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REDUCING THE RISKS FROM RAPID DEMOGRAPHIC CHANGE

MATHEW J. BURROWS



In association with



ZURICH

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Zurich Insurance Group and the Atlantic Council's Brent Scowcroft Center on International Security are engaged in a multi-year thought leadership effort to quantify aggregated global risks. In 2015, we used an extensive quantitative model pioneered by the University of Denver's Pardee Center for International Futures to explore the economic benefits and costs of cyber risks. In this report, we continue to use this unique model, this time focusing on demographic risks. We wish to acknowledge major contributions to the writing of this report from Pardee Center's Professor Barry Hughes and his team, David Bohl and Shelby Johnson. In 2017, a final report will investigate geopolitical risk.

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Cover photo credit: REUTERS/Pichi Chuang. An elderly woman poses in front of her house in the village of Guningtou, Taiwan, September 7, 2015.

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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 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 ages sixty-five 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 sixty to sixty-four 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 percentage of the population ages fifteen to sixty-four.
Youth bulge	The population ages fifteen to twenty-nine as a percent of all adults (fifteen and older). A bulge exists when this ratio is above a specified level, such as 50 percent.

EXECUTIVE SUMMARY

We are entering a period in which the West's postwar social welfare system is under growing threat as the global demographic structure is being turned upside down. And it is not just the West, but also China and other middle-income powers who will have to deal with an aging workforce and unsustainable health and pension costs in the next decade. For sub-Saharan African countries whose birthrates remain high, overpopulation carries big costs not only for them, but for the rest of the world, which will depend on them for a growing proportion of the world's workforce.

It is clear that managing demographic risk will be critical to every country's future. Not making the right choices now can lessen economic potential for decades. There will be few second chances. This study examines the economic impacts of impending demographic changes. Those impacts are different depending on a country's income level (explained below).

The World Bank defines high-income economies (\$12,736 or more in gross national income per capita) to include most Organisation for Economic Co-operation and Development (OECD) and European Union countries, Gulf states, Israel, and the Russian Federation. Middle-income economies are broken into two groups.

Upper-middle-income economies (\$4,126 to \$12,735) include China, most Latin American countries, and a number of Middle Eastern nations such as Iran, Iraq, and Tunisia.

Lower-middle-income economies (\$1,046 to \$4,125) include many of the Central American, Central Asian, and Caucasus countries in addition to India and Nigeria.

Low-income economies (\$1,045 or less) are concentrated in sub-Saharan Africa. Afghanistan is also in this low-income group.

This is the second in a series of reports in association with Zurich Insurance Group examining whether global risks are growing faster than global economic growth. The first report published in September 2015 focused

on cyber risks. As with the earlier report, we have teamed up with the Pardee Center for International Futures of the University of Denver to model the potential economic costs and benefits from changing demographics.¹

Biggest Risks Now for High-Income Economies

How prepared are high-income economies for the increased costs of pensions? In the fifty years between 1960 and 2010, public pension expenditure as a percent of gross domestic product (GDP) doubled for high-income countries from 4 to 8 percent. By 2035 the GDP share of public pension expenditure is forecast to grow another 3 percent at a time of shrinking workforces.

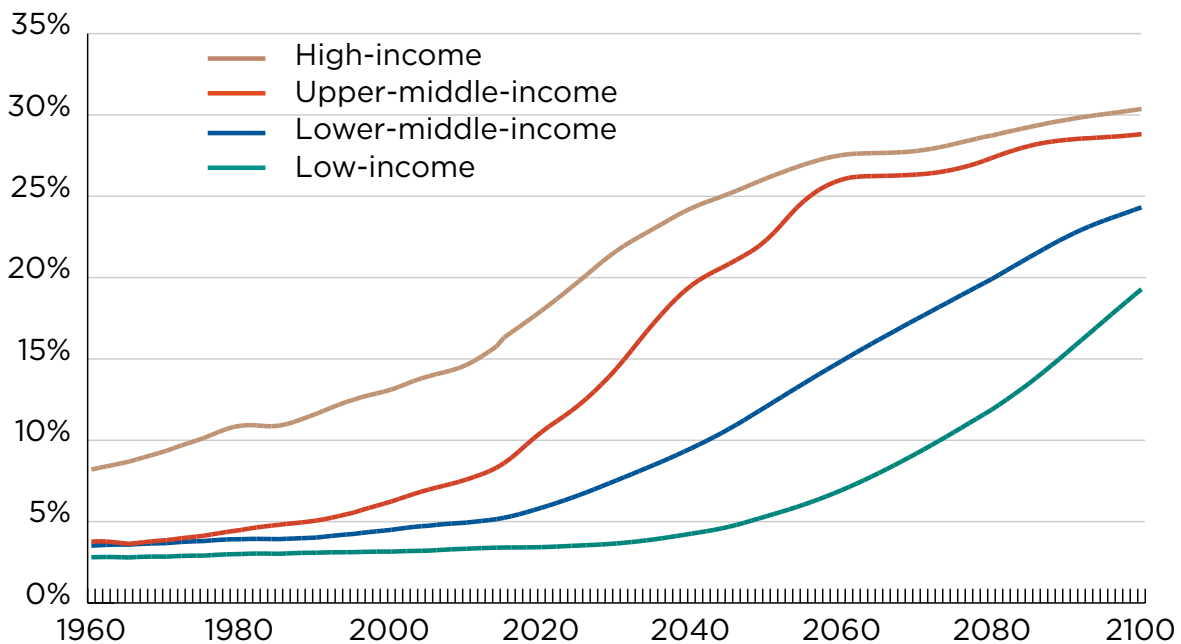
These increased pension costs are coming at a time of rapid extensions in life expectancy. Since 1990, lifespans increased more than 2.5 years per decade on average. Increases in pensionable ages for all high-income countries, on the other hand, averaged 1.8 years per decade. Life expectancy in some individual high-income countries increased at an even more rapid rate. Life expectancy in Switzerland, for example, increased by 5 years, or 2.5 years per decade, in the 1990–2010 period. In Germany, it increased 6.8 years in that same twenty-year period, or 3.4 years per decade.² Life expectancy could further increase, therefore, by at least two to three years or more over the next fifteen years in high-income countries. According to our calculations, the average pensionable age would need to be raised significantly in order for governments to meet pension demand.

There is a similar story for health care spending. The increasing proportion of those aged eighty and over—a consequence of increasing life expectancy—will necessitate more extensive and expensive health care

¹ Unless otherwise noted, the forecasts and historical data in this report come from the International Futures (IFs) model system at the Pardee Center. That system contains a database of more than three thousand series from a wide variety of sources, including the World Bank, International Monetary Fund, Organisation of Economic Co-operation and Development, multiple United Nations agencies, research groups, and think tanks. See Box 2 for more detail on IFs.

² Data provided by Zurich Insurance Group.

Figure 1. Population Aged 65 and over (percent of total population)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

needs, such as in-home or long-term care. With health care costs rising, retiree savings will be depleted, putting the onus on governments to pay a larger share. But governments will be increasingly strapped: government spending is forecast to cover less than half of the health care spending needed—down from 62 percent in 2015 to 49 percent in 2035.

With demand growing for pension and health care spending, high-income countries, especially, face a Catch-22 dilemma: cutting education, research and development (R&D), and infrastructure spending risks undercutting the higher productivity needed to offset declining workforces. With labor-driven growth increasingly behind us, high-income countries will have to boost productivity to compensate for declining labor forces or face slowing economic growth.

According to McKinsey & Company, even if productivity were to grow at the rapid 1.8 percent annual rate of the past fifty years, the rate of GDP growth would decline by 40 percent, slower than during much of the recovery since the 2008 financial crisis.³ Some economists already believe we are headed into a period of significantly slower growth because of declining workforces.⁴

Emerging labor-saving technologies—robotics, increased automation, and more sophisticated artificial intelligence—could help offset the declines in workforces. But past technology breakthroughs have also led to new employment demands. Will there be enough skilled workers for high tech industries if health care and pension costs swamp national budgets, squeezing revenues for education and R&D?

