Asia is aging, although there is significant heterogeneity across subregions and economies. Population aging poses two strategic challenges for the region: sustaining economic growth and delivering old-age economic security. In this paper, we leverage the lifecycle perspective—that individuals’ consumption and labor income differ at each age—and the National Transfer Accounts database to construct and analyze key economic indicators. Our analysis confirms that demographic change will challenge the region’s future growth and increase the cost of funding the consumption of the elderly. We also find that it will have a substantial impact on the public finances of some Asian economies.

Keywords: population aging, demographic change, Asia, economic growth, old-age economic security

JEL codes: J11, J14
I. Introduction

Asia and the Pacific, and indeed the entire world, is in the midst of a demographic transition that has fundamental implications for economic growth, generational equity, public finances, and other important features of national and regional economies. It is widely recognized that population aging may adversely affect economic dynamism, exacerbate inequality between generations, and harm public finances. More broadly, older populations pose two strategic challenges for Asia: (i) sustaining economic growth in the face of less favorable demographics; and (ii) delivering old-age economic security for a large and growing elderly population. In this paper, we undertake a granular analysis of demographic and economic data to improve our understanding of the economic impact of the demographic transition in Asia and the world.

Demographic data point to two interrelated and stylized global trends: population aging and slowing population growth. Significantly, Asian economies, which enjoyed a substantial dividend from large workforces in the past, will see effective labor growth drop sharply between 2020 and 2060. While the populations of Asia and the world are aging and growing more slowly, there is substantial heterogeneity within the world and Asia. A key objective of this paper is to explore this heterogeneity within Asia and the Pacific.

A lifecycle perspective allows us to better understand exactly how demographic change affects the economy at any point in time. The key principle here is that the profiles of average labor income and consumption depend heavily on age. Individuals consume more than they earn when they are young or old, and they earn more than they consume during productive middle-ages. While these broad stylized facts hold for all economies, there are significant differences across economies. The lifecycle perspective dates back to some of the earliest literature on population and economic growth. What is new here are the comprehensive efforts to quantify how economic data vary over the lifecycle and how patterns vary across economies due to development level and other factors.

Combining the lifecycle profiles of consumption and labor income with population estimates and projections from the United Nations (United Nations Population Division 2019), we are able to project three key indicators that capture the impact of demographic transition on the economy. These are (i) effective number of workers; (ii) effective number of consumers; and (iii) support ratio, which is the ratio of (i) to (ii). Asia will see a sharp decline in the effective number of workers in the coming decades. As a result, the first demographic dividend, or the boost to economic
growth due to rising support ratios, will dwindle across the region. The decrease will be most pronounced in East Asia, which has experienced a rapid decline in fertility.

Population aging gives rise to two strategic challenges: sustaining economic growth and securing adequate resources for old-age consumption. The resources for old-age consumption can come from two sources, either lifecycle savings or contemporaneous private or public transfers. We estimate the old-age GAP ratio (OAGAP), or the amount of resources required to meet the old-age deficit. Funding the old-age gap through 2060 would require funding in excess of 40% of contemporaneous labor income in East Asia and more than 20% of labor income in the rest of developing Asia.\(^1\) We estimate the retirement wealth that would be required to fund old-age needs. The estimates vary widely across developing Asia’s subregions and economies. We also show that, compared with relying on funded approaches to meeting old-age needs, relying on transfers is relatively cheap in the beginning but very expensive when aging sets in.

Finally, population aging will have sizable implications for the public finances of developing Asian economies. Public transfers are one of the main avenues for funding the gap between labor income and consumption at old age. The size of public transfer inflows and outflows will differ at each age. For example, during productive middle-ages we can expect outflows to the government (i.e., tax payments) to exceed inflows from the government (i.e., benefits). We use such age profiles to project the impact of population on public finances. The old-age gap, or the difference between labor income and consumption for those aged 65 years and above, varies significantly among economies and is rising significantly in the Republic of Korea, Thailand, and Taipei, China. As a result, net public transfers to those aged 65 and older are projected to rise sharply by 2060 to 15% and 25% of total labor income in the Republic of Korea and Taipei, China, respectively, although they will remain a much more modest 4% in Thailand.

The contribution of this paper to the literature is to provide new National Transfer Accounts (NTA) data for Asia and the Pacific and to assess the potential impact of population change on key dimensions of the economy. These data are sufficient to highlight very important differences within and between the subregions of Asia and the Pacific. We emphasize some of the simple, first-order effects of population rather than the complexities that have been explored elsewhere in our own work and the works of others. For example, we do not consider the impact of fertility on human capital (Becker, Murphy, and Tamura 1990; Lee and Mason 2010; \(^1\)Developing Asia refers to the 46 developing member economies of the Asian Development Bank.)
Lee et al. 2014); relationship between population and capital deepening (Tobin 1967); endogeneity of health-care spending, fertility, and economic growth (Ehrlich and Yin 2013, de la Croix 2017); or the possibility that population change will lead to secular stagnation and low interest rates in advanced economies (Eggertsson, Lancaster, and Summers 2019). These issues are more appropriately addressed in simulation or econometric models that are usually constructed for a single economy.

Another aspect of this study is that the availability of NTA data is limited. The growth of NTA has been rapid and there is widespread interest. The methods have been codified through close cooperation with the United Nations (UN) Department of Economic and Social Affairs. Resources for training and implementation have been provided by many agencies and foundations. Estimates are now available for 19 economies in Asia and the Pacific, 14 of which have a World Bank income status of upper–middle income or below. However, NTAs for some very important economies have not been constructed in recent years. Institutional support is essential to maintain up-to-date estimates, construct time series, and extend coverage to economies that have not yet participated.

II. Setting the Stage: Demographic Transition

The global demographic transition began with a decline in death rates, particularly among infants and children. This led to rapid population growth and a high concentration of the global population at young ages. During the 1970s, many economies entered a new phase of their demographic transition when declining birth rates led to slower population growth and a major shift in age distributions, a reduced concentration at child ages, and an increased concentration at working ages. As the demographic transition proceeds, low fertility rates lead to even slower population growth, population decline in some economies, and further changes in age structure (i.e., a lower concentration at working ages and a higher concentration at older ages).

Important differences in age structure across regions of the world are shown in Figure 1. Age structure as measured here incorporates differences across economies in the extent to which members of each age group rely on their own labor income to fund their own consumption. The “GAP ratio” is an estimate of the gap between total consumption and total labor income at each age as a percentage of total labor income. The significance of this distinction and the differences across economies are discussed in more detail below.

