Understanding and Forecasting Demographic Risk and Benefits

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Executive Summary

There is a global demographic transition underway—mortality rates and fertility rates are declining in almost every country. Different countries are at different stages of this demographic transition, generally corresponding to their level of economic development, and progressing at different speeds. Declining mortality and fertility, along with migration, determine the changing age structures of countries. There are macro-economic, financial, and social burdens and benefits associated with different age structures. Since demographics is largely determined by relatively well understood factors like fertility and mortality rates, it is possible to forecast how the age structure of countries will change over time. This report will analyze this demographic transition and provide insight on the burdens and benefits each country can expect.

Mortality rates and fertility rates have been declining globally over the past two centuries, with

societies moving from a state of high fertility and mortality rates to one of much lower rates. Global life expectancy has increased from 27 in the 1700s to over 70 in 2015. Likewise, fertility rates have declined from 6 births per woman in 1700s to around 2.5 in 2015. But this change has been dramatically more pronounced in the past 60 years (Figure 1).

After World War II and with the spread of modern health care around the world, the speed of the demographic transition, albeit highly variable across societies, accelerated. Illustratively, the number of children per woman in Iran fell from 6.4 in 1980 to 1.9 in 2010, across little more than a generation. And the life expectancy of South Korea rose from 53 in 1960 to 76 by 2000, adding more than 0.5 years of life annually. Furthermore, while it took France's elderly population 115 years to double its share of total population (from 7 to 14 percent), a third of the world's countries will likely make this transition in under 30 years.

Figure 1: The global demographic transition, a modern phenomenon. Sources: Lee (2003) and IFs 7.19

The demographic transition is a "'bad news, good news, bad news story'" of macro-economic, financial, and social consequences for societies (Cincotta 2013:30). Youthful societies face the

"bad news" of the financial challenges associated with educating large cohorts of youthful populations and finding jobs for them. As the country ages, there is the "good news" of a "demographic dividend" during which the size of the working-age population relative to the economically dependent populations offers a substantial boost to economic growth from higher levels of saving and increased labor force participation. As the workforce ages, however, there is more "bad news" as the country must pay for rising retirement and health costs as the workforce declines. Countries unable to create enough formal-sector jobs or adequately invest in human capital can squander the demographic dividend of a large workforce. This could make adapting to the imminent challenges of growing senescence even more exacting.

This report contributes to the second phase of a three-part study supported by Zurich Insurance that addresses the integrating question, "is global risk outpacing global growth?" The particular focus of this report is to explore, understand, and forecast the risks and opportunities associated with the great diversity of demographic patterns globally and the speed of their change.

We use the International Futures (IFs) integrated assessment tool to model the demographic dynamics of 186 countries and forecast their change and impacts through the year 2035, often looking somewhat beyond that year to put the change in still broader context. IFs is highly integrated across multiple human, social, and environmental systems and therefore allows us to better understand the impact that aging and demographic change can have on issues such as economic growth, government finance, and social stability.

Using the IFs system, we have explored the changing patterns of demographic risks and opportunities globally and across country-income categories in three general categories: macro-economic, financial, and social (see Table 1).[1] The **macro-economic** risks and benefits are related to growth, and are driven primarily from changing shares of the working-age population. This share will be increasing for some time in low-income and lower-middle-income countries, though it is now on a steady downward path in high-income and upper-middle-income societies (with China experiencing especially sharp decline).

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[1] We use the the World Bank's categorization of income groupings throughout this report. For the most part, these income groups align with the stages of the demographic transition i.e. low-income and lower-middle income countries tend to be younger, and upper-middle income and high income countries tend to be older. For more information on income groups see: http://data.worldbank.org/news/new-country-classifications-2015

Macro-economic
Savings and Investment
Labor Force Change
Productivity
Financial
Education Needs and Spending
Health Needs and Spending
Pension Needs and Spending
Social
Instability and Internal Conflict
Intergenerational Polarization
Intercultural Tension

Table 1: A taxonomy of impacts of demographic change. Source: Authors

With respect to **financial** risks, younger low-income countries are experiencing the burden of spending for education and providing health care for their young populations. While this financial burden will diminish as the size of the youth population begins to shrink, a new set of financial risks appears as countries pass into later stages of the demographic transition. In high-income countries and some upper-middle-income countries, especially China, the demand for both health-care spending and pension spending will rise significantly with the aging of populations, and the demands for increasing shares of this spending to be met with public funding will also almost certainly rise. The structure of the pension system, most of which have been financed on a pay-as-you-go (PAYG) basis, can further put such systems at risk. There will be high financial stress on many of these countries which will cut into their ability to finance other expenditures like education and infrastructure.

In some developing countries with very youthful populations, **social** risks such as internal instability or conflict have been and continue to be large, but are noticeably diminishing and in many countries will fall significantly in the next two decades as youth bulges (the share of young adults in the adult population) begin to decline more rapidly. With rapid aging in upper-middle and high-income countries, there is at least the potential for increased tension between older and younger generations vying for the same resources. Migration flows have almost always been associated with social pressures, especially for the wealthier recipient countries; the patterns of those flows and social pressures they exert will continue to be a large uncertainty.

Exploring the future of demographic change through this lens, we find that while there are risks associated with all stages of the transition, opportunities are largely a one-way street. The opportunities largely play out in lower-income countries where declining birth rates have begun to alleviate financial pressure of education and health care for the youth population. Using this opportunity to invest in the future workforce by closing the education spending gap can better position a country to take full advantage of the demographic dividend that is to follow, and to prepare for the financial burdens currently seen in older, high-income countries.

For many upper-middle-income countries, like China, which entered this demographic "sweet spot" in the 1980s and 1990s, the window is quickly closing. China, Thailand, South Korea, Chile, Cuba, and Russia likely have less than a decade left before the window shuts for good. Other countries like Brazil, Colombia, and Jamaica, which are more recent additions to the group, will

enjoy its benefits for a relatively short period of time. Still other young, developing countries like India and South Africa, which have only just entered the window, can expect to enjoy this confluence of demographic benefits for another 30 or even 40 years. No matter the timing or speed with which countries pass through this window, taking full advantage of the opportunities it provides is paramount for any country to prepare for the challenges that follow.

The bad news is that as we get older our health worsens and we rely on younger generations for financial support. For countries, this means dealing with the challenges of increasing health costs and growing pension demand (with which many high-income economies, such as Germany, Italy, and Japan, already struggle and will continue to struggle for decades). Nevertheless, as these countries age over the next twenty years, health costs and pension spending as a percent of GDP in these countries could be surpassed by those in rapidly aging countries like Cuba, Hong Kong, South Korea, Taiwan, and Singapore. These countries face a double burden of adapting to both the financial risks of rapidly rising costs and the macro-economic risks of diminishing labor contributions to economic growth, and could even encounter other unforeseen social risks arising from intergenerational competition over resources unless changes in migration, fertility, or technology bring greater relief.

While the core drivers of demographic change are relatively slow-moving and well understood, there still remains uncertainty around future migration patterns, increases in life expectancy, and the rate of decline of fertility rates. In Section 6 we explore three alternative scenarios to explore the uncertain issues.

First, the United Nations Population Division has highlighted the "stalling" of fertility declines across Equatorial Africa (East, Central, and Western Africa) relative to the reductions expected only a few years ago (UNDP 2014). This stalling (actually slowing) could well persist and extend the financial and social challenges associated with their very youthful and rapidly growing populations. It seems, however, more likely to end with renewed fertility decline. In the **Low Fertility Scenario**, average total fertility rates drop to near replacement rates by 2035, freeing up significant financial resources. Yet due to the delay in lessening the proportion of youths, even by 2035, Equatorial Africans will in this scenario only just begin to experience a demographic dividend.

Second, the growing share of retired populations already challenges many high-income countries and will soon become an obstacle for many middle-income societies, especially China. This development will intensify economic and financial challenges to those societies. Our **Longevity Scenario** explores a world in which advances in medical technology and treatments drive down mortality rates. In the short term, the mortality rate reductions translate into savings for many countries, but over the longer run all governments could face even greater fiscal pressure as this population distribution tips even further to the elderly.

Finally, while global migration rates are nowhere near as high as the peaks of the 1800s or early 1900s, specific patterns of flow, including the contemporary surge of migration into Europe,

may offer some demographic benefits for aging societies but could potentially create risks as well. The conflict in Syria has forced over 3 million people to flee the country, accounting for the vast majority of the estimated 1.1 million refugees that entered Germany in 2015. The effects of this wave of younger, predominantly male migration on age-sex distribution are pronounced in Germany, where the native population is on average much older and gender-balanced. Therefore, if the migrants can be integrated the biggest direct effect of increased migration may be economic growth. Germany's shrinking labor force is expected to be a net drag on the economy within the next five years and increasingly so over the next 20 years. In the **High Migration Scenario**, the inflow of migrants reverses this trend, providing nearly $350 billion more in GDP (relative to the Base Case) by 2035.

Demographic change can be so slow-moving as to be nearly imperceptible over short time-horizons, but the macro-economic, financial, and social implications can be enormous. The world is entering an era in which the global demographic structure is being turned upside-down. High-income countries and upper middle income countries (especially China) are entering, for the first time in global experience, a period not only of decline in the ratio of workers to the young and old, but very rapid decline. Low-income countries are, with some very important exceptions, beginning to experience the benefits (and new challenges) of moving into an era of growth in demographic opportunity, even as lower-middle-income countries consolidate that opportunity. By 2060 the world will have largely passed this period of demographic upheaval, but will be dramatically transformed in the process—the two country income categories that today have the greatest demographic advantages will have the least, and those advanteages will be much reduced; those countries with the least advantages today will have the greatest.

The forces that push populations through the stages of the demographic transition are relatively well understood and predictable. Yet other—more uncertain—interacting variables, like medical advancements leading to healthier, longer living populations, currently unanticipated drops in fertility rates across Equatorial Africa, or sustained high levels of migration from poor and war-torn regions to higher-income and aging countries, have the potential to change substantially the nature and balance of risks and benefits associated with demographic transformation.

For many individuals, living longer and healthier lives, seeking refuge and higher wages in a foreign land, or not having to care and provide for a very large family is a dream that is finally coming true. The interests of individuals are, however, not always aligned with those of society. Longer retirements mean higher demand for pensions, longer lives means more long-term health care costs, and greater migration means more possibilities of social tensions.

Preparing for these demographic-related societal risks, such as strained educational capacity, slowing economic growth, dwindling pension reserves, and fraying healthcare is the responsibility of governments, firms and individuals alike. Foresight plays a crucial role in mitigating these risks by not only identifying where reforms are necessary to escape fiscal crisis,

but also encouraging implementation of them early enough to avoid costly future tradeoffs and excessive social tension.

Glossary

Age structure — the distribution of a population by age and sex

Demographic transition — the progression of fertility and mortality patterns from high levels to low levels, leading eventually to a situation in which death rates outpace birth rates and population growth becomes negative

Demographic dividend — a period during which the size of the working-age population relative to the economically dependent populations offers a potential boost to economic growth from higher levels of saving and increased labor force participation

Dependency ratio — the size of an economically dependent population (young or old) relative to the economically active population

Elderly bulge — the population 65 and over as a percent of the total population. A bulge exists when the ratio is above a specified level, such as 20 percent.

Life expectancy at birth — the average number of years a newborn is expected to live

Life expectancy at ages 60-64 — the average number of years a person aged 60 to 64 is expected to live

Median age — the age marking the point in which half the population is younger than that age and half the population is older

Migrant stock — the number of people living in a given country other than their country of birth. This measure includes refugees and asylum seekers.

Total fertility rate — the average number of children a woman is expected to bear throughout her life

Working-age population — the percent of the population between the ages of 15 and 64

Youth bulge — the population 15 to 29 as a percent of all adults (15 and older). A bulge exists when this ratio is above a specified level, such as 50 percent.

1. The Diverse and Rapidly Changing Demographic Landscape

Demographic change is fundamentally intertwined with the history of modern human development. For the last 200-250 years (Birdsall 1980) countries have been passing through demographic stages, starting with initial patterns of high birth and death rates, followed by a decline in death rates, and a subsequent drop in birth rates. The transition concludes at a new, lower equilibrium state, where in some cases, deaths increase above births and natural population growth turns negative. This process, which has now taken all countries into at least the second stage, is known as the demographic transition.

Teitelbaum (2001:1) refers to the changes in fertility and mortality which drive this transition as "human tectonics," due to their hugely powerful yet slow-moving nature. Like plate tectonics, these human tectonic forces "embody enormous momentum that cannot be reversed or contained, and… can produce powerfully destructive events… if the circumstances do not allow for their energy to be dissipated in small increments." Demographic studies confirm that age structure often has a significant impact on many economic, financial, and socio-political issues (Cincotta 2013). Figure 1.1 uses age-sex distributions of the World Bank's four country-income categories to show the diverse global demographic landscape that these forces have created.
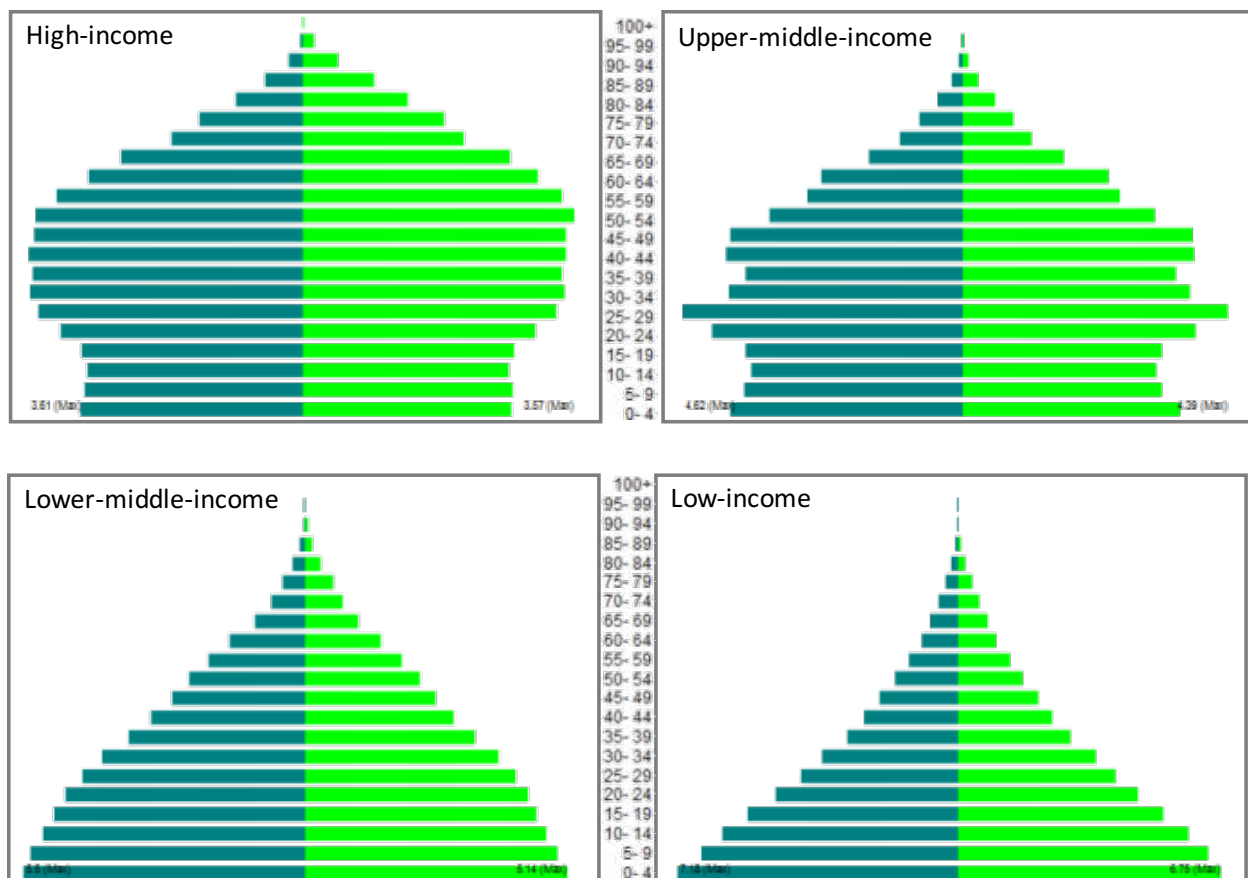

Figure 2.1: Age-sex distributions for World Bank Income Groups in 2015.
Source: IFs7.19. Males on the right, females on the left.

Consistent with the notion of long and slow change, in many of today's developed countries this transition has taken well over a century to play out (Dyson 2010). During the industrial revolution in Europe, declining mortality and sustained high fertility rates spurred unprecedented rates of population growth, such that between 1700 and 1900 the population more than quadrupled (from an estimated 20 million to 127 million) (Blue and Epenshade 2011). The growing, healthier, labor force provided a boost to economic growth that has only recently dissipated. While over the coming decades further contraction of the working-age population will make the increasing demand for social spending on the economically dependent more difficult to satisfy. The comparably gradual passage of these high-income countries through the transition has provided ample opportunity (though not always effectively utilized) to take advantage of the demographic dividend before passing into new and uncharted demographic territory of aging.

Demographic change can, of course, occur quite differently than it did in Europe. Some low-income countries, especially across Equatorial Africa, may remain precariously perched between stages, stuck in a state of high fertility rates, which can both prolong the vulnerability of internal conflict associated with young populations and delay the benefits associated with more intermediate age structures. At the same time, many developing countries have been undergoing or will experience this age-structure evolution in a fraction of the time. That means they will have a shorter demographic window of opportunity and less time to prepare for the financial burdens facing elderly populations. Many of these populations are aging not only historically fast, but at accelerating rate. Figure 1.2 shows that the rate of aging is increasing for many societies by measuring the number of years in which a country's population over 65 increases from 7 to 14 percent. Countries that have already completed this doubling took about 50 years on average to do so. The countries currently in this process will take just over 30 years on average and those countries which have not yet begun will take just under 20 years on average. The contracting timespan will make it more difficult for countries to prepare for this transition.
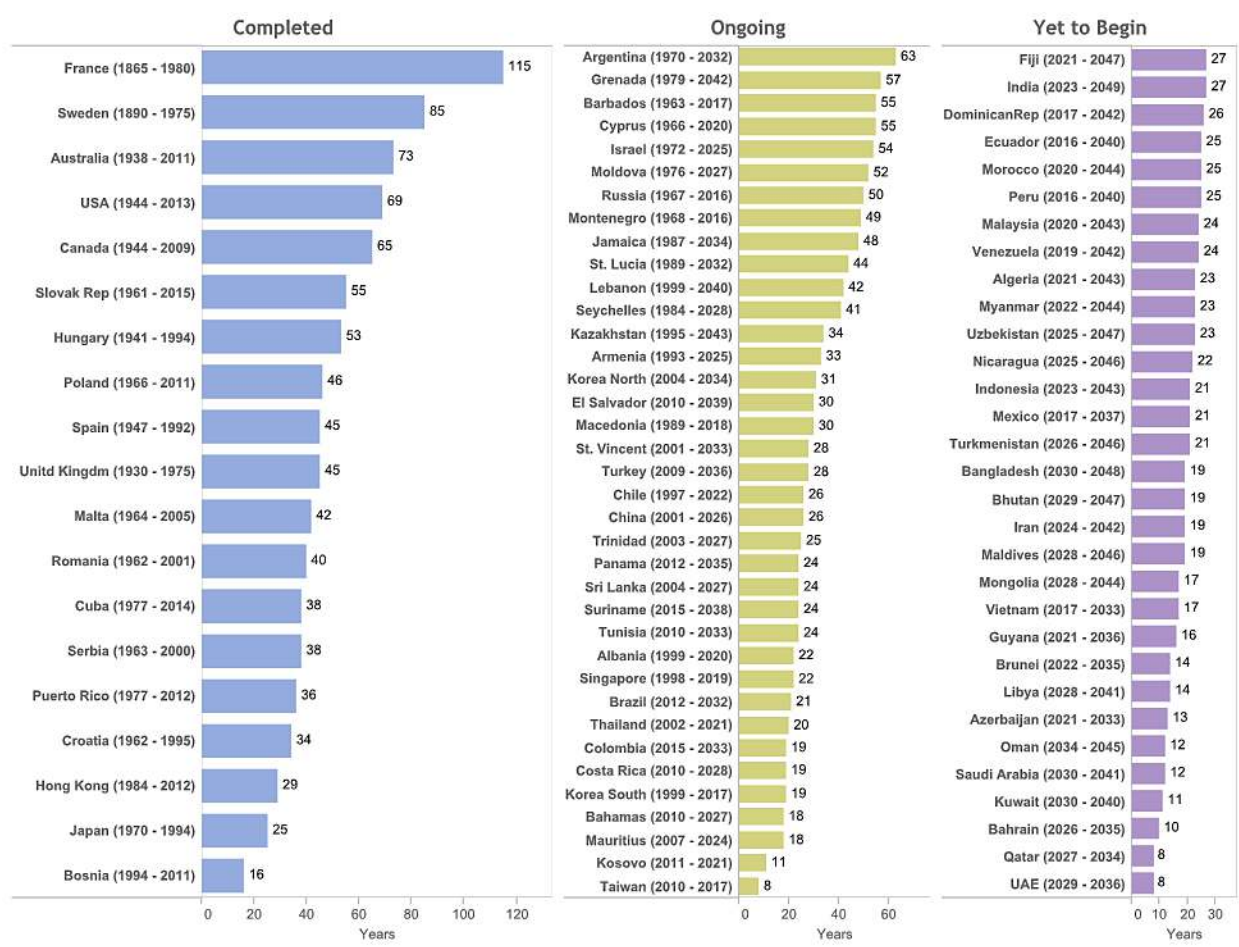
Figure 1.2: Number of years needed for population 65 and older to increase from 7 percent to 14 percent. The numbers to the right of the bars are the number of years it took or is likely (forecast) to take the population 65 and older to double from 7 to 14 percent of the population. The countries in the left column have already completed this transition, while those in the middle column are in the process of this transition and those in the right column have not yet begun. The dates to the left of the bars are the years during which this transition occurred or is forecast to occur.
Source: IFs 7.17 and Kinsella and Gist (1995:5). Graphic produced in Tableau.

In 2015 only 7 countries had populations with more than 20 percent of the population aged 65 or older, whereas 73 countries still had youthful populations in which those under 15 accounted for more than 30 percent of the population. By 2050, however, we forecast that the number of countries with youthful populations above 30 percent will drop to 33 and the number of countries with older populations above 20 percent will rise to 75 (Figure 1.3).
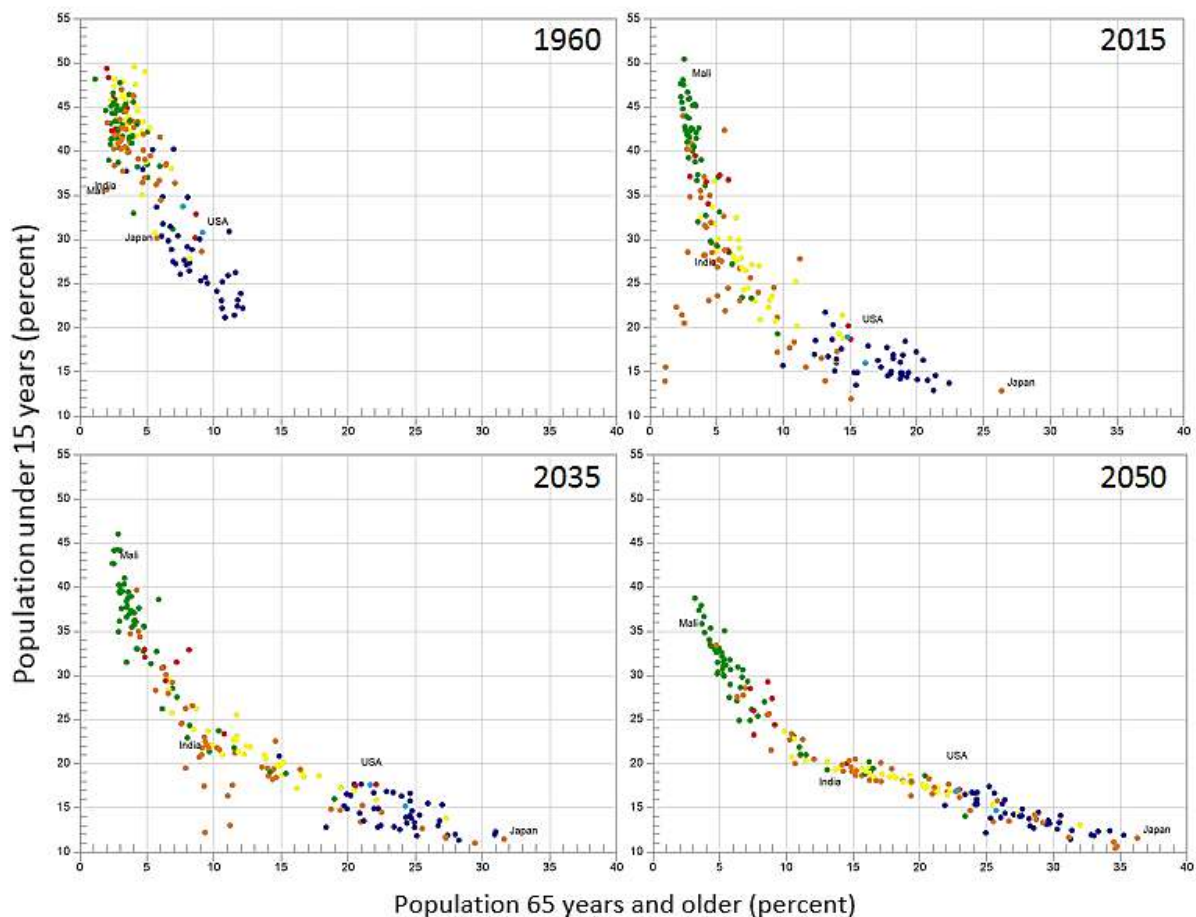
Figure 1.3: Age structure distribution in 1960, 2015, 2035, and 2050. Colors represent UN Regions.
Source: IFs 7.19

The maps in Figure 1.4 further demonstrate the progression of aging throughout the world, using median age as a macro indicator of the overall age structure. Youthful populations (median age range of 15-25 years) account for a large proportion of the world's countries now but by 2035, there will already be a noticable decease in their share of countries. The number of intermediate countries (median age range of 25-35 years) is also forecast to decline. Mature countries (median age range of 35-45 years) and post-mature countries (median age range of 45-55 years), on the other hand, are expected to increase in number.[2]

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[2] Age group categorizations taken from Cincotta. 2013. "The Future out to 2030: According to Demography."
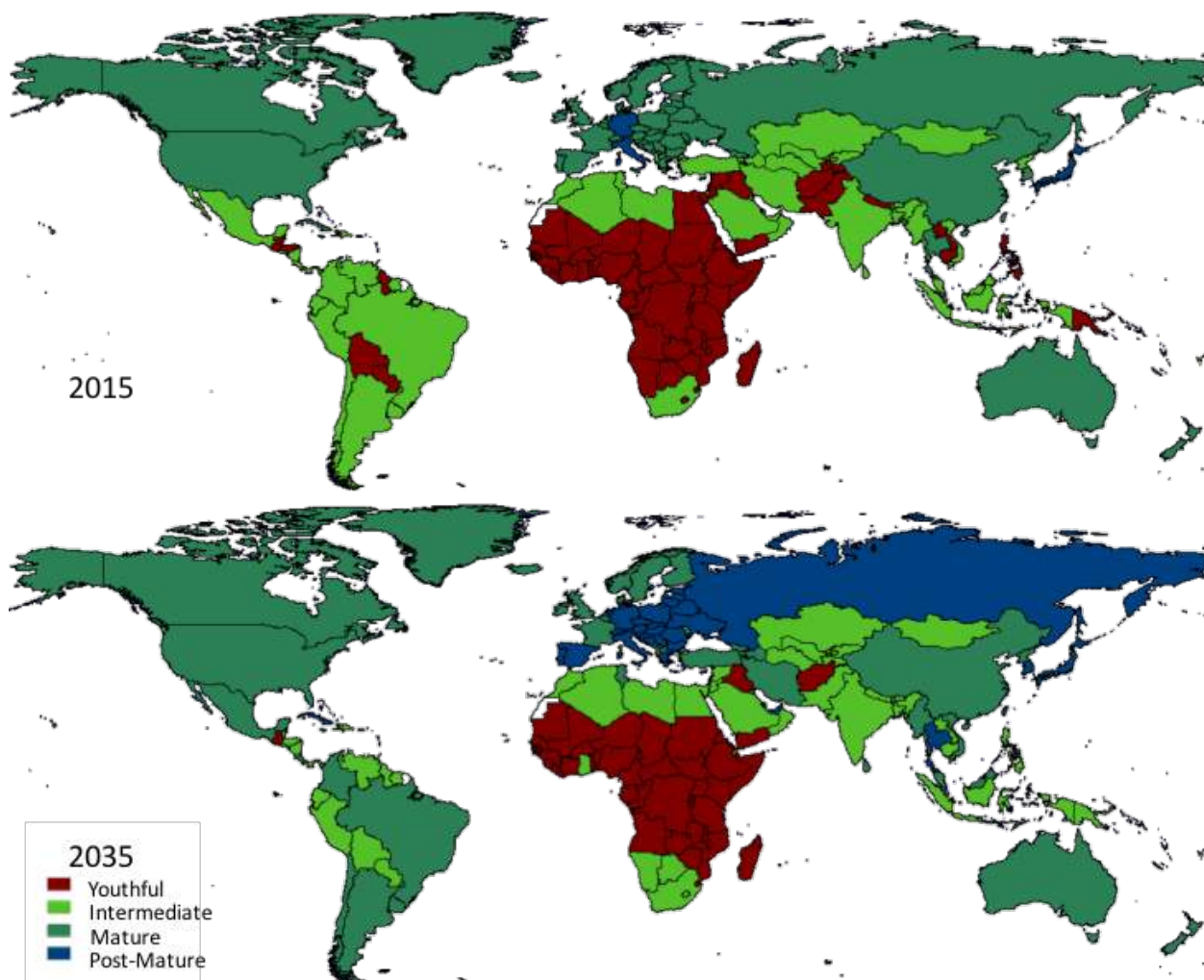
Figure 1.4: Median age of population using Cincotta (2013) groupings in 2010 and 2050.
Source: IFs 7.19

Today's demographic landscape therefore consists of a wide range of age structures, aging rates, and contexts, each of which carries implications for future prospects. The goal of this project is to understand how demographic change will shape challenges and opportunities—risks and benefits—that countries will encounter over the next 20 years. The following section provides the conceptual foundation and framework we will use to forecast and assess global demographic impacts through the year 2035.

2. The Sweep of Demographic Change and its Broad Impacts

Three components determine the changing patterns of age structures: fertility, mortality, and migration. Historically, declining fertility rates and reductions in mortality rates are responsible for most of the demographic change seen throughout the world. The demographic transition is a useful tool for explaining and exploring this "natural" evolution of age structures within and across countries. In other countries like the United Arab Emirates, Qatar, and Bahrain, which import a significant portion of their labor force, the foreign-born population heavily influences the age-sex profile of the country (as it did earlier in the colonial eras). Even in European countries like Germany, an influx of younger migrants has begun to noticeably change the structure of the population.

2.1 Fertility, Mortality, and the Demographic Transition

Figure 2.1 shows in stylized form the demographic transition and the associated age-sex structures of populations as they transition. Again, while the timing, speed, and context of this transition varies across countries, sometimes widely, the phenomenon itself appears universal (Dyson 2010).
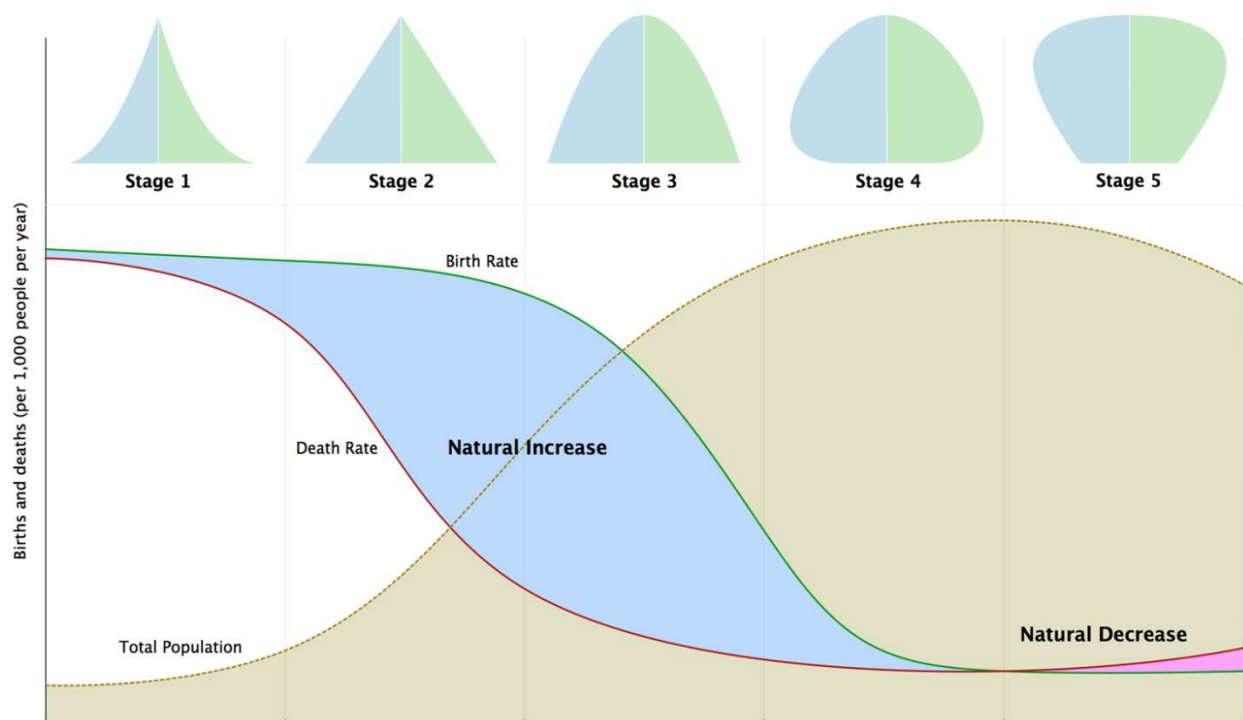

Figure 2.1: The demographic transition with stylized age-sex distributions. The age-sex distributions in the top row of the image correlate with the stage of demographic transition represented in the column below it. For example, the distribution for Stage 1 represents high birth and death rates and relatively small population size. The bottom of the distribution represents young cohorts, while the middle represents middle-age cohorts and the top represents elderly cohorts. In example, the distribution for Stage 1 has large shares of young populations and comparatively small shares of middle-age and older populations while the distribution for Stage 5 has a relatively small share of young cohorts and a larger share of older cohorts.
Source: Authors

Once mortality begins to drop in a country for the first time, its path along the demographic transition is set in motion. Throughout the demographic transition, countries will pass through five stages, beginning and ending with a high degree of equilibrium between birth rates and death rates. Humanity has existed in stage one—with high fertility and mortality rates—for most of its history. Though today all countries have statistically left the first stage, a few disparate rural communities still have both very high levels of mortality and fertility. The risks facing these communities are: a large burden of communicable disease, high infant mortality, and a short life expectancy.

Passage from stage one to stage two is marked by a sustained decline in mortality rates, most notably of infants and children. In stage-two countries like Afghanistan, Mali, and Yemen, a continuation of this declining mortality trend paired with persistently high birth rates creates a state of demographic disequilibrium that drives natural population growth to unprecedented rates (note the rapid increase of total population in Figure 2.1). While the decline (now often rapid decline) in mortality (generally from improvements in water and sanitation access and health care) marks an important, large stride in human development, countries in this second stage of demographic transition face a number of new financial and social challenges linked to youth dependency and rapid advancement through education systems and into the labor force. These are the societies often unable to educate widely and well, or to provide enough jobs (Cincotta 2013:31-32).[3]

These challenges tend to subside as the share of youth within a population declines and the country begins to age. This third phase of the transition is signaled by a decline in fertility rates, reducing the youth dependency as the working-age population grows relative to the younger, economically dependent population. Beginning in this phase, countries—which incidentally also have relatively low elderly populations—enter into a "sweet-spot" of the demographic transition, or are said to have a demographic dividend, during which the fiscal burden on governments of providing health care and education to children is lessened, freeing up resources for reinvestment in human capital, social goods, or other productive pursuits (Lee and Mason 2011).

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[3] In this report, youth dependency is calculated as the ratio of a country's population under the age of 15 to the population aged 15 to 65.
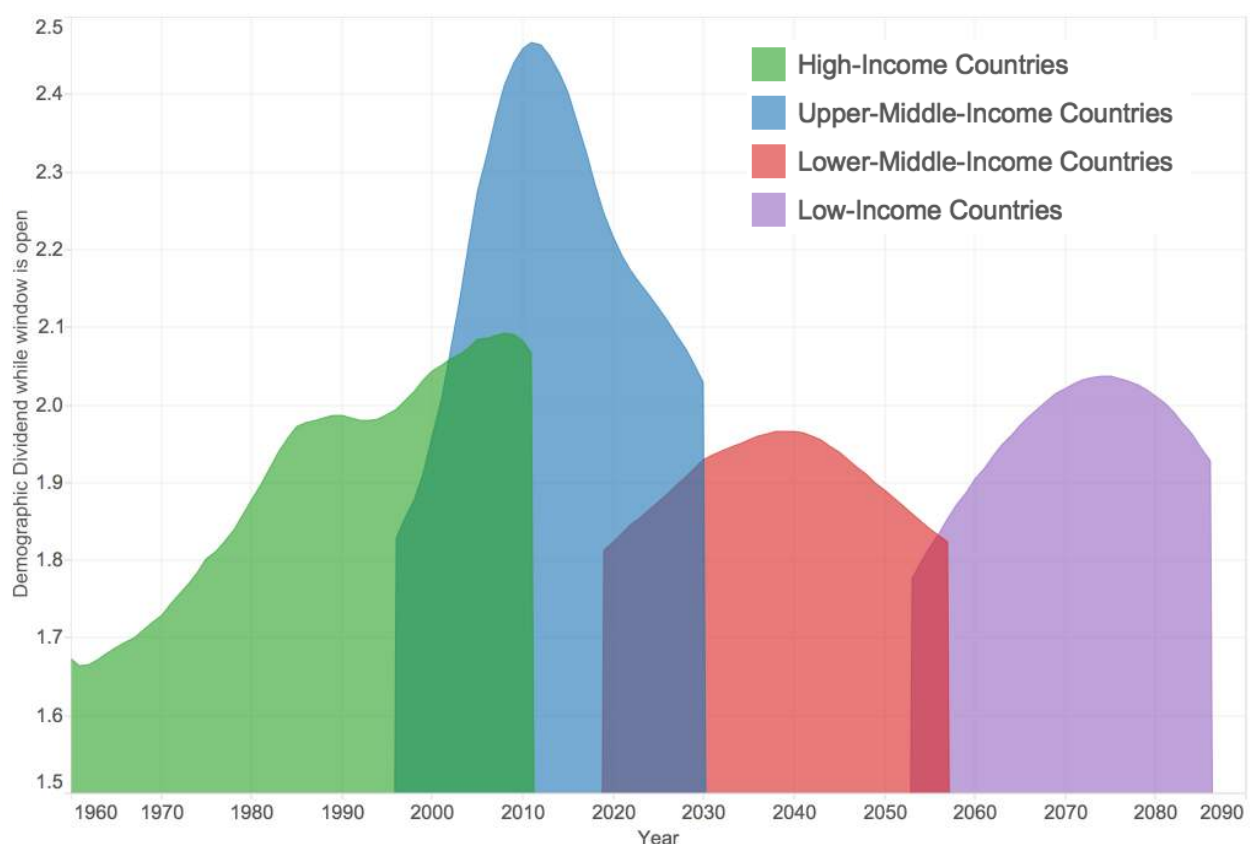
Box 1: The Demographic Window

The demographic window occurs when a country has a large working-age population and relatively small youth and elderly populations. The United Nations (2004:2) defines this as any time in which the share of a country's population under 15 is less than 30 percent while the share of those 65 and over is below 15 percent. Economic gains could be significant for countries that appropriately utilize their demographic window. South Korea, for example, paired declines in fertility rates with industry and job creation and infusions of capital (Gribble 2012) and, as a result, climbed from having the 106th highest GDP per capita in the world in 1960 to having the 29th highest in 2015.

However, South Korea will likely pass through this demographic window within the next few years to join many countries in which the window has already shut (advanced countries shown in grey in the figure below). For those countries within the demographic window in 2016, the time left varies based on when they entered the window and how quickly they are aging. For example, Singapore and Bosnia entered this window around the same time but in Bosnia the window has already closed, while Singapore is forecast to have several years left. The figure below demonstrates this variation. Countries that have passed or have yet to enter the demographic window are shown in grey, while countries in red are nearing the end of their time in this window and countries in blue still have around 40 years to utilize the potential benefit.
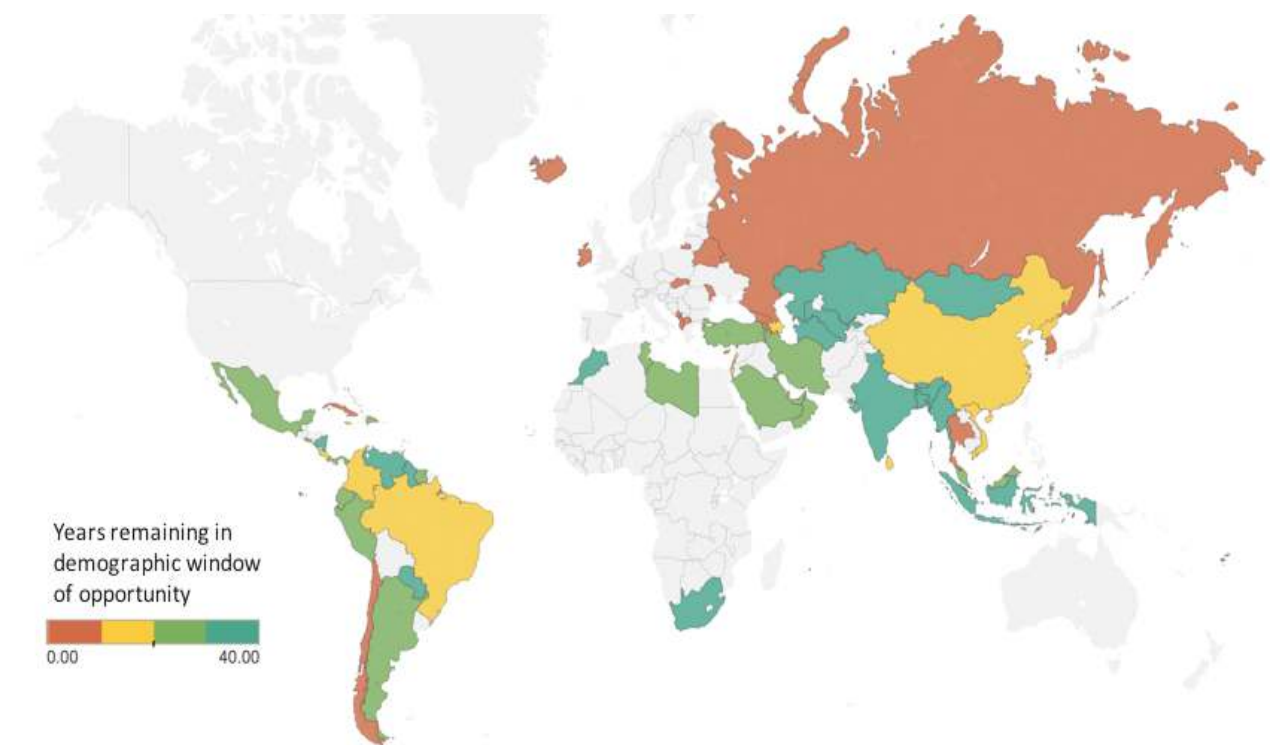
Years remaining in the demographic window of opportunity
Source: IFs 7.19

Countries that have not yet entered the demographic window will probably pass through it more quickly than those which have already passed through. High-income countries enjoyed more than 50 years within the window, while the other income groups will have fewer than 40 years. Upper-middle-income countries on the whole have entered the window and while they have less time than high-income countries, they have a much more significant demographic dividend (population between the ages of 15 and 64 as a percent of the total population) within the window (driven largely by China). Lower-middle-income countries are forecast to move into the window within the next several years and will stay for longer than upper-middle- and low-income countries but will have the smallest peak of demographic dividend. Low-income countries will not likely move into the demographic window until the second half of this century and will spend a relatively short period of time within the window. However, their now-large youth populations will translate into comparatively large demographic dividends.

Forecast of demographic opportunity for World Bank income groups: X-axis shows the time period during which the demographic window is open and Y-axis shows the size of the demographic dividend while the demographic window is open
Source: IFs 7.19

Some countries, however, remain precariously perched between the second and third stages, trapped in a state of high fertility rates which can both prolong the vulnerability of internal conflict associated with young populations and delay the benefits associated with more intermediate age structures. Figure 2.2 indicates that today women in many countries across Equatorial Africa have on average 5 or more births throughout their lifetimes.
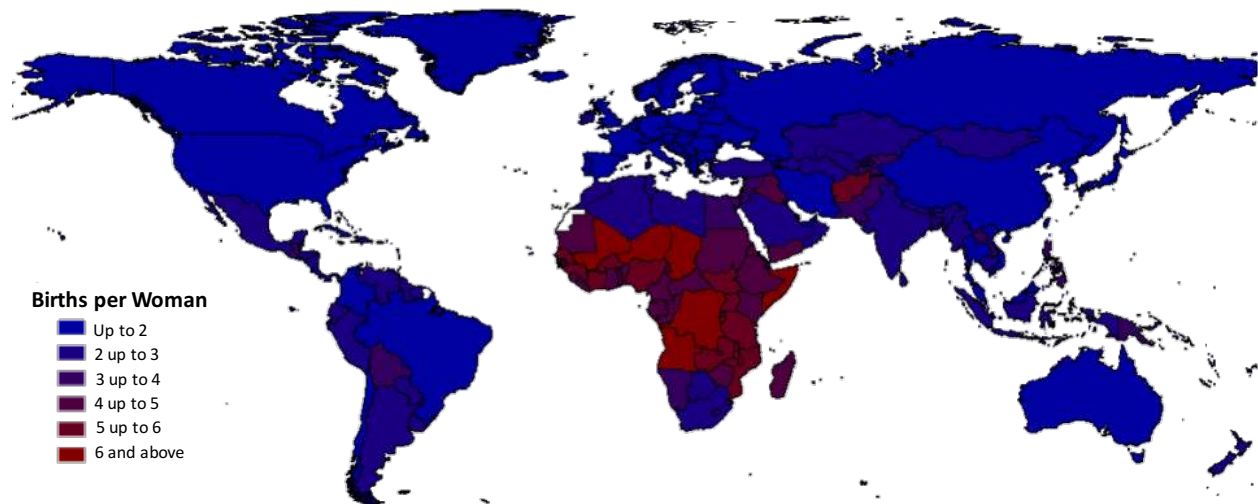
Figure 2.2: Total fertility rate by country in 2015.
Source: IFs 7.19

Ultimately, however, fertility rates are forecast to decline and these countries will move into a period where the burdens of large, young populations translate into the potential demographic dividend of that third stage. This shift will almost certainly happen in Equatorial Africa also.

Those fertility declines continue in the third stage until they approach replacement levels of about 2 children per woman (the fourth stage). The labor-force bubble of the demographic dividend period passes from young adults to aging ones. The demographic social resources once freed-up by the declining share of children begin to be put toward the increasing demands for pensions and then elderly health care. Most high-income countries have reached this stage.

The fifth stage of the demographic transition (Figure 2.1) is characterized by a declining population. This post-mature unknown land of age structures is only beginning to be explored by countries like Japan, Germany, and Russia where crude death rates have overtaken crude birth rates and natural population decline is underway. Since the history of countries in this stage is still unwritten, there exists a greater degree of uncertainty, particularly around questions of the longevity and health of elderly populations and the degree to which technology and migrant flows can offset the decline.

2.2 Migration

Migration is the third driver of population change. Immigration can potentially slow the aging of populations and extend the demographic dividend (or offset the demographic deficit) in recipient countries. Emigration can deplete the native labor force and leave larger proportions of dependent populations. Yet unlike fertility and mortality, migration has in recent decades played a much smaller role in changing the age-sex profile of countries. Exceptions are a few

cases such as the countries of the Gulf Cooperation Council and, increasingly, countries with little or no natural population growth.

There has, however, been a consistent upward trend of international migration since the 1960s. For the most part, historical migrant flows have been from developing to developed countries and have been primarily motivated by economic and security considerations. As Figure 2.3 shows, since the 1960s, high-income countries have experienced a net influx of migrants, while middle- and low-income countries have experienced a net loss, a trend that intensified during recent decades.[4]
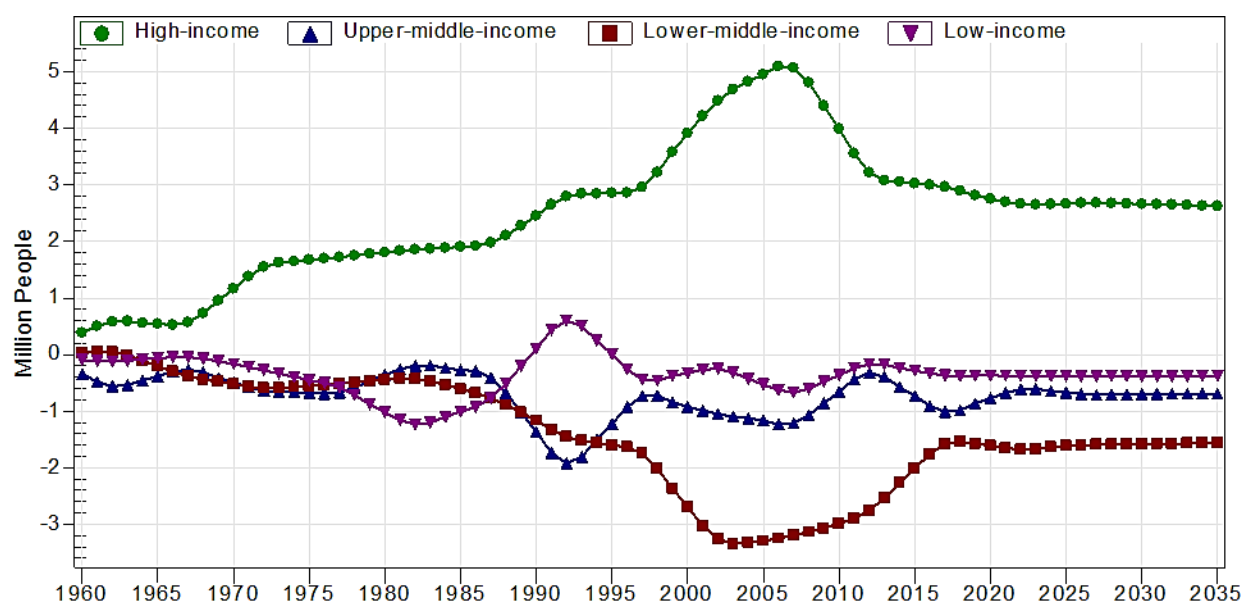

Figure 2.3: Net migration into the countries of the World Bank income categories.
Source: IFs 7.19

This increasing migration coupled with slowing population growth indicates that migration may influence demographic change to a greater extent in coming decades. In Germany, for example, the dominant driver of population change has transitioned from in-country fertility and mortality rates to net migration rates (Figure 2.4). Between 1980 and 2015 net migration kept the absolute population change above the natural population change, ensuring some population growth and likely keeping the population at lower median age than it would otherwise be. If fertility rates persist at below-replacement levels, for many countries, immigration may become an increasingly large determinant of the size and median age of a population.

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[4] Internal migration (rural to urban) has also been very large during the last several decades, and can offer similar economic benefits as China illustrates. Internal migration is, however, outside the scope of this report.
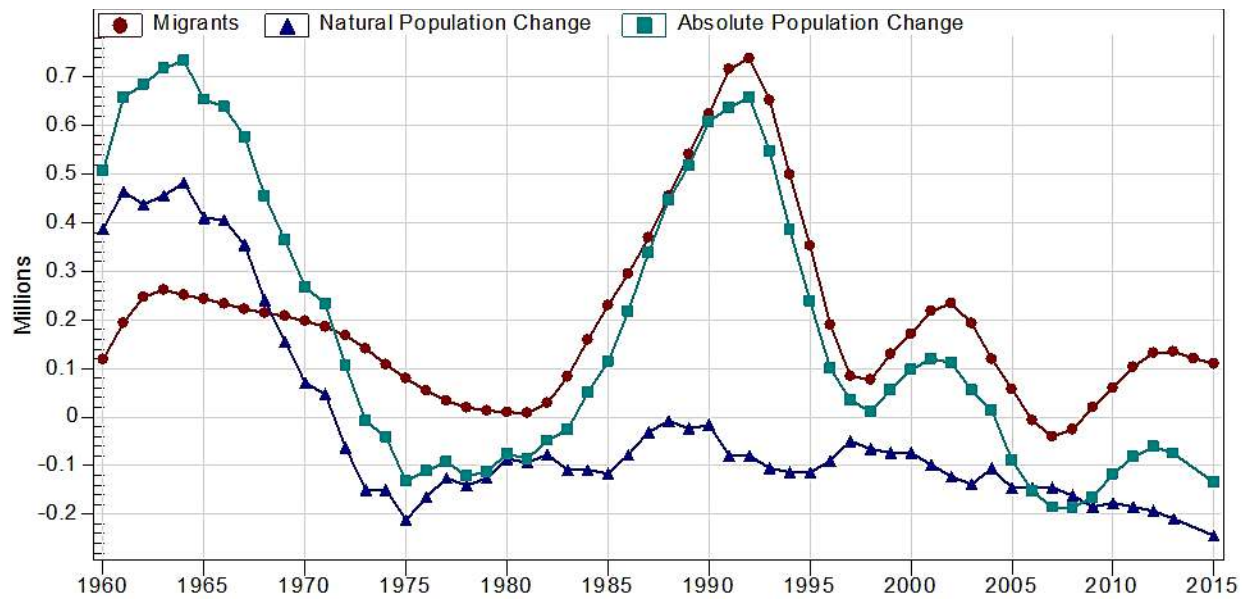
Figure 2.4: Natural and absolute population change compared with net migration rates for Germany, history
Source: IFs 7.18

Figure 2.5 shows that in high-income countries the average distribution of age cohorts is fairly balanced, with larger cohorts tending to be middle-age or older. The migrant stock entering these countries, on the other hand, is strongly skewed toward working-age cohorts.
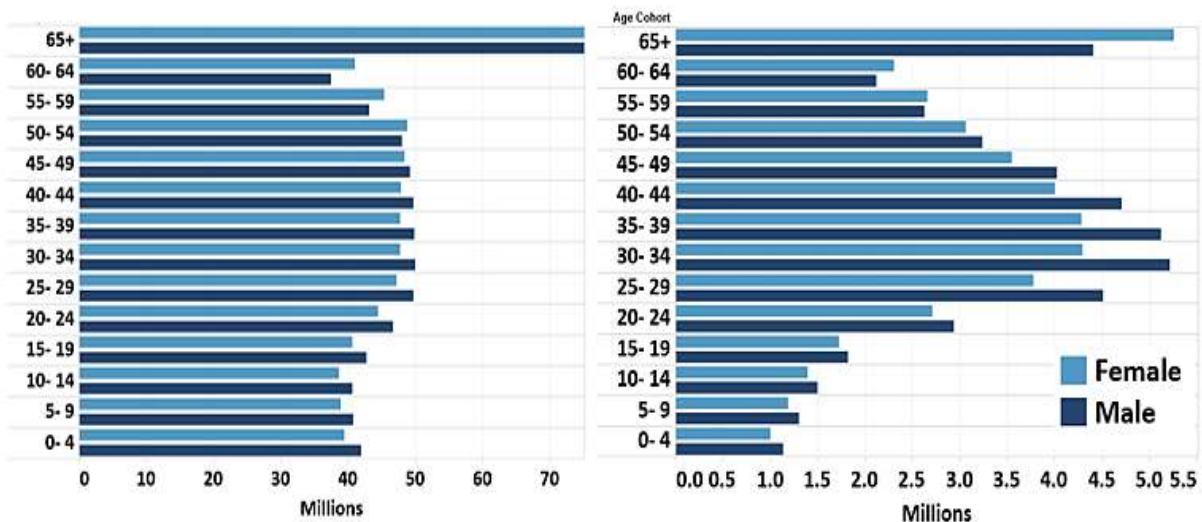

Figure 2.5: Age-sex distribution of high-income countries (left) compared with the age-sex distribution of the migrant stock in high-income countries in 2013
Source: IFs 7.18 & IFs 7.19

This difference in age-structure distribution between migrant and local populations is even more pronounced in recent years (Figure 2.6). Though the economic benefits to be gained from increases in the working-age population from high immigration rates seem desirable, some countries (such as Japan) are resistant to increasing their migrant stock due to the perceived

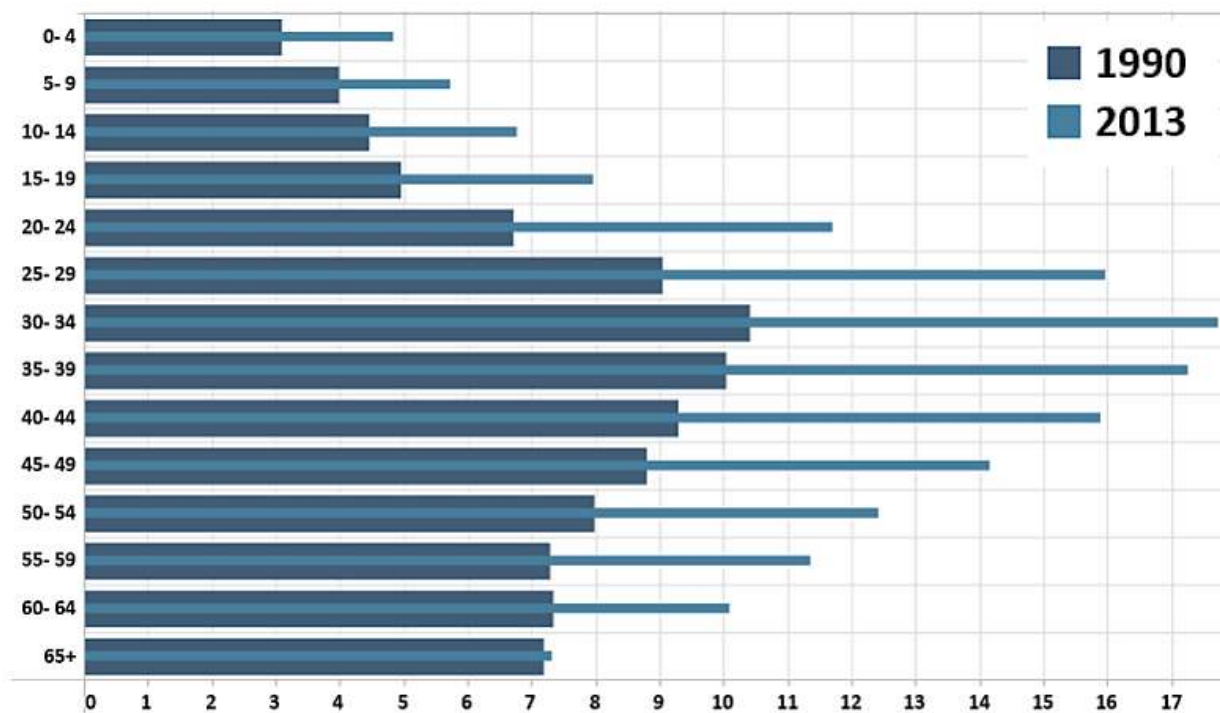social risks (the social risks of migration are discussed in more detail later), or resistances to racial heterogeneity.[5]

Figure 2.6: Migrant stock as a percentage of each age cohort of the total population for high-income countries, 1990 and 2013
Source: IFs 7.19

2.3 The Historical Pattern

Country specific variations in the timing and speed of changes in fertility and mortality (and to a lesser extent migration) translate to a world today with a wide diversity of demographic portraits (see Table 2.1). In some low-income countries, such as Niger or Uganda, nearly half of the population is under the age of 15, with less than 3 percent of the population 65 or older. The population of these countries is still growing rapidly, meaning extending basic services like water, sanitation, and education can be an uphill battle. At the same time, the high volume of young people moving into the job market leads to a large stock of labor which, like the stretching of a rubber band, has the potential to do great work if properly harnessed—or snap if pulled too far.