Crunch Comes Later for Middle- and Low-Income Countries

Most middle-income countries have proportionally larger and younger workforces, putting them in a better position to prepare for the inevitable aging process. For countries with fewer dependents, there is higher saving potential and more growth capacity. Our modeling shows, for example, that upper-middle-income countries will be able to devote more resources to education, closing the gap with advanced economies and moving them towards becoming knowledge economies.

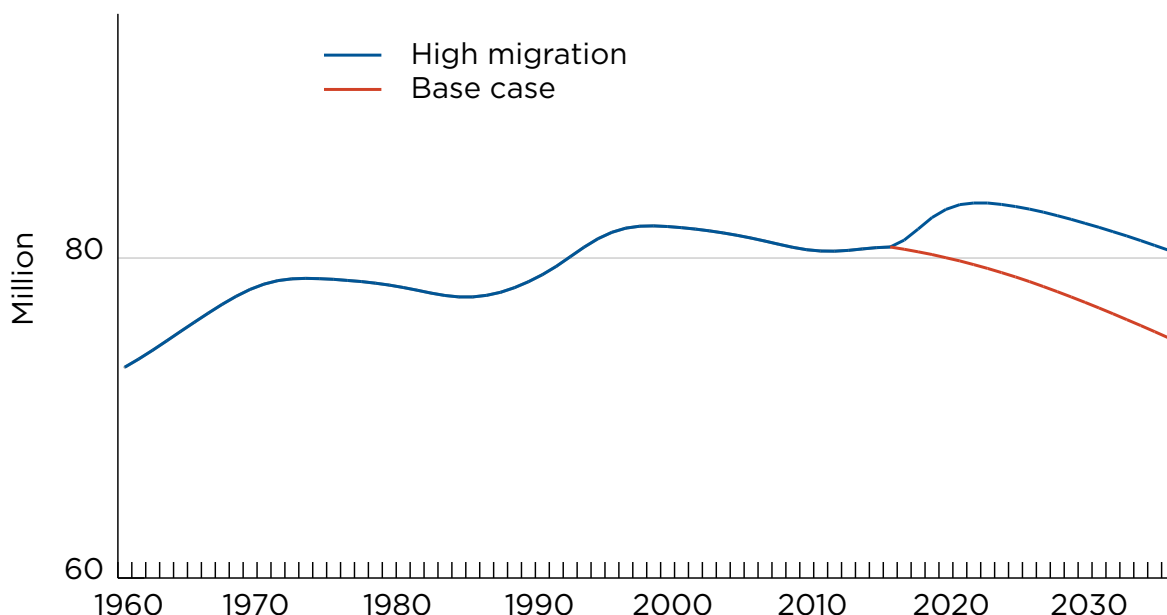
However, middle-income countries will soon face many of the same demands for increased government health care spending as high-income countries. The share of health care spending in upper-middle-income countries will slowly decline because of a government

3 “Can Long Term Global Growth Be Saved?” McKinsey Global Institute, January 2015, <http://www.mckinsey.com/global-themes/employment-and-growth/can-long-term-global-growth-be-saved>.

4 Ruchir Sharma, “The Demographics of Stagnation: Why

People Matter for Economic Growth,” *Foreign Affairs*, March/April 2016, <https://www.foreignaffairs.com/articles/world/2016-02-15/demographics-stagnation>.

Figure 2. Population in Germany, History and Scenario Forecast (in million people)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

inability to keep up with increasing demand. Upper-middle-income countries will also face pressures to increase public pension spending. Need for pension spending as a share of GDP will increase by close to 5 percentage points by 2035.

Of middle-income countries, China faces a particularly daunting challenge. By the early to mid-2020s with the sharp drop off in working-age population, the pressures for more health care spending and pensions will erode the Chinese government’s ability to keep up with them. The annual Chinese pension spending gap is currently \$175 billion and is forecast to grow to near \$1.4 trillion by 2035. A failure to complete the middle-income transition during the few remaining demographic dividend years would lead China and other middle-income countries to become old before getting rich.

Most low-income countries have the opposite problem. Instead of aging, their populations are youthful. The sooner they can bring down their high birth rates, the sooner they can move into the demographic bonus years where they have the opportunity to boost growth. So long as fertility remains high so do health care costs. Forty-eight percent of Afghanistan’s population is under the age of fifteen and infant care is estimated to account for over 40 percent of the country’s total health care costs.

The more that resources can be devoted to education, the more low-income countries can maximize the approaching demographic bonus years. Still, low-income countries will have a hard time matching the resources that high- and middle-income countries can devote to the educational needs of their large youthful populations. With Africa forecast to provide one out of every four workers by 2050, a poorly educated African workforce has negative implications for long-term global growth potential. High levels of unemployed youth lead to civil conflict. One hundred percent of the states marked as Very High Alert or High Alert on the Fragile States Index compiled by *Foreign Policy* and the Fund for Peace have very youthful age structures.⁵

Good and Bad Scenarios

Aging and demographic transitions are a given, but a number of variables, such as medical advancements leading to healthier, longer-living populations; unanticipated drops in fertility rates in low-income African nations; or sustained high levels of migration from poorer to higher-income countries could change the balance between risks and benefits for some countries.

What Happens When People Live Longer: Our Longevity scenario explores a world in which advances in medical technology and treatments drive down

⁵ Unpublished SFI research for National Intelligence Council, January 2016.

REDUCING THE RISKS FROM RAPID DEMOGRAPHIC CHANGE

Table 1. Risks and Benefits of Demographic Changes

	Health Care	Pensions	Education	Growth
High Income Countries	Extension of healthy old age may mitigate temporarily expected health care increases	Viability of pension funds would be threatened absent drastic reform	Decreasing educational needs, but risk of falling behind if spending decreased too much	Must boost productivity to compensate for no employment growth
Upper Middle Income Countries	With exception of China, these countries have time to prepare; China's aging accelerating health care pressures	Fewer resources than high income to fund pensions; China risks runaway pension gap by 2035	Larger expenditures could close educational gap with high-income countries	Likely productivity increases could partly compensate for waning employment growth
Lower Middle Income Countries	Improving spend-to-needs ratio with youth bulges	Least burden and smallest increases with ample time	Spending will go up, but it will be hard to catch up	Employment growth continues a couple more decades
Low Income Countries	Easing growth in health care costs so long as there is lower fertility; with continued high fertility, burdens spiral	Relatively small proportions of retirement populations even in 2035	Lowering fertility will help increase spending per student, but continued high fertility would increase spending gap on education	Labor contribution still strong at mid-century

■ High Risk;
 ■ Some Risk;
 ■ Low Risk and Possible Benefit

mortality rates by making extraordinary progress in finding a cure for cancer, heart disease, and diabetes. In this scenario, we used France and China as illustrative examples. The consumption needs of all French retirees—measured as percent of GDP—increase by over 14 percent by 2035. In the more rapidly aging China, the life expectancy increases could drive a 190 percent increase in retirees' consumption needs between 2015 and 2035. In this scenario, there is a stark contradiction between individual and societal needs. However desirable a longer and healthier life is for the individual, it comes with high costs for society.

What Happens with a Sustained Migration Influx: The rate of decline in Germany's labor pool will accelerate between 2015 and 2020 and be a net drag on its economy. A sustained influx of migrants would reverse this trend so long as migrants become as productive as the average German worker. In such a scenario, migrants would reduce labor's drag on economic growth by up to half and potentially add over \$350 billion more in GDP (relative to the Base Case) by 2035.

Reducing High Fertility in Africa: Today, the average African woman is expected to give birth to over twice the number of children as women in the rest of the world. In a Low Fertility scenario, average total fertility rates drop to near replacement levels by 2035. By 2035 Africans would just begin to enter the demographic dividend years, boosting growth potential and per capita incomes.

A Sense of Urgency Needed by All

Political and economic measures can make a critical difference to whether we all end up poorer and more unstable, or able to fully enjoy the benefits of growing longevity.

