Demographic Dividends and Aging in Lower-Income Countries

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Introduction

Countries at all levels of development are experiencing significant changes in their population age structure. Many countries in the world have experienced a sustained increase in the share of their working-age populations. The result has been a "demographic dividend" that has helped to raise economic growth (Bloom and Williamson 1998; Mason 2001; Bloom, Canning et al. 2002; Mason 2005; Mason and Lee 2007; Mason, Lee et al. 2010). Some of these countries are now beginning to experience significant population aging. This is raising concerns that economic growth will slow, that current support systems for the elderly will become unsustainable, and that generational inequity will emerge. These are predominantly the concerns of high-income countries and a few rapidly aging middle-income countries.

Many lower-income countries are at a very different place in their demographic transitions. Birth rates are still high or have declined only recently. Their populations are very young and still growing rapidly. They may just now be entering that part of the demographic transition that yields a demographic dividend, and population aging may seem to be quite a remote prospect.

The purpose of this study is to explore the economic implications of changing demographic conditions in lower-income countries. By this we mean countries classified as low- or lower-middle-income countries by the World Bank. This is done in a comparative way, where appropriate, by comparing lower-income countries to each other and contrasting them with upper-middle- and high-income countries.

The analysis draws on two sources of information. The first is population estimates and projections provided by the UN Population Division. We rely on the most recent version, World Population Prospects 2010 (United Nations Population Division 2011), and use the medium fertility scenario for all projections.

The second source of data is National Transfer Account estimates of economic flows by age. These data provide comprehensive information about how individuals at each age acquire and use economic resources to meet their material needs. Estimates have been constructed and evaluated for 34 economies. Of these, eight are lower-income countries: Cambodia, India, Indonesia, Kenya, Nigeria, the Philippines, Senegal, and Vietnam. NTA estimates of consumption and labor income are available for all 34 economies. For some countries, estimates of the support system are not complete, however. As a consequence, some analysis relies on a subset of the 34 economies. Table 1 lists the countries for which NTA estimates are available. A comprehensive discussion of National Transfer Accounts is available in Lee and Mason (2011) and the NTA website www.ntaccounts.org.

In the recent past, changes in population age structure were unfavorable in many lower-income countries as the share of the population at young ages increased and the share in the working ages declined. As this phase of the demographic transition comes to an end, lower-income countries have an opportunity to realize more rapid economic growth by capitalizing on the demographic dividend. A central issue addressed in this paper is whether conditions in lower-income countries are conducive to a robust demographic dividend and, if they are not, what steps could be taken to exploit the potential advantages of a favorable economic age structure.

The magnitude of the demographic divided is determined, in part, by the speed of fertility decline. Rapid fertility decline leads to rapid changes in population age structure. The share of children in the population declines sharply and the share of the working-age population rises sharply. Thus, the boost to economic growth that might be realized in lower-income countries will depend on how rapidly rates of childbearing drop.

The magnitude of the demographic divided is also determined by features of the economic lifecycle which determine the economic burden of the young and old relative to the ability of prime-age adults to bear that burden. The extent of dependency for any age group depends on how much members of that age group work and on how productive they are when they do work. The economic burden also depends on how much members of each age groups cost. Children and the elderly in lower-income countries are less dependent than their counterparts in high-income countries both because they produce more as measured by their labor income and cost less as measured by their consumption relative to prime-age adults.

An important contribution of this paper is that we show how features of the per capita age profiles of consumption and labor income influence the support ratio and, hence, the magnitude of the first demographic dividend. This is important information if countries are to judge how their own patterns of consumption and labor income compare with those of other countries that have experienced a significant demographic dividend. It is the first step in developing practical policies for generating a larger demographic dividend. The analysis indicates that labor income of young adults is key. The support ratio is much lower in African countries because those in their twenties and early thirties are much less productive than their counterparts in Asia and Latin America and the Caribbean.

An important feature of our previous work on demographic dividends has been to distinguish two demographic dividends (Mason and Lee 2007). The first dividend refers to the pro-growth effects that arise as a direct consequence of the changes in the share of the population in the working ages. The first dividend is transitory in nature because the bulge in the working ages is a transitory phenomenon. The second demographic dividend arises because changes in population age structure also influence investment in physical and human capital with lasting effects on economic growth. An updated assessment of the tradeoff between fertility and human capital confirms the finding that low fertility is accompanied by substantially higher per child spending on education and health (Lee and Mason 2010). A matter of great concern, however, is that human-capital spending does not appear to be as responsive to fertility decline in lower-income countries. The elasticity of human capital with respect to the total fertility rate is less in low income countries than for all countries combined.

In the next section of the paper we explore the support systems for children and the elderly. These vary considerably across countries and by level of income. Children under the age of 17 depend overwhelmingly on transfers for their material needs everywhere, but the importance of the family versus the state varies by level of development. In general, the state plays a much more important role in high- and upper-middle-income countries than in lower-income countries. This has potentially important implications for the resource availability and potential social mobility of children in poor families. This is an issue that should be explored further.

The final section of the paper focuses on population aging. An important objective of this section is to consider whether population aging should be a priority issue in lower-income countries. By any measure, aging is less important in lower- income countries than in higher income countries. A much smaller percentage of the population is elderly and this will continue to be the case for some decades to come. Lower income countries are very heterogeneous, however, and some are aging more rapidly than others. Indonesia and Vietnam are notable in this regard for their low fertility and more rapid aging. Because of the low pace of aging, lower-income countries, particularly those in Africa, may understandably be reluctant to give high priority to aging issues. This is a mistake, however, because successful dealing with aging requires preparation well in advance. Even in the poorest country, the great majority of those who are alive today can expect to live many years at the end of life when their labor income is no longer sufficient to provide for their material needs. To secure their economic future, today's worker must be accumulating wealth on which they can depend in old age. Governments have a very important role in creating an economic environment that is supportive of efforts to accomplish this goal.

Demographic transition

The demographic transition is a global phenomenon that governs population growth and age structure which, in turn, have important implications for economic development. The simplest description of the demographic transition was offered by Paul Demeny many years ago. "In traditional societies, fertility and mortality are high. In modern societies, fertility and mortality are low. In between, there is demographic transition."(Demeny 1968)

Although the demographic transition appears to be a universal phenomenon, key features of the transition vary systematically with the level of development. This is important to understanding why population growth rates and population age structure vary so much across the developing world. Death rates decline because of higher income and improved levels of nutrition, improvements in sanitation and water supply, higher rates of literacy, technological advance that helped to eradicate or greatly reduce many diseases, and better healthcare systems. Some of these factors operate across national boundaries but many are specific to countries and account for the higher death rates found in low income countries. Birth rates decline in response to declining rates of infant and child mortality, higher levels of literacy, urbanization, the decline in agriculture and the rise of manufacturing and service-sector employment, increased opportunities for women outside of the home, an increase in the importance of education and the associated higher cost of children, and better and more readily available contraceptives. Again many of the factors influencing fertility vary with the level of development accounting for higher birth rates in countries at lower levels of development.

Is it possible to go beyond these general characterizations to examine more concretely how the demographic transition in lower-income countries might differ from the transition in upper-middle income countries and in high income countries? This is not easy because completing the demographic transition may take a century or longer and is only documented in its entirety for a few high income countries that began their transitions long ago. The contemporary transitions, however, are quite different from the historical transitions.

To sharpen our understanding of demographic trends in lower-income countries we will rely on a synthetic representation of the demographic transition that is based on trends in birth and death rates available annually for 1950 to 2009 available from the UN (United Nations Population Division 2011). To characterize the post-World War II demographic transition we calculate the average birth and death rates for countries falling in the four standard income groups employed by the World Bank—low income, lower-middle income, upper-middle income and high income (see the appendix for the countries by income class). The values are simple averages for countries and not weighted by the population of each country.

The earliest part of the demographic transition is represented by trends in birth and death rates in the low income countries. The next segments are represented by the lower-middle-income countries, then the upper middle-income countries, and finally the high-income countries. The segments are spliced together using the death rate. The death rate in the low income countries did not reach the 1950 death rate of the lower-middle-income countries until 1967. Hence, the death rate and birth rates of the lower middle-income countries are positioned 17 years (1966-1950) further along in the demographic transition. Using this device to place each group of countries in the demographic transition, the upper-middle income countries were 11 years further along in the demographic transition in 1950 and the high income countries were 20 years further along in 1950. Altogether, the spliced segments provide a synthetic representation of the demographic transition over a span of 107 years. Even so, the complete transition is not represented. The death rate is much lower than the birth rate at the beginning of the stylized transition and the gap between birth and death rates has not been entirely closed at the end of the stylized transition. The results are plotted in Figure 1

The mortality paths virtually coincide for middle and high income countries indicating that the pace of decline at each point in the mortality transition has been similar for these groups of countries. Low-income countries are on a different path, however. Death rates for low-income countries declined more slowly and are on a higher trend line than death rates for middle-income countries at the same point in the demographic transition. In particular, the decline in death rates in low-income countries stalled when the death rate reached about 15 deaths per 1000 persons. A very substantial part of stalled mortality decline in the low-income countries is a consequence of HIV/AIDS epidemic. Analysis of the impact of the epidemic on mortality for 29 African countries concluded that the crude death rate would have been lower by 3% in 1985-89 and 10% in 1990-94 in the absence of the epidemic (United Nations Population Division 1999). If low-income death rates of the low-income countries had followed the same path as the lower-middle income countries they would have 10% lower in 1987 and 19% lower in 1992.

The birth rates are not on the same path in Figure 1. For any given death rate, the birth rate was higher the lower the income group. This is a very consistent pattern with important implications for population growth and age structure. Population growth rates over the demographic transition are similar for the low-income and the lower-middle-income countries because the higher fertility in low-income countries is offset by the higher death rate noted above. Otherwise, at each point in the demographic transition, as measured by the crude death rate, the population growth was more rapid the lower the level of

income (Figure 2). Low-income countries are completing their demographic transitions more slowly and they are growing more rapidly as a consequence.

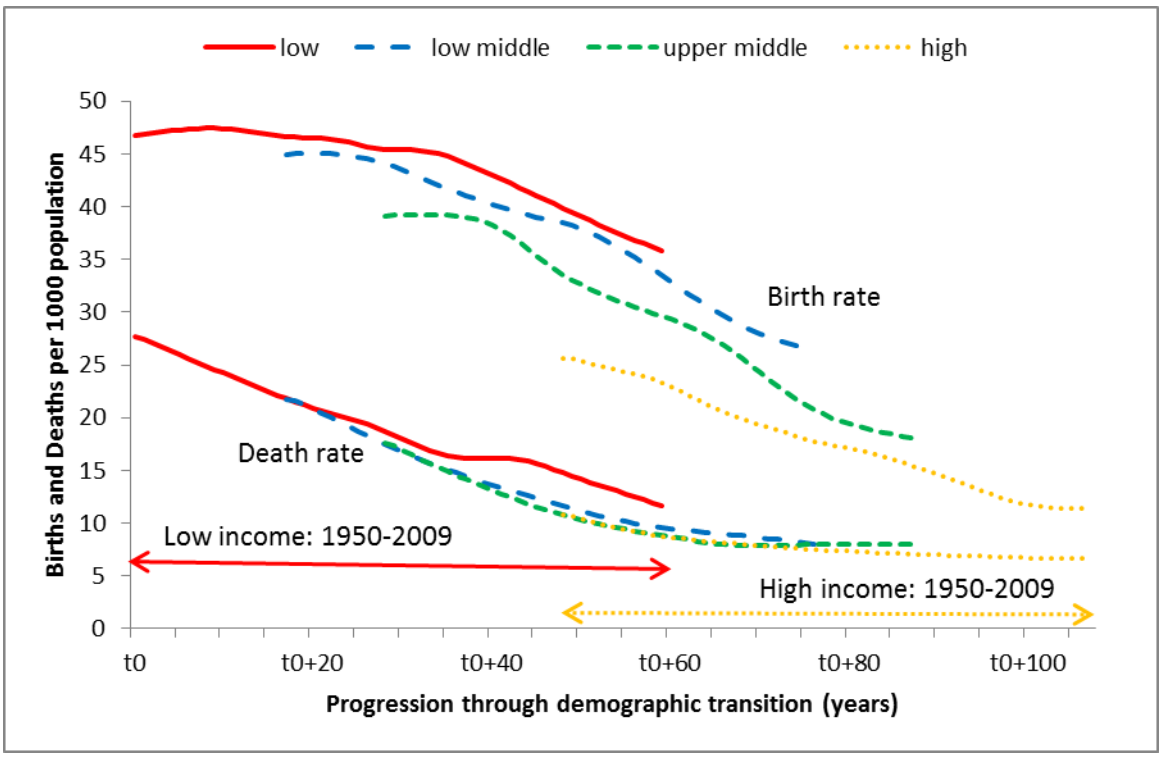

Figure 1. Demographic transition, 1950–2009, for low-, lower-middle-, upper-middle-, and high-income countries. Progression through the demographic transition, measured in years, is measured using techniques described in the text based on the crude death rate. Low-income countries are behind the lower-middle-, upper-middle-, and high-income country groups by 17, 28, and 38 years, respectively.

Source: Constructed from UN Population Division (2011).
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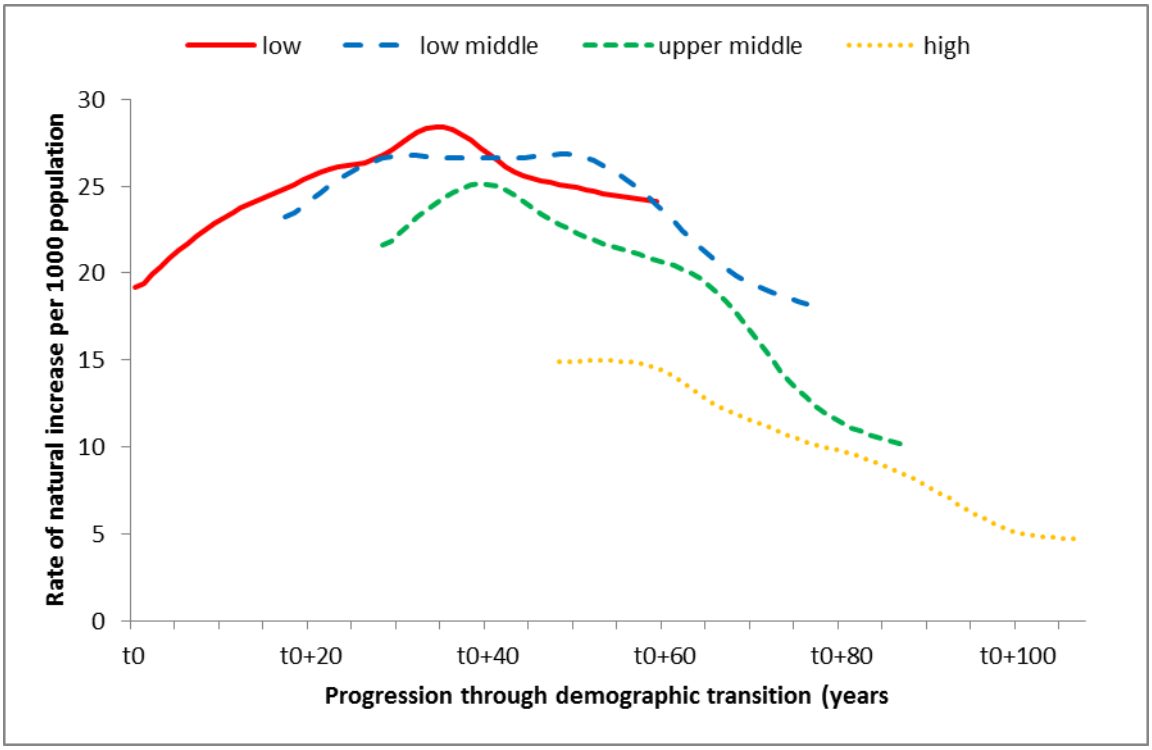

Figure 2. Rate of natural increase over the demographic transition, low, low middle, upper middle, and high- income countries, 1950–-2009. Figure 2 plots the difference between the birth rates and death rates in Figure 1, and the time scale for each line has been positioned in the same way.
Source: Constructed from UN Population Division (2011).
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Age structure also varies greatly across income group because of differences in the demographic transition. If we represent age structure using three broad age groups, children, working-age adults, and older adults, almost all countries have experienced three distinct phases in the transformation of their population age structures since 1950. During the first phase, population increase is greatest for children. This occurs in the developing world as a consequence of declining infant and child mortality while fertility remains high or is declining very slowly. In high-income countries the rise in fertility known as the baby boom was responsible for an increase in the percentage of the population in the child ages. The second phase is marked by an increase in the working-age population which we denote the dividend phase. This occurs when fertility decline, which declines with sufficient speed to outweigh the effects of rising child survival. During the final phase of the transition, the aging phase, the working age share of the population declines and the share of elderly increases. This occurs as sustained low fertility leads to fewer children and fewer working age adults. Improvements in survival at old ages reinforce the effects of low fertility, producing populations that are much more concentrated at older ages.

Figure 3 is constructed by classifying each country by the phase of its age transition based on the increase in the percentage in each age group—children (0–24), working-age adults (25–59), and older adults (60+). In 1960, at least 70 percent of the countries in each income group were experiencing the

greatest increase at the child ages. This phase of the age transition has now ended for high- and upper-middle-income countries. About 30 percent of lower-middle-income countries are at this point in their age transformation, while more than 60 percent of the low-income countries are still experiencing large increases in their child population.

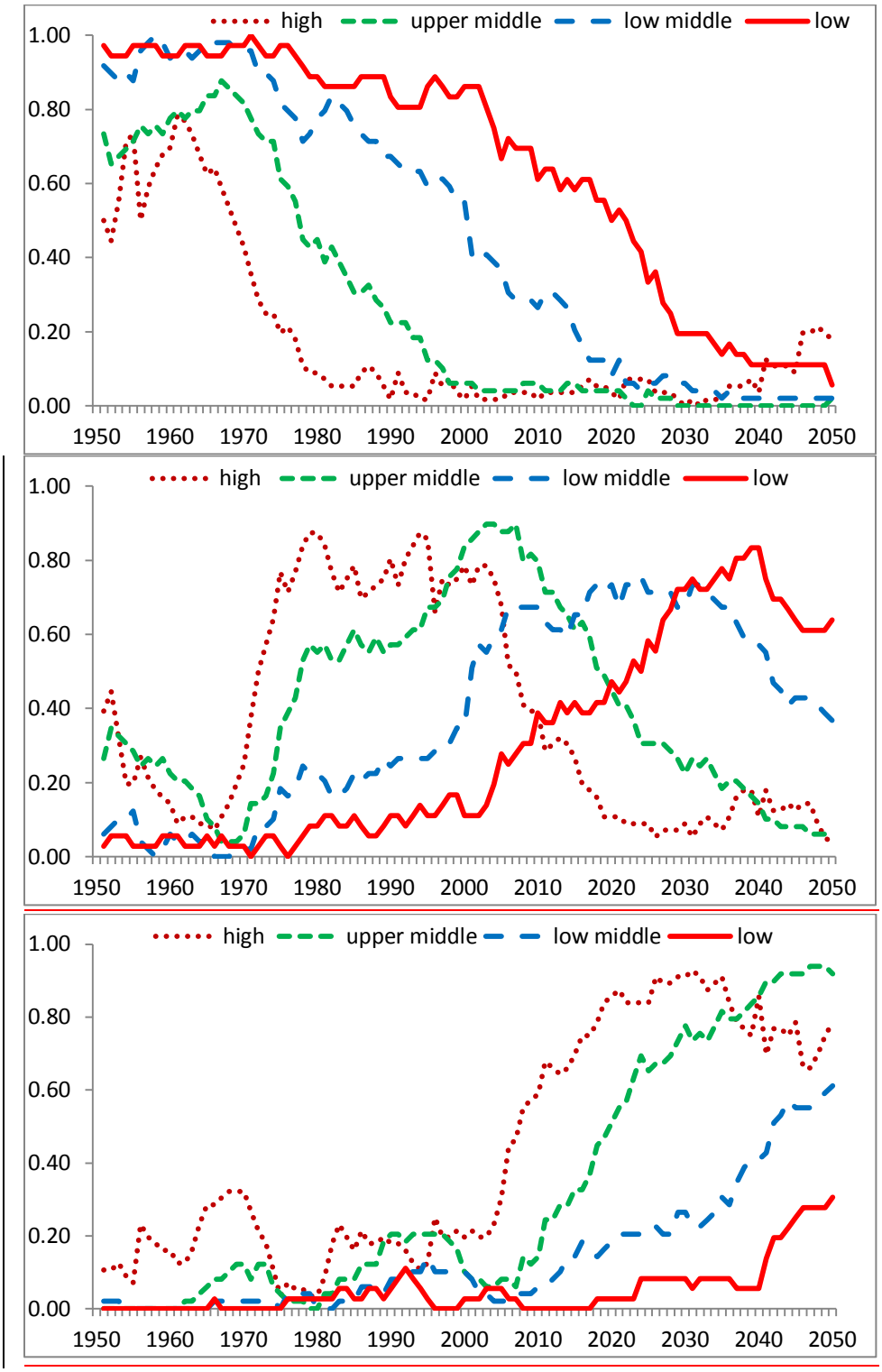

Figure 3. Age transition for low-, lower-middle-, upper-middle-, and high-income countries. Countries classified by age group with the largest absolute increase each year. Upper panel is proportion with largest increase in children 0–24; middle panel is proportion with largest increase in working-age population 25–64; lower panel is proportion with largest increase in elderly population 65 and older.