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[5] Gorodzeisky and Semyonov find that "negative attitudes [towards immigrants] tend to increase with the relative size of the non-European immigrant population."
Gorodzeisky and Semyonov. (2015). "Not Only Competitive Threat But Also Racial Prejudice: Sources of Anti-Immigrant Attitudes in European Societies."

		Avg. Population (billions)	Avg. Total Fertility Rate	Avg. Life Expectancy	Avg. Median Age	Avg. Infant Mortality
1951 - 1965	High-Income	0.9	3.0	66.8	29.0	40.4
	Upper-Middle Income	1.1	5.9	47.1	20.9	112.7
	Lower-Middle Income	1.0	5.9	44.0	20.5	142.0
	Low-Income	0.2	6.5	38.0	18.6	168.7
2001 - 2015	High-Income	1.3	1.7	77.7	38.1	6.0
	Upper-Middle Income	2.3	1.9	73.1	31.3	18.4
	Lower-Middle Income	2.6	3.2	65.1	23.9	45.7
	Low-Income	0.5	5.4	57.1	18.1	68.0
2016 - 2030	High-Income	1.4	1.7	80.0	41.6	4.6
	Upper-Middle Income	2.5	1.8	75.6	36.5	12.7
	Lower-Middle Income	3.3	2.7	69.3	27.2	29.9
	Low-Income	0.8	4.6	63.7	19.5	46.1
2031 - 2050	High-Income	1.5	1.8	82.1	44.7	3.2
	Upper-Middle Income	2.6	1.8	78.5	42.3	8.4
	Lower-Middle Income	3.9	2.3	73.7	31.6	15.8
	Low-Income	1.2	3.4	69.4	22.4	25.5

Table 2.1: 5-year averages of various demographic statistics by World Bank income groups, history and forecast.
Source: IFs 7.19

At the other end of the transition, in high-income countries such as Japan, Germany, or Italy, youths make up less than 15 percent of the population while populations 65 and over make up nearly a quarter or more of their overall population. In some of these countries, birth rates have already dropped below death rates and their populations have started to contract, indicating that the boost to economic growth from labor they once enjoyed is behind them, likely never to return.

The patterns and rapidity of demographic transition and of migration clearly have many economic, financial, and social impacts. We now turn to a more extended conceptual mapping of those.

3. Conceptualizing and Forecasting Demographic Challenges and Opportunities

Demographic studies indicate that the age structure of a country plays a (sometimes significant) role in influencing economic, social, and political issues (see Cincotta 2013). The demographic transition is a useful tool for outlining these impacts because it explains age structure within a common, generalizable, and relatively predictable dynamic framework. We need, however, to go further and to do so more systematically.

Macro-economic
- Savings and Investment
- Labor Force Change
- Productivity

Financial
- Education Needs and Spending
- Health Needs and Spending
- Pension Needs and Spending

Social
- Instability and Internal Conflict
- Intergenerational Polarization
- Intercultural Tension

Figure 3.1: A taxonomy of impacts of demographic change.
Source: Authors

This section offers a conceptual discussion of the historical and future risks and benefits countries face as a result of demographic change. They are categorized into three broad groups: macro-economic, financial, and social, each containing specific risks and benefits (see Figure 3.1).

While this is a useful taxonomy for thinking about the types of risk, the demographic profile and trajectory of a country will largely determine the particular way in which the risks and benefits are manifested and the policy measures that are available to overcome or take advantage of them.

In earlier discussions, we introduced a number of ways to think about age structure and its progression, such as dependency ratios, median age, and the demographic dividend, but below these aggregates of the demographic transition are households and individuals proceeding through their life cycles. It is therefore important to step back briefly and consider how a more micro-level perspective can supplement and elaborate that of the macro-level.

3.1 Sketching the Life-Cycle's Influence on Risks and Benefits

At a very young age, we tend to be entirely dependent on others. With respect to the economy, we make no productive contribution. We have no income with which to pay taxes, but we place demand on the household's and broader society's financial support of our health and education. We have minimal other impact on the broader society.

As we become older children (particularly in developing countries) or young adults, we may move into the work force and begin to pay for our own basic consumption needs. We are unlikely to earn much, to save anything of significance, or to pay taxes. We may need less health care and more support of our education (tertiary education, for example, tends to be much more expensive than primary or even secondary). We will have become aware of the

broader society and have beliefs about how it should be organized and how it should treat us. If we are young males entering the work force and are unable to secure employment and income, we may become unruly or even violent.

Moving into older phases of our still young life, we are likely to find employment (perhaps in the informal sector or perhaps in the formal one), to find spouses or life partners, and often to have children (with the number of those influenced by our culture, our educational level, and our income). As we continue to age as active adults, we will move into our most productive years of employment, pay taxes, and begin to save for old age (see Figure 3.2 on income and consumption; savings as residual).

In our later active adult years, we may come to be active in politics and will probably resent any suggestion that we should postpone retirement or contemplate a reduction in the benefits for which we have been paying into public and private schemes. Should we retire, we may draw heavily on private and public funds although, especially in higher-income countries, we may also continue to work at least part time and to husband assets for both contingencies and our descendants. Unfortunately, most of us will suffer various health deteriorations and increasingly demand attention and help with them (and not reject heroic efforts to extend our lives in the last weeks or days of them).

Analysis of economics and finance gives much attention to the life cycle, especially differing propensities to earn, consume, and save (Figure 3.2). So, too, does thinking about social stability.
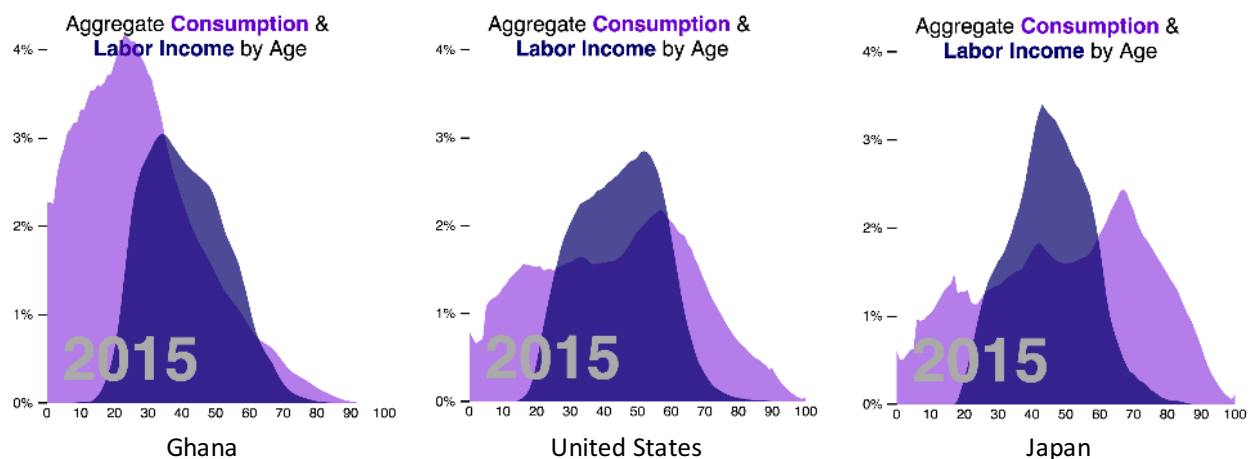

Figure 3.2: Aggregate consumption and labor income by age, as a percent of all age groups combined. The darker purple area graphs indicate the aggregate labor income as a percent of total (y-axis) of each country by age-cohort (x-axis). The general trend is similar for all countries, with little to no income until around the age of 15, a peak in income between 40 and 50 years of age, and a decline again to little or no income around the 80-year-old cohort. Consumption patterns have more cross-country variation, and tend to correlate with the age distribution, with older countries like Japan experience higher levels of consumption later in life, and younger countries like Ghana seeing a peak in earlier cohorts.
Source: National Transfers Account Project (http://www.ntaccounts.org/)

By applying insights of the life-cycle to the particular demographic context of a country, we can begin to infer and analyze many of challenges that countries may face at different stages of the

transition

3.2 Working Across Analytical Levels

The study of demographic impacts in the larger economy draws heavily on macro-level measures such as the median age of the population. Yet it is important to consider how other, more micro, understandings of the age structure and life cycle can inform and enhance macro analysis of demographic opportunities and risks. For example, the median ages of the six populations in Figure 3.3 in 2015 were China (37), Italy (46), United States (38), Japan (46), Mali (16), and India (27). The issues for Mali are clearly ones of a youthful society, struggling to educate children, faced with a relatively low labor-force participation rate, and quite possibly struggling with the socio-political instability of its youth bulge (50 percent of its adult population in 2015 was between 15 and 29 years of age compared to 38 percent in India, 25 percent in the U.S., and 17 percent in Japan). At the other end of the transition, Japan's top-heavy age structure has contributed to decline in national savings from over 33 percent of GDP in 1990 to less than 22 percent in 2011.
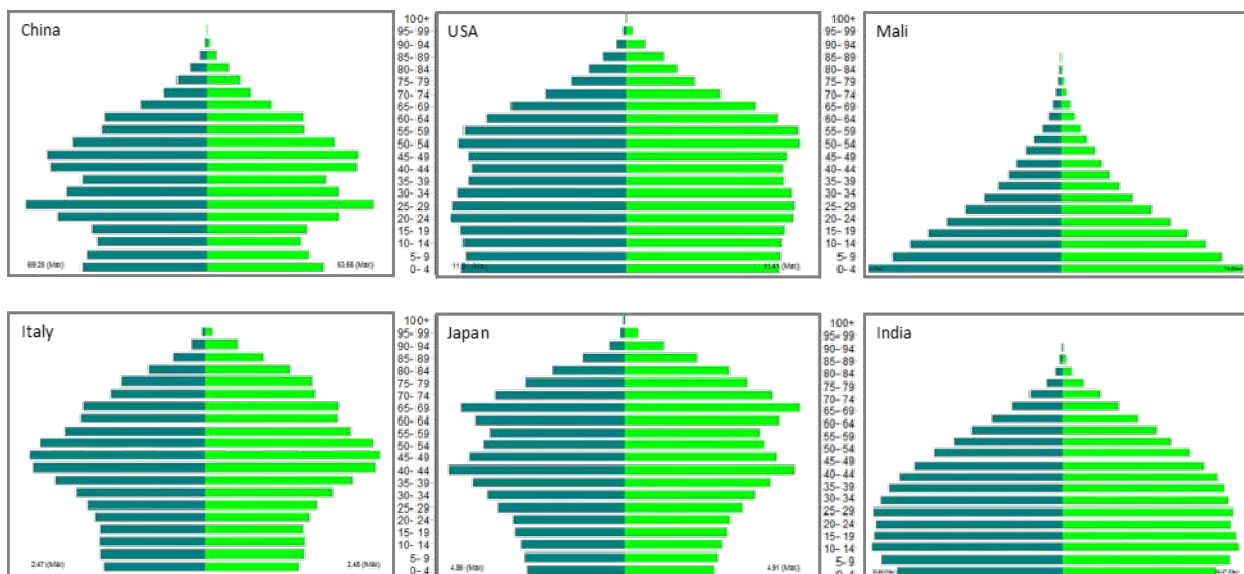

Figure 3.3: Population pyramids for select countries in 2015.
Source: IFs 7.17

Analyses of social stability and democratization have quite heavily relied on such macro-level demographic analysis (Cincotta 2013). Yet we must be very careful to recognize the limitations of means and medians. China and the United States both have very similar median ages and, likewise, Italy and Japan have very similar ones (45.9 and 46.4). But in the United States 14.7 percent of the population is 65 years of age or older, compared to 9.3 in China; that is, the pensioner segment is about 50 percent larger in the United States. It is similarly obvious from the graphic that Japan is facing two waves of retirement, one that is peaking now and another that will peak in about 20 years, compared to the single wave in Italy that will grow until its peak in 10 to 15 years. Using a broad range of analytical tools illuminates these differences and allows us to better understand country-level dynamics.

3.3 Analytical Tools: The International Futures (IFs) Forecasting System

International Futures (IFs) is a large-scale, long-term, integrated global modeling system for analysis of demographic risks and opportunities. It is informed by attention to the life cycle and the relationships of that, not just to age-sex structures of demography (and macro measures such as the median age), but to education, health, economics, government finance, social stability, and other systems (Figure 3.4).[6] IFs represents 186 countries and their interactions as well. It incorporates a database of more than 3,500 series across the issue areas with data from 1960, when available, to most recent values.
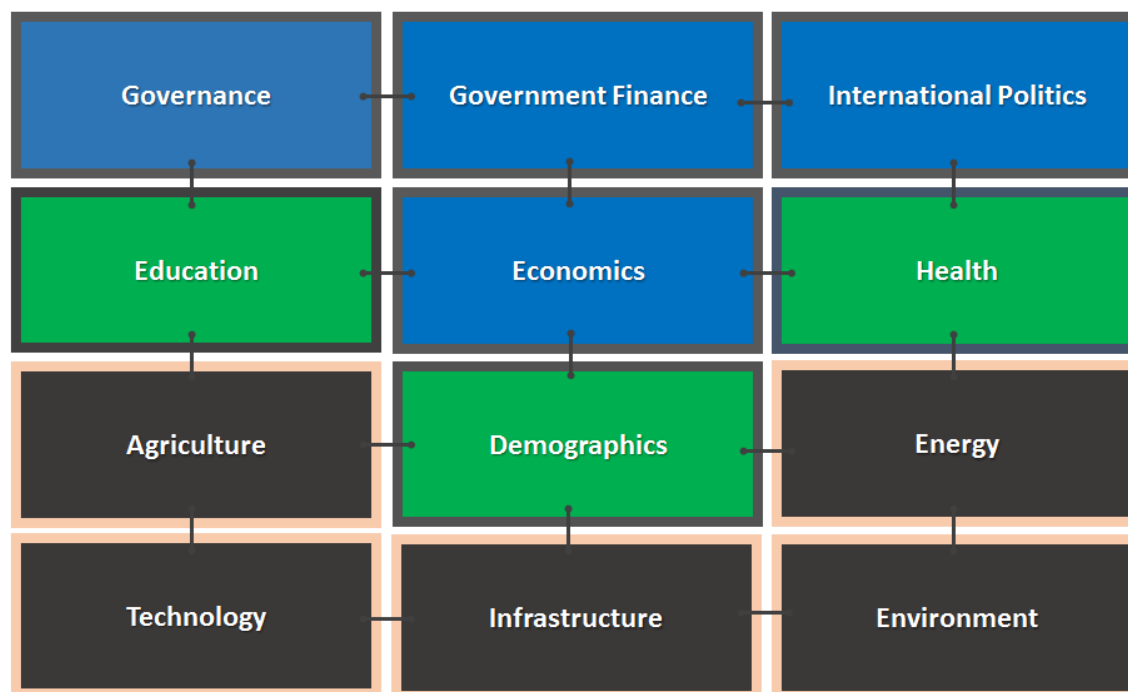

Figure 3.4: The Models of the international Futures (IFs) Forecasting System
Source: The Frederick S. Pardee Center for International Futures

A quick introduction to each model may help readers as a reference in subsequent discussion:

> The demographic model uses a standard cohort-component representation, portraying demographics in 5-year categories (adequate for most users), but building on underlying 1-year categories. Both fertility and mortality are computed endogenously (migration is specified exogenously, currently using forecasts from IIASA[7]).

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[6] Technical documentation on each model is available in the working papers on the Pardee Center web site (http://pardee.du.edu/working-papers).

[7] As a result of project work connected to the Shared Socio-economic Pathways initiative discussed later the IFs system includes in its database IIASA forecasts on migration and education, Organization for Cooperation and Development and Potsdam Institute for Climate Impact Research forecasts of GDP, and National Center for Atmospheric Research forecasts of urbanization. The system also includes forecasts on its key variables from many other sources, allowing systematic comparison of those with each other and with the forecasts of IFs.

The economic model structure represents the contributions to production from labor, capital, and multifactor productivity (which is substantially an endogenous function of human capital, social capital/governance, physical capital–infrastructure and energy– and knowledge capital). A social accounting matrix structure flows across sectors and agent categories assuring full financial flow consistency, including age-influenced savings and consumption patterns and relationships with government via taxes and transfers.

The education model represents the progression of students, year-by-year, through primary, lower secondary, upper secondary, and tertiary education, with some representation also of vocational education and the portion of tertiary students in science and engineering. Government spending on education per student and overall education spending is also important.

The IFs global health model uses drivers at both distal (i.e., income, education, and technology) and proximate (e.g. risk factors such as smoking rates and undernutrition levels) levels to produce outcomes. This approach enables users to explore dynamic age, sex, and country-specific health outcomes related to 15 individual and clustered causes of mortality.

The domestic governance model represents governance in terms of three dimensions: security, capacity, and inclusion, each of which involves two or more elaborating variables. Variables connected to the dimensions include risk of domestic conflict, corruption, government effectiveness, democracy, and gender empowerment. Change in these variables is driven by variables across the other models, especially by income and educational levels but also demographic structure. Change in the three governance dimensions, in turn, drives other aspects of the integrated system, including economic productivity growth.

Revenues and expenditures are another critical element of governance represented in the model. Revenues involve streams from firms, households, and, in the case of foreign aid, from other governments. Expenditures involve streams to transfer payments and to direct expenditure on the military, education, health, infrastructure, R&D, and a residual other category. Government revenues and expenditures are fully integrated within the larger social accounting matrix system.

Energy, agricultural, infrastructure, environmental, and international politics models are significant but less relevant to the demographic analysis of this report.

The strengths of the model include (1) its representation of a wide range of fundamental structures in global issue systems, (2) the extensive data foundations of the system, (3) its integration of important global subsystems, and (4) its usability and transparency. It allows us

to analyze the macro-economic, financial, and social implications of demographic change that we have sketched here and to which we now turn.

4. The Path we are On: Opportunities and Risks

The demographic change discussed in sections 1 and 2 has large-scale economic, financial, and social-political consequences for societies (see Cincotta 2013). Exploring these consequences within the context of the demographic transition, we see a "'bad news, good news, bad news story'" (Cincotta 2013:30) begin to emerge, bookended by the financial challenges that youthful populations face to educate a relatively large cohort of children and elderly populations face in paying for retirement and increasing health costs. For countries in-between, there exists a demographic "window of opportunity" during which the size of the working-age population relative to the economically dependent populations offers a boost to economic growth from higher levels of saving and increased labor force participation. But countries unable to create enough formal sector jobs or adequately invest in human capital can squander this demographic sweet-spot and make adapting to the imminent challenges of growing senescence even more exacting.
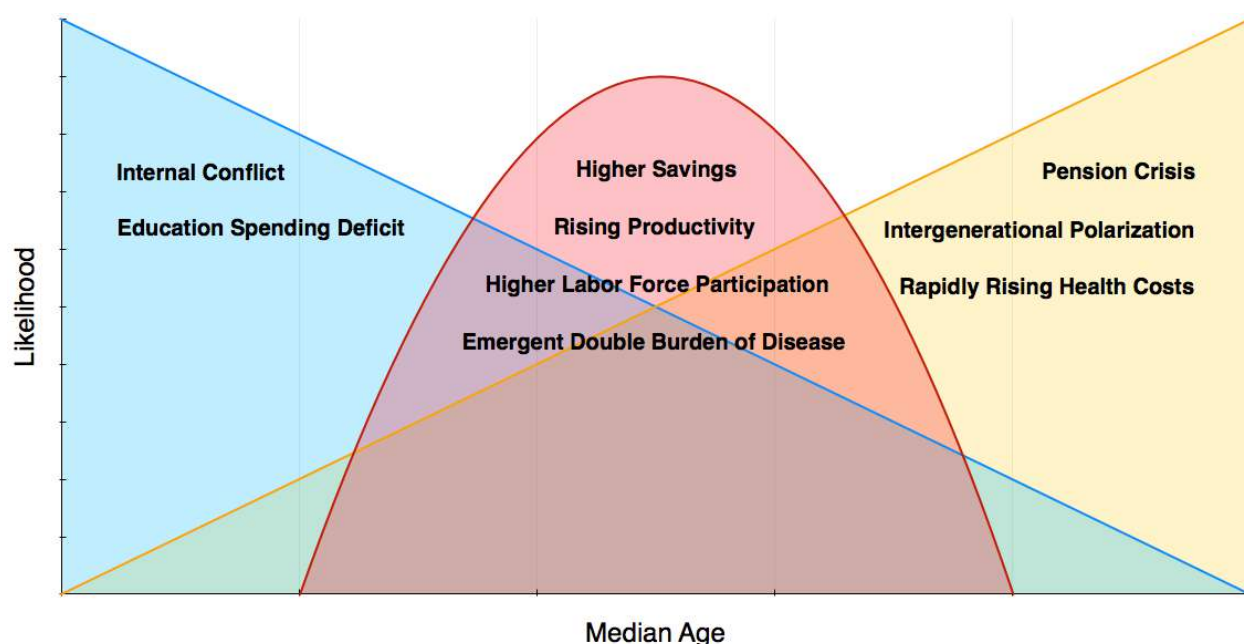

Figure 4.1: Stylized graphic depicting the likelihood of a country to experience various possible demographic-related risks and benefits given its median age. The characteristics identified in this graphic indicate those that have been identified from the literature, but are not necessarily covered in or corroborated by the analysis in this report.
Source: Authors

Migration trends also tend to follow progression through the demographic (net outward migration for younger, lower-income, or conflict-stricken countries, and inward for older, high-income countries), and its direct impact of age-sex structures and the labor-force boost (decrease in sending countries) is fairly well understood. However, the potential social risks associated with assimilation, religious or cultural differences, and perceptions surrounding

employment and social benefits are less understood and more anecdotal. This is, however, outside the scope of this paper.

This section offers a discussion of (1) macro-economic, (2) financial, and (3) social the opportunities and consequences associated with demographic change. We build on the large-scale database of the IFs system and its forecasting capabilities to explore the demographic path that the world (and its regions and countries) appear to be on (what we call the Base Case Scenario). Section 6 explores some of the uncertainties concerning that path.

4.1 Macro-economic

The macro-economic impacts of demographic change could theoretically fall into three categories corresponding to: (1) changes in investment rates and capital formation as a result of savings and consumption patterns that are driven by differential propensities to save and consume across age-categories; (2) labor force dynamics driven by changes in the overall share of the working-age population, (3) productivity changes due to changes in human capital, social capital, physical capital (e.g. infrastructure), and knowledge capital.

4.1.1 Savings and Investment

The micro-level or life-cycle analysis discussed in section 3 would seem to suggest that savings and investment would be greatest in societies where a very large share of the population was in the middle to late stage of their working careers and saving heavily for retirement (or governments were doing it on their behalf in preparation for pension spending). Our own cross-country analysis of household savings does, in fact, suggest a tendency to rise with median age (fairly substantially but with weak statistical significance). But median age and GDP per capita are strongly correlated and controlling for GDP per capita statistically removes the impact of median age. More generally, total national savings (including those of firms and governments as well as households) actually tend to fall with the median age of societies—again weakened by including GDP per capita. In short, we see no tendency for the well-established micro relationship to affect macro patterns in a consistent fashion.

The world now seems to be in an era that many economists, including Ben Bernanke (2005), have argued has a surplus of savings. That could be related to the aging of its population and savings for retirement; but it also could be related to a number of other factors, not least the high savings rates of middle-income countries, notably but not only China, that have generated much economic opportunity. In general, both in our work and the literature, there are not clear-cut implications of demographic change for savings and investment.[8]

4.1.2 Labor Force

McKinsey Global Institute's 2015 report "Can Productivity Save the Day in an Aging World?" finds that half of the global economic growth enjoyed over the past 50 years can be attributed

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[8] For more discussion on this matter see: Bloom, David E., and David Canning. 2004. "Global Demographic Change: Dimensions and Economic Significance." NBER Working Paper No. 10817. National Bureau of Economic Research, Cambridge, MA.

to increases in the labor force (Manyika et al: In Brief). However, very few higher-income countries are expected to ever again experience increasing contribution to growth from labor. Therefore, while the relationship between labor force size and economic growth can be a risk or a benefit depending on the demographic trajectory of a population, in terms of direct economic impact it is primarily viewed as a risk for higher-income countries in most forward-looking analyses. Ironically, in those lower-income countries where the labor force share of the population is still increasing and will for some time, the burden of putting those new workers into jobs can also be viewed as a risk. Figure 4.2 shows that not only has global growth in the ratio of working-age to dependent-age populations begun to decline, but that both high-income and upper-middle-income economies have only recently passed the peak of their dividend. We expect most lower-middle-income countries to experience this same peak within the next 30 years.
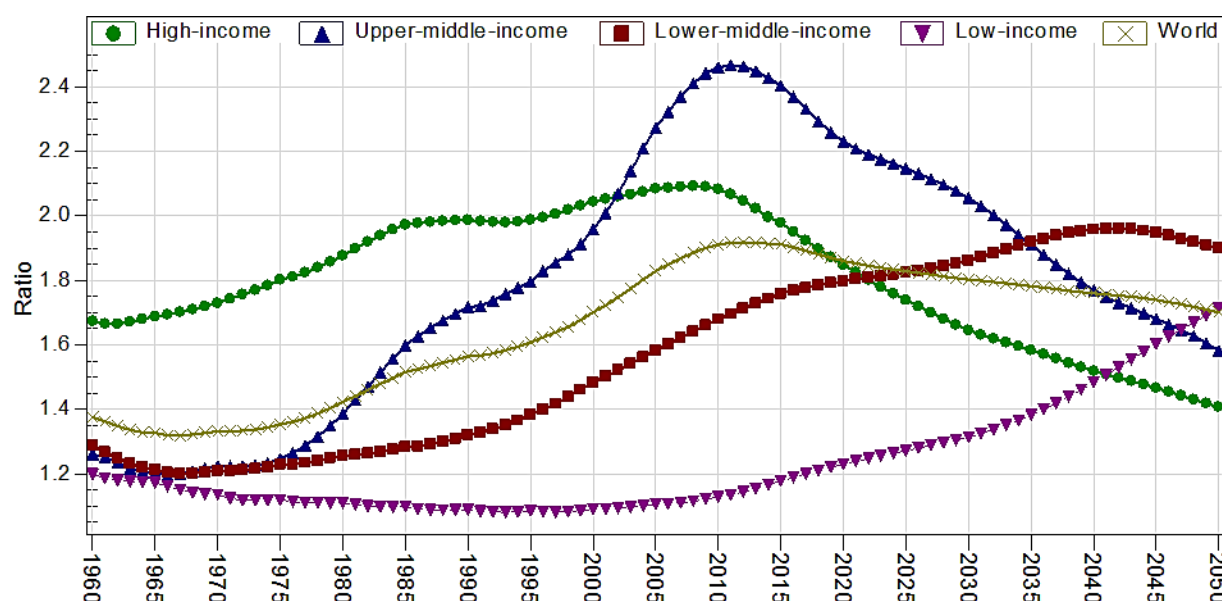

Figure 4.2: Demographic dividend (working-age population ratio to economically dependent population) for World Bank income groups, history and forecast. Since aggregations are popualtion-weighted, the upper-middle-income line (blue) is largely dominated by China's demographic dividend.
Source: IFs 7.19

With labor-driven growth increasingly behind us, at least the high- and upper-middle-income countries must turn to other factors of production to achieve growth rates on par with those of the past 50 years. Manyika et al (2015: In Brief) calculate that:

> *Even if productivity were to grow at the (rapid) 1.8 percent annual rate of the past 50 years, the rate of GDP growth would decline by 40 percent over the next 50—slower than in the past five years of recovery from recession. The global economy expanded sixfold in the 50 years after 1964 but would grow only threefold between 2014 and 2064, making it more difficult to meet social and debt obligations.*

Increasingly, it will be not just the labor share, but the total size of the labor force that will decline. Figure 4.3 illustrates that over the next 50 years, labor's historically high contributions

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to growth will begin to wane for all countries. By 2035, labor is expected to have a net negative contribution in higher-income economies and even greater negative contribution in the decades to follow. To maintain the levels of growth enjoyed by countries over the past half-century, Manyika et al (2015: In Brief) state that productivity growth would need to increase at a rate of 3.3 percent a year (80 percent faster than current levels).
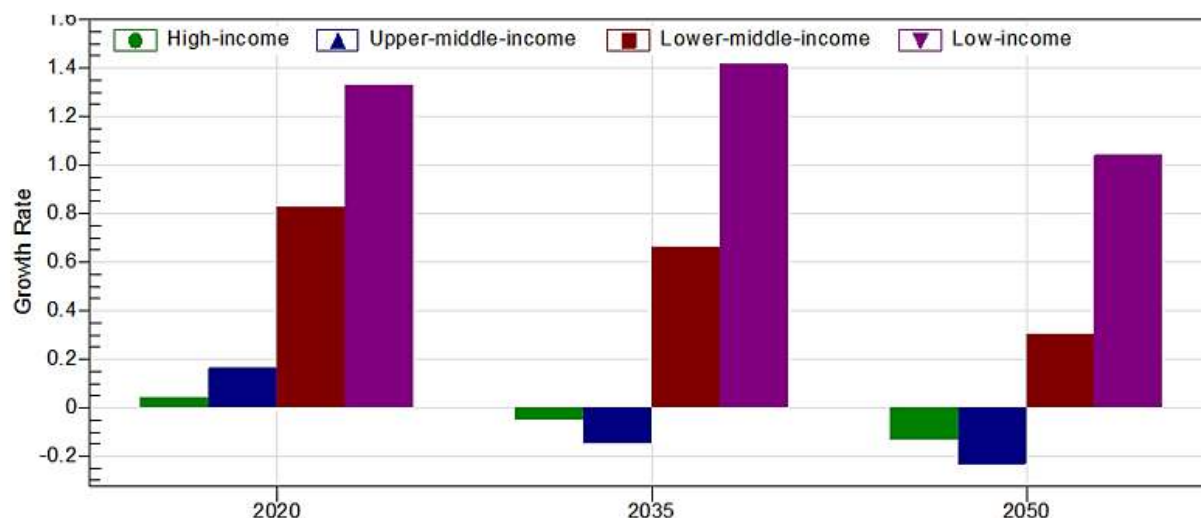

Figure 4.3: Labor's contribution to economic growth (percentage points).
Source: IFs 7.19

4.1.3 Productivity

As the previous section discussed, increasing productivity will be necessary to offset the declining contribution to economic growth from labor. But will such increase actually occur and, if so, will it be linked in any way to demographic changes? Figure 4.4 suggests that this increase is likely and may be especially marked in the coming years for middle-income countries and increasingly for low-income countries. High-income countries on the other hand, where productivity is already relatively high but the labor force is soon to be in decline, are forecast to less productivity gains.
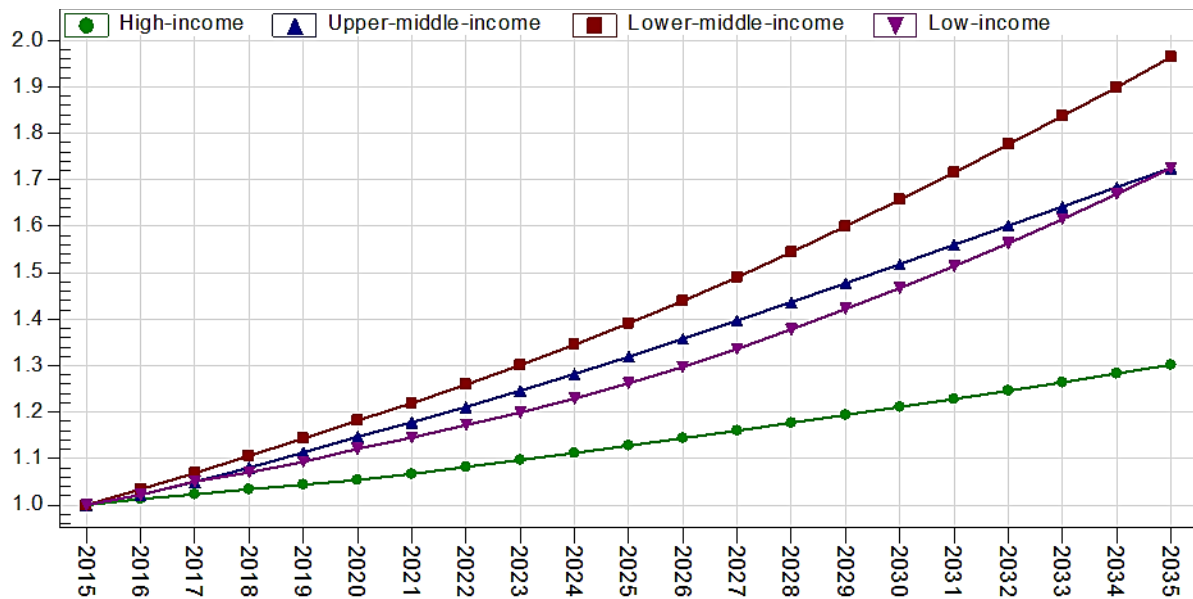
Figure 4.4: Multifactor productivity growth, annual rate
Source: IFs 7.19; initial dips are related to slow economic growth

Middle-income countries, even more than other countries, benefit from enhancements in their strength as knowledge societies, in part due to their educational systems becoming stronger at the tertiary level (having benefited from smaller youth populations and the ability to move those through primary and secondary education). In general, however, the extent of productivity growth is more likely to be tied to the advance of technology globally and the ability of societies not at the leading edge to learn from and adapt that technology (where, again, middle-income societies tend to have some advantages).

4.2 Financial: Government and Household Spending

As discussed above, different age cohorts have different financial needs throughout the life cycle; this shapes the financial implications of demographic change. As humans age, we often need financial assistance during youth in the forms of education and treatment of diseases (primarily communicable ones), during working years with the disruptions to employment and security, and during older years with pensions and again with treatment of diseases (primarily non-communicable ones). To the extent that government plays a role in providing that assistance, it relies on a variety of revenue streams including indirect taxes, household income taxes, household social security and welfare taxes, and firm social security and welfare taxes. On the other hand, the accumulation of assets during the ages of higher wage income can assist with the responsibility individuals and households bear for their own well-being expenses, especially during the ages of young and old dependency.

Figure 4.5 gives us a preliminary overall sense of how government spending will change over time. In the case of high-income countries, the greatest growth will be in pension and health spending, driven by the aging of their populations. That has a large chance of driving out any significant increases in other categories, especially traditional infrastructure (mostly roads, water, and sanitation) but also education, R&D, the military, other infrastructure, and total

other spending.

In the case of low-income countries, overall spending will likely rise much faster because of higher economic growth rates but also rising shares of government revenues and spending as a portion of GDP (that is unlikely in high-income countries). The biggest winner will be pensions again (but from a much lower base because those expenditures are currently less than 4 percent of the total, compared to 21 percent for infrastructure, 17 percent for education, 13 percent for the military, and 12 percent for health). The second largest increase will be education, even though it is currently so large, followed by R&D (another small sector likely to see high growth), and health.

Low-Income Countries
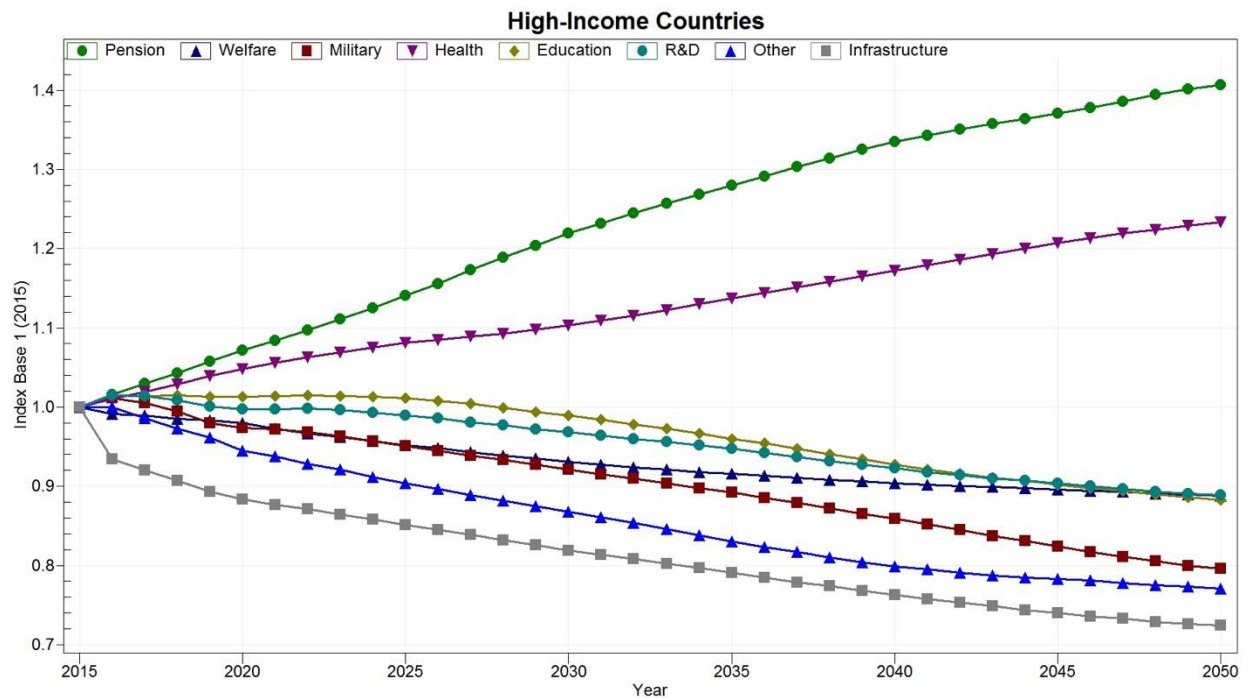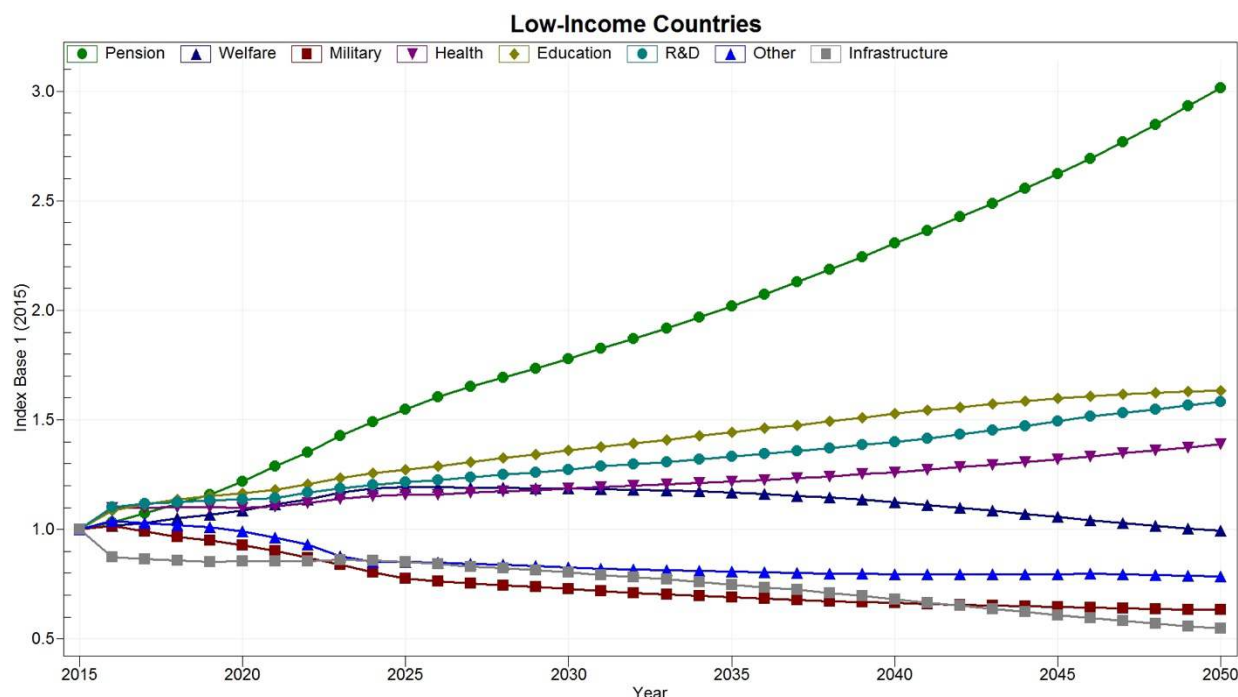
Figure 4.5: Growth patterns of government spending by destination as a percent of total government expenditures. Note: The infrastructure category includes both traditional and other infrastructure destinations.
Source: IFs 7.19

Nevertheless, these growing social expenditures will largely fail to keep up with the growth of demand. Just as the global decline of working-age populations relative to dependent ones is going to shrink the work force in many countries that are further into the demographic transition, it is also going to squeeze social spending. We will look in turn at the social financing of education, health, and pensions.

4.2.1 Education Needs and Spending

Investment in education is most challenging for those countries that need it the most. Many low-income countries have large youth populations in need of education, and due to this fact (and other developmental challenges they may face) are unable to spend as much per student (as a share of per capita GDP) as countries with a smaller share of school age children.

As fertility rates continue to fall however, the share of school age children will decline. Figure 4.6 shows that this decline will be most pronounced in lower-income countries (increasing briefly in the mid-to-late 2020s), but even by 2050, the share of the population between the ages of 5 and 15 will still be higher than that of lower-middle-income countries today.

This decline could theoretically free up resources that have been devoted to educating large youth cohorts. But will it? There actually could be three potential outcomes depending on the specific conditions of countries and their choices: (1) educating a higher portion of the young population; many lower-income countries are now far short of universal secondary education and sometimes even universal primary; (2) raising expenditures per student from levels that are far below those of higher-income countries (relative to GDP per capita in each case); (3) shifting

some education spending to other priorities ranging from infrastructure to health to caring for a growing elderly population.

There is actually a strong argument for using the reduction of demographic pressure for one of the first two choices. As these countries move toward their demographic dividends, human capital investment is of particular importance. Since the youth of today will be the labor force at the peak of the demographic dividend, focus on improving educational attainment and quality can help countries to fully harness their economic potential during this time, and better prepare them to face the potential risks associated with aging.
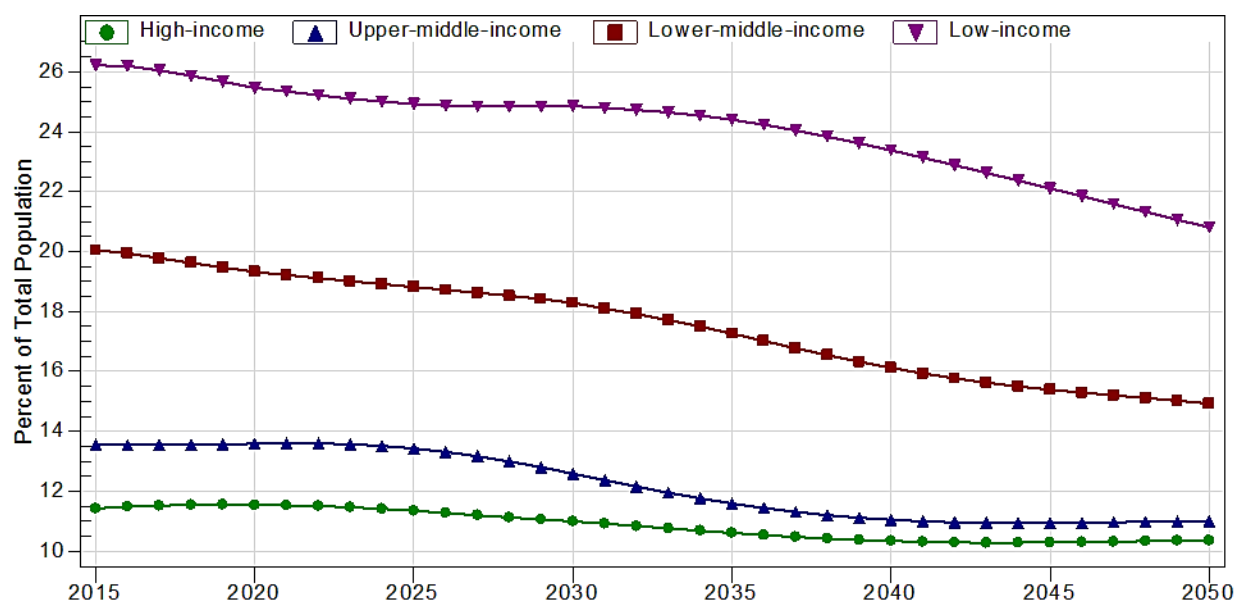
Figure 4.6: Population 5 to 15 as a percent of the total population for World Bank Income Groups.
Source: IFs 7.19

To accomplish that, most lower-income countries would need to spend more per student and educate all of their young people.[9] In high-income countries, spending per primary student is around 20 percent of GDP per capita—GDP per capita is a good benchmark for education spending because such a high portion of costs are for wages that vary with it Low-income countries now spend about half the share of GDP per capita (just over 10 percent) on each primary student as high-income ones do (Figure 4.7),[10] contributing to lower quality and higher drop-out rates. To close this spending gap, [11] countries must increase spending per student

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[9] Spending per student is always calculated as a share of GDP per capita in this section.

[10] Ironically, tertiary-level spending per student in low-income countries as a portion of GDP per capita is considerably higher than in high-income countries because qualified personnel are so much scarcer.

[11] The spending gap is calculated as the difference between actual education spending and the cost of educating all primary or secondary students and unenrolled age appropriate children at high-income spending per student (as a percent of GDP per capita) levels.
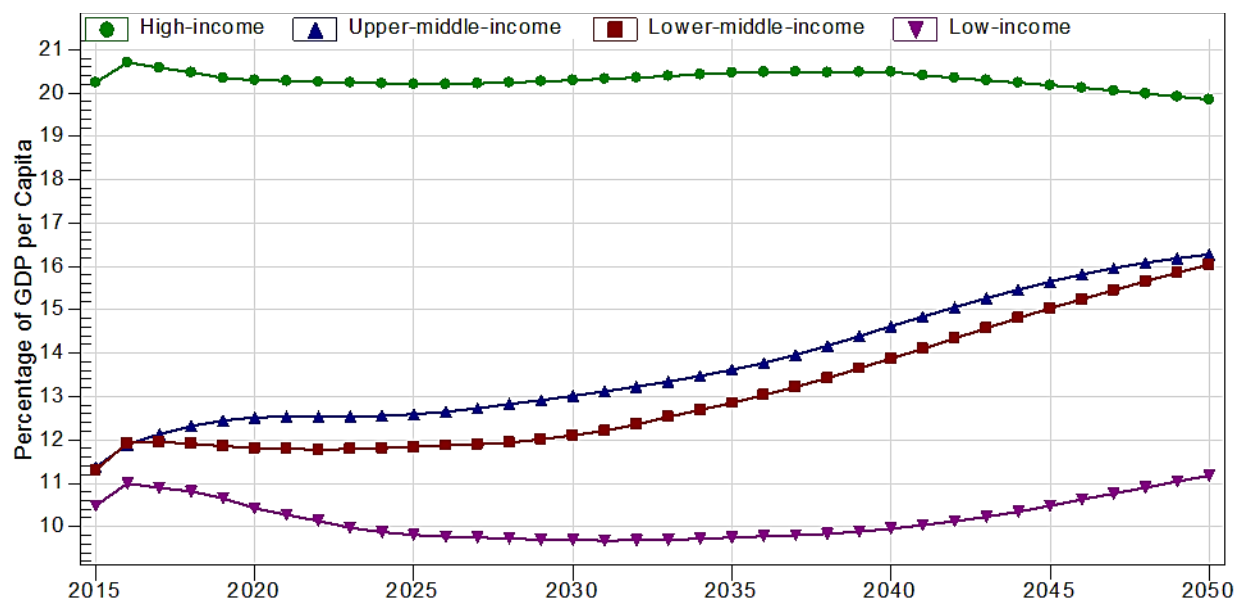
Figure 4.7: Education Spending per Primary Student as Percent of GDP per Capita.
Source: IFs 7.18

Ironically, in low-income countries the gap in primary per student spending relative to high-income countries is actually forecast to increase through the mid-2030s, before it begins to close. A major reason is the push that countries are making to increase enrollment rates, even as the student-age population share begins its decline.

We can calculate the overall primary and secondary school spending deficiencies of lower-income countries relative to high-income ones by combining the two shortfalls: spending per student (relative to the rates in high-income countries) and portion of the appropriate age population not yet in school. Figure 4.8 shows the total deficiency for the two schooling levels (primary in the top panel). Through 2050 these deficiencies are likely to shrink considerably as spending rates converge somewhat and developing countries move toward universal enrollment. With continuing decline in school-aged population, middle-income countries should be able to close the spending gap somewhat earlier than low-income countries.

Convergence to high-income levels may be delayed or slowed, however, due to the increased financial demands of pensions and health spending for their own aging populations.[12] Nevertheless, by 2050, the total gap in primary spending is forecast to decrease by over 1 percentage point of GDP in upper-middle-income countries and by nearly 2 percentage points of GDP in lower-middle-income countries.[13]

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[12] This is consistent with the argument by Lee and Mason that countries with diminishing young population shares experience freed financial resources that they direct towards expanding enrollment at higher levels of schooling and increasing per student expenditure. Lee, Mason, and International Development Research Centre (Canada). (2011). *Population Aging and the Generational Economy a Global Perspective*. page 173.
[13] As reference, 1 percent of 2015 GDP (MER) in upper-middle-income countries is $191 billion and 2 percent of 2015 GDP in lower-middle-income countries is $125 billion.
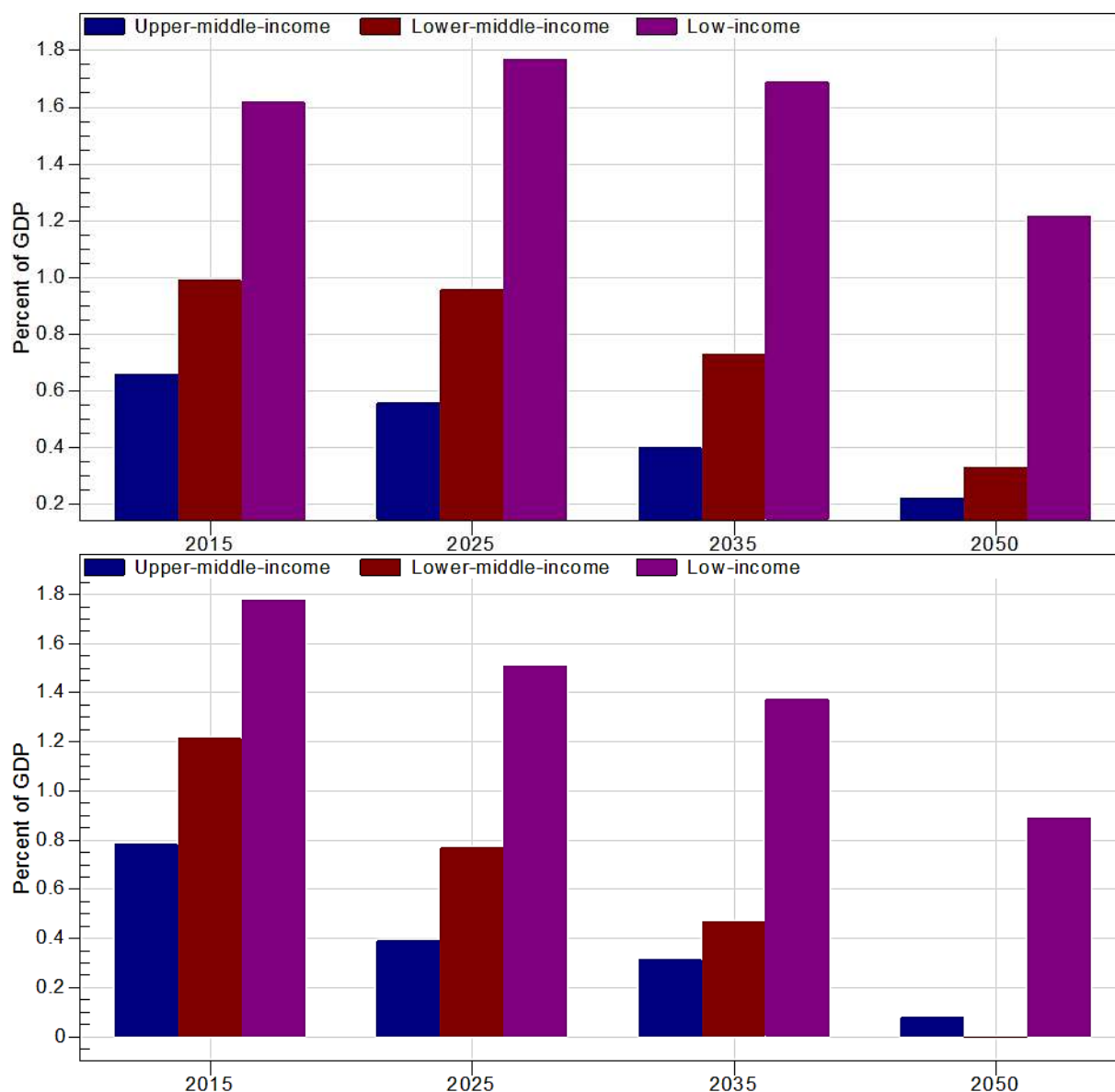
Figure 4.8: Unmet primary (top) and secondary (bottom) spending need as a percentage of GDP.
Source: IFs 7.19

Figure 4.8 (bottom) shows IFs forecasts of the secondary education spending gap. Middle-income countries will have mostly closed the gap by 2050. Low-income countries, however, will still have a significant gap between desirable spending levels for human capital outcomes and actual spending, though their gap will decrease by close to 1 percentage point of GDP between 2015 and 2050.

Combining the actual spending as a portion of GDP with the spending gaps (unmet need of Figure 4.8) allows us to see the desirable spending levels on education as a portion of GDP (Figure 4.9). Although there is an interim increase in this through 2035 for low-income countries and a delay in decrease for lower-middle-income countries, overall through 2050

there is mostly an easing of those desired spending rates around the world. That is where we see the benefits of the demographic shifts occurring toward decreased youth share in the total population.
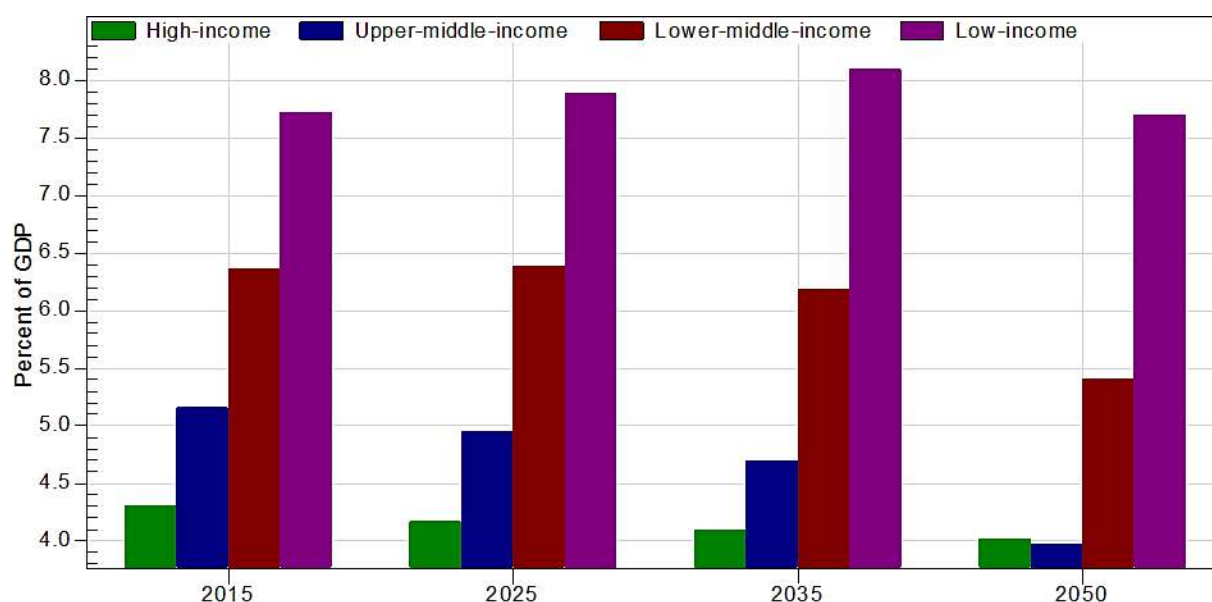

Figure 4.9: Total education spending need as a percentage of GDP through 2035, forecast
Source: IFs 7.19

Low-income countries with slowly decreasing fertility rates, like those in Equatorial Africa[14], are nonetheless likely to experience continued financial pressure for educational infrastructure, teachers, and supplies, with absolute spending need forecast to increase more than 10-fold by 2050l. They are a major reason for the interim increase in spending needs of the low-income countries. We return to this issue in scenario analysis.

4.2.2 Health Needs and Spending

The needs of young and elderly populations account for the majority of the health spending for most countries. This translates into a U-shaped pattern of health costs as a country traverses the stages of the demographic transition. Figure 4.11 illustrates the different health cost profiles for three countries at different stages of the demographic transition. In Afghanistan, 48 percent of the population is under the age of 15, and infant care accounts for over 40 percent of the country's total health costs. Japan, on the other hand, has only 13 percent of its population under the age of 15 and the vast bulk of its health spending supports the elderly while less than 15 percent goes to infant care. Although those in the middle of life generally have much smaller needs, specific mortality patterns, for instance those associated with the HIV/AIDS epidemic, can substantially affect country-specific patterns as demonstrated by Lesotho.

