum at retirement of at most 50 months salary, and takes contributions, but provides no additional benefits, for workers after 35 years of work who are over 65 years old.

While the optimal response with perfect markets may be for workers to have a longer working life as their health improves and they have longer life expectancies, mandatory or conventional retirement ages, coupled with the strong financial incentives to retire that are inherent in many social security systems, seem to result in early retirement and increased needs for saving for old age (Bloom et al. 2007).

The effect of saving on investment and domestic production depends on the nature of the capital market. With perfect capital mobility demographic change may have an impact on international capital flows (Higgins, 1998). In this case effects on domestic interest rates and investment may be minimal (Poterba, 2004). However if capital markets are imperfect the demographic transition can lead to a mismatch between the investment

[7] The earlier studies of national savings referenced above omit the life expectancy effect, suggesting that their age structure effects may be biased since longer life expectancy is highly correlated with an older population.

needs of a large young working age population and the savings of the older workers for retirement ()Higgins and Williamson, 1997).

2.3 Education

Demography can affect educational investments through several mechanisms. Perhaps the most important is the quantity–quality tradeoff whereby fertility choices and human capital investment decisions are jointly made. This framework points to lower fertility being both a cause and a consequence of increased educational investments, with both fertility and schooling determined as well by a common set of factors that affect families' incentives.

Notwithstanding families' desired fertility, actual fertility in the absence of contraception may be much higher. The provision of family planning services to populations in which desired fertility is low can both lower fertility outcomes and increase schooling levels. This effect may be particularly pronounced for girls' schooling because with high fertility girls are frequently kept out of school to help care for their younger siblings. Foster and Roy (1997) show how a randomized trial providing family planning services in Bangladesh affected both fertility outcomes and children's schooling levels.

The quantity-quality tradeoff can also appear to some extent at the national level if schooling is publicly funded. Smaller youth cohorts can increase the availability of educational funding per child and can lead to an expansion of public education (Kelley 1996).

One reason for an increased incentive to invest in education may be the rise in life expectancy. A longer life increases the time over which education investments can be recouped. Kalemli-Ozcan, Ryder and Weil (2000) argue that the effect of improved health and longevity on educational investments has played a large role in economic growth over the last 150 years. This incentive effect, however, is clearly linked to the prospective working life rather than total lifespan, suggesting that education levels may be linked to planned retirement ages and social security incentives.

3. Population aging and social security

The major reason population aging matters is that there is a mismatch between the timing of human productivity and human consumption. Children consume more than they produce. This phase now lasts into the late 20's in many countries as they continue in advanced education. Between 25 and 65 are the prime working years in which production exceeds consumption. After 65, consumption exceeds labor income. In almost most cases the young are supported by intra family transfers. Support for the elderly, who require normal consumption and medical care, is more complex, coming from family support, personal saving, and social security transfers. The mix of these support systems for the elderly differs greatly across countries. The ability of transfer systems to cope, wither family or state sponsored, is limited by the rising proportion of the elderly and implied high burden on the working age population.

Generous state transfer systems not only have financing problems they undermine and reduce labor supply of the elderly, increasing effective "dependency" rates. Many social security systems impose a very high effective tax rate on older workers by withholding or reducing benefits if they continue to work. Table 2 shows some institutional features of social security systems around the world in 2002. Data on social security systems come from the Social Security Administration's *Social Security Programs Throughout the World* (-2002). The raw data consist of the responses of various countries to a survey sent out by the Social Security Administration. These systems are often very complex, with a large number of conditions and caveats not fully explained in the responses; this makes it difficult to create a set of variables that both accurately captures the elements of the various systems and is consistent across countries.

Despite this, we constructed four variables from the data. We begin by defining a dummy variable for universal coverage. We consider a system universal when all employees are reported to be covered by the system. We take a system not to be universal when a group of employees, for example agricultural workers, informal sector workers, those in small firms, or the self employed, is excluded. We count as universal systems where some workers in particular sectors, for example public employees, are excluded but are reported to be covered by a different system. This approach ignores the

possibility that in practice actual coverage in "universal" systems may be low when there is an unrecognized informal sector.

Our second variable is a dummy that indicates the presence of a retirement incentive in the system. A retirement incentive occurs when benefits are only payable on retirement, or if benefits are conditional on an earnings test. Gruber and Wise (1998) show that in OECD countries retirement spikes at ages where retirement incentives begin. In some cases the retirement test is strict: retirement is required for an individual to be eligible for pension benefits that are lost if work continues. In others there is a partial reduction in pension benefits if there is earned income, and there are incentives to delay retirement in the form of higher pension payouts. We set the retirement test equal to one when there are any retirement incentives reported in the system; in other cases we set it to zero.

We also calculate the replacement rate for each country. This is the size of the annual pension as a percentage of the recipient's pre-retirement income for a man of average income (which we take to be income equal to two thirds of GDP per worker) who works from age 17 to the reported normal retirement age in the system, under the system's current rules. The replacement ratio depends on three components: any basic flat-rate pension, any pension that is related to earnings, and any lump sum of accumulated contributions.

For a flat-rate pension we take this flat rate relative to average earnings as its replacement ratio. For earnings-related pensions, there is usually a formula that depends on the number of years of contributions. For countries with defined-contribution schemes, we assume the worker earns a constant amount and contributions start at 17 and run to the normal retirement age; when the normal retirement age is 65 this gives 48 years of contribution. We assume that the contributions in the fund earn a real rate of return of 3% a year. At retirement we assume that the accumulated fund is used to finance an indexed linked (i.e. indexed to the retail price index) single life annuity that guarantees the same payout, in real terms, over the life of the pensioner. We take the annuity to pay out at a real rate of 5.25% per annum for the lifetime of the annuitant, based on current

rates for indexed annuities in the United Kingdom[8]. This means that each 1% of salary contributed to the fund over the working life should generate 5.7% of earnings as a pension.