Source: Calculated using population estimates and projections from the United Nations Population Division, World Population Prospects 2010.
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Growth in the working-age population currently dominates the middle-income countries. In about 60 percent of the countries, the greatest increase is concentrated at the working ages. About 40% of the low income countries have entered this phase. High-income countries experienced a dividend phase for the last quarter of the 20th Century, reflecting their earlier baby booms rather than the usual pattern of fertility decline, but this phase of the age transition has ended.

The aging phase has begun in high-income countries, and it will follow in middle- and low-income countries. For the upper-middle income countries, the aging phase is approaching rapidly, but for lower-income countries aging is a more remote prospect.

First demographic dividend

In lower-income countries, the share of the population in the working ages is increasing or will begin to increase in the near-future, producing what are called *demographic dividends.* The *first dividend* arises in a very direct fashion—higher standards of living are possible because the population in the working ages rises relative to that in the dependent ages. The *second dividend,* addressed in detail below, arises as resources previously devoted to supporting a large dependent population can be shifted into spending on physical and human capital that enhances economic growth.

The timing and the size of the first dividend can vary considerably across countries, however, because of differences in demographic change and differences in the age patterns of labor income and consumption. Both of these factors vary across countries, and this variation influences the timing and magnitude of the first demographic dividend. For some lower-income countries the dividend may provide an important assist to economic development, but for others this may not be the case.

Central to the analysis of the first demographic dividend is the support ratio (L/N) defined as the ratio of the effective number of workers (L) to the effective number of consumers (N). The effective number of workers is similar to the working-age population except that the members of each one-year age group are weighted by the average labor income (relative to the labor income of a 30-49-year-olds), which reflects their labor-force participation, hours worked, unemployment, and productivity—factors that determine how much individuals at each age contribute to national product through their labor. The weights are estimated separately for each country and reflect the policies, tastes, institutions, and other relevant country-specific features.

The effective number of consumers is constructed in similar fashion by weighting those in each one-year age group based on their consumption relative to those in other age groups. The consumption weights are estimated separately for each country. The methods and data are described in more detail shortly, but first we use a simple model to provide the context for the analysis to come.

The standard of living at any point in time is measured by total national consumption per effective consumer (C/N), which can be represented as depending on two terms—consumption produced by each worker ((1-s)Y/L) and the support ratio (L/N).

$$\frac{C}{N} = \frac{(1-s)Y}{L} \times \frac{L}{N}. \tag{1.1}$$

Where s is the saving rate and Y is total income. This is the amount of output produced beyond that which is saved and invested. A variety of important factors influence the consumption produced by each worker– saving and investment rates, capital, human capital, natural resource availability, institutions, and so forth. For the moment, however, our interest is exclusively in final term in the equation, the support ratio. Given consumption per worker, a higher support ratio translates directly into a higher material standard of living. The effect of an increase in the support ratio on C/N measured in absolute terms depends on the net productivity of workers. The effect in percentage terms does not, however. A one percentage point increase in the support ratio yields a one percentage point increase in consumption per equivalent consumer.

This simple identity can also be restated in growth terms as:

$$gr[C/N] = gr[(1-s)Y/L] + gr[L/N] \tag{1.2}$$

where gr[X] is the rate of growth of the argument X. Given the growth rate of consumption produced per worker, an increase in the growth rate of the support ratio by one percentage point yields an increase in the growth rate of consumption per equivalent consumer by one percentage point.

Support ratio fundamentals

The support ratio depends on the population age structure, but it also depends on basic features of the economic lifecycle that govern patterns of production and consumption. In many past studies, the lifecycle has been characterized in a simple fashion by distinguishing those in the working ages, say 15–64, from the dependent populations, 0–14 and 65 and older. This is a useful way to characterize age structure, and, in any case, refined information about how labor output and consumption vary with age has only recently become available. Incorporating estimates of the lifecycle into the analysis, however, offers two important advantages. First, it allows a more refined estimate of the effects of population age structure in any particular country. Second, it provides a way to evaluate how policies can influence the support ratio and, hence, the magnitude of the demographic dividend.

The lifecycle estimates presented here are drawn from National Transfer Accounts (NTA) data. A comprehensive overview and detailed information about methods are reported in Lee and Mason

(2011) and on the NTA website: www.ntaccounts.org. Estimates are used for 8 low- and lower-middle-income countries (Cambodia, Kenya, Indonesia, India, Nigeria, the Philippines, Senegal, and Vietnam), 11 upper-middle-income countries (Brazil, Chile, China, Colombia, Costa Rica, Jamaica, Mexico, Peru, South Africa, Thailand, and Uruguay) and 14 high-income countries/economies (Australia, Austria, Finland, France, Germany, Hungary, Italy, Japan, South Korea, Spain Sweden, Taiwan, United Kingdom, and the United States).

Two economic flows from National Transfer Accounts are used to construct the economic support ratio for each of the 34 economies. The first is labor income by age, which includes the estimated value of all returns to labor effort including the value of goods and services produced by informal-sector workers and the imputed earnings of unpaid family workers[i]. Per capita labor income varies by age under the influence of age variation in labor force participation, unemployment rates, hours worked, and productivity. The aggregate value of labor income at each age reflects the additional effect of population age structure. The second economic flow is consumption, a comprehensive measure that includes all goods and services including goods and services produced by governments, such as, public education, and publicly funded health care, as well as collective public consumption. All private and public consumption has been allocated to age groups.

The per capita labor income estimates for countries in three income groups—low and lower-middle, upper-middle, and high—provide the basis for the plots shown in Figure 4. Per capita labor income was calculated for each of the countries for which data are available and then expressed relative to the average value of individuals 30–49. Then, a simple average across countries belonging to each income group was computed and used in the figure. Although the patterns are broadly similar for all income levels, with labor income rising steeply for those in their 20s, reaching a peak at around age 40, and declining thereafter, there are important deviations from this broad pattern. In low- and middle-income countries, labor income is higher for children and lower in the upper-middle and high-income countries. The greatest differences among the country groups occur at older ages. Labor income peaks at a somewhat later age and then declines very sharply for high-income countries, reflecting the availability of public pensions and the incentives for early retirement they often contain (Gruber and Wise 1999), higher levels of income with increased demand for leisure, the importance of formal labor markets, and many other factors (Costa 1998). In the other two country groups, the decline is more gradual, especially among the low- and lower-middle-income countries.

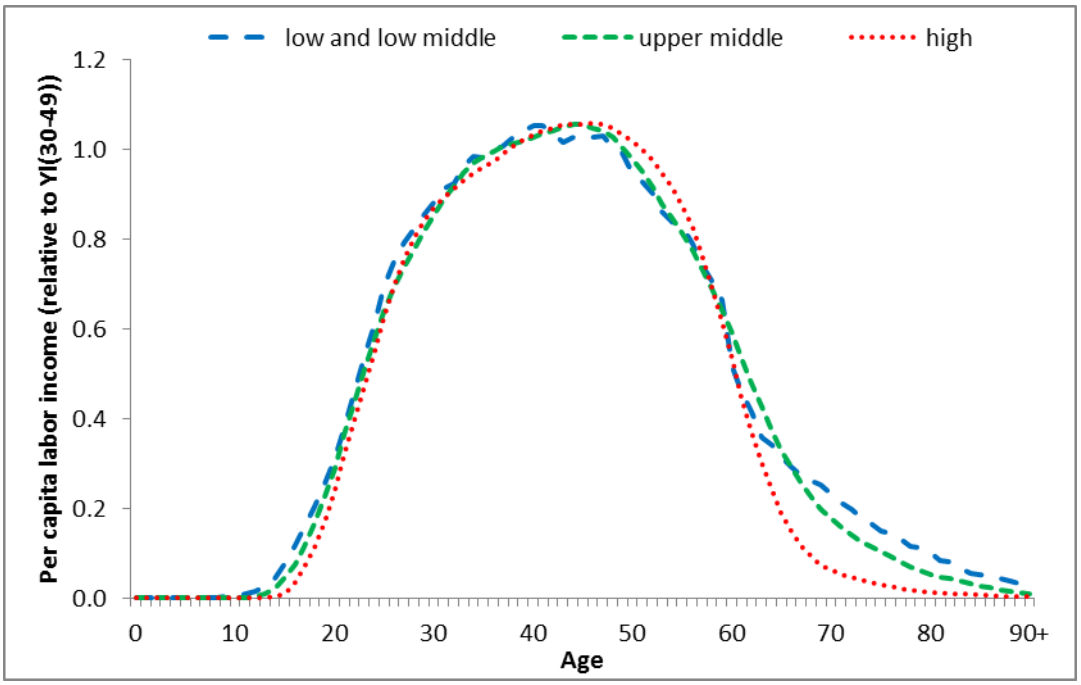

Figure 4. Per capita labor income by age for lower- (low- and lower-middle-), upper-middle-, and high-income countries for which NTA estimates are available. Values are expressed relative to average labor income of persons 30–49. Source: www.ntaccounts.org accessed August 9, 2012. File: lifecycle graphs v5.xlsx

Age-variation in consumption is also an important issue. Consumption at one age will differ greatly from consumption at another age, reflecting physiological needs, the importance of human-capital spending for children and young adults, attitudes and practices related to health spending and long-term-care spending for the elderly, and many other factors. Following a procedure similar to that followed for labor income, we calculate the effective number of consumers in each country by weighting the population using the average consumption at each age. On average, those 30–49 years old are counted as one consumer, and all others are measured relative to that base group. The total effective number of consumers will vary depending on population age structure and whether children and the elderly consume a lot or a little relative to a prime-age adult.

Per capita consumption by age relative to per capita consumption of the reference group, 30–49 year olds, is plotted for three income groups in Figure 5. These values are also simple averages of the values for each country in the income group.

Figure 5. Per capita consumption by age for lower- (low- and lower-middle-), upper-middle-, and high-income countries for which NTA estimates are available. Values are expressed relative to average consumption of persons 30–49. Source: www.ntaccounts.org accessed August 9, 2012. File: lifecycle graphs v5.xlsx

The high-income group is quite distinctive, both at young and old ages. In the high-income countries, consumption by children (reflecting heavy spending on education) and by the elderly (reflecting heavy public spending on health care and long-term care) is higher relative to the consumption of those 30–49 than it is in the other country groups. Consumption by children is somewhat higher in upper-middle-income countries than in low- and lower-middle-income countries.

The current support ratio and key elements as of 2010 are reported for NTA countries in Table 1. The first three columns report the population, the effective number of workers, and the effective number of consumers for each country estimated for 2010. Note that these values use population estimates for 2010 and lifecycle estimates for a recent year, but not 2010. Typically the effective number of workers is about half of the population. In Kenya and Nigeria, however, the effective number of workers is less than one-third of the population. This is because their populations are so young, and also because young adults in their twenties have very low productivity relative to adults 30–49. In the high-income countries, on average, the ratio of effective workers to population is highest, largely as a consequence of very favorable age structures, i.e., age structures concentrated in the working ages.

Table 1. Effective number of workers, consumers, and support ratio for NTA economies in 2010.

		Effective workers		Effective consumers			
Country	Population	Number	Percent of Population	Number	Percent of Population	Support ratio (SR)	SR annual growth rate, 2005–2010
Low and lower-middle income			***45.3***		***83.8***	***0.538***	***0.006***
Cambodia	14137	8129	57.5	11824	83.6	0.688	0.0090
India	1224614	579288	47.3	1044827	85.3	0.554	0.0054
Indonesia	239871	122301	51.0	211416	88.1	0.578	0.0068
Kenya	40513	13185	32.5	33278	82.1	0.396	0.0075
Nigeria	158423	48991	30.9	118693	74.9	0.413	0.0024
Philippines	93261	40315	43.2	82539	88.5	0.488	0.0046
Senegal	12434	5786	46.5	9527	76.6	0.607	0.0033
Vietnam	87847	46756	53.2	80331	91.4	0.582	0.0081
Upper-middle income			***49.3***		***89.7***	***0.550***	***0.004***
Argentina	40412	19572	48.4	37254	92.2	0.525	0.0042
Brazil	194946	98138	50.3	171521	88.0	0.572	0.0044
Chile	17114	8818	51.5	15614	91.2	0.565	0.0027
China	1341335	710952	53.0	1331433	99.3	0.534	0.0042
Colombia	46295	22353	48.3	41105	88.8	0.544	0.0036
Costa Rica	4659	2393	51.4	4269	91.6	0.561	0.0059
Jamaica	2741	1343	49.0	2385	87.0	0.563	0.0025
Mexico	113423	54435	48.0	96787	85.3	0.562	0.0041
Peru	29077	13859	47.7	25778	88.7	0.538	0.0044
South Africa	50133	20735	41.4	38012	75.8	0.545	0.0039
Thailand	69122	37287	53.9	64400	93.2	0.579	0.0013
Uruguay	3369	1641	48.7	3204	95.1	0.512	0.0026
High income			***52.0***		***102.1***	***0.510***	***–0.002***
Austria	8394	4450	53.0	8447	100.6	0.527	–0.0003
Finland	5365	2644	49.3	5364	100.0	0.493	–0.0082
France	62787	29953	47.7	63308	100.8	0.473	–0.0053
Germany	82302	42095	51.1	85853	104.3	0.490	–0.0022
Hungary	9984	5173	51.8	10016	100.3	0.517	0.0001
Italy	60551	32224	53.2	60482	99.9	0.533	–0.0012
Japan	126536	66959	52.9	143022	113.0	0.468	–0.0081
Slovenia	2030	964	47.5	2131	105.0	0.452	–0.0034
South Korea	48184	27002	56.0	48205	100.0	0.560	–0.0018
Spain	46077	24351	52.8	45131	97.9	0.540	0.0024
Sweden	9380	4917	52.4	10450	111.4	0.470	–0.0019
Taiwan	23216	12751	54.9	22895	98.6	0.557	0.0026
UK	62036	31893	51.4	60885	98.1	0.524	–0.0011
US	310384	166511	53.6	310100	99.9	0.537	–0.0033

In quite a few high-income countries the population and the effective number of consumers are very close because children have consumption lower and the elderly have consumption higher than that of prime-age adults, so these two groups more or less balance out. For high-income countries as a group, the effective number of consumers exceeds the population by about 2 percent. Japan and Sweden are distinctive among high-income countries because their effective number of consumers exceeds the population by more than 10 percent. This reflects high levels of consumption by the elderly in both countries combined with relatively heavy concentrations of their populations at older ages.

In middle- and low-income countries the effective number of consumers is less than the population for two reasons. The first is that per capita consumption by children and the elderly, relative to that of prime-age adults, is lower in these countries than in high-income countries. Secondly, their populations are more heavily concentrated at low-consuming child ages. For upper-middle-income countries, the effective number of consumers is 90 percent of the population and in low- and lower-middle-income countries the effective number of consumers is only 84 percent of the population.

If the calculations of the support ratio were based solely on which age groups are most productive, the high-income countries would appear to be in the most favorable position. But once we incorporate differences in consumption patterns, we see that the support ratio is least favorable on average in the high-income countries. The upper-middle-income countries, on average, have a support ratio that is highest, followed by the low- and lower-middle-income countries.

The support ratio in most high-income countries has peaked and is beginning to decline. On average, the decline is moderate, but for some countries it is quite substantial. Both in Finland and Japan, the support ratio is declining by 0.8 percent per annum, a very significant drag on economic growth.

Support ratios for countries by income group

The support ratios for the three income groups, high, upper-middle, and lower (consisting of low and lower-middle), are presented in Figure 6 for 1950–2060, using the simple average of country values in each year plus or minus one standard deviation. The broad similarity across countries at very different levels of development is striking. The support ratio declined in the 1950s and 1960s throughout the world. In the high-income countries, the decline was a consequence of a temporary spike in fertility—the baby boom. Elsewhere, the decline in the support ratio was a consequence primarily of improving infant and child mortality, which led to an increase in the child share of the population. The decline in the support ratio bottomed out within a three year period—1971 in the high-income countries, 1973 in the upper-middle-income countries, and 1974 in the lower-income countries. At that point, the support ratio began to rise, on average, for all country groups. The lower income countries are quite varied, however, as shall be seen.

The rise in the support ratio in high-income countries, due to the baby boom generations moving into the working ages, was short-lived, lasting 34 years until 2005. It was also modest, increasing from trough to peak by 12.6 percent. Using an average support ratio across many countries understates the swing in individual countries, because the peaks and troughs tend to be averaged out.

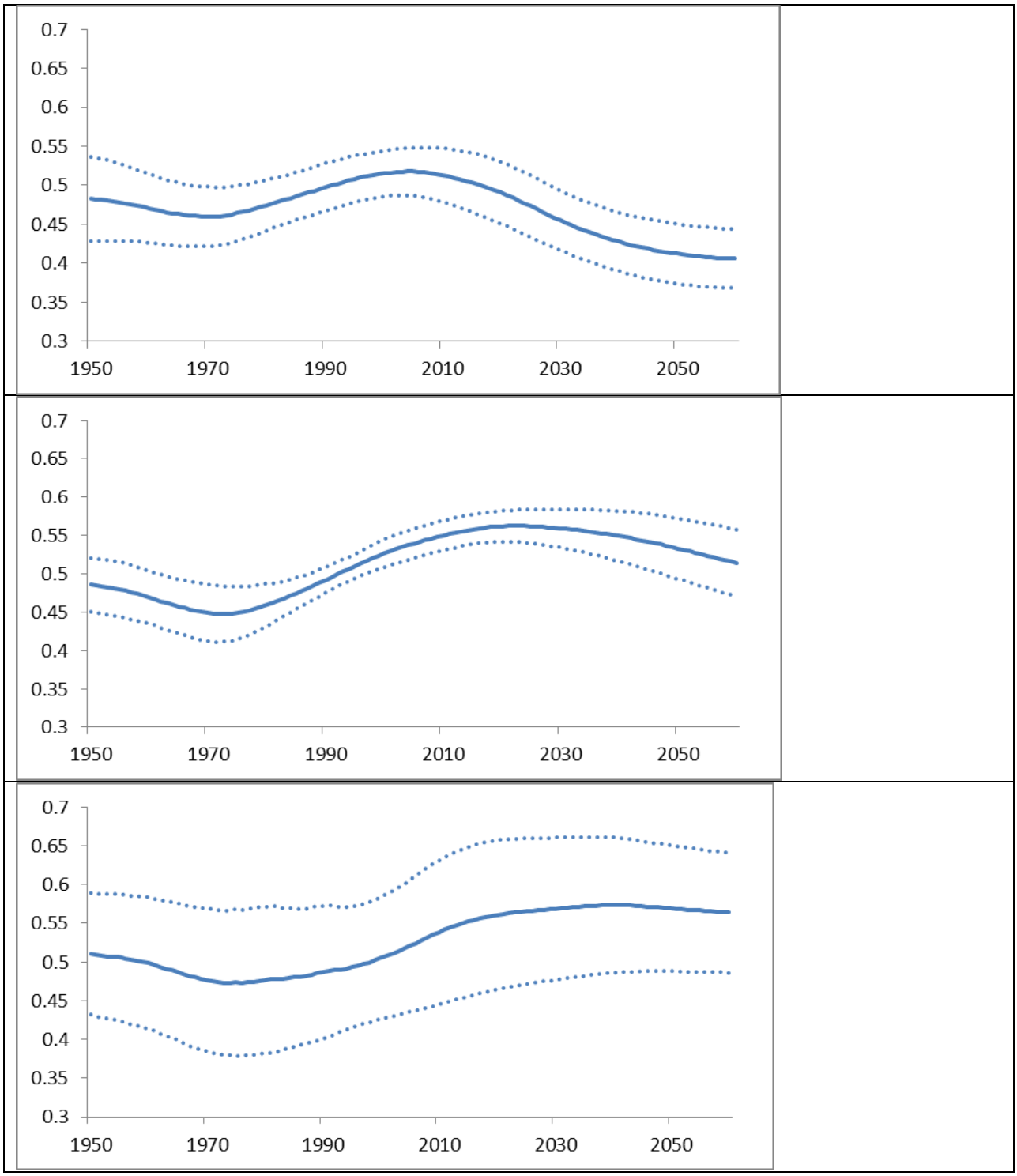

Figure 6. Support ratios +/– one standard deviation, 1950–2060, high-income (upper panel), upper-middle-income (middle panel), and lower-middle and low income countries (lower panel), 1950-2060. Source: Calculated by authors, see text. File: Support ratio tables of Sept 28 by Diana.xlsx

In the upper-middle income countries, the rise in the support ratio is projected to continue until 2022 with an increase from trough to peak of 25.6%.