- With the aging process in full swing, high-income countries face a particularly difficult task of raising retirement ages, implementing efficiencies in health care, and reforming pension systems if they are to avert an economic slowdown.
- Middle-income countries have more time, but the accelerating aging process means they need

BOX 1: INCOME PROTECTION GAPS EXACERBATED BY ACCELERATING AGING

In this study, the International Futures (IFs) model, run by the University of Denver's Pardee Center for International Futures, has forecasted that, particularly in higher-income countries, an aging population will mean people working longer to stem rising state or public pensions. Meanwhile, in both the developed and developing world, public and private pension arrangements will need to be scaled back.

But what would happen to your household if you were unable to work due to sickness, disability, or even premature death? Some of the consequences can be profound and it is a risk that is far more common than one may think. Research shows as many as one out of four people may face disability during their working lifetime.

These Income Protection (IP) Gaps are the reduction in household income as a consequence of the death or incapacitation of an adult wage earner on whom that household relies, taking all public and private sources of replacement income into account. They can have a large impact on our lives, our productivity, and our welfare needs—meaning consequences for households, public and private sectors alike.

To investigate IP Gaps further, Zurich has partnered with the Oxford Smith School of Enterprise and the Environment, a part of Oxford University, on a three-year project. The project will comprise of three key phases that investigate the scale and behavioral drivers of Income Protection Gaps, before proposing solutions to help mitigate the risks.

The first phase of the project was completed in 2015, with a keynote report along with other related material available at www.zurich.com/en/knowledge/topics/protection-gap. A second report, containing groundbreaking research on the behavioral drivers behind Income Protection Gaps, will be released later in 2016.

The findings of today's report threaten to compound the issue of IP Gaps. For example, incidence of disability also increases with age, creating a link to the rise in state pension ages foreseen by this study. Meanwhile, the model's predicted health spending deficits relative to need will also have an impact. These important and interconnected themes will be noted in that forthcoming publication.

to move quickly to align pension schemes to increasing longevity and build efficient health care systems. They have a big opportunity in closing the education gap with high-income countries, boosting their productivity levels and attractiveness to foreign investment.

- Migration into societies with declining labor forces can relieve many of the economic growth and financial pressures associated with that decline, but can also create many social problems, especially when cultural and socioeconomic differences with the host population are great. Countries will need to balance these issues carefully and make decisions that consider the longer term, not just the immediate impacts of migration.
- Low-income countries need to bring down fertility quickly and increase educational standards if they are to maximize their advantages during the demographic bonus years.

Firms have a key role to play in managing pension schemes that take into account likely extensions in longevity. While raising the retirement age faces strong political opposition, firms can help encourage workers to remain at work longer with more flexible workplace schemes. Increases in government funding for education in the high-income economies are likely to be limited, if any, so firms should prepare to offer more on-the-job training of new entrants and reskilling of older workers. By contrast, in upper-middle-income countries, firms have the opportunity to recruit an increasingly better educated workforce.

Demographics does not have to be destiny if we take action now to ensure the promise of longer and healthier lives does not turn into a net cost for society, putting an extra burden on future generations.

DISCUSSION

Aging's Growing Acceleration

For the last 200–250 years, countries have been passing through a sequence of demographic stages. In the eighteenth century, birth and death rates were both high. Then death rates began to fall with sanitary and medical advances first seen in the rich countries. Falling birth rates were also driven by the switch out of agriculture and the diminishing need for large families. Now, people most everywhere are living longer, and birth rates in advancing and many middle-income countries are falling below replacement levels.

There is enormous momentum behind these demographic changes, accelerating the aging of societies, as measured by the number of years it takes a country's population aged over sixty-five to increase from 7 to 14 percent. Countries such as France, the United States, or Japan completed this doubling on average in fifty or so years. The countries where the doubling is currently underway such as Israel, Chile, and China will take just over thirty years on average and those countries where it has not yet begun such as Peru, Indonesia, and Mexico are forecasted to

BOX 2: THE PROCESS AND MODEL

The goal of this report is to understand countries' risks and benefits from an accelerating aging process, and to explore ways of maximizing the opportunities over the challenges in the next twenty years. It is part of a broader project examining the economic impacts of key emerging risks, including a report on cyber, which has already been published, and a forthcoming one on geopolitics. The goal of all of these studies is to test the hypothesis of whether these risks are growing faster than global economic growth.

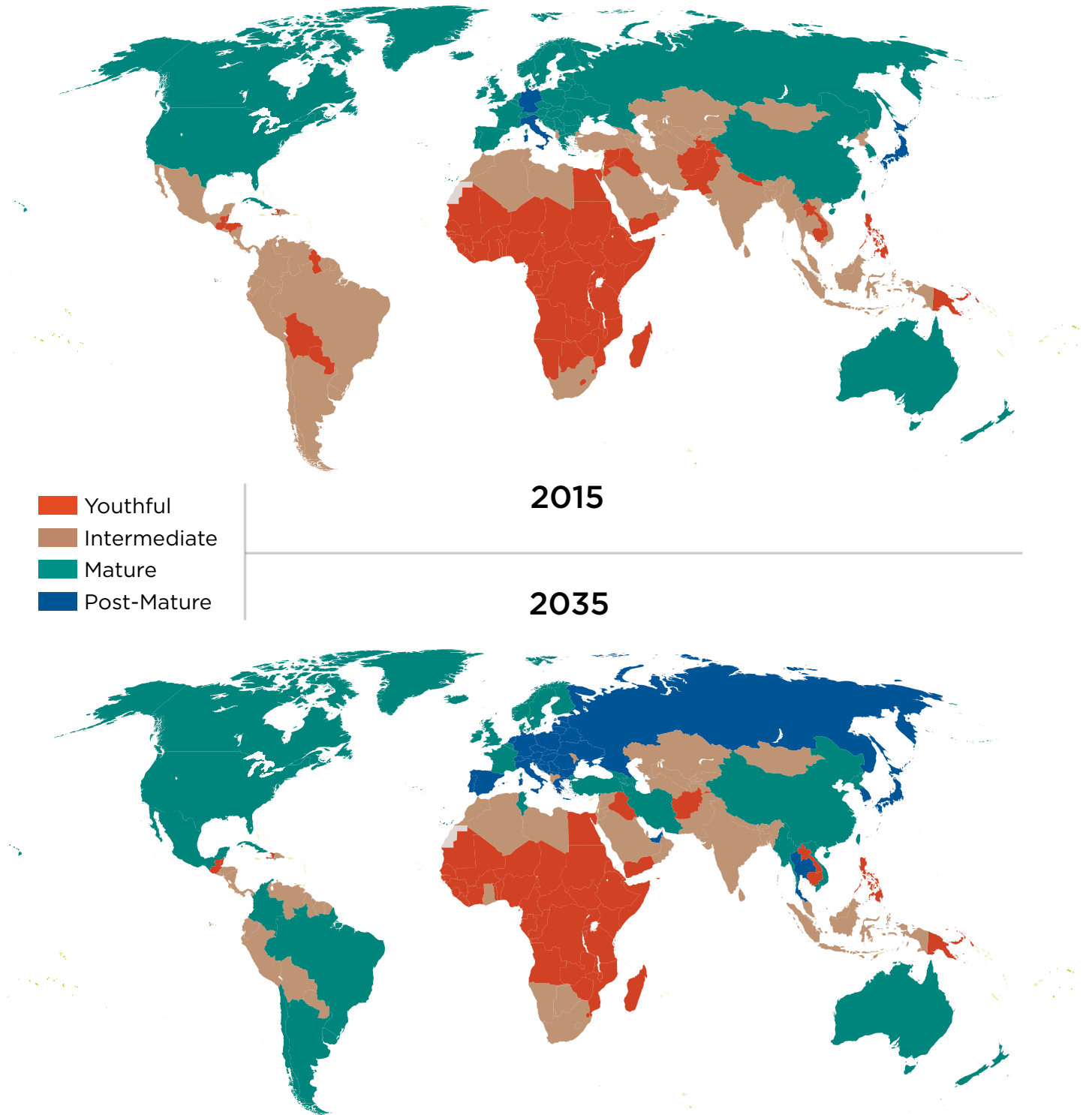
As in the earlier cyber report, we used the International Futures model, run by the University of Denver's Pardee Center for International Futures, for the quantitative modeling. IFs is a large-scale, multi-issue, long-term global forecasting tool. It represents interacting demographic, economic, energy, agricultural, health, educational, infrastructure, socio-political, and environmental subsystems for 186 countries. The model is integrated with a database of more than thirty-five hundred historical series.