We split the replacement rate into two portions. One is pay-as-you-go, where the benefits are paid by the government. The second is funded pensions, where a fund holds financial assets to meet the future claims of the pensioners. Funding is common in defined-contribution schemes, while pay-as-you-go is common in defined-benefit programs, but the alignment is not perfect. For example, defined-contribution schemes can invest the contributions or can be notional schemes where repayment is out of general government funds. We take a system to be funded when the assets are held either by an independent provident fund or private companies that invest freely in a portfolio of assets[9]. We count as pay-as-you-go systems, such as Sri Lanka, where the social security fund is limited to hold only government debt on the grounds that this debt reflects an accounting rule within the government rather than real funding of the liability. Some countries, such as Switzerland, have a two-pillar system in which there is a basic flat-rate pension funded by pay-as-you-go and an earnings-related contribution system that is fully funded.

Preliminary analysis has shown that the social security system has large effects on labor supply at ages above 55. Universal, pay-as-you-go, systems with retirement incentives substantially reduce labor market participation of older workers. Pay as you go systems also depress national saving, while fully funded systems increase saving (Bloom, Canning, Mansfield and Moore, 2007). Table 2 suggests that Philippines, Sri Lanka and South Korea will face problems due to universal pay as you go pension system, with retirement incentives and high replacement rates. Japan also has a pay as you go system but the replacement rate is somewhat lower and the system does not encourage early retirement; older workers who continue working receive higher pensions when they do retire to compensate them for the lack of a pension while they work.

[8] Compulsory purchase of annuities in the United Kingdom diminishes the adverse selection that appears to be common in the United States, though it is still present.

[9] We include as funded systems countries like Chile, where pension companies are restricted in buying foreign assets. We exclude countries like Argentina, where the bulk of private pension company assets must be held in government securities (which subsequently defaulted).

Singapore, Malaysia and Hong Kong have universal fully funded systems. These systems are personal accounts so an older worker who continues in employment benefits by accumulation a large sun to retire on. These systems should not discourage work at older ages and should be associated with high savings rates. Taipei,China, India, Vietnam and Indonesia do not have universal systems. In these countries planning for retirement has historically been rare. However they do have systems for the formal sector and public sector than can generate large future liabilities.

These social security systems where designed for existing demographic situation and my not be appropriate when population aging arrives. However transforming these systems once established is very difficult politically as entitlements under the systems are difficult to reduce. In countries without universal systems population aging will put pressure on governments to provide more coverage given the difficulties of families and saving to cope with the issue. The systems they put in place will have a large impact on how aging affects those economies.

Old age dependency is not a given. Conventionally we model it as the fraction of the population 65 years old to the working population. However the compression of morbidity means that this population can continue to work, if they so desire. By working longer they can save enough for their retirement. Of course rising income means greater demand for leisure and retirement, and this effect may dominate, leading to early retirement (Costa. 1998). However if retirement is voluntary and older people have saved enough for their old age, they are not really “dependents”. Dependency is really the result of financing old age consumption through a transfer system. Such transfer systems, particularly if they have strong retirement incentives, produce large cohorts of “dependent” older people. The solution to this problem is not to reduce the number of old people, but to change the institution.

It is tempting to reply on the market to provide pensions to avoid the problems of public pension systems. However this is unlikely to work well. This would require financial institutions that could channel saving productively. These institutions would also have to provide insurance against ill health and against an unexpectedly long life span that might exhaust savings. Te health insurance and annuity markets can provide such insurance but both suffer from averse selection problems; "bad risk" individuals

drive up prices and force ordinary consumers out of the market. This points towards forcing all consumers to participate in these insurance markets to avoid the bad risks driving out the good risks. Market failures of this type provide a rationale for public systems (Feldstein, 1985, Hubbard and Judd, 1987)).

More important than these market failures, however, is the problem that individuals are not rational in the economic sense and do not plan sufficiently for the future. There is evidence both from economics and psychology that people are short term in their planning horizon; always leaving actions that address long term problems to tomorrow (Laibson 1998, Laibson et al. 1998). This points towards forced participation in pensions schemes, or participation as a default, rather than leaving it up to the individual to decide to save. No state provision is a recipe for large scale old age poverty.

One solution to these issues is a three pillar system for pensions. The first pillar is a minimal flat rate pension funded by taxes and transfers to prevent poverty in old age. The second pillar is forced saving throughout the working life in personal accounts to guard against short sightedness. The final pillar is private saving for old age allowing a choice of how long to work and how much to consume when old.

4. What we don't know

While we can forecast that population aging is coming, it is a new phenomenon. We have little experience to go by making it difficult to be confident of our predictions. While the developed world will give some guidance for the effects of population aging in rich countries we will see population aging in poor countries in Asia as well. We are uncertain in poorer countries to what extent longer lifespans reflect healthy as opposed to unhealthy aging. We also don't know to what extent incentive programs in poor countries may be able to increase fertility rates. Such programs would increase youth dependency in the short run but after 20 years would reduce old age dependency rates once the children born enter the working age group.

Most developed countries have seen a decline in family support for the elderly and a shift towards saving and public transfer systems. It is unclear if family support mechanism can be relied on in Asia in the face of falling numbers of children to support the elderly and increasing separation of living arrangements with urbanization. The

opening up of developed countries to large scale immigration from developing countries in Asia appears politically unlikely at present but may become a real prospect when labor shortages appear. It is unclear how this will affect developing countries and what their policy response should be.