For the low-income and lower-middle-income countries, on average, the rise in the support ratio is more gradual, lasting for 66 years from 1974 to 2040. The change from trough to peak is 21.2 percent. The two standard deviation interval is much higher for the lower-income countries, however. Thus, it is important to look at individual countries within this group, as shown in Figure 7.

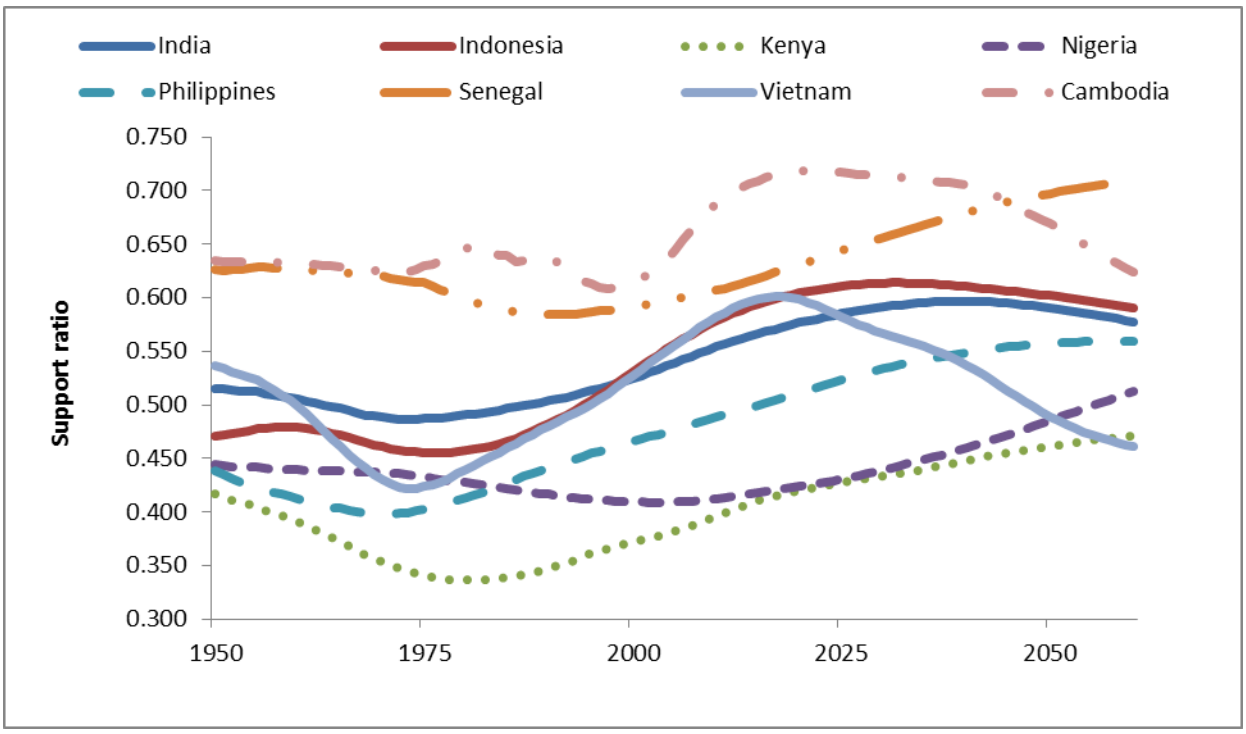

Figure 7. Support ratio for eight low- and lower-middle-income countries, 1950–2060. Source: Calculated by authors, see text. File: Support ratio tables of Sept 28 by Diana.xlsx. Note: This may need to be updated.

The diversity among these countries is quite substantial. First, consider the levels. In 2010, the support ratio varied from a low of 0.40 in Kenya to a high of 0.69 in Cambodia. Part of this difference occurs because low-income countries are at different points in their demographic transition. But the differences are substantial even after controlling for a country's position in its age transition. If we compare the average of the lowest and highest values of the support ratio over the dividend phase, the differences are still very large—for Cambodia and Senegal the average dividend phase support ratios during the dividend phase are 0.66 and 0.64, respectively, while in Kenya and Nigeria they are 0.40 and 0.45, respectively, reflecting the higher earnings of young workers in the first pair of countries.

All of the lower-income countries do go through the three phases of the population age transition, although the final stage of aging, marked by a decline in the support ratio, does not occur to any noticeable extent in the African countries or the Philippines until after 2050. In Vietnam the swings in the support ratio are quite sharp, and the age transition is very compressed. Vietnam traverses from the

trough to the peak of its dividend phase in 44 years, while the Philippines completes the same transition in a leisurely 79 years.

The total gain from trough to peak also varies greatly from country to country, although in many of these countries the support ratio is still rising in 2050. The total gain is relatively small for India, Nigeria, Senegal, and Cambodia, ranging between 12 and 23 percent. For the other countries, the total gain ranges from 35 to 43 percent.

Understanding this variation in the support ratio is one of the key goals of this study and we will address this issue in some depth below.

Demographic transition and the first demographic dividend

The trends in the support ratio mirror the trends in population age structure that arise over the demographic transition. The decline in the death rate early in the transition is concentrated at young ages and leads to an increase in the number of children and a lower support ratio. When fertility declines enough to more than offset the effects of lower infant and child mortality, the share of population at the child ages declines and the share at the working-ages rises pushing the support ratio higher. In the final phase of the transition, sustained low fertility leads to a smaller workforce relative to the older population. Continued declines in death rates lead to increased survival at old ages. Together, these, two elements of the demographic transition lead to a decline in the support ratio. Of course, countries vary in the details of their demography, with some countries experiencing unusual changes in age structure due to war, epidemics, or famine. But all lower-income countries experience a long dividend phase due to fertility declining and, barring some unforeseen catastrophe will experience a long period during which the support ratio will decline.

We can illustrate these ideas with the case of India, which is experiencing a slow, smooth demographic transition. India's dividend phase began in 1973 and is projected to continue until 2040, lasting for a relatively long 67 years. The largest first dividends have just occurred, between 2000 and 2010, boosting economic growth by about 0.5 percent per annum. The total gain during the first dividend can be judged by the percentage increase in the support ratio during the dividend phase. The projected support ratio for 2040 is 23 percent greater than the support ratio in 1973. This gain is more modest than that experienced in many countries.

The rate of growth of the support ratio is equal to the difference between the annual rates of growth of the effective number of workers and the effective number of consumers, as shown in Figure 8. Before 1973, the effective number of consumers was growing more rapidly than the effective number of workers in India because the decline in infant and child mortality led to a substantial increase in the child population. This led, with a lag, to an increase in the growth rate of the effective number of workers. In the 1970s, fertility decline began to drive down the rate of growth of the effective number of consumers to levels below the rate of growth of the effective number of workers. This is an important point and one that is sometimes misunderstood. The first dividend occurs because of fertility decline. The number of children, and consequently the effective number of consumers, grows more slowly than the effective number of workers, who were born in an earlier era of higher fertility. The effective

number of workers also eventually grows more slowly because of fertility decline, but with a considerable lag. Thus during this lag period, the decline in fertility leads to a demographic dividend.

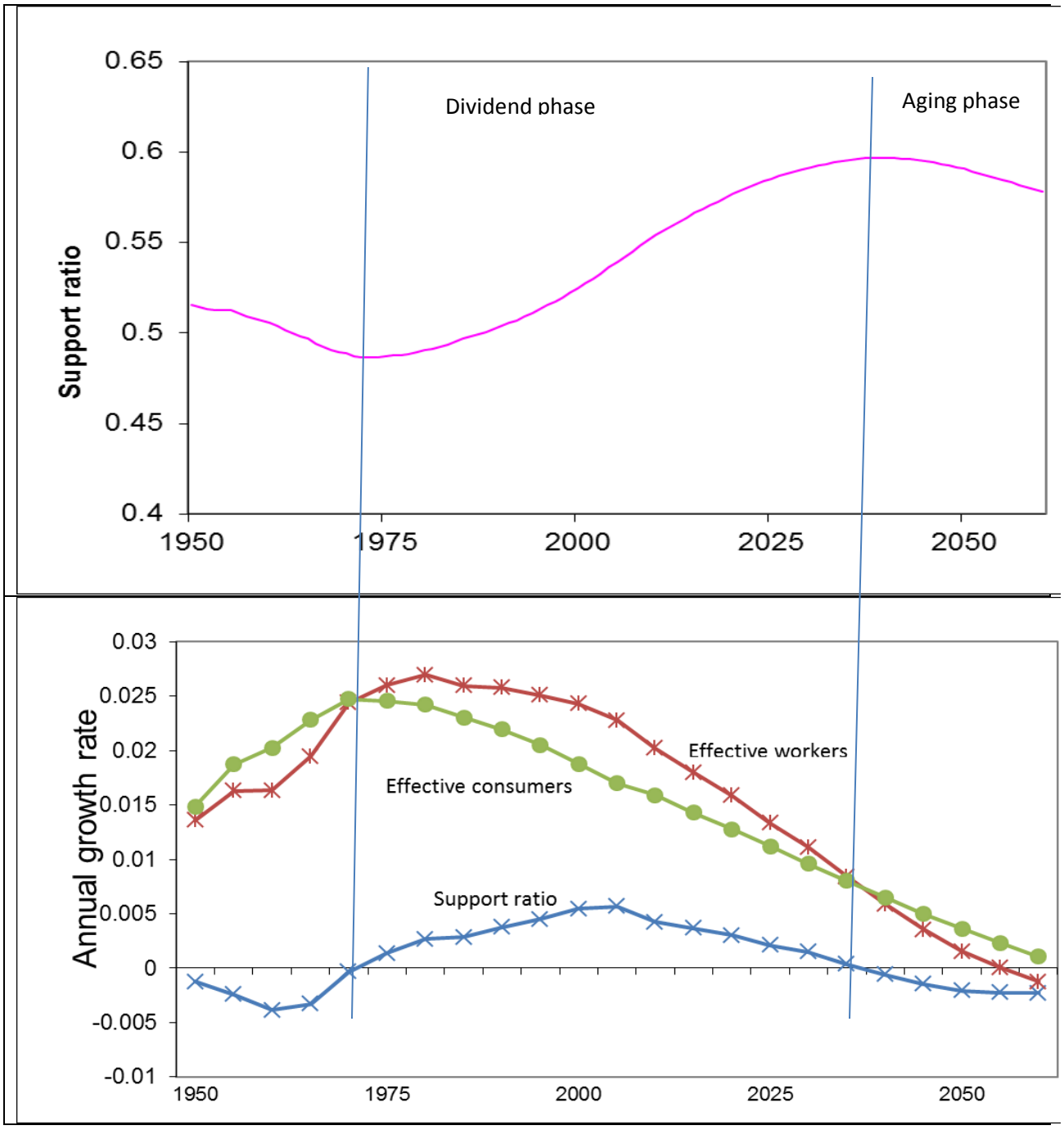

Figure 8. Support ratio (upper panel) and growth rates of support ratio, effective number of workers, and effective number of consumers (lower panel), India, 1950–2060.

The trends in the support ratio vary, however, depending primarily on the speed of fertility decline. Rapid fertility decline leads to a very sharp decline in the child population and a steep rise in the support ratio during the dividend phase. But the duration of the dividend phase is shorter as the small cohorts

produced by low fertility conditions enter the working ages. This was the pattern in several East Asian economies, such as China and Korea, and led to a very substantial demographic dividend there (Bloom and Williamson 1998; Mason 2001).

The lifecycle and the first demographic dividend

Changes in age structure matter only because of the lifecycle—the systematic divergence between labor income and consumption that leads to substantial lifecycle deficits during the young and old ages and a lifecycle surplus at prime ages. The lifecycle is not fixed, however, but varies across countries and responds to changes in circumstances, attitudes, and policies. The lifecycle profile may also change with economic development. The cross-section profiles reported above exhibit important differences—greater relative consumption per child and per older adult in high-income countries and greater relative labor income at younger and older ages in lower-income countries. The economic lifecycle can also be influenced by public policy, e.g., child labor laws and their enforcement, educational policy, retirement policy, and public financing of healthcare spending (Gruber and Wise 1999). Thus, the magnitude and duration of the first dividend will depend on features of the lifecycle and policies that influence those features.

Raising the support ratio or increasing the first demographic dividend is not sufficient to argue for a particular policy. Staying longer in school rather than working, greater spending on healthcare by the elderly, and a leisurely retirement for more people all have benefits that must be weighed against the costs. Thus, any particular policy must be fully evaluated, not pursued solely because it raises the support ratio or yields a greater first demographic dividend.

With this important proviso in mind, it is important to explore how changes in the economic lifecycle influence the support ratio and, hence, the magnitude of the demographic dividend. This is complicated because the effects on the support ratio of changes in the economic lifecycle depend on the population age structure. In a very young population, changes in consumption and labor income patterns at older ages will have much less impact on the support ratio than in a country with a large elderly population.

Our approach is to consider a synthetic cohort that is subject to given age-specific survival rates and cross-sectional per capita labor income and consumption profiles such as the ones presented in Figures 4 and 5. The dynamics of the support ratio are important, but to understand how characteristics of the lifecycle influence the support ratio it is very helpful to consider the support ratio for a stable population:

$$L/N = \int_{a1}^{a2} e^{-nx} s(x)\phi(x)dx \Big/ \int_{0}^{\omega} e^{-nx} s(x)\gamma(x)dx. \qquad (1.3)$$

where *n* is the population growth rate, *s(x)* is the proportion surviving from birth to age *x*, and $\phi(x)$ and $\gamma(x)$ are the labor income and consumption weights at each age as defined above. The limits of integration for the numerator are the ages of entry to and departure from the workforce and for the denominator birth and the maximum age lived.

Taking the natural log of both sides yields an approximation of the relationship between the aggregate support ratio, the population growth rate, and features of the per capita profiles of labor income and consumption:

$$
\begin{aligned}
&\ln L/N \simeq \ln \phi_0 / \gamma_0 - n(\mu_\phi - \mu_\gamma) + 0.5n^2(\sigma_\phi^2 - \sigma_\gamma^2).\\
&\phi_0 = \int_{a1}^{a2} s(x)\phi(x)dx,\ \gamma_0 = \int_0^{\omega} s(x)\gamma(x)dx\\
&\mu_\phi = \int_{a1}^{a2} x\delta_\phi(x)dx,\ \mu_\gamma = \int_0^{\omega} x\delta_\gamma(x)dx\\
&\sigma_\phi^2 = \int_{a1}^{a2} x^2\delta_\phi(x)dx - \mu_\phi{}^2,\ \sigma_\gamma^2 = \int_0^{\omega} x^2\delta_\gamma(x)dx - \mu_\gamma{}^2\\
&\delta_\phi(x) = s(x)\phi(x)dx \Big/ \int_{a1}^{a2} s(x)\phi(x)dx\\
&\delta_\gamma(x) = s(x)\gamma(x)dx \Big/ \int_0^{\omega} s(x)\gamma(x)dx.
\end{aligned}
\tag{1.4}
$$

The first moments, ϕ_0 and γ_0, are the expected lifetime effective years of work and consumption, respectively, for the synthetic cohort. The second moments, μ_ϕ and μ_γ, are the mean ages of expected effective lifetime work and consumption. The third moments, σ_ϕ^2 and σ_γ^2, measure the variance or the extent to which earning and consumption are dispersed over the lifecycle rather than concentrated near the mean ages.

The expression for the support ratio can be thought of as consisting of two components. The first term on the right-hand-side in equation (1.4) is independent of the population growth rate and captures the *level* of the support ratio. The value is equal to the expected effective years of labor relative to the expected effective years of consumption. This is a lifetime measure of dependency for a synthetic cohort. In a society where individuals typically worked most of their lives, the lifetime support ratio would be very high. If entry to the labor force is delayed, retirement comes at an early age, and life expectancy is high, the lifetime support ratio will be low. In the simplest case of zero population growth (n equal to zero), equation (1.4) is exact and the support ratio for the population equals the lifetime support ratio for the synthetic cohort.

The remaining terms in equation (1.4) capture the effects of the timing of labor income and consumption over the lifecycle. If people tend to consume a lot at young ages and earn a lot at older ages, then a young, rapidly growing population will have a lower support ratio. But if people tend to consume a lot at older ages and earn labor income at younger ages, then a young, rapidly growing population will have a higher support ratio.

Algebraic manipulation of equation (1.4) yields a close approximation of the influence of population growth on the support ratio:

$$\frac{\partial \ln L/N}{\partial n} \simeq \left(\mu_\gamma - n\sigma_\gamma^2\right) - \left(\mu_\phi - n\sigma_\phi^2\right) \tag{1.5}$$

The second derivative is given by:

$$\frac{\partial^2 \ln L/N}{\partial n^2} \simeq \sigma_\phi^2 - \sigma_\gamma^2. \tag{1.6}$$

The simplest case is n is zero (or sufficiently close to zero). Then, the effect of a change in the population growth rate depends only (or primarily) on the mean ages of consumption and labor income for the synthetic cohort in equation (1.5). If consumption occurs at an earlier age over the lifecycle than labor income, then the mean age of consumption is exceeded by the mean age of labor income and a decline in the population growth rate leads to a rise in the support ratio.

The variance terms come into play in equation (1.5) when population growth is no too close to zero. This occurs because as the population growth rate changes, the mean age of earnings and consumption for the population change depending on the variance of the age profiles of earnings and consumption. In general, the variance of the age profile of consumption is greater than the variance of the age profile of labor income. Consequently, the mean age of consumption for the population is affected more than the mean age of earning for the population by changes in the population growth rate. Thus, the second derivate of the support ratio (equation 1.6) is negative. This implies, in turn, that the support ratio reaches a peak value where the population is neither too old nor too young.

Estimates of the moments of consumption and labor-income profiles for each country are reported in the appendix. Measures are calculated using two different mortality schedules from the life table for Japan in 1949 and 2009 from the Human Mortality Database. In 1949, Japan had the lowest life expectancy of any OECD country and in 2009 it had the highest life expectancy in the world.