The GAP ratio varies considerably across the world and within Asia and the Pacific because some economies are very far along in their demographic transition and
Figure 1. **GAP Ratios by Region for 2020, 2040, and 2060 (%)**

Notes: GAP ratios are the gap between consumption and labor income as a percentage of total labor income for children and young adults aged 0–24 years, seniors aged 65 years and older, and both age groups combined. To facilitate comparison with the Asian Development Bank classifications, the developed member economies in Asia (Australia, Japan, and New Zealand) are not included. Values for developing member economies are reported in the figure. Values are the simple averages of values for each economy belonging to the regional group in question. Source: Authors’ calculations based on the National Transfer Accounts, www.ntaccounts.org (accessed 15 March 2020).
others are at a relatively early stage. Currently, countries in Africa are relatively early in their demographic transitions. They have a very high GAP ratio because the material needs of children greatly exceed what they produce through their labor. In 2020, almost 63% of the total labor income of African economies was needed to fund the gap between consumption and labor income for those under the age of 25. The burden of supporting children and youth in Africa is expected to decline very sharply over the next 40 years. The projected changes in the child GAP ratio are also projected to be substantial in Asia and in Latin America and the Caribbean. Based on the situations in Europe and North America, the child GAP ratio might stabilize at about one-quarter of total labor income for each region in the future, but that will depend on trends in consumption among children and young adults and features of labor markets that are uncertain.

Aging, as measured by the old-age GAP ratio, is a universal phenomenon occurring in all regions of the world. The countries of Europe and North America have higher old-age GAP ratios, and that will continue to be the case in the future. The situations are similar in Asia and in Latin America and the Caribbean, although Asia is not quite as “old.” Both regions will experience sharp increases in the old-age share of their respective populations. African and Pacific Island economies are, on average, aging more slowly than economies in other parts of the world.

The second global trend is slower growth. Throughout the world, the number of children is growing more slowly than in the past. In many economies, the number of children has declined substantially. This has been matched, with a delayed effect, by slower growth or a decline in the number of workers. This slowdown in population growth has fundamental implications for economic growth. Given the productivity of effective labor, slower growth in the number of workers means slower growth in gross domestic product (GDP). This trend for each major region is captured in Figure 2 using estimates and projections of the annual growth rate of effective labor. Effective labor is the population weighted to capture age variation in labor force participation, unemployment, hours worked, and wages.

Starting in the 1970s, rapid growth in the number of effective workers has led to more rapid growth in GDP throughout the world. But the era of population-driven economic growth is coming to an end everywhere except in Africa. There, growth in the effective number of workers was estimated to add 2.9 percentage points per year to economic growth in 2020. In Asia and the Pacific economies, growth in the number of effective workers was estimated to add only 1.5 percentage points to GDP growth per year. The effect is somewhat smaller in Latin America and the Caribbean. Among countries in North America, growth in the number of effective workers was estimated to add only 0.4 percentage points per year to GDP growth in 2020. In Europe, growth in the effective labor force is already estimated to have a negative impact on GDP growth.
Over the next few decades, population numbers per se will no longer be an important driver of GDP growth. Africa will increasingly become the only region of the world where growth in the effective number of workers will play an important role.

Within the broad context outlined above, demographic conditions are very diverse in Asia and the Pacific, with some economies very far along in their demographic transition and others at a relatively early stage. The diversity is quantified using two measures—the old-age GAP ratio and the growth of the effective labor force—that are expected to play a crucial role in macroeconomic performance.

The left-hand side panel in Figure 3 provides current values (projected values for 2020) distinguishing members of the Asian Development Bank by region. Economies

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2 In the figures, Central Asia consists of Armenia, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. East Asia includes Hong Kong, China; China; the People’s Republic of China; the Republic of Korea; and Taipei, China. South Asia covers Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Southeast Asia includes Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Viet Nam. The Pacific consists of Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu. Other economies are Australia, Japan, and New Zealand (also referred to here as developed member economies). ADB placed on hold its assistance in Afghanistan effective 15 August 2021 (https://www.adb.org/news/adb-statement-afghanistan).
that are earliest in their demographic transition are frequently found in South Asia. In Nepal, for example, effective labor force growth is very rapid at about 4% per annum and the old-age GAP ratio is 8.4%. In many economies, the old-age GAP ratio is less than in Nepal. Thirteen economies have a GAP ratio of less than 5%. Among the developing Asian economies, those that are furthest along in their demographic transition are a varied group. Growth in the effective labor force is negative in four East Asian economies—the People’s Republic of China (PRC); Hong Kong, China; the Republic of Korea; and Taipei, China—but also in Armenia, Georgia, and Thailand. The extent of aging in these economies varies greatly, however. The PRC is not yet very old, for example, with an old-age GAP ratio of only about 6%.

As the demographic transition proceeds in Asia and the Pacific, further aging and slower growth will become pervasive. By 2060, the old-age GAP ratio will exceed 20% in 14 developing member economies, compared with only two—Georgia and Hong Kong, China—in 2020. Growth of the effective labor force will be negative or essentially zero in 21 developing member economies in 2060, compared with six today. Aging and slower growth are pervasive in the region, however. Every

developing member economy in Asia and the Pacific will have a population that is older and growing more slowly in 2060 than in 2020.

Both demographic and economic factors explain the distinctive features of regions and economies, which are highlighted further below. Although the broad outlines of the age transition appear to be common to all economies in Asia, there is enormous diversity across subregions and economies. Most East Asian economies have experienced a rapid fertility decline, leading to rapid population aging and slowing population growth. The same is true of some Southeast Asian economies like Thailand and Singapore. However, in Singapore, the effects of low fertility have had less effect because of its liberal immigration policies. Elsewhere in Asia, especially in South Asia, the demographic transition is an evolving event where birth and death rates continue to decline more slowly and steadily in many cases than in other rapidly aging economies.

Economic behavior matters as well. In Japan, the effects of aging are reinforced by high levels of health-care spending. In the Republic of Korea, the economic effects of aging are more moderate because consumption by seniors is low relative to consumption by children and younger adults. In India, the impact of aging is affected by the sharp drop in labor income at age 60 due to labor policies.

**III. The Generational Economy and the Lifecycle: An Overview**

Understanding how a change in population will influence the economy builds on an understanding of the lifecycle. What does it mean to be young or to be old from an economic perspective? Chronological age is widely used with those under 15 years old often classified as children, those 15–64 years old as working-age adults, and those 65 years and older as seniors. However, the meaning of childhood or youth varies from economy to economy and is changing over time depending on many factors. How long do children remain in school and how quickly can they secure quality jobs when they leave school? Likewise, the meaning of old age depends on the health of older individuals, attitudes and policies toward working at older ages, public policies toward pensions and health-care spending, and other features of later years of life. Several other scholars have also recently explored different concepts of age that are not based on years since birth but other markers of the aging process (Balachandran et al. 2019, Sanderson and Scherbov 2010).

The results presented make use of detailed data from the NTA project and population projections by age prepared by the UN to explore how changing age structure is likely to interact with age-specific economic behavior to influence the macroeconomy (United Nations Population Division 2013, Lee and Mason 2011).
The NTA framework provides a comprehensive accounting of any economy that incorporates age details while maintaining broad consistency with the UN System of National Accounts. The NTA flow accounts can be expressed in simplest terms by the following identity:

$$C(x, t) - Y_l(x, t) = T(x, t) + Y_a(x, t) - S(x, t),$$  \(1\)

where \(C\), \(Y_l\), \(T\), \(Y_a\), and \(S\) are the aggregate consumption, labor income, net transfers, asset income, and saving, respectively, of persons aged \(x\) in year \(t\). The left-hand side of equation (1) captures the basic lifecycle problem: the considerable differences between consumption and labor income depending on the age of individuals. The right-hand side, referred to as age reallocations, quantifies the economic mechanisms available to deal with the lifecycle. Economies can rely on net transfers from parents to children, for example, or from taxpayers to retirees, as another example, to fund lifecycle needs. The alternative economic mechanism is asset-based reallocations. People can rely on asset income or dis-saving to fund lifecycle needs.