While we do not know what the future holds in terms of the consequences of population aging our experience of population growth in the 20th centaury holds great hope. The world economy proved extremely flexible in terms of absorbing the massive increase in population numbers, and even produced rising incomes instead of the forecast impoverishment. If we make no changes in our behavior population aging is likely to have very negative consequences but if institutions and markets are allowed to respond the prospects will be much less bleak..

Figure 1
Life Expectancy in Asia 1950-2050

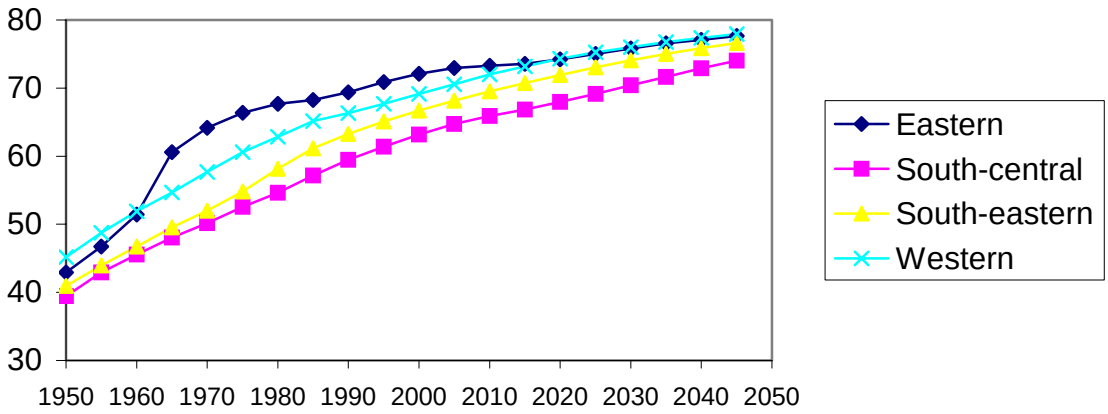


Figure 2
Fertility in Asia 1950-2050

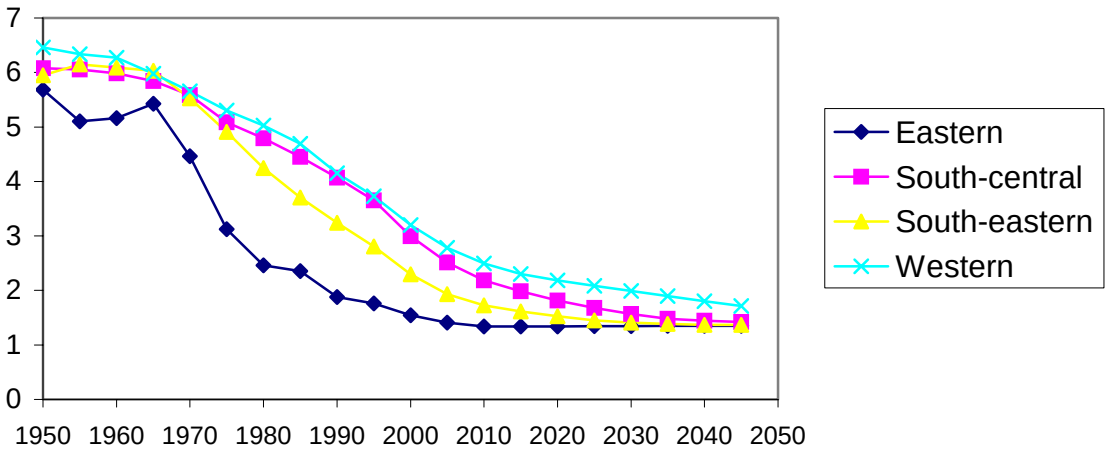


Figure 3

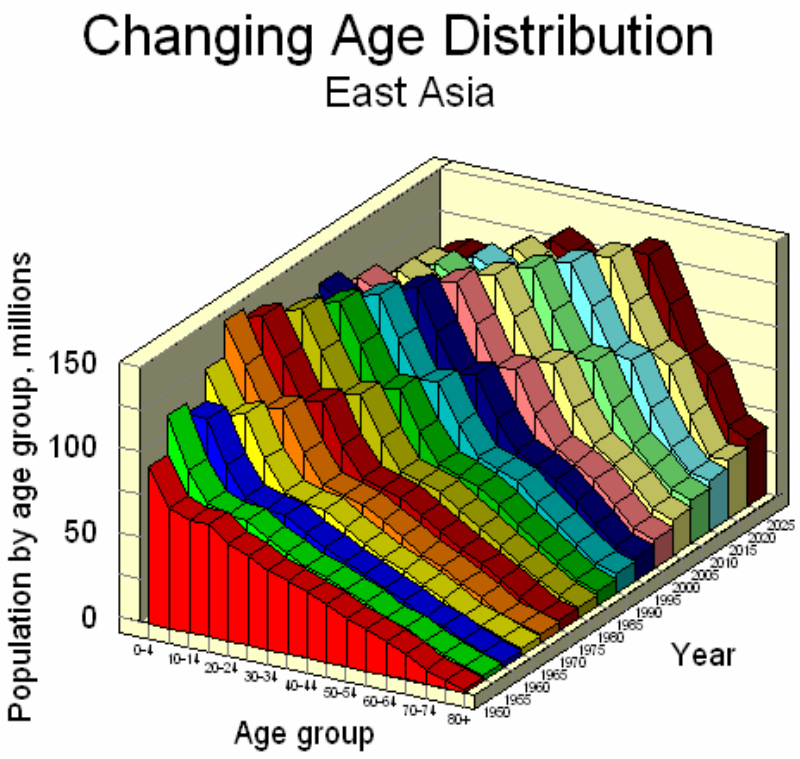

Changing Age Distribution
East Asia
Population by age group, millions
150
100
50
0
0-4
10-14
20-24
30-34
40-44
50-54
60-64
70-74
80+
Age group
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
Year