Table 2 reports values of the lifecycle that determine the level of the support ratio: the expected effective years working and consuming. The values are averages for high-, upper-middle-, and lower-income countries computed as simple averages of the values for NTA countries falling in each income group. The "support ratio" is computed for the synthetic cohort based on the expected effective years of working and consuming over the entire lifetime.

Table 2. Expected effective years of earning and consuming, synthetic cohorts, high- and low-mortality assumptions, by country income group.

	High mortality			Low mortality		
	Expected effective years		Support	Expected effective years		Support
Country income group	Working	Consuming	ratio	Working	Consuming	ratio
High income	24.9	50.7	0.490	36.5	85.3	0.428
Upper-middle income	25.7	46.8	0.549	38.4	77.8	0.493
Lower income	26.2	46.1	0.568	39.4	76.7	0.514

Source: Calculation by authors. File: Analysis of C and Yl profiles.xlsx

Roughly speaking, people effectively work about one year for every two effective years they are consuming, but the value of the support ratio varies. Given high-mortality conditions, the expected lifetime support ratio ranges from a low value of 0.49 in high-income countries to a high value of 0.57 in lower-income countries. The higher value in lower-income countries reflects effective years of work higher by about 5 percent and effective years of consuming lower by almost 10 percent, as compared with values for high-income countries. The gap in the lifetime support ratio between lower- and upper-middle-income countries is much smaller.

Given low-mortality conditions, the effective years of working and consuming both increase substantially, but the expected effective years of consuming increase by more because of gains at older ages when labor income is relatively low. As a consequence, the support ratio drops for all sets of consumption and labor-income profiles. The decline is somewhat greater for high-income countries because they have high levels of consumption and low levels of labor income at the oldest ages.

Simply put, the support ratios for synthetic cohorts are higher in lower-income countries because people are both working longer and because they are consuming less—requiring less support—during their non-working years. The differences in lifecycle patterns of consumption and labor income are reinforced by differences in mortality between lower- and high-income countries. Comparing the synthetic support ratio for a lower-income, high-mortality population (0.57) to a high-income, low-mortality population (0.43) reinforces this point. One way to look at this is that high-income countries are using their wealth to but a more expensive lifecycle!

But this tells us nothing about how support ratios change in countries as fertility rates and population growth rates decline. To answer this question we must consider the timing of labor income and consumption over the lifecycle. The mean ages and variances of consumption and labor income for the high-, upper-middle, and lower-income NTA countries provide the information required to make this assessment. The values, shown in Table 3, are calculated using the high and low survival rates employed for Table 2.

Table 3. Mean ages and variances of labor income and consumption, synthetic cohorts, high- and low-mortality assumptions, by country income group.

	High mortality				Low mortality			
	Labor income		Consumption		Labor income		Consumption	
Country income group	Mean age	Variance	Mean age	Variance	Mean age	Variance	Mean age	Variance
High income	41.4	132.7	36.0	455.9	42.8	141.7	46.0	644.6
Upper-middle income	41.7	154.4	37.0	430.7	43.7	176.4	46.0	591.4
Lower income	41.4	164.7	37.1	420.7	43.8	198.4	45.9	582.5

Source: Calculation by authors. File: Analysis of C and Yl profiles.xlsx

For the high mortality case, the mean ages of per capita labor income are virtually identical in the high- and lower-income countries, at 41.4. For the low-mortality case, the mean age of labor income is greater for lower- and upper-middle-income countries. People are effectively working longer in low-

income countries, as shown above, but this is coming both at young ages and older ages. Given high mortality conditions, the mean age of consumption is about one year greater in upper-middle- and lower-income countries than in high-income countries. Given low-mortality assumptions, the average age of consumption is nearly identical in all countries. This is somewhat surprising given the focus on high healthcare spending at older ages in high-income countries. But consumption is also high at young ages in high-income countries because of spending on education, and these balance each other out.

Given high mortality, the mean age of labor income is much greater than the mean age of consumption for any of the consumption and labor income-profiles. Child dependency dominates because only a small percentage of the population is surviving to old age. Thus, when the population growth rate is close to zero, lower fertility and population growth lead to a higher support ratio. But low-mortality conditions reverse this. When high percentages are surviving to old age, the mean age of consumption is greater than the mean age of labor income for the synthetic cohort, implying that when the population growth rate is near zero higher fertility and population growth lead to a higher support ratio.

Because people consume, but do not work, throughout their lives, the age pattern of labor income is always more heavily concentrated than the age pattern of consumption, as reflected in their variances. As population growth speeds up, the mean age of consumption for the population declines relative to the mean age of labor income for the population. Thus, the partial effect of population growth on the support ratio declines as the population growth rate increases.

The variances of labor income and consumption depend on income level. Labor income has a greater age variance in lower-income countries and, hence, the average age of labor income in lower-income countries declines more rapidly as population growth increases. Consumption has a smaller variance in lower-income countries and, hence, the average age of consumption declines more slowly as population growth increases. This means that the support ratio tends to decline more rapidly as population growth increase in high-income countries and more slowly in lower-income countries The high-income country consumption and labor-income profiles are particularly susceptible to the effects of population aging.

Importance of consumption and labor income profiles

The level of the support ratio varies across countries irrespective of the population age structure because of variation in the expected lifetime support ratio. In countries where people begin to work earlier or continue to work until an older age, the expected lifetime support ratio is greater as will be the level of the support ratio other things equal. Consumption patterns matter, as well, and in countries where children and the elderly consume more relative to prime-age adults, the lifetime support ratio will be lower, other things equal.

Which is more important as a determinant of the level of the support ratio, patterns of labor income or consumption? This question is answered using analysis of variance. The percentage variation in the lifetime support ratio across countries depends on the percentage variation in the amount of labor, the percentage variation in the amount of consumption, and the interaction between lifetime labor and lifetime consumption:

$$\text{var}(\ln \phi_0/\gamma_0) = \text{var}(\ln \phi_0) + \text{var}(\ln \gamma_0) - 2\,\text{cov}(\ln \phi_0, \ln \gamma_0) \quad (1.7)$$

The components of variation calculated for the high- and low-mortality scenarios are reported in Table 4. If the analysis is applied to all countries combined, labor income and consumption explain the same amount of variation in the lifetime support ratio irrespective of the mortality assumption. Interaction between the consumption and labor-income profiles magnifies their effect because the covariance between them is negative. Countries with low lifetime labor income have high lifetime consumption.

A very different picture emerges when the analysis is applied separately for each country income group. For high-income countries with low mortality, the relevant scenario, and upper-middle-income countries, lifetime levels of labor income and consumption are both important in explaining the lifetime support ratio. The interaction is negative, however. Within country income groups, countries with less lifetime effective years of work also have less lifetime effective years of consumption.

The situation is entirely different for lower-income countries. For them, lifetime consumption plays virtually no role in explaining why some have higher lifetime support ratios than others. Differences in the lifetime support ratio are almost entirely a consequence of differences in the years of lifetime effective labor.

Table 4. Components of variation in lifetime support ratio.

		Percentage explained by		
		Labor income	Consumption	Interaction
High-mortality conditions				
All countries	100.0	37.2	39.6	23.2
High income	100.0	51.9	32.9	15.2
Upper-middle income	100.0	41.8	78.4	-20.2
Lower income	100.0	85.7	6.9	7.4
Across income groups	100.0	11.9	43.9	44.2
Low-mortality conditions				
All countries	100.0	40.7	41.6	17.8
High income	100.0	72.3	62.9	-35.2
Upper-middle income	100.0	50.4	81.3	-31.7
Lower income	100.0	87.5	9.7	2.8
Across income groups	100.0	16.2	36.4	47.4

File: Analysis of C and Yl profiles.xlsx

This analysis applies only to the level of the support ratio, but it can be repeated to evaluate whether differences in the timing of consumption, or the timing of labor income, or both are responsible for the effects of population growth on the support ratio. This is accomplished by applying analysis of variance to equation (1.5). We calculate the variance of the consumption effect and the labor effect and the covariance between the two, given possible values of the population growth rate, n. The results are similar to those shown in Table 4. For high- and upper-middle-income countries, the timing of

consumption and labor income over the lifecycle are both important. For low-income countries, however, there is very little variation among countries in the timing of consumption. Almost all of the variation in timing stems from labor income and whether it is concentrated at younger or older ages.

This finding has important implications for understanding why some countries have higher support ratios than others and why demographic dividends are higher (given demography) in some countries than others. For lower-income countries, labor markets and policies that influence employment and labor productivity over the lifecycle play the key roles in determining the level of the support ratio in the near term. Differences in consumption patterns do not play an important role in explaining why some lower-income countries have low support ratio and others have high support ratio.

As lower-income countries become richer and become upper-middle- or high-income-countries, a broader set of issues will become more relevant. Labor policies that influence employment and productivity over the entire lifecycle will continue to be important. Policies, e.g., the role of public transfers, that influence consumption over the entire lifecycle will also become increasingly important. In this regard, of particular concern is spending on education for children and health and long-term care for the elderly.

What other conclusions do we draw from this cross-sectional data? The key features of the lifecycle appear to be fairly persistent as we shift from lower- and upper-middle-income countries, and these features favor a higher support ratio as population growth rates decline. When we consider the shift from upper-middle- to high-income countries, however, the changes in the lifecycle reinforce the effects of population aging, leading to a substantial decline in the support ratio. Given low mortality and population declining by 1 percent per year, for example, we see 47 effective workers per 100 effective consumers given the upper-middle-income profile but only 40 effective workers per 100 effective consumers given the high-income profile. There is a substantial cost to high consumption and low labor income among the elderly in high-income, aging societies.

Second demographic dividend

The first demographic dividend occurs because fertility decline and the decline in child dependency free up resources. Some of those resources can be used to raise current standards of living. But some of those resources can also be invested to fuel more rapid economic growth producing a second demographic dividend. Resources can be invested in human capital by spending more per child on health and education. Or resources can be used to increase physical capital. Individuals can start new businesses or improve and expand existing businesses. Governments can invest in infrastructure, such as communication and transportation systems, and or in institution-building that will strengthen the rule of law and the functioning of financial markets, for example.

The impact of the demographic dividend on the availability of resources is very clear from comparing total consumption and labor income at each age for lower-, upper-middle-, and high-income countries (Figure 9). Consumption and labor income are expressed as a proportion of total labor income. The values were calculated for each NTA country and then averaged over the countries in each income

group. A simple average was used rather than weighting each country based on its population or the size of its economy.

The total net cost of children, or the "child deficit," is measured as the lifecycle deficit, the gap between consumption and labor income, for those under the age of 25. For high-income countries, shown in the lowest panel, the child deficit is 28 percent of the total labor income of all adults 25 and older. In other words, about one in four dollars earned by adults is going to support children. For upper-middle-income countries, the child deficit is 47 percent of the labor income of adults 25 and older. And for lower-income countries, the child deficit is 56 percent of the labor income of those 25 and older. More than one of every two dollars in labor income is going to support children because there are so many children.

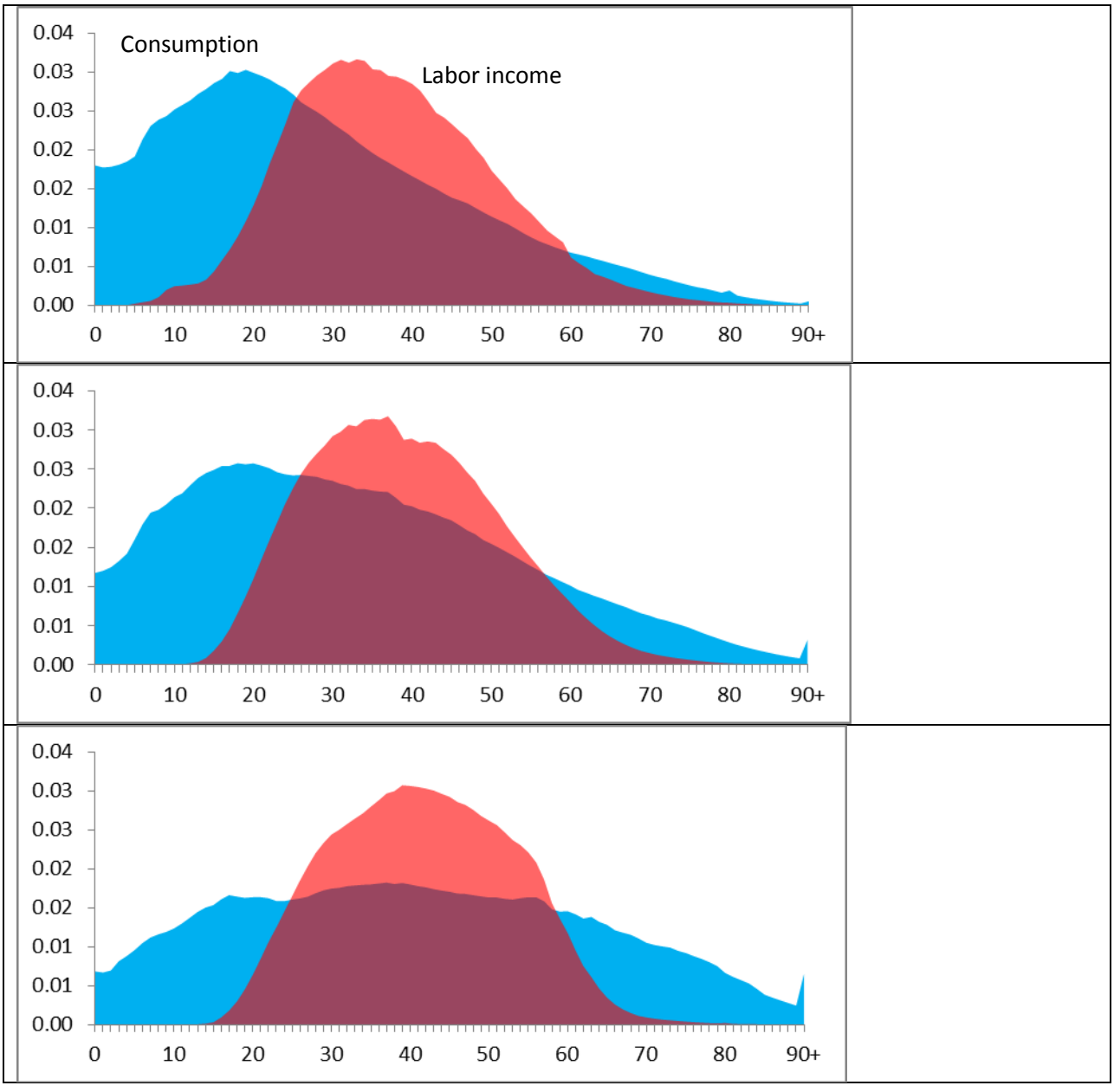

Figure 9. Aggregate consumption and labor income by age for countries in three income groups: low- and lower-middle (upper panel), upper-middle (middle panel) and high (upper panel). All values expressed as a proportion of total labor income. Simple averages for countries in each group. Source: Calculated by authors from NTA database accessed on August 9, 2012. File: Same as other lifecycle graphs.

The high burden of spending on children in low-income countries is balanced in part by the low burden of spending on the elderly. Overall, the support ratio is lowest in the high-income countries, with 51 producers per effective consumer versus 54 producers per effective consumer in the lower-income countries and 55 effective producers per effective consumer in the upper-middle-income countries (Table 1).

Human-capital spending and the second demographic dividend

Investment in children is a key channel for realizing a second demographic dividend. One could think of investment as consisting solely of human-capital spending, in other words, investing in children's education and health. But particularly in low-income countries, spending on basic needs, e.g., food, housing, and clothing, may also have a substantial influence on the ability of children eventually to lead full and productive lives.

Consumption by children is inextricably tied to the standard of living in the country in which they live. Hence, children in lower-income countries are generally consuming much less than children in upper-middle- or high-income countries. But even after controlling for the level of development, we still see differences in consumption by children related to age structure.

Synthetic cohort measures of per capita consumption for lower-, upper-middle-, and high-income countries are reported in Table 5. We control for the level of development by normalizing consumption on average labor income of prime-age adults (30–49). Even normalized child consumption rises with income. In lower-income countries, children consume about 11.9 years of prime-age adult labor income over their first 24 years of life. In upper-middle-income countries children consume 13.2 equal to 13.2 years of prime-age adult labor income and, in high-income countries, slightly more – consumption valued at 13.4 years of prime-age adult labor income. The patterns for child consumption, consumption from 0 to 9 and from 10 to 17, are similar. As average income increases and the aggregate burden of childrearing declines, moving from lower- to higher-income countries, spending per child clearly increases for these age groups.

The consumption pattern for young adults, those 18-24, is different than that for children. Normalized consumption is highest for upper-middle-income countries and lowest for high-income countries, with consumption for low-income countries falling between the two. The consumption pattern for young adults is very similar to the consumption pattern for prime-age adults, those 30-49. For both young adults and prime-age adults, the consumption patterns closely follow the support ratio patterns. The high-income countries have the lowest support ratio and the lowest normalized consumption, the upper-middle-income countries have the highest support ratio and the highest normalized consumption,

while the lower-income countries have intermediate values for both variables. The increase in the old-age population in high-income countries is squeezing out consumption by both young adults and prime-age adults, but not by children.

Table 5. Per capita consumption by children, young adults, and prime-age adults, normalized on per capita labor income of those 30–49, synthetic cohorts, by country income group.

	Children and young adults				Adults
	0–24	0–9	10–17	18–24	30–49
Lower income	11.93	3.31	4.15	4.48	13.14
Upper-middle income	13.23	3.90	4.66	4.67	14.29
High income	13.43	4.26	4.85	4.32	12.19

Note: Synthetic cohort without survival weighting. Values are calculated separately for each NTA country and normalized on labor income for adults 30–49. Country group averages are simple averages across all NTA countries within the income group.

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The consumption pattern for children is much more consistent with a tradeoff between the number of children and spending per child traces – the quantity-quality tradeoff proposed by Becker as one of the key features of fertility decline(Becker and Lewis 1973; Becker 1991). A strong quantity-quality tradeoff would have important implications for the use of resources that are freed up by the demographic dividend. Some of those resources can be used to raise current standards of living, but some portion will be diverted into raising investment in child health and education. These smaller cohorts with their enhanced human capital will be more productive when they enter the labor force, allowing them to invest in the next generation of children at an even higher level. The result can be a virtuous circle that sustains higher rates of economic growth after the first dividend phase ends and the support ratio begins to decline. Analysis by Lee and Mason (2010), based on the first set of estimates of human-capital spending from NTA data, shows that the quantity-quality tradeoff is sufficiently strong to realize this favorable outcome. Fertility decline will lead not just to a first demographic dividend but also to a second dividend through human- capital investment that will lead to higher standards of living in the long term.

These estimates have been periodically updated and the results reinforce the original conclusion. Values reported in Figure 10 show the latest human-capital estimates for 34 countries. The elasticity of human capital with respect to the total fertility rate is –0.83, a value that is very similar to earlier estimates. This implies that a 10 percent decline in the number of children born is accompanied by an 8 percent increase in human-capital spending per child. Time series estimates for East Asian countries show an even stronger quantity-quality tradeoff than exhibited in the cross-sectional data (Ogawa, Mason et al. 2009).