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[14] The Equatorial Africa regional group is comprised of Burundi, Cameroon, Central African Republic, Democratic Republic of Congo, Republic of Congo, Equatorial Guinea, Ethiopia, Gabon, Kenya, Rwanda, Sao Tome and Principe, Somalia, and Uganda.
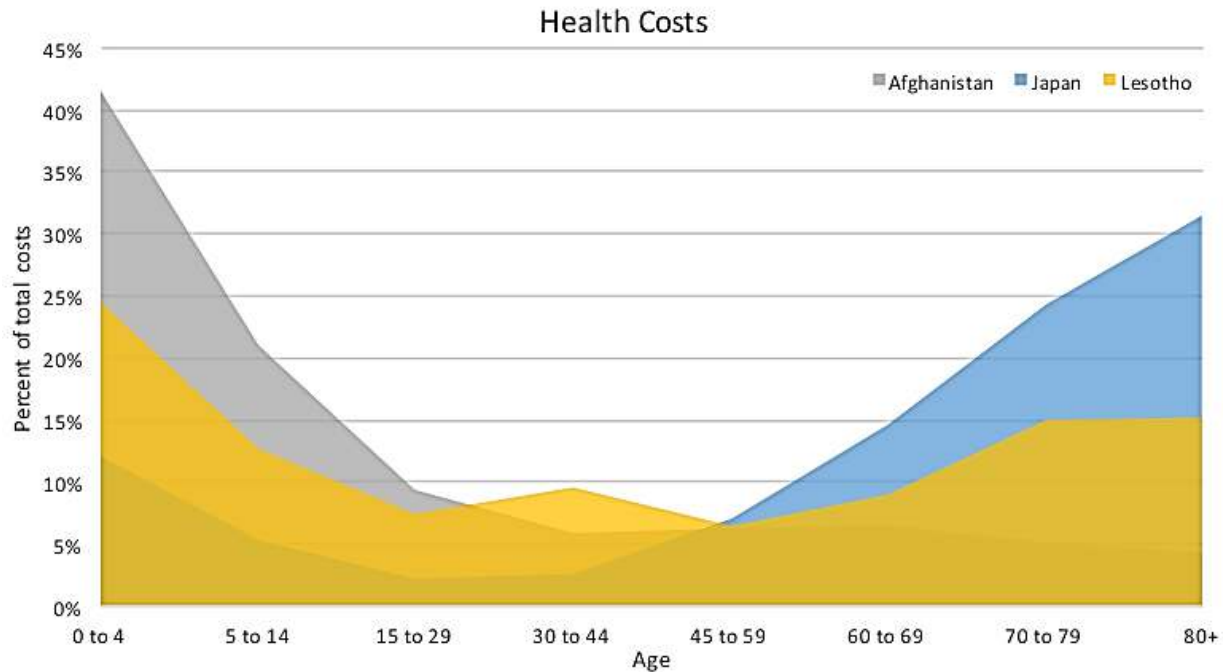
Figure 4.11: Health costs by age category
Source: IFs 7.18

Figure 4.12 shows the broader pattern across all countries and the great variations within it, tracing the share of GDP that societies direct to health care (public and private spending) as a function of median age. Whereas youthful countries average about 8 percent–mostly for coummunicable disease care–that declines somewhat for countries of intermediate median age, rising steadily for those that are mature or post-mature and becoming dominated by spending on non-communicable diseases. The United States is an extreme outlier at nearly 18 percent of GDP but for countries with a median age above 40 the typical spending rate rises to about 10 percent of GDP. The pattern is U-shaped but not as sharply as that of Figure 4.11 because it aggregates spending across all age categories. Whereas countries like Afghanistan have limited health burden from the elderly and those like Japan have limited ones from the young, countries in the middle face "double burdens" of disease that also require signifcant if lesser health spending.
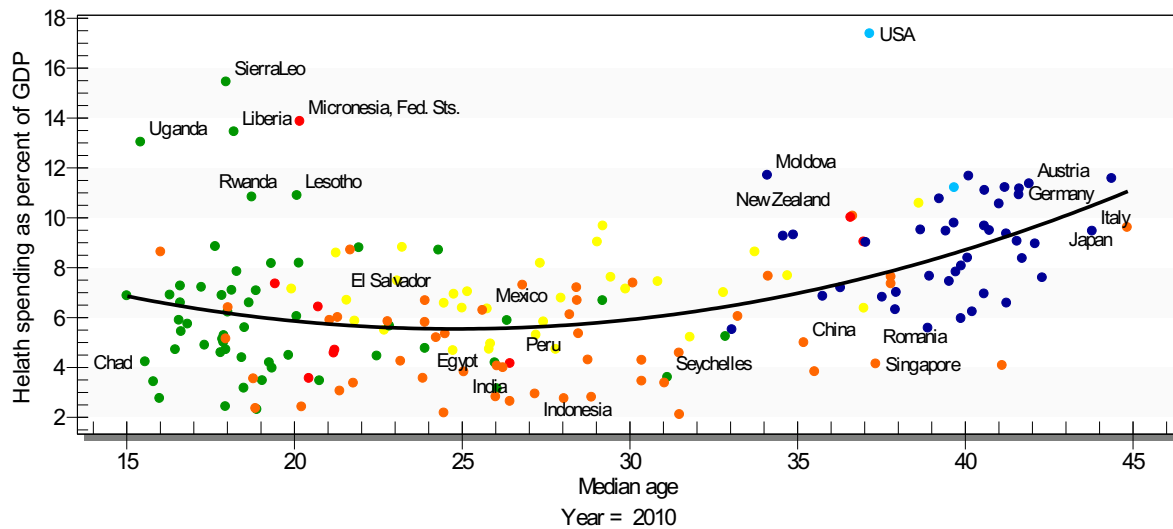
Figure 4.12: Public and private spending on health as share of GDP by median age
Source: IFs 7.19. Green points are African countries, yellow are Latin American, orange are Asian, light blue are North American, and dark blue are European. Health spending=13.98 − 0.608*Median age +0.014*Median age squared; R-squared=0.235

Not surprisingly, because countries with older populations tend also to be richer and to be able to mobilze greater resources publicly, government (public) spending as a share of GDP rises with median age and shows less of the U-shaped pattern corresponding to shifting disease burden (Figure 4.13). Public health spending in younger and poorer societeies is about one-half of the total whereas in older and richer countries it is closer to two-thirds.
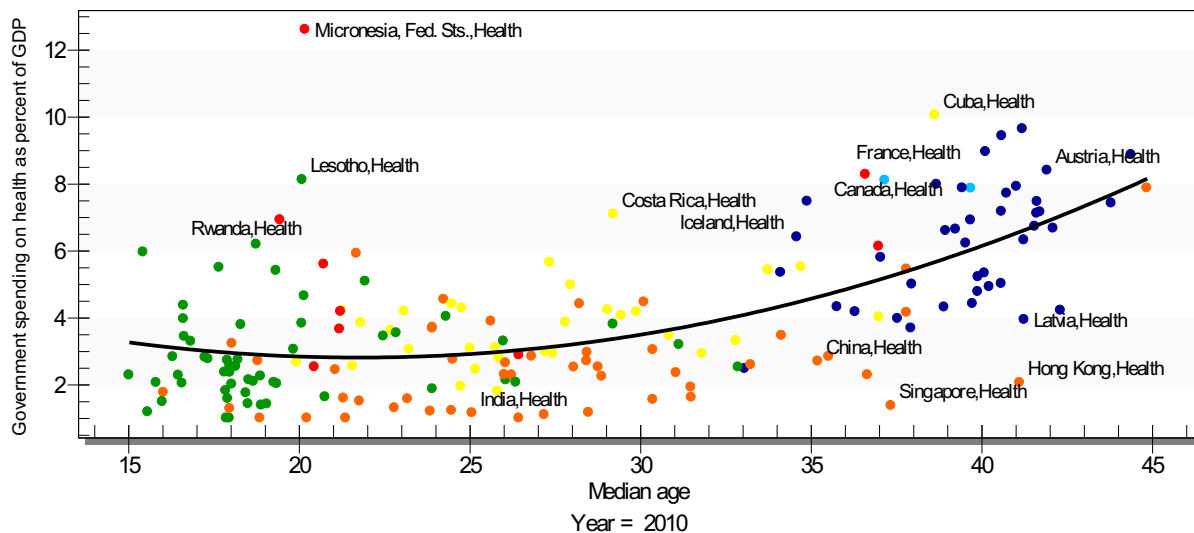

Figure 4.13: Government (public) spending on health as share of GDP by median age
Source: IFs 7.19. Green points are African countries, yellow are Latin American, orange are Asian, light blue are North American, and dark blue are European. Government health spending=7.55 − 0.435*Median age +0.01*Median age squared; R-squared=0.398

Overall then, in coming years we can expect to see some easing of total–and to a lesser degree of public health–spending burdens for lower-income countries but steady rises in those for high-income ones, with governments in high-income and increasingly in upper-middle-income facing quite intense increases in spending pressure.

However, the extent of increases in higher-income countries will be shaped, in part, by two major uncertainties. First, the "compression of morbidity," or the extension of healthy old-age, may mitigate the expected increases in health costs (Bloom et al 2010:43). Yet, IFs forecasts that years of life lost to disease (non-communicable) and disability to increase for high-income countries. Second, the "deepening of aging," or an increasing proportion of those aged 80 and over, is likely to neccessitate more extensive and expensive health care needs, such as in-home or long-term care (Lefebvre and Goomar 2005: 43).

The extent of increasing health care demand will also rely on the savings stocks of the elderly. For older cohorts, the difficulty associated with saving during retirement as well as unexpectedly long life after retirement may lead to a depletion of savings, forcing the elderly to rely even more heavily on government provided health care (Bosworth et al 2004:18). As Bosworth et al (2004:6) assert:

> *Many business writers and economists believe population aging will lead to declining rates of saving as older households begin to draw down their retirement savings. The decline in household saving will be accompanied by increased pressures on the public sector to meet the income and health needs of the aged. Heavier spending requirements could push public budgets toward large deficits.*

As Figure 4.14 demonstrates, IFs forecasts that the savings stocks of the elderly in high-income countries will be surpassed by the savings need within the next decade. By 2035 the gap will increase to $50 trillion.
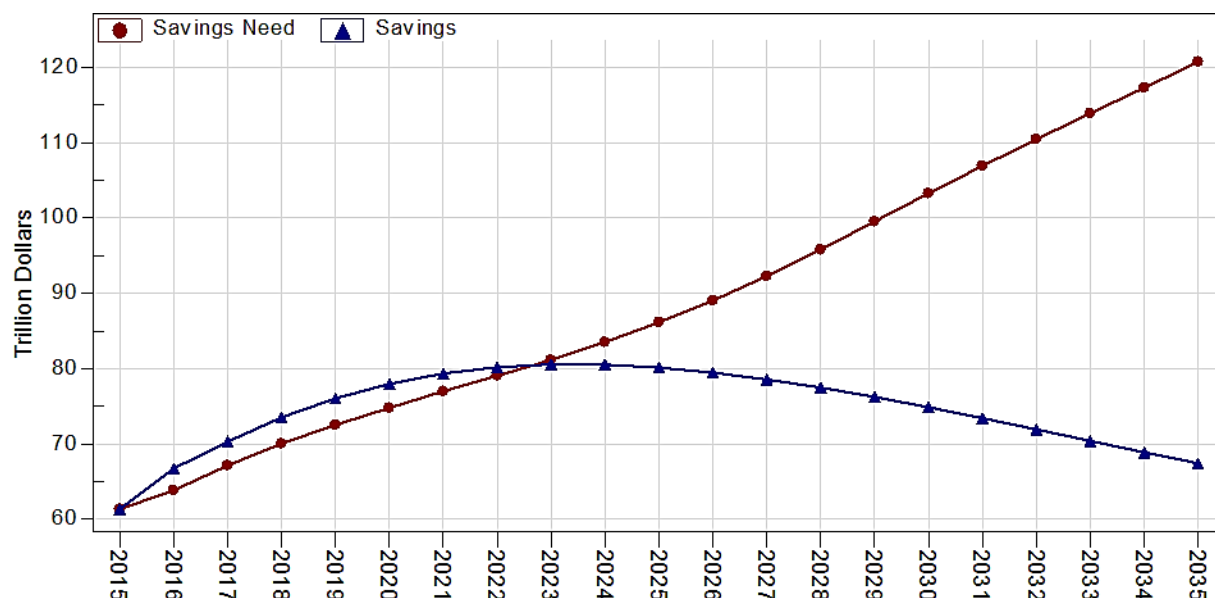
As the demand for total health spending rises in high-income countries, the demand for the government to pay a larger share will also rise. Figure 4.15 shows that in high-income countries, actual public health spending will not keep pace with demand in the coming decades. By 2035, government spending will cover less than half of the spending needed (down from 62 percent in 2015 to 49 percent in 2035). Upper-middle-income countries will face a similar, though slower, decline. A significant exception is China in the upper-middle-income category. Our Base Case forecast anticipates that government spending on its health care needs will rise sharply until the early 2020s, at which time the pressure of needs for health care will begin to erode governmental ability to keep up with them (we return to this issue in Section 6). On the whole, lower-income countries are in better positions as they continue to experience reductions in younger populations prior to large-scale increases in their older ones and will steadily improve their spending-to-needs ratios through 2035.
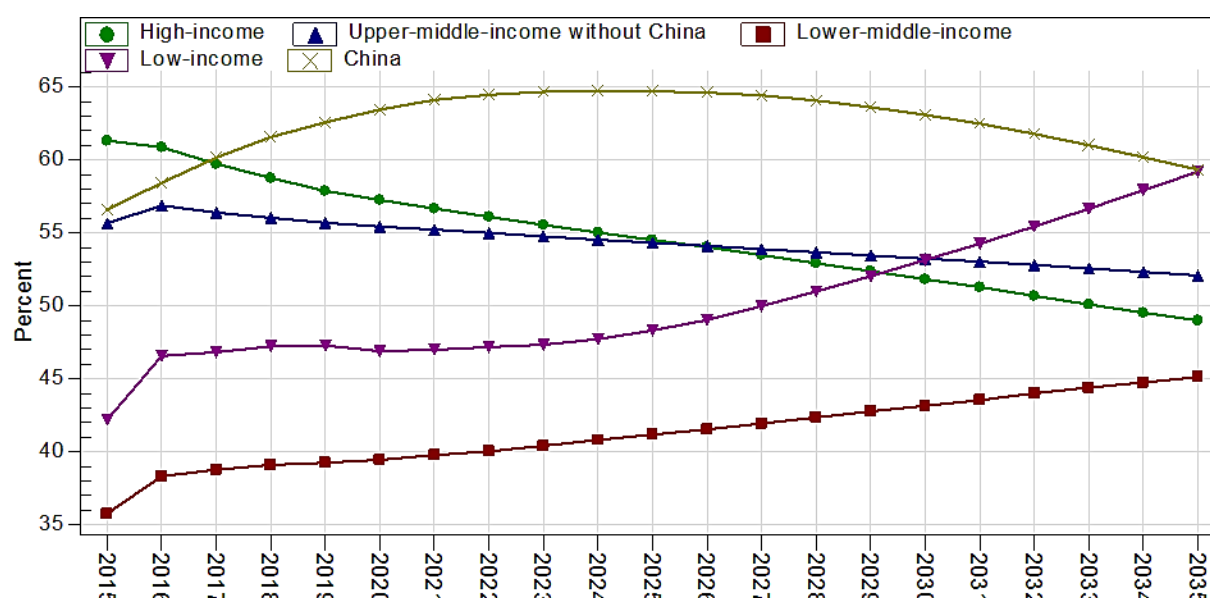

Figure 4.15: Government spending as a percent of total health care costs, across country income categories
*Source: IFs 7.19*

4.2.3 Pension Needs and Spending

As the share of older populations continues to rise, the corresponding demand for pension benefits puts pressure on public pension systems. In countries with well-established systems (mostly higher-income countries), pension schemes must address the dual challenges of providing adequate retirement income and remaining financially sustainable, challenges exacerbated by growing proportions of elderly and longer life expectancy after retirement. Countries still working to establish viable pension systems (mostly developing countries) face the risk of getting old before they get rich. For these countries, resource constraints and "the predominance of informal sector labor…makes the design and implementation of such systems all the more difficult" (Bloom et al 2010:32).

Box 3: Pension Systems

For countries with established pension systems, defined benefit plans present the most risk, especially unfunded, pay-as-you-go systems (PAYG). Defined benefit schemes are pension plans in which payments are determined by earnings history, tenure of service, and age, rather than an individual's contributions. In unfunded PAYG schemes, pension payments are made from the contributions or taxes from current workers. For defined benefit plans, in general, the risk lies in the gap between assets available for pension payments and the growing number of pension payments required. They are also subject to longevity risk, in which there is an underestimation of how long individuals will live after retirement. In many cases, governments or companies have promised more than they can handle in the face of growing demand and extended payment periods. In PAYG systems, the pool of workers able to supply funds for pensions is shrinking while the relative number of eligible pensioners is increasing.

The figure below shows the distribution of pension schemes for 125 countries. Defined benefit plans are by far the most common and most are PAYG schemes (IMF 2011:9). This puts these countries at high risk for facing pension insolvency in the coming decades.

Global Distribution of Public Pension Types

■ DB   ■ Other   ▩ Mixed   ■ DC

| 2013 | 87% | | 7% | 5% | 1% |
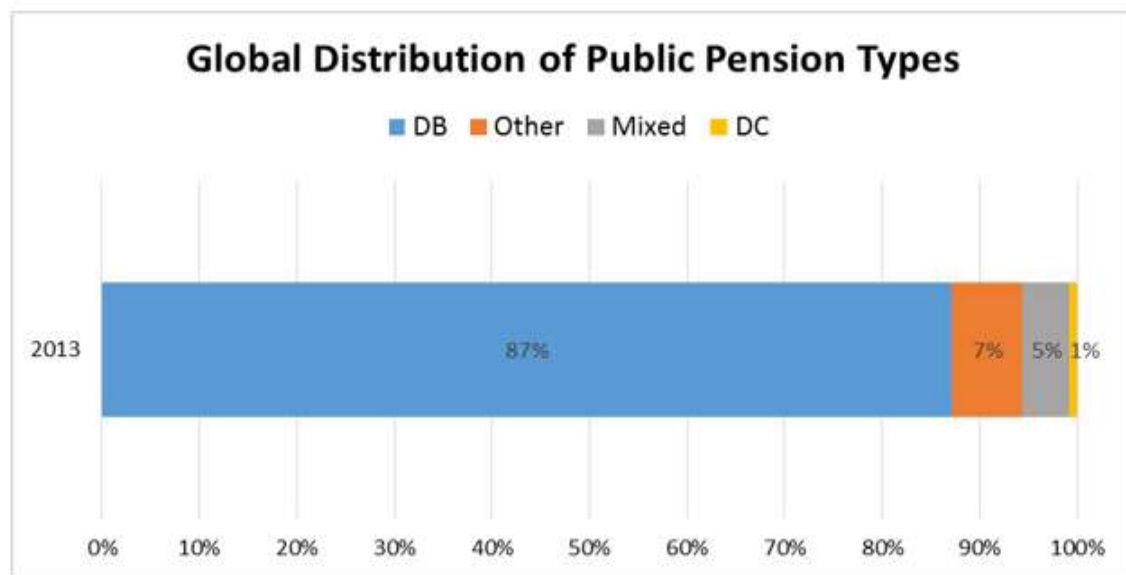
Global Distribution of Public Pension Types from a sample of 125 countries in 2013
Source: OECD (2014: 212) and Montserrat et al (2012: 115-159)

Despite impending risk facing rapidly aging countries with defined benefit schemes (see Box 3), most countries have been hesitant to enforce drastic reforms, such as switching to defined contribution schemes, in which pension payments are directly linked to individual contributions and the risk transfers from governments and employers to individuals. Rather, many have chosen simpler reforms such as increasing the pensionable age or increasing tax or contribution rates (OECD 2015:18-33).

While these reforms extend the viability of pension funds in the short term, it is questionable whether they will ensure longer term sustainability. While pensionable ages have increased and are likely to continue doing so, they are not keeping pace with the gains in life expectancy after retirement. Between 1990 and 2013, life expectancy at ages 60-64 in high-income countries increased by 2.8 years for women and for men increased by 3.3 years (Figure 4.16). Both genders increased at an average rate of more than 1 year per decade.[15] Between 1990 and 2010, on the other hand, pensionable ages increased by 0.7 years for men and 1 year for women, averaging less than 1 year per decade.[16]
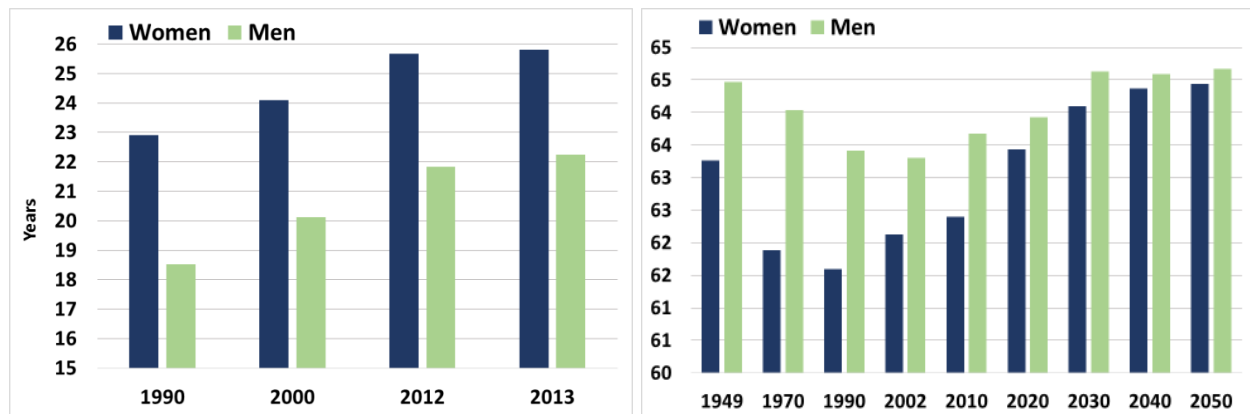

Figure 4.16: (Left) Average life expectancy (additional years of life) at ages 60-64 for high-income countries by gender. (Right) Average pensionable ages for high-income countries by gender, history and forecast.
Source: (Left) World Health Organization (2015), (Right) IMF (2011:57) and OECD (2011:25-26)

The IMF forecasts that by 2030 the average pensionable age for men will increase by 1 year, while the average pensionable age for women will increase by 1.7 years.[17] However, if life expectancy at ages 60-64 continues on its current trajectory, it is expected to increase by about 2 years for men and women.

Data also show that pension replacement rates in high-income countries, or the ratio of average pension income to average working income, have decreased for both men and women of all pay grades in the past ten years (Figure 4.17). This indicates that strained pension funds are supplying less generous pension benefits in the face of increased demand.

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[15] Between 1990 and 2000, women's life expectancy at ages 60-64 increased by 1.2, while men's increased by 1.6. Between 2000 and 2012, life expectancy increased by 1.6 and 1.7 years, respectively.
Data from: World Health Organization. (2015). "Global Health Observatory Data Repository."
[16] Between 1990 and 1999, women's pensionable age increased by 0.2 while men's decreased by 0.4. Between 1999 and 2010, pensionable ages increased by 0.7 and 0.6, respectively.
Data from: OECD. (2011). "Pensionable Age and Life Expectancy, 1950-2050." and IMF. (2011). "The Challenge of Public Pension Reform in Advanced and Emerging Economies."
[17] Women's pensionable ages are increasing more quickly as equalization of pensionable ages between genders occur.
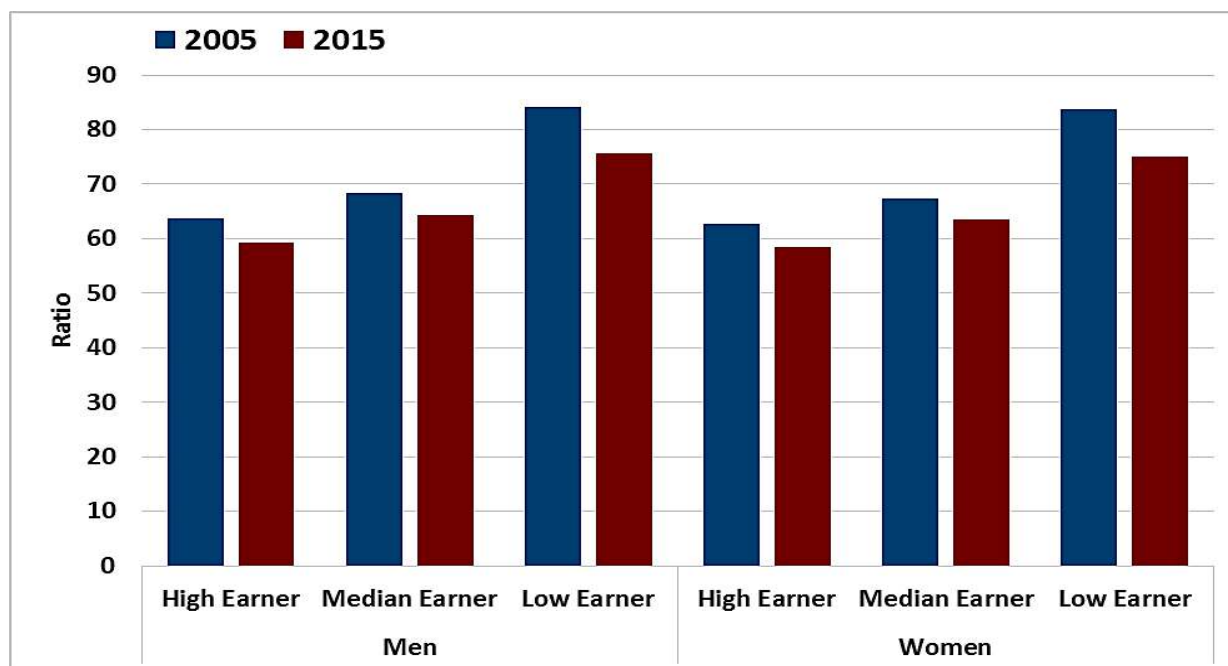
Figure 4.17: Pension replacement rates (average pension income/average wage while working) for high-income countries by earnings categories and gender, history.
Source: IMF (2011:52)

The discussion above suggests that aging countries are already feeling the pressure of increased pension demand and that pension funds will become increasingly unsustainable. While the Base Cases of IFs does not yet incorporate dynamic forecasts of retirement ages, it does indicate a growing unmet pension demand. Over the next 20 years, pension transfers are forecast to grow another 25 percent for high-income countries, but the share of the population 65 and older will increase by over 40 percent, further constraining the ability for governments to cover the retirement needs of their elderly population.

But this challenge is not only felt by high-income countries. Figure 4.18 shows upper- and lower-middle-income countries passing high-income levels of the pension spending gap (annual retirement needs minus government transfers for pensions as a percent of GDP) by the late 2030s and mid 2040s respectively. The trend of these two middle-income groups is largely dominated by large, more quickly-aging countries like China, India, and Indonesia, but nevertheless illustrates the pressing importance of pension planning, particularly in countries that are still working to meet universal attainment of basic education and health coverage.
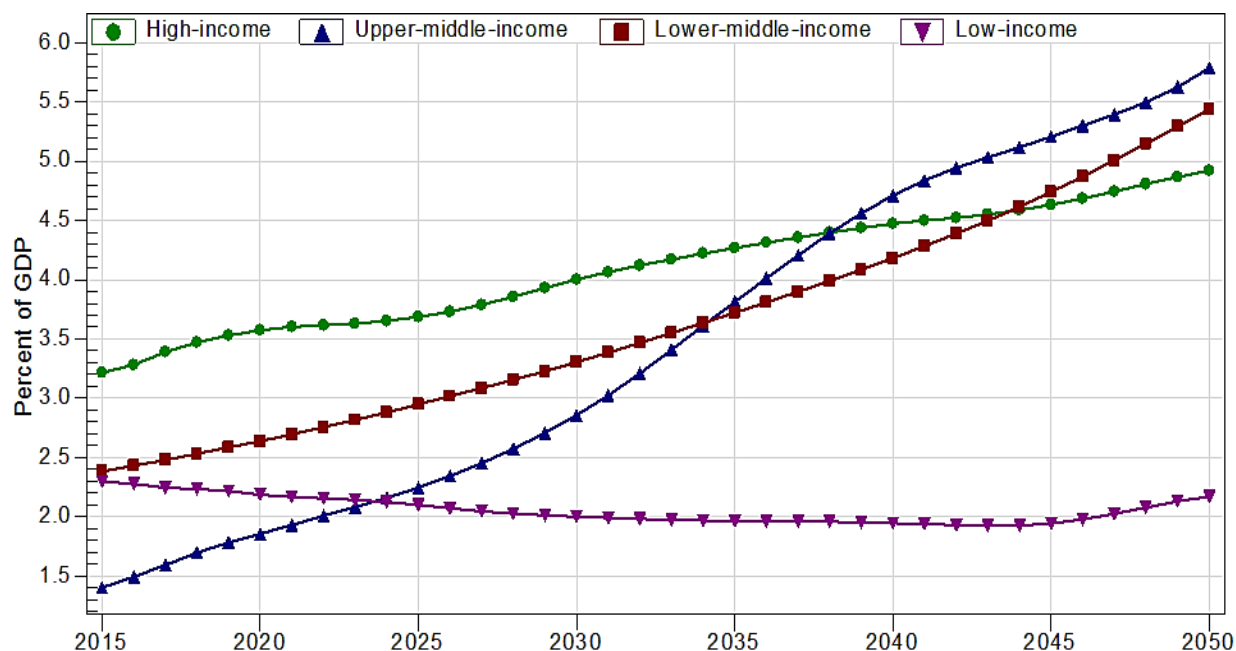
Figure 4.18: Government pension spending gap (pension need minus transfers) as percent of GDP.
Source: IFs 7.19

4.2.4 Total Financial Need

This section has discussed the financial burdens of education, health care, and pensions. While the forecasts of these measures are driven by a wide range of macroeconomic dynamics, each is strongly influenced by changing demographic patterns. Today, education spending needs are roughly 8 percent of GDP in low-income countries with large youth populations. This falls between the overall pension and health care needs of high-income countries (12 and 11 percent of GDP, respectively) and those of upper-middle-income countries (6 and 5 percent of GDP, respectively). As the share of school-aged children begins to drop and as spending per student raises to high-income country levels, education needs fall, and play an increasingly smaller role in overall demographic related financial needs.

Unlike education needs, sometime during the middle-income passage, health care costs begin to rise again. Today's high-income country health costs are estimated to be around 12 percent of GDP, and forecast to increase fairly linearly to over 16 percent in 2035, and over 20 percent by 2050. Retirement needs, like education needs are fairly one-directional, rising in parallel with the growth in share of population over the retirement age. For all but high-income countries this financial burden is fairly low as a percent of GDP, but forecast to grow rapidly through 2050 for middle-income countries.

China's extreme fertility declines in the 1970s and 1980s accelerated the country's movement through the demographic transition. As a result, China's population, which increased by over 731 million between 1960 and 2015, is forecast to decline by 67 million between 2015 and 2035.

The rapid fertility declines coupled with an already large population led to an unparalleled demographic dividend and favorable dependency ratios for the latter half of the 20th century and the beginning of the 21st century. However, the coming decades will be less generous. The country's demographic dividend is today just past its peak, signaling the beginning of a dramatic growth in the elderly dependency ratio as the share of elderly nearly triples between 2015 and 2050.

China Population Cohorts, History and Forecast

Dependency Ratios

Demographic Dividend
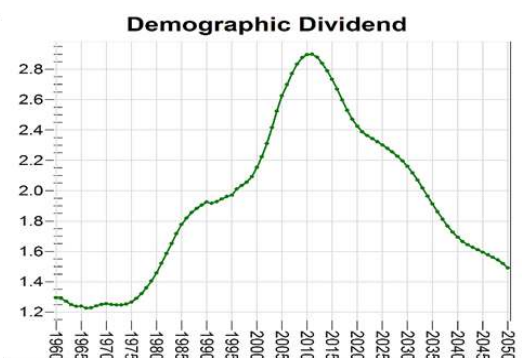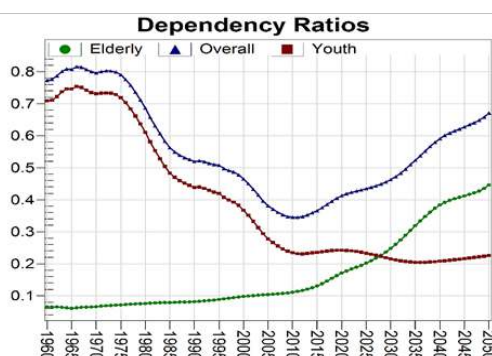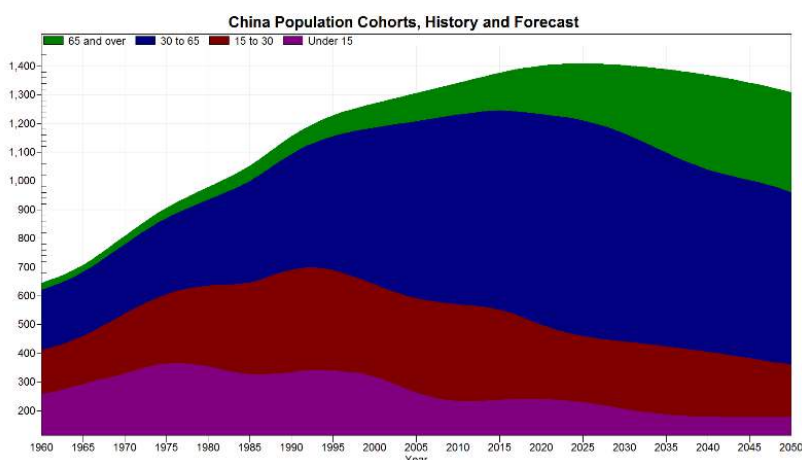
The result of this transition is that pension needs will surge past education spending needs and health costs within 10 or 15 years, despite health care costs growing to over 11 percent of GDP by 2050. Education need will shrink during the same period, but not enough to offset the increases in health care and pension costs. An additional challenge in dealing with these changing costs is the country's labor's contribution to economic growth, which already negative by 2020, is forecast to sink considerably for the following 3 decades.

Demographic Related Financial Risk

Labor's Contribution to Growth
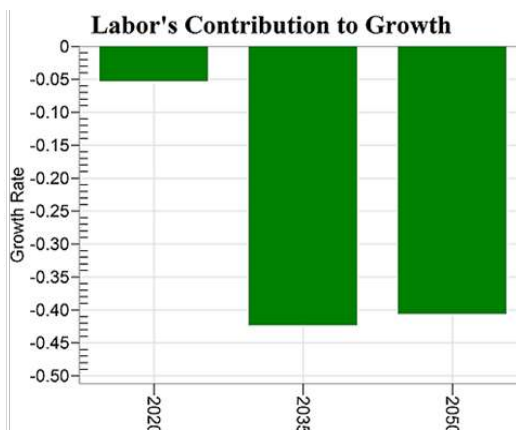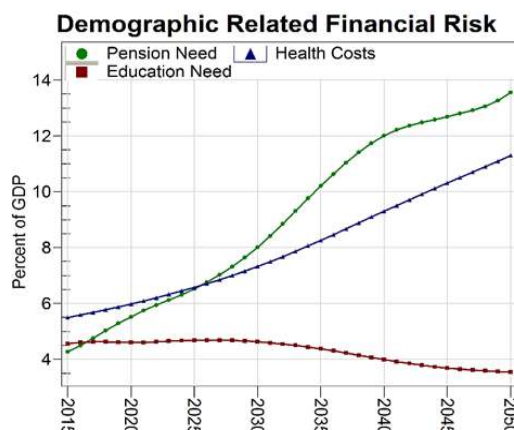
For additional country profiles please refer to Appendix B: Country Profiles.

We have combined these broad financial measures into a single summary measure of overall social need.[18] Figure 4.19 shows each of the three sub-components and the overall measure (a linear combination of the three) for the four World Bank Income Groups. High-income countries stand out as having by far the largest overall burden today and through 2050. Low- and middle-income countries all begin around similar levels in 2015, but diverge significantly over the forecast.
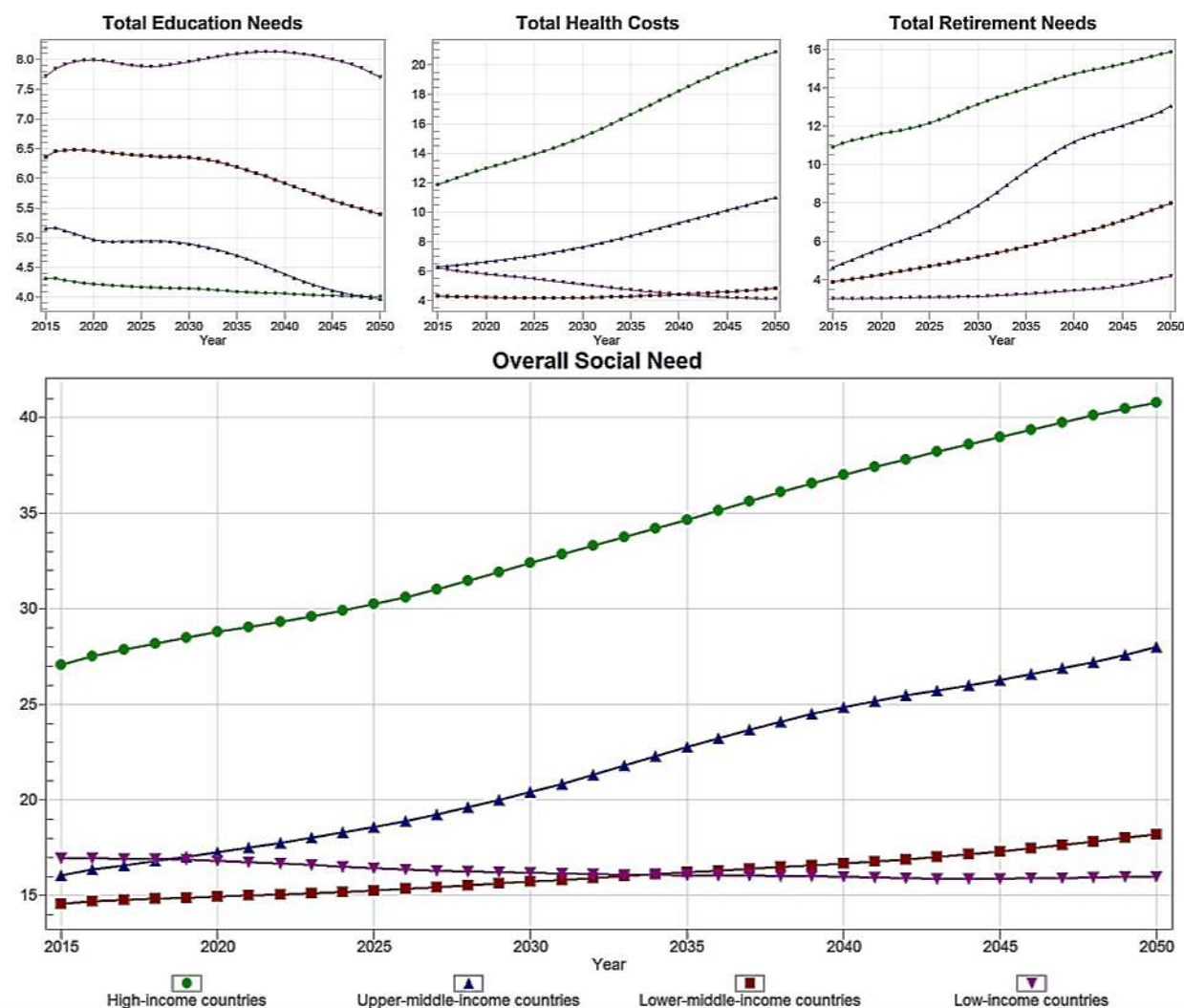

Figure 4.19: Overall demographic related financial need and its components as a percent of GDP.
Source: IFs 7.19

The forecast corroborates the idea visited throughout this report that younger (primarily low-income) countries experience some financial benefit with changing demographic patterns, with low-income overall financial need starting above that of middle-income economies but declining to levels below that of upper-middle and lower-middle countries by 2035.

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[18] As a reminder overall demographic related social need includes: (1) education need, calculated as total educational spending plus the cost of educating all primary and secondary students and unenrolled age appropriate children at high-income spending per student (as a percent of GDP per capita) levels; (2) total health costs; and (3) annual consumption needs of all retirees.

4.3 Social

The discussion around socio-political risks and benefits centers around questions of stability and democracy and suggests that countries with more youthful age structures are at a disadvantage when it comes to achieving either. However, older and aging populations may face another set of intergenerational risks associated with a greying, politically active citizenry and the tough political reforms such countries must enact in order to assure financial security for subsequent generations. These wealthier aging countries are also the destination for an increasing flow of migrants, which can help to offset a declining workforce, but may also bring other social challenges as the both the native population and the new arrivals adjust to a changing demographic landscape.

4.3.1 Instability and Internal Conflict

Cincotta (2013) finds that countries in which more than half of the population is 25 years or younger are particularly vulnerable to conflict and political instability, and argues that this relationship will make the coming decades particularly trying for many countries in the Middle East, South Asia, and Sub-Saharan Africa.

Regarding the relationship between instability, democracy, and age structure, Cincotta (2013:31) explains:

> Since 1970, states with a youthful population have comprised about 80 percent of each decade's newly emerged intrastate conflicts. Notably, revolutions during this transitional stage can be extraordinarily violent and, if successful, may end with the near-complete dispossession of the political, commercial, and military elites. After states have surpassed the median age of 25 years, analysts should expect them to be less likely to initiate a new intrastate conflict, more likely to experience the winding down of an ongoing civil or ethnic war, and more likely to experience sustainable democratization.
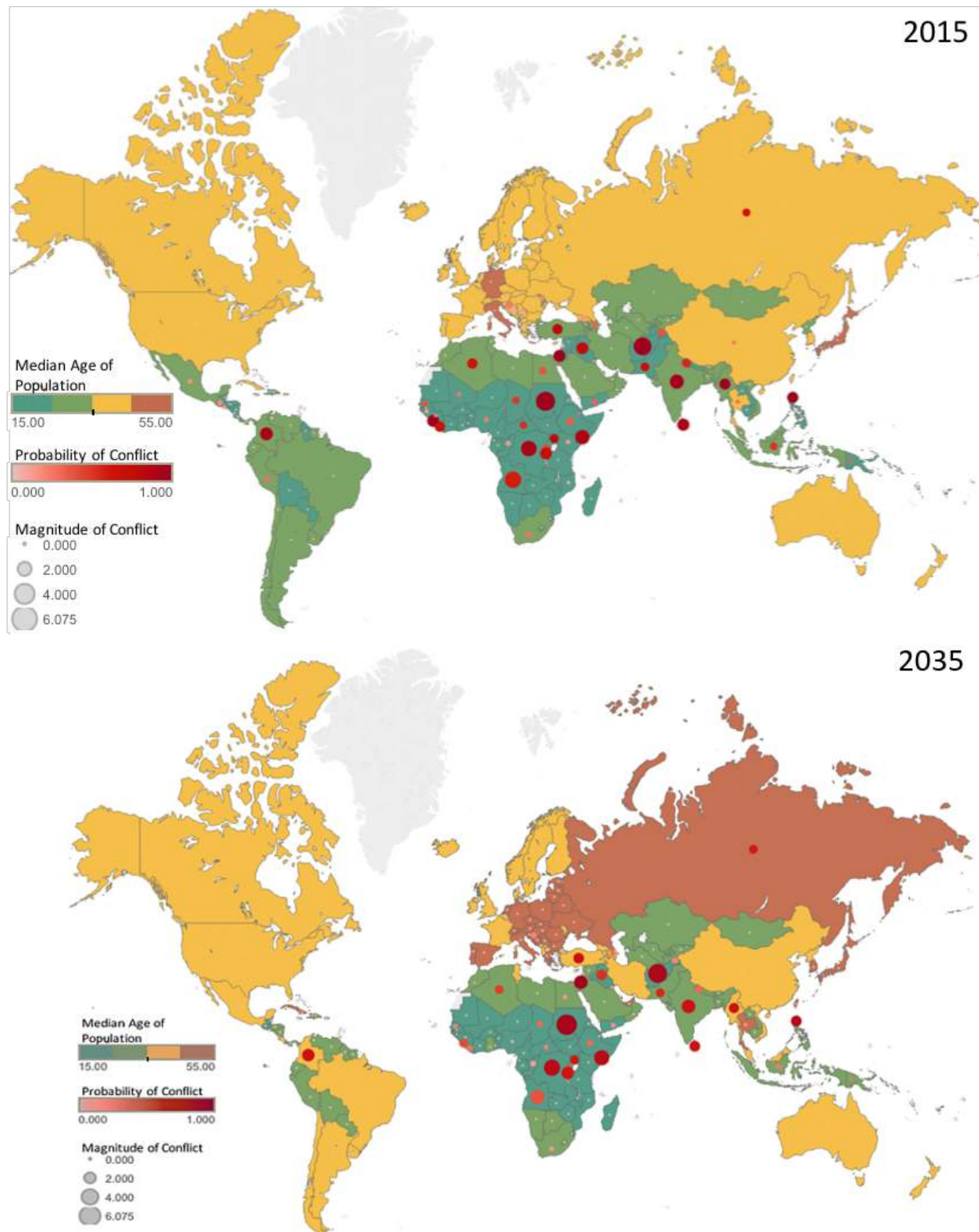
Figure 4.20: Median age of population (using groupings from Cincotta 2013a) and internal conflict for 2015 (above) and 2035 forecast (below).
Source: IFs 7.17 (graphics rendered in Tableau version 9.2)

Forecasting median age alongside the probability and magnitude of conflict out to 2035 (Figure 4.20), we see a continuation of this pattern of political instability, primarily in countries across the Equatorial Africa belt which are forecast to sustain their historically high youth bulges over the coming decades.

The youth bulge, or the share of young adults (15 to 29) in the adult population is an important measure when considering the relationships between age structure and socio-political risk. A disproportionately large population of young (particularly male) people is widely cited as a significant driver of the political turmoil of the Arab Spring,[19] the logic being that young people without adequate outlets to express their frustration with the current state of the economy (unemployment) or the government (corruption and ineffectiveness) are more likely to join or create activist (and potentially violent) movements in order to illicit change.

In the 1960s and through the mid-1980s, most developing countries had high youth bulges. Today, most countries in the world have grown past this stage, though many low-income countries, particularly those across Equatorial Africa, can be expected to retain a large youth bulge unless they are able to dramatically reduce fertility rates (even then, however, significant reductions in the youth bulge will not appear for at least 15 years) (Figure 4.21).
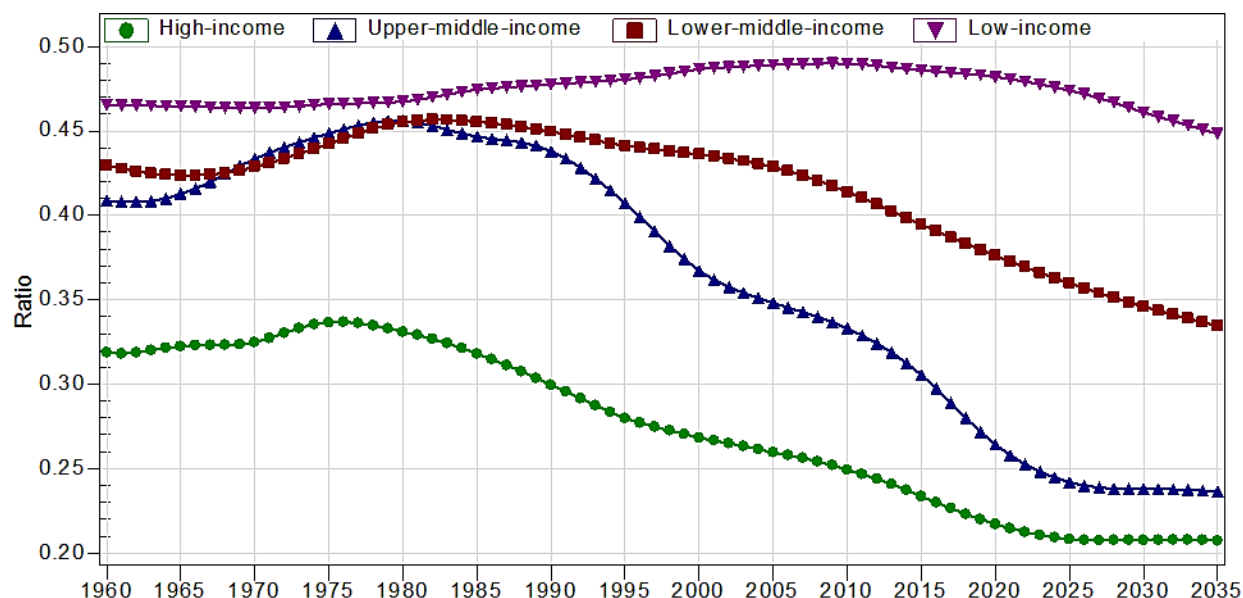

Figure 4.21: Youth bulge size for World Bank income groups, history and forecast.
Source: IFs 7.17

Policies aimed at lowering these high levels of fertility can not only reduce the risk of internal instability and conflict, but, as we have seen above, free up resources to spend on other social goods like education, health care, or infrastructure, and reduce the cost of extending basic

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[19] See in example: LaGraffe, Daniel. 2012 "The Youth Bulge in Egypt: An Intersection of Demographics, Security, and the Arab Spring." *Journal of Strategic Security* 5 (2): 65-80. And: Hoffman, Michael, and Amaney Jamal. 2012. "The Youth and the Arab Spring: Cohort Differences and Similarities." Middle East Law and Governance 4: 168–188.

services that may in turn further reduce the risk of violence and political instability. However, as we have also seen, these (generally policy driven) reduction also set the country on a path of much more rapid aging.

4.3.2 Strained Intergenerational Relationships

The intergenerational risks associated with aging are largely those of intergenerational redistribution. Be it pensions (transfers of income from working-age populations to retired populations) or competition over jobs between would-be retirees and would-be first-time job holders, some of the financial challenges facing aging countries have the potential to spill over into social and political challenges. Foresight plays a crucial role in mitigating these risks by identifying the reforms that are necessary to escape fiscal crisis, but implementing them early enough to avoid intergenerational tension is a more challenging task.

In 2010, in order to stop the annual pension shortfall from growing to $70 billion by 2020 the French government proposed raising the official retirement age from 60 to 62. The protests that followed attracted both union members demonstrating against having to push back their retirement plans and younger students concerned with what the proposal would mean for finding jobs in an already scarce market (Bon 2010). France's retirement age reform was developed with an eye 20 years towards the future. Furthermore, as shown earlier, France has had the luxury of the most gradual rate of aging in the world (recall Figure 1.2), providing even more time to deal with the impending fiscal crunch associated with its aging population.

For other countries, putting off these hard decisions will only exacerbate the magnitude of the necessary adjustments and the social backlash that can follow (Clark et al 2007). Illustrating the disproportionate burden that different generations within the United States will experience when faced with pension and retirement age, Kotlikoff et al (2001:Abstract) state:

> *Is there a painless way out of our demographic dilemma? No. A much faster rate of technical progress would help, but still leave a major problem. Getting workers to retire later in life would increase aggregate labor supply, but reduce aggregate capital formation. And cutting Social Security benefits either directly or by raising the program's retirement age renders major welfare losses on current or near term retirees. However, advance funding the receipt of retirement income, while not being a free lunch, more evenly spreads the pain across generations: it entails moderate pain for living generations and provides major gains for future generations, particularly those with very low incomes.*

In aging countries such as France, retired populations and those approaching retirement age have increasing voting power (due to their increasing share of the population), voting opportunity (particularly among those that are retried), and incentive to postpone these necessary reforms. Since both financial risk due to pension demand and intergenerational polarization regarding the political changes necessary to avoid such dangerous imbalances increase with aging, it is in countries' best interest to begin thinking about solutions as early as

possible, particularly for those that are passing through the demographic transition at much faster speeds than previously seen.

4.3.3 Migrants and Native-Born Tension

Our analysis so far indicates that immigration is likely to be an economic benefit for countries with slowing or negative population growth. However, as illustrated in the media coverage of the current surge of refugees and asylum seekers into Europe, there is also the possibility for heightened social tensions between native populations and immigrants. The magnitude, or propensity of these risks may depend on a number of cultural dynamics within the native population including a country's openness to migration or presence of far-right, anti-immigrant political parties, which IFs does not attempt to model or forecast.

While IFs does not model the social implications of migration, the tool can help to show changes in migration patterns that may affect the propensity for social tensions to arise. As an example, there is a strong relationship between how citizens agreed or disagreed with the statement 'when jobs are scarce, employers should give priority to people of this country over immigrants' and the traditionalism vs. secular-rationality index, which measures whether the aggregate values of a country align more with traditional and religious values or those that are more secular in nature.[20] Figure 4.22 indicates that countries with more secular values are more open to the employment of immigrants during times when jobs are scarce, and therefore may have less of a propensity for social tensions to arise from increases in migration.

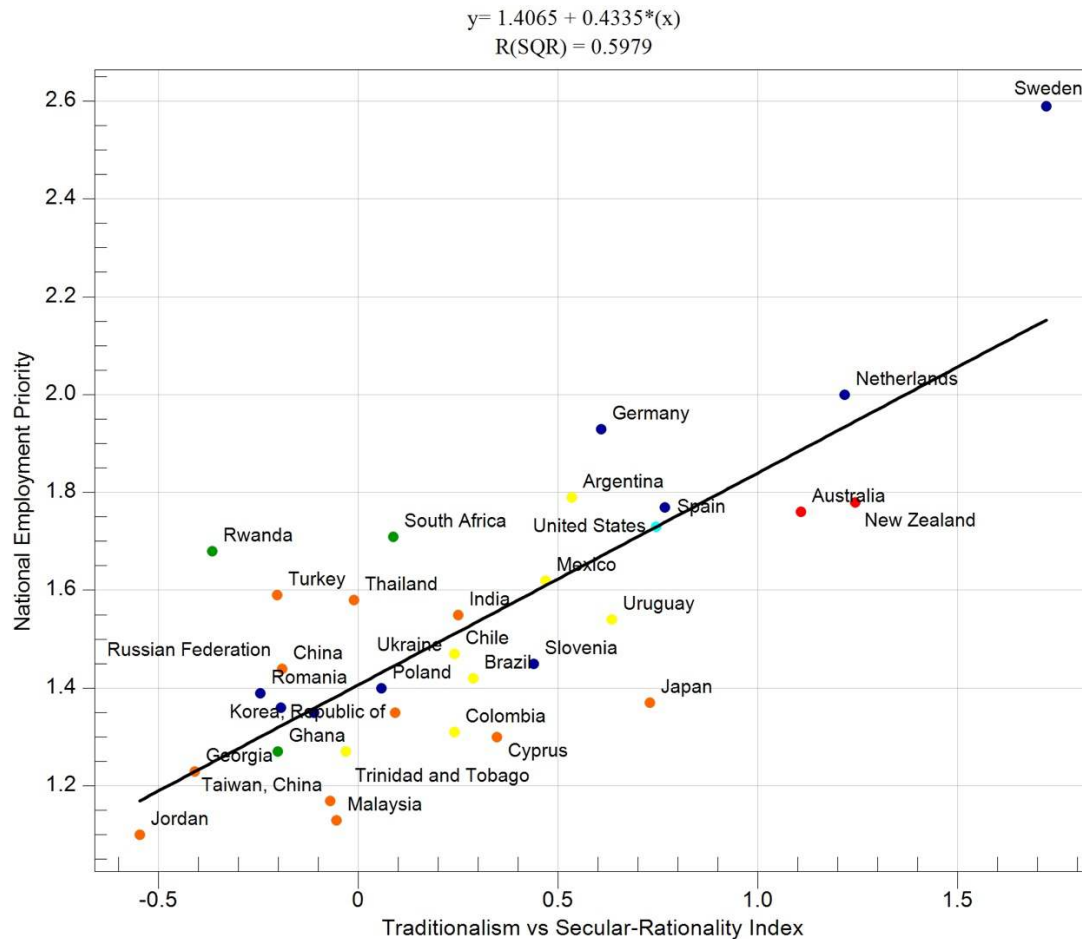[20] These measure are from IFs, but utilize information from the World Values Survey.

Figure 4.22: National employment priority (lower indicates greater agreement with the notion that employment should prioritize people of the country as opposed to immigrants) vs. the traditionalism vs secular-rationality index (where lower scores indicate values more aligned with traditional or religious values). Note: Both indices are from the World Values Survey.
Source: IFs 7.19

In countries with a history or higher propensity for tensions between native and migrant populations, a migrant age-sex distribution skewed heavily towards young males could further exacerbate the potential for social risks. Data shows that age-sex distribution of immigrants in high-income countries has been and is increasingly dominated by young men. Figure 4.24 shows the gender difference of migrants living in high-income countries. In 1990, there were roughly 1.5 million more male migrants between the ages of 15 and 35 than females. By 2013 this increased to nearly 2 million. In countries where this influx of young men skews the gender balance, social implications may follow.
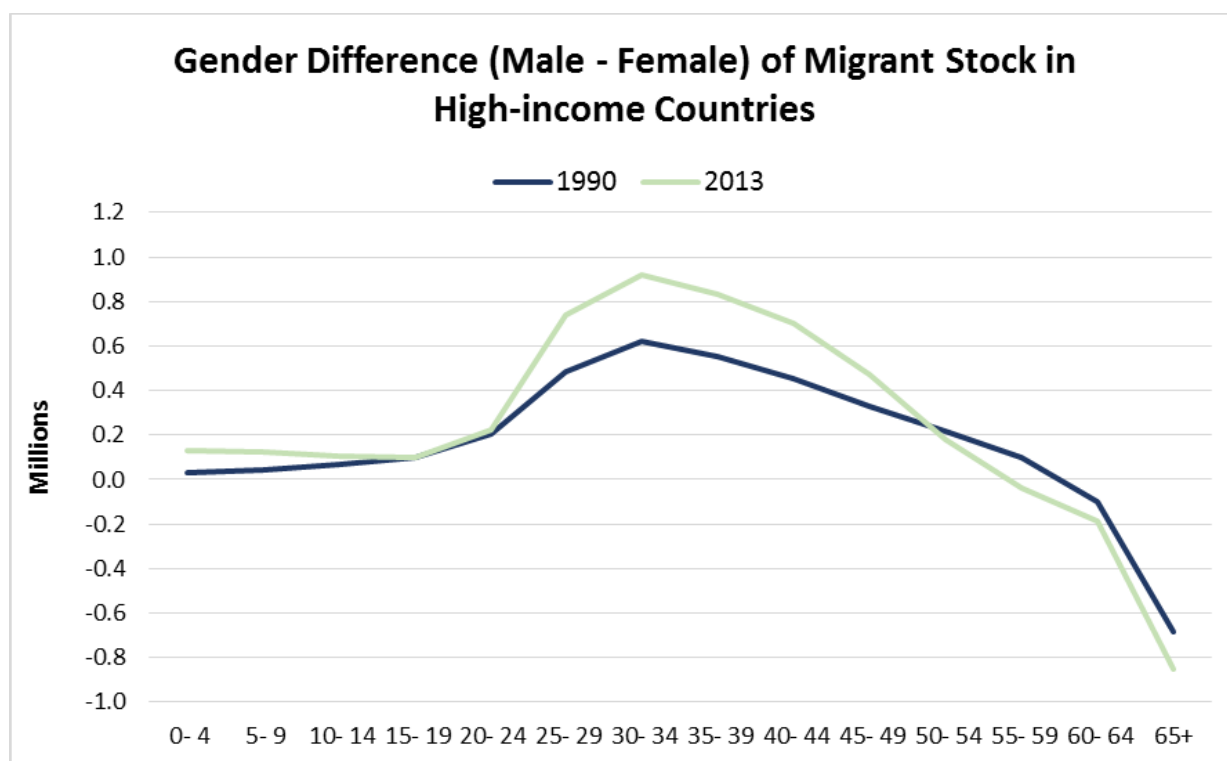
Figure 4.24: Gender difference of migrant stocks in high-income countries, 1990 and 2013
Source: IFs 7.19

4.4 Summary

This section highlighted the great variance of demographic profiles among countries, as well as the macroeconomic, financial, and social risks and benefits characteristic of countries at different points along the demographic transition. While these risks and benefits are associated with particular stages of the demographic transition, the pressure they exert is largely defined by the magnitude and speed with which countries experience them. These two factors determine the relative size of benefit or burden a country will face and the time horizon available for preparation (either for harnessing benefit or diminishing burden).