Figure 4
Ratio of Working Age to Dependent Population in Asia

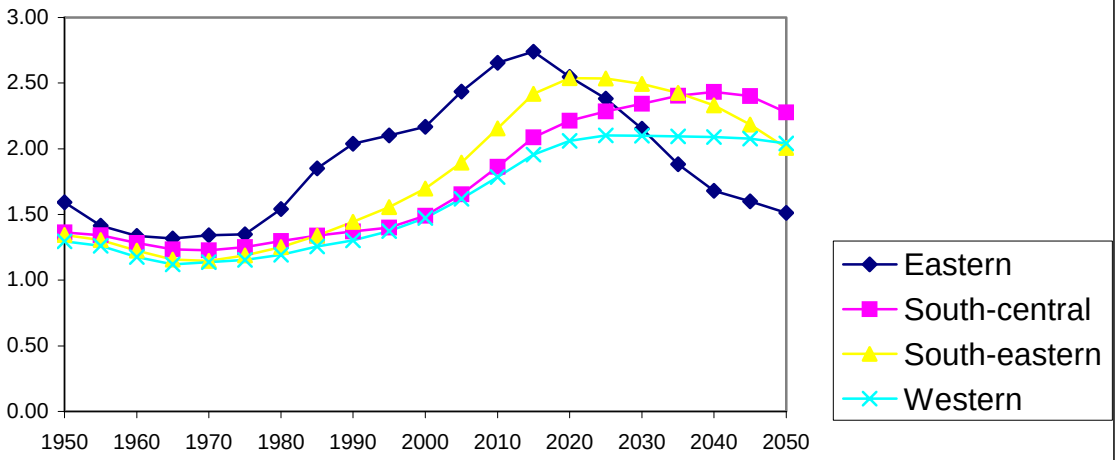


Figure 5
World Dependency Ratios

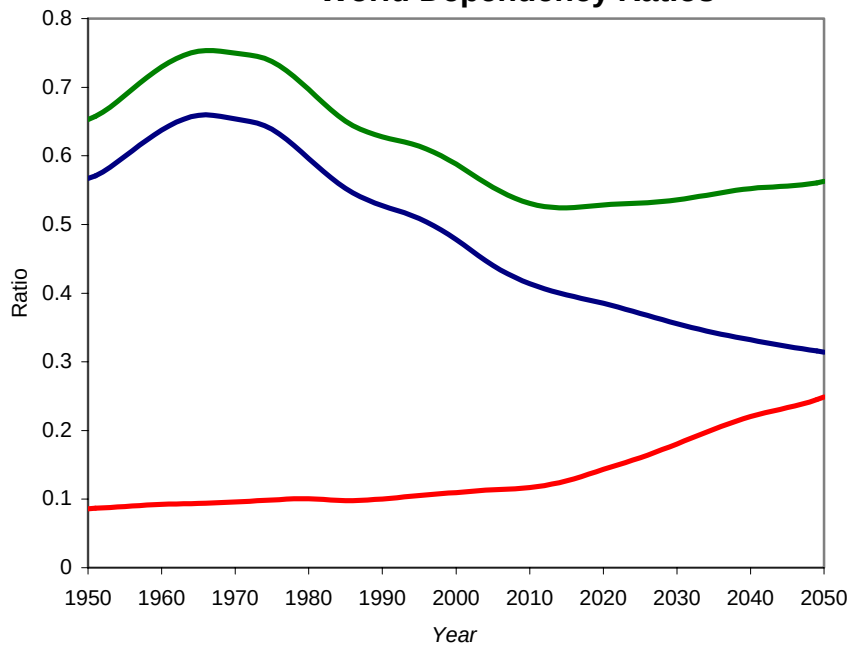


Figure 6
Ratio of Working Age to Dependant Population - Regions

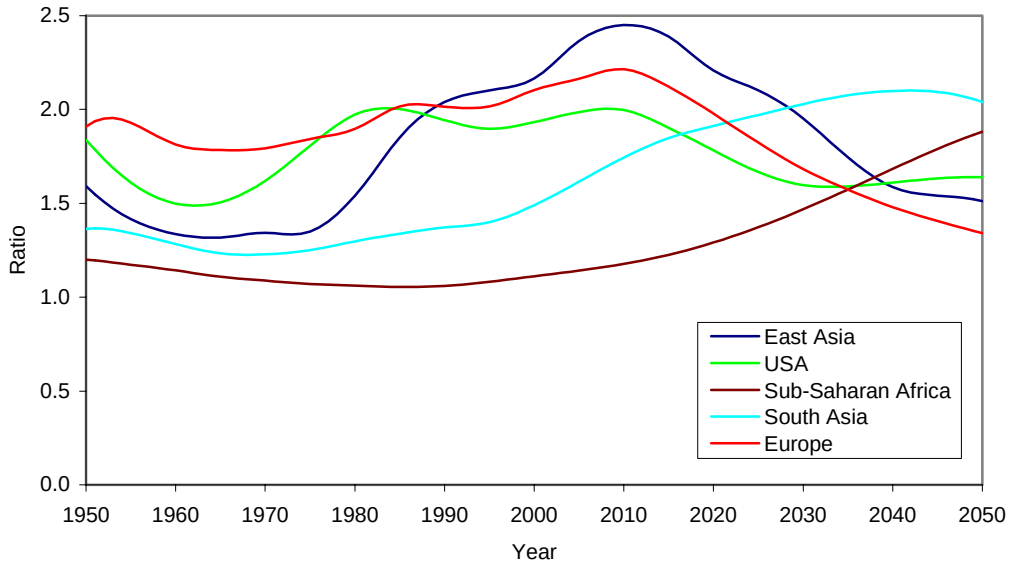
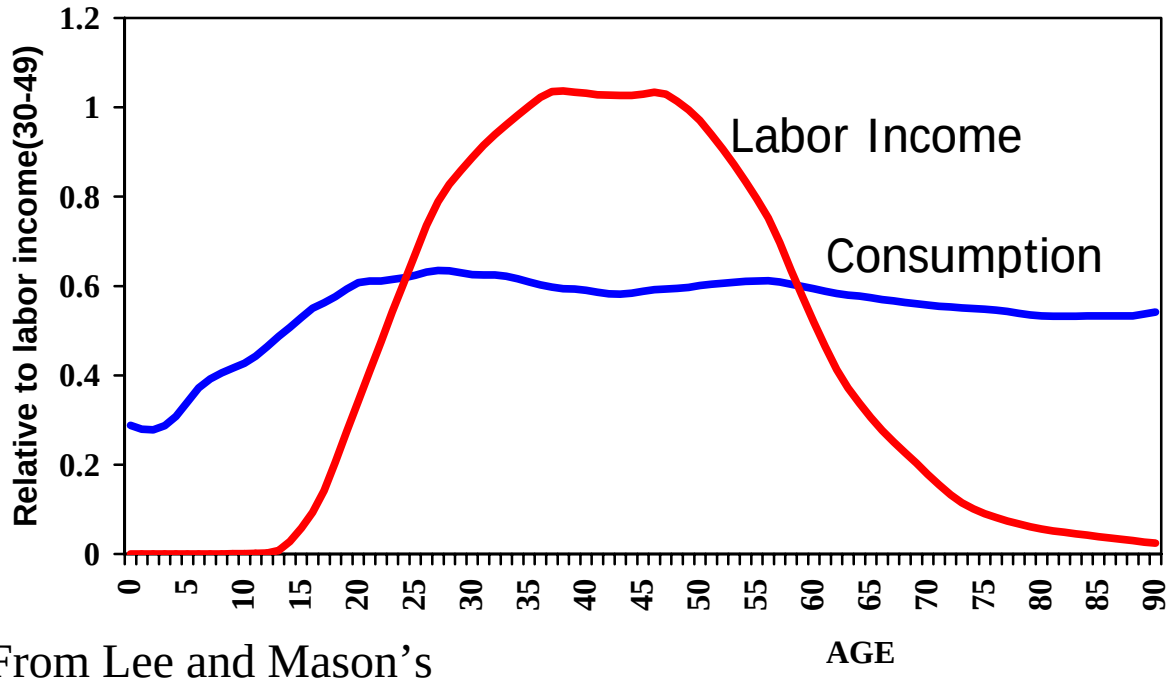


Figure 7
The Economic Lifecycle



From Lee and Mason's