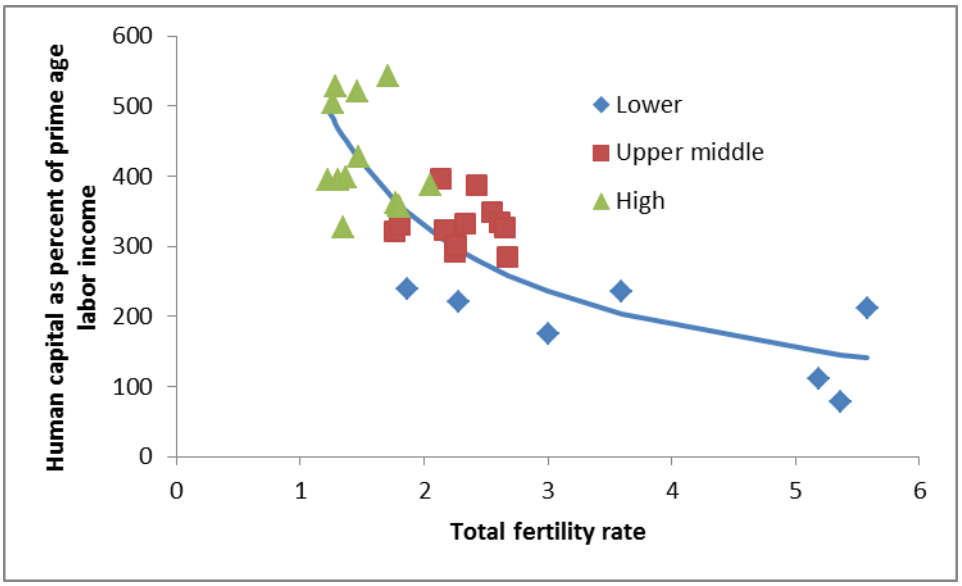

Figure 10. Tradeoff between human-capital spending and fertility. Lifetime human-capital spending per child is a synthetic cohort measure constructed by cumulating per capita health spending from ages 0–17 and per capita education spending from ages 3–26. The values are expressed as a percentage of average labor income of adults aged 30–49. The fertility measure is an average of the Total Fertility Rate in the five years preceding the NTA estimate year. Update of estimates presented in Lee and Mason (2010).

One important aspect of the quantity-quality tradeoff is its implication for old-age support in low-fertility, aging societies. Low fertility will lead to a decline in the number of taxpayers relative to the number of elderly. But if more taxpayers who are less productive are being traded for fewer taxpayers who are more productive, the fiscal implications are far from clear. The smaller, more-productive group may produce more than the large, less-productive group and, hence, better able to support the elderly dependent population. The issue is not just the number of taxpayers but also the productivity of those taxpayers.

Among the seven lower-income countries shown in Figure 10, five have human-capital spending below the regression line. Among these, India, Indonesia, and Vietnam have fairly low fertility. It appears, then, that they are fully exploiting the quantity-quality tradeoff. In principle, the quantity-quality tradeoff can be driven by either private spending, as postulated by Becker, or by public spending. Previous work has shown that both public and private human capital spending rise with fertility decline in Asia (Lee and Mason 2012). In a global context, however, the quantity-quality tradeoff is much more pronounced for public than for private spending.

Support systems for the young

For lower-income countries with their very young age structures, a key development issue is how children access economic resources. The totals spent on children in lower-income countries, as seen above in Figure 9, are very high, but per capita spending, and especially per capita human-capital

spending on children is low. How do children acquire resources in countries that differ in terms of income level, or region, or other characteristics? Answering this question is limited to some extent by data availability. Complete National Transfer Accounts, which provide comprehensive documentation of the reallocation system, are available for 10 high-income countries, 9 upper-middle-income countries and 3 lower-middle-income countries. Hence, this analysis emphasizes the differences between middle- and high-income economies.

Young children depend on two sources of support, their families and their governments. They are too young to work, they have no assets, and they have no access to credit markets. Hence, they are utterly dependent on transfers. This is true, of course, for children in both middle- and high-income countries. Children begin to contribute to their own material needs at a little younger age in middle-income countries than in high-income countries. By age 15, they depend on their own resources to fund almost 10 percent of their consumption. Children do not meet this mark in high-income countries, on average, until they are 17, but as they get older they catch up. By age 20, children in both middle- and high-income countries are funding 43 percent of their consumption. By age 24, young adults in high-income countries are funding 99 percent of their consumption. Young adults in middle-income countries reach this level of self-sufficiency by age 25. As the importance of a young person's own resources increases, the importance of transfers necessarily declines. Transfers are a little more important for those in their early twenties in middle-income countries than in high-income countries. These are averages, however, and there are important differences across countries within the two income groups.

The extent to which the young rely on their own resources, private transfers, or public transfers is charted for middle- and high-income countries in Figure 11. Transfers exhibit broad patterns common to both middle- and high-income countries. Private (familial) transfers are more important than public transfers at all ages. Public transfers are a bit more important for newborns, probably reflecting publicly funded healthcare spending, than for older pre-school children. Public transfers increase substantially as children enter public school. In both middle- and high-income countries, public transfers are most important at age seven. Thereafter, they decline relative to private transfers.

Although private transfers are more important than public transfers in both income groups, public transfers are much more important in high-income countries than in middle-income countries at every age. If we use a simple average of the ratio of private and public transfers for ages 0–18 as an indicator, public transfers are 35 percent of private transfers in middle-income countries, while they are 75 percent of private transfers in high-income countries.

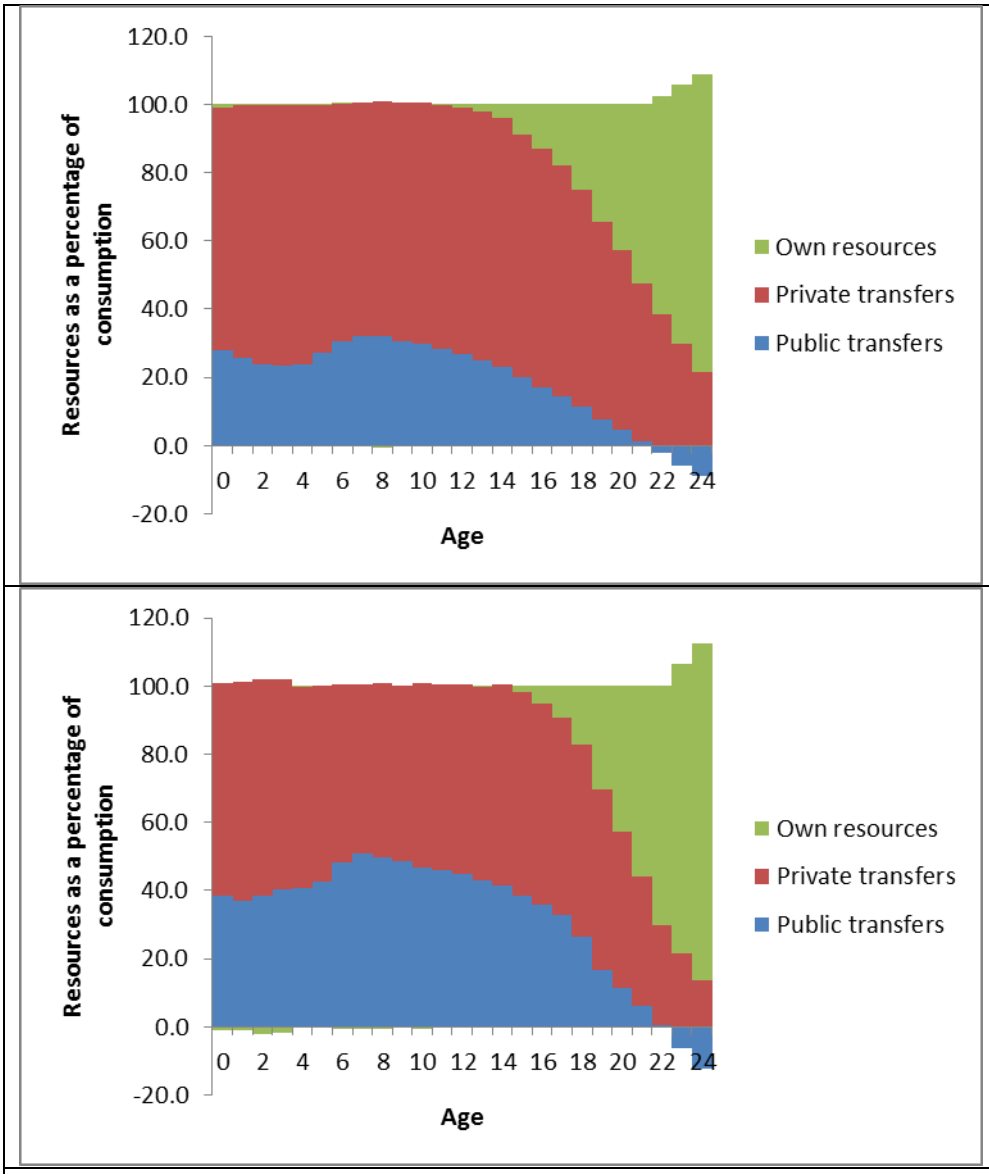

Figure 11. Sources of support as a percentage of consumption for middle- (upper panel) and high-income (lower panel) countries. Own resources include labor income and asset-based reallocations. Values are simple averages of the percentages for the available countries. Middle-income countries are: Argentina, Brazil, Chile, China, Costa Rica, India, Indonesia, Mexico, the Philippines, South Africa, Thailand, and Uruguay. High-income countries/economies are: Austria, Germany, Hungary, Japan, Slovenia, South Korea, Spain, Sweden, Taiwan, and the United States.

The variation across countries in support systems for children and young adults can be seen in the next three triangle graphs that show public transfers, private transfers, and own resources as a share of consumption for three broad age groups—0–9, 10–17, and 18–24 (Figures 12–14). The 0–9 and the 10–17 age groups are similar in important respects. First, the differences between the high- and middle-income countries are quite clear. There is some overlap in these two groups, but in the middle-income countries children are quite consistently less dependent on public transfers and more dependent on

private transfers than in the high-income countries. Children 10–17 are slightly more dependent on their own resources in middle-income countries, but own resources are not very important in any of the countries for this age group.

There is a great deal more overlap between the middle- and high-income countries when we consider young adults age 18–24. In middle-income countries, young adults depend somewhat more on private familial transfers and somewhat less on public transfers than do young adults in high-income countries. But there is considerable variation from country to country and a great deal of overlap between the two income groups.

Regional patterns (not shown) are not very distinctive: Middle-income countries in Asia look similar to middle-income countries in Latin America. For those aged 10–17, for example, public transfers as a share of consumption are lowest in India, Brazil, Uruguay, and the Philippines. By contrast, when we turn to support systems for the elderly, we shall see some very important regional differences.

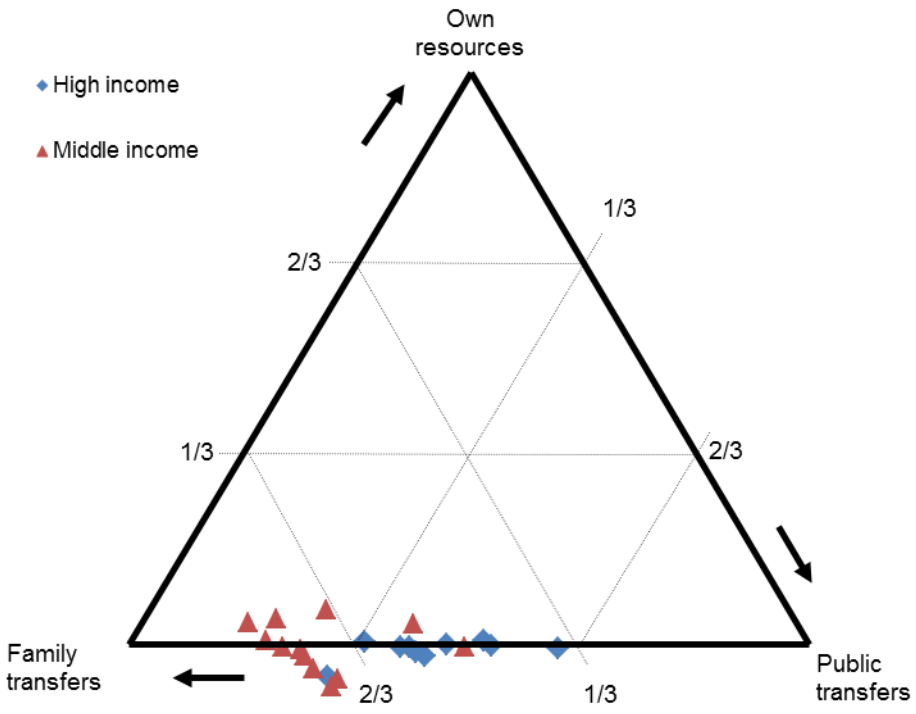

Figure 12 Support system for 0–9 year olds in high- and middle-income countries, synthetic cohort estimates, not survival weighted.

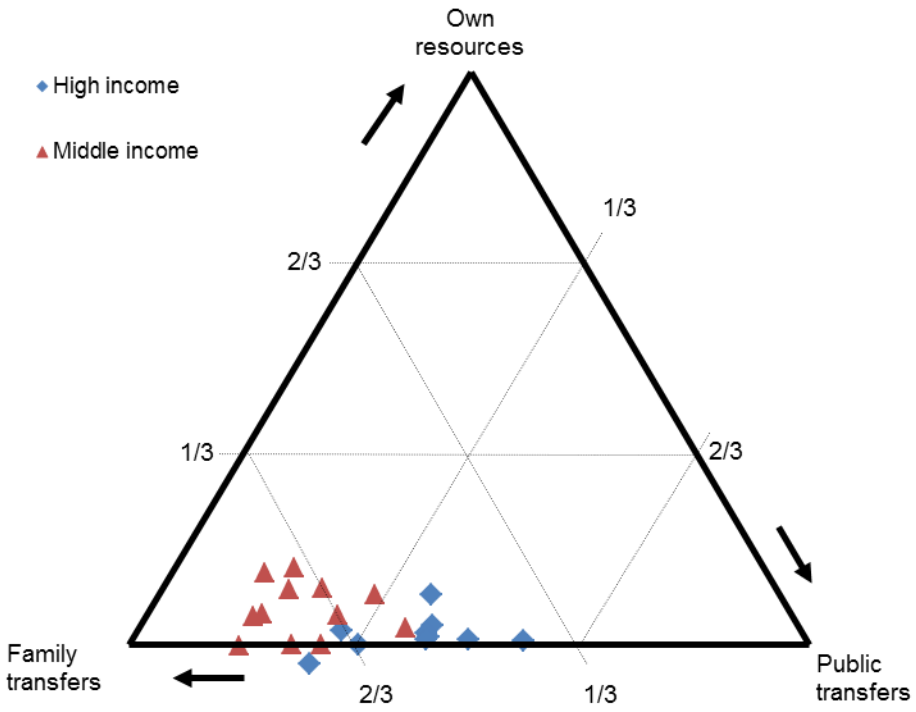

Figure 13. Support system for 10–17 year olds in high- and middle-income countries, synthetic cohort estimates, not survival weighted.

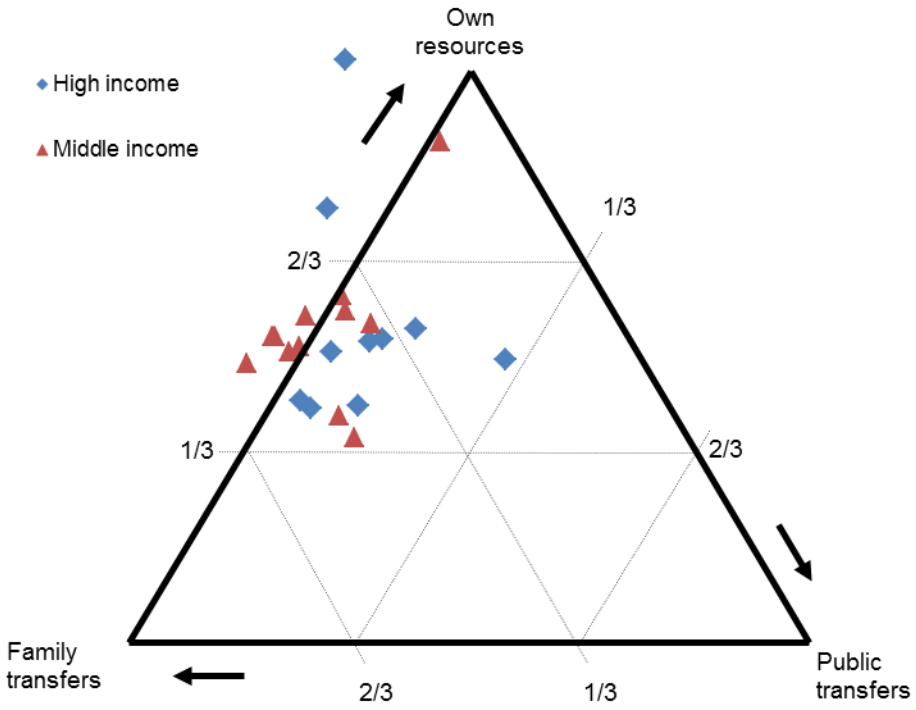

Figure 14. Support system for 18–24 year olds in high- and middle-income countries, synthetic cohort estimates, not survival weighted.

Public support systems, by their nature, can share the cost of children more broadly across all members of society than can family systems. For parents, this can mean that the costs are shared with those who do not have dependent children. This may have the salutary effect of increasing the resources available to children who would otherwise not receive the investment in health and education appropriate to development objectives. Increasing the role of the public sector can help to reduce the degree of income inequality within generations and to increase intergenerational mobility. There is no guarantee that public services actually serve this role, but heavy reliance on private human-capital spending will likely serve to perpetuate inequality over time.

In lower-income countries with high fertility, opportunities for increasing the role of the public sector in sharing the costs of childrearing may be limited simple by the large size of the child population. Older generations are small in size, and if they provide support to children, it is likely to be channeled through family networks. Heavy public sharing of childrearing cost may also create incentives for childbearing, and this may not be a desirable outcome in a high-fertility, low-income country. Nevertheless, public

spending on child health and education can improve economic mobility and encourage economic growth by fostering a more productive workforce.

Indeed, investment in human capital is a natural focus for lower-income countries. A large portion of their populations are school age or have recently completed their schooling, and decisions about education have lasting implications for their economic prospects and for lower income countries.

Saving and Investment in physical capital is also extremely important. Rates of investment are typically quite high in rapidly growing economies, and a much larger share of national income is devoted to investment in physical capital than to human-capital spending. From a lifecycle perspective, however, saving may seem unimportant in lower income countries as retirement is a relatively remote prospect, decades away, for most members of the population. Whether this perception is misguided or not is one of the issues to which we now turn as we review the support system for the elderly, population aging, and its implications for capital accumulation.

Support systems for the elderly

The elderly have four ways to meet their material needs. They can continue to work. They can rely on public transfer programs, e.g., public pensions and publicly funded healthcare. They can rely on their families, often by living with and depending on adult children. And finally, they can rely on assets—a home, a business, a farm, or financial assets, for example—that they have acquired by saving during their working years or inherited. Thus, the support system for the elderly is more complex and varied than the support system for children.

Another important feature of the support system is that many elderly are providers of support. One important form is time provided mostly by grandmothers who care for their grandchildren. Unfortunately, we do not have measures of time use for low-income countries at this time. Even if we limit ourselves to financial flows, the elderly are often important providers of support. They pay taxes and they provide direct financial support to younger generations. A full understanding of the support system is essential to understanding the implications of population aging and the economic role of older persons.

In the results presented below we group countries in two ways—by income distinguishing middle- from high-income countries and by region distinguishing East Asia, South and Southeast Asia, Latin America and the Caribbean, and the West. These groups overlap. East Asia includes high-income countries/economies (Japan, Republic of Korea, and Taiwan) and a middle-income country (China). The countries in South and Southeast Asia and Latin America are all middle-income countries. The countries in the West are all high-income countries. For Africa and low-income countries estimates of the support system are not available other than the extent to which the elderly fund their consumption by continuing to work.

At age 60, labor income supports between 75 and 81 percent of consumption on average for middle- and high-income countries—and for the regional groupings: East Asia, South and Southeast Asia, Latin American and the Caribbean, and the West (Figure 15). It is surprising that these values fall within such a

narrow range. After age 60, we see substantial divergence, with much more rapid decline in the West and in high-income countries, very slow decline in South and South East Asia, and the other regions falling between.