Previous demographic studies have focused on the national security implications of youth bulges and the correlation with state failure in many countries. They have also examined the productivity losses due to declining employment growth in aging countries. We touch on those issues, but we have highlighted the increasing fiscal demands on high-income countries in the areas of health care and pensions and the unfortunate trade-offs with education and R&D despite the need to increase productivity. We have also highlighted the accelerating pace of aging for developing states—sometimes ignored in general discussion—and the desirability for them to prepare for the same increased health and pension demands facing high-income countries. Finally, our long-term economic future rides on how well the low-income countries—concentrated in sub-Saharan Africa—are able to lower fertility rates and move into the demographic bonus years. Increasing educational attainment should be a key goal for these countries. It is our belief that the risks will far outweigh the benefits for most countries if action is not taken by governments, businesses, educational institutions, nongovernmental organizations, and social activists to reduce the costs of aging and extended longevity.

We use scenarios to highlight plausible changes in current trends and likely consequences. A particular concern for increasing pension and health care costs is the increasing rate of extended life expectancy, which is explored in one of the scenarios. The other scenarios deal with costs and benefits of recent influxes of migrants into rapidly aging countries such as Germany and possible fertility drops in low-income countries.

For more details on the model, data, and process used in this report, please see and use the IFs model at <http://www.pardee.du.edu>. A companion report produced by Denver University's Pardee Center for International Futures is available at <http://pardee.du.edu/understanding-and-forecasting-demographic-risk-and-benefits>.

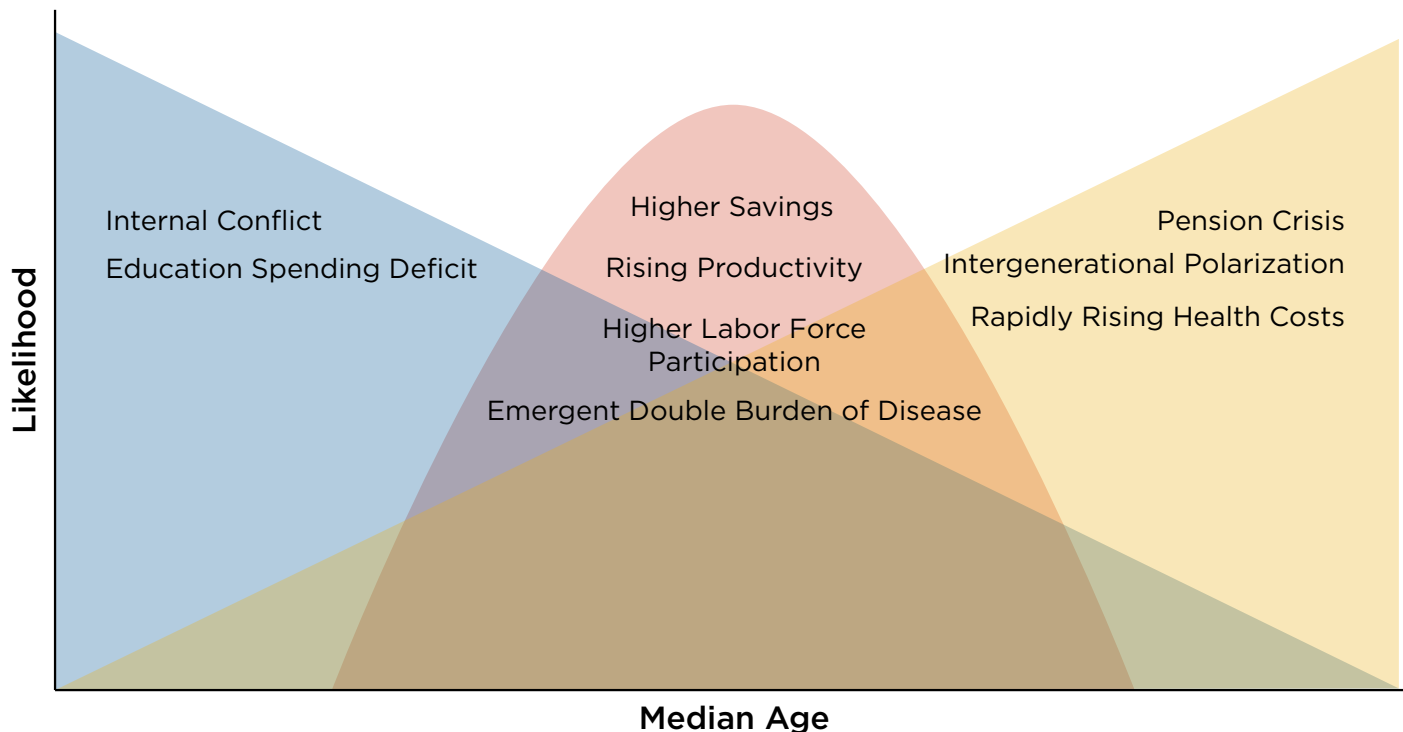
Maps 1 and 2. Progression of Aging Populations, from 2015 to 2035



The above maps show 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 fifteen to twenty-five years), which account for a large proportion of the world's countries now, will be fewer in 2035, and by 2050 are forecast to represent only a small proportion. The number of intermediate countries (median age range of fifteen to twenty-five years) is also forecast to decline. Mature countries (median age range of thirty-five to forty-five years) and post-mature countries (median age range of forty-five to fifty-five years), on the other hand, are expected to increase in number.

Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 3. Country Risks and Benefits at Various Median Ages



Source: International Futures model, Pardee Center for International Futures, University of Denver.

average under twenty years. The contracting timespan increases the urgency for not just the high-income countries to prepare for this transition.

Today only a few countries have an elderly bulge, defined in this report as having over 20 percent of the population aged sixty-five or older. A larger number of countries still have youthful populations in which those under fifteen account for more than 30 percent of the population. By 2050, however, we forecast this pattern will have reversed, with the number of elderly countries increasing substantially, and only a few countries with youth populations above 30 percent.

Assessing the Costs and Benefits

Demographers typically see a “bad news, good news, bad news story” facing us.⁶ At one end of the spectrum where elderly populations are growing, these countries face increasing retirement and health care costs. For the small number of countries that still have youthful populations, there are the economic, financial, and social stability challenges of educating a relatively large cohort of children and moving them into the workplace.

6 Richard Cincotta, “The Future Out to 2030: According to Demography,” in Steven Gale and Sarah Jackson, *The Future Can't Wait* (Washington, DC: US Agency for International Development, 2013).

For countries in between, there can continue to be a socially challenging youth bulge, but there also 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. Many countries in this sweet spot are also moving rapidly out of it because of the quickening pace of aging.

Macroeconomic Risks and Benefits

McKinsey Global Institute’s 2015 article “Can Productivity Save the Day in an Aging World?” finds that half of the global economic growth enjoyed over the past fifty years can be attributed to increases in the labor force.⁷ By 2030 labor is expected to make a net negative contribution in high-income economies and make an even greater negative contribution in