National transfer Accounts

Based on estimates for Costa Rica,
Indonesia, Taipei,People's Republic

Figure 8
Foroign Born Population in 2003 that Entered United States 2000-2003

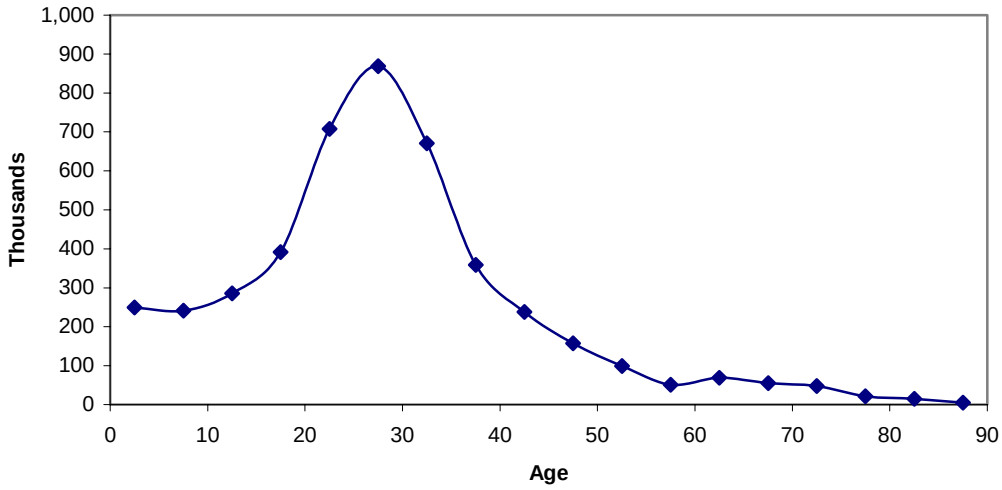
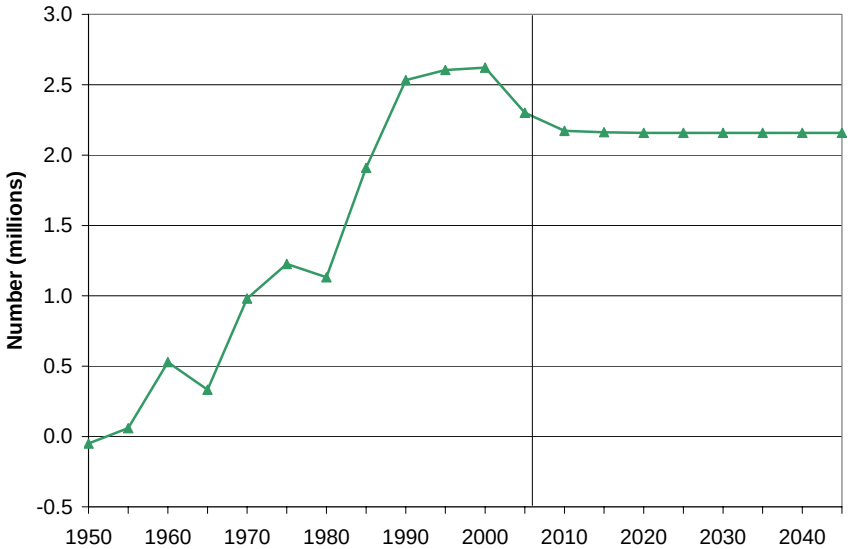


Figure 9
Number of Migrants from
Less Developed to More Developed Countries: per annum



Source: UN, World Population Prospects, 2004.