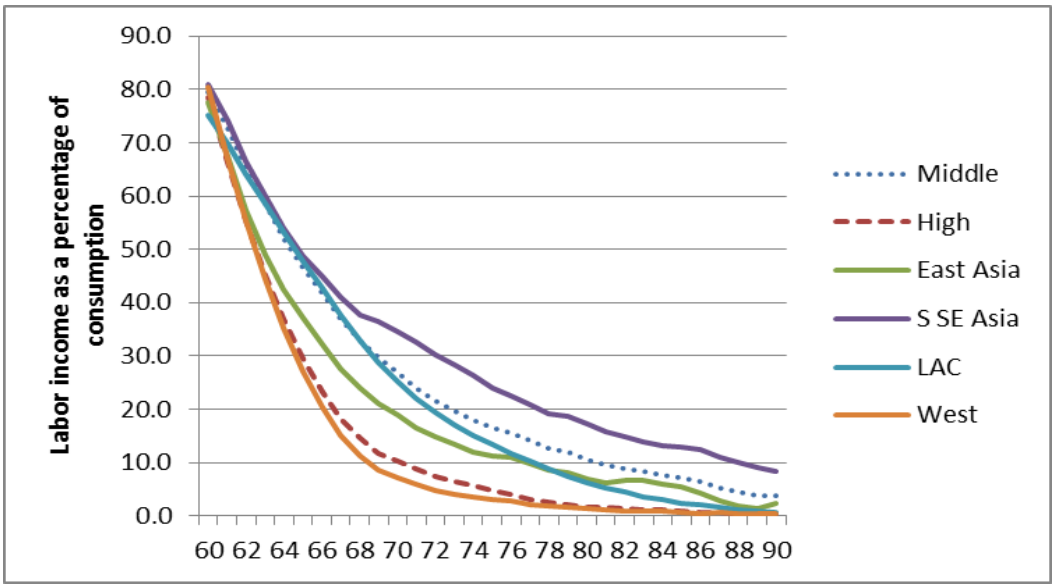

Figure 15. Labor income as a percentage of consumption at age 60 and older, for high- and middle-income countries and for major regions.

Source: Calculated by authors. File Support systems data.xls

The importance of public transfers to the elderly varies widely by income class and region (Figure 16). Public transfers to the elderly rise steeply with age in high-income countries, Latin America and the Caribbean, and the West. In South and Southeast Asia, public transfers to the elderly are quite small on average. For the most part in these countries, the elderly are paying as much in taxes as they are receiving in benefits. Middle-income countries, as an average of a quite diverse set, and East Asia countries are intermediate cases with public transfers rising to around 40 percent of consumption for those in their 70s and remaining at similar levels for older populations.

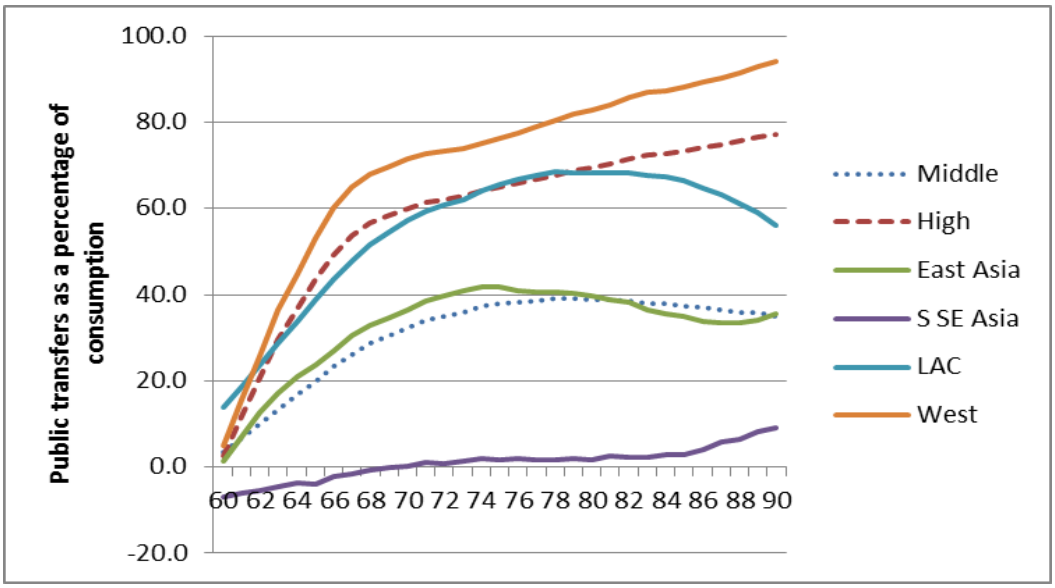

Figure 16. Public transfers as a percentage of consumption at age 60 and older, for high- and middle-income countries and for major regions. LAC is Latin America and the Caribbean; S SE Asia is South and Southeast Asia.

Source: Calculated by authors. File Support systems data.xls

Private transfers are not very important in Western countries or in most high-income countries (Figure 17). In the West they are negative—the elderly are transferring more to their descendants than they are receiving from them. These values do not include bequests. If they did, downward transfers in the West would be substantially larger. In Latin America and the Caribbean, familial transfers are much more important, but the direction of the flow depends greatly on age. In this region, those in their 60s and even their 70s are giving more to family members than they receive. They only begin receiving more than they give in their 80s. In Asia, the situation is very different. In South and Southeast Asia, the elderly begin receiving more than they give in their early 70s, and they receive much more in their late 70s and 80s than in Latin America and the Caribbean. Familial transfers in East Asia standout. Here, the elderly begin receiving more than they give to family members at age 61, and they receive very high levels of support as they age, funding 40 percent or more of total consumption.

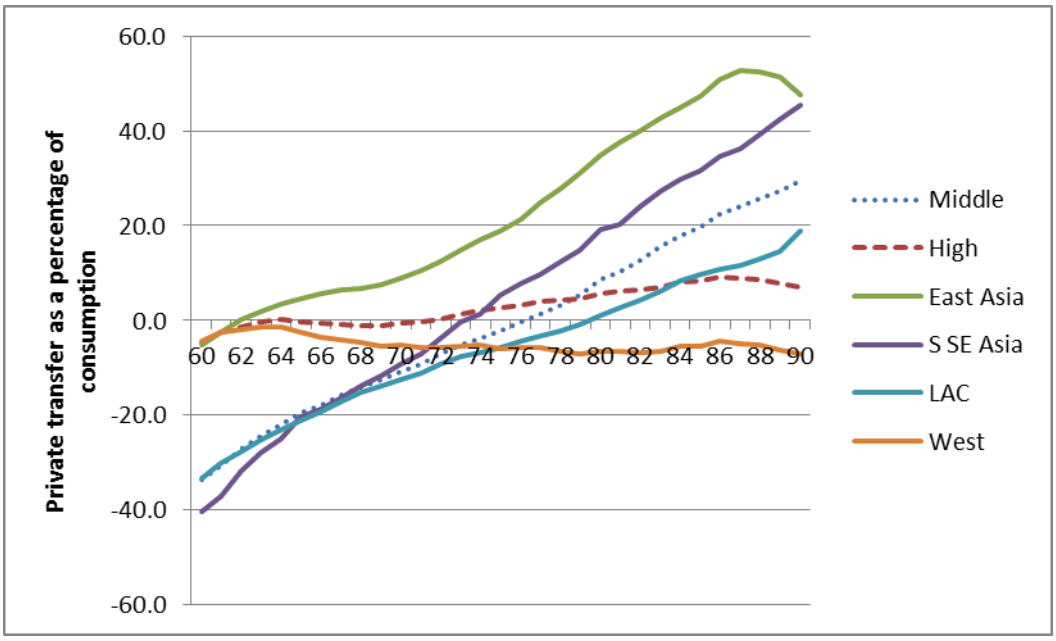

Figure 17. Private transfers as a percentage of consumption at age 60 and older, for high- and middle-income countries and for major regions. LAC is Latin America and the Caribbean; S SE Asia is South and Southeast Asia.

Source: Calculated by authors. File Support systems data.xls

In all regions of the world, the elderly fund part of their consumption by relying on assets, primarily relying on private asset income including the value of the flow from owner-occupied housing (Figure 18). The elderly could spend down their saving to support their old age needs, and undoubtedly some do, but on average, dis-saving is rare in any country. The elderly rely more on assets in middle-income than in high-income countries. The regional breakdown is instructive, however. Asset-based reallocations are important in middle-income countries in South and Southeast Asia, and less so in Latin American and the Caribbean, although there is considerable variation. Asset-based reallocations are much more important in Mexico and Uruguay than they are in the other Latin American countries for which we have estimates.

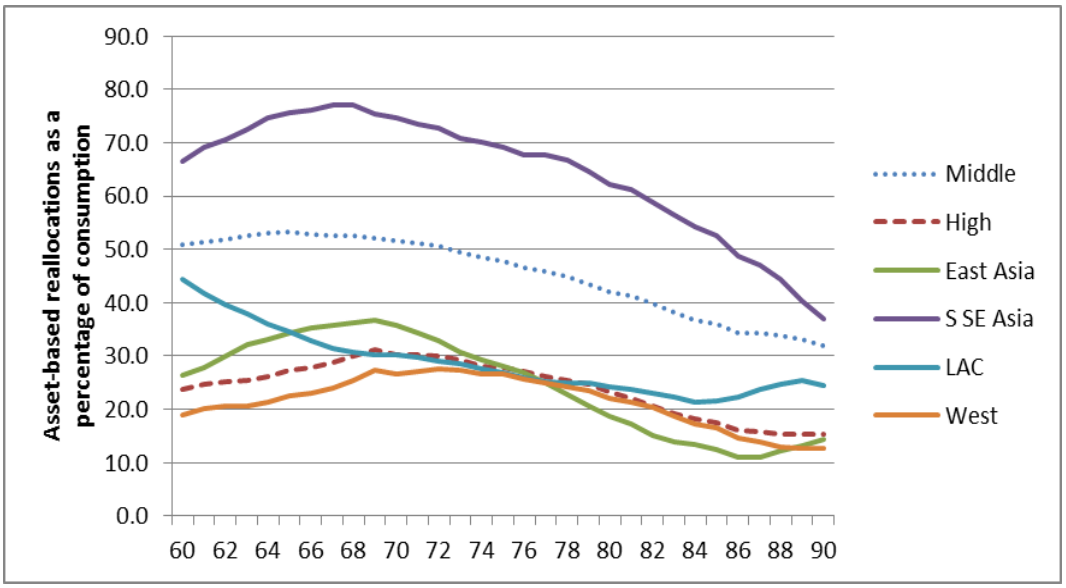

Figure 18. Asset-based reallocations as a percentage of consumption at age 60 and older, for high- and middle-income countries and for major regions. LAC is Latin America and the Caribbean; S SE Asia is South and Southeast Asia.

Source: Calculated by authors. File Support systems data.xls

Preparing for aging

Aging is more advanced in high-income countries, and the economic issues associated with aging are more immediate. Aging is occurring much more rapidly in many middle- and low-income countries than it did in rich Western countries, however, suggesting that many of these countries will become old before they are rich.

The prospect of rapid aging raises a number of concerns for lower-income countries. One, discussed in detail above, is that high rates of old-age dependency may undermine economic growth and seriously impede efforts to achieve even modest standards of living. Aging also raises a complex set of issues related to achieving economic security for the elderly in a way that promotes economic growth. What is the appropriate role for governments in this arena? Should comprehensive, publicly funded pension and healthcare programs for the elderly be a goal? And what share of the material needs of the elderly should be shouldered by governments? For many low-income countries, an important issue is whether decisions about these issues should be postponed until population aging becomes more advanced.

Currently the elderly in lower-income countries around the world do not depend to any significant degree on governments to access economic resources. Rather, they are relying on a combination of labor income, assets, and familial transfers, mostly from their adult children, to maintain their standard of living. In the immediate future, then, the economic security of the elderly will depend on the functioning of labor markets, capital markets, and family support systems. In these arenas, governments

play a critical role by maintaining property rights, encouraging a favorable investment environment, and by challenging discriminatory employment practices, for example.

The purpose of this section is to provide basic information about aging from an economic perspective that will elucidate the economic importance of aging in low-income countries and how this is likely to change over the next few decades. We will approach this in two ways. First, we will discuss the current needs of the elderly relative to the current resources that are available. This is useful, but limited, because it fails to consider a central feature of aging—asset accumulation. Thus, the second approach considers the need for assets to meet support consumption during old-age.

Current needs

Suppose that, contrary to what is actually the case in most countries, the elderly did not depend on assets to support themselves at all. If that were the case, they would have to depend on income from their own labor and public and private transfers from younger generations. This would impose a level of economic burden that would depend on the economic needs of the elderly and the economic resources of the non-elderly. The needs of the elderly would depend on the number of elderly and the gap between their consumption and labor income—that is, their lifecycle deficit— at each age. The economic resources of the non-elderly would depend on the number of non-elderly at each age and their per capita resources. In the calculations presented here, we measure the resources of the non-elderly as the labor income of adults age 25–59. The labor income of those less than 25 is not included in the calculation because, in most countries, those under age 25 are consuming all of their labor income. They have no lifecycle surplus with which to fund the needs of the elderly. The calculation here is equivalent to an "earnings tax" on adults 25–59 that would be required to fund the lifecycle deficit of the elderly. The "earnings tax" in this case includes both public and private transfers to the elderly.

In 1950, an earnings tax of 11 percent imposed on adults 25–59 would have funded the lifecycle deficit of the elderly in high-income countries. A 6 percent tax would have been required in upper-middle-income countries and a 5 percent tax in lower-income countries. By 2012, the required earnings tax increases to 23 percent in high-income countries and 10 percent in middle-income countries, but in low-income countries the change is negligible, with the required earnings tax rising to only 5.5 percent (Figure 19).

Thus for both high- and middle-income countries, we see a fairly rapid increase in the economic burden of old age. By 2035, the required earnings tax is projected to increase to 40 percent in high-income countries and 18 percent in middle-income countries. By comparison, the burden of aging appears to be rather modest for lower-income countries. The required earnings tax is projected to increase slowly, starting in 2010 and reaching 9 percent in 2035.

The cost of populating aging measured in this way is quite moderate for lower-income countries as a group and does not appear to be an urgent concern.

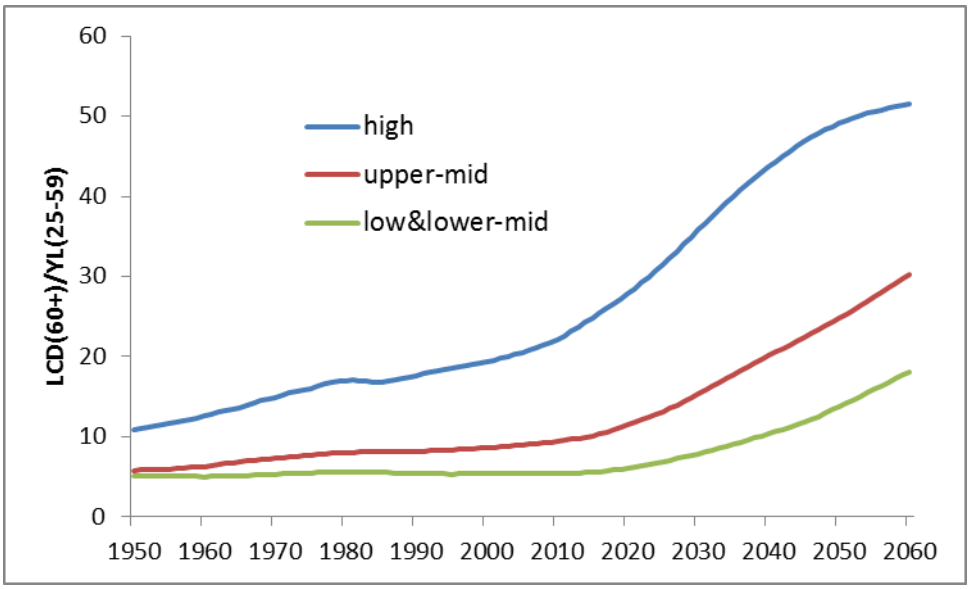

Figure 19. Lifecycle deficit for those 60 and older as a percentage of labor income of adults 25–59, low- and lower-middle-income, upper-middle-income, and high-income countries, 1950–2060. *Note:* Values are simple averages across countries within each income group. Values are calculated using UN World Population Prospects 2010 population estimates and projections (medium variant).

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The situation for countries within the lower-income group is quite varied, however. The three African countries show very little signs of aging for several decades. Three Asian countries, Cambodia, India, and the Philippines, show clear signs of aging but the required earnings tax increases slowly, reaching 8 to 10 percent in 2035. Indonesia and Vietnam, however, show clear signs of a sharp increase in the required earnings tax to 14 and 16 percent, respectively, by 2035 (Figure 20).

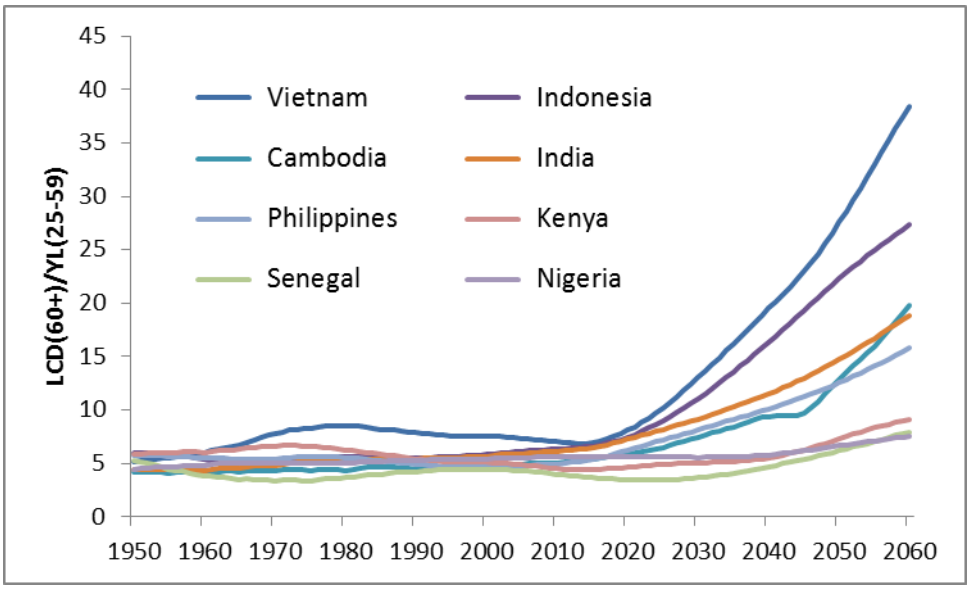

Figure 20. Lifecycle deficit for those 60 and older as a percentage of labor income of adults 25–59, eight low- and lower-middle-income countries, 1950–2060. *Note:* Values are calculated using UN World Population Prospects 2010 population estimates and projections. Values are based on the average profiles of consumption and labor income for middle- and lower-income countries combined.

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For several reasons, these projections provide a conservative view of the economic burden of aging in lower-income countries, because it might in fact rise more rapidly. First, the economic lifecycles in lower-income countries could shift in ways that would exacerbate the current burden of aging. The per capita labor income at old ages, assumed to be constant, could decline if retirement becomes a more accepted practice or is encouraged by public policy. Likewise, consumption at older ages could increase if to additional spending is allocated to the healthcare needs of the elderly. Policies that accomplish these goals may be advisable, but they do come with a cost that will increase as populations age. In addition, this approach to measuring aging from an economic perspective assumes that consumption by the elderly is funded only out of their own labor or through transfers from the prime working age population. It does not incorporate economic responses that are inevitable as young and middle-aged adults anticipate and prepare for old age.

Wealth and aging

Is aging a salient issue for a young adult living in a low-income country like Kenya? No doubt a good job and supporting a family are more pressing concerns, as is surely the case for young adults living anywhere. Retirement as a formal concept, however, is much less common in a country like Kenya than it is in high- income countries. Most Kenyans are self-employed, working in agriculture or in the urban informal sector, and thus not subject to a formal retirement age. Nevertheless labor income drops significantly at older ages, and it is insufficient to meet material needs by age 60 in Kenya. In fact, in almost every country, labor income funds no more than one-third of the needs of the elderly.

Young adults in low-income countries such as Kenya might be unconcerned about aging because they believe the prospects of reaching old age are not very good. This would be a mistaken view. Of the 800,000 Kenyans who were 25 in 2012, the most recent UN projections anticipate that 600,000, or three-quarters, will survive to age 60, and more than 400,000 will survive to age 75. Thus most young adults in Kenya can expect an extended period in old age and should plan accordingly.