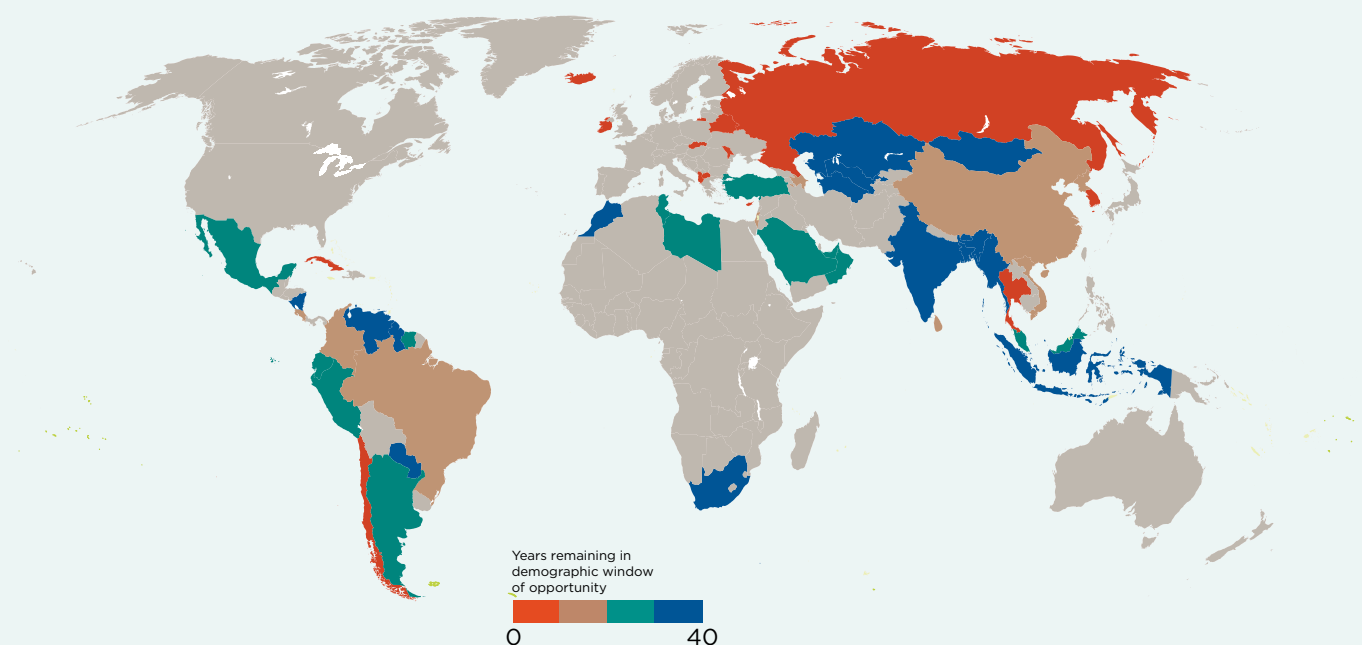
7 James Manyika, Jaana Remes, Richard Dobbs, “The Productivity Challenge of an Aging Workforce,” *Harvard Business Review*, January 20, 2015, <http://www.mckinsey.com/mgi/overview/in-the-news/the-productivity-challenge-of-an-aging-global-workforce>.

BOX 3: 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 defines the window¹ as occurring when the share of a country’s population under fifteen is less than 30 percent while the share of those sixty-five and over is below 15 percent. Economic gains could be significant for countries that harness their demographic dividend. South Korea, for example, paired declines in fertility rates with economic development, including job creation, climbing from having the 106th highest GDP per capita in the world in 1960 to the 29th highest in 2015.

For those countries within the demographic window in 2016, the time left in the window varies based on when they entered it and how quickly they are aging. For example, Singapore and Bosnia entered this window around the same time, but Bosnia has already closed the window, while Singapore is forecast to have several years left in it. Countries that have passed or have yet to enter the demographic window are shown in grey, while countries in brown are nearing the end of their time in this window, and countries in blue still have around forty years to use the potential benefit.

Map 3. Years Remaining in the Demographic Window of Opportunity

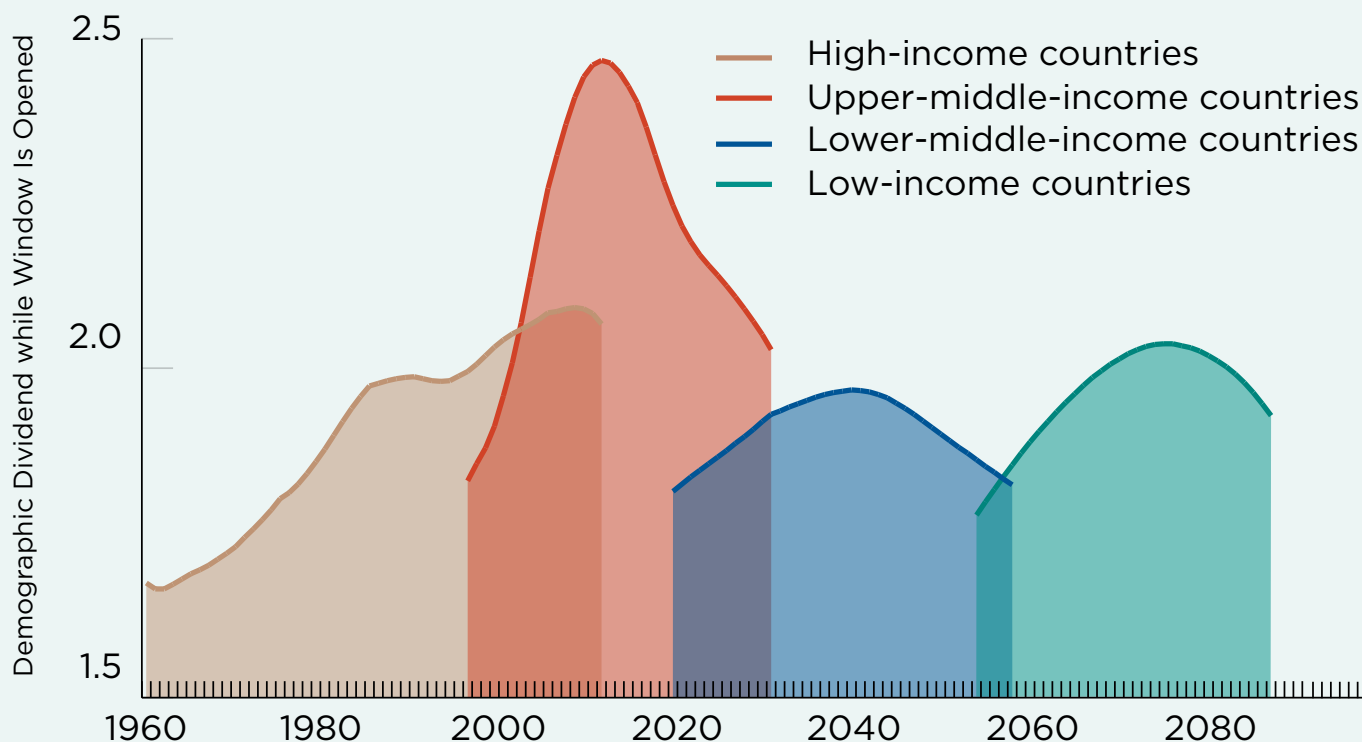


Source: International Futures model, Pardee Center for International Futures, University of Denver.

Countries that have not yet entered the demographic window will pass through it more quickly than those that have already experienced it. High-income countries enjoyed more than fifty years within the window, while the other income groups will have fewer than forty years there. While they have less time in the demographic window, upper-middle-income countries—especially China—have benefitted from having a much larger proportion of their populations in their working-age years. 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.

¹ Department of Economic and Social Affairs, *World Population to 2300* (New York, NY: United Nations, 2004).

Figure 4: History and Forecast of Demographic Window for World Bank Income Groups



The 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: International Futures model, Pardee Center for International Futures, University of Denver.

upper-middle-income economies (especially China) in the decades to follow.