Table 1

Demographic Characteristics and Aging in Asia, 2005

	Fertility rate	Life expectancy	Youth Dependency	Old Age Dependency	Urban	Working Age per Dependent
Japan	1.3	82.1	14.0	19.7	65.8	2.0
Australia	1.8	80.6	19.6	12.7	88.2	2.1
New Zealand	2.0	79.6	21.4	12.3	86.2	2.0
Armenia	1.4	73.3	20.8	12.1	64.1	2.0
Hong Kong, China	1.0	81.6	14.5	12.0	100.0	2.8
Korea, Rep.	1.1	77.6	18.6	9.4	80.8	2.6
Kazakhstan	1.8	66.3	23.2	8.5	57.3	2.2
Singapore	1.2	79.7	19.5	8.5	100.0	2.6
Macao, China	0.9	80.3	16.3	7.7	100.0	3.1
People's Republic of China	1.8	71.8	21.4	7.6	40.4	2.4
Sri Lanka	1.9	74.7	24.1	7.3	15.1	2.2
Azerbaijan	2.3	72.3	25.8	7.1	51.5	2.0
Thailand	1.9	70.9	23.8	7.1	32.3	2.2
Korea, Dem. Rep.	2.0	63.9	25.0	6.8	61.6	2.1
Kyrgyz Republic	2.4	68.3	31.5	6.1	35.8	1.7
Guam	2.8	75.2	30.0	6.1	94.0	1.8
New Caledonia	2.3	75.2	28.2	6.0	63.7	1.9
Tonga	3.3	72.7	35.9	6.0	24.0	1.4
Indonesia	2.3	67.8	28.3	5.5	48.1	2.0
Vietnam	1.8	70.7	29.5	5.4	26.4	1.9
India	2.8	63.5	32.1	5.3	28.7	1.7
Myanmar	2.2	61.1	29.5	4.9	30.6	1.9
French Polynesia	2.3	73.8	27.8	4.9	51.7	2.0
Uzbekistan	2.2	67.4	33.2	4.7	36.7	1.6
Turkmenistan	2.6	62.9	31.8	4.7	46.2	1.8
Bhutan	2.5	64.0	38.4	4.6	11.1	1.3
Malaysia	2.7	73.7	32.4	4.6	67.3	1.7
Philippines	3.2	71.0	35.1	3.9	62.7	1.6
Fiji	2.8	68.3	31.7	3.9	50.8	1.8
Tajikistan	3.5	64.0	39.0	3.9	24.7	1.3
Pakistan	4.1	64.9	38.3	3.9	34.9	1.4
Mongolia	2.3	66.8	30.5	3.8	56.7	1.9
Nepal	3.5	62.7	39.0	3.7	15.8	1.4
Lao PDR	4.5	55.7	40.9	3.7	20.6	1.3
Bangladesh	3.0	63.9	35.5	3.6	25.1	1.6
Maldives	4.0	67.6	40.7	3.5	29.6	1.3
Cambodia	3.9	57.0	37.1	3.4	19.7	1.5
Micronesia, Fed. Sts.	3.7	68.1	39.0	3.4	22.3	1.4
Vanuatu	3.9	69.5	39.9	3.4	23.5	1.3
Brunei Darussalam	2.4	77.0	29.6	3.2	73.5	2.0
Timor-Leste	7.5	56.7	41.1	2.9	26.5	1.3
Solomon Islands	4.0	62.9	40.6	2.4	17.0	1.3

Papua New Guinea	3.8	56.4	40.3	2.4	13.4	1.4

Table2

Social Security Systems Around the World 2002

Country	Universal Coverage	Replacement rate: fully funded	Replacement rate: pay as you go	Retirement Incentive
Greece	1	0.00	1.00	1
Spain	1	0.00	1.00	1
Philippines	1	0.00	0.91	1
Sri Lanka	1	0.00	0.90	1
Ecuador	1	0.00	0.85	1
Finland	1	0.00	0.83	1
Portugal	1	0.00	0.80	1
Tunisia	1	0.00	0.80	1
Italy	1	0.00	0.68	1
Israel	1	0.00	0.66	1
Korea, Rep.	1	0.00	0.64	1
Mali	1	0.00	0.63	1
Madagascar	1	0.00	0.53	1
France	1	0.00	0.50	1
United States	1	0.00	0.45	1
Norway	1	0.00	0.42	1
Senegal	1	0.00	0.40	1
Denmark	1	0.68	0.24	1
Uruguay	1	0.38	0.22	1
Jamaica	1	0.00	0.21	1
South Africa	1	0.00	0.20	1
Kenya	1	0.45	0.00	1
Mexico	1	0.27	0.00	1
Sweden	1	0.00	1.43	0
Brazil	1	0.00	1.00	0
Argentina	1	0.00	0.92	0
Germany	1	0.00	0.83	0
Austria	1	0.00	0.80	0
Egypt, Arab Rep.	1	0.00	0.80	0
Ghana	1	0.00	0.80	0
Turkey	1	0.00	0.79	0
Belgium	1	0.00	0.60	0
Venezuela, RB	1	0.00	0.60	0
Netherlands	1	0.00	0.58	0
Japan	1	0.00	0.51	0
United Kingdom	1	0.00	0.41	0
Canada	1	0.00	0.37	0