The terms in equation (1) are broad macroeconomic measures, and NTA accounts are constructed to conform to each economy’s total income accounts data. The classification of these data by age provides a simple mechanism for assessing how demographic change will influence the economy. The lifecycle patterns of behavior are quantified using per capita age profiles. To illustrate, aggregate consumption and labor income are equal to

$$C(x, t) = \bar{c}(x, t)P(x, t),$$

$$Y_l(x, t) = \bar{y}_l(x, t)P(x, t),$$ \(2\)

where \(\bar{c}(x, t)\) is the per capita consumption of persons aged \(x\) in year \(t\), \(\bar{y}_l(x, t)\) is the per capita labor income of persons aged \(x\) in year \(t\), and \(P(x, t)\) is the population aged \(x\) in year \(t\).

Considering economies at different income levels illustrates some of the key features of the lifecycle of consumption and labor income. In Figure 4, labor income and consumption are compared across economies by calculating the per capita values relative to the average value for the 30–49-year-old age group. This normalization allows us to compare age shapes for economies at very different levels of development. The estimates are available for 70 economies, which have been grouped by income class. The median value for each income group is charted.

At young ages, children consume less than adults in all economies irrespective of their income level, but consumption increases as children mature and, in particular, as they enter school. The increase is particularly sharp in high-income, low-fertility economies due to high levels of spending on education. The age pattern of consumption at adult ages also varies with the level of income. In low-income economies,
consumption per adult is lower at older ages. Adults in their mid-20s are consuming about 10% more while adults at age 70 are consuming about 10–15% less than adults in the 30–49-year-old age range. Consumption is flatter for adults living in middle-income economies. And for high-income economies, on average, consumption is much higher at older ages. By age 60, adults in high-income economies are consuming about 10% more than those in the 30–49-year-old age range. Under the influence of spending on health care, adults in their late 80s are consuming about 20% more than adults aged 30–49 years.

Labor income is low for the young, rises with age during the 20s and 30s, reaches a plateau during the 40s, and declines beginning in the 50s and early 60s. Labor income is concentrated in a narrower age range in high-income economies, with labor income rising at later youth ages and declining to low levels at an earlier point in old age. Even though older adults are healthier in high-income economies, they have lower labor income relative to earnings at prime ages than do older adults in middle- or low-income economies.

Figure 4. Consumption and Labor Income by Age and Income Group

Notes: Values for each economy are expressed relative to the mean value of those in the 30–49-year-old age group. Average values for each income group are calculated as the median value for the economies belonging to that group. See Appendix for additional information.

The remaining results presented in this paper emphasize Asia and the Pacific. NTA estimates are now available for the 19 Asia and the Pacific economies shown in Figure 5. (These estimates have been constructed by research teams in each of the 19 economies with support provided by the NTA project and the UN Population Fund.) The broadest patterns reported above generally hold for individual economies, but there are important differences in the details. In high-income economies, for example, consumption rises with age in Japan and Australia, but not in the Republic of Korea, Singapore, or Taipei, China. Labor income reaches a peak at very young ages in the PRC and Viet Nam. In India, labor income declines very sharply at age 60 due to the effects of mandatory retirement on high-paid workers in the formal sector. Of all NTA economies, including those outside Asia and the Pacific, the PRC has very low consumption at every age. Some like the Philippines and Timor-Leste have high consumption relative to their labor income. This can occur due to high net transfers from the rest of the world or due to high total income from natural resources, although this is not a factor for the economies shown in Figure 5. These differences are important for assessing how changes in population age structure will influence economic growth.

An important general feature of the labor income profiles is that they do not rely on an arbitrary definition of the working-age population. The labor income profile for each economy reflects actual labor force participation plus three other important dimensions of labor: unemployment, hours worked, and earnings per hour. These elements are critical to assessing the contribution of adults in the working ages and older.

Reallocation systems receive less attention in this paper, but in every economy the lifecycle deficit of children is funded almost entirely by transfers. For young children, private (familial) transfers are particularly important. For older children, public transfers approach or even exceed private transfers due to the high level of public spending on education in many economies. The reallocation system for funding old-age needs is much more varied. In continental Europe and Latin America, public transfer systems play a very prominent role. In Australia, Canada, Japan, the United Kingdom, and the United States, seniors depend on a more balanced combination of public transfers and asset-based reallocations. In several East Asian economies, net private transfers from children still remain important to seniors. In many Asian developing economies for which data are available, seniors rely heavily on asset-based reallocations.

A. Transforming Population and Lifecycle Profiles into NTA Indicators

Population data and age profiles of consumption and labor income are combined to produce indicators that capture the effects of population trends on the aggregate
Figure 5. Per Capita Consumption and Labor Income in International Dollars by Income
Group in Asia and the Pacific (Purchasing Power Parity-Adjusted)

(a) High-Income Economies

(b) Upper-middle-income Economies

(c) Lower-middle and low-income Economies

\( C_{ppp} \) = per capita consumption, \( Y_{l ppp} \) = labor income.

The approach taken here is to answer a simple question. Suppose the age patterns of consumption and labor income do not change in the future, how would changes in population age structure lead to strains or imbalances in the macroeconomy? The results are not a forecast of changes in the macroeconomy. Without question, patterns of consumption and labor income must change to restore balance in the macroeconomy. The goal is to assess the nature, timing, and magnitude of those imbalances.

Three measures are emphasized in this subsection—effective labor, effective consumers, and the support ratio—that capture the impact of age structure on economic growth. Additional indicators are considered below. In all cases, we project values by combining population projections by age with per-age profiles held at the baseline value estimated from NTA.

For any economy, the effective number of workers measures the impact of population change on effective labor by incorporating age variation in labor force participation, unemployment, hours worked, and wages (or estimated productivity for those who are self-employed or unpaid family workers). Effective labor in year \( t \) is as follows:

\[
L(t) = \sum_{x=0}^{49} \frac{y_j(x, b) P(x, t)}{\sum_{x=30}^{49} y_j(x, b)} P(x, t),
\]

where \( L(t) \) is the total number of effective workers in year \( t \), \( y_j(x, b) \) is per capita labor income of persons aged \( x \) in the base year, and \( P(x, t) \) is the population of age \( x \) in the year \( t \). This formulation counts adults in the 30–49-year-old age range as one effective worker, on average, while those at each single year of age are counted as more or less than one effective worker depending on how their per capita labor income compares with that of the 30–49-year-old age group. The age profiles of per capita labor income shown in Figure 5 are used for this purpose.