To summarize these benefits and risks we have developed three indices: (1) the Youth Benefit Index (Figure 4.25) identifies those countries that through 2035 are forecast to be best positioned to take advantage of favorable demographic change, including reduction in youth bulge, school-age population, and health care costs, as well as the increase in share of the working-age population, (2) the Youth Risk Index (Figure 4.26- left) aims to identify countries that may face elevated financial and social risk due to large and sustained youth bulge and school-age cohorts, and (3) the Elderly Risk Index (4.26 - right) identifies those countries that by 2035 face the largest increases in pension demand, health care costs, labor deficits, and the potential intergenerational tension.
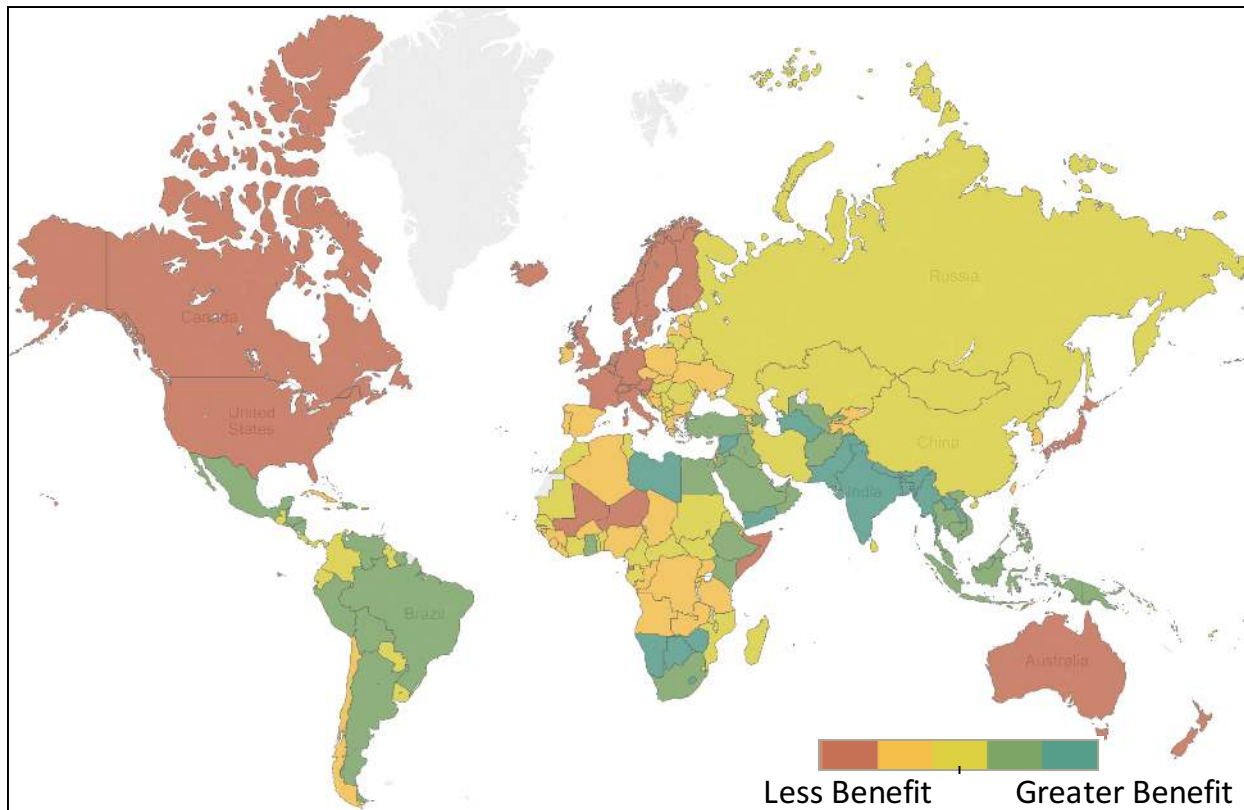
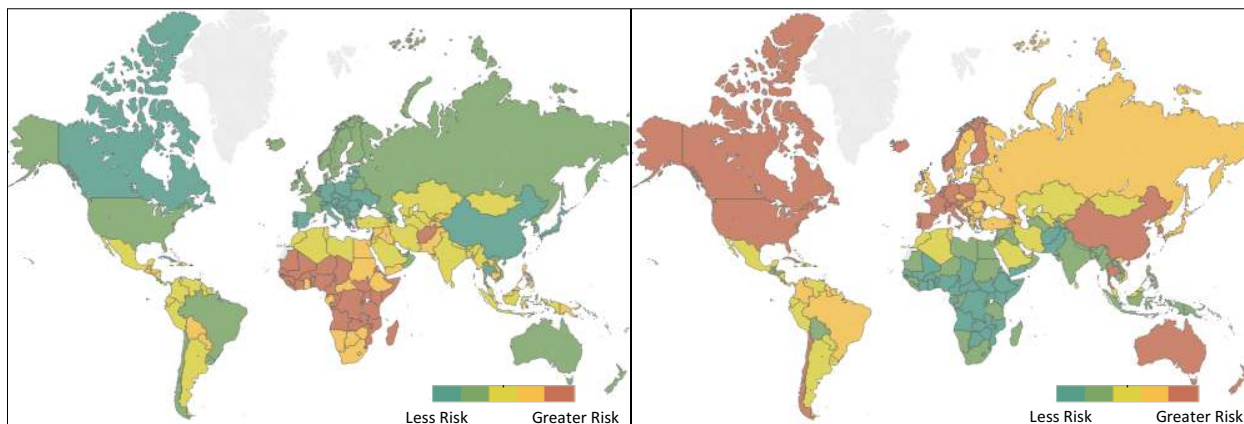*Figure 4.25: Youth Benefit Index.*
Source: IFs 7.19

Figure 4.26: Youth Risk Index (left) and Elderly Risk Index (right).
Source: IFs 7.19

These indices and the countries which fair the best and worst according to each of their sub-components can be found in Appendix A: Winners and losers of Demographic Change.

5. Uncertainties and Scenarios

The "human tectonics" of fertility and mortality that push populations through the stages and associated risks and benefits of the demographic transition are relatively well understood and forecastable. Other—more uncertain—interacting variables, like medical advancements leading to healthier, longer living populations (particularly in countries already facing challenges from aging), unanticipated drops in fertility rates across Equatorial Africa (West, Central, and Eastern African regions), or sustained high levels of migration from poor and war-torn regions to higher-income and aging countries, have the potential to change substantially the nature and balance of risks and benefits associated with demographic change.

This section uses the IFs integrated assessment tool to explore and consider the implications of three demographic futures that differ from the Base Case Scenario discussed in the previous sections. The Longevity Scenario explores a world in which advances in medical technology and treatments drive down mortality rates, particularly from the non-communicable diseases that have an increasing burden on older, wealthier populations. Though in this alternative future populations are healthier and live longer, governments, particularly those of rapidly aging countries like China, face the challenge of paying for pensions and for potentially delayed, but ultimately increasing, health costs of a growing and economically dependent elderly population.

The Low Fertility Scenario focuses on Equatorial Africa, where instead of a continuation of the largely stalled reduction in high levels of fertility that the region has been experiencing, countries are able to dramatically reduce the number of births per woman across a lifetime. This frees up resources for reinvestment back into the economy and labor force, reducing the cost of extending basic services, like access to safe water and sanitation, and shifting the regional course toward a higher demographic dividend.

The High-Migration Scenario explores a future where over the next decade economic disparity and conflict drive higher levels of global migration from low-income or conflict-stricken countries like Syria to wealthier, aging countries like Germany and other EU members. While our analysis in this scenario does not model the social implications of migration, we do forecast its impact on demographic structure and the economic benefits that countries like Germany might ultimately receive from the influx of working-age migrants into an otherwise declining population.

To better understand the implications of each scenario, we examine them in reference to the IFs Base Case. The IFs Base Case is a collection of baseline forecasts that, while dynamically interacting, represent a continuation of current policy choices and underlying dynamics. Although the Base Case generally demonstrates continuity with historical patterns, it provides a structure that generates a wide range of non-linear, dynamic, and endogenous forecasts rather than just a simple extrapolation of historical trends. The Base Case assumes no major paradigm shifts, policy changes or "black swans" (very low probability but high impact events, such as a global pandemic or a nuclear war). Given that the Base Case is built from initial conditions of all

historical variables and is periodically analyzed in comparison to many other forecasts, it is a good starting point to carry out scenario analysis and construct alternative future scenarios.

6.1 Longevity Scenario

In the mid-1950s the average global life expectancy was 50 years. Today it is 70. Forecasts from IFs anticipate life expectancies in high-income (leading edge) countries to rise by about the same number of years per decade as in recent ones and for developing countries to increase at an even greater pace as they converge to life expectancies of high-income societies. Already we see the impact of HIV/AIDS treatment programs in extending life expectancy in low-income countries (Figure 5.1).
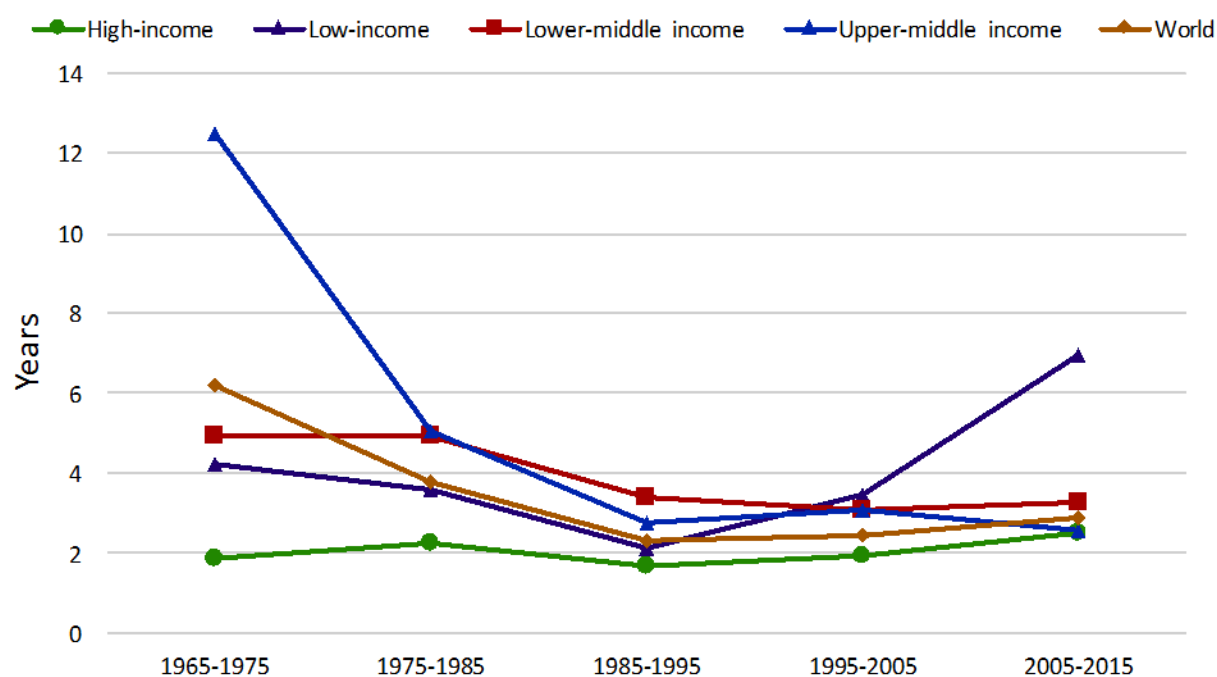

Figure 5.1: Life expectancy increase per decade for World Bank income groups and the world.
Source: IFs 7.19

With advances in medical technology, growth in life expectancies in all countries could again increase at a higher rate, meaning a child born in Europe in 2035 could expect to live 90 years. The Longevity Scenario simulates a reduction in the burden of heart disease, cancers, and some communicable diseases (not including HIV/AIDS, diarrhea, malaria, and respiratory infections).[21] While individuals may benefit, the extension of life expectancy that results from the reduction of these diseases may exacerbate the longer-run challenge for governments in meeting demand for pensions and eventually health care.

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[21] The Longevity Scenario has been adapted from the Lifeex150 Scenario developed for the "Opportunities and Challenges of a World with Negligible Senescence" report produced by the Pardee Center for the SENS Research Foundation. For information on the details of the scenario please see: http://www.pardee.du.edu/sites/default/files/Hughes_2014_SENS.pdf
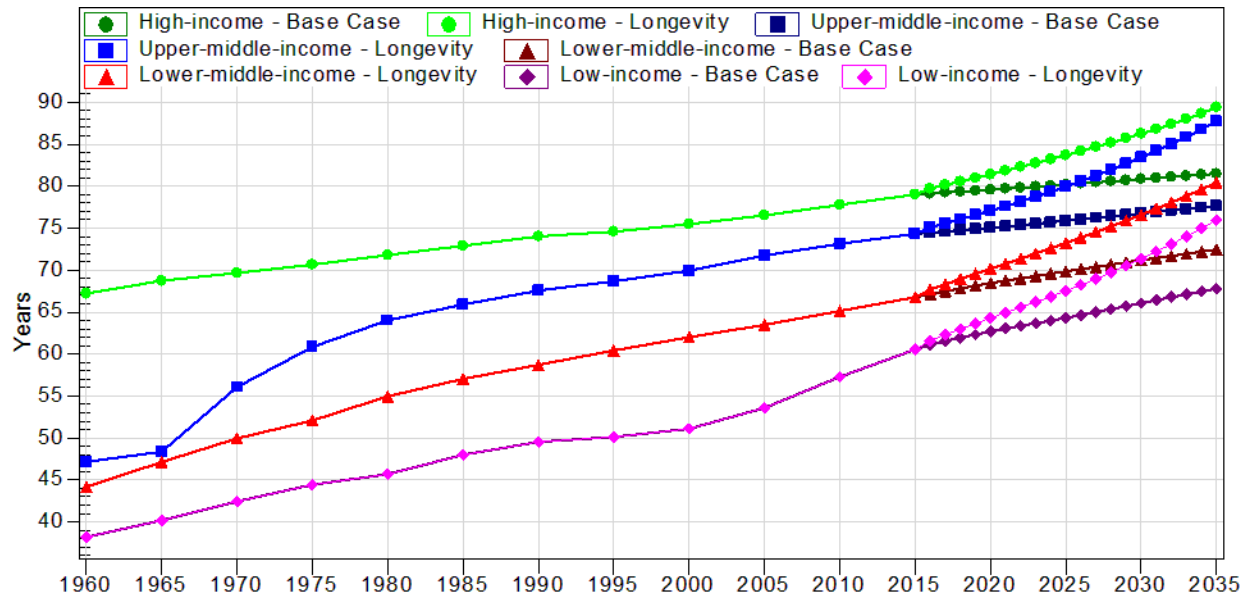
Figure 5.2: Life expectancy for World Bank income groups, showing historical data, Base Case and Longevity Scenario forecasts. Not that the upper-middle income average is largely dominated by China, recognizable by the Great Leap Forward during the 1960s.
Source: IFs 7.19

In this section we compare the impacts of life extension in two countries. France, having already passed through the demographic transition, serves as a useful case study in the financial and social implications of further aging in already aged populations. China, on the other hand, is representative of the many countries expected to undergo aging at a considerably quicker pace.

In 2010, the French government announced that, in order curb a rapidly growing pension shortfall which by 2020 would reach to unsustainable levels, it would raise the retirement age from 60 to 62. At that time 17 percent of the country's population was 65 or older (Figure 5.3), and by 2020 (the reference year for the government's analysis) the share of France's elderly population will have grown to over 20 percent.

Today in China, approximately less than 10 percent of the population is 65 years or older. By the early 2030s the country is expected to reach France's 2010 value of 17 percent, and less than 4 years later reach 20 percent. While the economic and social contexts are quite different between the two countries, it is important to note that France's slower-moving demographic change afforded the country much more time to anticipate and adapt to the financial repercussions of aging. As another point of comparison, France's share of population 65 years and older increased from 7 percent in 1865 to 14 percent in 1980 (115 year doubling time). China's share of 65 years and older reached the 7 percent mark in 2001, and is forecast to pass 14 percent by 2025, resulting in a doubling time five times shorter than what France experienced. And while China's rate of aging is somewhat higher than other countries that are

still undergoing this doubling (average doubling time for those countries is 32 years), it is still lower than around 40% of the world's countries.
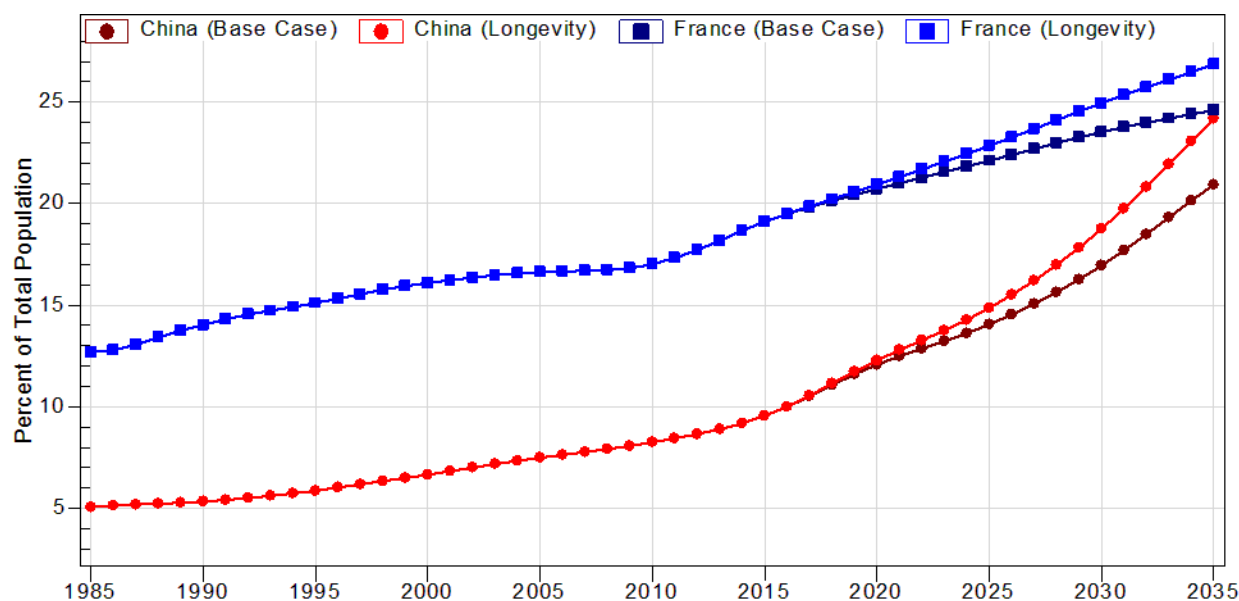

Figure 5.3: Population 65 and older as a percent of the total population for France and China, history and forecast. Source: IFs 7.19

In the Longevity Scenario, children born in either country in 2035 have a life expectancy of 90 years. But how these breakthroughs in life extension translate to the national economy depends to a large extent on the current age-structure of their populations. For example, China's life expectancy and median age (74.2 and 37.0 respectively in 2015) are significantly lower than that of France (81.9 and 41.2 respectively in 2015). Nevertheless, China's demographic dividend passed its peak in 2015. By 2035, the working-age share of China's population is forecast to shrink by 7 percentage points and the country will be experiencing the first of several large waves of retirement (Figure 5.4). Under the Longevity Scenario, China's working-age share of the population is forecast to decline by over 10 percentage points relative to the 2015 mark, but the size of the greater-than-65 cohort will have grown by over 60 million.
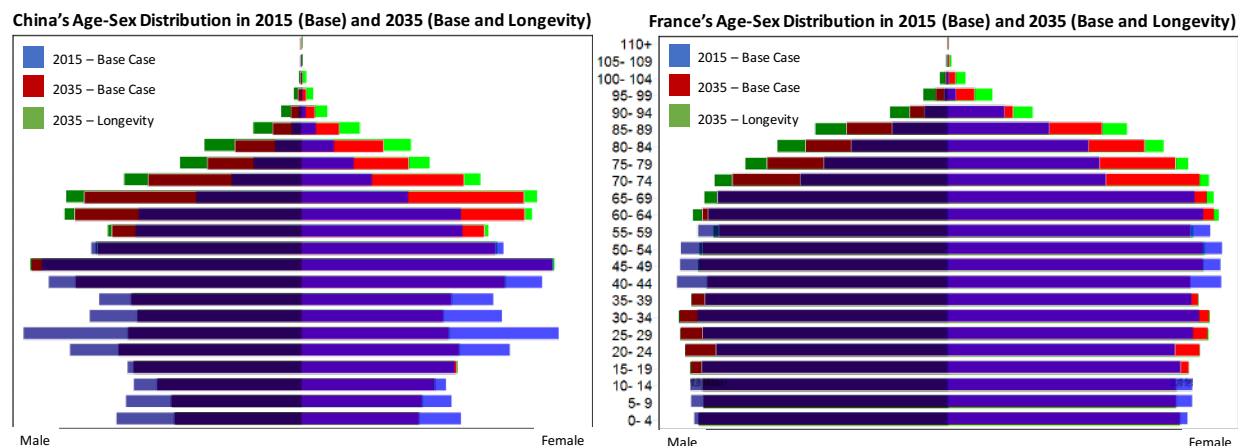
Figure 5.4: Age-sex distribution for China and France in 2015 and 2030 across the Base Case and Longevity Scenarios.
Source: IFs 7.19

One implication of these shifting balances is the increased consumption needs of the retired population. The annual consumption needs as a percent of GDP of all French retirees are forecast to increase over 25 percent between 2015 and 2035 in the Base Case. In the Longevity Scenario, annual consumption needs are 42 percent higher by 2035 (Figure 5.5). In the more rapidly aging China, the life expectancy increases of the Longevity Scenario could drive a 190 percent increase in retirees' consumption needs between 2015 and 2035.
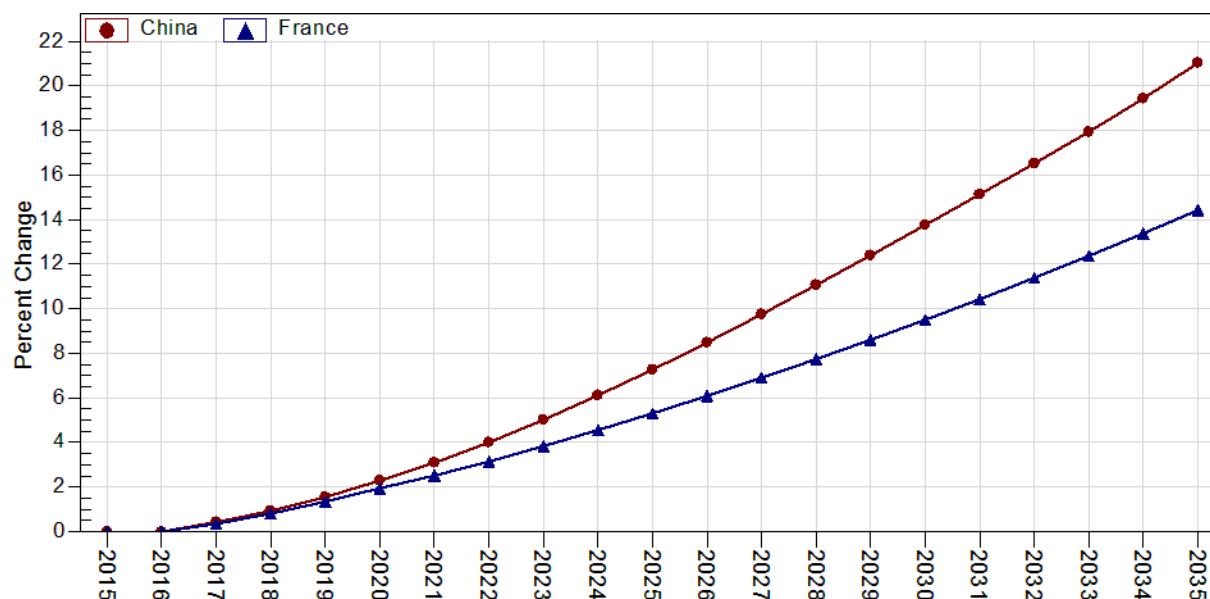

Figure 5.5: Percent change in annual consumption needs for all retirees as a percent of GDP between the Base Case and Longevity Scenarios for China and France.
Source: IFs 7.19

Since the growth of the elderly population in this scenario is paired with a decline in the share of the economically active population, the government's capacity to support the consumption needs of all retirees will become even more constrained. In the Base Case, the annual Chinese pension spending gap (retirement needs minus government transfers for pensions) grows from around $200 billion in 2015 to roughly $1.4 trillion in 2035, but grows to over $1.8 trillion in the

Longevity Scenario (Figure 5.6). However, since this intervention benefits many of the older (but still productive), working-age population in China, the increased pension spending gap during this period is somewhat muted compared to what it could grow to once the country has reached a more mature age-structure (a pension gap reaching over $5 trillion, or 50 percent higher relative to the Base Case).
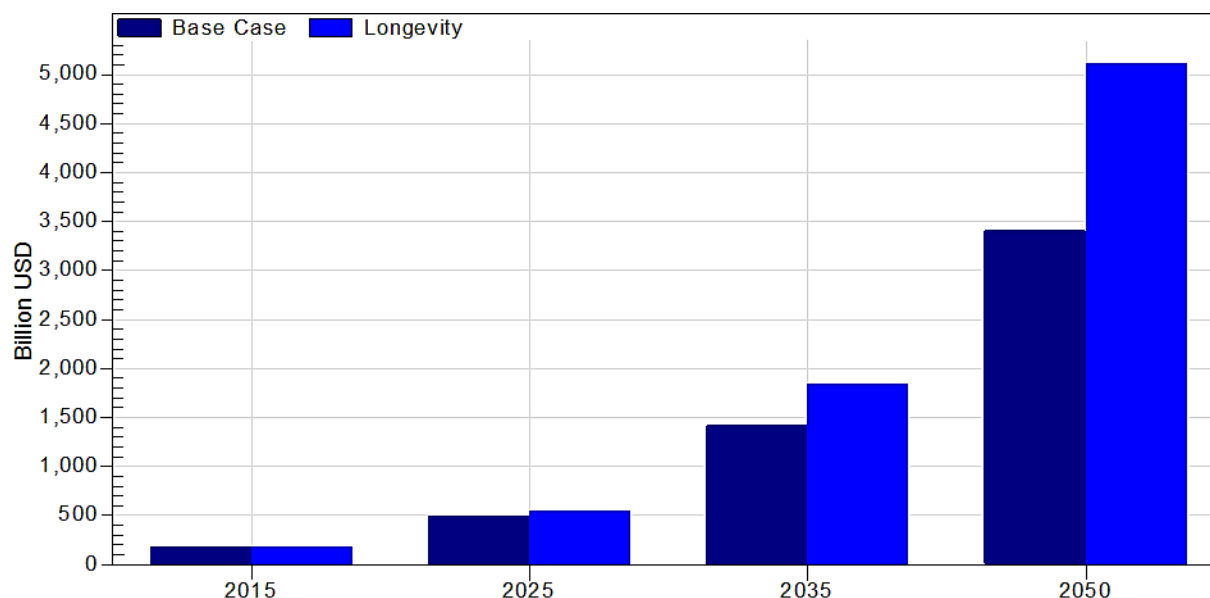

Figure 5.6: The difference between total annual pension needs and government to household transfers for China.
Source: IFs 7.19

This example is illustrative of the health-care dilemma: while individuals enjoy the benefits of longer, healthier lives, the social burden of delaying care until later in life can, in fact, increase in the long-run. Since health costs are generally lower for the working-age population then they are for those later in life, China's health costs are much lower than they would be given France's age-distribution. One way of understanding this is by looking at the health cost distribution of the two countries in 2015 (Figure 5.7). Today in France, health costs attributed to the population 65 and older account for over 80 percent of the country's total costs. In China, however, the same population group accounts for only 50 percent of the country's total health costs. Jumping ahead to 2035, the Base Cases forecasts the French health costs attributed to the population 65 and older to increase by 8 percentage points, in China however, this value jumps by 20 percentage points.
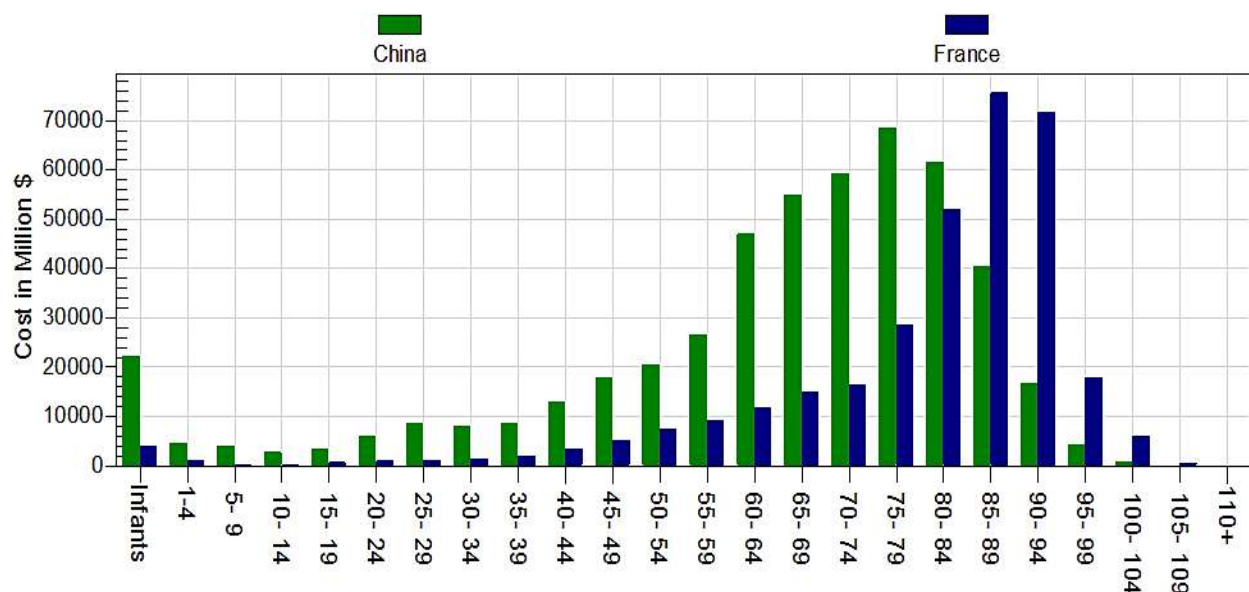
Figure 5.7: Health costs by age cohort for China and France in 2015.
Source: IFs 7.19

While exogenously reducing mortality rates of particular diseases affecting elderly populations does translate into savings in health costs in the short term, over the longer run governments can face even greater fiscal pressure. For higher-income countries like France, which have already achieved mature, or post-mature status, these life extensions will largely benefit those who are already within the retirement age, increasing the share of middle-old and old-old cohorts. Furthermore, by the time the delayed costs are realized the balance of economically active and inactive populations will have shifted towards the later. Figure 5.8 shows that before 2015 health costs in France already exceeded government spending on health by about 30 percent, and the spending gap is forecast to increase. This gap widens even more rapidly in the Longevity Scenario, as the elderly population grows relative to the working-age population.

For countries like China, that have a younger, but rapidly aging, age-structure, the benefits initially impact a larger share of working age cohorts. Because of this, the country sees a longer period of sustained cost reduction. However, as the 2030-2035 wave of pensioners begin to require higher levels of most-costly medical attention, Chinese health care demand is expected to increase dramatically.
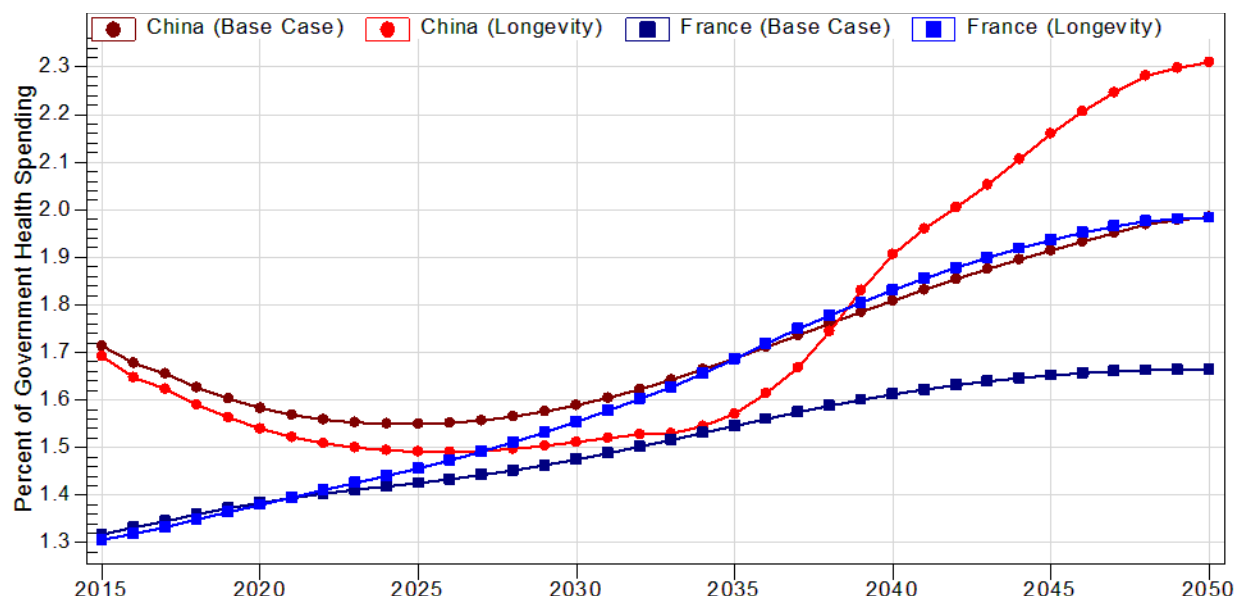
Figure 5.8: Health costs as a percent of government health spending.
Source: IFs 7.19

This is perhaps more easily seen by looking at age-specific financial impacts of life extension. In any population, reducing the relative risk of one disease means greater exposure to another later in life. In the case of younger, developing countries, the disease risks associated with a lack of access to safe water and sanitation far outweigh the risks of diseases of affluence found in older, high-income countries. Figures 5.9 and 5.10 show the differential impacts of extending life expectancy through the reduction in cancers and heart disease by 2035 for France and China respectively.

By deferring healthcare costs of the middle-old, and extending average life spans, by 2035 France experiences an even greater financial burden from the other non-communicable diseases affecting the population later in life (Figure 5.9). In the case of China, we can see that the spike in cost reductions from averted cancer and heart disease seen in 2035 matches the first major wave of seniors (see Figure 5.4). If permitted to play out further, we would begin to see a net reversal and dramatic divergence in health spending gaps between the Base Case and Longevity scenarios (illustrated in Figure 5.10).

Though beyond the horizon of this report, this departure from the current path brings to light an important and unique challenge that could (perhaps already is) severely limiting the developmental potential of China. In avoiding the burden of cancer and heart disease, a longer living Chinese population inadvertently exposes itself to continually high levels of air-pollution, which through causing long-term respiratory health problems can drive the health spending gap to unprecedented levels, amplifying the risks it will be facing due to rapid aging.[22]

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[22] IFs (7.19) forecasts that by 2035 carbon emissions in China will be greater than the 6 largest polluters today combined (China excluded).

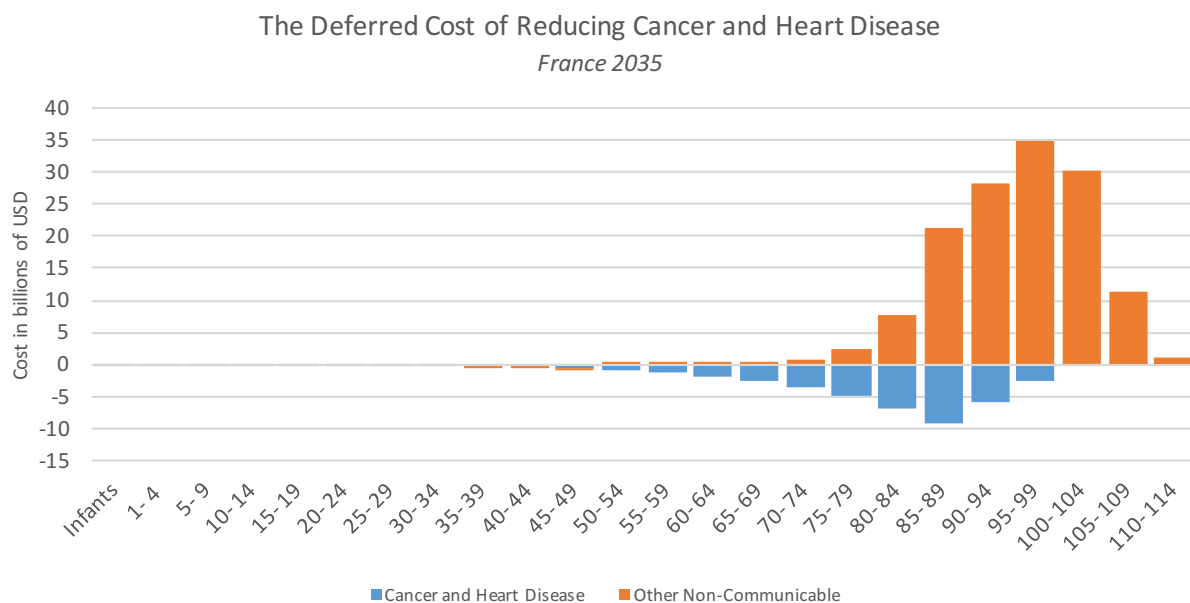The Deferred Cost of Reducing Cancer and Heart Disease
France 2035

Figure 5.9: The costs and costs savings associated with extending longevity through reductions in cancer and heart disease mortality in 2035. Positive values represent a net cost for the particular disease group and age cohort.
Source: IFs 7.19

The Deferred Cost of Reducing Cancer and Heart Disease
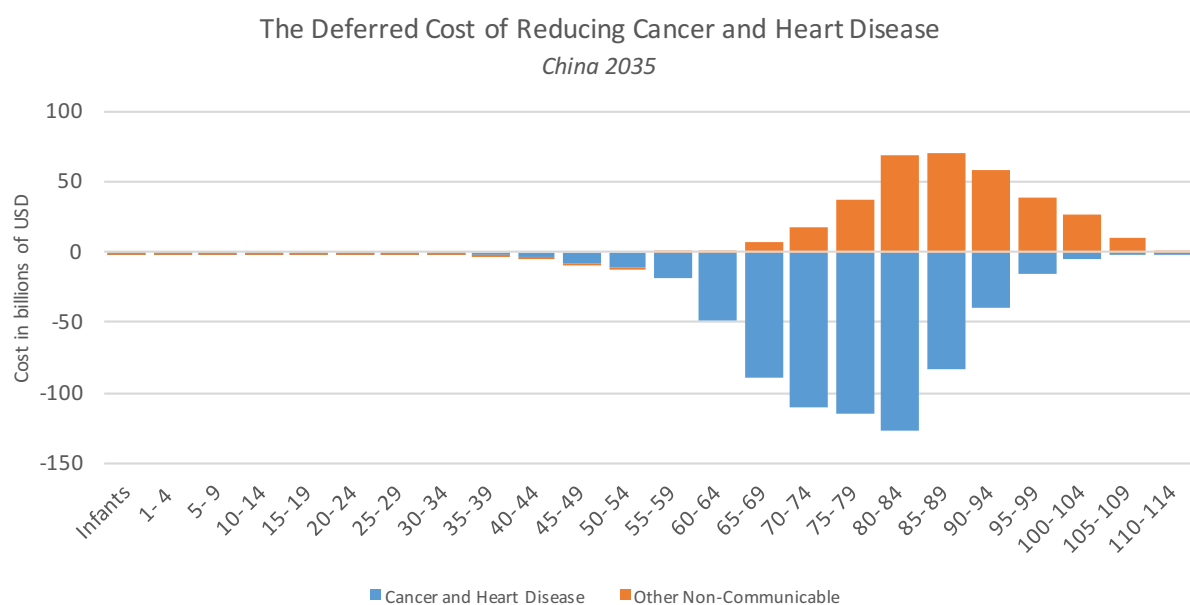*China 2035*

Figure 5.10: The costs and costs savings associated with extending longevity through reductions in cancer and heart disease mortality in 2035. Positive values represent a net cost for the particular disease group and age cohort.
Source: IFs 7.19

By 2035, IFs forecasts little divergence between the Base Case and Longevity Scenario in overall social need associated with demographic change for China (Figure 5.11). This trend begins to change dramatically as the first large wave of retirees begins to receive pensions and accrue larger health costs. France, on the other hand, receives little reprieve at the national level from these advances in health care. Without reforms to the pension system or retirement age, the country could see a 12 percent increase in financial needs by 2035 relative to the Base Case.
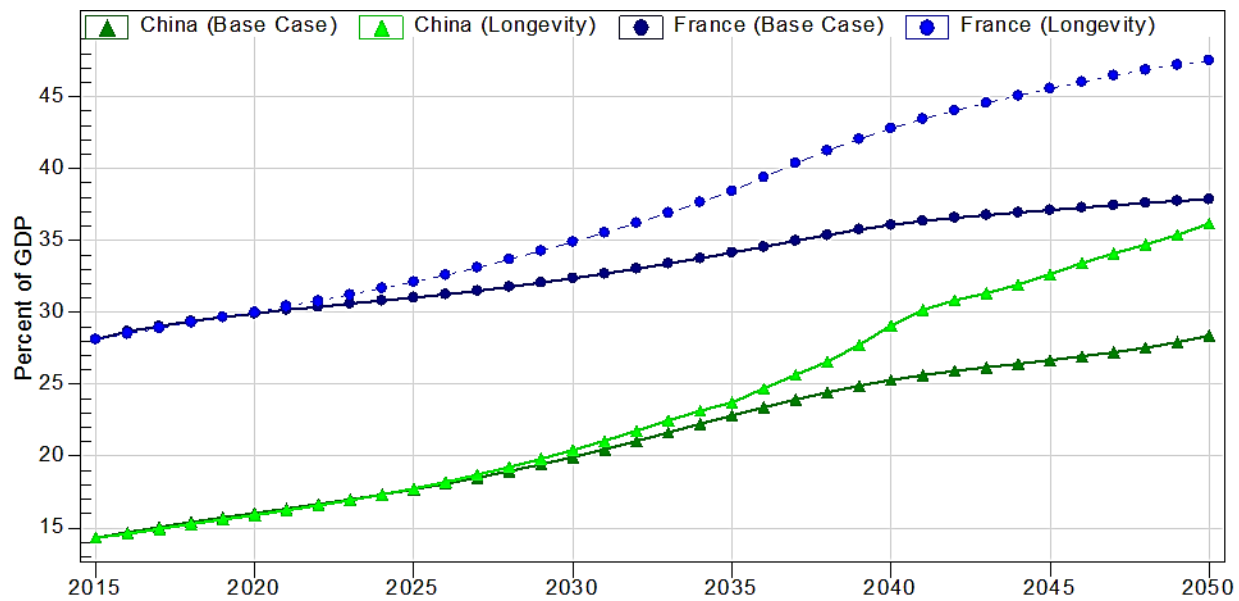

Figure 5.11: Overall financial risk associated with demographic change for China and France across the Base Case and Longevity Scenario. Note: This measure is calculated as the sum of education need, pension need, and health care costs, all as a percent of GDP.
Source: IFs 7.19

6.2 Low Fertility Scenario

Many countries across Equatorial Africa have fallen behind in the global decline in fertility. Today, African woman give birth to over 5 children on average, more than double the global average. These historically high birth rates have perpetuated large youth bulges and delayed the onset of demographic dividends in the region. Decreasing fertility rates beyond the expected trajectory would lower youth dependency, and provide a boost to the demographic dividend for many countries. If utilized properly, this demographic window of opportunity offers higher growth potential for African countries and reduces the cost of extending basic services to populations still stuck in poverty.

History shows that dramatic fertility reductions are indeed possible. For example, in China total fertility rates dropped from 6 to 2 births per woman in just 20 years, and in Iran rates dropped from 6 to 1.5 over 35 years. In the Low Fertility Scenario we explore the implications of a similar reduction in Equatorial Africa.[23] In 2015, average total fertility rates were around 5.2 births per woman. The IFs Base Case forecasts a decline to 3.8 over the next 20 years (though this may actually be optimistic given historical trends). The Low Fertility Scenario changes the regional trajectory so that by 2035 average total fertility rates reach 2.3 (see Figure 5.12).
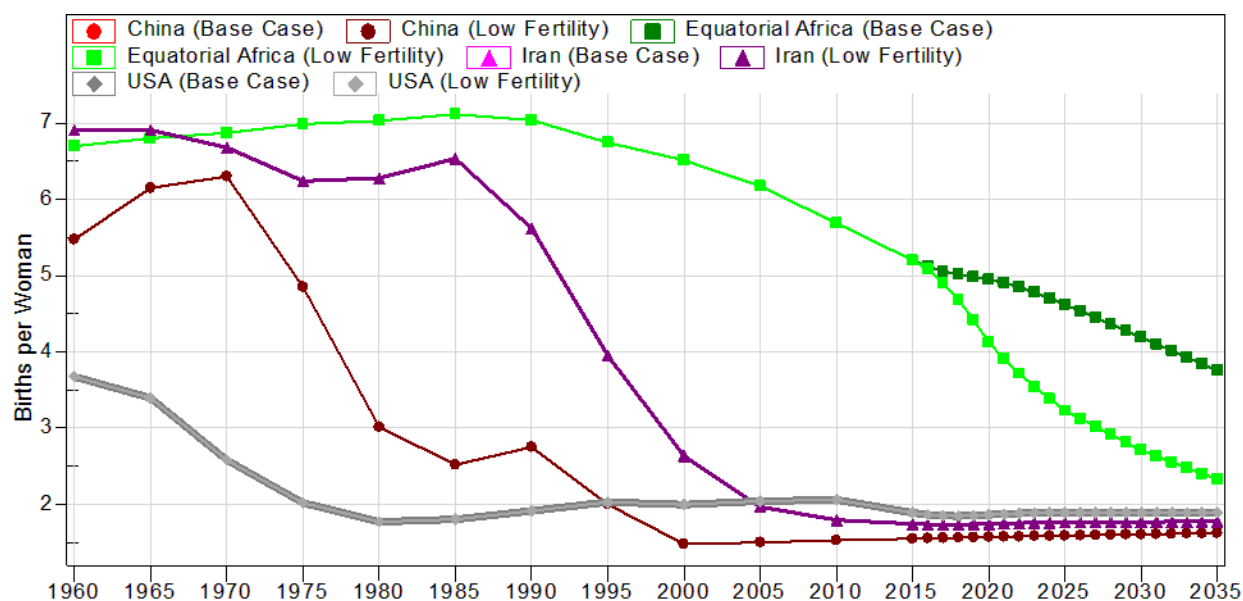

Figure 5.12: Total fertility rate for China, Iran, USA, and Equatorial Africa, history and forecast.
Source: IFs 7.19

By 2035 the effect of this intervention on the region's age-sex distribution is quite pronounced (Figure 5.13) with far fewer young people relative to the Base Case. This has the immediate benefit of reducing the number of economically dependent cohorts within the population.

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[23] The Low Fertility scenario includes the following parameter changes/specifications: the total fertility rate multiplier (tfrm) was decreased from 1 to 0.625 over 20 years for Equatorial Africa

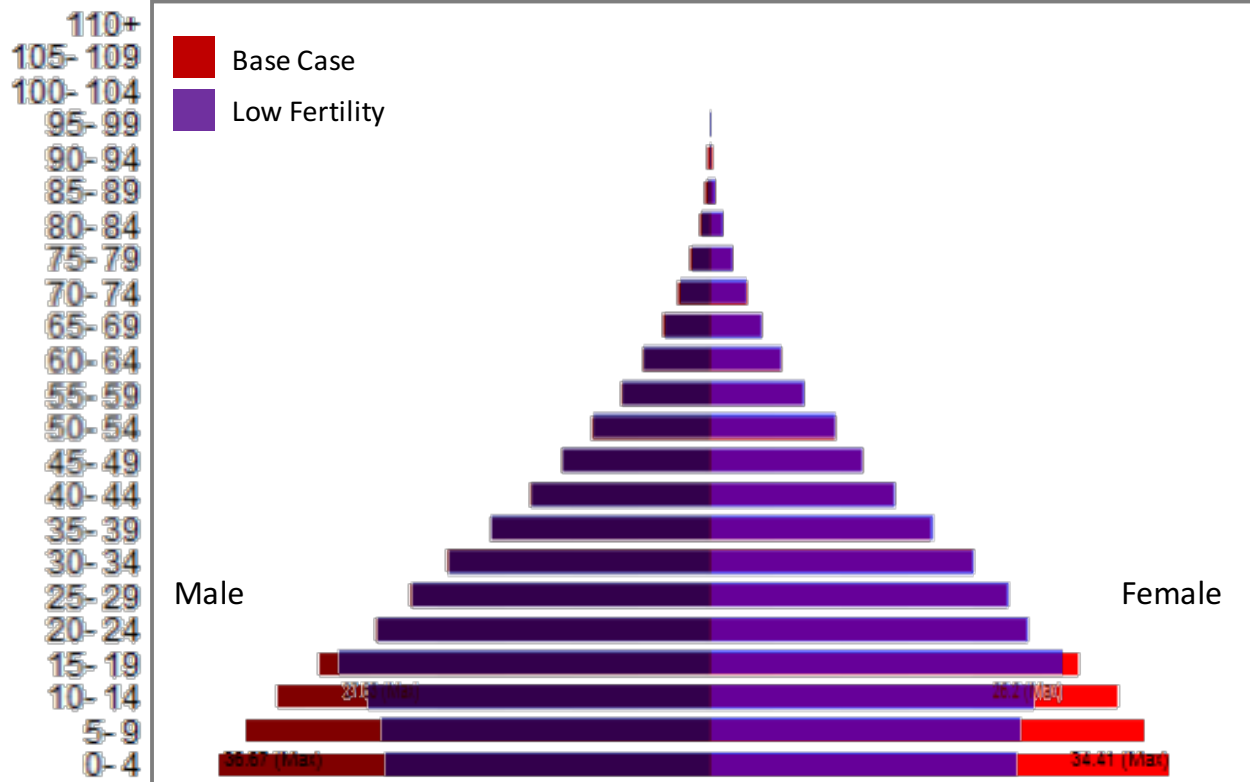## Equatorial Africa's Age-Sex Distribution in 2035

Figure 5.13: Age-Sex distribution for Equatorial Africa in 2035. Males are on the left, and females are on the right.
Source: IFs 7.17

Yet even by 2035 this intervention may do little to reduce the risks of internal conflict, instability, or the fragility of democracy since the share of young adults (15 to 29) remains relatively unchanged over the given time horizon. Nevertheless, the years following will see a dramatic reduction in the potentially dangerous youth bulge (Figure 5.14).
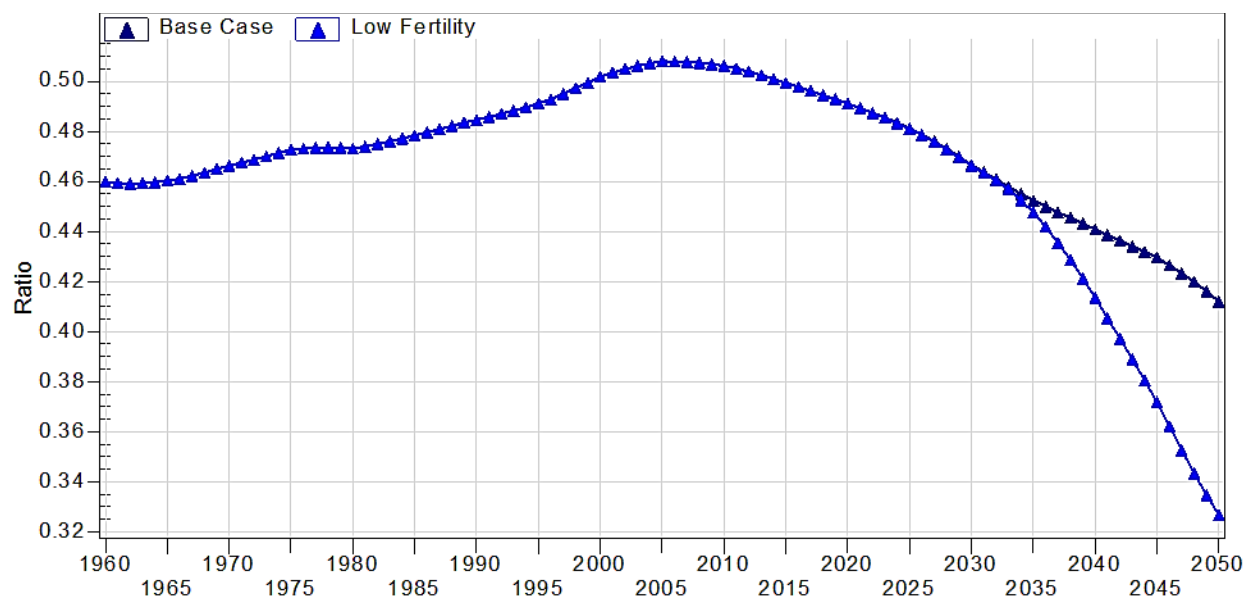
Figure 5.14: The youth bulge in Equatorial Africa, history and forecast. Note that by 2030 the youth bulge remains largely unchanged since the intervention has only affected the cohort of under 20 year olds, with a more pronounced impact on younger cohorts. Nevertheless, by 2050, the benefits of fertility reduction are quite obvious.
Source: IFs 7.19

In the Base Case, the demographic dividend in Equatorial Africa is expected to increase at a moderate rate compared with the historical growth of lower- and upper-middle income groups, meaning that, even by 2035 and despite the fact that the global average demographic dividend is already in decline, the region will still have the lowest levels in the world. However, in the Low Fertility Scenario the reduction in the share of younger cohorts sets the region on a completely different trajectory; one in which the region has the highest demographic dividend in the world by the mid-2030s and it continues to grow even after all other regions were in decline (Figure 5.15).
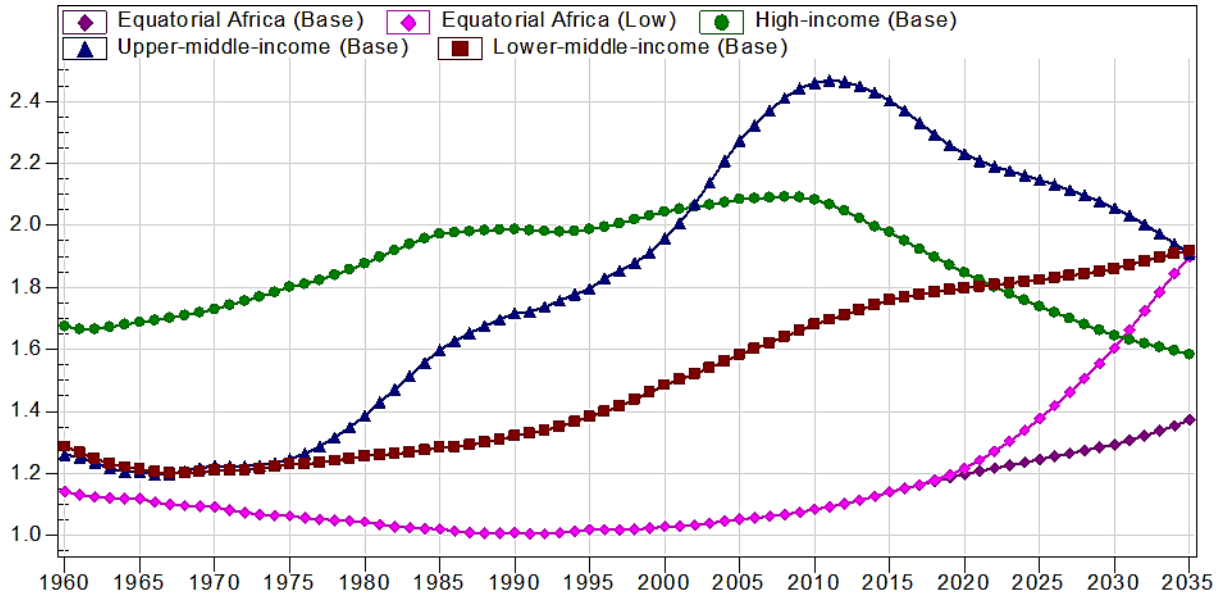
Figure 5.15: Demographic dividend in Equatorial Africa, history and forecast.
Source: IFs 7.19

Educational costs are rising in Equatorial Africa due to an increasing number of children entering into the system. In the Base Case, the primary and secondary education spending gap, or the cost of educating all primary and secondary students at high-income country spending-per-student (as a percent of GDP per capita) levels, is expected to grow from around $8.5 billion annually in 2015 to over $26.5 billion annually by 2035. With the sustained high birthrates found in the Base Case, this gap could grow to over $50 billion by 2050. However, by decreasing fertility rates this spending gap begins to plateau by 2035, and reverse directions by 2050, resulting in a spending gap of $26.6 billion less than the Base Case.
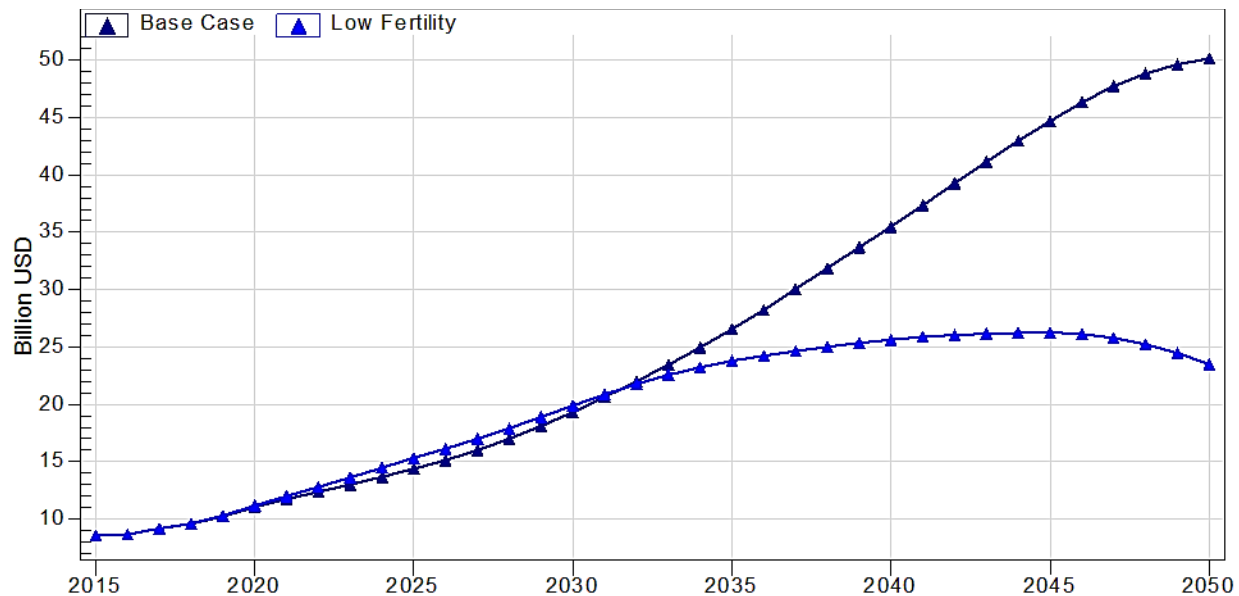
Figure 5.16: Primary and secondary education spending gap (the difference between current primary education spending and total spending if countries adopted per student spending levels of high-income countries) for Equatorial Africa.
Source: IFs 7.19

Another benefit that comes from a reduction in fertility rates is an increase in per capita GDP. This is not attributable to any substantial increases in labor productivity, but instead results from a simple reduction in population size (Figure 5.17).
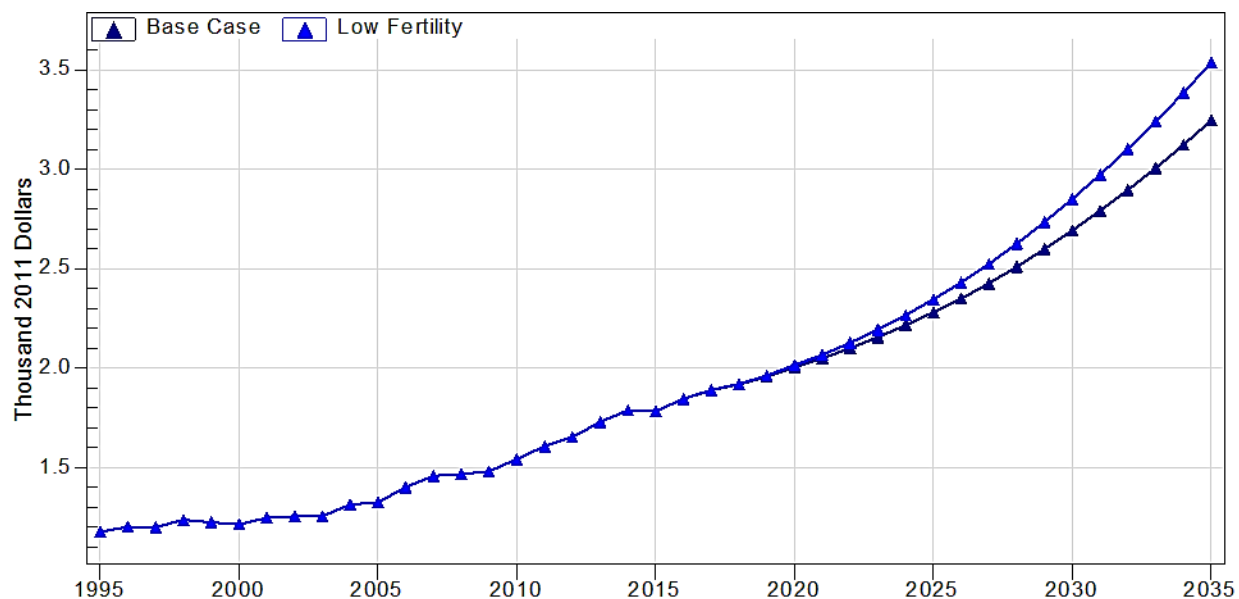

Figure 5.17: GDP per capita (PPP), history and forecast.
Source: IFs 7.19

6.3 High-Migration Scenario

In aging countries where births have fallen below replacement levels, migration can be the dominating factor in population growth (Figure 5.18) and can offset a decline in the working-age population. Most of the variation in Germany's population since 1975 can be explained by

episodes of increased migration. From 1980 to the mid-1990s Germany saw a large influx of both ethnic Germans from the Soviet Union and refugees from Iran and Lebanon, and later from Yugoslavia, Romania, and Turkey (Solsten 1995).
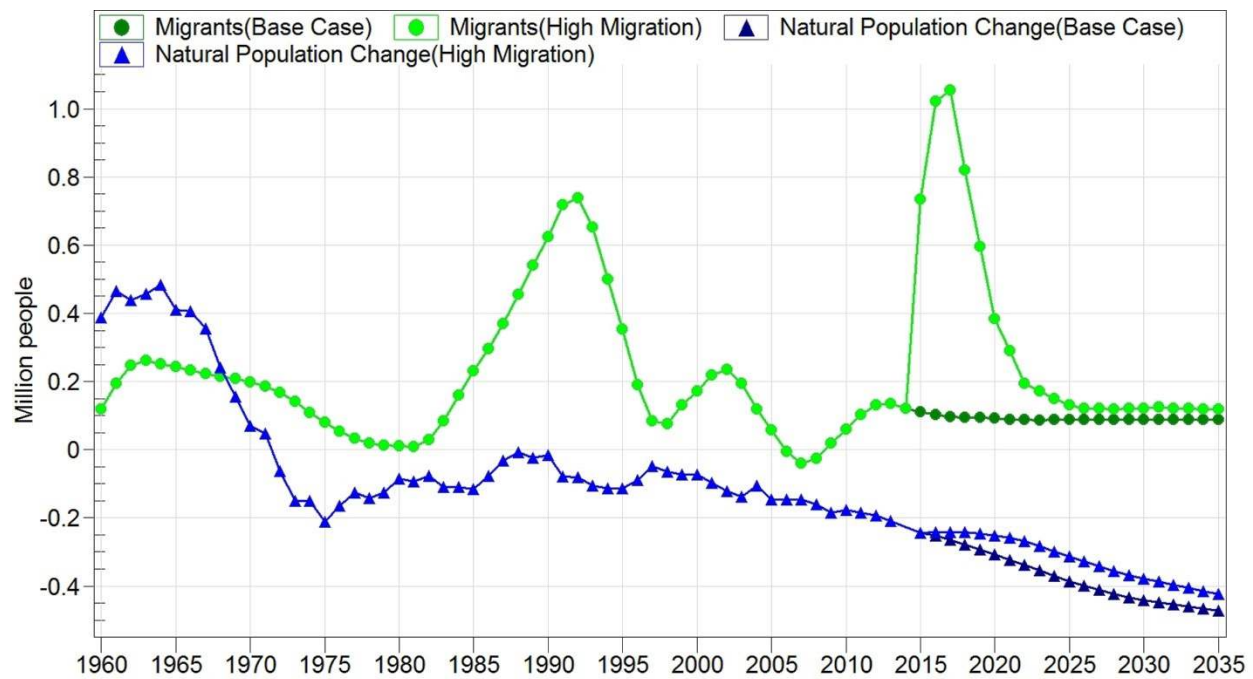

Figure 5.18: Natural population growth (births minus deaths) and net migration.
Source: 7.19

Conflict in Syria has forced over three million people to flee the country. While most of these refugees seek asylum in neighboring countries, many have made their way to the European Union, with 85 percent resettling in Germany (Migration Policy Center et al 2016). In 2015 the German Federal Office estimated an inflow of up to 800,000 refugees seeking to escape conflict in Syria and other war-torn countries, or the economic conditions in Greece and North African countries (Die Welt 2016).