To maintain the levels of growth enjoyed by countries over the past half century, McKinsey states that productivity growth would need to increase at a rate of 3.3 percent a year, 80 percent faster than current levels. Furthermore, the report finds that the “declining prime-working-age population share implies a 19 percent decrease in per capita income growth over the next 50 years. To sustain past per capita income growth, historical productivity growth would need to accelerate by 22 percent.”⁸

Potential for Productivity Increases

Productivity growth acceleration may be desirable to compensate for a declining workforce, but will such acceleration actually occur and, if so, will it be

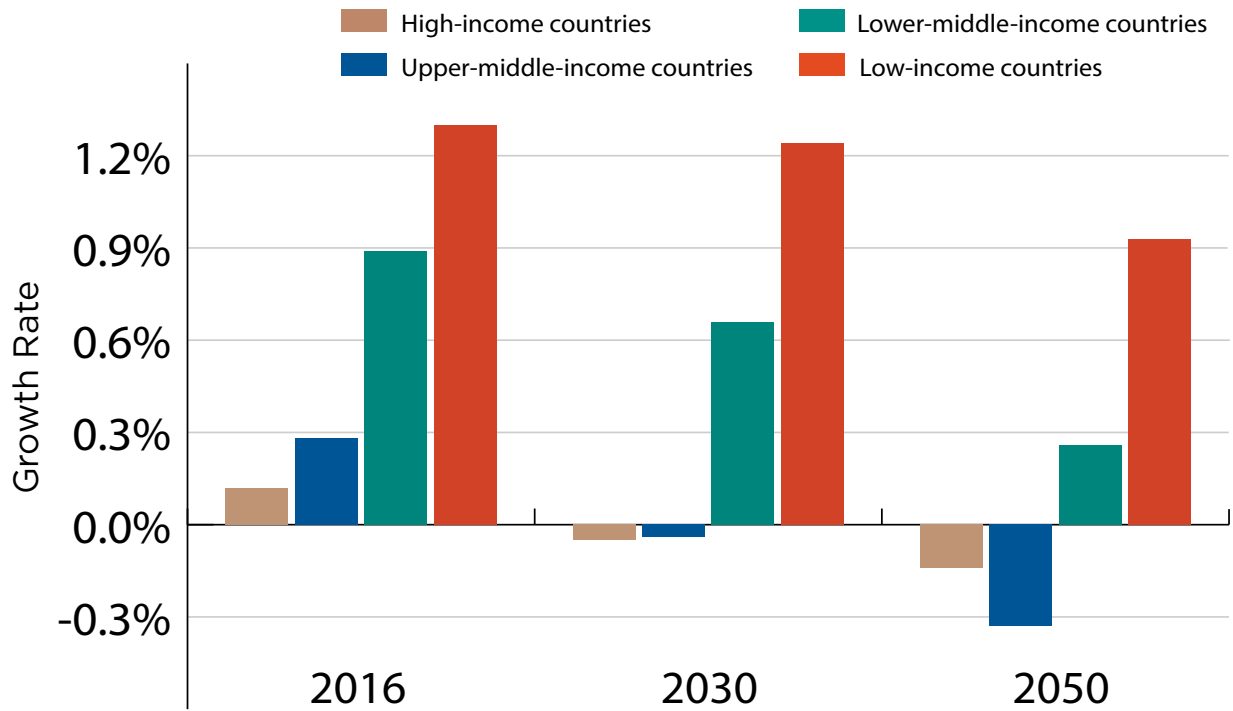
linked in any way to demographic or income profiles? Future productivity growth will be tied to technology advances and the ability of societies not at the leading edge to learn from and adapt to that technology.

Middle-income societies have an advantage in their ability to boost productivity levels because they are starting from a lower base. To increase their productivity, they need only to copy the more efficient practices—such as greater use of the Internet in business operations—present in advanced economies. But even more, middle-income countries benefit from enhancements in their strength as knowledge societies, in part due to their educational systems becoming stronger. They thus derive benefits from smaller youth populations that are increasingly well-educated. East Asian economies, particularly, benefit from growth in excellence of East Asian universities.⁹ With some lag,

⁸ Ibid. Prime working age is defined by McKinsey as fifteen to sixty-four years old.

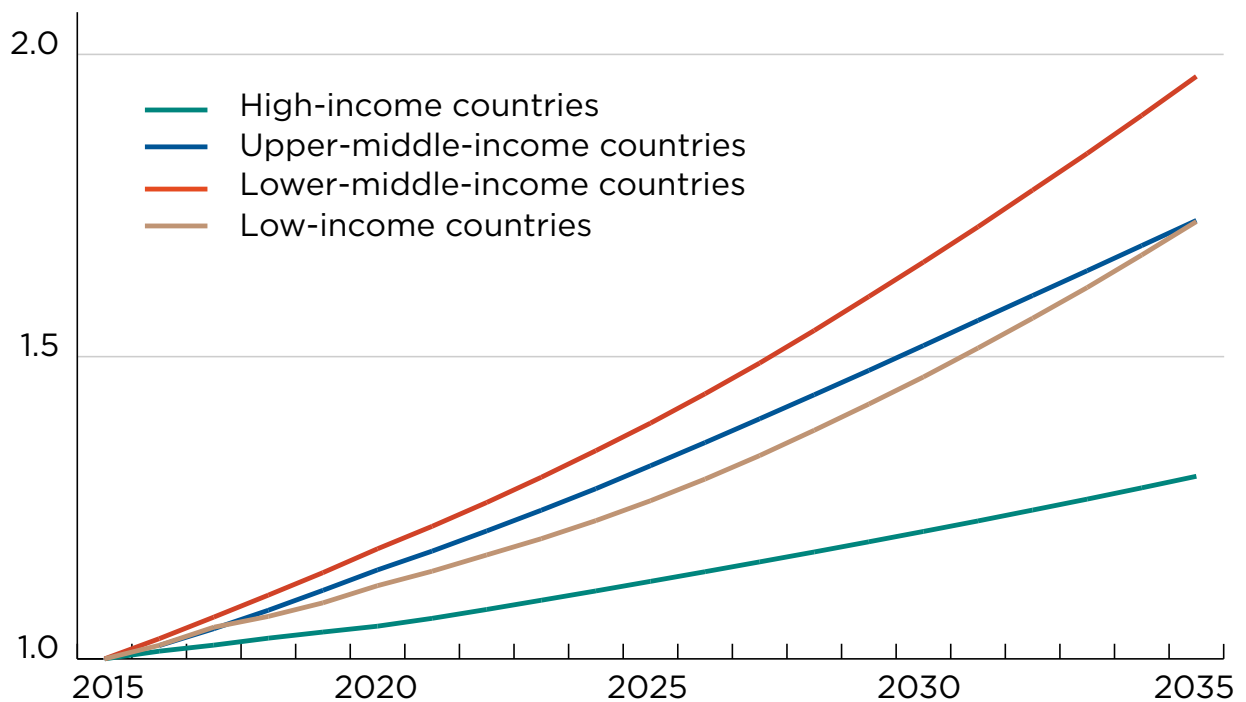
⁹ According to University of London Professor Simon Marginson, a United Kingdom educational expert, “In terms of science

Figure 5. Labor’s Contribution to Economic Growth for World Bank Income Groups (growth rate in percentage points)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 6. Productivity Forecast from 2015 to 2035 for World Bank Income Groups (indexed to 2015 values)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

the same factors should increase productivity in low-income countries.

For high-income countries whose productivity has largely plateaued in recent years, it is possible that emerging technologies—such as artificial intelligence, robotics, the Internet of Things, and biotech—will provide productivity gains in addition to reducing the demand for labor. Productivity gains often significantly lag behind the introduction of new technologies. Over time, the expansion of new technologies may not only increase productivity, but also lead to the creation of new jobs. Countries lacking sufficient numbers of highly skilled workers would lose the potential for productivity gains and job growth.¹⁰

Fiscal Risks and Benefits

During youthful years, people need help with 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 chronic ones).

In providing assistance during those transitions, governments rely 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. Individuals and households also bear responsibility to provide for their needs, using accumulated assets during periods of higher income to offset the expenses connected with growing up and older dependency.

In the case of high-income countries, the greatest growth will be in pension and health care spending, driven by the aging of their populations. That has a significant chance of driving out any significant increases in other categories, especially infrastructure, but also education, R&D, the military, and other administrative spending. Yet even the growing government expenditures on pensions and health care will not keep up with the growth of demand.

and technology, and R&D universities, East Asia has already overtaken Europe, and it's on a par with North America. It has gone ahead since 2011, and I expect that, in the next batch of figures from the OECD, it will have overtaken North America." See Liz Heron, "Asian Universities Are Set to Improve in World Rankings, Says Expert," *South China Morning Post*, July 14, 2014, <http://www.scmp.com/lifestyle/family-education/article/1551985/asian-universities-are-set-improve-world-rankings-says>.

10 James Manyika, Sree Ramaswamy, Somesh Khanna, Hugo Sarrazin, Gary Pinkus, Guru Sethupathy, and Andrew Yaffe, *Digital America: A Tale of the Haves and Have-Mores* (McKinsey Global Institute, December 2015), <http://www.mckinsey.com/industries/high-tech/our-insights/digital-america-a-tale-of-the-haves-and-have-mores>.