The effective number of consumers captures the reality that needs, as well as productivity, vary over the lifecycle. The effective number of consumers is given as follows:

\[
N(t) = \sum_{x=0}^{49} \frac{c(x, b) P(x, t)}{\sum_{x=30}^{49} c(x, b)} P(x, t),
\]

where \( N(t) \) is the total number of effective consumers in year \( t \), \( c(x, b) \) is per capita consumption of persons aged \( x \) in the base year, and \( P(x, t) \) is the population of age \( x \) in the year \( t \). This formulation counts adults in the 30–49-year-old age range as one effective consumer, on average, while those at each single year of age are counted as...
more or less than one effective consumer depending on how their per capita consumption compares with that of the 30–49-year-old age group. The age profiles of per capita consumption shown in Figure 5 are used for this purpose.

The support ratio is the ratio of the number of effective workers to the number of effective consumers in year $t$:

$$SR(t) = \frac{L(t)}{N(t)}.$$  \hspace{1cm} (5)

IV. The Great Slowdown of Labor Force Growth

At the global level, the effective labor force was growing rapidly during the last half of the 20th century, providing a tailwind to economic growth. The winds are shifting, however, and for many economies labor force growth is slowing or even turning negative. The first-order effects of population on GDP are captured by a simple identity

$$Y(t) = \frac{Y(t)}{L(t)} L(t).$$  \hspace{1cm} (6)

Output or GDP in year $t$, $Y(t)$, is equal to output per effective worker times the number of effective workers. The relationship in growth terms is as follows:

$$\text{gr}(Y(t)) = \text{gr} \left( \frac{Y(t)}{L(t)} \right) + \text{gr}(L(t)),$$  \hspace{1cm} (7)

where $\text{gr}()$ represents the growth rate of the argument. Given the growth in output per effective worker, a 1 percentage point increase (decrease) in the effective number of workers leads to a 1 percentage point increase (decrease) in the growth of GDP.

The impact of demography on GDP growth is remarkably diverse in Asia and the Pacific. In 2020, the effective labor force was expected to have grown most rapidly (between 3.5% and 3.6%) in Afghanistan, Cambodia, and Solomon Islands. In contrast, the most rapid declines (between $-0.5\%$ and $-0.6\%$) were expected in Georgia, the PRC, and Japan. In most economies, demographic change is currently providing a tailwind for GDP growth. The effective labor force was expected to grow in 2020 in all Central Asian economies except Armenia and Georgia, all South Asian economies, all Southeast Asian economies except Thailand, and all Pacific economies. East Asia is an exception to this regional pattern. Total effective labor was projected to decline in 2020 in all East Asian economies except Mongolia. Among the developed member economies, Australia and New Zealand were also projected to experience moderate growth in their respective effective labor force (Figure 6).
With rare exception, however, growth in the effective number of workers is expected to decline over the coming decades, serving as a significant drag on GDP growth. Some economies that are experiencing a moderate decline now are projected to experience a much more rapid decline in the future. The rate of growth of the effective number of workers is projected to decline by more than 1 percentage point per annum by 2060 in Japan, the Republic of Korea, and Taipei, China. In many economies, the effective number of workers will continue to grow over the next two decades but much more slowly than today or in the recent past. The growth rate of the effective number of workers in Bangladesh, for example, is projected to decline from 1.7% per year in 2020 to 0.3% per year in 2040. The growth rate for the effective number of workers in India is projected to decline by a full percentage point between 2020 and 2040.

Projections of effective labor for 2040 are somewhat more reliable than other indicators because everyone 20 years and older has already been born. Projections
beyond 2040 are less reliable due to uncertainty about fertility trends. Accepting UN projections at face value indicates that the slowdown in the effective number of workers will continue. The decline is projected to moderate in a few economies—such as Georgia, Japan, and Taipei, China—that have already experienced a very rapid decline.

Projections of effective number of workers for smaller economies are also subject to uncertainty to the extent that their future will depend to a large degree on immigration. Singapore and Hong Kong, China are two obvious cases in point.

V. The First Demographic Dividend: The Adverse Impact of Population Aging on Growth in Asia

The first demographic dividend refers to the positive effect of demographic change on standards of living due to a rise in the support ratio; that is, when the effective number of workers is growing more rapidly than the effective number of consumers (Bloom and Canning 2001, Bloom and Williamson 1998, Mason 2001, Mason and Lee 2007). Extending the identities presented in equations (2) and (3), output per effective consumer is equal to the following:

\[
\frac{Y(t)}{N(t)} = \frac{Y(t)}{L(t)} \text{SR}(t).
\]

Given the productivity \( \frac{Y(t)}{L(t)} \), income per effective consumer varies directly with the support ratio. In growth terms,

\[
\text{gr} \left( \frac{Y(t)}{N(t)} \right) = \text{gr} \left( \frac{Y(t)}{L(t)} \right) + \text{gr}(\text{SR}(t)),
\]

where \( \text{gr}() \) represents the growth rate of the argument. The growth rate of income per effective consumer is equal to the growth rate of productivity plus the growth rate of the support ratio.

The effect of population on the support ratio is referred to as the first demographic dividend while the effect of population on productivity is referred to as the second demographic dividend. The rise in the support ratio over the demographic transition is referred to as the dividend phase.

The first dividend was especially pronounced in East Asia. Using the values for the median economy as a marker, the support ratio began to increase in the early 1970s and continued to be favorable for about four decades (Figure 7). The first dividend has now turned negative as population aging is leading to a decline in the support ratio. This condition is expected to persist to 2060 and beyond. During its peak years, mostly in the 1980s and 1990s, the dividend added more than 1% per year to GDP per effective consumer.
consumer. At the trough, the decline in the support ratio will be about 1% or less per year and will persist for two decades before tapering off. Comparing the least and the most favorable periods, the downturn in economic growth as measured in GDP per effective consumer due to population change amounts to a swing of 2 percentage points.

The actual and projected first dividends in other regions of Asia and the Pacific are similar to the East Asia pattern, although the swings are somewhat more moderate. The median support ratio began to increase in the 1970s everywhere in the region except in South Asia, where the dividend phase was delayed until the early 1990s. The rise and fall of the dividend is less pronounced outside of East Asia because fertility declines were not as rapid in other subregions. The historical and projected first dividends have been or will be most moderate in the Pacific and developed member economies. Swings in the support ratio of developed member economies were generally moderate, although in Japan the impact of aging has already begun and is substantial.
Some highlights of our findings on the first demographic dividend in Asia and the Pacific include the following:

- **1950–1999**: the effective labor force was growing in every member economy of the Asian Development Bank except Georgia and Armenia;
- **2000**: the growth of the effective labor force ended in Japan; and
- **2016–2017**: the growth of the effective labor force ended in the PRC; Hong Kong, China; the Republic of Korea; Taipei, China; and Thailand.

Based on median values, the dividend phase began and ended in subregions of Asia and the Pacific at the following times:

- **1968–1999**: dividend phase in developed member economies;
- **1970–1975**: dividend phase began in Central Asia, East Asia, Southeast Asia, and the Pacific;
- **1992**: dividend phase began in South Asia;
- **2014 and 2018**: dividend phase ended in East Asia and Central Asia, respectively;
- **2028 and 2038**: dividend phase will end in Southeast Asia and South Asia, respectively; and
- **2076**: dividend phase will end in the Pacific.