The High Migration Scenario simulates this influx by increasing the number of migrants flowing from conflict-stricken countries (particularly Syria) and low-income countries with limited economic opportunity to the European Union, particularly Germany.[24] While our analysis in this scenario does not model the social implications of migration, we do forecast its impact on overall population (see Figure 5.19), demographic structure, and the economic benefits that

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[24] The High Migration scenario includes the following parameter changes/specifications: (1) the world migration rate multiplier (wmigrm) was increased from 1 in 2015 to 1.1 in 2016 and kept at 1.1 through 2100 (2) net inward migration rate (percent) (migrater) for Syria was decreased from -4.43 in 2015 to -10 in 2015, then reduced to -0.3 over 5 years (3) net inward migration rate (percent) (migrater) for WB Low-income countries was decreased from -0.15 in 2015 to -0.25 in 2017, increased to -0.118 by 2035 (4) net inward migration rate (percent) (migrater) for Germany was increased from 0.85 in 2015 to 1.1 in 2017, then decreased to 0.12 by 2035 (5) net inward migration rate (percent) (migrater) for the EU plus Turkey (without Germany) was increased from 0.2 in 2015 to 0.4 in 2019, decreased to 0.17 through 2031, then kept at 0.17.

countries like Germany might ultimately receive from the influx of working-age migrants into an otherwise declining population.
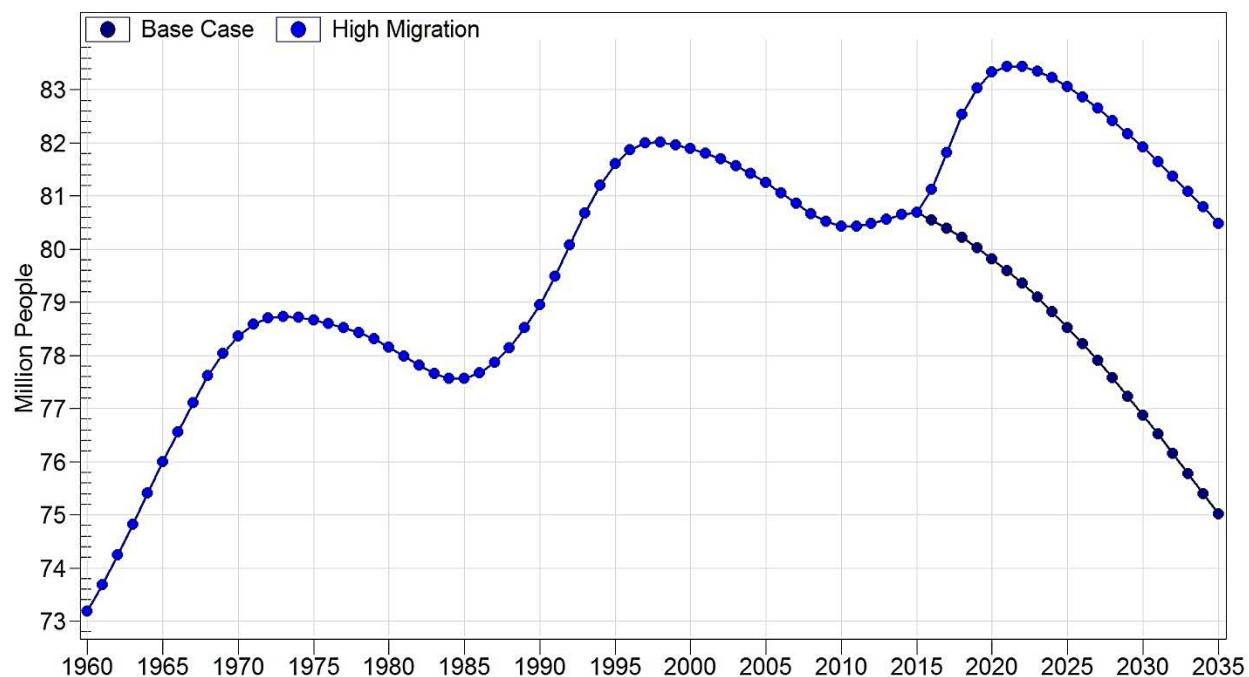

Figure 5.19: Total population of Germany, history and forecast.
Source: IFs 7.19

The effects of this influx of young, predominately male, migrant population has the possibility of fueling social tensions with older and more gender-balanced native populations (a dimension that we do not attempt to model in this analysis). Nevertheless, it can also provide a beneficial boost to the relative size of the working-age population. In Germany, the High Migration Scenario leads to working-age population that is 9 percent larger in 2035 than the Base Case.

While this infusion of labor does not solve the potential risks of aging, it does mitigate them. As Figures 5.20 and 5.21 show, the High Migration Scenario could lower the gap between pension spending and pension need in Germany by over $17 billion annually by 2035, relative to the Base Case, while the health spending gap could close by nearly $25 billion annually relative to the Base Case.
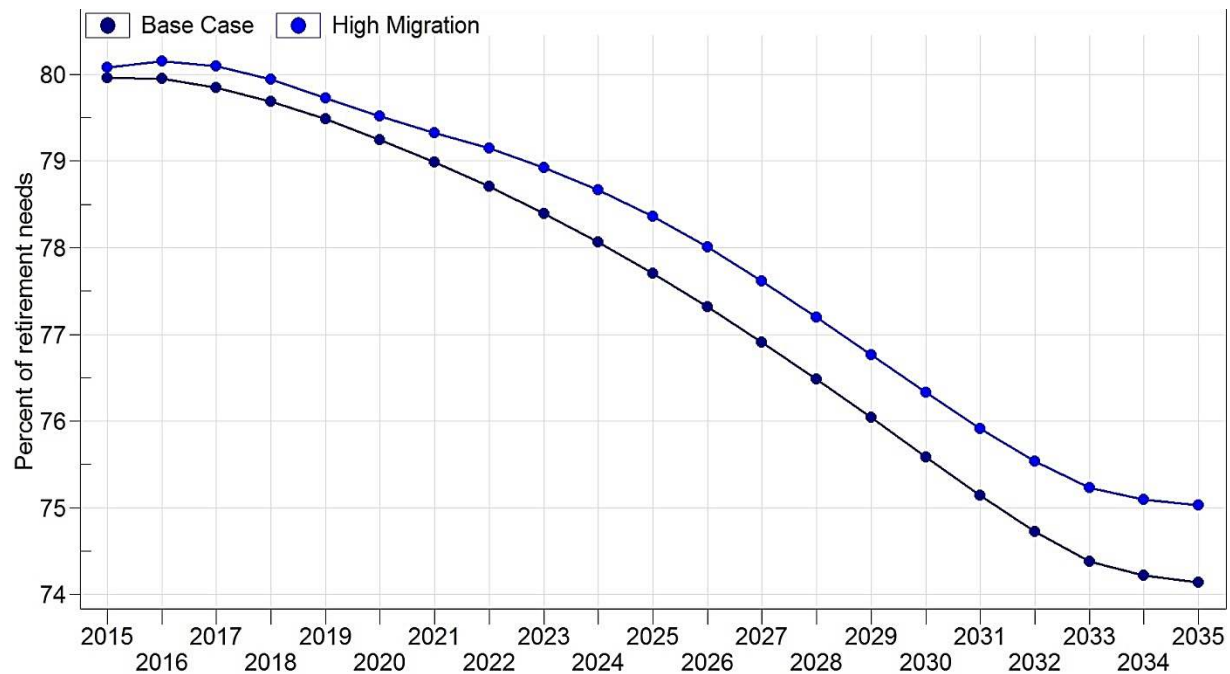
Figure 5.20: Government pension transfers as a percent of total retirement needs in Germany.
Source: IFs 7.19

Figure 5.21: Government spending on health as a percent of total health costs in Germany for the Base Case and High Migration scenarios.
Source: IFs 7.19

Perhaps most important is the direct contribution to economic growth that migration can provide for aging countries in which the labor force is already in decline. Since migrants are primarily younger, working-age adults, they help to offset the growing labor defict in these

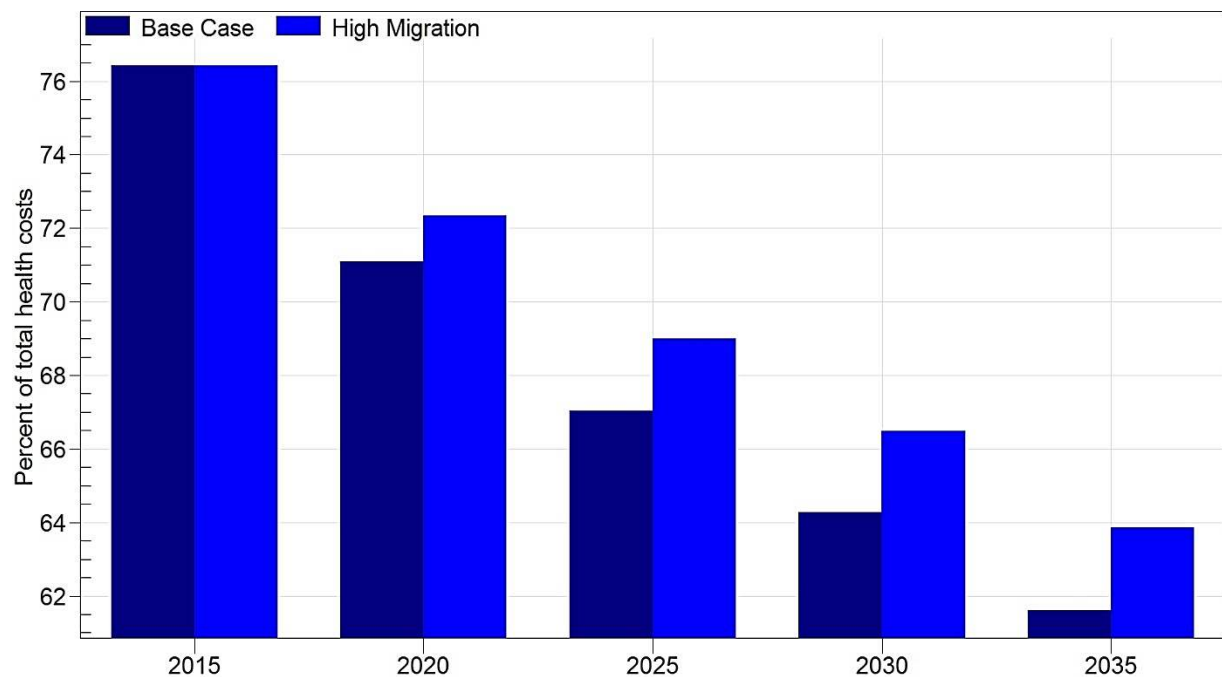countries and in turn mitigate some of the loss in economic growth attributable to labor force shrinkage.
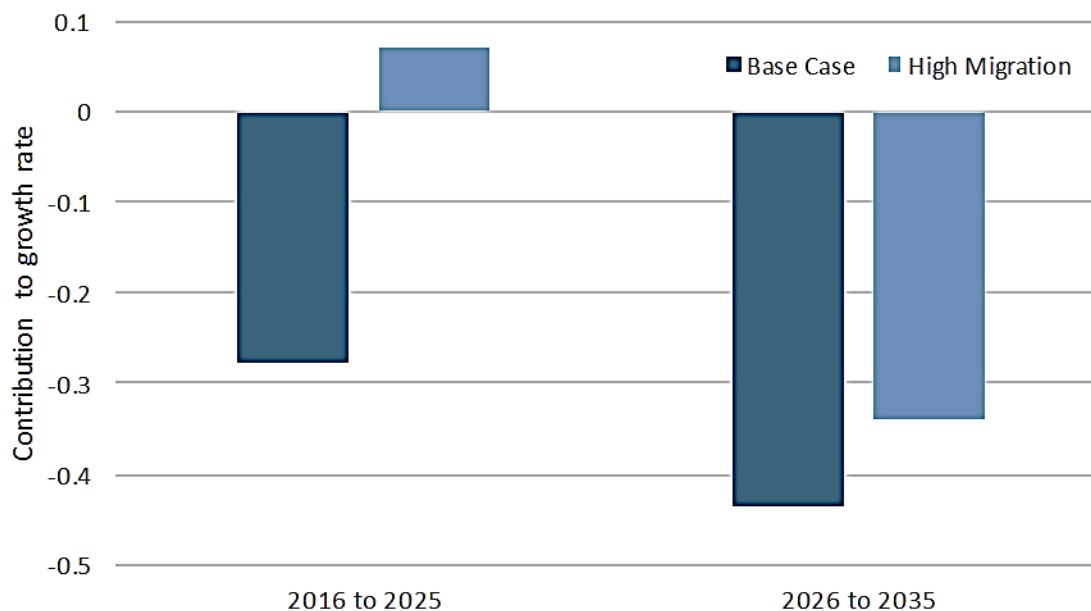
Figure 5.22: Labor's contribution to economic growth for Germany in the Base Case and High Migration scenarios. Source: IFs 7.19

In the Base Case, Germany's shrinking labor force is expected to be a net drag on the economy probably within the next five years and increasingly so over the next 20 years (Figure 5.22). In the High Migration Scenario, the inflow of migrants acutally reverses this trend over the next few years, which translates to nearly $140 billion more in GDP annually (relative to the Base Case) by 2035 (Figure 5.23).[25]

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[25] The High Migration Scenario is built on the assumption that migrants are able to quickly integrate into the German economy. In that sense the economic gains seen in this scenario may overestimate the initial impact of migration.

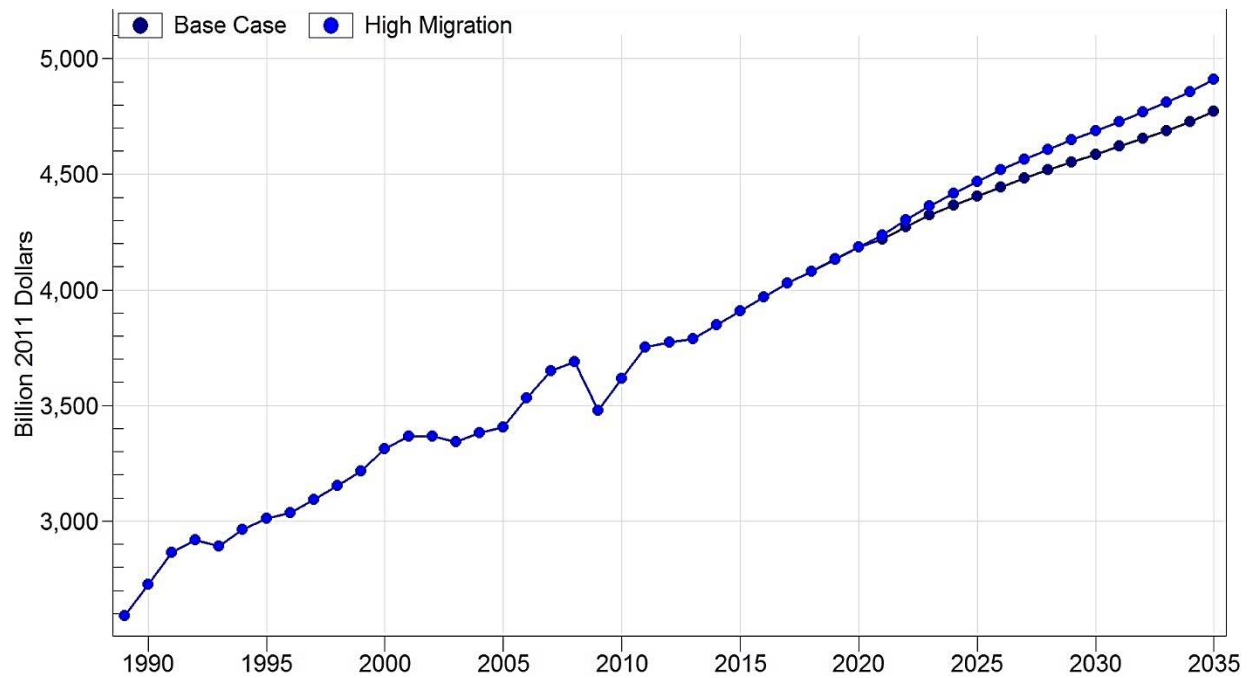*Figure 5.23: German GDP at MER for the Base Case and High Migration scenarios.*
Source: IFs 7.19

7. Conclusion

Demographics and developmental are intertwined. Most of today's richest countries are well through their traversal of the demographic transition, having already enjoyed decades of a demographic dividend and a relatively long period to adjust to the changing macroeconomic, financial, and social landscape. Lower-income economies are typically younger, some having only just passed into the second stage of the transition and others trapped in a state of demographic pause with sustained high fertility rates. And many middle-income countries, like China, India, and Brazil, are in a demographic sweet spot where a fairly recent decline in fertility rates has translated into a relatively small economically dependent population. The risks and benefits associated with demographic change also break along similar developmental lines, with younger, developing countries enjoying simultaneously declining education costs and a demographic dividend, and older and richer countries facing the financial challenges associated with higher health care costs and pension demands all while a declining labor force undermines the potential for economic growth.

While these dynamics are fairly well understood historically, we are currently entering into an era of unprecedented aging and agedness. In Japan, Italy, Germany, Portugal, Greece and Finland over 20 percent of the population is over the age of 65. These countries, and others, may be heading towards a financial crunch where, if reforms in the areas of retirement age and pensions are not realized, their governments will face great difficulty meeting the demand for health care and pensions. At the same time, many younger populations face a double burden of development, in that they are in a race to address remaining developmental challenges such as extending basic services and treating communicable disease in the poorest populations, while at the same time preparing for the financial and macroeconomic issues associated with rapid aging.

Our analysis suggests that it is important for countries of all demographic and developmental stages to begin preparing for these challenges. Countries with sustained high fertility rates face the burden of educating and providing health care to large youth populations, but reducing fertility rates can set the country on a path which greatly facilitates the extension of basic human services through a decline in youth dependency and an increase in the share of the economically active population. Younger countries which are already well underway in the transition can enjoy a period of opportunity in terms of a freeing up of resources, a growing demographic dividend, and also the time they have before they are confronted with the challenges associated with large elderly populations. Reinvestment in the country's youth is critical in this stage since it is that cohort which will be contributing most at the peak of the demographic dividend. But for most countries today, the financial risk associated with aging is already a one-way street. Advances in technology and increased migration may help to offset the handicap imposed by a declining labor force size, but financial pressure will nonetheless build as declining younger generations are expected to provide for a growing retired population. High-income economies must make the necessary reforms to retirement age and pension structures to avoid financial, and perhaps social, crisis.

Countries like France, Greece, and New Zealand have already encountered protests around retirement and pension reform, even though these countries had the luxury of aging at very gradual rate. Where it took 115 years for France's population above the age of 65 to increase from 7 percent of the total to 14 percent, we now expect one-third of the world's countries to make this transition in under 30 years, and many to make the transition in less than 10. For these developing countries, preparing for future demographic risks requires taking full advantage of their current demographic benefits.

We are not getting any younger. Preparing for demographic risks is critical to every country's future, no matter what median age or stage of development they are at today. Not making the right choices now can lessen economic growth potential for decades. While there will be few second chances, foresight can play a crucial role in mitigating these risks by not only identifying the reforms that are necessary to escape fiscal crisis, but also implementing them early enough to avoid costly tradeoffs or excessive social tension.

Bibliography

Adams, Richard H. 2011. "Evaluating the Economic Impact of International Remittances on Developing Countries Using Household Surveys: A Literature Review." *Journal of Development Studies* 47(6): 809–28. doi:10.1080/00220388.2011.563299.

Agrawal, Ajay, Devesh Kapur, John McHale, and Alexander Oettl. 2011. "Brain Drain or Brain Bank? The Impact of Skilled Emigration on Poor-Country Innovation." *Journal of Urban Economics* 69(1): 43–55. doi:10.1016/j.jue.2010.06.003.

Apuzzo, Matt, Michael S. Schmidt, and Julia Preston. 2015. "U.S. Visa Process Missed San Bernardino Wife's Online Zealotry." *The New York Times*. December 12, 2015. http://www.nytimes.com/2015/12/13/us/san-bernardino-attacks-us-visa-process-tashfeen-maliks-remarks-on-social-media-about-jihad-were-missed.html.

Asch, Beth J., and Courtland Reichmann, eds. 1994. *Emigration and Its Effects on the Sending Country*. California: RAND. ISBN: 0-8330-1485-4.

Aydemi, Abdurrahman, and George J. Borjas. 2007. "Cross-Country Variation in the Impact of International Migration: Canada, Mexico, and the United States." *Journal of the European Economic Association* 5(4): 663–708.

Barrell, Ray, John Fitzgerald, and Rebecca Riley. 2010. "EU Enlargement and Migration: Assessing the Macroeconomic Impacts." *JCMS: Journal of Common Market Studies* 48(2): 373–95. doi:10.1111/j.1468-5965.2009.02056.x.

Bernanke, Ben S. 2005. "The Global Saving Glut and the U.S. Current Account Deficit." Speech at the Sandridge Lecture, Virginia Association of Economists, Richmond, Virginia. March 10, 2005. http://www.federalreserve.gov/boarddocs/speeches/2005/200503102/

Berrada, Mohamed, Sara Burke, Hernán Cortés, and Isabel Ortiz. 2013. "World Protests 2006-2013." Working Paper. New York: Inititative for Policy Diaglogue and Friedrich-Ebert-Stiftung New York. policydialogue.org/programs/taskforces/global_social_justice/.

Birdsall, Nancy. 1980. "Population and Poverty in the Developing World." World Bank Staff Working Paper no. 404. World Bank, Washington, D.C.

Bloom, David E., and David Canning. 2004. "Global Demographic Change: Dimensions and Economic Significance." NBER Working Paper No. 10817. National Bureau of Economic Research, Cambridge, MA. http://www.nber.org/papers/w10817

Bloom, David E., David Canning, and Günther Fink. 2010. "Implications of Population Ageing for Economic Growth." *Oxford Review of Economic Policy* 26(4): 583–612. doi:10.1093/oxrep/grq038.

Blue, Laura, and Thomas J. Espenshade. 2011. "Population Momentum Across the Demographic Transition." *Population and Development Review* 37(4): 721–47. doi:10.1111/j.1728-4457.2011.00454.x.

Bon, Gerard. 2010. "French protesters rally over pension reform." *Reuters.* October 16, 2010. http://www.reuters.com/article/us-france-pensions-idUSTRE69E43320101016

Bosworth, Barry, Ralph Bryant, and Gary Burtless. 2004. "The Impact of Aging on Financial Markets and the Economy: A Survey." The Brookings Institution, Washington, D.C. SSRN: 1147668.

Burtless, Gary. 2005. "The Impact of Global Aging on Saving, Investment, Asset Prices, and Returns." The Brookings Institution, Washington, D.C.

Capuano, Stella, Herbert Brücker, and Abdeslam Marfouk. 2013. "Education, Gender and International Migration: Insights from a Panel-Dataset 1980-2010, Mimeo." Institute for Employment Research (IAB), Nuremberg, Germany. http://www.iab.de/en/daten/iab-brain-drain-data.aspx.

Castles, Stephen, Mark J. Miller, and Giuseppe Ammendola. 2005. "The Age of Migration: International Population Movements in the Modern World." *American Foreign Policy Interests* 27(6): 537–42. doi:10.1080/10803920500434037.

Choudhry, Misbah T. 2013. *Age Dependency and Labor Productivity Divergence*. No. 113. Università di Perugia, Dipartimento Economia.

Choudhry, Misbah T., Enrico Marelli, and Marcello Signorelli. 2015. "Age Dependency and Labour Productivity in Developing and Developed Economies." Presented at the Asian emerging economies in the post crisis era: growth trajectories, challenges and perspectives, Turin Center on Emerging Economies, Turin, Italy, March 12-13, 2015.

Cincotta, Richard P. 2011a. "Demography & Liberal Democracy: The Age-Structural Maturity Thesis." Presented at Foreign Policy Research Institute, Philadelphia.

———. 2008. "Half a Chance: Youth Bulges and Transitions to Liberal Democracy." *Environmental Change and Security Program Report* 13: 10.

———. 2013. "The Future Out to 2030: According to Demography." In Gale, Steven, and Sarah Jackson, eds. 2013. *The Future Can't Wait*. United States Agency for International Development, Washington, D.C.

———. 2011b. "Tunisia Predicted: Demography and the Probability of Liberal Democracy in the Greater Middle East." Presented at The Woodrow Wilson International Center for Scholars, Washington, D.C.

Crush, Jonathan, and Sujata Ramachandran. 2010. "Xenophobia, International Migration and Development." *Journal of Human Development and Capabilities* 11(2): 209–228. doi:10.1080/19452821003677327.

Cuaresma, Jesús Crespo, Wolfgang Lutz, and Warren Sanderson. 2012. "Age Structure, Education and Economic Growth." Interim Report IR-12-011. International Institute for Applied Systems Analysis, Laxenburg, Austria.

de Haas, Hein. 2010. "Migration and Development: A Theoretical Perspective." *International Migration Review* 44(1): 227–264. doi:10.1111/j.1747-7379.2009.00804.x.

Denhart, Matthew. 2015. "America's Advantage: A Handbook on Immigration and Economic Growth." The Bush Institute at the George W. Bush Presidential Center, Dallas, Texas.

Denton, E. Hazel. 2011. "How Changes in Age Structure Can Impact Policy Making." *SAIS Review* 31(2): 15–34. doi:10.1353/sais.2011.0018.

Die Welt. 2016. "Zahl Der Flüchtlinge Erreicht 'Allzeithoch.'" http://www.welt.de/politik/deutschland/article145402071/Zahl-der-Fluechtlinge-erreicht-Allzeithoch.html.

Dobriansky, Paula J., Richard M. Suzman, and Richard J. Hodes. 2007. "Why Population Aging Matters: A Global Perspective." National Institute of Aging, National Institutes of Health, U.S. Department of Health and Human Services, U.S. Department of State, Washington, D.C.

Dyson, Tim. 2010. *Population and Development: The Demographic Transition*. London: Zed Books. ISBN: 978-1-84277-959-0.

Fuller, Jaime. 2016. "Foreign Men Attacked in Cologne As Protests Ramp Up in Response to New Year's Assaults." *New York Magazine*. January 11, 2016. http://nymag.com/daily/intelligencer/2016/01/#.

Furchtgott-Roth, Diana. 2014. "Does Immigration Increase Economic Growth?" Issue Brief 2. *Economic Policies for the 21st Century*. The Manhattan Institute, New York.

Gale, Steven, and Sarah Jackson, eds. 2013. *The Future Can't Wait*. United States Agency for International Development, Washington, D.C.

Galor, Oded, and David N. Weil. 2000. "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond." *American Economic Review* 90(4):806–828. doi:10.1257/aer.90.4.806.

Genc, Murat, Masood Gheasi, Peter Nijkamp, and Jacques Poot. 2011. "The Impact of Immigration on International Trade: A Meta-Analysis." Discussion Paper Series 6145. Institute for the Study of Labor, Bonn, Germany. http://hdl.handle.net/10419/58524.

Gomez, Rafael, and David K. Foot. 2003. "Age Structure, Income Distribution, and Economic Growth." *Canadian Public Policy* 24.

Gorodzeisky, Anastasia, and Moshe Semyonov. 2015. "Not Only Competitive Threat But Also Racial Prejudice: Sources of Anti-Immigrant Attitudes in European Societies." *International Journal of Public Opinion Research*. doi:10.1093/ijpor/edvo24.

Greenstone, Michael, and Adam Looney. 2010. "Ten Economic Facts About Immigration." The Hamilton Project, The Brookings Institution. www.hamiltonproject.org.

Gribble, James N. 2012. "South Korea's Demographic Dividend." Population Reference Bureau, Washington, D.C. http://www.prb.org/Publications/Articles/2012/south-korea-population.aspx.

Grogger, Jeffrey, and Gordon H. Hanson. 2011. "Income Maximization and the Selection and Sorting of International Migrants." *Journal of Development Economics* 95(1): 42–57. doi:10.1016/j.jdeveco.2010.06.003.

Hassan, Afm, Ruhul Salim, and Harry Bloch. 2011. "Population Age Structure, Saving, Capital Flows and the Real Exchange Rate: A Survey of the Literature." *Journal of Economic Surveys* 25(4): 708–36. doi:10.1111/j.1467-6419.2010.00665.x.

Hoffman, Michael, and Amaney Jamal. 2012. "The Youth and the Arab Spring: Cohort Differences and Similarities." Middle East Law and Governance 4: 168–188. doi: 10.1163/187633712X632399

Hughes, Barry B. 2010. "EU Consumers in 2030: Population, Consumption Power, and Education." Denver, CO: Pardee Center for International Futures, Josef Korbel School of International Studies, University of Denver, Denver, CO.

Hughes, Barry B., Randall Kuhn, Eli S. Margolese-Malin, Dale S. Rothman, and José R. Solórzano. 2014. "Opportunities and Challenges of a World with Negligible Senescence." Final Report to the SENS Foundation. Denver, CO: Pardee Center for International Futures, Josef Korbel School of International Studies, University of Denver, Denver, CO.

International Monetary Fund (IMF). 2011. "The Challenge of Public Pension Reform in Advanced and Emerging Economies." International Monetary Fund, Washington, D.C. https://www.imf.org/external/np/pp/eng/2011/122811.pdf.

Immigration Policy Center. 2007. "The Economic Impact of Immigration." American Immigration Law Foundation, Washington, D.C. www.immigrationpolicy.org.

Jackson, Richard, Neil Howe, and Tobias Peter. 2013. "The Global Aging Preparedness Index." Center for Strategic and International Studies, Washington, D.C. http://csis.org/files/publication/131010_Jackson_GlobalAgingPreparednessIndex2E_Web.pdf.

Jappelli, Tullio, and Franco Modigliani. 1998. "The Age-Saving Profile and the Life-Cycle Hypothesis." Working Paper no.9. Centre for Studies in Economics and Finance, Napoli, Italy.

Kanas, Agnieszka, and Frank van Tubergen. 2009. "The Impact of Origin and Host Country Schooling on the Economic Performance of Immigrants." *Social Forces* 88(2): 893–915. doi:10.1353/sof.0.0269.

Kerr, Sari Pekkala, and William R. Kerr. 2011. "Economic Impacts of Immigration: A Survey." National Bureau of Economic Research, Cambridge, MA.

Kinsella, Kevin, and Yvonne J. Gist. 1995. "Older Workers, Retirement, and Pensions: A Comparative International Chartbook." IPC/95-2. U.S. Department of Commerce, U.S. Department of Health and Human Services, Washington, D.C.

Kinsella, Kevin, and Wan He. 2009. "An Aging World: 2008." International Population Reports P95/09-1. U.S. Department of Commerce, U.S. Department of Health and Human Services, Washington, D.C.

Kotlikoff, Laurence, Kent Smetters, and Jan Walliser. 2001. "Finding a Way out of America's Demographic Dilemma." Working Paper no. 8258. National Bureau of Economic Research, Cambridge, MA.

Lee, Ronald. 2003. "The Demographic Transition: Three Centuries of Fundamental Change." *Journal of Economic Perspectives* 17 (4): 167–190. doi: 10.1257/089533003772034943.

Lee, Ronald Demos, Andrew Mason. 2011. *Population Aging and the Generational Economy a Global Perspective*. Cheltenham, UK: Northampton, MA, USA: Edward Elgar Publishing Limited, Ottawa, Canada: International Development Research Center. ISBN: 978 1 55250 514 4.

Lefebvre, Rock, and Amar Goomar. 2005. "Growing up: The Social and Economic Implications of an Aging Population." No. 050101. Certified General Accountants Association of Canada, British Colombia, Canada.

LaGraffe, Daniel. 2012 "The Youth Bulge in Egypt: An Intersection of Demographics, Security, and the Arab Spring." Journal of Strategic Security 5 (2): 65-80. doi: http://dx.doi.org/10.5038/1944-0472.5.2.4

Lisenkova, Katerina, Miguel Sanchez-Martinez, and Marcel Mérette. 2013. "The Long-Term Economic Impacts of Reducing Migration: The Case of the UK Migration Policy." Discussion Paper no. 420. National Institute of Economic and Social Research, London. niesr.ac.uk/publications.

Little, Jane Sneddon, and Robert K. Triest. 2001. "Seismic Shifts: The Economic Impact of Demographic Change. An Overview," In *Conference Series* 46:1–30. Federal Reserve Bank of Boston, Boston, MA.

Manyika, James, Jonathan Woetzel, Richard Dobbs, Jaana Remes, Eric Labaye, and Andrew Jordan. 2015. "Global Growth: Can Productivity Save the Day in an Aging World?" McKinsey Global Institute, New York. http://www.mckinsey.com/insights/growth/can_long-term_global_growth_be_saved.

Mayda, Anna Maria. 2010. "International Migration: A Panel Data Analysis of the Determinants of Bilateral Flows." *Journal of Population Economics* 23(4): 1249–74. doi:10.1007/s00148-009-0251-x.

Meichtry, Stacy, Noemie Bisserbe, and Matthew Dalton. 2015. "Paris Attacks' Alleged Ringleader, Now Dead, Had Slipped Into Europe Unchecked." *The Wall Street Journal*. November 19, 2015. http://www.wsj.com/articles/abdelhamid-abaaoud-alleged-mastermind-of-paris-attacks-is-dead-french-prosecutor-says-1447937255.

Migration Policy Center, European University Institute, and Robert Schuman Centre for Advanced Studies. 2016. "Syrian Refugees: A Snapshot of the Crisis in the Middle East and Europe." http://syrianrefugees.eu/?page_id=148.

Montserrat, Pallares-Miralles, Carolina Romero, and Edward Whitehouse. 2012. "International Patterns of Pension Provision II : A Worldwide Overview of Facts and Figures." Social Protection and labor discussion paper no. 1211. World Bank, Washington, D.C. http://documents.worldbank.org/curated/en/2012/06/16406441/international-patterns-pension-provision-ii-worldwide-overview-facts-figures.

National Research Council. 2012. *Aging and the Macroeconomy: Long-Term Implications of an Older Population*. Washington, D.C: National Academies Press. ISBN: 978-0-309-26196-8

Organization for Economic Co-operation and Development (OECD). 2014. "Is Migration Good for the Economy?" Migration Policy Debates. Organization for Economic Co-operation and Development, Paris. www.oecd.org/migration-insights.

———. 2011a. "Pensionable Age and Life Expectancy, 1950-2050." Pensions at a Glance 2011: Retirement-Income Systems in OECD and G20 Countries. Organization for Economic Co-operation and Development, Paris. http://dx.doi.org/10.1787/pension_glance-2011-5-en.

———. 2014. *Pensions at a Glance 2013 OECD and G20 Indicators.* Paris: OECD Publishing. ISBN: 978-92-64-20393-8

———. 2016. *Pensions at a Glance 2015 OECD and G20 Indicators.* Paris: OECD Publishing. ISBN: 978-92-64-24444-3

———. 2005. *Public Policies across OECD Countries*. Pensions at a Glance. Paris: OECD Publishing. ISBN: 978-92-64-01871-6

———. 2007. *Public Policies across OECD Countries*. Pensions at a Glance. Paris: OECD Publishing. ISBN: 978-92-64-03214-9

———. 2011b. *Retirement-Income Systems in OECD and G20 Countries*. Pensions at a Glance. Paris: OECD Publishing. ISBN: 978-92-64-09628-8

———. 2009. *Retirement-Income Systems in OECD Countries*. Paris: OECD Publishing. ISBN: 978-92-64-06071-5

Ortega, Francesc, and Giovanni Peri. 2009. "The Causes and Effects of International Migrations: Evidence from OECD Countries 1980 - 2005." In *Working Papers* 9(6). University of California, Department of Economics, Berkley, CA. http://hdl.handle.net/10419/31360.

Park, Donghyun, Sang-Hyop Lee, and Andrew Mason, eds. 2012. *Aging, Economic Growth, and Old-Age Security in Asia*. Asian Development Bank. Cheltenham, UK : Northampton, MA: Edward Elgar. ISBN 978 1 78195 230 6.

Poterba, James. 2004. "The Impact of Population Aging on Financial Markets." No. w10851. National Bureau of Economic Research, Cambridge, MA.

Quisumbing, Agnes, and Scott McNiven. 2010. "Moving Forward, Looking Back: The Impact of Migration and Remittances on Assets, Consumption, and Credit Constraints in the Rural Philippines." *Journal of Development Studies* 46(1): 91–113. doi:10.1080/00220380903197960.

Simon, Mathilde. 2016. "The November 13 Paris Attacks: Rethinking the Concept of Identity." *Foreign Policy Journal*. http://www.foreignpolicyjournal.com/2016/02/02/the-november-13-paris-attacks-rethinking-the-concept-of-identity/.

Solsten, Eric, ed. 1996. *Germany: A Country Study*. 3rd ed. Area Handbook Series: 550-173. Washington, DC: Federal Research Division, Library of Congress, DIANE Publishing. ISBN: 0-8444-0853-0.

Spence, Michael, Danny Leipziger, James Manyika, and Ravi Kanbur. 2015. "Restarting the Global Economy: Harnessing the Forces of Economic Growth." A Growth Dialogue White Paper, The Bellagio Symposium on Growth. Bellagio, Italy. http://www.growthdialogue.org/.

Stöver, Britta. 2012. "The Influence of Age on Consumption." Discussion Paper no. 3808. Institute of Economic Structures Research (GWS), Osnabrück, Germany.

Teitelbaum, Michael S. 2001. "Political Dimensions of Demographic Change: An Address." In *Conference Series; Proceedings* 46. Federal Reserve Bank of Boston, Boston, MA.

The Economist. 2016. "How to Manage the Migrant Crisis," February 6, 2016. http://www.economist.com/news/leaders/21690028-european-problem-demands-common-coherent-eu-policy-let-refugees-regulate.

The Economist. 2016a. "Oh, boy: Are lopsided migrant sex ratios giving Europe a man problem?" January 16, 2016. http://www.economist.com/news/europe/21688422-are-lopsided-migrant-sex-ratios-giving-europe-man-problem-oh-boy

Turner, Adair. 2006. "Pension Challenges in an Aging World." *Finance and Development: A Quarterly Magazine of the IMF* 43(3). International Monetary Fund, Washington, D.C.

United Nations Population Division (UNPD). 2014. "World Population Prospects The 2012 Revision: Methodology of the United Nations Population Estimates and Projections." New York: United Nations. http://esa.un.org/unpd/wpp/publications/Files/WPP2012_Methodology.pdf.

United Nations Population Division (UNPD). 2004. "World Population to 2300." ST/ESA/SER.A/236. Department of Economic and Social Affairs, United Nations. New York: United Nations.

Vallin, Jacques. 2005. "The Demographic Window: An Opportunity to Be Seized." *Asian Population Studies* 1(2): 149–67. doi:10.1080/17441730500317170.

Ven, Rutger Van Der, and Jeroen Smits. 2011. "The Demographic Window of Opportunity: Age Structure and Sub-National Economic Growth in Developing Countries." Working Paper 11-102. Nijmegen Center for Economics (NiCE), Institute for Management Research, Nijmegen, The Netherlands. http://www.ru.nl/nice/workingpapers.

Williams, Allan M., and Vladimír Baláž.2008. *International Migration and Knowledge*. Routledge Studies in Human Geography 25. New York: Routledge. ISBN 978-0-415-43492-8.

World Economic Forum (WEF). 2013. "Developing Future Social Protection Systems Retirement Income: Sustainability, Risks and Challenges of Current Retirement Income Schemes." World Economic Forum, Cologny, Switzerland. www.weforum.org.

World Health Organization (WHO). 2015. "Global Health Observatory Data Repository." World Health Organization, Geneva, Switzerland. http://apps.who.int/gho/data/node.main.

Yardley, Jim. 2016. "Sexual Attacks Widen Divisions in European Migrant Crisis." *The New York Times*. January 13, 2016. http://www.nytimes.com/2016/01/14/world/europe/a-climate-of-fear-widens-divisions-in-europes-migrant-crisis.html?_r=0.

Yoon, Jong-Won, Jinill Kim, and Jungjin Lee. 2014. "Impact of Demographic Changes on Inflation and the Macroeconomy." IMF Working Paper WP/14/210. International Monetary Fund, Washington, D.C.

Zurich Insurance Group. 2015a. *Risk Nexus - Pension Gap Country Sheets.* Zurich Insurance Company Ltd, Zurich Switzerland: University of Oxford, Oxford, UK.

———. 2015b. *Risk Nexus Income Protection Gaps: A Rising Global Challenge.* Zurich Insurance Company Ltd, Zurich Switzerland: University of Oxford, Oxford, UK.

———. 2015c. *Risk Nexus Income Protection Gaps: A Rising Global Challenge - Executive Summary.* 1-3. Zurich Insurance Company Ltd, Zurich Switzerland: University of Oxford, Oxford, UK.

Appendix A: Winners and Losers of Demographic Change

The previous sections highlighted the great variance of demographic profiles among countries, as well as the risks and benefits characteristic of countries at different points along the demographic transition. While these risks and benefits are *associated* with particular stages of the demographic transition, the pressure they exert is largely *defined* by the magnitude and speed with which countries experience them. These two factors determine the relative size of benefit or burden a country could potentially face and the time horizon available to either harness the benefits or mitigate the burden.

This appendix explores which countries are likely to face the greatest and least risks and benefits of demographic change. We forecast various indicators associated with these challenges and opportunities (identified in the body of this report and described at the beginning of each section) to evaluate the evolving risk/benefit landscape for the ten countries with the largest and smallest magnitude, as well as those with the largest and smallest change from 2015 to 2035.[26]

5.1 Macro-economic

5.1.1 Working Age Population

Changes to the share of the working-age population have a direct impact on the economic growth prospects of a country. As section 4.1.2 showed, during the past 50 years, labor force growth has accounted for half of global economic growth (Manyika et al: In Brief). IFs forecasts that this important contribution will increasingly be a thing of the past. Between 2015 and 2035, the share of the working-age population will steadily decline for higher-income countries (Figure A.2), leading to a net negative contribution of labor on growth. And though lower-income countries are forecast to see a continued increase in their share of working-age populations during this time horizon as a result of an overall decline in fertility rates, the rate of increase will be slower than in previous decades, meaning labor's contribution to growth will wane for these countries during this period (Figure A.2).

Countries at the most advanced stages of aging in 2035 (Japan, Germany, Italy) will have the smallest share of working-age populations while those with the most rapidly aging populations (Hong Kong) will have both a relatively small proportion of working age people and the most precipitous decline between 2015 and 2035 (Figure A.1). On the other hand, countries that

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[26] The first graphic in each sub-section plots the change of the indicator in question between 2015 and 2035 against its overall magnitude in 2035. These dimensions are summarized in the second graphic, which looks at the Base Case forecast of the indicator for the four World Bank income groups. Finally, the third graph identifies the 10 countries with the highest risk potential and the 10 countries with the lowest risk potential measures by the overall magnitude in 2035 and change between 2015 and 2015 of the summary indicator.

experienced fertility declines within the past 20 years (Egypt, Libya) are forecast to have the largest share of working-age people in 2035.
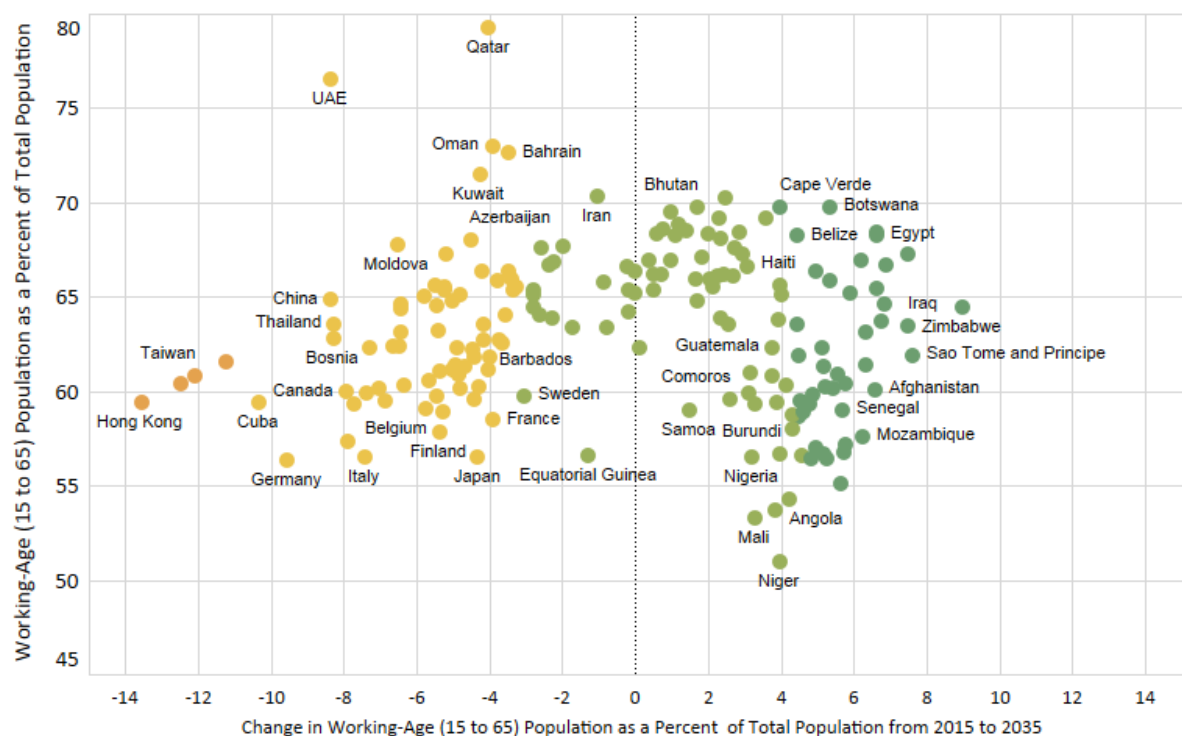

Figure A.1: Cross-sectional relationship between working-age populations as a percent of total population in 2035 and the percent change of working-age population between 2015 and 2035.
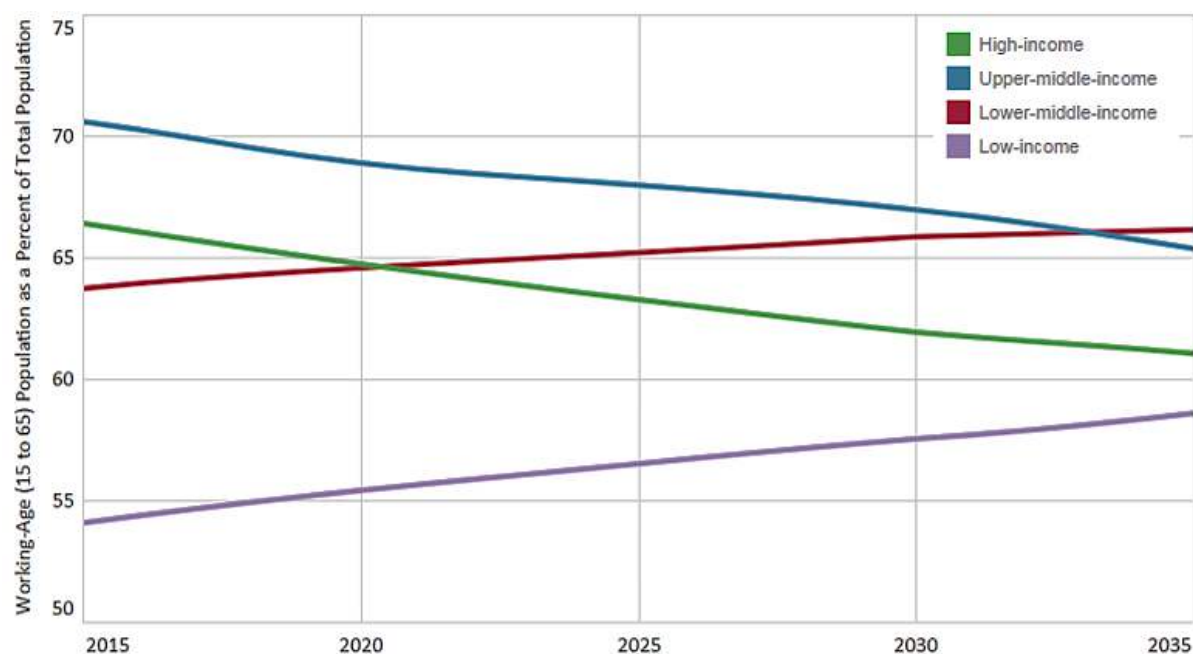*Source: IFs 7.18*

Figure A.2: Forecast of working-age population as a percent of total population for World Bank income groups.
Source: IFs 7.18.

The top ten countries with the largest proportions of working-age people in 2035 are dominated by those that rely heavily on migrant labor (Figure A.3 - left). Due to the relative magnitude of migrants within the labor force, these countries are unlikely to accrue much economic benefit from natural population change and will have to promote increasing levels of migration in order to sustain the benefits they currently enjoy. The gains to economic growth from labor in other top-ten countries are more sensitive to the demographic transition, and these countries may have less of an ability to artificially hold open the demographic window of opportunity. The ten countries with the smallest share of working-age populations are characteristically young and have yet to experience a demographic dividend.

The ten countries with the most rapid decrease in their working-age populations between 2015 and 2035 will require large scale innovation, migration, or, in the longer run, increased fertility in order to offset the economic disadvantages of a declining labor force. On the other hand, the ten countries with the most rapid increase in their working-age populations have the potential to reap substantial economic benefits, though they may have little time to create the formal sector jobs and human capital investments necessary to adequately harness it (Figure A.3 - right).

Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
Qatar	1	79.28	Hong Kong	1	-13.56
UAE	2	76.55	South Korea	2	-12.46
Oman	3	73.00	Taiwan	3	-12.09
Bahrain	4	72.63	Singapore	4	-11.23
Kuwait	5	71.45	Cuba	5	-10.34
Iran	6	70.29	Germany	6	-9.54
Maldives	7	70.27	UAE	7	-8.38
Libya	8	69.88	China	8	-8.36
Bhutan	9	69.77	Bosnia	9	-8.28
Cape Verde	10	69.75	Thailand	10	-8.27
Nigeria	177	56.47	Nepal	177	6.62
Tanzania	178	56.45	Syria	178	6.63
Zambia	179	56.42	Egypt	179	6.65
Germany	180	56.33	Yemen	180	6.74
Uganda	181	55.09	Ghana	181	6.85
Angola	182	54.27	Namibia	182	6.88
Chad	183	53.69	Iraq	183	7.50
Mali	184	53.24	Lesotho	184	7.51
Somalia	185	52.88	Sao Tome and Principe	185	7.61
Niger	186	50.94	Zimbabwe	186	8.97

Figure A.3: (Left) The ten countries with the largest and smallest working-age populations as a percentage of the total population in 2035. (Right) The ten countries with the greatest and least change in working-age population as a percentage of the total population between 2015 and 2035.
Source: IFs 7.18

5.2 Financial

5.2.1 Education

Countries with large shares of youth populations are pressed to devote a greater share of GDP to education spending. Though few countries will experience notable increase in their share of school age children (ages 5 to 15), countries with consistent high proportions (Niger, Mali, Uganda) will be challenged to keep up with spending needs. On the other side, a rapidly declining share of school-age children can quickly free up resources for reinvestment into the country's youth or in to other productive areas of the economy.

Figure A.5 shows that the share of school-age children is forecast to decline for all income groups between 2015 and 2035, with low- and lower-middle-income countries experiencing the most significant declines (around 3 percentage points each) due to overall reductions in fertility rates.