Country	Universal Coverage	Replacement rate: fully funded	Replacement rate: pay as you go	Retirement Incentive
New Zealand	1	0.00	0.26	0
Australia	1	0.46	0.20	0
Switzerland	1	0.63	0.18	0
Ireland	1	0.00	0.11	0
Singapore	1	1.62	0.00	0
Malaysia	1	1.04	0.00	0
Bolivia	1	0.57	0.00	0
Chile	1	0.57	0.00	0
Hong Kong, China	1	0.57	0.00	0
Peru	1	0.46	0.00	0
Dominican Republic	1	0.40	0.00	0
Panama	0	0.00	1.00	1
Morocco	0	0.00	0.70	1
Nigeria	0	0.00	0.65	1
Burkina Faso	0	0.00	0.51	1
Zambia	0	0.00	0.40	1
Taipei,China	0	0.00	0.20	1
India	0	0.96	0.00	1
Tanzania	0	0.90	0.00	1
Uganda	0	0.68	0.00	1
Zimbabwe	0	0.00	1.00	0
Colombia	0	0.00	0.85	0
Vietnam	0	0.00	0.75	0
Indonesia	0	0.32	0.00	0

References

Ahlburg, D. A. 2002. “Does Population Matter?” *Population and Development Review*, 28(2).

Bennett N.G., Bloom D.E., and Ivanov S.F. 1998. "Demographic Implications of the Russian Mortality Crisis, *World Development*, 26:1921-1937.

Birdsall N., A. C. Kelley, and S. W. Sinding, eds. 2001. *Population Matters: Demography, Growth, and Poverty in the Developing World.* New York: Oxford University Press.

Bloom, D., and D. Canning. 2001. “Demographic Change and Economic Growth: The Role of Cumulative Causality.” In N. Birdsall, A. C. Kelley, and S. W. Sinding, eds. *Population Does Matter: Demography, Growth, and Poverty in the Developing World.* New York: Oxford University Press. pp. 165–97.

Bloom, D., D. Canning, and B. Graham. 2003. "Longevity and Life-Cycle Savings." *Scandinavian Journal of Economics* 105: 319–38.

Bloom, D., D. Canning, and P. Malaney. 2000. “Demographic Change and Economic Growth in Asia.” *Population and Development Review*, 26: 257–90.

Bloom, D., D. Canning, and M. Moore. 2004. “Health, Longevity, and Optimal Retirement.” NBER Working Paper.

Bloom, D., D. Canning, R. Mansfield, and M. Moore, 2007. "Demographic Change, Social Security Systems, and Savings". *Journal of Monetary Economics*, 54, 92-114.

Bloom, D., D. Canning, and J. Sevilla. 2002. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, California: RAND, MR–1274.

Bloom, D., D. Canning, and J. Sevilla. 2004. “The Effect of Health on Economic Growth: A Production Function Approach.” *World Development*, Vol. 32, No. 1, pp. 1-13.

Bloom, D., R. Freeman and S. Korenman. 1987. “The Labor Market Consequences of Generational Crowding”, *European Journal of Population*, 1987, 131–176.

Bloom, D., and J. D. Sachs. 1998. “Geography, Demography and Economic Growth in Africa”. *Brookings Papers on Economic Activity*, 2: 207–95.

Bloom, D., and J. G. Williamson, 1998. “Demographic Transitions and Economic Miracles in Emerging Asia”. *World Bank Economic Review*, 12: 419–56.

Bongaarts J. 1994. "The Impact of Population Policies: Comment,” *Population and Development Review* 20, 616–620.

Bongaarts J. 1997. “The Role of Family Planning Programmes in Contemporary Fertility Transitions,” in Gavin W. Jones, Robert M. Douglas, John C. Caldwell, and Rennie M. D’Souza (eds.), *The Continuing Demographic Transition*. Oxford: Clarendon Press, 422–444.

Costa, D. L. 1998a. *The Evolution of Retirement: An American Economic History, 1880–1990.* National Bureau of Economic Research Series on Long-Term Factors in Economic Development. Chicago: University of Chicago Press.

Cutler, D., Deaton A. and A. Lleras-Muney (2006), The Determinants of Mortality, *Journal of Economic Perspectives*, 20(3): 97-120.

Deaton A. and Paxson C. (2000), "Growth, Demographic Structure, and National Saving in Taipei,China," *Population and Development Review* 26, Supplement: 141-173.

Easterlin, R. 1980. *Birth and Fortune: The Impact of Numbers on Personal Welfare*. New York: Basic Books.

Easterly, W., and R. Levine (1997) "Africa's Growth Tragedy: Policies and Ethnic Divisions," Quarterly Journal of Economics, 112(4), November: 1203-50.

Feldstein, M. S. 1985. "The Optimal Level of Social Security Benefits." *Quarterly Journal of Economics* 10: 303–20.

Foster, A., and N. Roy. 1997. "The Dynamics of Education and Fertility: Evidence from a Family Planning Experiment"**.** Unpublished manuscript.

Fry, M. and Mason, A. (1982), The Variable Rate of Growth Effect in the Life-Cycle Model, *Economic Inquiry 20*, 426-42.

Gallup, J. L., J. D. Sachs, and A. Mellinger. 1999. "Geography and Economic Development." *International Regional Science Review* 22: 179-232.

Gruber, J., and D. Wise.1998. "Social Security and Retirement: An International Comparison." *American Economic Review* 88: 158–63.

Hatton, T. J. and Williamson, J. G. (2001), “Demographic and Economic Pressure on Emigration Out of Africa,” NBER Working Paper 8124, National Bureau of Economic Research, Cambridge, MA.