There are different ways of meeting material needs in old age. Unfortunately estimates of current practice in Kenya and other low-income countries are not available, and of course these could change considerably over the coming decades. We do know that public transfer systems are minimal in most low-income countries and, hence, the elderly currently are depending on their own resources or on their families to fill the gap between what they produce and what they consume. Either support mechanism requires that young adults invest during their working years in order to support themselves in old age. This can take the form of investing in children and building a family, or it can take the form of conventional saving and investment—acquiring a home, a farm, a business, or financial assets in various forms.

To pursue this line of reasoning further, suppose that Kenyans of all ages were accumulating sufficient wealth to support their lifecycle needs in old age. How much wealth would be required at each age, and how will this change over time? The calculations needed to answer these questions are based on several assumptions. First, we will assume that low- and middle-income countries will follow the average age patterns of consumption and labor income found in this income group as a whole. Second, we will assume that a moderate rate of economic growth will persist into the future, shifting both consumption and labor income profiles upward by 2 percent per annum. If economic growth is stronger, as may well be the case in many countries, the required assets will be much higher because higher levels of consumption will prevail in old age. Third, we assume that all assets yield a real annual rate of return of 6 percent. Fourth, we assume that fertility and survival rates for all populations follow the UN World Population Prospects for 2010, medium variant. Fifth, members of each cohort pool the risk of mortality by acquiring costless annuities, so that bequests from those who die prematurely support the consumption of those who live longer than expected.

The total wealth needed to fund retirement at each age is reported for 2010, 2030, and 2050 in Figure 21 and shows a four a massive increase over the four decade period. The peak wealth needed in 2050 is more than 10-fold the peak wealth needed in 2010. In large part, the increase reflects general growth projected for Kenyan's economy. Total labor income is projected to grow at 4.75 percent per annum, as a consequence of 2 percent annual productivity growth and 2.7 percent annual growth in the effective labor force. Together these lead to a more than a six-fold increase in total labor income over the 40-year period from 2010 to 2050. In addition to economic growth, gains in life expectancy are leading to an increase in the number of years lived beyond age 60, and this also results in an increased demand for retirement wealth.

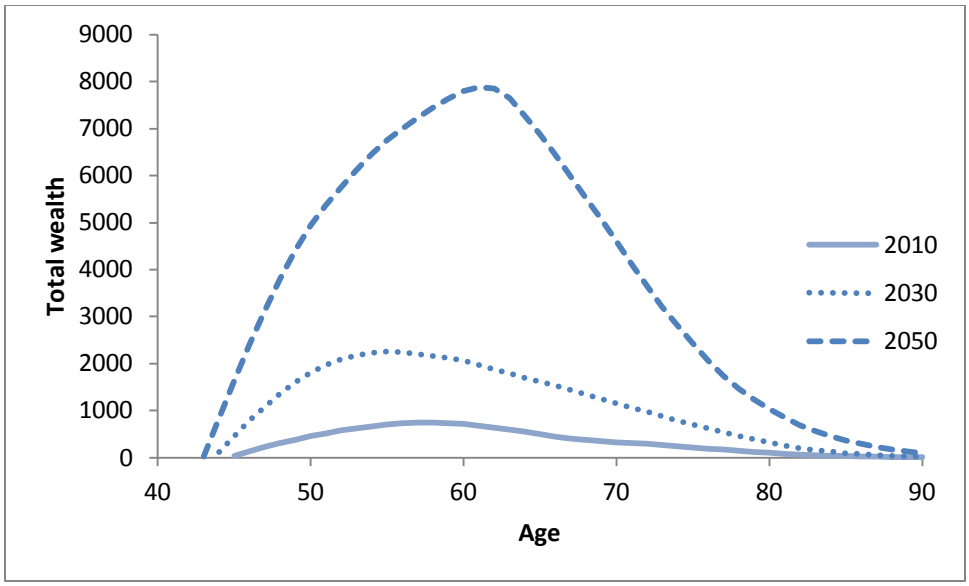

Figure 21. Needed lifecycle wealth by age, Kenya in 2010, 2030, and 2050. Simulation based on average lifecycle profiles for low- and middle-income countries, population projections from World Population Prospects 2010,medium variant, annual productivity growth of 2 percent, and a real of return on assets of 6 percent. Lifecycle wealth is the wealth that a country must accumulate to fund the expected gap between consumption and labor income for individuals who are currently alive, assuming perfect annuitization. *Source:* Calculated by authors.

File: Kenya lifecycle.xlsx

A more detailed description of the method for calculating the wealth profiles shown in Figure 21 is available in the appendix.

Needed lifecycle wealth also depends on the trend in the age distribution of the population, which is shifting towards older ages at which the values of lifecycle wealth are highest. The combined effect of all factors influencing the needed wealth in Kenya is shown in two ways in Figure 22. The upper panel shows the ratio of lifecycle wealth to labor income between 2010 and 2060, and the lower panel shows the annual growth rates of wealth and total labor income in the five intervening decades.

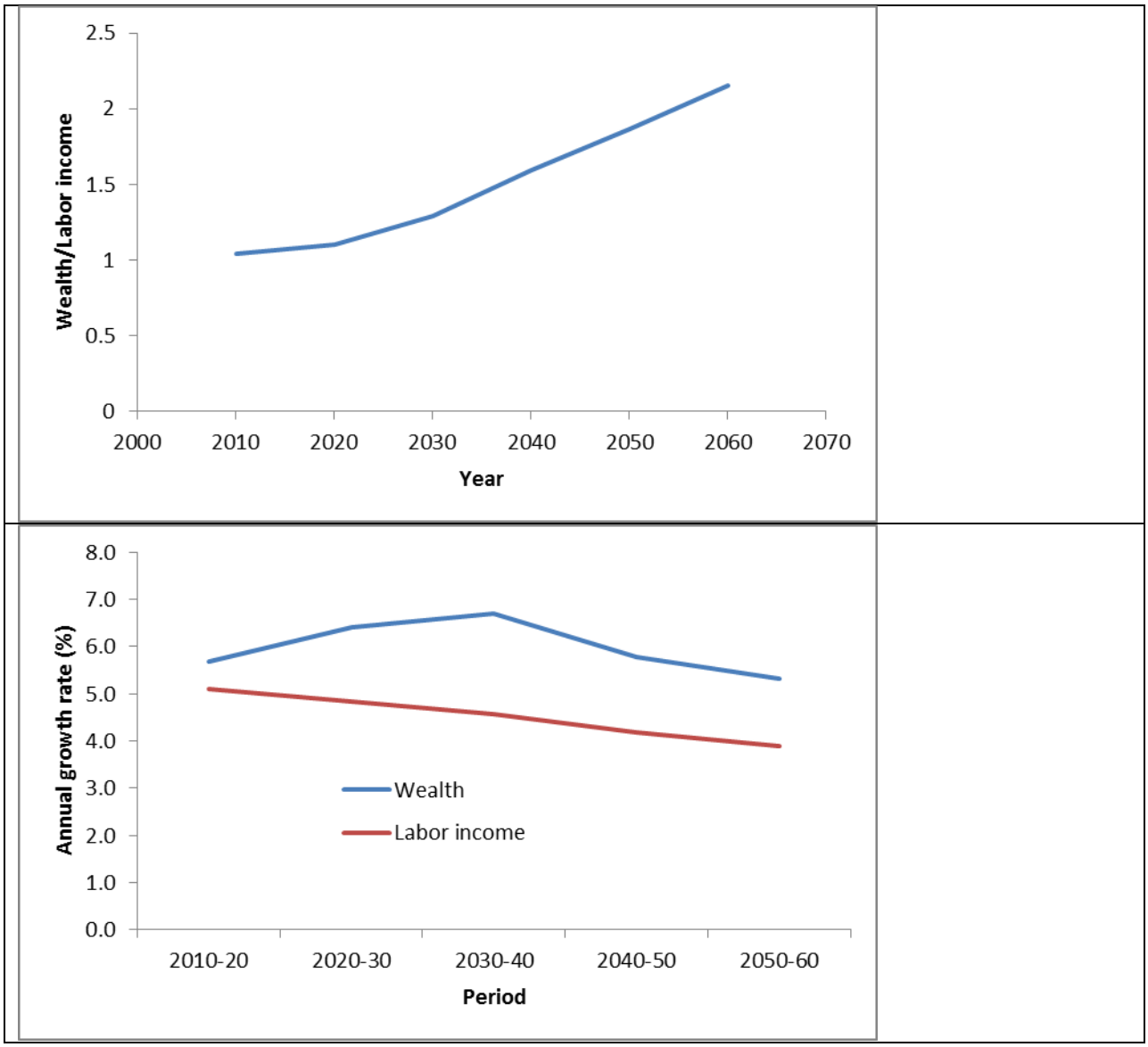

Figure 22. Needed lifecycle wealth relative to total labor income, Kenya, 2010–2060 (upper panel) and annual rates of growth of wealth and labor income, Kenya, 2010–2060 (lower panel). Needed lifecycle wealth is the wealth that a country must accumulate to fund the expected gap between consumption and labor income in old age. *Source:* Calculated by authors.

File: Kenya lifecycle.xlsx

The ratio of needed lifecycle wealth to labor income in Kenya is projected to double during the next 50-year period. Needed wealth will grow significantly faster than growth in total labor income during the next 50 years because of the need to prepare for aging. Somewhat surprising is that the annual rate of growth in needed lifecycle wealth is particularly high during the next 30–40 years—rising from almost 6 percent per annum for 2010–2020 to substantially more than 6.7 percent per annum I 2030-40. It turns out that population aging is a much more immediate concern in Kenya than appears to be case if we

focus just on the economic needs of the current population of elderly, because advance preparation is critical to meeting retirement needs.

Comparative perspective on economics of aging

The lifecycle wealth needed to fund old-age needs is charted from 2000 to 2060 for lower-, upper-middle-, and high-income countries (Figure 23). In 2010, the required lifecycle wealth was about 4 times total annual labor income in high-income countries, about twice total annual labor income in upper-middle-income countries, and about 20 percent greater than total annual labor income in low- and lower-middle-income countries. These estimates are simple average of the values for each NTA country falling in the respective income group.

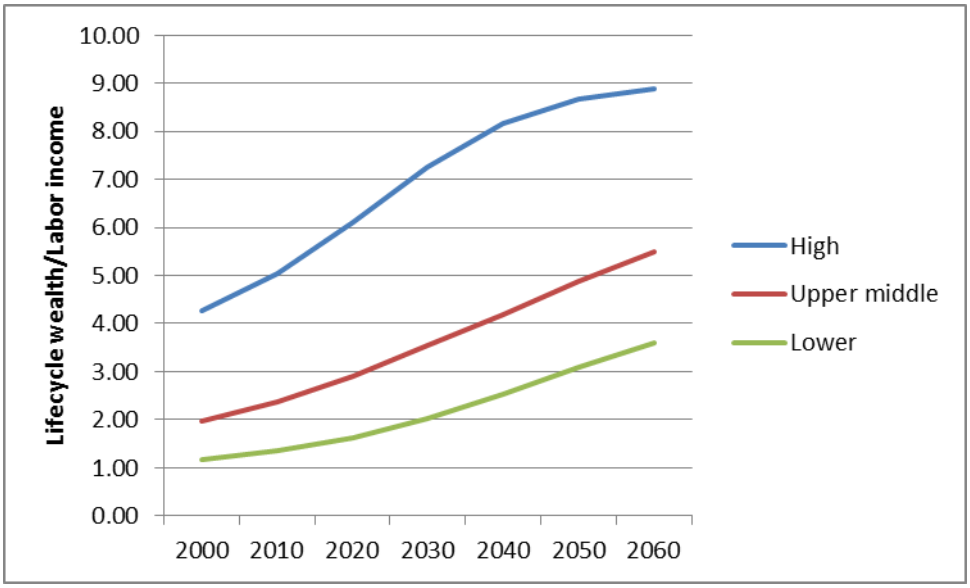

Figure 23. Required lifecycle wealth for old-age needs relative to total labor income, lower, upper middle, and high-income countries, 2000–2060. Values are simple averages across NTA countries in each of the respective income groups. See notes for Figure z. *Source:* Calculated by authors; see text.

File: UNFPA_givenTAU_CYl_givn_Asia_TAU_CORRECTED_18-Oct-2012.analysis.xlsx

In fact, needed lifecycle wealth increased more rapidly than labor income during the past 10 years in all three country income groups, and further increases are projected for the coming decades. For the decade beginning in 2010, lifecycle wealth is projected to grow at about 2 percent per annum faster than labor income in all three income groups, with growth slightly more rapid in upper-middle-income countries than in high- or lower-income countries. After 2020, the fastest growth in lifecycle wealth is projected for lower-income countries. The gaps between the three income groups are reduced in percentage terms after 2020, but not in absolute terms.

The diversity that characterizes current consumption needs of the elderly in lower-income countries also carries over to their need for lifecycle wealth. In Figure 24 we see the countries clustered more or less into three groups. The populations of the African countries are aging most slowly. Lifecycle wealth is about equal to total annual labor income in each of the three countries and is growing at about the

same rate as total labor income until 2020. Only after 2020 do we see an upturn in lifecycle wealth in Kenya, Senegal, and Nigeria.

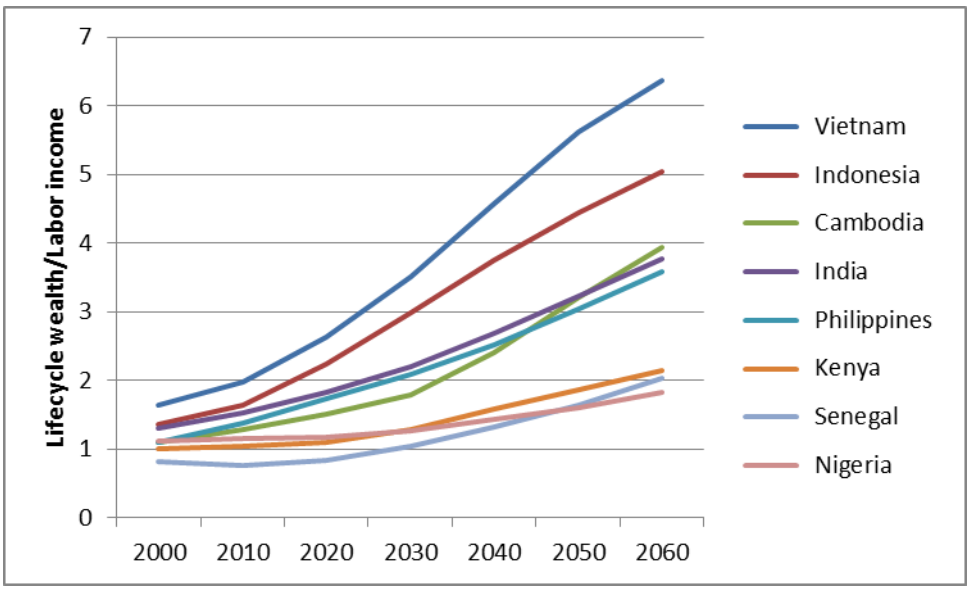

Figure 24. Needed lifecycle wealth for old-age needs relative to total labor income, eight low- and lower-middle-income countries, 2000–2060. *Source:* Calculated by authors.

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In three Asian countries, Cambodia, India, and the Philippines, we see a substantially more rapid increase in needed lifecycle wealth from the outset as compared with the lower-income countries of Africa. The economic importance of old age needs in these countries is substantial but somewhat less than the average for upper-middle-income countries.

Finally we see two lower-middle-income countries, Indonesia and Vietnam, experiencing very rapid increases in needed lifecycle wealth. The situation in Vietnam is particularly striking, with the need for lifecycle wealth currently growing at almost 3 percent per annum faster than labor income. By 2020 wealth equal to 2.6 times total annual labor income will be required to meet the country's old-age needs.

Another way to measure the economic impact of population aging is by calculating the share of labor income that must be saved in order to meet the resources required for the old-age needs of the current population. These values, calculated by decade from 2000 to 2060 for lower-, upper-middle-, and high-income countries, are reported in Figure 25. Again, these are simple averages of values calculated for each NTA country in the respective income groups.

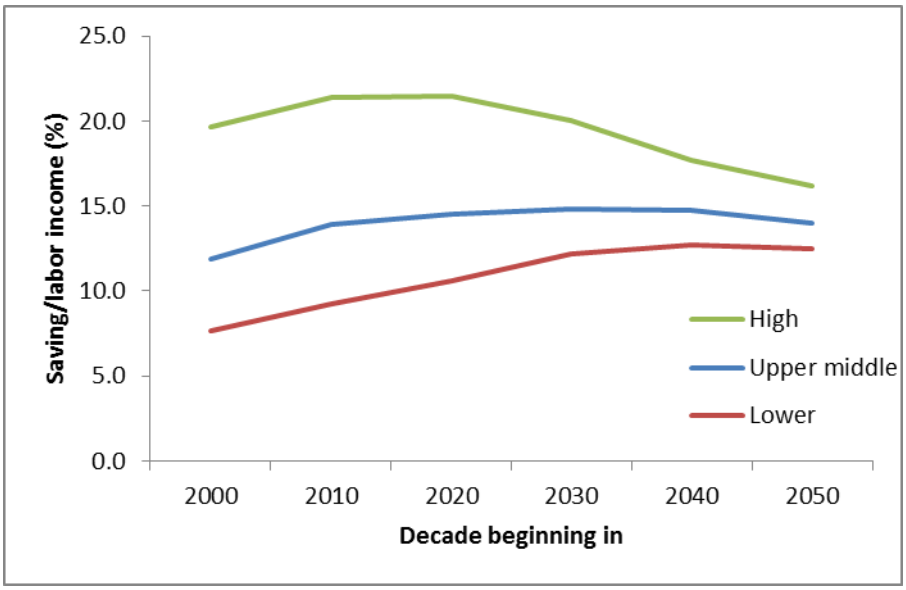

Figure 25. Needed lifecycle saving for old-age needs as a percentage of total labor income, lower-, upper-middle-, and high-income countries, 2000–2060. Values are simple averages across NTA countries in each of the respective income groups. *Source:* Calculated by authors.

File: UNFPA_givenTAU_CYl_givn_Asia_TAU_CORRECTED_18-Oct-2012.analysis.xlsx

The needed level of saving for 2000–10 as a percentage of total labor income was lowest in lower-income countries, at 7.6 percent of total labor income, compared with 11.9 percent of total labor income in upper-middle-income countries and 19.7 percent in high-income countries. Today, the share of labor income that must be saved is rising in all three income groups, but it begins to decline noticeably in the high-income countries after 2030 as a consequence of slowing population growth. Slowly the required saving rates converge, with saving rates in lower-income countries above 12 percent of total labor income after 2030.

The required saving rates vary considerably among individual lower-income countries, however, ranging from a low of 5 percent of total labor income in Senegal to very high values of 12.7 percent in Indonesia and 15.2 percent of total labor income in Vietnam (Figure 26).

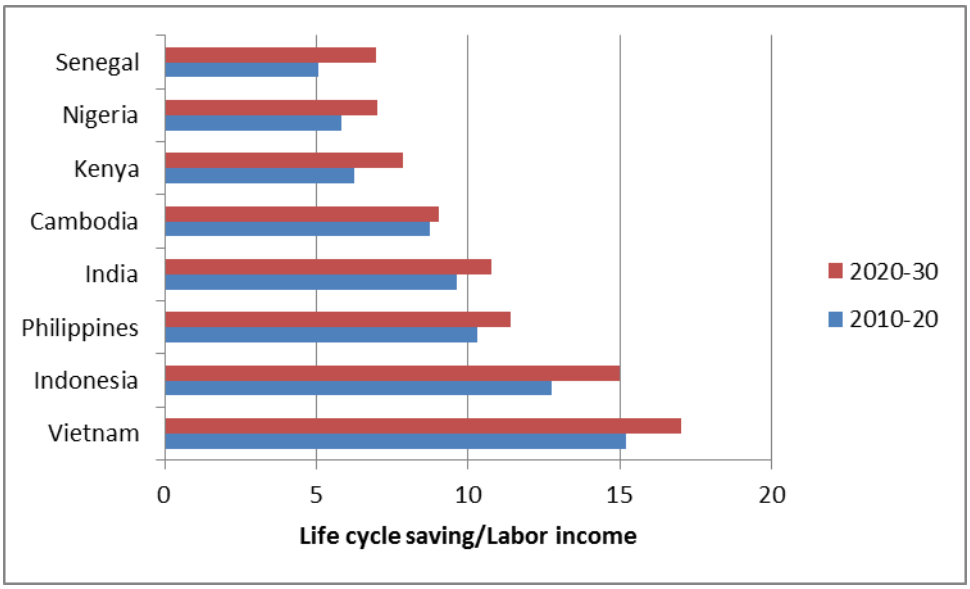

Figure 26. Required lifecycle saving for old-age needs as a percentage of total annual labor income, eight low- and lower-middle-income countries, 2000–2060.