Within these groups, the countries forecast to have the highest burden in 2035 are countries (primarily Sub-Saharan African countries) which retain relatively high fertility rates through 2035 (Figure A.4). Those with the most rapid decrease between 2015 and 2035 will be those countries (Afghanistan, Nepal, Sao Tome and Principe) which experienced significant decreases in their TFR between 1985 and 2015. A small share of countries, such as Hong Kong and Lithuania, which had below replacement fertility rates for decades before 2015, could even see a slight increase in the share school-age children because of increases in TFR.
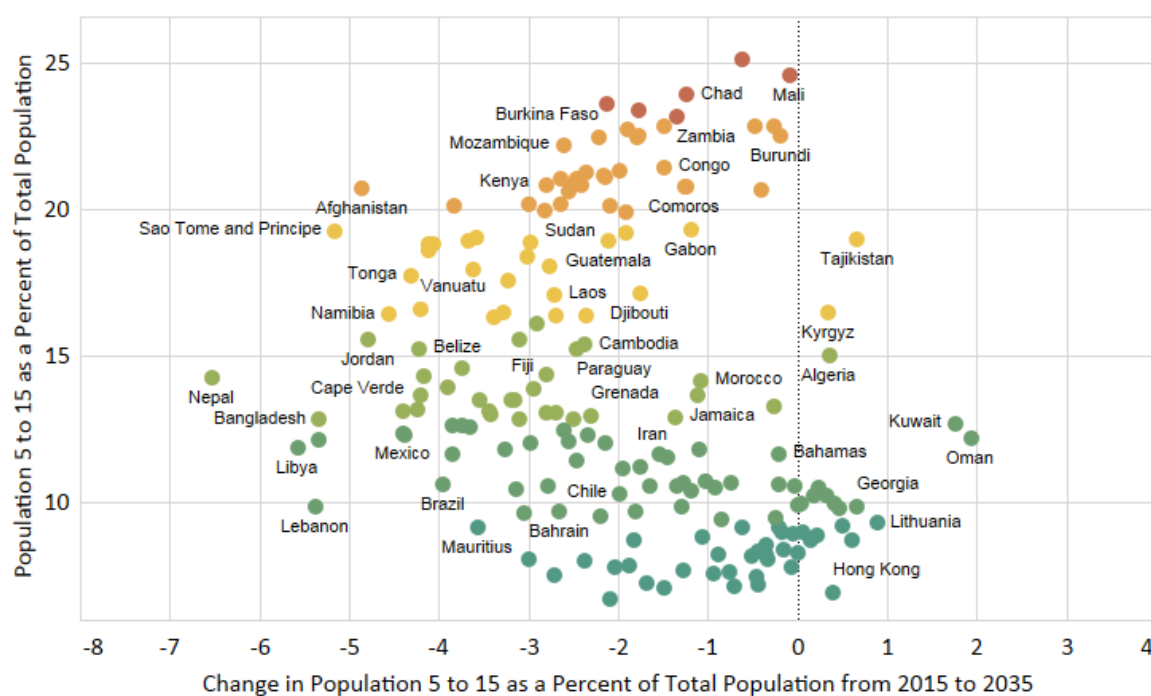

Figure A.4: Cross-sectional relationship between population between the ages of 5 and 15 as a percent of total population in 2035 and the percent change of population between the ages of 5 and 15 between 2015 and 2035.
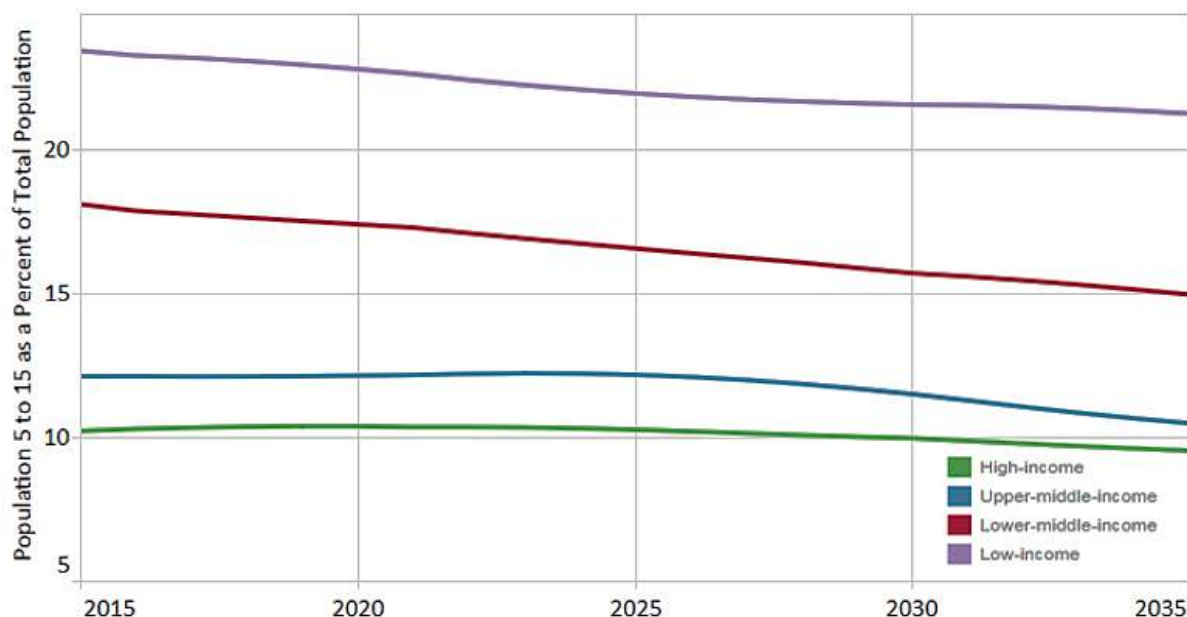*Source: IFs 7.18*

Figure A.5: Forecast of population between the ages of 5 and 15 as a percent of total population for World Bank income groups. Source: IFs 7.18

Despite the wide-spread decreases, in 2035 many countries are still forecast to sustain relatively large financial burdens due to high proportions of school-aged children. The top ten of these—mostly Sub-Saharan African countries—will have close to a quarter of their population between the ages of 5 and 15 (Figure A.6 - left). Moreover, these countries (because of stagnant fertility rates) will see little change in the magnitude of their burden between 2015 and 2035, meaning they could face this financial risk for a prolonged period.

For most countries where fertility rates are forecast to bounce back from below-replacement levels, education spending needs are already fairly low, and increased population growth may help to offset some of the financial risks of aging societies within a couple decades. The ten countries with the most rapid decrease will benefit most from decreased need for education spending, but may face increased risk from the rapid growth of a youth bulge and may not have enough time to adequately prepare for a demographic dividend.

Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
Niger	1	25.10	Oman	1	1.94
Mali	2	24.57	Kuwait	2	1.76
Chad	3	23.90	Lithuania	3	0.89
Uganda	4	23.59	Tajikistan	4	0.67
Angola	5	23.38	Georgia	5	0.66
Zambia	6	23.17	Ukraine	6	0.61
Timor-Leste	7	22.83	Latvia	7	0.51
Gambia	8	22.82	Canada	8	0.47
Nigeria	9	22.81	Finland	9	0.41
DRC	10		Hong Kong	10	
Italy	174	7.63	Cape Verde	173	
South Korea	175	7.59	Namibia	174	-4.55
Cuba	176	7.54	Jordan	175	-4.78
Bosnia	177	7.47	Afghanistan	176	-4.85
Portugal	178	7.23	Sao Tome and Principe	177	-5.16
UAE	179	7.19	Bangladesh	178	-5.33
Japan	180	7.14	Myanmar	179	-5.34
Taiwan	181	7.11	Lebanon	180	-5.38
Hong Kong	182	6.91	Libya	181	-5.57
Qatar	183	6.72	Nepal	182	-6.53

Figure A.6: (Left) The ten countries with the largest and smallest populations between the ages of 5 and 15 as a percentage of the total population in 2035. (Right) The ten countries with the greatest and least change in populations between the ages of 5 and 15 as a percentage of the total population between 2015 and 2035.
Source: IFs 7.18

5.2.2 Health

Health costs (as a percentage of GDP) follow a U-shaped pattern correlated with development and aging. Countries with large youth populations face high demand for health spending, countries with larger, middle-aged populations have somewhat of a reprieve from the health spending burden, and countries with large elderly populations face high demand again.

The rapidly aging populations in high-income countries will drive health costs to levels much higher than those for countries with large youth populations because these countries face a higher prevalence of non-communicable diseases (such as heart disease and cancer) which are more expensive to treat than the communicable diseases more prevalent in younger countries. Moreover, the rapidity of aging could lead to significant increases in costs over a short period. The combination of these factors will pull resources from other sectors of society.

Figure A.8 indicates that high-income countries have double the healthcare costs (as a percentage of GDP) of middle-income countries in 2015 and forecasts indicate that the gap in spending will grow through 2035, to about 9 percentage points for lower-middle-income countries and nearly 12 percentage points for upper-middle-income countries. The cross-sectional graph in Figure A.7 demonstrates this point, showing that high-income countries will have high health costs in 2035 and will also experience rapid increases of health costs between 2015 and 2035. However, this risk is not confined to high-income countries. As Figures A.7 and

A.8 show, lower-middle-income countries on average are forecast to experience over 2 percentage point increase in health costs as a percent of GDP by 2035, with some of the older upper-middle-income countries, such as Cuba, expected to experience rapid increases in health costs in the next 20 years, such that they will have some of the highest costs in the world by 2035.
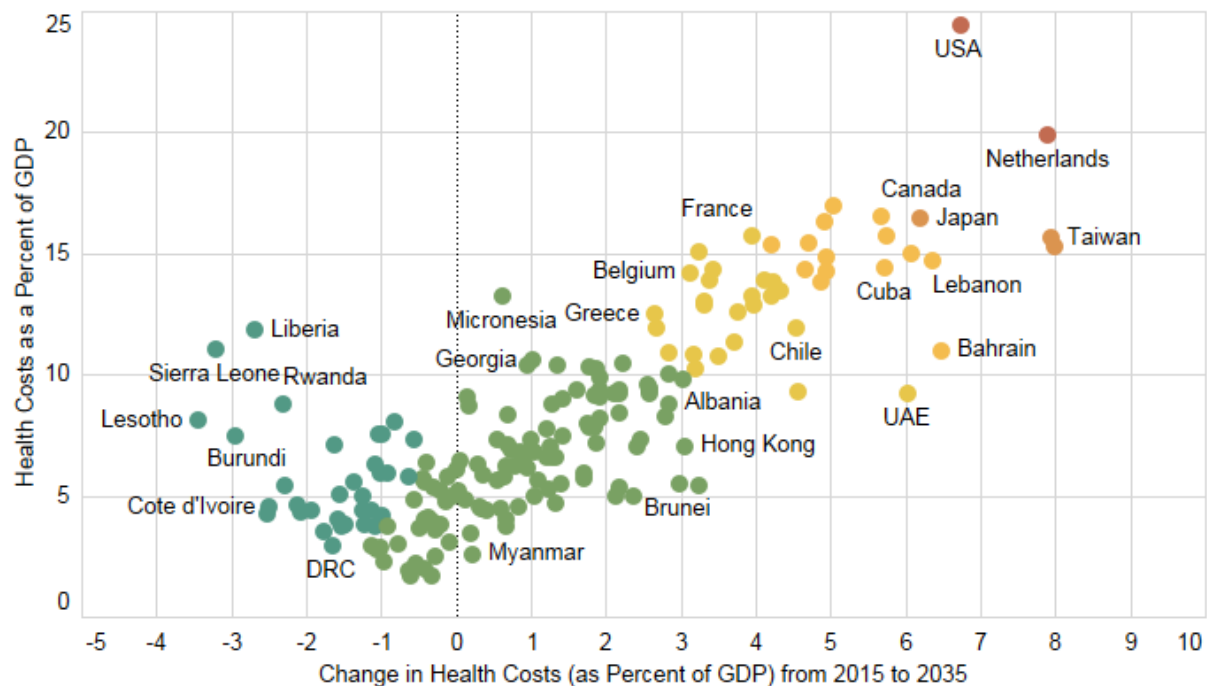

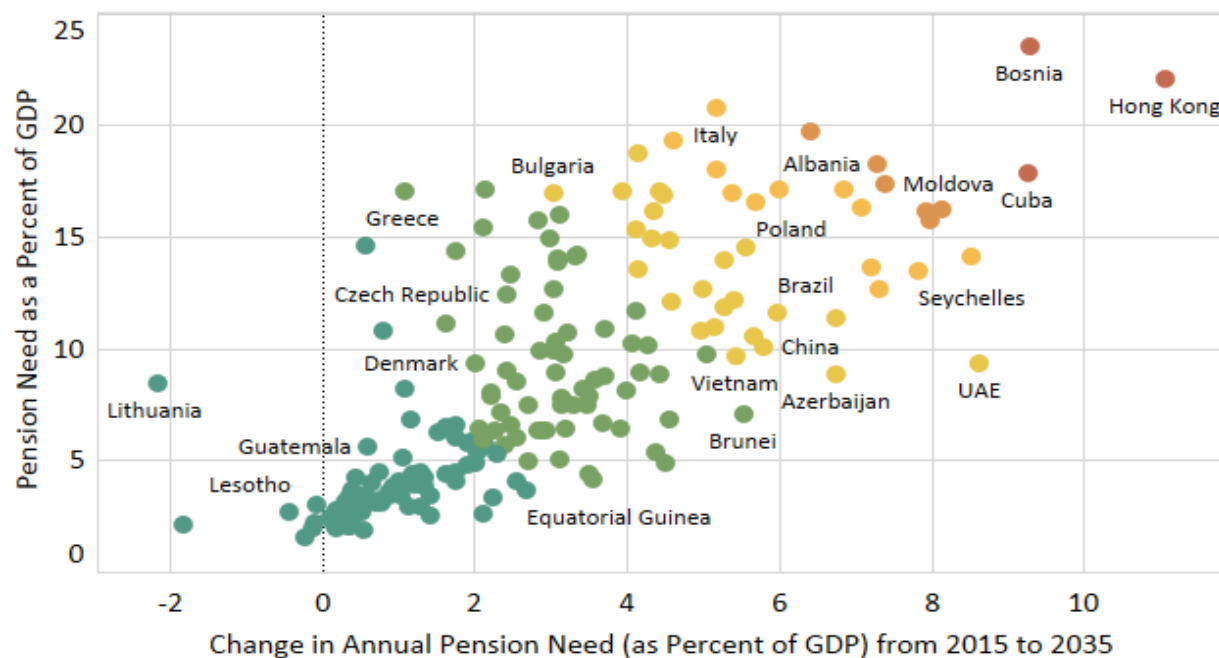*Figure A.7: Cross-sectional relationship between population between health costs as a percentage of GDP in 2035 and the percent change of health costs as a percentage of GDP between 2015 and 2035.*
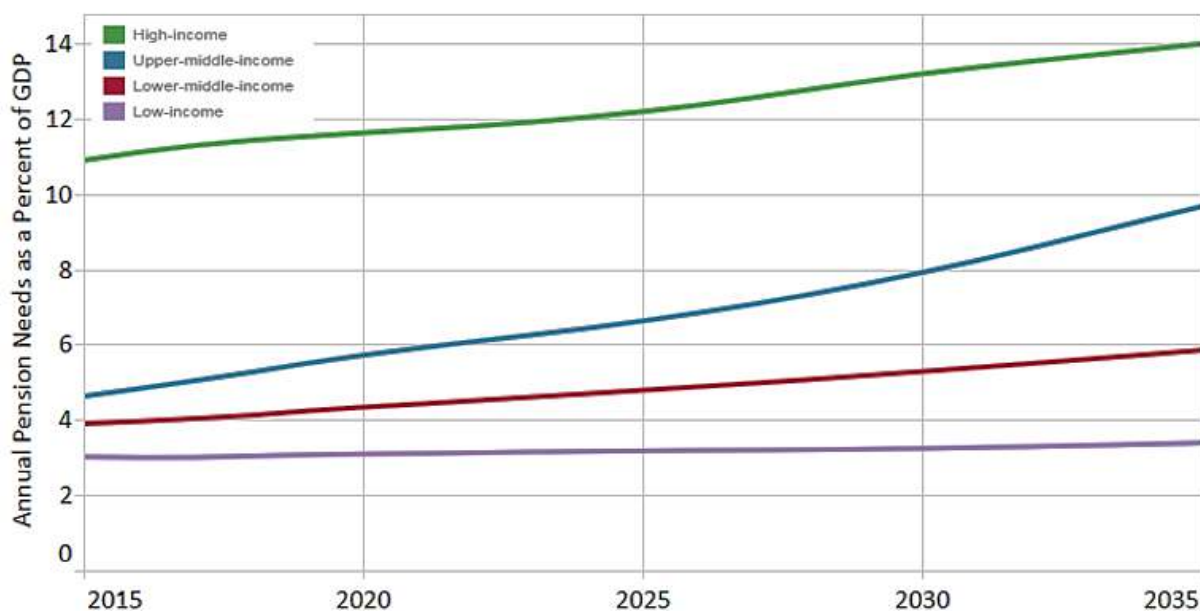*Source: IFs 7.18*
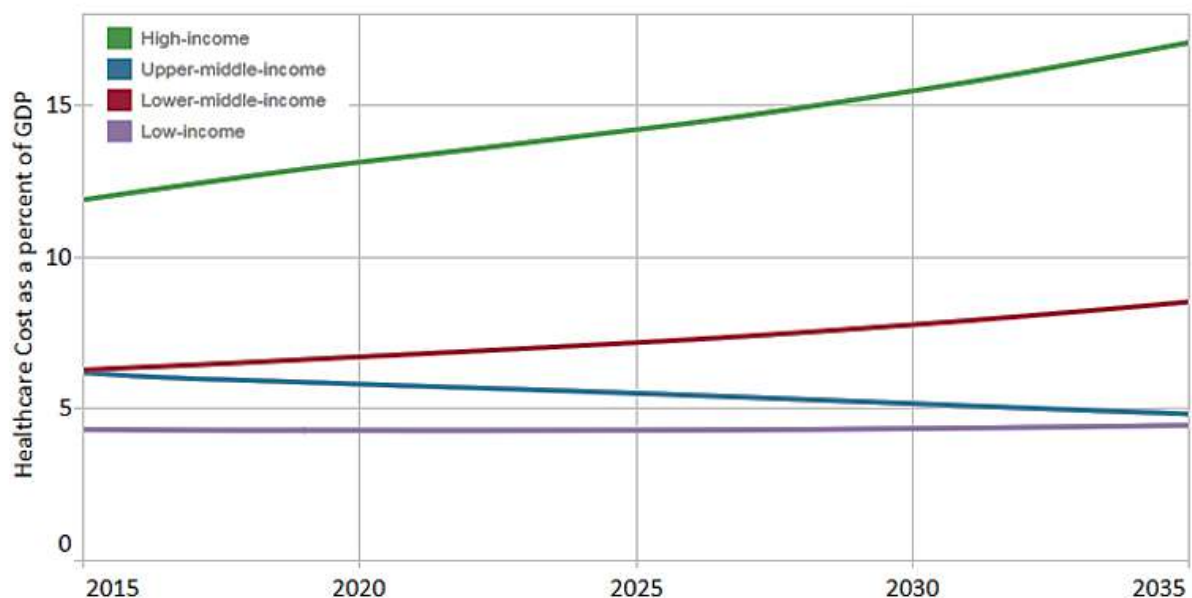
Figure A.9 (left) shows the top ten countries forecast to have the largest health care cost (as a percentage of GDP) in 2035. By 2035 these countries will have reached a mature or post-mature median age and are likely to have increasingly large burdens of non-communicable diseases driving up health costs. They are also likely to have a larger share of 'old' old whose health care needs will be greater and more expensive. The ten countries with the most rapid change between 2015 and 2035 (Figure A.9 – right) will face the greatest challenge in preparing for these health costs.

Also shown in Figure A.9 (left) are the countries with the smallest health costs in 2035. These countries have large youth populations in 2015, but the share of youths is forecast to decline between 2015 and 2035 and most of these countries will be moving into a demographic dividend. The countries with the most rapid decrease in health costs between 2015 and 2035 will benefit from smaller youth populations and relatively larger working age populations (Figure A.9 – right). However, the rapidity of this change means they will be challenged to create enough formal sector jobs or adequately invest in human capital in order to harness the potential benefits of their demographic dividends.

Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
USA	1	24.38	South Korea	1	8.00
Netherlands	2	19.86	Taiwan	2	7.95
Switzerland	3	16.93	Netherlands	3	7.91
Canada	4	16.53	USA	4	6.73
Japan	5	16.42	Bahrain	5	6.48
Germany	6	16.27	Lebanon	6	6.36
Costa Rica	7	15.73	Japan	7	6.20
France	8	15.71	Malta	8	6.09
Taiwan	9	15.64	UAE	9	6.04
Denmark	10	15.40	Costa Rica	10	5.76
Gabon	173	3.00	Mali	177	-2.06
DRC	174	2.93	Niger	178	-2.13
Congo	175	2.90	Burundi	179	-2.28
Central AfR	176	2.86	Rwanda	180	-2.32
Angola	177	2.79	Cote d'Ivoire	181	-2.49
Eritrea	178	2.48	Mozambique	182	-2.51
Chad	179	2.28	Liberia	183	-2.68
Laos	180	1.98	Uganda	184	-2.94
Turkmenistan	181	1.69	Sierra Leone	185	-3.21
Timor-Leste	182	1.68	Lesotho	186	-3.44

Figure A.9: (Left) The ten countries with the largest and smallest health care costs as a percentage of GDP in 2035. (Right) The ten countries with the greatest and least change in health care costs as a percentage of GDP between 2015 and 2035.
Source: IFs 7.18

5.2.3 Pensions

High-income countries will experience, by far, the greatest demand for pension spending between 2015 and 2035. However, need for pension spending as a percentage of GDP will increase by 3 percentage points during this time horizon, whereas need in upper-middle-income countries will increase by close to 5 percentage points (Figure A.11). Upper-middle-income countries will have less time to prepare for this increase and will be at risk of getting old before they get rich.

The cross-sectional graph in Figure A.10 shows that by 2035 the countries with both the largest magnitude of pension need and the greatest increase in need between 2015 and 2035 are forecast to be a mix of upper-middle-income countries and high-income countries, while lower-income countries, for the most part, will have the least burden and smallest increase. Notable outliers are Hong Kong, Bosnia, and Cuba, which will be hardest hit by the pension burden because they have both the greatest need in 2035 and the most rapid increase in need between 2015 and 2035, and Lithuania, where GDP growth is forecast to significantly outpace increases in the share of the population over 65.

Figure A.10: Cross-sectional relationship between population between pension need as a percentage of GDP in 2035 and the percent change of pension need as a percentage of GDP between 2015 and 2035.
Source: IFs 7.18

Figure A.11: Forecast of pension need as a percentage of GDP for World Bank income groups.
Source: IFs 7.18

Figure A.12 (left) shows the 10 countries forecast to have the highest and lowest pension needs as a percentage of GDP in 2035. Countries in the top ten have the largest pension burden and demand for pension resources may need to divert resources from other sectors of the economy. However, the relative burden could be less for countries such as Italy and Germany which have more established pension systems and more financial resources available. Figure A.12 (right) shows the change of pension needs as a percentage of GDP between 2015 and 2035. Countries such as Hong Kong, Bosnia, and Cuba, which are forecast to have both the largest proportion of pension needs and the greatest increase in need between 2015 and 2035, will have relatively larger burdens since they will have to prepare more quickly.

Those in the bottom ten in 2035 will still have relatively small proportions of retirement aged populations (and relatively low life expectancies), but will continue to face the challenges associated with youthful societies (i.e. high education spending and large youth bulges). For those with the least amount of change between 2015 and 2035, these challenges will be exacerbated by prolonged periods with a large share of youth populations (with the exception of Lithuania, where the growing elderly population is forecast to be outpaced by gains in GDP).

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Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
Bosnia	1	23.47	Hong Kong	1	11.08
Hong Kong	2	22.06	Bosnia	2	9.31
Italy	3	20.75	Cuba	3	9.27
Germany	4	19.69	UAE	4	8.64
Serbia	5	19.29	Taiwan	5	8.53
Portugal	6	18.71	Mauritius	6	8.13
Albania	7	18.27	South Korea	7	7.98
Ukraine	8	17.96	Chile	8	7.94
Cuba	9	17.84	Seychelles	9	7.82
Moldova	10	17.37	Moldova	10	7.40
Nigeria	174	2.41	Tanzania	174	
Mali	175	2.19	Zambia	175	0.17
Timor-Leste	176	2.14	Nigeria	176	0.12
Zambia	177	2.14	Malawi	177	-0.07
Burkina Faso	178	2.00	Mali	178	-0.10
Gabon	179	1.99	Uganda	179	-0.13
Eritrea	180	1.95	Chad	180	-0.22
Uganda	181	1.94	Lesotho	181	-0.43
Angola	182	1.83	Timor-Leste	182	-1.82
Chad	183	1.51	Lithuania	183	-2.16

Figure A.12: (Left) The ten countries with the largest and smallest pension need as a percentage of GDP in 2035. (Right) The ten countries with the greatest and least change in pension need as a percentage of GDP between 2015 and 2035.
Source: IFs 7.18

5.3 Social

5.3.1 Youth Bulge

As discussed in section 4.3.1, countries with large youth bulges face greater risk of social instability (Cincotta 2013). Sustained high fertility rates in a country could exacerbate and prolong the risk of social instability, while declines in fertility will diminish the size of the youth bulge and push countries into a demographic dividend.

Forecast show the share of young adults in high-income and upper-middle-income countries will decline and level off between 2015 and 2035, while low-income and lower-middle-income countries will see steady declines during this time (Figure A.14). However, youth bulges will remain comparatively high in low- and lower-middle-income countries and low-income countries will remain especially at risk in 2035.

Figure A.13 shows that few countries will see increases in their youth bulge between 2015 and 2035. Those that do are forecast to experience declines in their fertility rates during the same period, meaning this risk will likely diminish beyond the time horizon considered here. On the other hand, many countries experiencing declines in their young adult populations, will still have proportions above 30 percent in 2035, meaning they will still have a potentially higher risk of social instability.
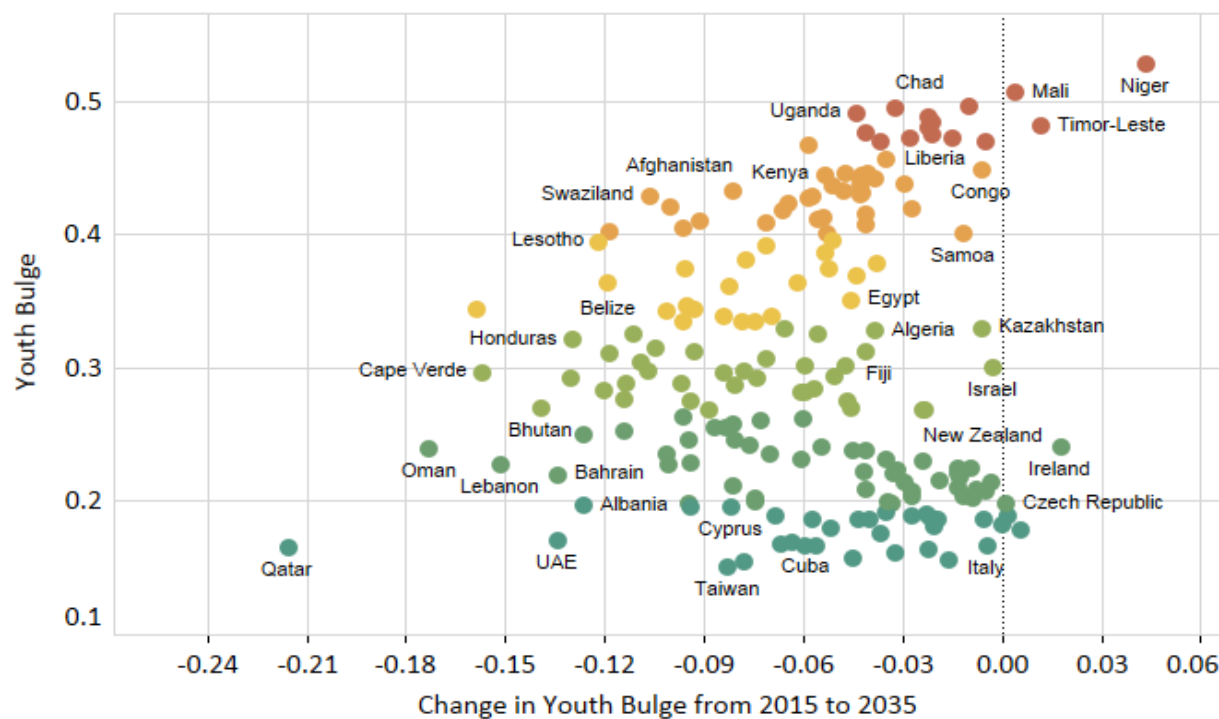
Figure A.13: Cross-sectional relationship between population between the ages of 15 and 29 as a percent of total population in 2035 and the percent change of population between the ages of 15 and 29 between 2015 and 2035.
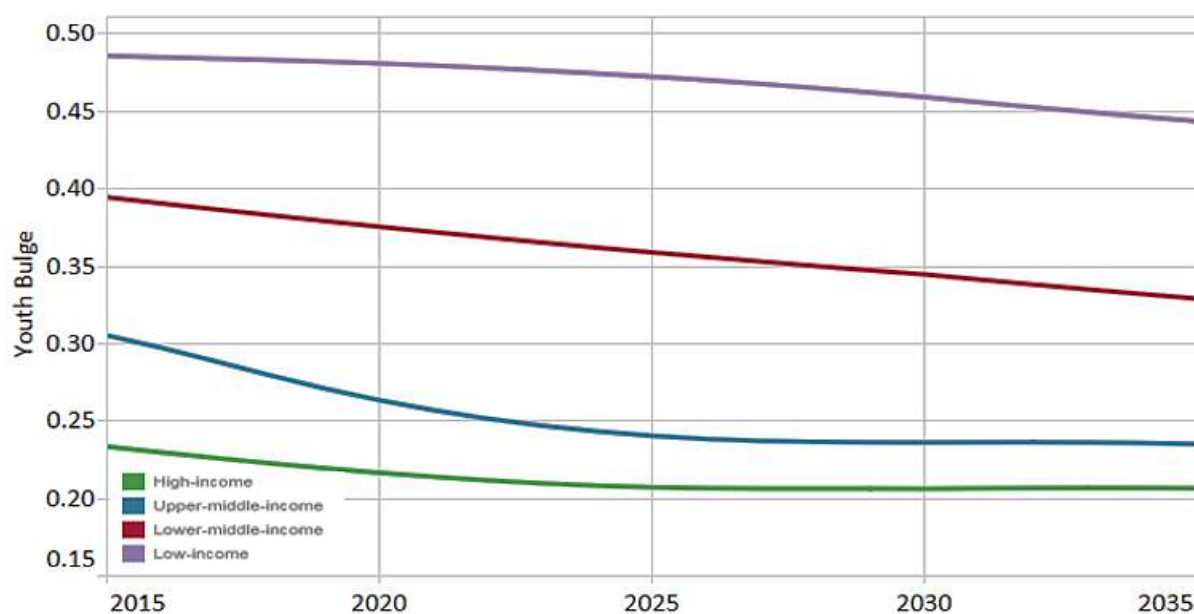*Source: IFs 7.18*

Figure A.14: Forecast of population between the ages of 15 and 29 as a percent of total population for World Bank income groups.
Source: IFs 7.18

The ten countries with the largest youth bulges in 2035 will mostly be Sub-Saharan African countries (Figure A.15 - left) where the young adult populations are forecast to make up around half of the population. These countries will face double risk from large school-age and young

adult populations. Moreover, they may be particularly susceptible to social instability if their large young adult populations are coupled with high unemployment levels and high (perceived) levels of corruption. The ten countries with the smallest young adult populations in 2035 will be relatively safe from this particular risk, and those with more rapid declines in their young adult populations could benefit the most from gains in potential security (Figure A.15 – right).

Few countries are forecast to experience significant increases in their young adult populations (Figure A.15 – right). Of the top ten countries with the most rapidly increasing youth bulge populations, only Niger will experience a noticeable (though still slight) increase.

Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
Niger	1	0.527	Niger	1	0.043
Mali	2	0.506	Ireland	2	0.018
Somalia	3	0.495	Timor-Leste	3	0.012
Chad	4	0.495	Spain	4	0.006
Uganda	5	0.491	Mali	5	0.004
Angola	6	0.488	Slovenia	6	0.002
Gambia	7	0.483	Czech Republic	7	0.001
Timor-Leste	8	0.480	Greece	8	0.000
Burundi	9	0.479	Israel	9	-0.003
Zambia	10	0.476	France	10	-0.003
Cuba	176	0.167	Honduras	177	-0.130
Bosnia	178	0.166	Maldives	178	-0.130
Malta	179	0.166	Bahrain	179	-0.134
Qatar	180	0.164	UAE	180	-0.134
Portugal	181	0.164	Bhutan	181	-0.139
Germany	182	0.160	Lebanon	182	-0.152
Hong Kong	183	0.157	Cape Verde	183	-0.157
Japan	184	0.156	Micronesia	184	-0.159
South Korea	185	0.155	Oman	185	-0.173
Taiwan	186	0.150	Qatar	186	-0.215

Figure A.15: (Left) The ten countries with the largest and smallest populations between the ages of 15 and 29 as a percentage of the total population in 2035. (Right) The ten countries with the greatest and least change in populations between the ages of 15 and 29 as a percentage of the total population between 2015 and 2035.
Source: IFs 7.18

5.3.2 Adult Distribution Index

As countries age, competition for resources between younger and older generations could potentially increase societal tensions over government spending and pension or retirement age reform (Bon 2010). The closer these groups are to being proportionally balanced (in which neither group has definitive voting power over the other), the more pronounced tensions could become. Countries which have large proportions of both age groups and have strong balance between these two populations may face greater risk of social frictions while rapid aging intensifies these tensions by leaving little time for countries to develop and enact reforms. The Adult Distribution Index captures both the balance between those 65 and over and those aged

15 to 30 and the relative size of both populations and is used here to measure the social risks stemming from intergenerational competition.[27]

The Adult Distribution Index is forecast to increase for all but low-income countries between 2015 and 2035, and will increase most significantly for upper-middle-income countries (Figure A.17). In 2035, high-income countries will likely have the highest scores for the index, meaning they will face the greatest risk. However, though some high-income countries will also be increasing rapidly, countries with the most rapid increase between 2015 and 2035 will primarily be upper-middle-income countries (Figure A.16).
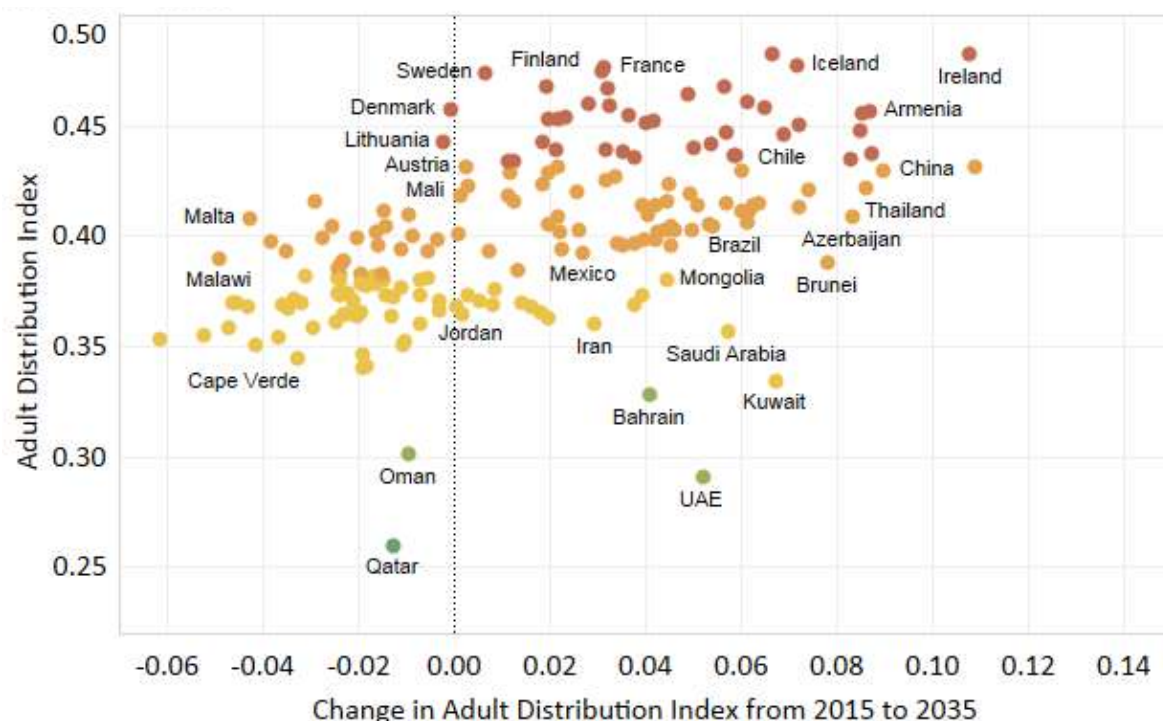
Figure A.16: Cross-sectional relationship between population between Adult Distribution Index in 2035 and the percent change in the Adult Distribution Index between 2015 and 2035.
Source: IFs 7.18

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[27] The adult distribution index is calculated as: $1 - \frac{|population\ 15\ to\ 30 - population\ 65\ and\ older|}{Population\ 15\ to\ 30 + Population\ 65\ and\ older} * Population\ over\ the\ age\ of\ 15$. Higher scores indicate higher potential risk.
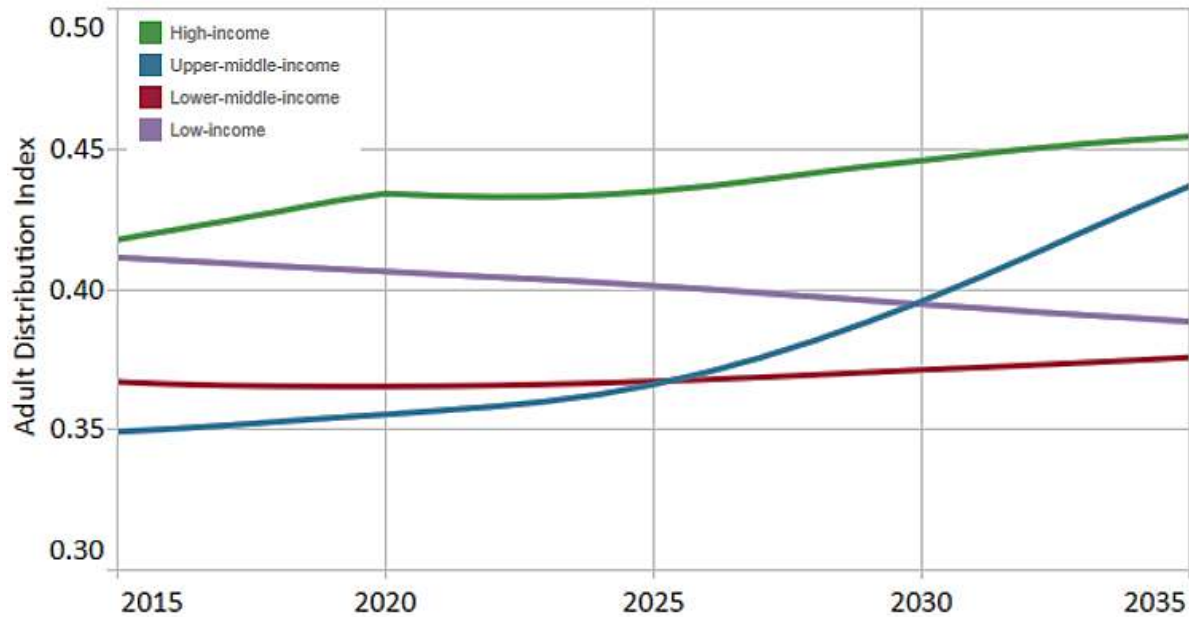
Figure A.17: Forecast of Adult Distribution Index for World Bank income groups.
Source: IFs 7.18

The top ten countries forecast to have the highest scores on the Adult Distribution Index in 2035 will face the greatest risk of social friction (Figure A.18 – left). France, Ireland, the U.K., and the U.S. have all experienced protests over pension reforms and pension spending in the past several years, attesting to the tension that can occur (Berrada et al. 2013:19). For the countries forecast to experience the most rapid adult distribution index score increase between 2015 and 2035, the challenge of allaying social tensions could be large, particularly the older they are, but may be offset by various financial and social conditions such as high unofficial retirement ages (Figure A.18 – right).

Country	Rank	Value in 2035	Country	Rank	Change 2015 to 2035
New Zealand	186	0.483	Seychelles	186	0.109
Ireland	185	0.482	Ireland	185	0.108
Iceland	184	0.477	China	184	0.090
France	183	0.476	Armenia	183	0.087
United Kingdom	182	0.474	Thailand	182	0.086
Sweden	181	0.473	Russia	181	0.085
Finland	180	0.468	Sri Lanka	180	0.085
USA	179	0.467	Azerbaijan	179	0.083
Belgium	178	0.466	Bahamas	178	0.083
Australia	177	0.464	Brunei	177	0.078
Belize	10	0.346	Nepal	10	
Cape Verde	9	0.344	Malta	9	-0.043
Bhutan	8	0.341	Afghanistan	8	
Botswana	7	0.340	Swaziland	7	-0.045
Lesotho	6	0.338	Ethiopia	6	
Kuwait	5	0.334	Micronesia	5	-0.047
Bahrain	4	0.328	Malawi	4	-0.049
Oman	3	0.301	Yemen	3	-0.052
UAE	2	0.291	Zimbabwe	2	-0.061
Qatar	1	0.260	Lesotho	1	-0.075

Figure A.18: (Left) The ten countries with the largest and smallest populations Adult Distribution Index scores in 2035. (Right) The ten countries with the greatest and least change in Adult Distribution Index score between 2015 and 2035. Source: IFs 7.18

5.4 Risk Indices

As we have highlighted, younger countries are subject to different risks and benefits than older ones, though the indicators used to measure risk may overlap. We have created three indices, the Youth Risk Index, Youth Benefit Index, and Elderly Risk Index, to help identify the countries that by 2035 could face high levels of demographic risk and benefit.[28] Each index is a composite of a sub-set of the indicators discussed throughout this section. Using the country rankings for the above indicators, each index is calculated as the highest possible sum of indicator rankings (for both magnitude in 2035 and change between 2015 and 2035) minus the actual sum of indicator rankings, divided by the highest possible sum of indicator rankings.

The Youth Benefit Index identifies those countries that through 2035 are forecast to be best positioned to take advantage of favorable demographic change, including reduction in youth bulge, school-age population, and health care costs, as well as the increase in share of the working-age population (Figure A.19). This index highlights the fact that many countries in South Asia and Latin America are in a position to take advantage of favorable demographic tailwinds over the coming years.

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[28] The absence of an Elderly Benefit Index is due to the face that the research in the report has not identified a set of macro-economic, financial, or social benefits associated with aging at the country-level.
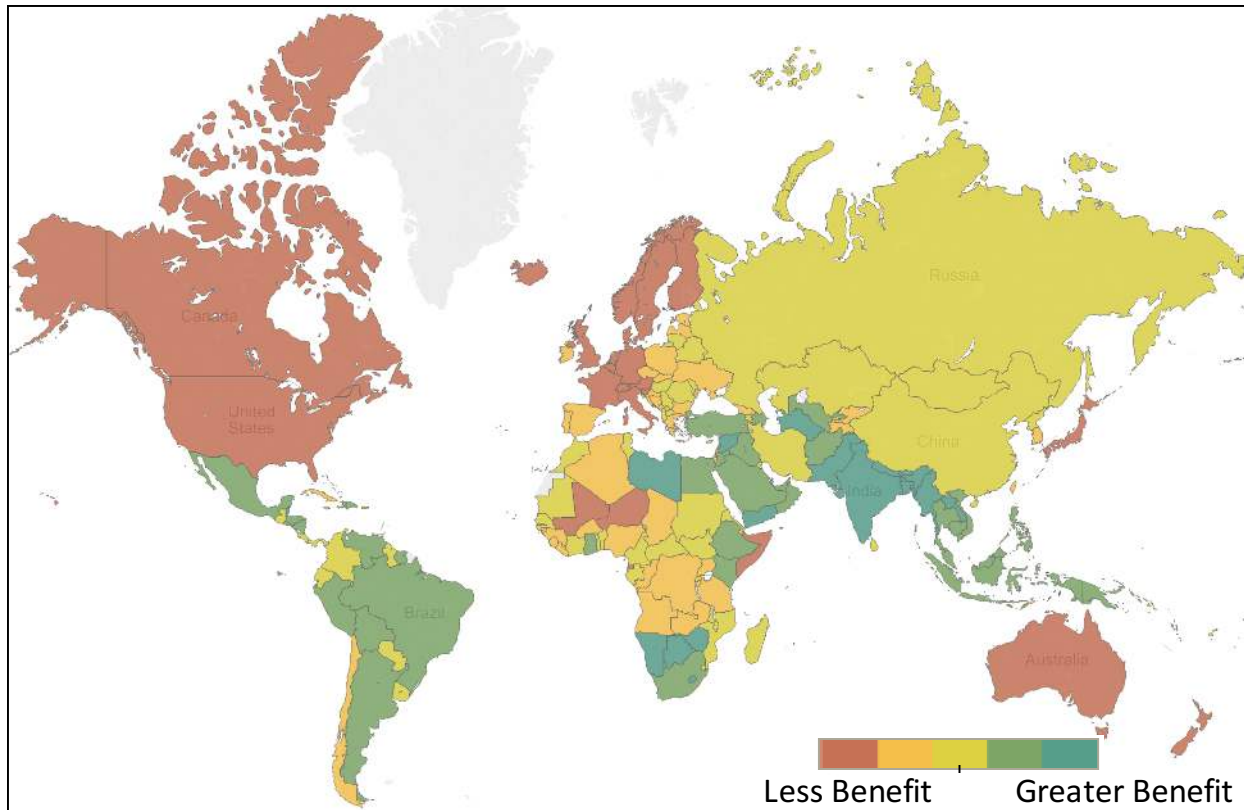
Figure A.19: Overall Youthful Country Benefit Index in 2035. Note: darker indicates higher benefit.
Source: IFs 7.19

The Youth Risk Index aims to identify countries that may face elevated financial and social risk due to large and sustained youth bulge and school-age cohorts (Figure A.20). In order to capture risk, rather than differential rates of decline, the change for youth bulge and school-age population ranks only those countries with increases. Countries with negative values (declines) are given null values for these two indicators. Country scores are based on additive rankings for each of the four indicators and each indicator is given equal weight. Countries with higher scores face greater potential risk. The index shows, unsurprisingly, that countries in Equatorial Africa where fertility rates have stalled have the highest risk in 2035. Other countries with high risk are those where fertility rates are still relatively high or have only recently dropped.
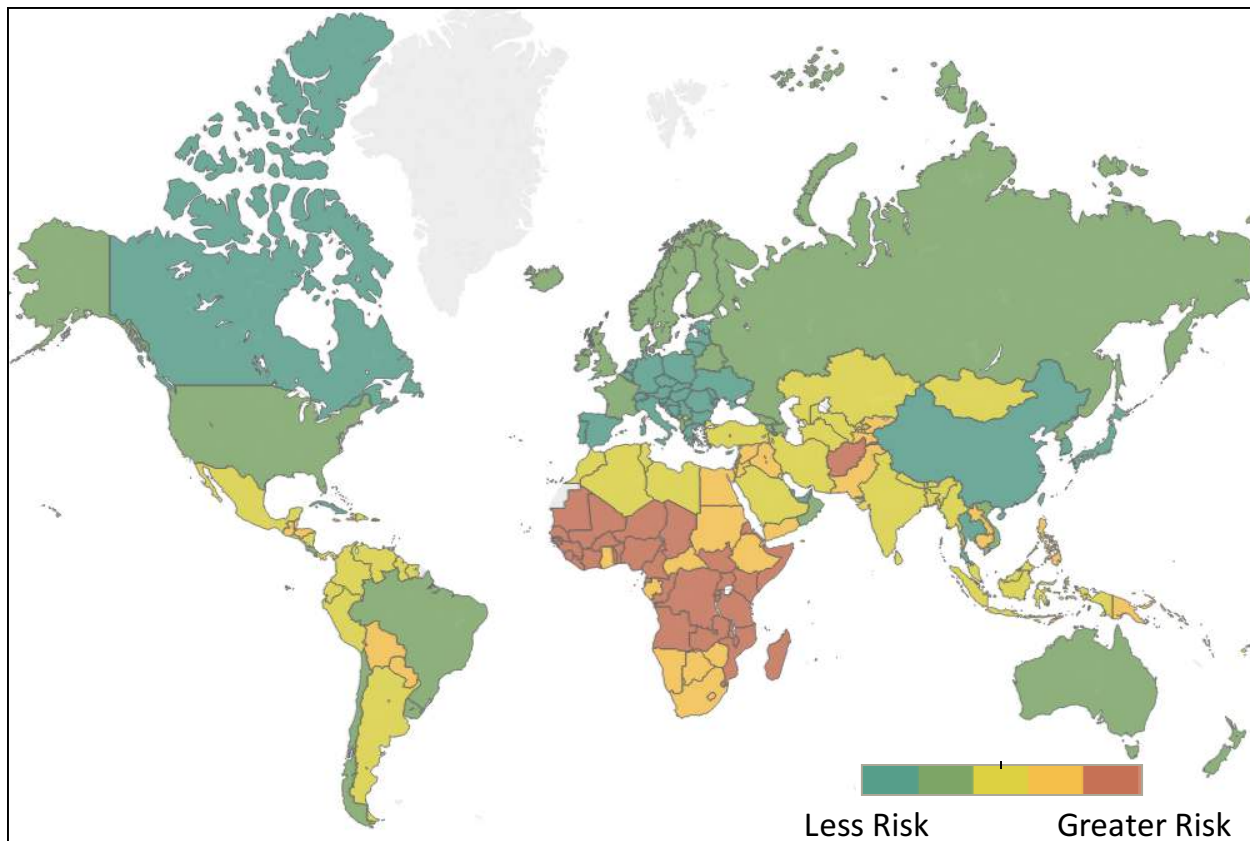
Figure A.20: Overall Youth Risk Index in 2035. Note: red indicates higher risk.
Source: IFs 7.19

Finally, the elderly country risk index measures the aggregate risks characteristic of aging societies. This index includes the change between 2015 and 2035 and magnitude in 2035 for pension need as a percent of GDP, working age population (percent), health costs as a percent of GDP, and Adult Distribution Index score. Country scores are based on additive rankings for each of the eight indicators and each indicator is given equal weight. Countries with higher scores face greater potential risk

As Figure A.21 shows, countries in Western Europe and North America have the highest risk in 2035. Japan is a notable exception. Though it will have high health care and pension costs in 2035, Japan's pension needs are forecast to change comparatively less than more rapidly aging countries, meaning its score is slightly lower than countries in Europe and North America.
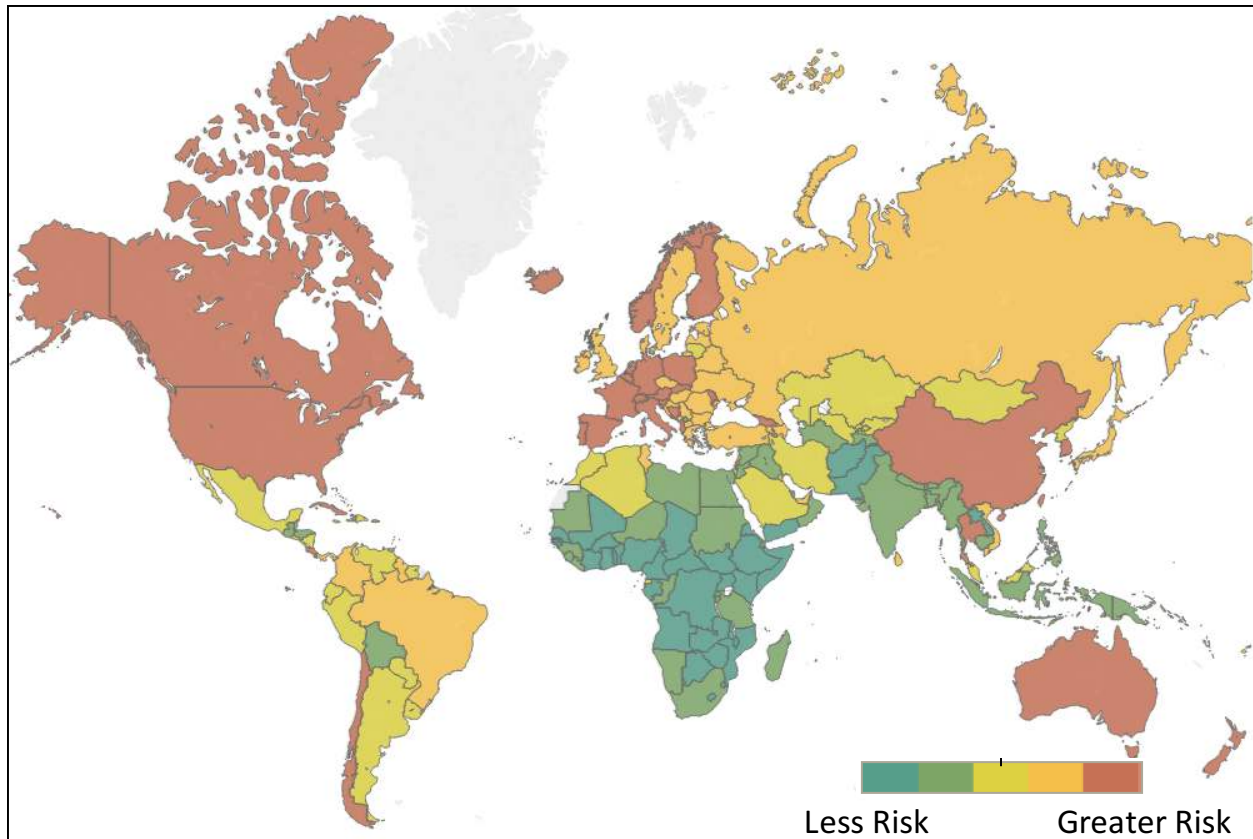
Figure A.21: Overall Elderly Risk Index in 2035. Note: red indicates higher risk.
Source: IFs 7.19

Demographic change is fluid, as are the associated risks and benefits. All countries will be exposed to multiple risks and benefits at any given time throughout their passage through the demographic transition. At times, multiple risk factors may coexist, stymieing efforts to mitigate their negative impact. Other times, risks and benefits may overlap. However, since the political, social, or financial context of a country can greatly influence the level to which these risks and benefits are realized, the indices are not meant to represent the actual risk a country can expect to face over the next 15 years, but instead an aggregate level of potential risk and benefit.

Appendix B: Country Profiles

As we have shown, the demographic transition creates differential risks and benefits for different countries. Throughout this report, we highlight the variation in demographic risk among countries in different stages of the demographic transition and with different age-sex structures. In the following section we provide snapshots of specific demographic attributes and the potential risks they carry for Brazil, China, France, Germany, India, Japan, Mexico, Nigeria, the United Kingdom, and the United States.

Figure B.1 shows that many of the countries considered here have already moved beyond the peak of their demographic dividend and into decline, while others (Brazil, India, Mexico) still have several more years. Nigeria, on the other hand, is forecast to see an increase in its demographic dividend through 2035. Figure B.2 further illustrates the diversity in age structures and rates of aging, with the youngest and oldest countries (Nigeria and Japan respectively) aging somewhat less than the other countries between 2015 and 2035. Over these 20 years, China will age the most, followed by the U.S., Germany, and Brazil.
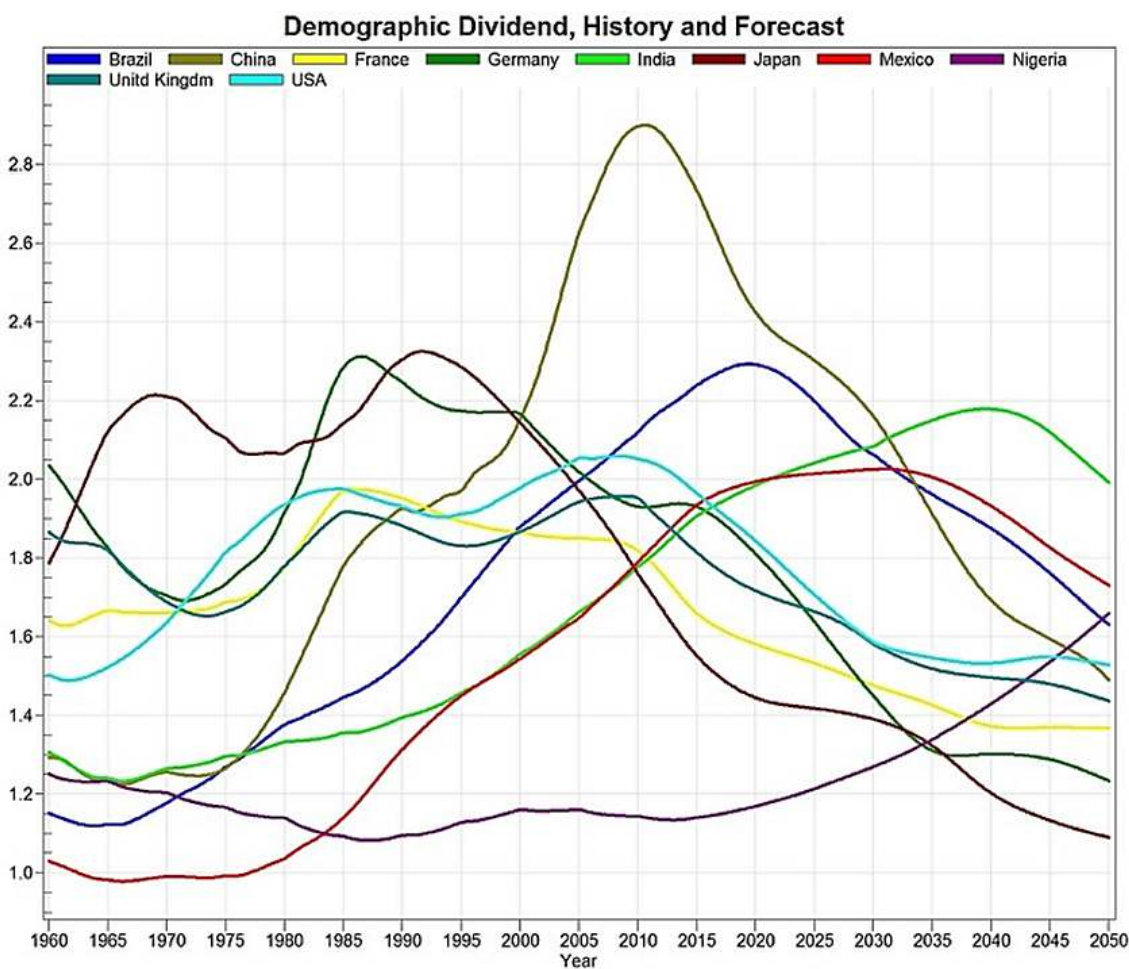
Figure B.1: History and forecast for demographic dividend of select countries
Source: IFs 7.19
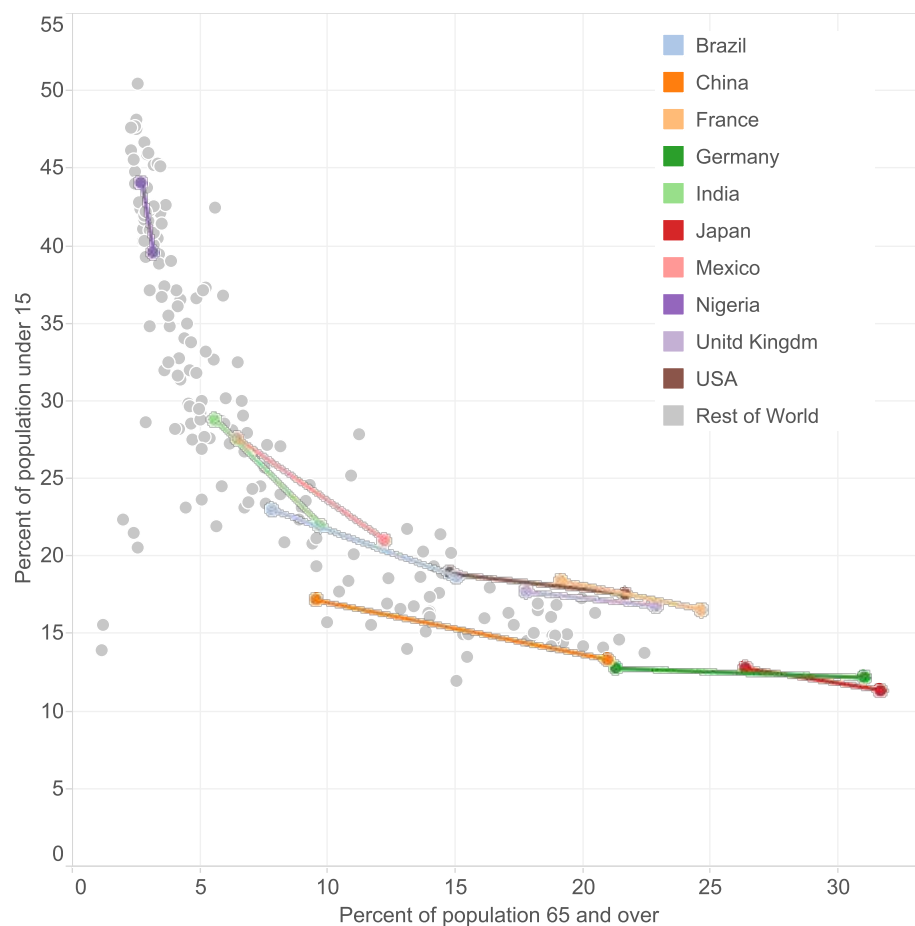
Figure B.2: Age-structure distribution in 2015 and 2035
Source: IFs 7.19

Structure and speed will largely determine the macro-economic, financial, and social risks and benefits these countries may face in the coming decades. Table A1 highlights the impacts of demographic change for each of these countries through 2035. Germany is forecast to see the greatest decline in its working-age population between 2015 and 2035, followed closely by China. However, China's working-age population will still account for 66 percent of its population whereas, Germany's will only account for 57 percent. India, Nigeria, and Mexico will be the only countries to have increases in their working-age populations.