### VI. Funding the Consumption of the Elderly

Aging is beginning to have important economic implications for many economies in Asia and the Pacific. The pace of aging is accelerating so the interactions between aging and the economy will become increasingly important in the coming decades (Mason and Lee 2018).

The economic impact of aging depends on the institutions and economic mechanisms on which the elderly rely to fund old-age needs. One possibility is lifecycle saving. Assets can be accumulated during the surplus ages to fund deficits, by relying on asset income and dis-saving, during old age. This mechanism is explored in more detail below. The second possibility is that societies may rely on inter-age transfers with resources flowing from surplus ages to old-age deficit ages. These transfers may be private, funded by family members, often between co-resident family members. Or they may be public, funded through public transfer programs such as publicly funded health-care programs that support the elderly or through public pension programs based on pay-as-you-go principles.
Transfers are governed by an iron rule: transfer inflows must be matched by transfer outflows. Changes in age structure produce an imbalance between inflows and outflows that requires rebalancing. How large is that imbalance? That depends on the extent of aging and the importance of transfers in meeting lifecycle needs as determined by policy and practice in any particular economy. Given the per capita age profile of consumption and labor income, the maximum imbalance from any change in age structure would arise if the lifecycle deficit were funded entirely by transfers.

The OAGAP measures contemporaneous resources that would be required to meet the old-age deficit given the projected population at each age and per capita consumption and labor income. The old-age deficit is measured as a percentage of total labor income:

$$\text{OAGAP}(t) = 100 \times \frac{\sum_{x=65}^{\omega} P(x, t)(c(x, b) - y_l(x, b))}{Y_l(t)}, \quad (10)$$

where $P(x, t)$ is the population aged $x$ in year $t$, $c(x, b)$ is per capita consumption, and $y_l(x, b)$ is per capita labor income of persons aged $x$ in the base year. The OAGAP has a simple interpretation. It is the share of total labor income in year $t$ that would be required to fund the lifecycle deficit of the elderly in that year. It is also the maximum tax on labor income that would be required to fund old-age needs entirely. Changes in the OAGAP over time for any economy quantify the imbalances created by changes in the population age structure.

The OAGAP values in 2020 for 41 economies in Asia and the Pacific are presented by subregion in Figure 8. The values are calculated using projected populations by age in 2020 and consumption and labor income profiles in the base year (see Appendix for the base year for each economy). The 2020 ratios fall below 3% in a handful of economies: Tajikistan, Afghanistan, Bangladesh, and the Lao People’s Democratic Republic. The highest values for each subregion are found in Georgia (Central Asia; 20.9%); Hong Kong, China (East Asia; 21.9%); Sri Lanka (South Asia; 15.2%); Thailand (Southeast Asia; 13.6%); and Fiji (Pacific; 6.8%). Among the developed member economies, the highest 2020 OAGAP value belongs to Japan (43.6%).

Subregional averages for 2020 are calculated as the simple average for economies in each subregion. Excluding developed member economies (30.4%), the highest subregional average is in East Asia (12.4%), while in other developing subregions the values vary from 8.5% to 4.4% (Figure 9).

Aging will produce substantial lifecycle imbalances in developing member economies over the next four decades. Aging is most advanced in East Asia, with the average value expected to rise to 41.5% in 2060, an increase of almost 30 percentage
Figure 8. OAGAP Values for Economies in Asia and the Pacific in 2020 (%)

Notes: The OAGAP measures contemporaneous resources that would be required to meet the old-age deficit given the projected population at each age and per capita consumption and labor income. The old-age deficit is measured as a percentage of total labor income.


points from 2020. The projected OAGAP values in 2060 are very similar for Central Asia, South Asia, and Southeast Asia at 21% to 22%, with an increase in the OAGAP of 13–16 percentage points for each subregion during the review period. The Pacific economies are aging more slowly, with a projected OAGAP value of only 8.4% in 2060, which is a 4-percentage-point increase compared with 2020. For developed member economies, the average OAGAP is projected to reach 53.7% by 2060, reflecting a 24-percentage-point increase compared with 2020.

The bottom line is that maintaining the existing lifecycle profiles in the presence of population aging would require funding in excess of 40% of labor income in East Asia and more than 20% in the rest of developing Asia by 2060. This funding could rely to some extent on transfers but also on asset-based reallocations: asset income, and dis-saving. To explore this possibility, we consider the implications of aging from a longitudinal perspective.
Old-age needs can be met relying exclusively on current income through a combination of public and private transfers. The old-age gap measures presented above are particularly relevant for assessing transfer programs, but many economies, particularly in Asia, do not rely heavily on transfer systems to meet old-age needs. Instead, they rely on assets to fund old-age needs. In this section, we consider the implications of population aging for asset-based systems relying again on a polar case where economies rely exclusively on assets and not at all on transfers to fund old-age needs (i.e., the gap between consumption and labor income at old ages).

Asset-based systems are more complex than transfer systems. During their working years, each cohort must accumulate the lifecycle wealth on which it will rely during their retirement phase. We call this the preretirement or accumulation phase. To some extent, the accumulation of retirement wealth occurs at all working ages. For example, workers may participate in employment-based funded pension plans. We abstract from this, however, and assume that the lifecycle surplus for young adults is devoted to supporting children, while the lifecycle surplus for older adults is devoted exclusively to accumulating retirement wealth. The accumulation phase is defined by the age range over which lifecycle wealth is positive and rising. See Mason et al. (2017) for more details.

Notes: The OAGAP measures contemporaneous resources that would be required to meet the old-age deficit given the projected population at each age and per capita consumption and labor income. The old-age deficit is measured as a percentage of total labor income. Regional values are simple averages of the values for economies in each region.

The accumulation phase is followed by the retirement phase. During this phase, lifecycle wealth is declining but sufficient to meet anticipated retirement needs in the future. The cohort relies on asset income and dis-saving to fund the old-age lifecycle deficit. (Note that the peak of lifecycle wealth may occur later than the age at which the lifecycle deficit first occurs because seniors may rely on only some part of their asset income to fund the lifecycle deficit. For simplicity, we refer to the retirement phase with reference to the peak of lifecycle wealth, but this has no bearing on the analysis.)

Estimates of the retirement wealth that would be required to fund old-age needs are presented for economies in Asia and the Pacific in 2020 in Figure 10 (see Appendix for details). There is a wide range in the values. In Japan, lifecycle wealth is 12 times the total labor income, with similarly high values found in Hong Kong, China; Australia; and New Zealand. In nine additional economies, retirement wealth ranges from about 5 to 7.5 times the total labor income. Much lower values of

Figure 10. **Lifecycle Retirement Wealth as a Percentage of Total Labor Income for Asia and the Pacific in 2020**

Lao PDR = Lao People’s Democratic Republic, $W_R^\text{r}$ = aggregate lifecycle retirement wealth, $Y_I$ = labor income. Source: Authors’ calculations based on the National Transfer Accounts, www.ntaccounts.org (accessed 15 March 2020).
retirement wealth are found in seven economies, with the lowest in Tonga (49%) and the Lao People’s Democratic Republic (44%).