Hatton, T. J. and Williamson, J. G. (2002), “What Fundamentals Drive World Migration?", NBER Working Paper 8124, National Bureau of Economic Research, Cambridge, MA.

Higgins, M. (1998), Demography, National Savings, and International Capital Flows, *International Economic Review 39*, 343-69.

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

Hubbard, R. G., and K. L. Judd. 1987. "Social Security and Individual Welfare: Precautionary Saving, Borrowing Constraints, and the Payroll Tax." *American Economic Review* 77: 630–46.

Kalemli-Ozcan, S., H. Ryder, and D. N. Weil. 2000. "Mortality Decline, Human Capital Investment, and Economic Growth." *Journal of Development Economics* 62: 1–23.

Kelley, A. C., 1988. “Economic Consequences of Population Change in the Third World”. *Journal of Economic Literature*, 27:1685–728.

Kelley, A. C. 1996, "The Consequences of Population Growth for Human Resource Development: The Case of Education." In D. A. Ahlburg, A. C. Kelley and K. Oppenheim Mason, *The Impact of Population Growth on Well-being in Developing Countries*, Berlin: Springer-Verlag, pp. 67-137.

Kelley, A. C. 2001. “The Population Debate in Historical Perspective: Revisionism Revised”. In N. Birdsall, A. C. Kelley, and S. W. Sinding, eds. *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford University Press. 24–54.

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

Kelley, A. C. and R. Schmidt. 2001. “Economic and Demographic Change: A Synthesis of Models, Findings, and Perspectives.” In N. Birdsall, A. C. Kelley, and S. W.

Sinding, eds. *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World.* Oxford University Press.

Korenman, S. and D. Neumark. "Cohort Crowding and Youth Labor Markets: A Cross-National Analysis," *In Youth Employment and Joblessness in Advanced Countries,* D. G. Blanchflower and R. B. Freeman, eds. University of Chicago/NBER, 2000, pp. 57-105.

Laibson, D. 1998. "Life-Cycle Consumption and Hyperbolic Discount Functions." *European Economic Review* 42: 861–71.

Laibson, D. I., A. Repetto, J. Tobacman, R. E. Hall, W. G. Gale, and G. A. Akerlof. 1998. "Self-Control and Saving for Retirement." *Brookings Papers on Economic Activity 1998*: 91–196.

Lee, R. D. 2000. "Intergenerational Transfers and the Economic Life Cycle: A Cross Cultural Perspective", in A. Mason and G. Tapinos (eds.), *Sharing the Wealth: Demographic Change and Economic Transfers between Generations,* Oxford University Press.

Lee, R. D. 2003. "The Demographic Transition: Three Centuries of Fundamental Change." *Journal of Economic Perspectives* 17: 167–90.

Lee, R. D., A. Mason, and T. Miller. 2000. "Life-Cycle Saving and the Demographic Transition: The Case of Taipei,China." *Population and Development Review* 26, Supplement: 194–219.

Leff, N.H. (1969), Dependency Rates and Savings Rates, *American Economic Review* 59, 886-96.

Mason, A. (1987), National Saving Rates and Population Growth: A New Model and New Evidence, in D. G. Johnson and R.D. Lee (eds.), *Population Growth and Economic Development: Issues and Evidence*, University of Wisconsin Press, Madison.

Mason, A. (1988), Saving, Economic Growth, and Demographic Change. *Population and Development Review 14*, 113-44.

Mason, A., ed. 2001. *Population Change and Economic Development in East Asia: Challenges Met, Opportunities Seized*. California: Stanford University Press.

Mason A., R. Lee, A-C. Tung, M-S. Lai and T. Miller, 2006. Population Aging and Intergenerational Transfers: Introducing Age into National Accounts, NBER Working Papers 12770, National Bureau of Economic Research, Inc.

Murray, C. J. L., and L.C. Chen. 1992. "Understanding Morbidity Change." *Population and Development Review* 18: 481-503.

Murray, C. J. L., and A. D. Lopez. 1997. "Regional Patterns of Disability-Free Life Expectancy and Disability Adjusted Life Expectancy: Global Burden of Disease Study." *Lancet* 349: 1347-52.

Mathers, C. D., R. Sadana, J. A. Salomon, C. J. L. Murray, and A. D. Lopez. 2001. "Healthy Life Expectancy in 191 Countries, 1999." *Lancet* 357(9269):1685–91.

Poterba J. M., 2004, "Impact of Population Aging on Financial Markets in Developed Countries," paper presented to the Symposium on Global Demographic Change, Federal Reserve Bank of Kansas.

Preston S. (1975). "The Changing Relation between Mortality and Level of Economic Development," *Population Studies*, Vol. 29, pp. 231-248.

Pritchett, L. H., 1994. "Desired Fertility and the Impact of Population Policies." *Population and Development Review* 20(1): 1-55.

Pritchett, L. H., and Lawrence H. Summers. 1996. "Wealthier is Healthier." *Journal of Human Resources* 31(4):841-868.

Schultz, T. P., 1997, "The Demand for Children in Low Income Countries," *Handbook of Population and Family Economics, Vol. 1A*, Chapter 8, (eds.) M.R. Rosenzweig and O. Stark, Amsterdam: North-Holland Publishing.

Tsai I-J, C.Y.C. Chu and C-F Chung. 2000. "Demographic Transition and Household Saving in Taipei,China," *Population and Development Review* 26, supplement: 174-193.

UNAIDS. 2004. *AIDS Update 2004*. Geneva Switzerland.

United Nations. 1998. *Demographic Indicators 1950-2050.* New York.

Young, A. 1994. "Lessons from the East Asian NIC's: A Contrarian View." *European Economic Review* 38: 964-73.

Young, A. 1995. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." *Quarterly Journal of Economics* 110: 641-80.