Brazil, China, India, and Mexico will all benefit from declines in their share of youth populations, helping to close the gap of education spending, whereas advanced aging in Japan, France, Germany, the U.K., and the U.S., will lead to increased pressure to divert resources away from education towards healthcare and pension spending. From 2015 to 2035, pension needs will rise most rapidly for China, Germany, and Brazil and least rapidly for Nigeria and Japan. Healthcare costs will increase the most for the U.S. and Japan, but will decrease only for Nigeria.

All of the countries considered here will experience declines in their youth bulge populations. Brazil, China, and India will have the most rapid decreases during the next 20 years. By 2035, only Nigeria is forecast to still have a relatively large youth bulge.

Country	Working Age Population (Percent of Total Population)		Education Spending Gap (Percent of GDP)		Pension Needs (Percent of GDP)		Healthcare Costs (Percent of GDP)		Youth Bulge (Percent of Total Population)	
	Value in 2035	Change 2015 to 2035	Value in 2035	Change 2015 to 2035	Value in 2035	Change 2015 to 2035	Value in 2035	Change 2015 to 2035	Value in 2035	Change 2015 to 2035
Brazil	66	-3	-0.3	-0.5	12	5	14	4	24	-9
China	66	-8	0.8	-0.9	10	6	8	3	20	-8
India	68	3	0.8	-2	6	2	4	0.2	30	-8
Japan	57	-4	-0.3	0.3	15	0.5	15	6	16	-2
France	59	-4	-0.5	0.1	15	3	15	3	22	-0.1
Germany	57	-9	-0.2	0.1	20	6	15	4	16	-3
Mexico	67	0.8	0.6	-0.9	8	3	8	2	28	-9
Nigeria	57	4	0.9	1	2	0.1	4	-2	47	-0.8
United Kingdom	60	-4	-0.2	0.3	14	2	12	2	22	-1
United States	61	-6	-0.2	0.2	13	2	24	6	22	-3

Table B1: Value in 2035 and difference between 2015 and 2035 for select demographic risk indicators and select countries
Source: IFs 7.19

1. Country Profile: Brazil

A considerable decline in Brazil's TFR between 1960 and 2015 (from 6 to less than 2) has already substantially slowed the country's population growth. Between 2015 and 2050, Brazil is forecast to add 31 million people to its population, a small fraction compared to the 135 million people added between 1960 and 2015 (Figure B.3). In a continuation of historical trends, net migration (forecast to balance around zero) is not expected to contribute to any substantial demographic change (Figure B.4 – right).
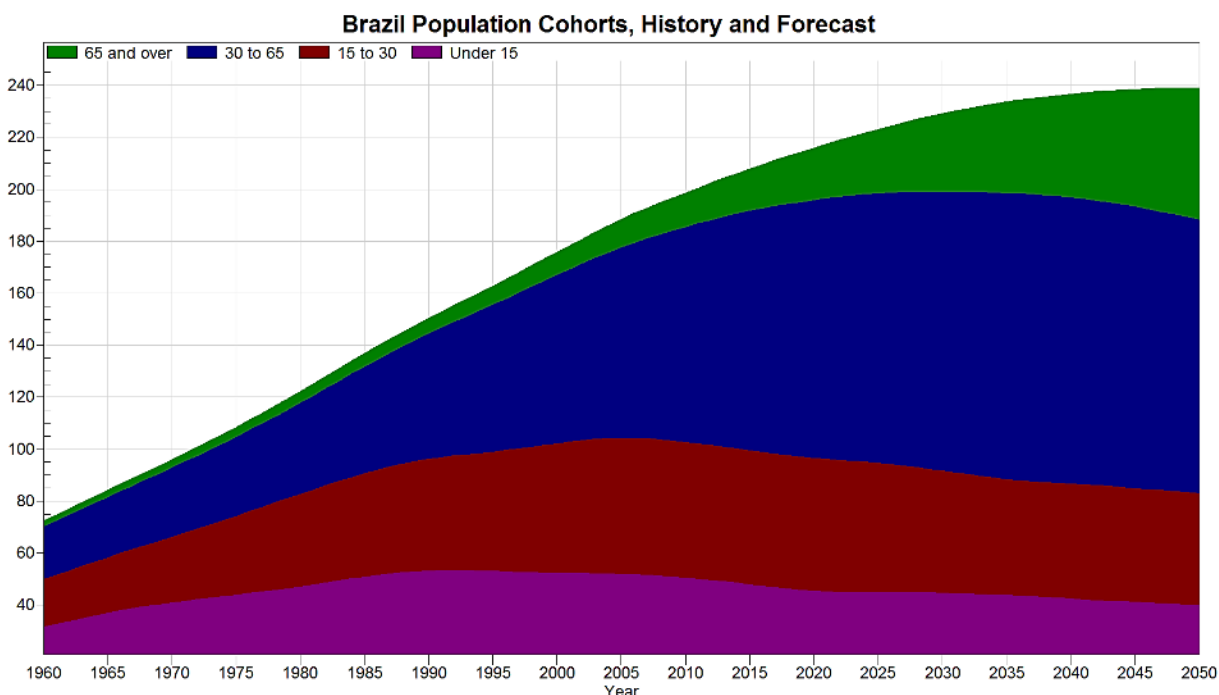
Figure B.3: Population cohort distribution for Brazil, 1960 to 2050
Source: IFs 7.19

Between 2015 and 2050, the country's share of people aged 65 and over is forecast to increase by 13 percentage points (from 8 to 21) and the median age is forecast to increase by 12 years (from 31 to 43) (Figure B.4 – left). Life expectancy during this time horizon is forecast to rise by around 5 years.

Life Expectancy and Median Age

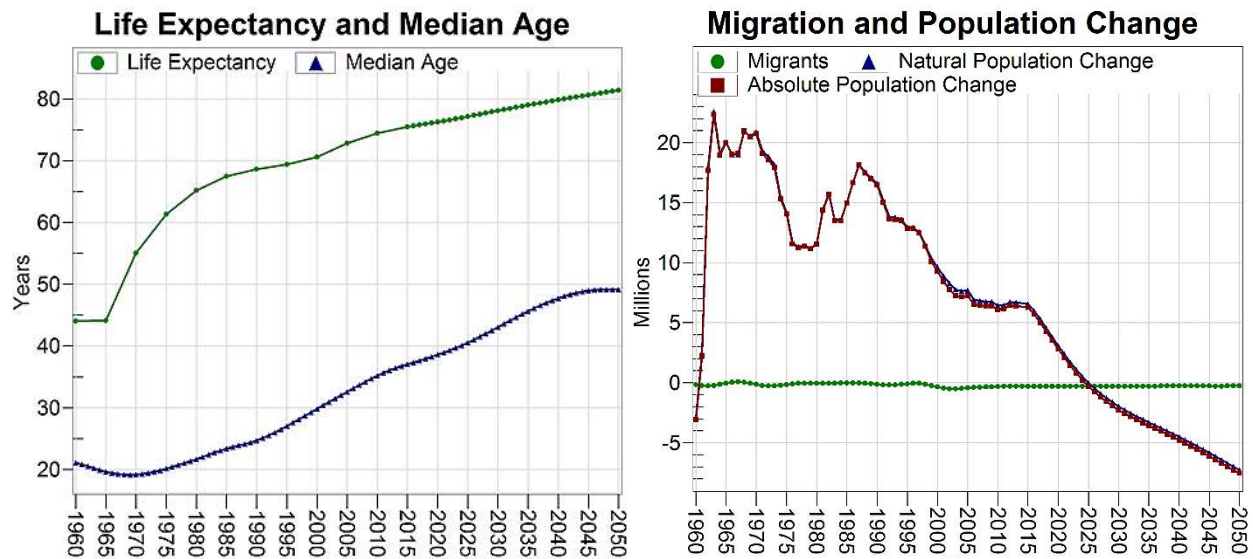**Migration and Population Change**
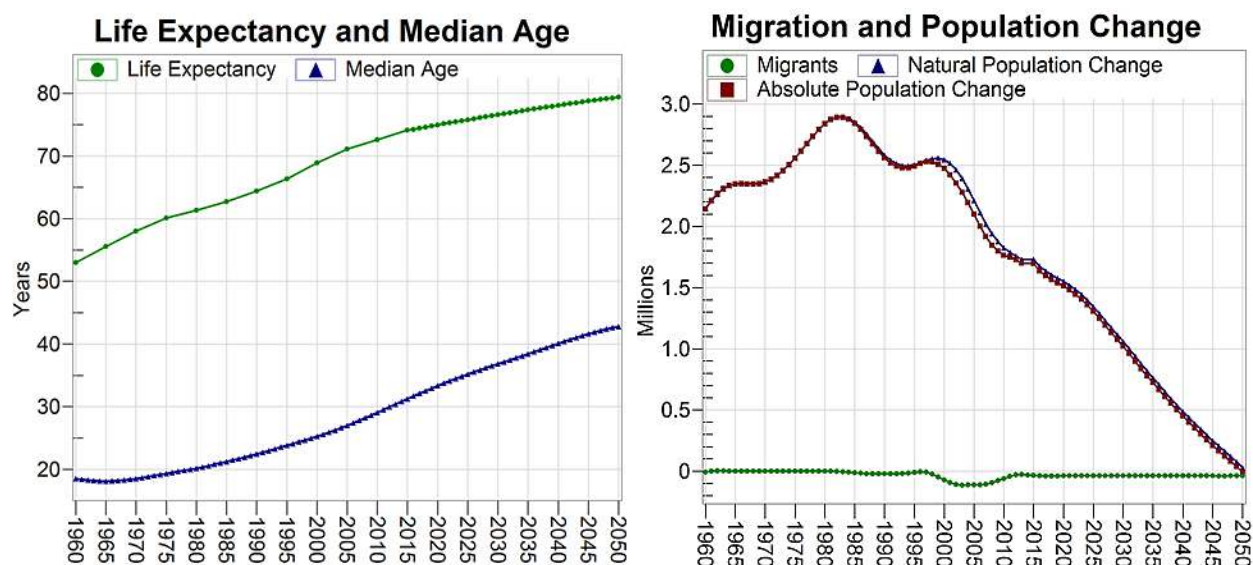
Figure B.4: (Left) Life expectancy and median age for Brazil, 1960 to 2050 (Right) Net migration and population change for Brazil, 1960 to 2050.
Source: IFs 7.19

During the past 50 years, Brazil benefited from abating youth dependency and low elderly dependency (Figure B.5 – left) as well as a growing demographic dividend (Figure B.5 – right). The coming decades, however, are likely to realize sizable growth in elderly dependency and, after a peak around 2020, a waning demographic dividend.

Dependency Ratios
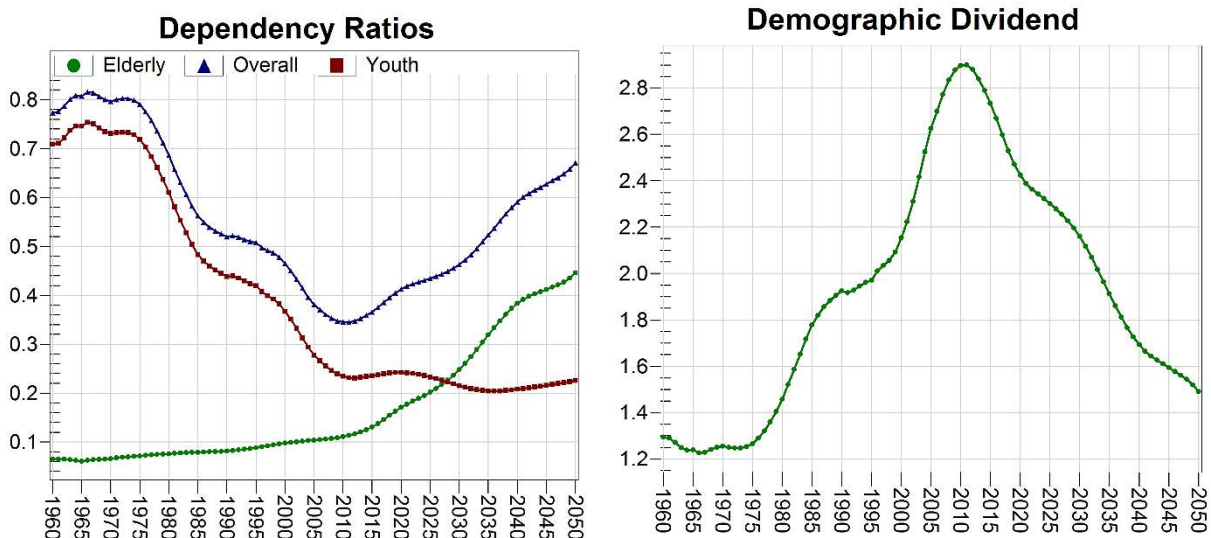
Demographic Dividend
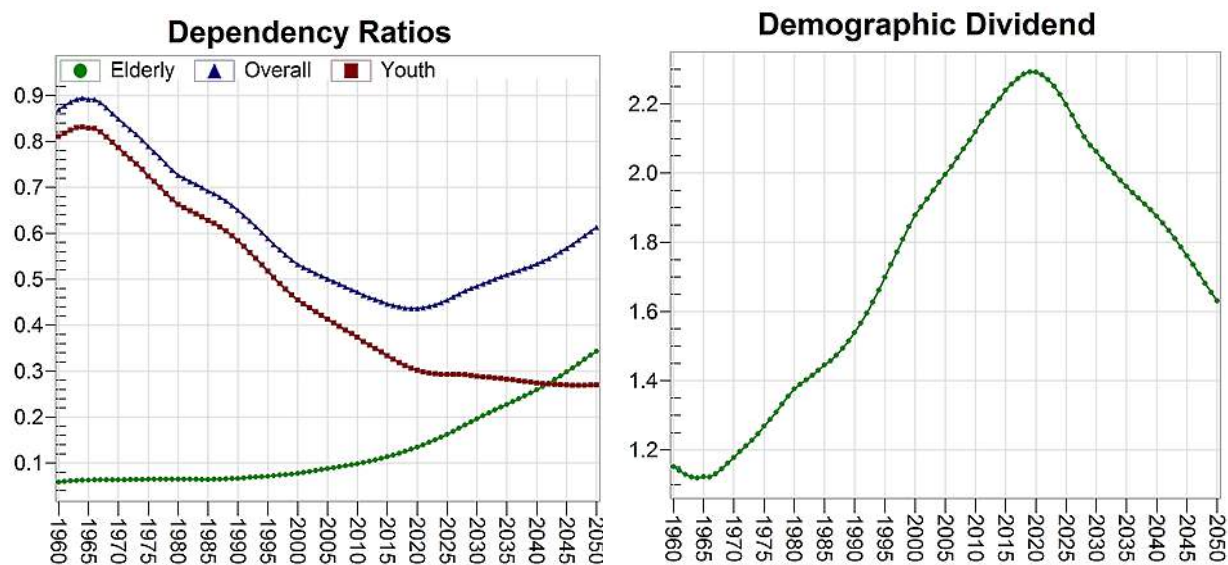
Figure B.5: (Left) Elderly, youth, and overall dependency ratios for India, 1960 to 2050 (Right) Demographic dividend for India, 1960 to 2050.
Source: IFs 7.19

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The risks stemming from the demographic dynamics unfolding in Brazil are shown in Figure B.6. Healthcare costs are forecast to increase by roughly 8 percentage points of GDP between 2015 and 2050 while pension needs are forecast to increase by more than 10 percentage points of GDP during the same period (Figure B.6 – left). Further exacerbating this increasing financial burden, the country's labor's contribution to growth is not only forecast to decline, but will likely be negative by 2050 (Figure B.6 – right). However, education spending needs are forecast to fall by nearly 2 percentage points during the same period, providing a slight easing of the financial risks facing Brazil (Figure B.6 – left).
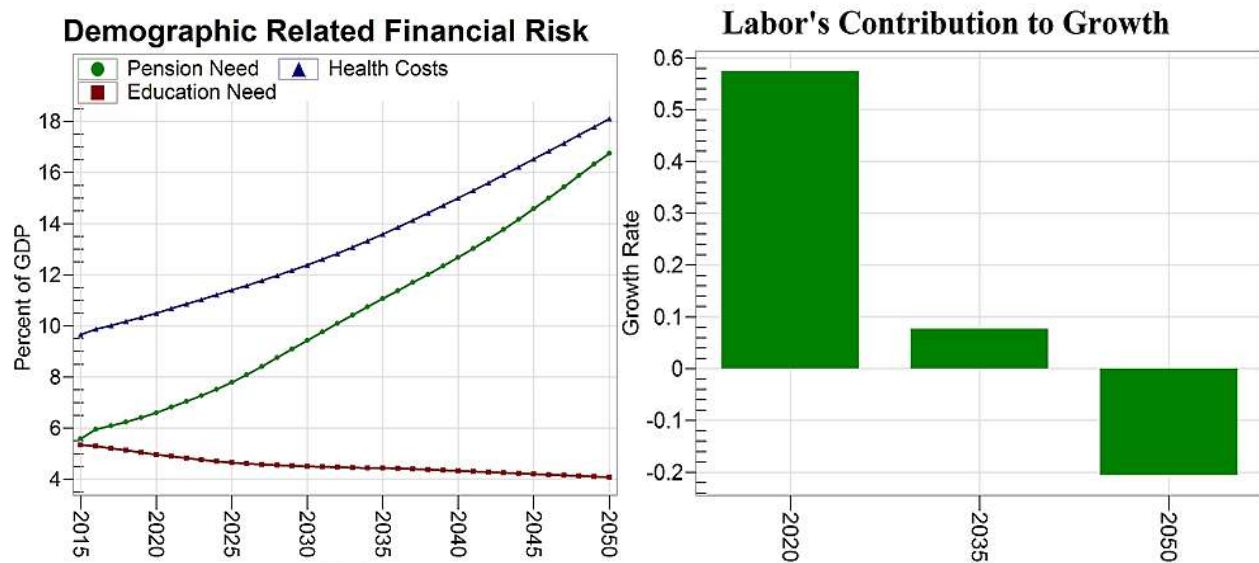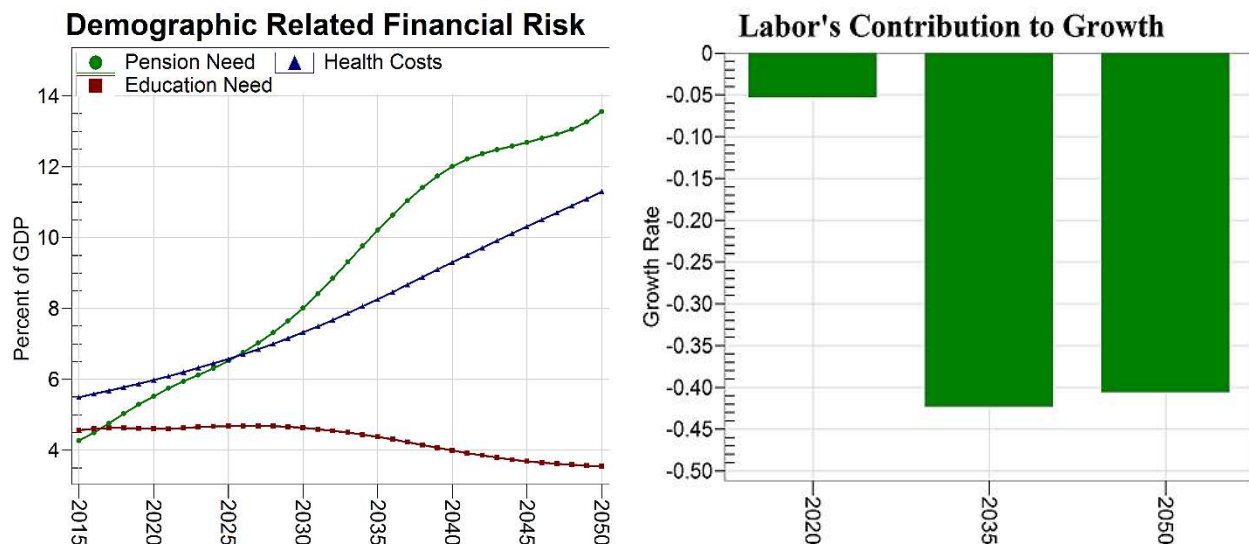

Figure B.6: (Left) Demographic related financial risks from pensions, health care, and education for India, 2015 to 2050 (Right) Labor's contribution to economic growth for Brazil, 2020, 2035, and 2050
Source: IFs 7.19

2. Country Profile: China

China's extreme fertility declines in the 1970s and 1980s accelerated the country's movement through the demographic transition. As a result, China's population will likely peak within the next 20 to 30 years, not long after Germany, whose transition began much earlier. China's population, which increased by over 731 million between 1960 and 2015, is forecast to decline by 67 million between 2015 and 2035 (Figure B.7).
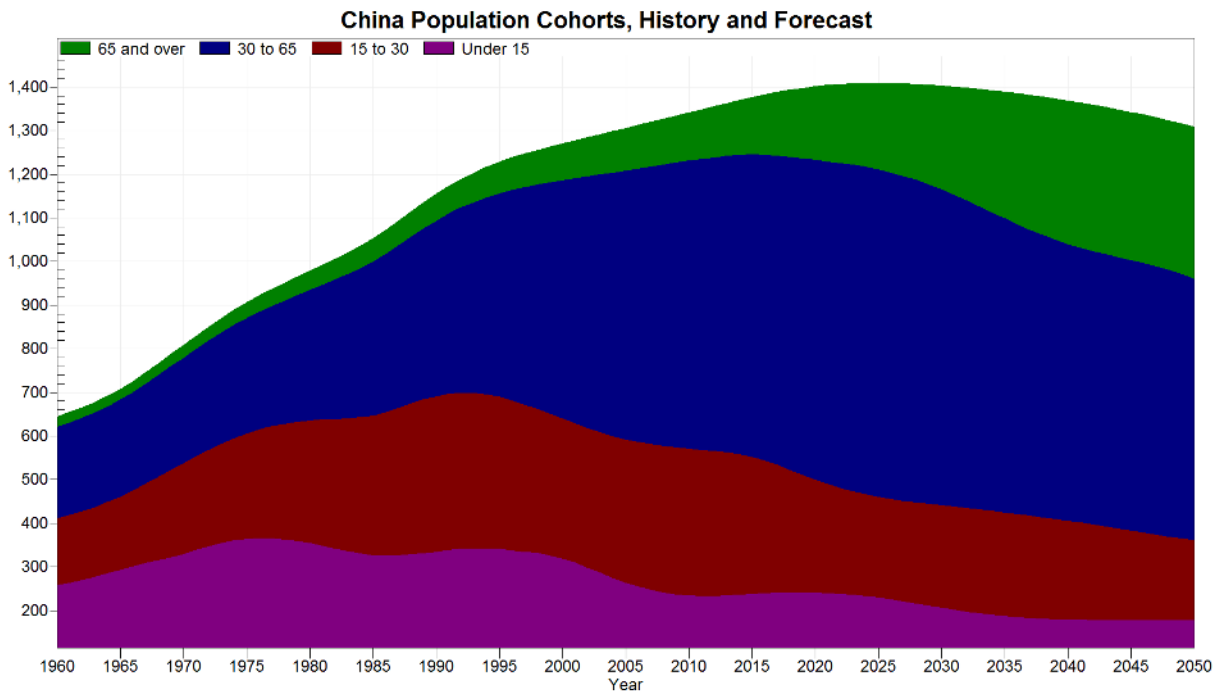
Figure B.7: Population cohort distribution for China, 1960 to 2050.
Source: IFs 7.19

China's accelerated pace through the demographic transition translates into a rapidly aging population. The country's median age is forecast to increase 12 years (to 49 years) between 2015 and 2050, vaulting from the 50th highest median age in the world to the 21st (Figure B.8 – left). In addition, China's life expectancy is forecast to increase by 6 years between 2015 and 2050, a rate of increase larger than all of the countries considered in this appendix excepting Nigeria (Figure B.8 – left). Furthermore, the country can expect little alleviation from an inflow of young migrants, as the country's net migration is forecast to stay around zero through 2050 (Figure B.8 – right).
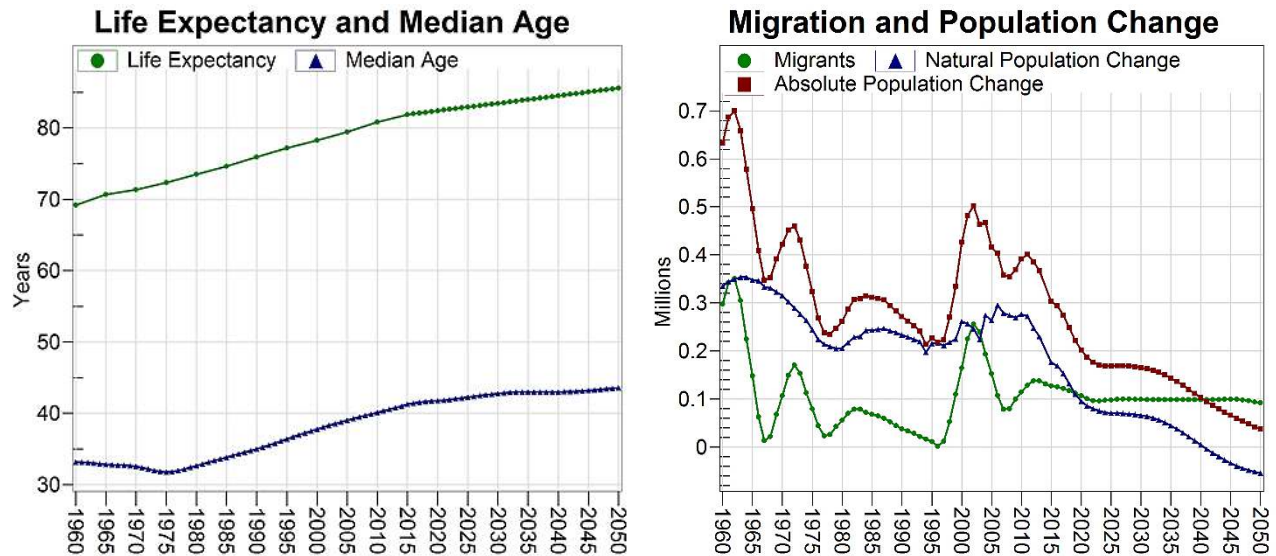
Figure B.8: *(Left) Life expectancy and median age for China, 1960 to 2050 (Right) Net migration and population change for China, 1960 to 2050.*
Source: IFs 7.19

China enjoyed an unparalleled demographic dividend (Figure B.9 – right) and favorable dependency ratios (Figure B.9–left) for the latter half of the 20th century and the beginning of the 21st century. However, the coming decades will be less generous. The country's demographic dividend is today just past its peak, signaling the beginning of a dramatic growth in the elderly dependency ratio as the share of elderly nearly triples between 2015 and 2050.
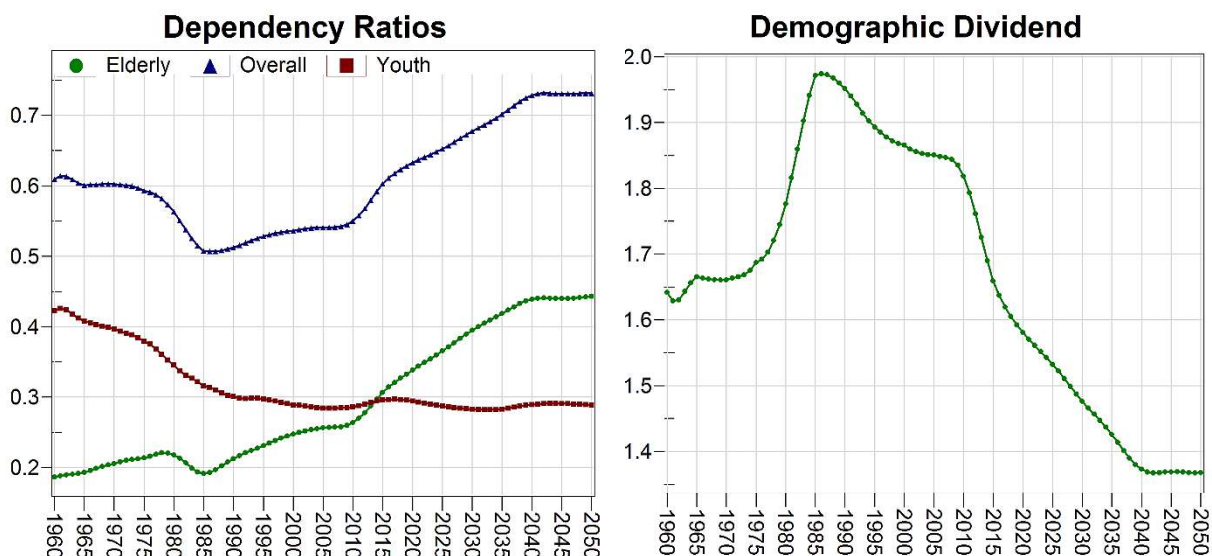

Figure B.9: *(Left) Elderly, youth, and overall dependency ratios for China, 1960 to 2050 (Right) Demographic dividend for China, 1960 to 2050.*
Source: IFs 7.19

The result of this transition is that pension needs will surge past education spending needs and health costs within 10 or 15 years, despite health care costs growing to over 11 percent of GDP by 2050 (Figure B.10 – left). Education need will shrink during the same period, but not enough to offset the increases in health care and pension costs (Figure B.10 – left). An additional challenge in dealing with these changing costs is the country's labor's contribution to economic growth, which already negative by 2020, is forecast to sink considerably over the following 3 decades (Figure B.10 – right).
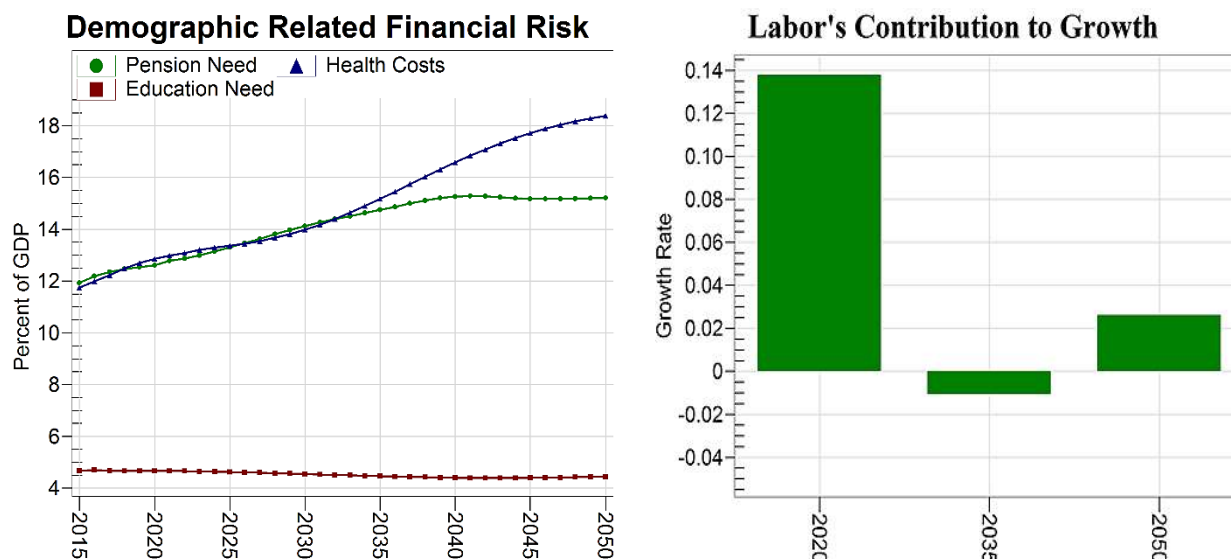

Figure B.10: (Left) Demographic related financial risks from pensions, health care, and education for India, 2015 to 2050 (Right) Labor's contribution to economic growth for India, 2020, 2035, and 2050.
Source: IFs 7.19

3. Country Profile: France

France's population increased by over 18 million between 1960 and 2015. Between 2015 and 2050, it is forecast to grow by less than 5 million (Figure B.11). As population growth continues to slow, median age and life expectancy are forecast to increase by 3 and 4 years respectively (Figure B.12 – left).
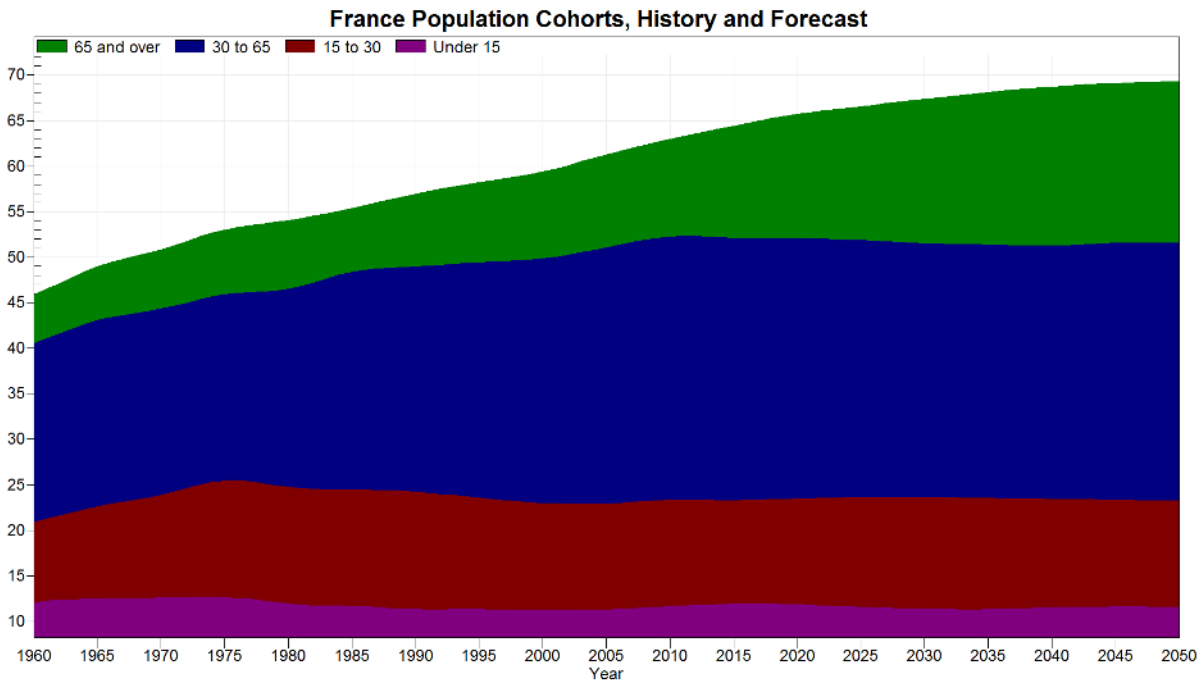
Figure B.11: Population cohort distribution for France, 1960 to 2050.
Source: IFs 7.19

France is relatively advanced in terms of aging. In 2015, 19 percent of its population was aged 65 or over, giving it the 11th largest share of elderly in the world. Having already passed through most of the demographic transition, France will not be subject to the dramatic demographic changes that face countries like China. In fact, its share of elderly will have fallen to 40th largest by 2050. Demographic dynamics are, however, more sensitive to shifts in migration, which has historically played a significant role in population change within the country (Figure B.12 – right).

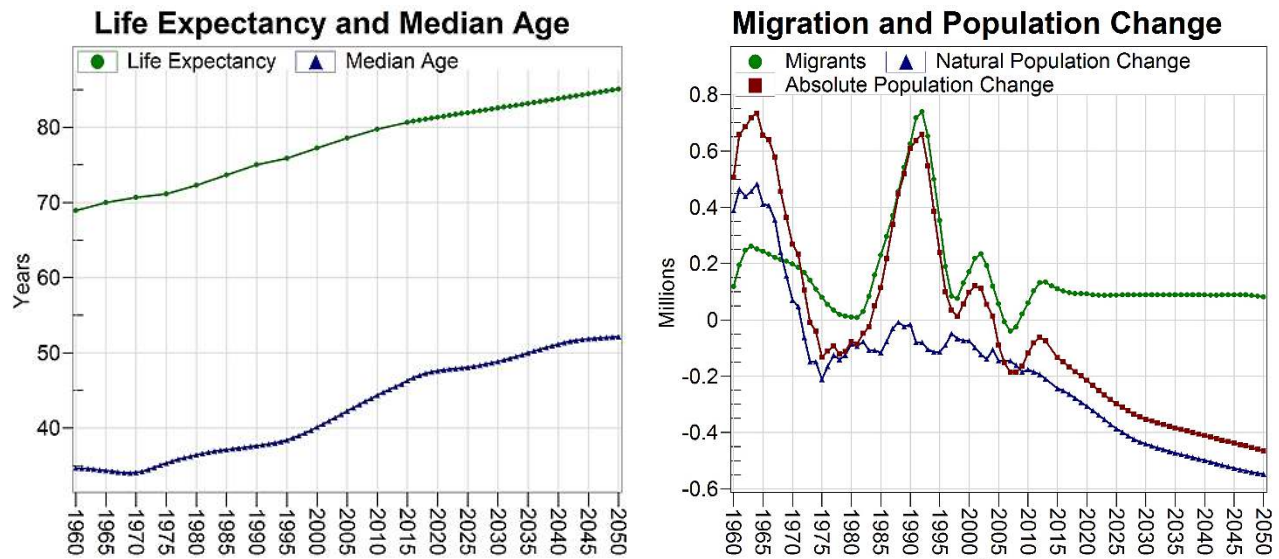**Life Expectancy and Median Age**

Migration and Population Change

Figure B.12: (Left) Life expectancy and median age for France, 1960 to 2050 (Right) Net migration and population change for France, 1960 to 2050
Source: IFs 7.19

France will inevitably face a fairly substantial increase in the elderly dependency ratio through the coming decades, yet forecast show this burden leveling off around 2040 (Figure B.13 - left), potentially providing some financial relief and demographic stability. The country's demographic dividend has been beyond its peak for nearly 2 decades (B.13 – right) and is also likely to level off around 2040.
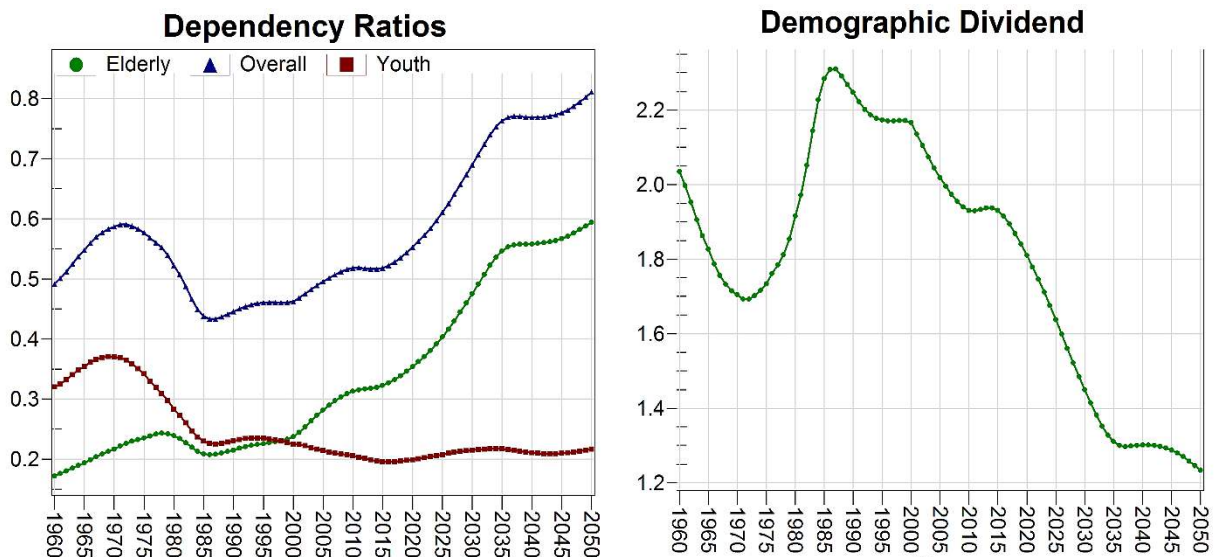

Dependency Ratios

Demographic Dividend

Figure B.13: (Left) Elderly, youth, and overall dependency ratios for France, 1960 to 2050 (Right) Demographic dividend for France, 1960 to 2050
Source: IFs 7.19

France may be moving toward a steadier state with respect to demographic risks and benefits. Though they already rank among the highest in terms of health costs and pension needs, demand is forecast to plateau to some extent around the middle of the century (Figure B.14 –

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left) and education spending needs are unlikely to change much during this period. Moreover, though labor's contribution to economic growth will likely decline between 2020 and 2050, the burden is fairly marginal compared with other, more rapidly aging, countries (Figure B.14 – right).
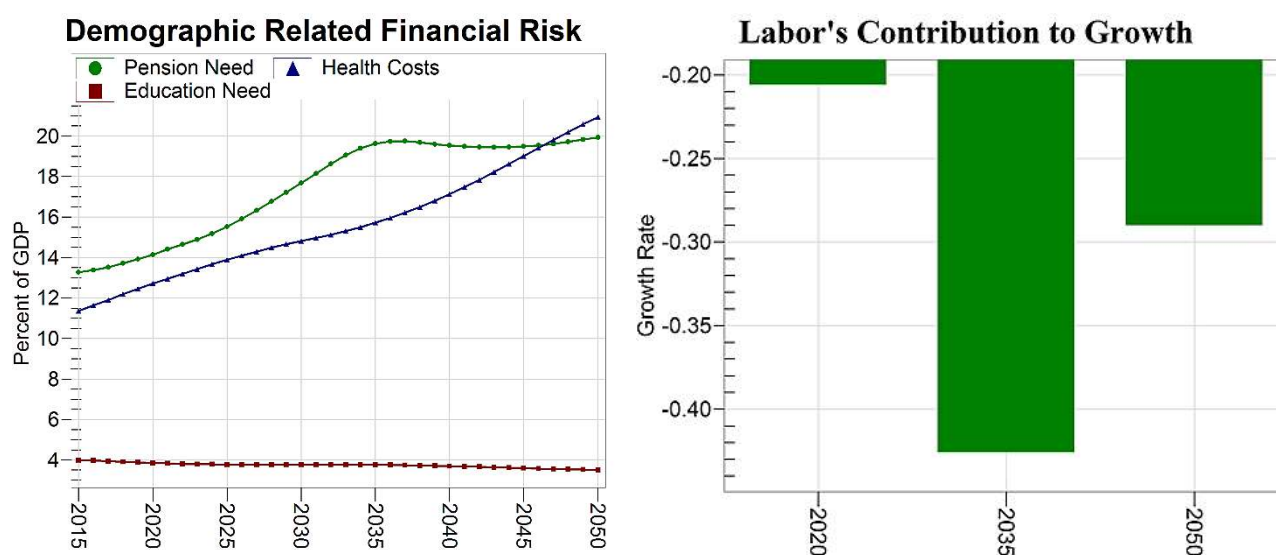

Figure B.14: (Left) Demographic related financial risks from pensions, health care, and education for France, 2015 to 2050
(Right) Labor's contribution to economic growth for France, 2020, 2035, and 2050
Source: IFs 7.19

4. Country Profile: Germany

Germany today is one of the oldest countries in the world with a median age second only to Japan. It will be one of the first countries to experience a shrinking population between 2015 and 2050. In fact, Germany's population is forecast to decrease by 12 million during this time horizon, whereas it increased by over 7 million between 1960 and 2015 (Figure B.15).
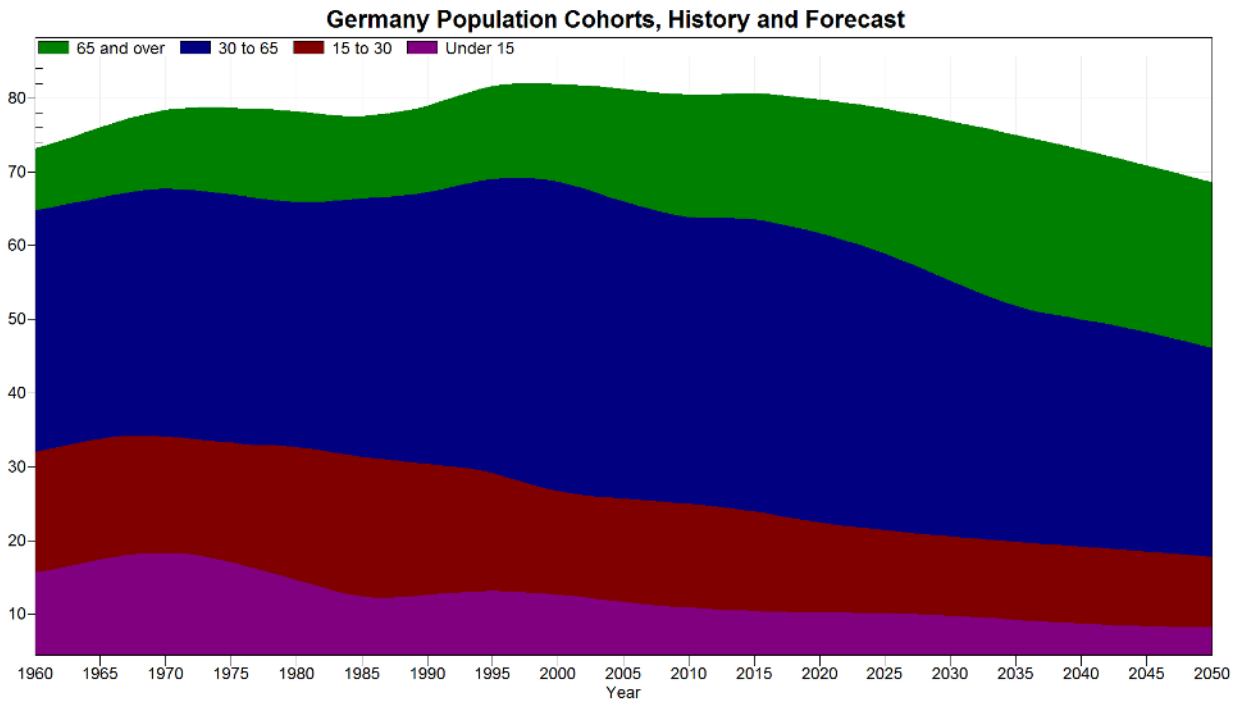
Figure B.15: Population cohort distribution for Germany, 1960 to 2050.
Source: IFs 7.19

Germany's median age, though forecast to increase by 6 years between 2015 and 2050, will not hold its rank. By 2050 it will have fallen to 7th in the world as today's younger, but faster aging countries surpass it. Nevertheless, the share of its population 65 and over will increase by nearly 12 percentage points (to 33 percent). Germany's life expectancy, however, forecast to increase by over 4 years, will move from 22nd highest to 20th highest in the world between 2015 and 2050 (Figure B.16).

Figure B.16: *(Left) Life expectancy and median age for Germany, 1960 to 2050 (Right) Net migration and population change for Germany, 1960 to 2050.*
Source: IFs 7.19

Germany's already large elderly dependency ratio is forecast to continue to climb through 2050 (Figure B.17 – left) while the country's demographic dividend, which has been in decline for around 20 years, will continue its decline (Figure B.17 – right). Germany has, however, historically had relatively high levels of immigration. If this trend continues, it may help offset the loss of the demographic dividend (Figure B.17 – right).
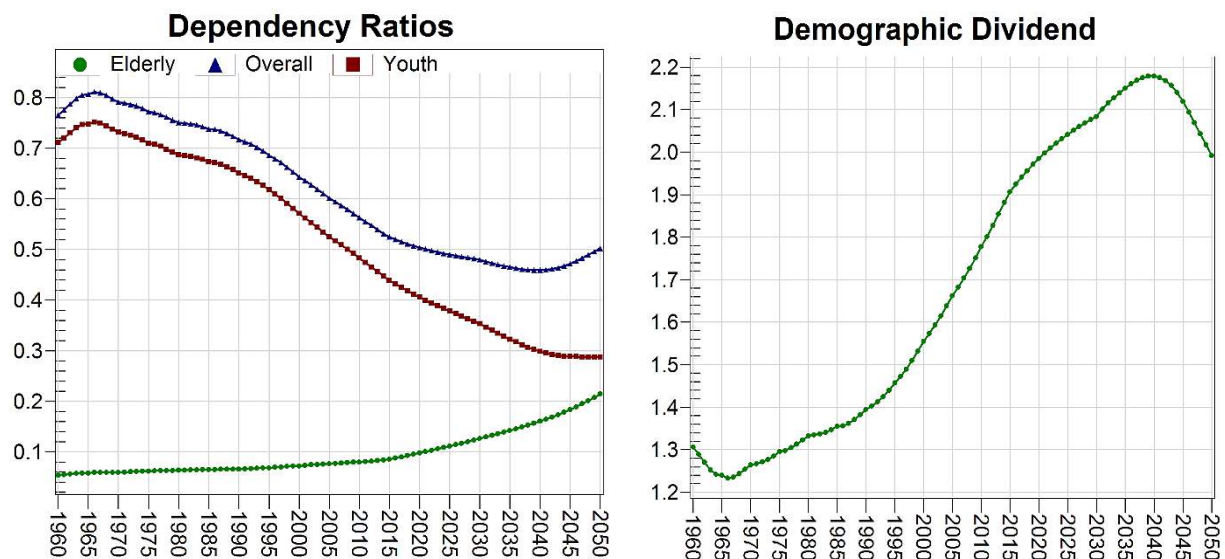

Figure B.17: *(Left) Elderly, youth, and overall dependency ratios for Germany, 1960 to 2050 (Right) Demographic dividend for Germany, 1960 to 2050.*
Source: IFs 7.19

By 2035, Germany is forecast to have the 4th highest pension need and the 6th highest health care costs in the world. Between 2015 and 2050, health costs as a percent of GDP will increase by approximately 6 percentage points and pension need will increase by nearly 10 percentage points. However, the country will experience some reprieve as its pension needs are forecast to level off after 2035 (Figure B.18 – left).

Another reprieve may come in the form of labor's contribution to growth. Already negative by 2020, contribution is forecast to fall considerably by 2035. Yet, by 2050, labor's contribution may have begun to improve due in part to a gradual increase in fertility rates since the mid-2000s and the first generation of children born to today's migrant population (Figure B.18 – right).

Figure B.18: (Left) Demographic related financial risks from pensions, health care, and education for Germany, 2015 to 2050 (Right) Labor's contribution to economic growth for Germany, 2020, 2035, and 2050.
Source: IFs 7.19

5. Country Profile: India

India had the second largest population in the world in 2015 and it will have the largest by 2050. However, the country's population growth is slowing and the population is getting older. Specifically, India's population is forecast to grow by nearly 400 million people between 2015 and 2050, which is less than half the number of people added between 1960 and 2015 (Figure B.19). Life expectancy is forecast to increase by 10 years and the median age by 11 years (Figure B.20 - left).