These values might strike people as extraordinarily high when compared, for example, with capital–output ratios that are often in the 4–5 range in rich countries. It is important to keep two considerations in mind, however. The values presented here take labor income as the denominator, which would be about two-thirds of net national income and even smaller when compared with GDP. In Japan, for example, the ratio of lifecycle wealth to GDP would be less than 8. Second, economies do not rely exclusively on assets for their retirement. In the analysis presented elsewhere, we find that Japan relies on transfer for about half of old-age needs. Applying this value would bring the demand for retirement assets to fund old-age needs to around four times the GDP in Japan.

The result for the PRC is also somewhat surprising. Retirement wealth is only 243% of labor income even though the PRC will be aging very rapidly over the coming decades. Moreover, labor income among the elderly in the PRC is relatively low. These two factors are outweighed, however, by the PRC’s very low level of consumption among those in the retirement and preretirement phases.

There are pronounced regional differences in lifecycle wealth across Asia and the Pacific (Figure 11). Currently, East Asia has the highest subregional average value at

![Figure 11. Lifecycle Retirement Wealth as a Percentage of Total Labor Income in 2020, 2040, and 2060](image)

$W_R = \text{Aggregate lifecycle retirement wealth, } Y_I = \text{labor income.}$

Notes: Subregional values are simple averages of values for the member economies.

561% of total labor income. In Central Asia and Southeast Asia, lifecycle wealth falls between 300% and 400%, while lower values are found in South Asia (259%) and the Pacific (149%). Between 2020 and 2060, the retirement wealth relative to labor income is projected to almost double in Central Asia, East Asia, and the Pacific, and to more than double in South Asia and Southeast Asia.

In every economy in Asia and the Pacific, retirement assets are projected to rise much more rapidly than labor income. This would be possible only if an economy’s total saving rates were sufficient, but how high would saving rates have to be to achieve the projected wealth paths that underlie the results presented in Figure 11? And how would those saving rates compare with transfers if an economy were to rely on transfers rather than assets to fund old-age needs?

The connection between saving and wealth operates under the influence of two opposing effects. In many economies in Asia and the Pacific, slower growth in the effective labor force is leading to downward pressure on the rate of growth of labor income. This will reduce the need for capital widening. A lower saving rate will maintain the existing ratio of assets to labor income if labor income is growing more slowly. This effect of slower economic growth is countered by the demand for capital deepening, an increase in the ratio of asset to labor income, due to population aging.

The existence of these two effects is easily formalized. We use the following terminology. Aggregate lifecycle retirement wealth is represented by $W_R(t)$, labor income by $Y_l(t)$, saving by $S(t)$, and the rate of growth of total labor income by $\text{gr}(Y_l(t))$:

$$W_R(t + 1) = W_R(t) + S(t) \quad (11)$$

and

$$Y_l(t + 1) = (1 + \text{gr}(Y_l(t)))Y_l(t). \quad (12)$$

Dividing equation (11) by equation (12) gives us the following:

$$\frac{W_R(t + 1)}{Y_l(t + 1)} = \frac{W_R(t) + S(t)}{(1 + \text{gr}(Y_l(t)))Y_l(t)}. \quad (13)$$

Letting $w = W_R/Y_l$, the ratio of wealth to labor income, and $s = S/Y_l$, the ratio of saving to labor income, and rearranging terms gives us the following:

$$(1 + \text{gr}(Y_l(t)))w(t + 1) = w(t) + s(t). \quad (14)$$
The saving rate required to produce the wealth path from the beginning of period $t$ to the beginning of period $t+1$ is as follows:

$$s(t) = \text{gr}(Y_l(t))w(t) + \Delta w(t), \quad \text{where} \quad \Delta w(t) = w(t+1) - w(t).$$  \hspace{1cm} (15)

Rearranging the terms, we have

$$s(t) = \left(\text{gr}(Y_l(t)) + \frac{\Delta w(t)}{w(t)}\right)w(t).$$ \hspace{1cm} (16)

Or letting $\text{gr}(w(t))$ represent the growth rate of the ratio of wealth to labor income, we have

$$s(t) = (\text{gr}(Y_l(t)) + \text{gr}(w(t)))w(t).$$ \hspace{1cm} (17)

In general, the demographic transition will lead to a temporarily elevated saving rate. Both growth terms in equation (17) will be high. Growth in total labor income will be high because of growth in the effective labor force. Growth in wealth relative to labor income will be high due to the effects of aging. The growth effects will be reinforced by the upward trends in wealth. These effects are likely to dissipate over time, however. Growth in total labor income will decline with growth in the effective labor force. Growth in the wealth-to-labor-income ratio will decline as the age distributions of economies stabilize. The outcome in the distant future will depend on many details that are unknowable. Simulations can be used, however, to consider possible effects. The results presented in Figure 6 rely on the assumptions and results presented above. The growth in total labor income is equal to growth in productivity (1.5% per annum) and growth in the effective labor force (see Figure 6 for growth in the effective labor force at 20-year intervals). The simulated ratios of wealth to labor income are based on the same assumptions and methods used in Figures 10 and 11.

The economies of Asia and the Pacific follow a broadly similar pattern of rising over the demographic transition and then falling as the effects of the demographic dividend dissipate and the forces of aging set in (Figure 12). Simulated saving for East Asian economies reached a peak of about 25% of labor income in 2013 and is projected to decline through the mid-2050s, reaching a low of only about 9% of total labor income. The simulated saving rate in Southeast Asian economies is similar in that the peak value also occurs in 2013, but the peak is lower and saving rates remain at a high plateau for longer. The patterns for Central Asian and South Asian economies are similar but the simulated saving rate peaks are not reached until the mid-2030s. The simulated saving rates for the Pacific economies are generally lower, rising slowly, and do not reach a peak until around 2070.
Simulated savings and the old-age deficits as a share of total labor income are compared in Figure 12. An important and general lesson is illustrated. Funding old-age needs by accumulating assets requires a commitment of resources long before aging sets in. Taking East Asia in 2020 as an example, the gap between consumption and labor income could be funded with only 12% of total labor income; but in the same year, accumulating the assets needed to fund old-age needs in the future would require 23% of total labor income.

There is a natural temptation then to rely on transfer programs rather than asset accumulation to deal with old-age needs. One impact of this approach, however, is very evident in Figure 12. By 2033, the resources needed to fund a transfer system in East Asia would exceed the resources needed to accumulate pension assets. Thereafter, the resource requirements diverge sharply. By 2050, funding pensions through transfers would require 38% of total labor income, while the required funding for pension assets would drop to 10% of total labor income.

A second implication of the asset-based approach has been discussed more extensively. Higher saving rates and greater capital accumulation will lead to higher productivity and higher standards of living, which is often referred to as the second demographic dividend. As a practical matter, however, governments are relying on a combination of public transfers and capital accumulation to fund old-age needs. In the following section, we consider the impact of aging on the public sector in economies for which detailed data are available.