Lower-income countries are developing not just their economies, but also their ability to mobilize portions of it to meet social needs. Consequently, their governments are increasing the shares of GDP that they take in revenues and provide in direct consumption and transfer payments. Where will those greater expenditures go? Even in low-income countries, the biggest growth rate will be in pensions but starting from a much lower base. The second biggest winner will be education, followed by R&D (another small sector likely to see high growth), health care, and other infrastructure.

Pension Risks

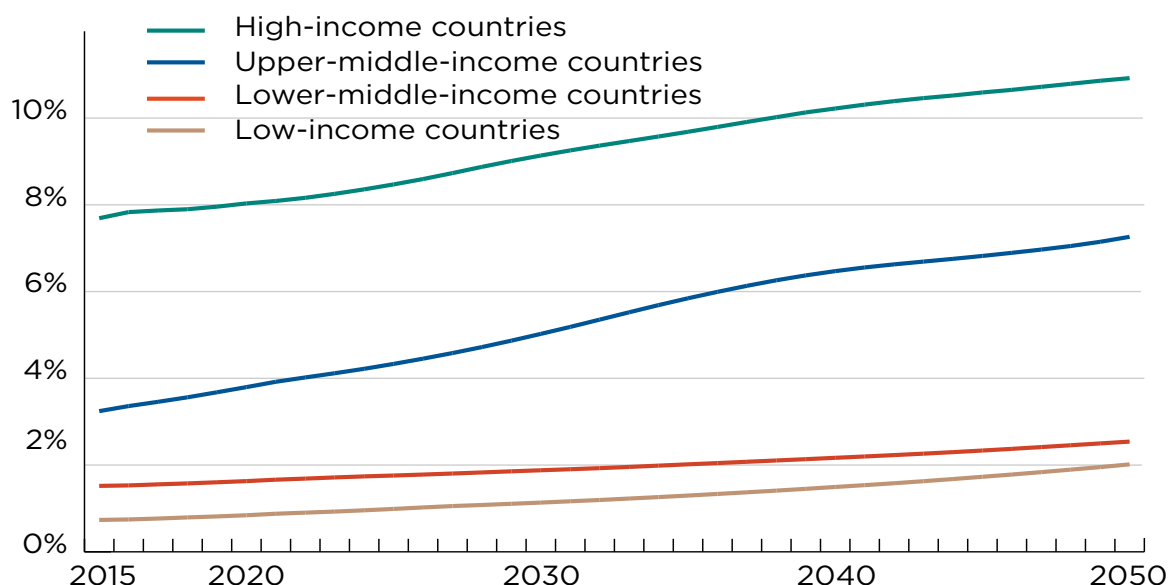
High-income countries will experience, by far, the greatest demand for pension spending between 2015 and 2035. However, need for pension spending as a percentage of GDP will increase by 3 percentage points during this time horizon, whereas need in upper-middle-income countries will increase by close to 5 percentage points. Upper-middle-income countries will have less time to prepare for this increase and will have fewer resources, making the pension burden more pronounced. Low-income countries in 2035 will have relatively small proportions of retirement-age populations (and relatively lower life expectancies), and will still be facing the challenges associated with youthful societies (i.e., high education spending and large youth bulges).

For high-income countries, defined benefit plans present the most risk, especially unfunded, pay-as-you-go systems (PAYG).¹¹ 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.

For countries still working to establish viable pension systems (mostly developing countries), other pressing budgetary demands, such as funding education and the predominance of informal sector labor, make it difficult to design and implement pension programs.

11 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.

Figure 7. Government Pension Transfers (percent of GDP)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

Despite the impending risk facing rapidly aging countries with defined benefit schemes, 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. Rather, most have chosen simpler reforms such as increasing the pensionable age or increasing tax or contribution rates.¹²

While these reforms extend the viability of pension funds in the short term, it is questionable whether they will ensure longer-term sustainability. In the fifty years between 1960 and 2010, public pension expenditure as a percent of GDP doubled for high-income countries on average from 4 to 8 percent. By 2035 the GDP share of public pension expenditure is forecast to grow another 3 percent at a time of a shrinking proportion of active workers.

Moreover, 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. Since 1990, average lifespans increased more than 2.5 years per decade. Increases in pensionable ages for all high-income countries, on the other hand, averaged less than one year per decade.¹³

Current forecasts are for life expectancy to increase by at least two years over the next fifteen years. The International Monetary Fund 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.¹⁴ According to our calculations, the average pensionable age may need to be raised significantly for some countries by 2035 in order for governments to meet pension demand.

Finally, data show that pension replacement rates in high-income countries, or the ratio of average pension income to average working income, have been decreasing for both men and women of all pay grades over the past ten years. In the future, we would expect strained pension funds to supply less generous pension benefits in the face of increased demand. Pension transfers as a percentage of retirement needs in high-income, OECD countries are forecast to decline by almost 3 percentage points between 2015 and 2035.

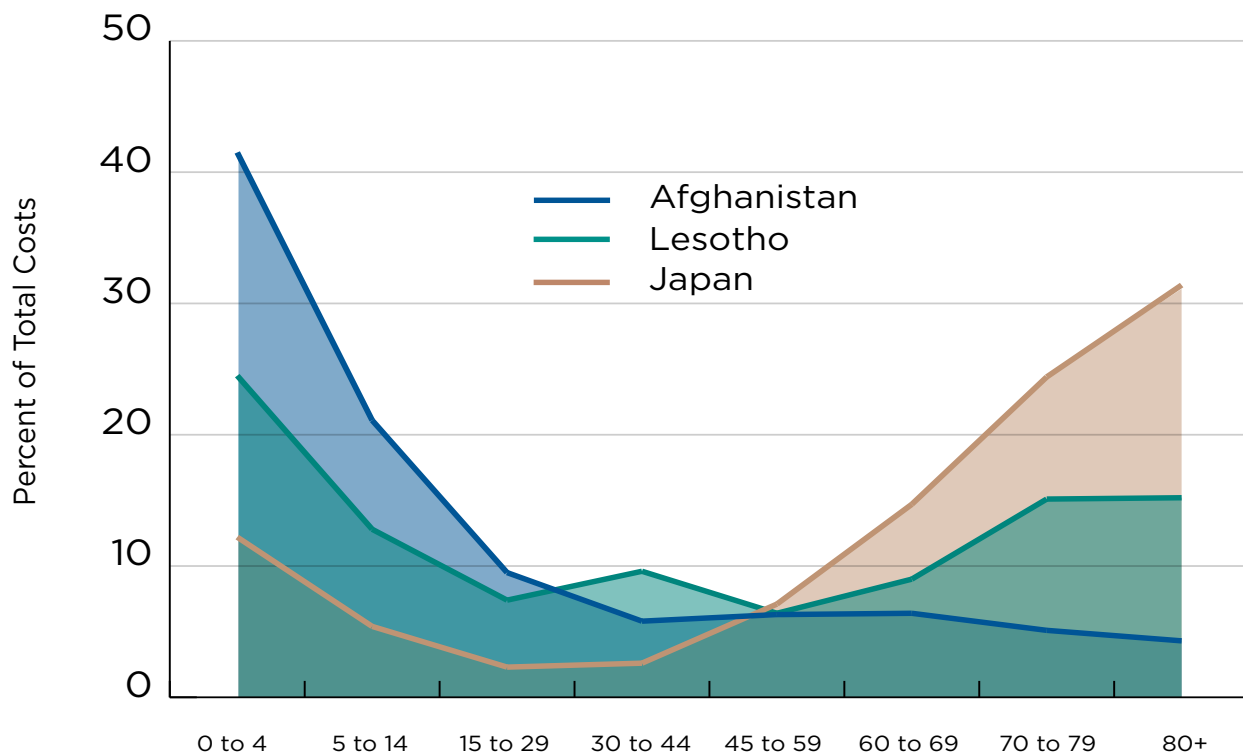
12 *Pensions at a Glance 2015: OECD and G20 Indicators* (Paris: OECD Publishing, 2015).

13 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 *Pensionable Age and Life Expectancy, 1950-2050* (Paris: OECD Publishing, 2011) and *The Challenge of Public Pension Reform in Advanced and Emerging Economies* (Washington, DC: International Monetary Fund, 2011).