Indian Population Cohorts, History and Forecast
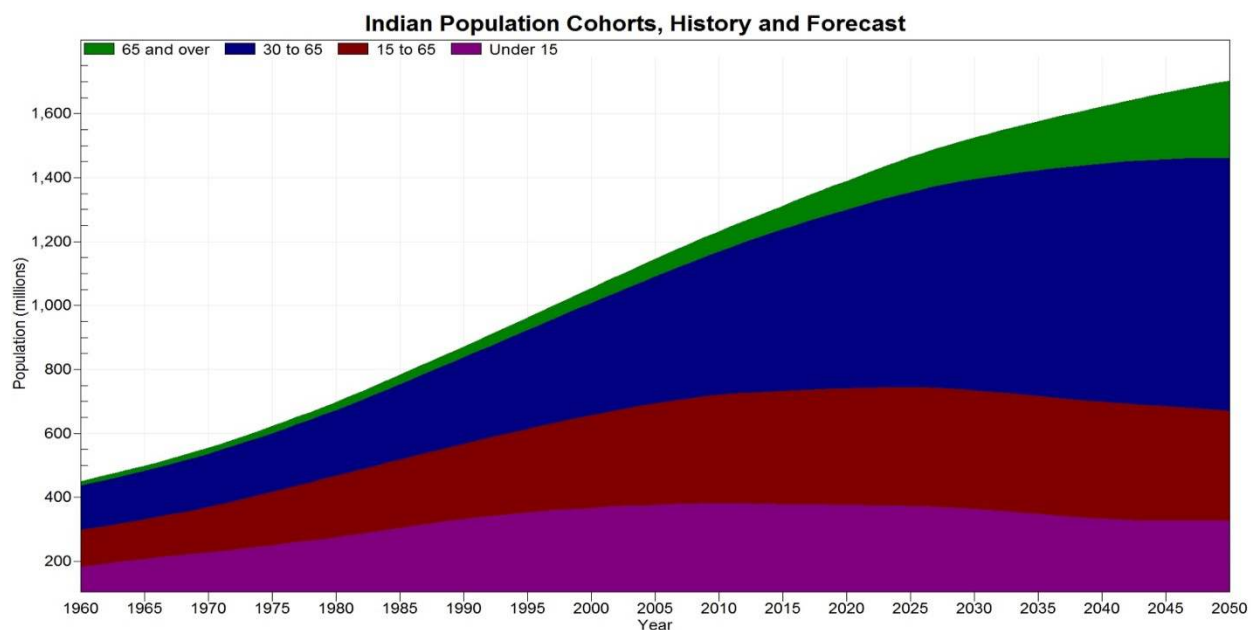
Figure B.19: Population cohort distribution for India, 1960 to 2050.
Source: IFs 7.19

However, India is not forecast to experience substantial benefit or risk from external migration. The net number of migrants is forecast to hover around zero between 2015 and 2035 and will have almost no impact on population change (Figure B.20 – right).
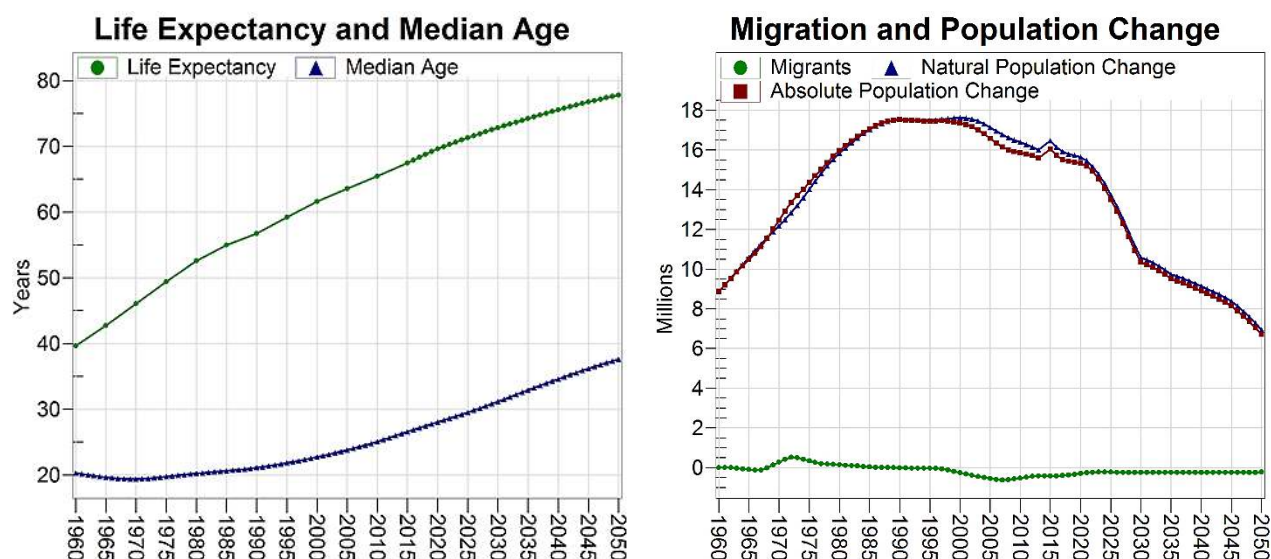
Figure B.20: (Left) Life expectancy and median age for India, 1960 to 2050 (Right) Net migration and population change for India, 1960 to 2050.
Source: IFs 7.19

Despite a substantial increase in the share of those 65 and over between 2015 and 2050 (approximately 10 percentage points), by 2050 India will still not have reached an advanced

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stage of aging. In fact, the country will enjoy an increasingly large demographic dividend (Figure B.21 - right) and sharp declines in its overall dependency ratio (driven by declines in youth dependency) through 2040 (Figure B.21 - left), before the country's elderly dependency begins to climb and its demographic dividend drops off.
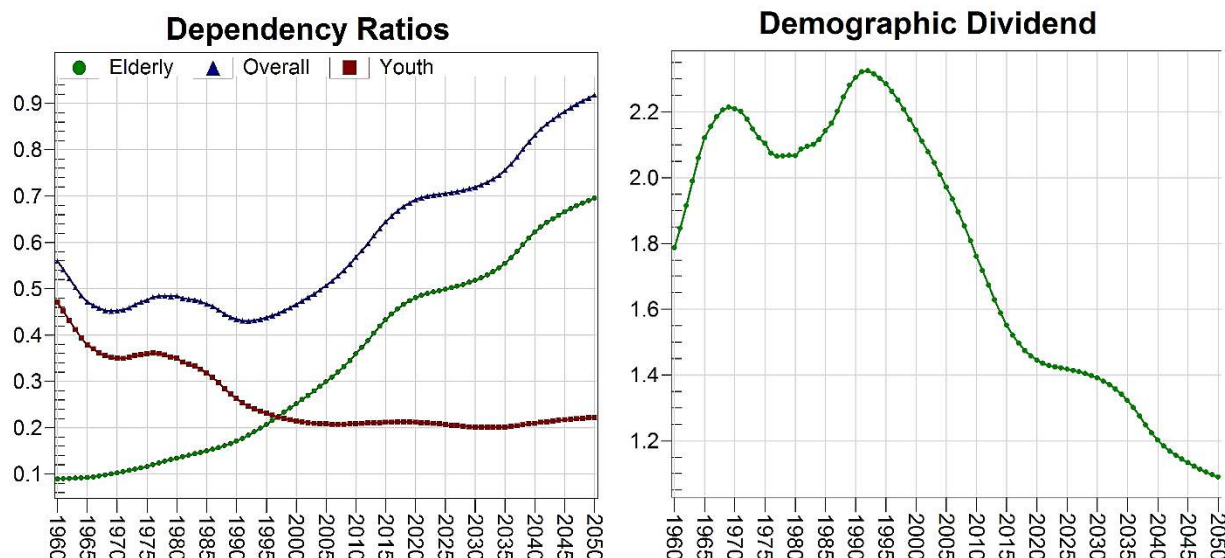

Figure B.21: (Left) Elderly, youth, and overall dependency ratios for India, 1960 to 2050 (Right) Demographic dividend for India, 1960 to 2050.
Source: IFs 7.19

Because of this, India's economic potential over the next few decades is fairly large. However, the country must begin to harness this potential immediately because labor's contribution to growth is already in decline (Figure B.22 - right). Moreover, though increasing more slowly than countries like Germany and France, India's pension need (as a percent of GDP) will more than double between 2015 and 2050 and the sheer size of its population will ensure that pension needs will rise considerably beyond 2050. Yet, healthcare costs will rise only slowly in the coming decades while education needs fall significantly (Figure B.22 - left).
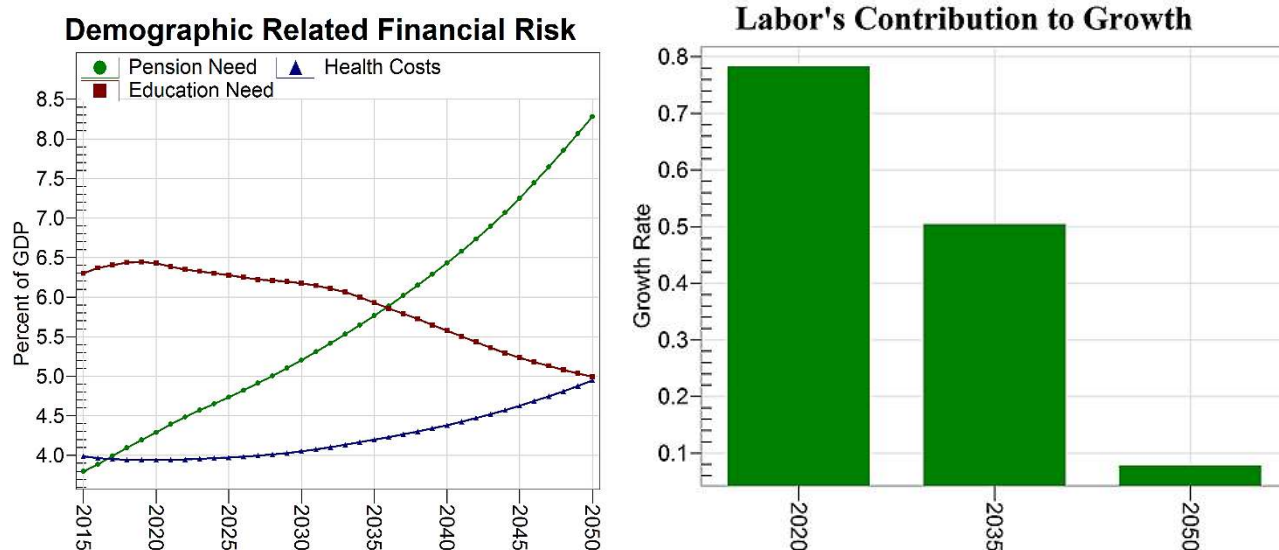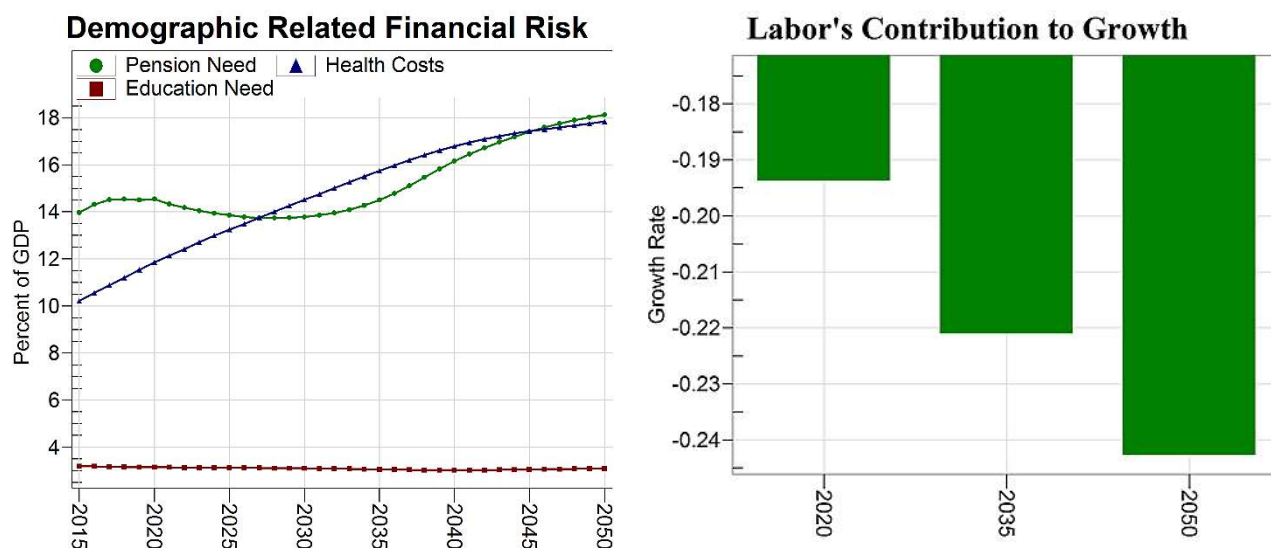
Figure B.22: (Left) Demographic related financial risks from pensions, health care, and education for India, 2015 to 2050 (Right) Labor's contribution to economic growth for India, 2020, 2035, and 2050.
Source: IFs 7.19

6. Country Profile: Japan

Japan is the oldest country in the world and its share of elderly will remain higher than any other country through 2050. Japan is also forecast to experience a 19 percent decline in the size of its population (a decrease of 24 million people) between 2015 and 2050, a substantial difference from the 37 percent (34 million) increase the country experienced between 1960 and 2015 (Figure B.23).
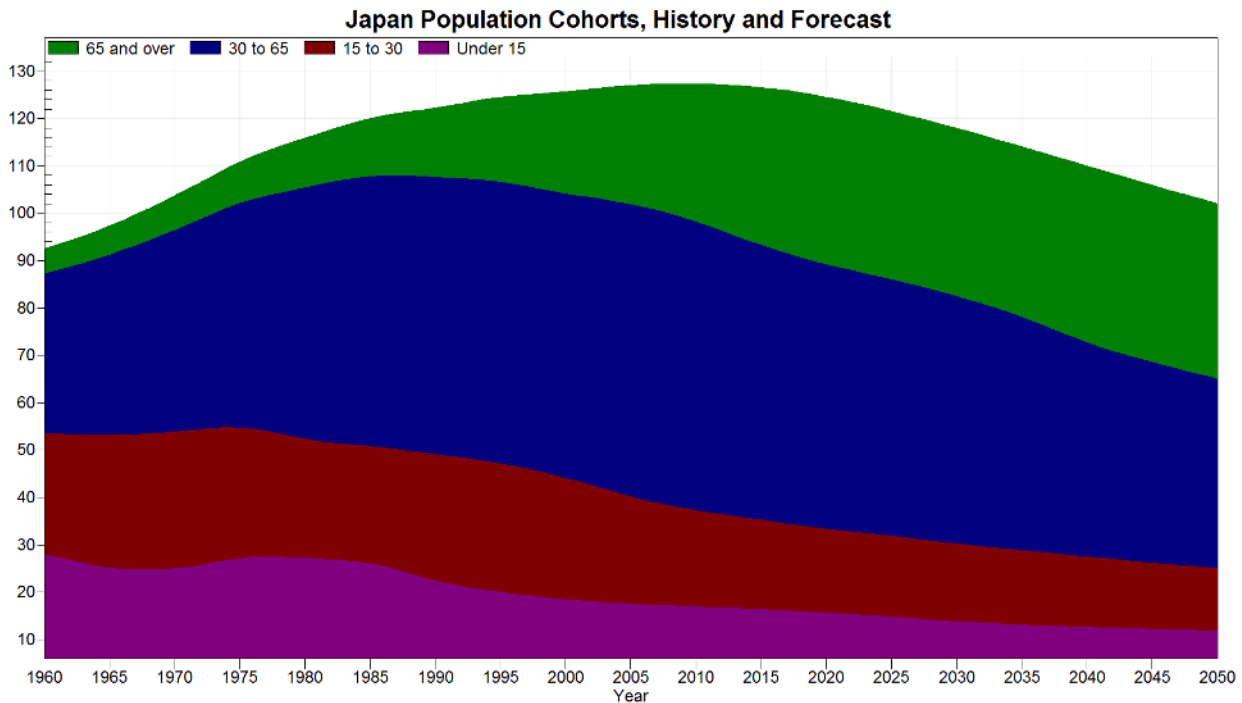
Figure B.23: Population cohort distribution for Japan, 1960 to 2050.
Source: IFs 7.19

Japan's life expectancy (also highest in the world) is forecast to rise 4 years between 2015 and 2050, while the median age will likely grow by 8 years (Figure B.24 – left). Without reform to Japan's strict immigration controls, or an increase in fertility rates, the country is unlikely to see any revitalization of its working-age population from immigration (Figure B.24 – right).
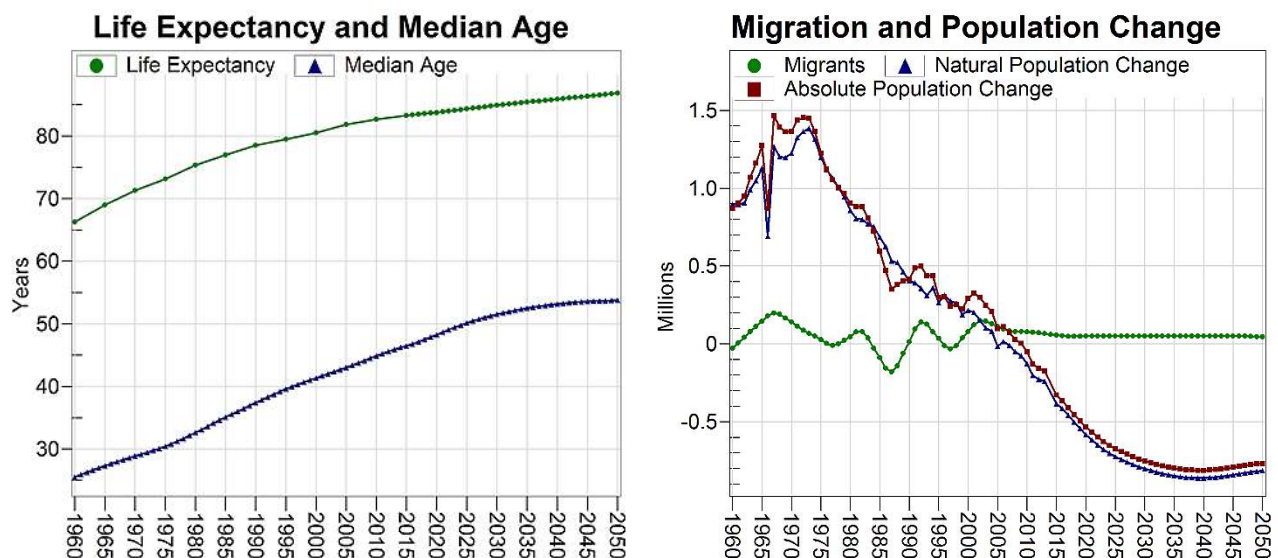
Figure B.24: (Left) Life expectancy and median age for Japan, 1960 to 2050 (Right) Net migration and population change for Japan, 1960 to 2050.
Source: IFs 7.19

In Japan's advanced stage of aging, elderly dependency ratios are high and rising (they are forecast to reach 0.7 by 2050) (Figure B.25 – left), and the country's demographic dividend is a thing of the past (Figure B.25 - right).

Figure B.25: (Left) Elderly, youth, and overall dependency ratios for Japan, 1960 to 2050 (Right) Demographic dividend for Japan, 1960 to 2050.
Source: IFs 7.19

Like France and Germany, aging brings high and increasing health and pension costs to Japan, though increases in both may begin to taper off towards 2050 (Figure B.26 – left). Unlike countries more open to migration, Japan is forecast to see continued, considerable declines in labor's contribution to economic growth through 2050 (Figure B.26 – right).

Figure B.26: (Left) Demographic related financial risks from pensions, health care, and education for Japan, 2015 to 2050 (Right) Labor's contribution to economic growth for Japan, 2020, 2035, and 2050.
Source: IFs 7.19

7. Country Profile: Mexico

Mexico still has a relatively young population, but is forecast to age rapidly in the coming decades. The country can expect to see substantial, though slower, growth in its population size in the coming decades. Between 2015 and 2050, Mexico's population is forecast to grow by 35 million people, which is less than half of the 89 million added between 1960 and 2015 (Figure B.27).
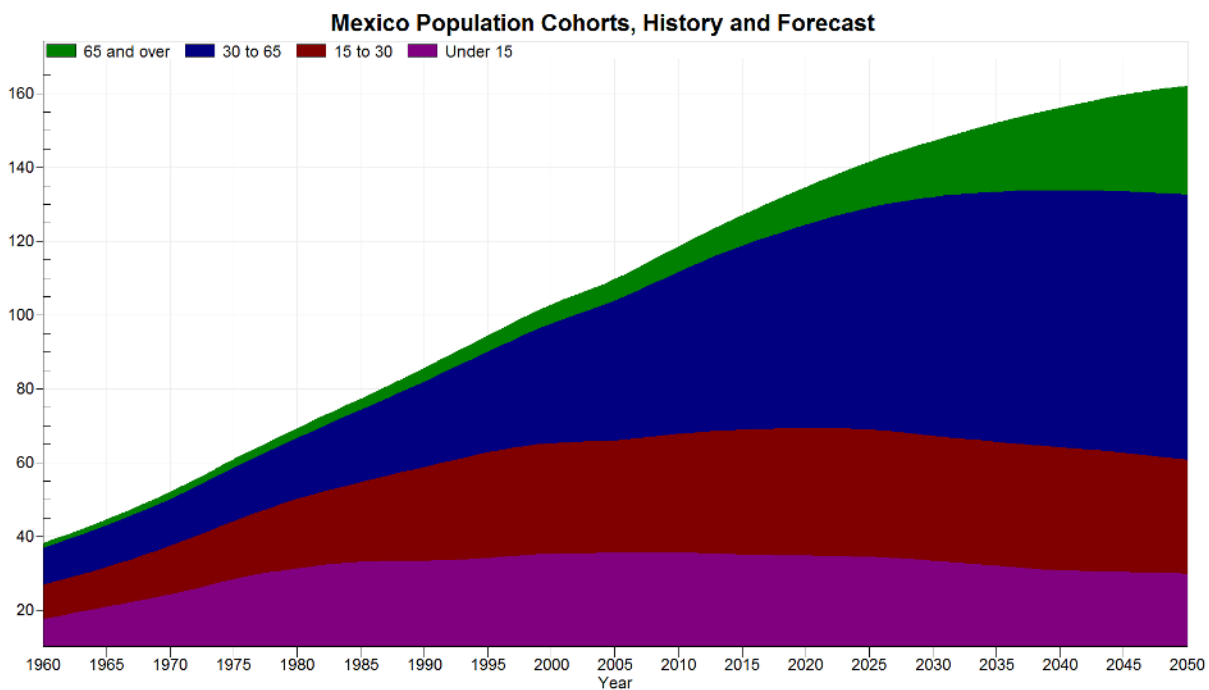
Mexico Population Cohorts, History and Forecast

Figure B.27: Population cohort distribution for Mexico, 1960 to 2050.
Source: IFs 7.19

Mexico's life expectancy is expected to rise by 5 years between 2015 and 2050 while its median age is forecast to increase by 12 years, similar to rates found in China and Brazil (Figure B.28 – left). Emigration is expected to decline over the coming decades, but could play a larger role in demographic dynamics as the crude birth rate approaches replacement levels (Figure B.28 – right).

Life Expectancy and Median Age

Migration and Population Change
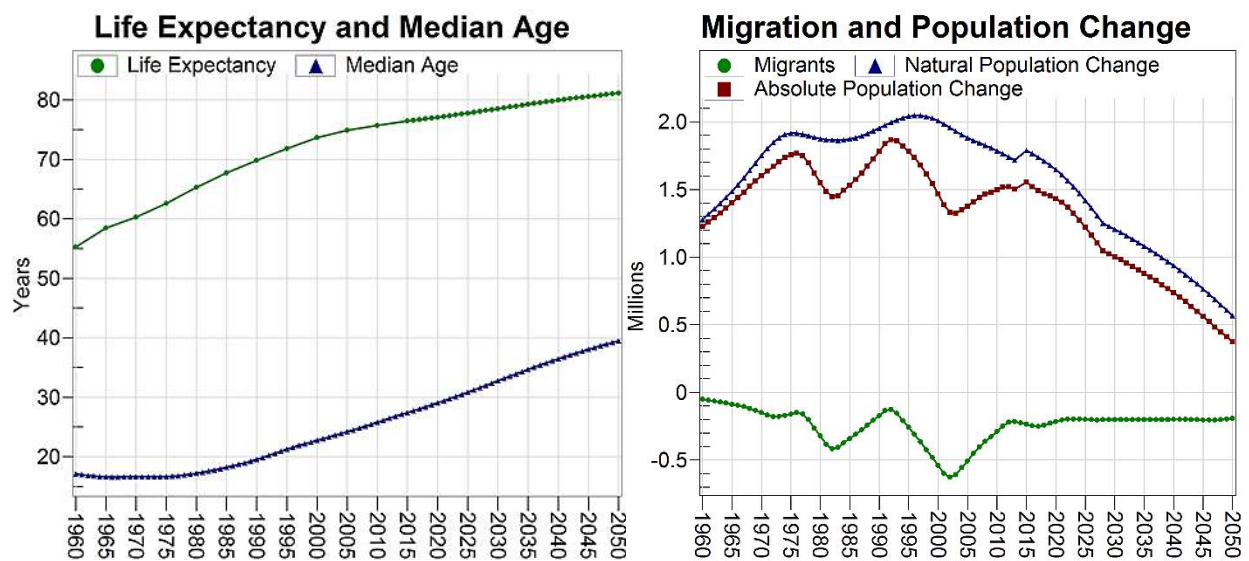
Figure B.28: (Left) Life expectancy and median age for Mexico, 1960 to 2050 (Right) Net migration and population change for Mexico, 1960 to 2050.
Source: IFs 7.19

Mexico has recently begun to enjoy a demographic dividend (Figure B.29 – right). The next two decades will be an opportunity for the country to benefit from a large working-age population and relatively low dependency ratios (Figure B.29 – left). However, after 2040, the country's demographic dividend will peak and begin to fall off as the elderly dependency ratio grows at a higher rate.

Dependency Ratios

Demographic Dividend
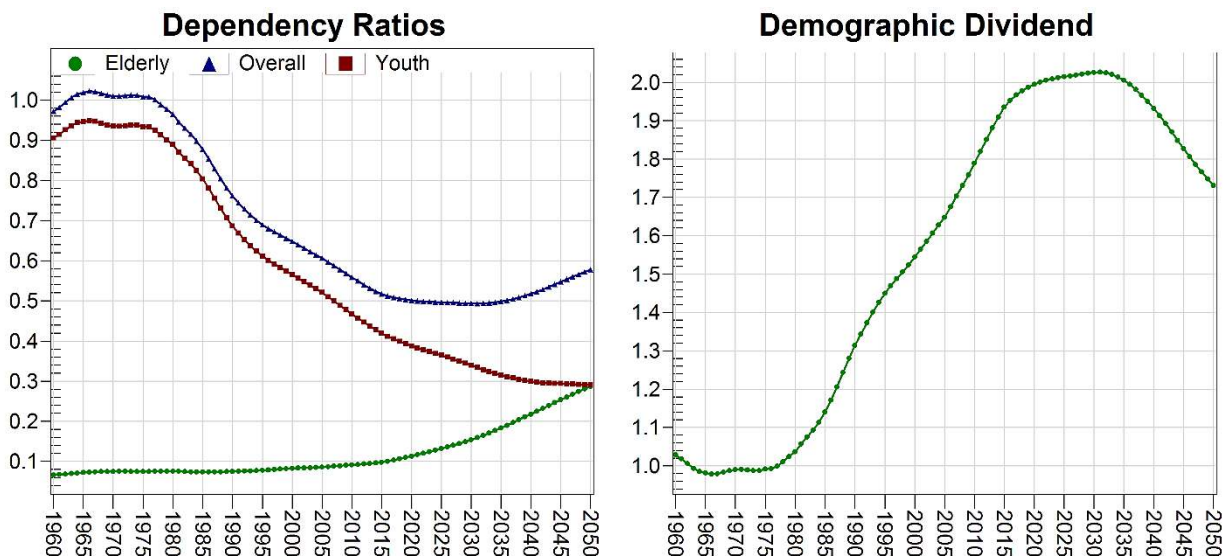
Figure B.29: (Left) Elderly, youth, and overall dependency ratios for Mexico, 1960 to 2050 (Right) Demographic dividend for Mexico, 1960 to 2050
Source: IFs 7.19

As a result of rapid aging, healthcare costs and pension needs will rise considerably between

2015 and 2050 (roughly 5 and 8 percentage points, respectively) (Figure B.30 – left) and will be coupled with steep declines in labor's contribution to growth (Figure B.30 – right). An almost 2 percent decrease in education spending need (as a percent of GDP) will provide some relief, but not nearly enough to offset health care and pension costs increases (Figure B.30 – right).
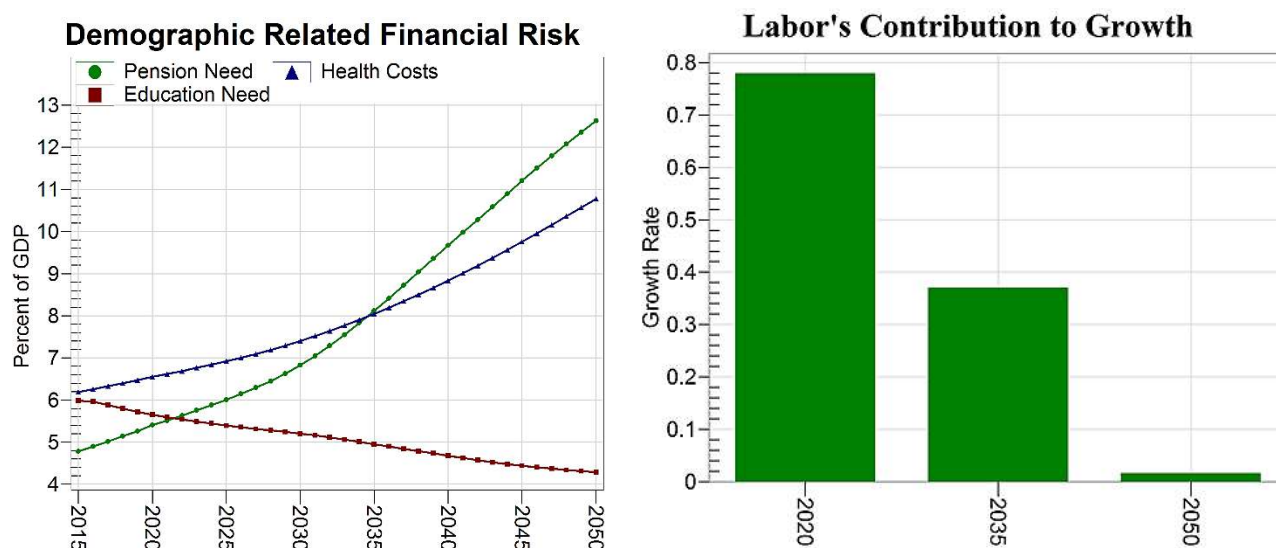

Figure B.30: (Left) Demographic related financial risks from pensions, health care, and education for Mexico, 2015 to 2050
(Right) Labor's contribution to economic growth for Mexico, 2020, 2035, and 2050
Source: IFs 7.19

Demographically speaking, Mexico is in an enviable position. The country can expect its demographic dividend to last for around to two more decades and it still has some time to prepare for the health care and pension burdens of an aging society.

8. Country Profile: Nigeria

Of the countries considered in this section, Nigeria is the youngest and the only one forecast to have greater population growth in the coming decades than in the past 55 years. Between 2015 and 2050, Nigeria's population is forecast to increase by 217 million people, a considerable jump from the 137 million people added between 1960 and 2015 (Figure B.31).
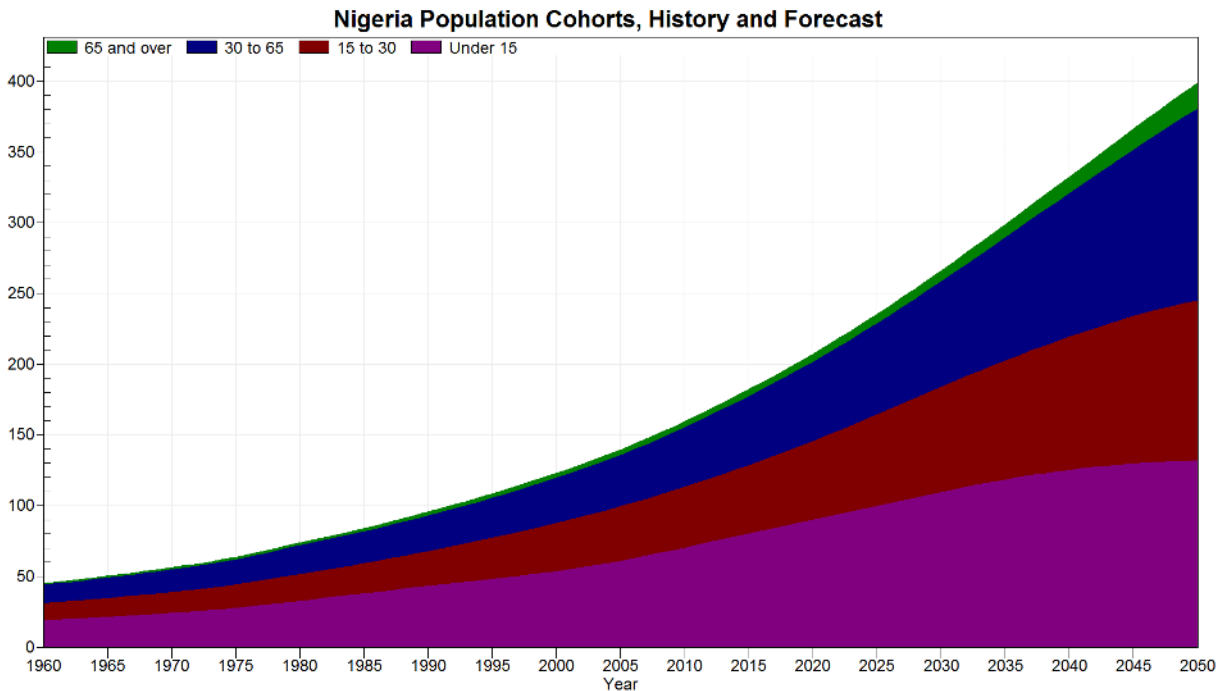
Figure B.31: Population cohort distribution for Nigeria, 1960 to 2050.
Source: IFs 7.19

Nigeria's life expectancy will also increase more than any other country consider here (16 years between 2015 and 2050). However, sustained high fertility rates mean that the country's median age will increase little (Figure B.32 – left). Migration is not forecast to play a significant role in Nigeria's population change (Figure B.32 – right).
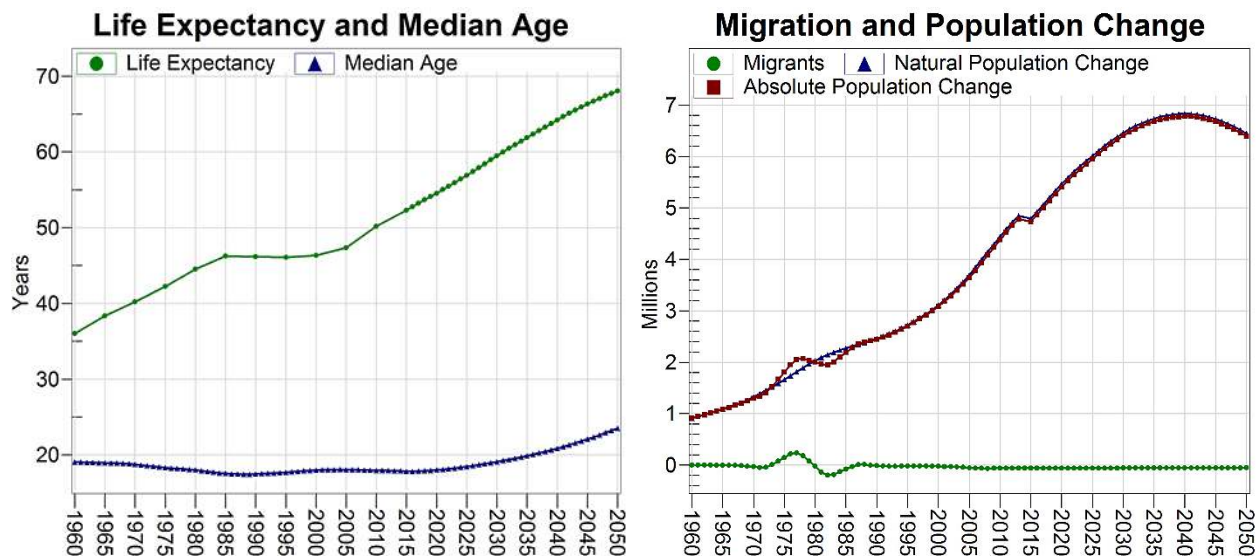

Figure B.32: (Left) Life expectancy and median age for Nigeria, 1960 to 2050 (Right) Net migration and population change for Nigeria, 1960 to 2050.
Source: IFs 7.19

Nigeria's total fertility rate is forecast to remain relatively high through 2050. As a result, the country's youth dependency ratio will be substantial throughout the coming decades, but will begin to taper off around 2030 (Figure B.33 – left). Reflecting this trend, the country will not see a significant move toward a demographic dividend until around the same time (Figure B.33 – right).
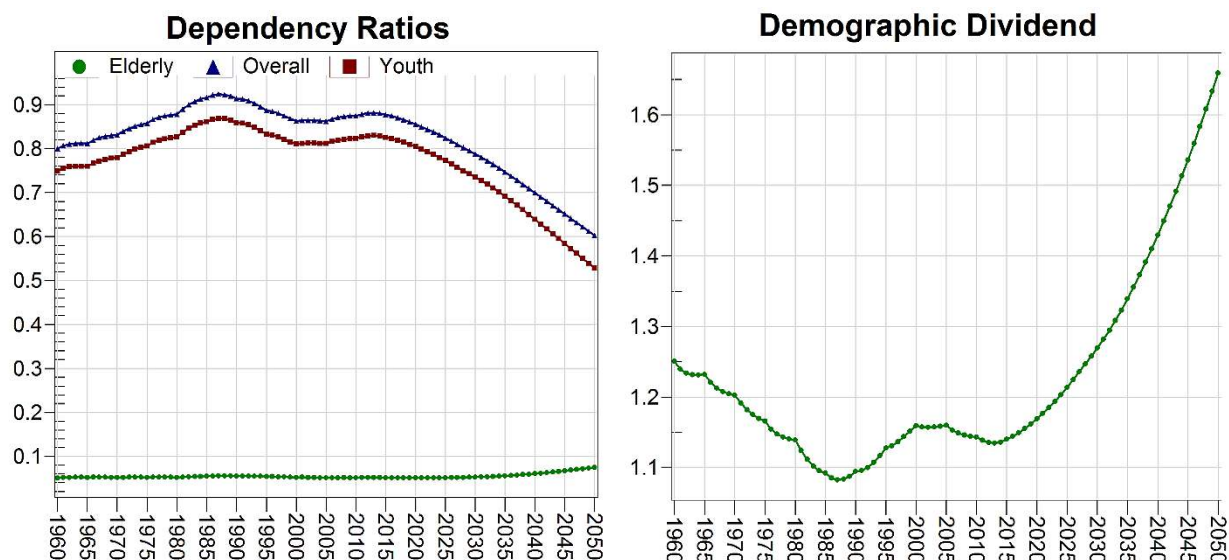

Figure B.33: (Left) Elderly, youth, and overall dependency ratios for Nigeria, 1960 to 2050 (Right) Demographic dividend for Nigeria, 1960 to 2050
Source: IFs 7.19

Nigeria's large youth population will lead to rising education spending needs in the coming decades, though, as the share of the youth population begins to decline, the country is likely to enjoy lower education needs and healthcare costs. Later in the horizon, however, pension needs will begin to increase (Figure B.34 – left) and the labor force contribution to economic growth will decline dramatically (Figure B.34 - right).
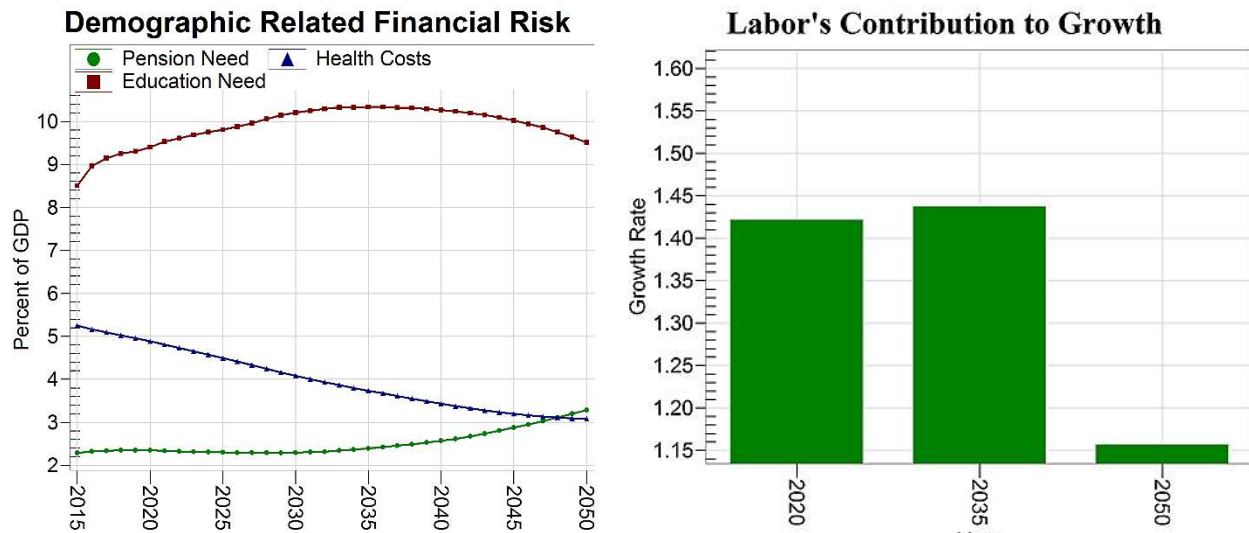
Figure B.34: (Left) Demographic related financial risks from pensions, health care, and education for Nigeria, 2015 to 2050 (Right) Labor's contribution to economic growth for Nigeria, 2020, 2035, and 2050.
Source: IFs 7.19

9. Country Profile: United Kingdom

The United Kingdom (U.K.) has a relatively old population, but is not as far advanced in aging as countries such as Germany and Japan. The country's share of population 65 and over was at 18 percent in 2015 and is forecast to be at 24 percent in 2050, whereas Japan's share was at 26 percent in 2015 and is expected to be at 36 percent in 2050. The U.K. is also the 27th longest living society, with a life expectancy of 80 forecast to increase to 85 by 2050 (Figure B.36 – left).

Additionally, unlike Germany and Japan, the U.K. is forecast to have continued growth in its population size through 2050. Between 2015 and 2050, the country is expected to experience a 14 percent increase to its population (roughly 9 million people) as compared with the 23 percent increase (12 million) between 1960 and 2015 (Figure B.35).
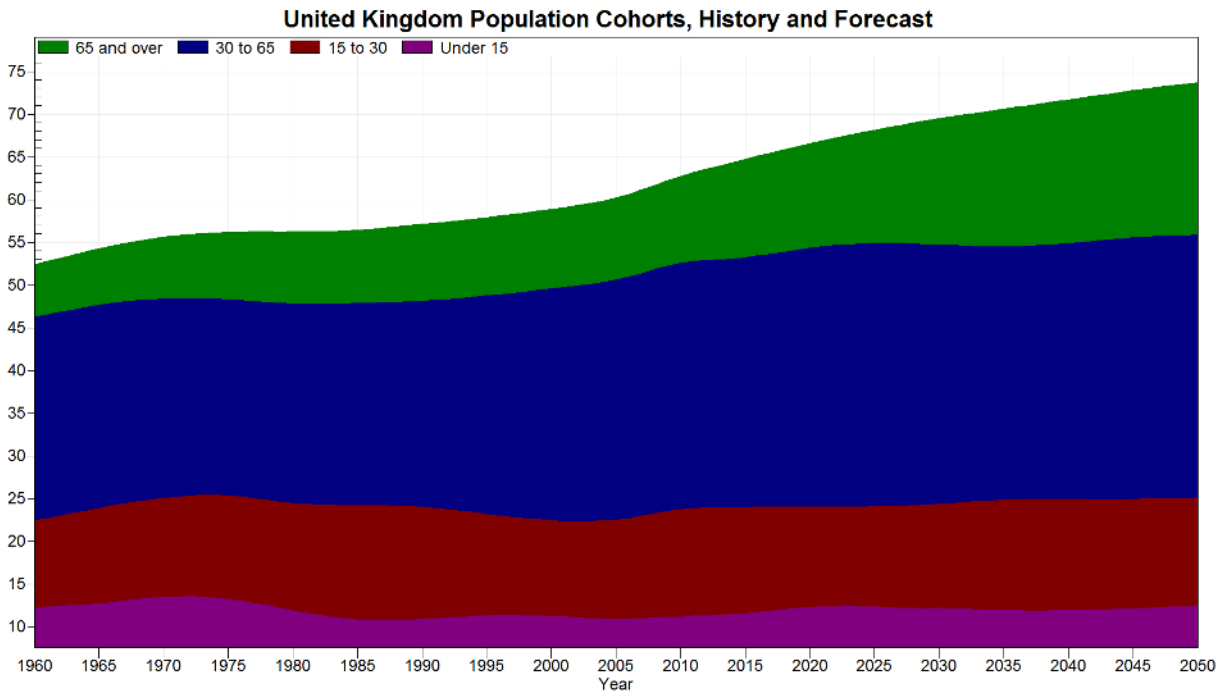
Figure B.35: Population cohort distribution for the United Kingdom, 1960 to 2050
Source: IFs 7.19

Between 2015 and 2050, the median age of the U.K. is forecast to rise by 3 years (Figure B.36 – left), falling behind China by the mid-2020s. Immigration could play a role in this slower aging process. Historically a significant factor in the U.K.'s population change, migrants entering the country are forecast to continue infusing the economy with younger workers (Figure B.36 – right).
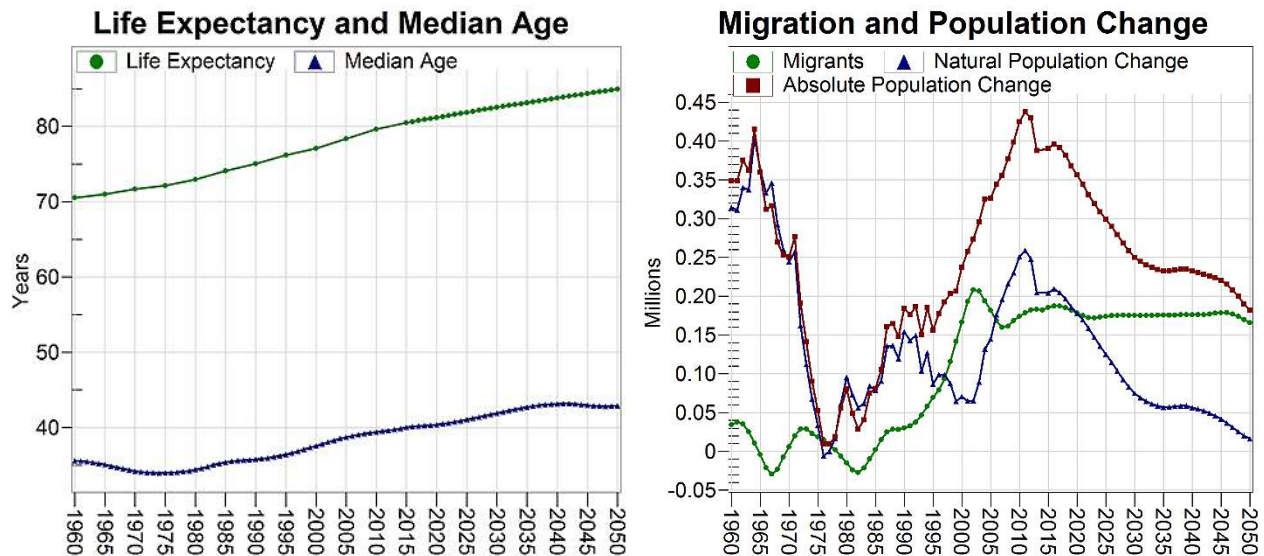

Figure B.36: (Left) Life expectancy and median age for the United Kingdom, 1960 to 2050 (Right) Net migration and population change for the United Kingdom, 1960 to 2050
Source: IFs 7.19

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The U.K. has already moved in to a period of rapidly accelerating elderly dependency (Figure B.37 – left) and decelerating demographic dividend (Figure B.37 – right).
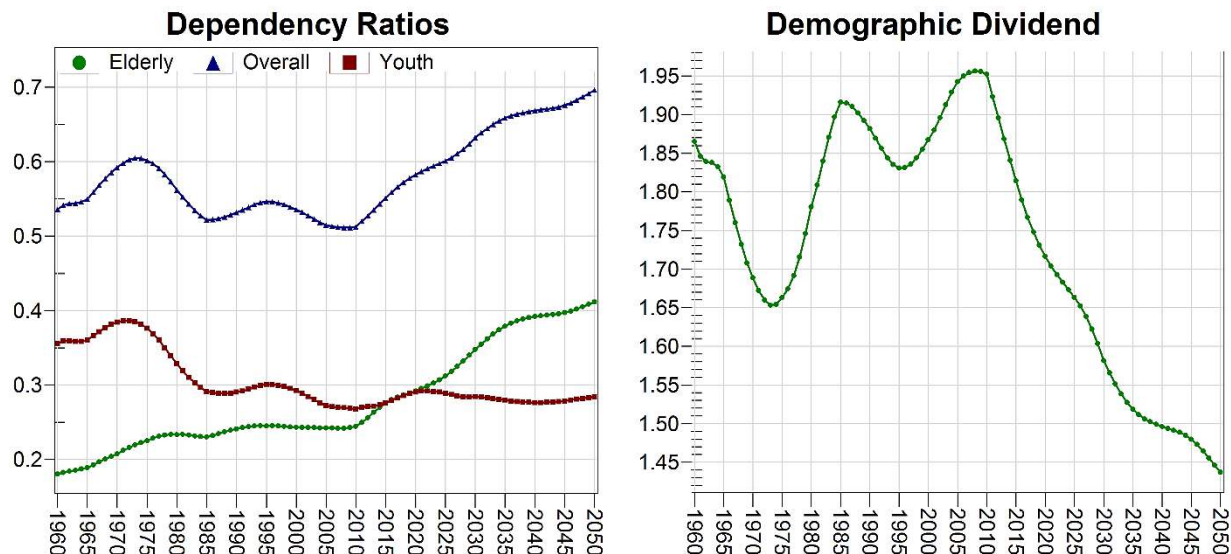

Figure B.37: (Left) Elderly, youth, and overall dependency ratios for the United Kingdom, 1960 to 2050 (Right) Demographic dividend for the United Kingdom, 1960 to 2050
Source: IFs 7.19

Yet, the slower pace of the country's aging means that health costs and pensions needs may not rise as quickly and may begin to plateau by 2050 (Figure B.38 – left). In addition, the county's labor force contributions are forecast to remain positive (though very small) through 2050 (Figure B.38 – right).
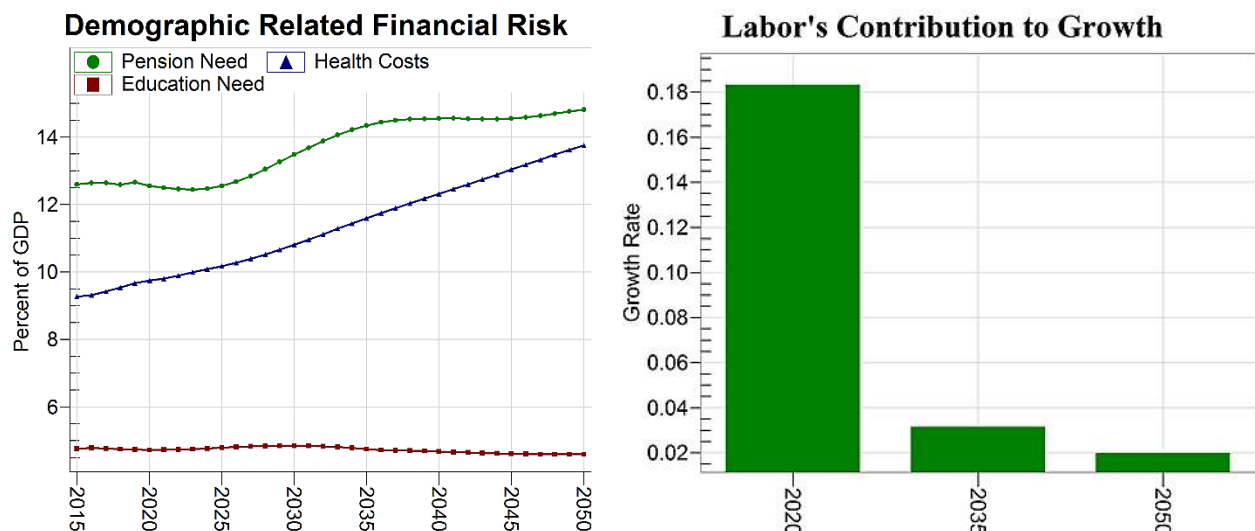

Figure B.38: (Left) Demographic related financial risks from pensions, health care, and education for the United Kingdom, 2015 to 2050 (Right) Labor's contribution to economic growth for the United Kingdom, 2020, 2035, and 2050
Source: IFs 7.19

10. Country Profile: United States

Like the U.K., the United States (U.S.) has a relatively old population, but not to the extent of Germany or Japan. The U.S.'s median age is forecast to increase 5 years between 2015 and 2050 (Figure B.40 – left) while the share of its population over 65 is expected to rise from 15 to 23 percent. The U.S. is also forecast to see notable growth in its population size – a 17 percent increase (55 million people) between 2015 and 2050 – though this is only a fraction of the 73 percent increase (136 million people) the country saw between 1960 and 2015 (Figure B.39).
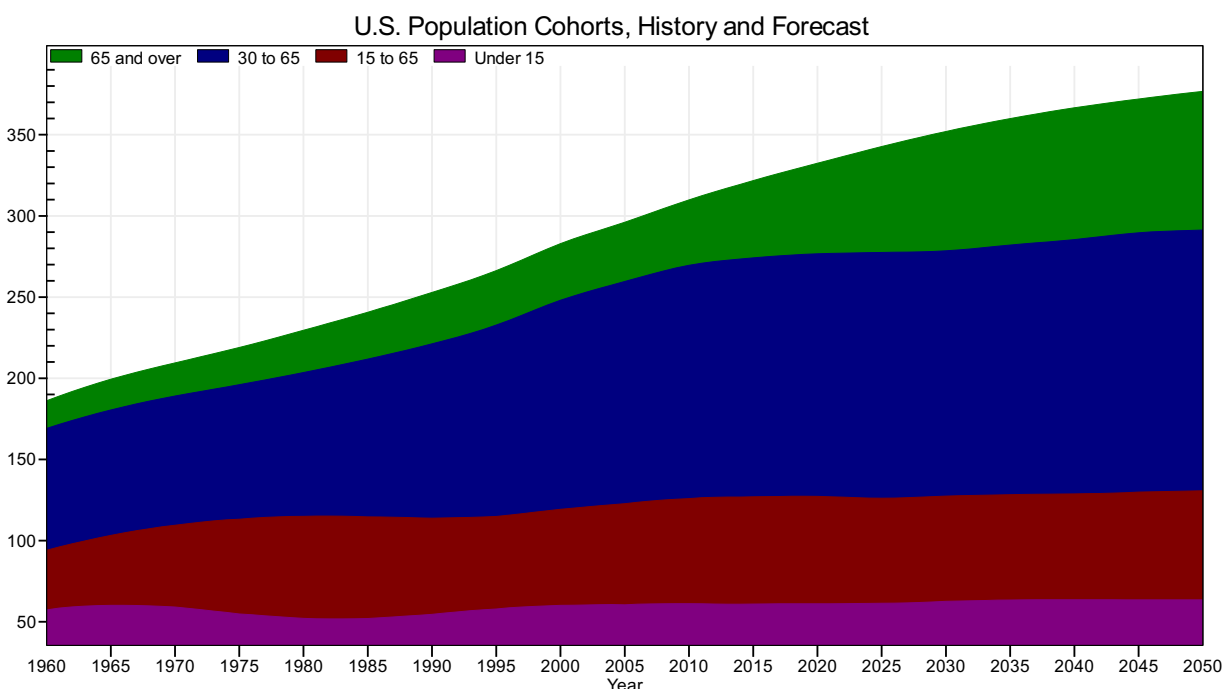

Figure B.39: Population cohort distribution for the United States, 1960 to 2050.
Source: IFs 7.19

Like Brazil and Mexico, life expectancy in the U.S. is forecast to increase by 5 years by 2050 (Figure B.40 – left). Immigration has and will likely continue to help to offset the aging of the U.S., but will have a less significant impact on population change than immigration in countries like Germany (Figure B.40 – right).

Life Expectancy and Median Age
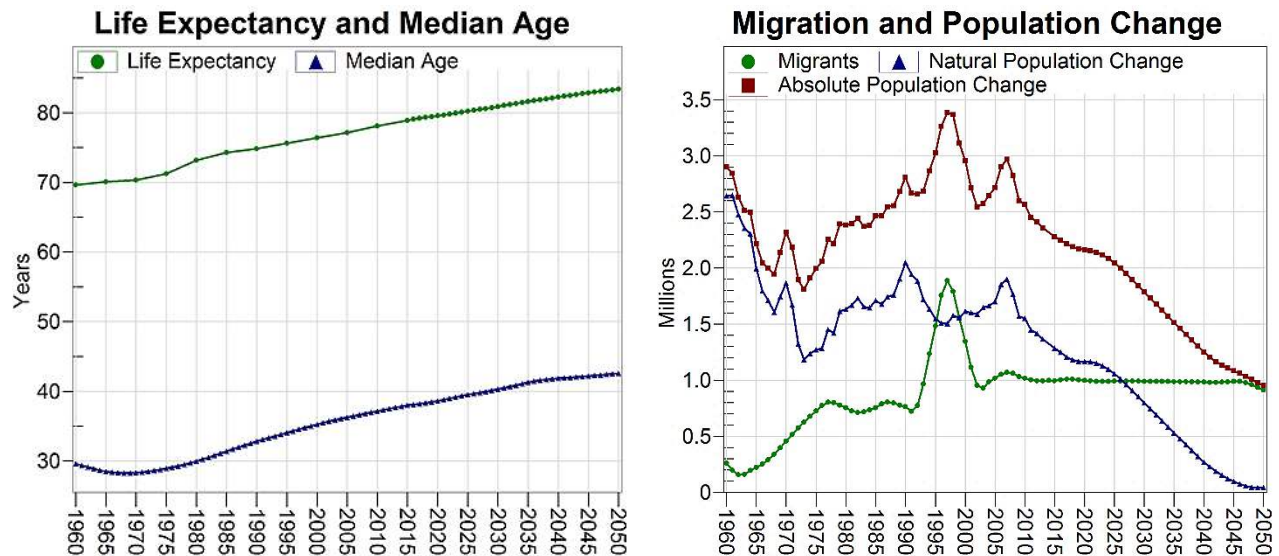
Migration and Population Change

Figure B.40: (Left) Life expectancy and median age for the United States, 1960 to 2050 (Right) Net migration and population change for the United States, 1960 to 2050
Source: IFs 7.19

Though the U.S. has recently begun its transition out of its demographic dividend (Figure B.41 – right), the country is likely to see a plateau in its already relatively low overall dependency ratio around 2030 (Figure B.41 – left).

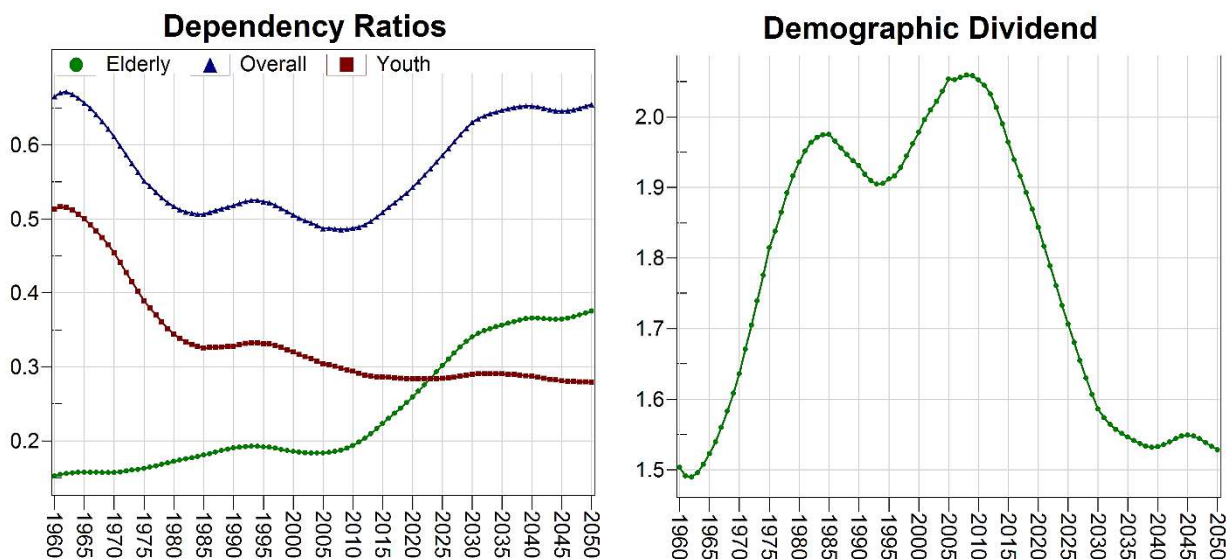## Dependency Ratios

Demographic Dividend

Figure B.41: (Left) Elderly, youth, and overall dependency ratios for the United States, 1960 to 2050 (Right) Demographic dividend for the United States, 1960 to 2050.
Source: IFs 7.19

The U.S.'s somewhat younger and relatively slower aging society means that the country will have high, but not rapidly increasing, pension need between 2015 and 2050 (Figure B.42 – left). However, the U.S. today, has the highest healthcare costs in the world, and is expected to retain this rank through 2050, with healthcare costs as a percent of GDP increasing by around

11 percent (Figure B.42 – left). Moreover, labor's contribution to economic growth will be in decline, though the country will still enjoy a positive (though small) boost through the time horizon (Figure B.42 – right).
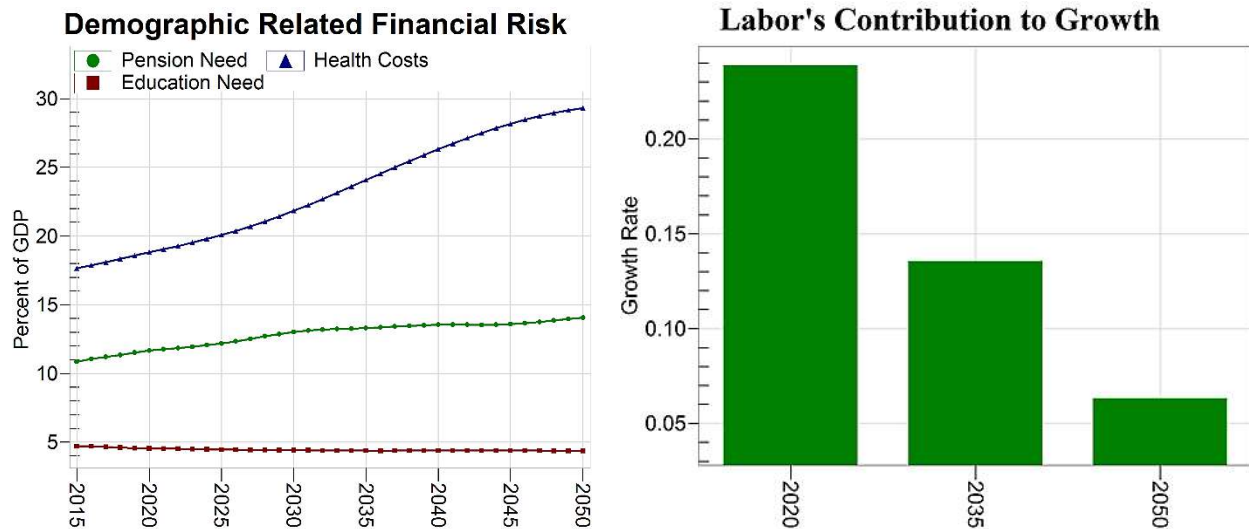

Figure B.42: (Left) Demographic related financial risks from pensions, health care, and education for the United States, 2015 to 2050 (Right) Labor's contribution to economic growth for the United States, 2020, 2035, and 2050.
Source: IFs 7.19