VIII. Aging and Its Implications for Asia’s Public Finances

The connection between aging and the public sector is very important in Asia and the Pacific as it is everywhere. In some economies, the impact of aging on public finances is of immediate concern. As discussed above, aging is expected to lead to an increase in the old-age resource gap, and in some economies, governments are heavily involved in filling that resource gap for their older populations. In economies with rapid aging and expansive public support for the elderly, the pressure to increase public spending may outstrip the availability of public resources. In many economies, the public sector is playing a more limited role. This is due in part to the fact that aging is delayed and in part to the fact that the public sector is less involved in filling the resource gap for their senior citizens.
The differences in old-age support systems are illustrated using estimates of public transfer inflows and outflows by age in Indonesia and the Republic of Korea (Figure 13). The Republic of Korea’s public sector is much larger than Indonesia’s. At peak ages in the Republic of Korea (early 40s), public transfer outflows are about 40% of the per capita labor income of an adult aged 30–49 years, compared with about 15% for those at their peak age in Indonesia (mid-40s). If we consider the importance of the public sector based on public transfer inflows, the Republic of Korea’s public sector is also much larger than Indonesia’s.

The age patterns of inflows also differ markedly between the Republic of Korea and Indonesia. Inflows to children are higher than inflows to prime age adults in both countries, although the inflows are especially high in the Republic of Korea compared with Indonesia and almost every other economy in the world. Of particular importance to the impact of aging is the very large difference in public transfer inflows to seniors. In Indonesia, we see virtually no tendency for inflows to be higher at older ages; neither major spending on pensions nor that on health lead to higher support for the elderly. The Republic of Korea, on the other hand, has a pattern that is similar to many high-income economies: substantial public transfer inflows to the elderly.

Age profiles like those presented in Figure 13 are used below to project the impact of population aging on public finances in the absence of public sector reform for eight developing member economies—Cambodia, the PRC; India; Indonesia; the Philippines; the Republic of Korea; Taipei, China; and Thailand—and two developed economies.
member economies—Australia and Japan. Before those results are presented, however, we present our earlier estimates of the impact of aging on the old-age gap as a ratio of total labor income in those economies for 2020, 2040, and 2060. These results show the maximum impact of aging on public sector spending irrespective of the public policy pursued (Figure 14).

The OAGAP is rising sharply in three developing member economies: the Republic of Korea, Thailand, and Taipei, China. By 2060, resources needed by the elderly in those economies will range from 40% of total labor income in Thailand to almost 70% in Taipei, China. The percentage of resources needed in Australia by 2060 will be less at about 38%, while in Japan the OAGAP is projected to reach 76% of total labor income.

In the other five developing economies in Asia and the Pacific—Cambodia, the PRC, India, Indonesia, and the Philippines—the maximum impact of aging on public transfer systems is much smaller. But the increases are by no means inconsequential. The old-age GAP ratios will be three–four times as large in 2040 as they were in 2020. Still, the results suggest that very generous old-age support systems in these economies are an attractive option. Expansive programs may be feasible in the shorter term, but they could well prove to be unsustainable in the more distant future depending on how they are designed.

In Figure 15, we consider projections of net public transfers if the normalized age profiles of inflows and outflows are held constant relative to labor income of those aged 30–49 years. Of the five economies experiencing medium-level gains in the

![Figure 15. Projected Net Public Transfers to Those Aged 65 Years and Older as a Percentage of Total Labor Income in 2020, 2040, and 2060](source: Authors’ calculations based on the National Transfer Accounts, www.ntaccounts.org (accessed 15 March 2020).)
old-age GAP ratio, none but the PRC will experience significant upward pressure on net public transfers. By 2060, the projected value of net public transfers to the elderly will increase to 1% of total labor income in Cambodia and by less in the other four economies. In the Philippines, net transfers to seniors are projected to be negative, with seniors receiving less in benefits than they pay in taxes. The PRC is an exception among these economies with net public transfers projected to reach between 10% and 15% of total labor income by 2060.

The importance of policy in conjunction with aging is also apparent in the projections for the Republic of Korea; Taipei, China; and Thailand. Net public transfers to the elderly are relatively modest in Thailand and, hence, the projected values in 2060 reach only 4% of the total labor income. The increases are much more substantial in the Republic of Korea and Taipei, China, where the net public transfers are projected to reach 15% and 25%, respectively, in 2060. In Japan, the projected increases in net public transfers to the elderly are very substantial, reaching 45% of total labor income by 2060.

IX. Conclusions

For many decades to come, the landscape in Asia and the Pacific will be dominated by two demographic trends: slower population growth and population aging. The region is diverse and, hence, the timing and severity of these trends will vary considerably from economy to economy. However, these trends will intensify, not dissipate, with significant implications for economies over the foreseeable future. Demographic transition will pose two strategic challenges for the region: maintaining economic growth in the face of less favorable demographics and securing adequate resources to meet the consumption needs of the elderly.

By and large, our analysis confirms the conventional wisdom that population aging will adversely affect Asia’s economic growth. GDP and other aggregate economic indicators can be expected to grow more slowly in the future. In the past, recent growth in the effective labor force led to more rapid GDP growth, but this will not be the case in the future. In some instances, where fertility rates are very low, the effective labor force may shrink substantially and GDP may actually decline. Per capita income could also grow more slowly because of a decline in the support ratio. The effective number of workers is expected to grow more slowly than the effective number of consumers.
Our analysis also underlines the challenges of securing adequate resources for the region’s large and growing elderly population. Generational features of economies in Asia and the Pacific are in the midst of change. Other things being equal, aging will lead to a very substantial increase in the resources required to support seniors. The implications of this change are very complex and difficult to anticipate. Some of the most important effects may be felt at the family level rather than the aggregate level. Providing support to the elderly could prove to be a significant financial burden to prime-age adults, particularly in societies where spending on children is reaching high levels. In many families, the financial costs may prove to be less important than the burdens from caregiving that often fall on women.

In some societies, providing for seniors is less a family responsibility and more a social responsibility. In most of the region’s economies, public transfers to the elderly are less important than in many European and Latin American countries. In those places where public transfer systems are important, tax revenues are expected to rise much more slowly than promised benefits. Either tax rates will have to rise or benefits will have to be curtailed, or both. Other economies may hope to implement more extensive old-age support systems in response to the greater needs of seniors in aging societies. A cautious approach is surely warranted.

Many working-age adults may accumulate assets in anticipation of their retirement. They may participate in funded pension programs, buy a home, pay down debt, or accumulate assets in many other ways. For now, elevated saving rates will be essential to fund future retirement needs. Eventually, however, accumulating assets will ease the financial burden imposed by an aging society.