File: UNFPA_givenTAU_CYl_givn_Asia_TAU_CORRECTED_18-Oct-2012.analysis.xlsx

Need for better data

Even in populations with relatively few elderly people today, the economic status of the elderly is an important issue about which there is insufficient information. NTA estimates of average consumption by age (Figure 5 above) provide one indicator of how the elderly are faring by comparison with non-elderly adults. These results are encouraging because they show similar levels of consumption at all adult ages. National Transfer Account estimates have been constructed for only a few low-income countries at this point and we do not know how conditions in other low-income countries compare with those found for NTA countries. A second issue is that no distributional data are available yet for consumption by the elderly. NTA estimates presented here are averages. In the absence of poverty indicators for the elderly, however, it is impossible to fully assess the extent to which economic security in old age is a serious social issue.

There is also little information about how the elderly in low-income countries are supporting themselves. NTA estimates show that the elderly in these countries are meeting one-third or less of their material needs by continuing to work. For the other two-thirds, the elderly are relying on some combination of their own assets and public and private transfers. In Latin America, public-transfer programs are very important for many middle-income countries. In a second group of middle-income countries located primarily in South and Southeast Asia, but including Mexico, the elderly are relying very little on the public sector. Rather, they are relying on their own assets to meet their materials needs. Precise information is not available for African countries with the exception of South Africa. In general, however, it is clear that public transfer systems are not important in Africa and that the elderly there are relying on some combination of familial transfers and personal assets for their old-age security.

Conclusions

Lower-income countries are progressing through the demographic transition with important implications for both economic opportunities and challenges. The opportunities are coming first in the form of the demographic dividend that arises as a consequence of lower fertility, fewer children, and an increased concentration of the population in the working ages. The decline in the number of children per working age adult has a direct and immediate economic effect, the first demographic dividend, because economic resources that would otherwise go to support many children can be used to raise current standards of living. Some or all of the additional resources can be redirected into human capital spending, entrepreneurial activities, investment or other uses that enhance economic development. To the extent that this occurs, low income countries can expect a second demographic dividend.

The demographic transition presents challenges because the decline in fertility and increased life expectancy eventually lead to population aging. At the aggregate level this means that the share in the working ages will decline and the share at older ages will increase. At the individual level the increase in life expectancy means that people can expect to live a larger portion of their life in final stage of the lifecycle when they are not earning enough to fund their consumption. Because of the decline in childbearing, the elderly will have fewer adult children on whom they can rely to meet the increasing needs of old age.

The possibility of a demographic dividend raises several important immediate issues for lower-income countries. The first issue is whether steps can be taken to realize a larger first dividend. Two kinds of complementary policies are possible. The first set would address the demographic transition itself. Our analysis of the demographic transition shows: first, that lower-income countries have begun their demographic transitions much late; second, that death rates have dropped more slowly over the demographic transition in low-income, but not lower-middle-income, countries than in upper-middle- and high-income countries; and, third that fertility rates are higher in lower-income countries at each point in the demographic transition. As a consequence, population growth rates are high and changes in age structure are more gradual in lower-income countries as compared with the demographic transitions that occurred elsewhere during the post-World War II era. Unless countries can accelerate the demographic transition, the first demographic dividend will be smaller in lower-income countries than was the case in parts of Asia, for example, where the transition was very rapid and the first dividend was very large.

The second set of policies that can influence the first demographic dividend are those that influence the economic lifecycle itself. Changes in age structure matter because the amounts that we produce and consume vary with age. Analysis of how the lifecycle vary across lower-income countries shows that the most important feature of the lifecycle is the age pattern of labor income and not consumption. The greatest first dividend will be achieved in countries that can raise lifetime labor income, including increasing economic opportunities for women, and in countries that raise employment opportunities for younger adults. The goal here is not just more jobs, but jobs that are highly productive.

If countries are successful in generating a significant first dividend, the next issue is whether those additional resources are directed at raising current standards of living or growth-enhancing investment

in physical and human capital. Both are pressing needs and can be complementary. Reducing child poverty, for example, may be one way to raise current standards of living and to increase human capital and the productivity of future generations of workers. As a general rule, the decline in fertility around the world has been matched by increased spending on child health and education. Resources made available due to the first dividend have been invested in human capital. Similarly, there are many countries where rates of saving and investment increased dramatically during the dividend phase. These response lead to more rapid economic growth and allow the demographic dividend to produce sustainably higher levels of consumption even after the dividend phase has ended.

Some of the observed responses to the first demographic dividend are changes in private behavior. But the public sector has also played an important role. The response of public sector spending on human capital has been quite robust in its response to lower fertility. An issue of some concern is that human-capital spending in lower-income countries has been less responsive to low fertility than in other countries. This raises the possibility that the second demographic dividend will be smaller in lower-income countries than elsewhere.

Eventually aging will become an important issue for lower-income countries, but is it an issue that needs to be addressed today? Aging is a more pressing issue in upper-middle and high-income countries from either a demographic or an economic perspective. Countries that are richer and further along in the demographic transition have populations more concentrated at older ages and a much larger share of GDP must be devoted to the needs of the elderly. The demographics of aging are reinforced by features of the economic lifecycle in high-income countries. The elderly there have lower labor income and higher consumption relative to prime age adults adding further to the economic resources that must be directed to the elderly. Upper-middle- and high-income countries have implemented public programs for the elderly that rely heavily on taxes on the working-age populations that face heavy strains.

The demographic dividend is a one-time opportunity that lower-income countries can exploit to increase standards of living for current and future generations alike. Eventually, the dividend will end and lower-income countries will experience significant population aging. Is this so remote that lower-income countries can safely ignore it? Or are there steps that lower-income countries should be taking today to prepare for population aging?

There are some lower-income countries for which population aging is not so remote. Vietnam and Indonesia, for example, are two countries that will experience rapid population aging over the next few decades. But even for countries where the share of the population will remain low for decades, there are important issues related to aging that should be addressed. First, achieving economic security for the elderly is an admirable goal even in countries where there are relatively few elderly. In addition, however, the great majority of people who are alive today even in low-income countries can expect to live well into old age. For all of them, realizing economic security is an important goal.

At the moment, the elderly in lower-income countries are meeting their material needs relying on a combination of work, familial support, and their own assets – a home, a farm, a business, or in some cases financial assets. Government programs are not playing an important role. As countries become

richer many begin to consider establishing public pension programs and expanding health care services for the elderly. Indeed, the public sector has important role to play in providing for the basic economic security of its older population. The key goal should be to establish public programs that provide some basic level of security but can be sustained as population aging does occur. It is essential that governments be very forward-looking, and fully anticipate the impact of population aging, as they consider establishing public programs to support the elderly. At the same time governments should realize that they have other important roles to play in supporting the elderly. Steps can be taken to improve labor markets and to discourage discrimination against the elderly, such as, mandatory retirement policies. Moreover, governments can play an important role in creating an economic environment that supports elderly who are accumulating wealth and seeking some degree of financial independence. Well-function financial markets, secure property rights, a competitive economy, and financial literacy are critical to the goal of economic security for the elderly, as well as, economic growth irrespective of a country's level of development.

Table A.1. Low- and middle-income countries by income group

Low-income countries		
Afghanistan	Gambia, The	Mozambique
Bangladesh	Guinea	Myanmar
Benin	Guinea-Bisau	Nepal
Burkina Faso	Haiti	Niger
Burundi	*Kenya	Rwanda
*Cambodia	Korea, Dem Rep.	Sierra Leone
Central African Republic	Kyrgyz Republic	Somalia
Chad	Liberia	Tajikistan
Comoros	Madagascar	Tanzania
Congo, Dem. Rep	Malawi	Togo
Eritrea	Mali	Uganda
Ethiopia	Mauritania	Zimbabwe
Lower-middle-income countries		
Albania	*Indonesia	Samoa
Armenia	*India	São Tomé and Principe
Belize	Iraq	*Senegal
Bhutan	Kiribati	Solomon Islands
Bolivia	Kosovo	South Sudan
Cameroon	Lao PDR	Sri Lanka
Cape Verde	Lesotho	Sudan
Congo, Rep.	Marshall Islands	Swaziland
Côte d'Ivoire	Micronesia, Fed. Sts.	Syrian Arab Republic
Djibouti	Moldova	Timor-Leste
Egypt, Arab Rep.	Mongolia	Tonga
El Salvador	Morocco	Ukraine
Fiji	Nicaragua	Uzbekistan
Georgia	*Nigeria	Vanuatu
Ghana	Pakistan	*Vietnam
Guatemala	Papua New Guinea	West Bank and Gaza
Guyana	Paraguay	Yemen, Rep.
Honduras	*Philippines	Zambia
Upper-middle-income countries		
Angola	Ecuador	Palau
Algeria	Gabon	Panama
American Samoa	Grenada	*Peru
Antigua and Barbuda	Iran, Islamic Rep.	Romania
*Argentina	*Jamaica	Russian Federation
Azerbaijan	Jordan	Serbia
Belarus	Kazakhstan	Seychelles
Bosnia and Herzegovina	Latvia	*South Africa

Botswana	Lebanon	St. Lucia
*Brazil	Libya	St. Vincent and the Grenadines
Bulgaria	Lithuania	Suriname
*Chile	Macedonia, FYR	*Thailand
*China	Malaysia	Tunisia
*Colombia	Maldives	*Turkey
*Costa Rica	Mauritius	Turkmenistan
Cuba	*Mexico	Tuvalu
Dominica	Montenegro	*Uruguay
Dominican Republic	Namibia	*Venezuela, RB

*Members of National Transfer Account network.

Table A.2 Moments of per capita consumption, C, and labor income, Yl, profiles by income group, high mortality assumption.

	Lifetime years		Mean age		Variance		Standard deviation	
	Yl	C	Yl	C	Yl	C	Yl	C
High	***24.9***	***50.7***	***41.4***	***36.0***	***132.7***	***455.9***	***11.5***	***21.4***
Australia	26.4	48.4	39.8	36.5	144.7	436.5	12.0	20.9
Austria	25.2	50.2	40.4	36.3	133.7	448.8	11.6	21.2
Finland	24.6	49.7	41.6	35.9	126.5	450.1	11.2	21.2
France	24.1	51.5	41.4	35.4	116.7	446.4	10.8	21.1
Germany	24.2	50.1	41.6	37.7	120.2	454.5	11.0	21.3
Hungary	24.2	49.5	41.9	36.8	119.2	454.4	10.9	21.3
Italy	25.0	50.0	42.3	35.8	130.7	456.0	11.4	21.4
Japan	25.7	54.2	43.6	36.7	134.2	479.1	11.6	21.9
South Korea	25.0	50.8	40.5	35.0	143.7	426.6	12.0	20.7
Spain	23.9	49.5	41.7	35.6	125.3	443.4	11.2	21.1
Sweden	26.3	54.7	42.6	34.9	141.2	486.8	11.9	22.1
Taiwan	24.1	50.2	39.8	34.2	128.0	440.3	11.3	21.0
United Kingdom	25.9	48.7	40.1	36.9	142.3	445.0	11.9	21.1
US	26.2	49.6	43.7	38.7	148.0	465.3	12.2	21.6
Slovenia	22.0	53.9	39.8	34.2	102.9	475.7	10.1	21.8
Upper middle	***25.7***	***46.8***	***41.7***	***37.0***	***154.4***	***430.7***	***12.4***	***20.8***
Argentina	25.8	47.6	41.0	35.8	150.5	441.2	12.3	21.0
Brazil	25.7	45.9	42.1	37.7	159.0	431.0	12.6	20.8
Chile	25.6	46.6	41.7	37.2	154.0	431.1	12.4	20.8
China	24.2	50.4	40.2	35.9	141.4	438.4	11.9	20.9
Colombia	26.0	47.3	42.1	37.7	159.1	438.6	12.6	20.9
Costa Rica	26.3	47.8	42.0	37.9	160.5	428.3	12.7	20.7
Jamaica	27.0	45.7	40.7	37.2	166.5	419.8	12.9	20.5
Mexico	26.2	45.2	42.0	37.0	169.0	412.7	13.0	20.3
Peru	26.6	47.3	41.6	37.4	167.1	437.7	12.9	20.9
South Africa	24.0	41.3	43.6	38.4	119.7	401.9	10.9	20.0
Thailand	25.1	47.3	40.9	35.9	143.0	425.4	12.0	20.6
Uruguay	25.9	48.7	42.7	36.3	149.3	447.7	12.2	21.2
Lower	***26.2***	***46.1***	***41.4***	***37.1***	***164.7***	***420.7***	***12.8***	***20.5***
India	26.6	46.4	42.6	38.4	161.2	430.4	12.7	20.7
Indonesia	26.3	45.5	42.2	35.6	176.6	407.2	13.3	20.2
Kenya	22.6	46.4	40.6	36.8	126.2	423.2	11.2	20.6
Nigeria	25.9	44.5	47.0	38.4	144.6	418.1	12.0	20.4
Philippines	26.7	48.1	42.8	36.7	170.6	431.5	13.1	20.8
Vietnam	25.1	46.6	37.9	35.8	126.5	406.1	11.2	20.2
Cambodia	30.2	45.5	37.0	37.8	169.2	419.3	13.0	20.5

Notes. Based on NTA estimates from www.ntaccounts.org accessed September 26, 2012. Low mortality is based on life table for Japan, combined sexes, 1949.

Table A.3 Moments of per capita consumption, C, and labor income, Yl, profiles by income group, low mortality assumption.

	Lifetime years		Mean age		Variance		Standard Deviation	
	Yl	C	Yl	C	Yl	C	Yl	C
High	*36.5*	*85.3*	*42.8*	*46.0*	*141.7*	*644.6*	*11.9*	*25.4*
Australia	38.2	80.3	41.2	45.6	152.3	605.1	12.3	24.6
Austria	36.5	83.5	41.7	45.6	138.3	619.1	11.8	24.9
Finland	36.2	84.9	42.9	46.7	134.3	669.0	11.6	25.9
France	35.2	84.1	42.6	44.3	120.8	616.3	11.0	24.8
Germany	35.3	86.3	42.7	47.8	123.6	625.6	11.1	25.0
Hungary	35.6	83.6	43.1	46.6	126.4	626.3	11.2	25.0
Italy	37.1	82.6	43.7	45.1	139.4	624.4	11.8	25.0
Japan	38.8	93.8	45.2	47.5	146.0	669.3	12.1	25.9
South Korea	36.7	81.2	42.2	43.3	158.2	591.6	12.6	24.3
Spain	35.2	81.4	42.9	44.8	130.1	620.8	11.4	24.9
Sweden	39.2	96.9	44.0	47.7	146.5	750.7	12.1	27.4
Taiwan	35.0	81.3	41.2	43.4	142.0	634.8	11.9	25.2
United Kingdom	37.6	83.0	41.5	47.0	150.6	632.1	12.3	25.1
US	39.9	87.9	45.7	49.4	167.6	634.9	12.9	25.2
Slovenia	31.5	88.9	40.7	44.2	107.8	677.9	10.4	26.0
Upper middle	*38.4*	*77.8*	*43.7*	*46.0*	*176.4*	*591.4*	*13.3*	*24.3*
Argentina	38.1	78.8	42.7	45.1	163.6	619.5	12.8	24.9
Brazil	38.8	77.2	44.4	46.8	190.0	583.6	13.8	24.2
Chile	38.3	78.1	43.7	46.3	177.7	594.9	13.3	24.4
China	35.7	82.0	42.2	44.4	172.9	594.2	13.1	24.4
Colombia	39.2	80.0	44.3	47.0	186.6	595.1	13.7	24.4
Costa Rica	39.5	80.8	44.1	47.1	182.0	586.4	13.5	24.2
Jamaica	40.2	75.8	42.9	46.0	194.1	578.8	13.9	24.1
Mexico	39.6	74.2	44.3	45.4	196.2	565.4	14.0	23.8
Peru	39.8	80.2	43.8	46.9	190.8	606.6	13.8	24.6
South Africa	35.9	68.2	44.9	46.3	124.8	531.6	11.2	23.1
Thailand	36.9	77.7	42.6	44.9	157.6	600.0	12.6	24.5
Uruguay	38.9	81.1	44.5	45.7	165.0	620.7	12.8	24.9
Lower	***39.4***	***76.7***	***43.8***	***45.9***	***198.4***	***582.5***	***14.1***	***24.1***
India	40.5	79.0	45.0	47.6	193.2	580.2	13.9	24.1
Indonesia	40.9	73.2	45.7	43.8	245.3	573.2	15.7	23.9
Kenya	33.1	77.7	42.1	46.2	144.1	599.1	12.0	24.5
Nigeria	41.8	75.7	49.6	47.6	175.3	572.1	13.2	23.9
Philippines	40.9	80.2	45.3	45.9	200.5	602.9	14.2	24.6
Vietnam	35.7	75.0	39.2	43.8	137.8	566.0	11.7	23.8
Cambodia	43.0	76.1	38.7	46.5	185.5	567.4	13.6	23.8

Notes. Based on NTA estimates from www.ntaccounts.org accessed September 26, 2012. Low mortality is based on life table for Japan, combined sexes, 2009.

Appendix

The effective years worked in steady state equilibrium (per newborn) is defined as:

$$L = \int_{a1}^{a2} e^{-nx} s(x)\phi(x)dx. \tag{1.8}$$

Define a new variable $\delta(x)$ such that:

$$\delta(x) = s(x)\phi(x) \Big/ \int_{a1}^{a2} s(x)\phi(x)dx \tag{1.9}$$

the age distribution of corresponding to $\phi(x)$. The effective years worked can be rewritten as:

$$\begin{aligned} L &= \int_{a1}^{a2} s(x)\phi(x)dx \int_{a1}^{a2} e^{-nx}\delta(x)dx \\ \ln L &= \ln \int_{a1}^{a2} s(x)\phi(x)dx + \ln \int_{a1}^{a2} e^{-nx}\delta(x)dx \end{aligned} \tag{1.10}$$

The second term on the right-hand side, known as the cumulant-generating function, can be approximated as a linear combination of moments of the labor income age distribution.[1] Thus, an approximation of the natural log of the effective number of workers is given by:

$$\begin{aligned} \ln L &\simeq \ln \phi_0 - n\mu_\phi + 0.5n^2\sigma_\phi^2. \\ \phi_0 &= \int_{a1}^{a2} s(x)\phi(x)dx \\ \mu_\phi &= \int_{a1}^{a2} x\delta(x)dx \\ \sigma_\phi^2 &= \int_{a1}^{a2} x^2\delta(x)dx - \mu_\phi^{\,2} \end{aligned} \tag{1.11}$$

The natural log of the number of effective consumers can be approximated in exactly the same manner.

The accuracy of the approximation will depend on features of the age profile and the magnitudes of higher moments. We have investigated this issue quite extensively and find that that the approximation

[1] See Weisstein, Eric W. "Moment-Generating Function." From *MathWorld*--A Wolfram Web Resource. http://mathworld.wolfram.com/Moment-GeneratingFunction.html.

for the support ratio is very precise even though the approximation is much less reliable for either the effective number of workers or the effective number of consumers.

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[i] Two thirds of mixed income is counted as labor income and one third is counted as a return to assets such as a farm or shop.