“Demographics is destiny” refers to the widely held pessimistic view that economies are powerless in the face of population aging; that is, the demographic transition to older populations is often blamed for the loss of economic dynamism. However, there are many things that Asian policy makers can do to mitigate the impact of population aging on economic growth and old-age economic security. For example, governments can invest more in education and human capital so that higher labor productivity can mitigate the reduction of the first demographic dividend. Another example is creating a working environment that enables seniors to remain productive for a longer time. This will contribute to both old-age economic security and economic growth. In short, public policy is hardly impotent in the quest to achieve a more benign demographic destiny in Asia and elsewhere.
Appendix. Methodology

A1. Consumption and Labor Income Profiles

Consumption and labor income profiles have been estimated by members of the NTA network using methods described in the United Nations’ *National Transfer Accounts Manual: Measuring and Analyzing the Generational Economy* (United Nations Population Division 2013). These members belong to the Asia Regional Group led by Sang-Hyop Lee, and their work has relied heavily on financial support from the United Nations Population Fund and their home institutions.

Labor income consists of wages and earnings of employees and estimates of the value of labor of the self-employed and unpaid family workers. The age profile is affected by age variation in labor force participation, unemployment, hours worked, and productivity. Consumption consists of both public and private consumption, with separate estimates for health, education, and all other consumption expenditure combined.

All estimates are based on surveys and administrative data. They are adjusted to match aggregate data from the System of National Accounts.

Data are available for the following economies included in Table A1, as well as the year for which data have been estimated.

Age profiles have been rescaled to match the most recently available System of National Accounts data, but important changes may have occurred in the age patterns of estimates in some economies. More recent estimates for Japan (not yet released by the Statistics Bureau) show considerable stability in the age profiles. Efforts are underway to update estimates for India, but they are not yet completed.

Table A1. **Data Availability by Income Group**

<table>
<thead>
<tr>
<th>High Income</th>
<th>Upper-Middle Income</th>
<th>Lower-Middle Income</th>
<th>Low Income</th>
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<td></td>
<td>of China (2014)</td>
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<td>Timor-Leste (2011)</td>
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<td>Viet Nam (2012)</td>
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</tbody>
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Source: Authors’ compilation.
A2. Lifecycle Retirement Wealth

An economy relies on lifecycle wealth, broadly defined, to fund old-age needs. For a cohort of age \( x \) in year \( t \), lifecycle wealth is equal to the present value of prospective consumption less the present value of prospective labor income of members of that cohort over the remainder of their lifetimes. The accumulation of lifecycle wealth can be divided into two phases: the retirement phase and the preretirement (or accumulation) phase. During the retirement phase, lifecycle wealth will be declining as members of the cohort rely on their wealth to fund consumption in excess of labor income. During the preretirement phase, lifecycle wealth is rising, being accumulated as members of the cohort approach retirement. The cohort’s lifecycle wealth will depend on the per capita consumption and labor income at each age and the number of cohort members who are still alive.

For members of the cohort, wealth consists in part of assets accumulated through saving or from bequests received in previous years. But wealth also consists of the value of prospective net transfers. Prospective public transfers have a value determined by the prospective benefits received from public programs less the prospective taxes paid to support public programs. Likewise, the prospective private transfers have a value that depends on the prospective private transfers received less the prospective private transfers given. We refer to these two forms of lifecycle wealth as assets and transfer wealth.

Assets and transfer wealth are equivalent as a means of meeting lifecycle needs. In other respects, they are quite different, however. Assets are invested and lead to an increase in capital, a rise in labor productivity, and possibly a decline in interest rates. Transfer wealth is not invested and consists of nothing more than an obligation of future generations to transfer resources to the cohort in question. Indeed, transfer wealth must be balanced by transfer debt, including the net obligations of future generations.

Formally, per capita lifecycle wealth for the cohort aged \( x \) in year \( t \), \( w_r(x, t) \), for \( x \) equal to or greater than the beginning of preretirement \( (x_p) \), is equal to the present value of consumption less the present value of labor income,

\[
\begin{align*}
w_r(x, t) &= \text{PV}c(x, t) - \text{PV}y_l(x, t) \quad \text{for } x \geq x_p, \\
\text{PV}c_r(x, t) &= \sum_{z=0}^{\omega - x_p} (1 + r)^{-z}c(x + z, t + z) \quad \text{for } x \geq x_p, \\
\text{PV}y_{lr}(x, t) &= \sum_{z=0}^{\omega - x_p} (1 + r)^{-z}y_l(x + z, t + z) \quad \text{for } x \geq x_p,
\end{align*}
\] (A1)
where $c$ and $y_l$ are prospective per capita consumption and labor income, respectively, over the remaining lifetime of the cohort aged $x$ in year $t$. Total lifecycle wealth is equal to the following:

$$W_R(t) = PV C_R(t) - PV Y_{IR}(t),$$

$$PVC_R(t) = \sum_{x=x_p}^{\omega} P(x, t) PV c(x, t),$$

$$PV Y_{IR}(t) = \sum_{x=x_p}^{\omega} P(x, t) PV y_I (x, t),$$

(A2)

where $W_R(t)$ is the total lifecycle wealth in year $t$; $PVC_R(t)$ is the total prospective consumption and $PV Y_{IR}(t)$ is the total prospective labor income, both in present value terms in the year $t$; and $P(x, t)$ is the population of age $x$ in year $t$. All values are calculated for preretirement and retirement age cohorts.

The calculations presented here are based on the consumption and labor income profiles for each economy, an exogenous rate of growth of the profiles by 1.5% per annum, and a discount rate of 3% per annum. More detailed information about the calculation of the lifecycle phases and the values of $x_p$ calculated for each economy is available in Mason et al. (2017).

A3. Accumulating Wealth and Saving

In this subsection, we consider the connection between savings in wealth under the influence of two opposing effects. Aging is leading to an increase in wealth relative to total labor income, but at the same time, slower growth in labor income has the opposite effect. Here is the derivation using the following terminology: lifecycle wealth is $W(t)$ and labor income is $Y(t)$, the rate of growth of total labor income is $g(t)$, and $S(t)$ is the net saving of lifecycle wealth during the year $t$,

$$W(t + 1) = W(t) + S(t).$$

(A3)

Let $g(t)$ be the growth rate of total labor income:

$$Y(t + 1) = (1 + g(t))Y(t).$$

(A4)

Dividing equation (A3) by equation (A4) gives the following:

$$\frac{W(t + 1)}{Y(t + 1)} = \frac{W(t) + S(t)}{(1 + g(t))Y(t)}. $$

(A5)
Letting \( w = W/Y_l \), the ratio of wealth to labor income, and \( s = S/Y_l \), the ratio of saving to labor income, and rearranging the terms, we have

\[
(1 + g(t))w(t + 1) = w(t) + s(t). \tag{A6}
\]

The saving rate required to produce the wealth path from the beginning of period \( t \) to the beginning of period \( t + 1 \) is as follows:

\[
s(t) = g(t)w(t) + \Delta w(t), \quad \text{where} \quad \Delta w(t) = w(t + 1) - w(t). \tag{A7}
\]

Rearranging the terms, we have

\[
s(t) = \left( g(t) + \frac{\Delta w(t)}{w(t)} \right)w(t). \tag{A8}
\]

Or letting \( gr(w(t)) \) represent the growth rate of the ratio of wealth to labor income, we have the following:

\[
s(t) = (g(t) + gr(w(t)))w(t). \tag{A9}
\]

References