14 *The Challenge of Public Pension Reform in Advanced and Emerging Economies* (Washington, DC: International Monetary Fund, 2011).

Figure 8. Health Costs by Age Category (model-based estimates)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

Health Needs and Spending

The needs of young and elderly populations account for most health care spending in all countries. The proportion of total national health care costs specific to each age category shifts as countries move through the demographic transition, making a U-shaped pattern of spending. For example, 48 percent of Afghanistan’s population is under the age of fifteen, and infant care may well account for over 40 percent of the country’s total health care costs. Japan, on the other hand, has only 13 percent of its population under the age of fifteen, and the vast bulk of its health care 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, health epidemics like HIV/AIDS or recurring pandemics could substantially increase costs for middle age groups, illustrated here by Lesotho’s increased health care costs during the adult years.

Whereas youthful countries average about 8 percent in spending on health care (both public and private) that declines somewhat for countries of intermediate median age, rising steadily for those that are mature or post-mature and are therefore increasingly dominated by spending on noncommunicable diseases. The United States is an extreme outlier at nearly 18 percent

of GDP, but for countries with a median age above forty the typical spending rate rises to about 10 percent of GDP.

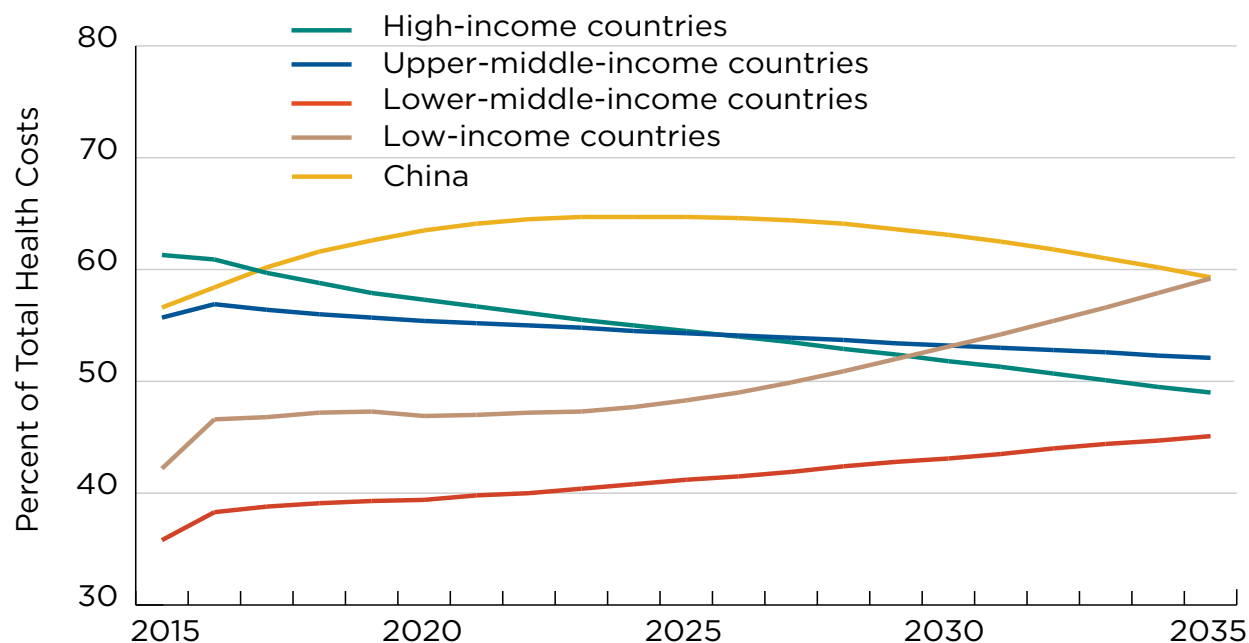
Not surprisingly, because countries with older populations also tend to be richer and able to mobilize greater resources publicly, government spending as a share of GDP rises with median age and shows less of the U-shaped pattern corresponding to shifting disease burden. Public health care spending in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

Overall then, in coming years we can expect to see some easing of growth in total health care spending burdens for lower-income countries but steady rises for high-income ones, with governments in high-income and upper-middle-income countries facing increased spending pressures.

The “compression of morbidity,” or the extension of healthy old age, may mitigate, *temporarily*, the expected increases in health care costs among high-income countries.¹⁵ Nevertheless, years of life lost to

¹⁵ David E. Bloom, David Canning, and Günther Fink, “Implications of Population Ageing for Economic Growth,” *Oxford Review of*

Figure 9. Government Health Spending as a Percent of Total Needs



Government spending as a percent of total health care costs, across country income categories.

Source: International Futures model, Pardee Center for International Futures, University of Denver

disease (noncommunicable) and disability are forecast to increase costs for high-income countries over the longer run. The “deepening of aging,” or an increasing proportion of those aged eighty and over, would necessitate more extensive and expensive health care needs, such as in-home or long-term care.¹⁶

The increasing health care costs will also draw on the elderly’s savings stocks. The difficulty associated with saving for and living an 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.¹⁷ The savings stocks of the elderly in high-income countries will be surpassed by the savings needed within the next decade. By 2035, the gap is forecast to grow to approximately \$50 trillion.

Actual public health care spending will not keep pace with that 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) in the case of high-income countries.

Lower-middle-income and low-income countries without such large elderly populations are in a better position. However, the Chinese government’s share of spending on health care needs will rise until the early 2020s, at which time the pressure for more health care spending and pensions will begin to erode the government’s ability to keep up with them. The share of health care spending in other upper-middle-income countries will also slowly decline. By contrast, lower-middle- and low-income countries will steadily improve their spending-to-needs ratios through 2035.

Education Needs and Spending

High-income countries with aging populations are likely to see decreasing demand for educational spending as a portion of GDP. Upper-middle-income countries still have much unmet educational need. The spending gap in upper-middle-income countries will narrow, converging toward spending levels of the high-income countries that will be increasingly squeezed by pension and health care spending for their aging

Economic Policy, 2010, vol. 26, no. 4, pp. 583-612, doi:10.1093/oxrep/grq038.

16 Rock Lefebvre and Amar Goomar. “Growing Up: The Social and Economic Implications of an Aging Population,” Certified General Accountants Association of Canada, British Columbia, Canada, 2005.

17 Barry Bosworth, Ralph Bryant, and Gary Burtless, *The Impact of Aging on Financial Markets and the Economy: A Survey* (Washington, DC: The Brookings Institution, 2004).

populations. This is consistent with the argument by Ronald Lee and Andrew Mason that countries with diminishing young populations are able to free up financial resources that can be directed towards expanding enrollment at higher levels of schooling and increasing per-student expenditure.¹⁸

Lower-middle- and low-income countries will probably direct more GDP to education but will remain constrained by low levels of government revenue. Because of the lower share of GDP spent on education and the larger burden of students, low-income

countries now spend about half the share of GDP per capita on each primary student that high-income ones do, contributing also to lower quality.

In short, educational spending in many developing countries will benefit from changing demographic patterns while that in OECD countries will be squeezed by competing social demands. Lower-income countries with continued high fertility rates, like those in Equatorial Africa, are likely to experience continued stress on financing for educational infrastructure, teachers, and supplies. This will hinder increases in spending per student and, consequently, impede the expansion of human capital.

18 Ronald Lee and Andrew Mason, eds., *Population Aging and the Generational Economy: A Global Perspective* (Ottawa, Canada: Edward Elgar, International Development Research Centre, 2011), p. 173.

UNCERTAINTIES AND SCENARIOS

The “human tectonics”¹⁹ of fertility and mortality that push populations through the stages and associated risks of the demographic transition are relatively well understood and predictable. Other—more uncertain—interacting variables, like medical advancements, migration, and unanticipated drops in fertility rates in low-income countries—have the potential to change substantially the nature and balance of risks and benefits associated with demographic change.

Major Uncertainty #1: What If We Live Longer?

Our first scenario explores a world in which advances in medical technology and treatments drive down mortality rates, particularly from the chronic diseases, which have an increasing burden on older, wealthier populations. In this scenario, governments face the challenge of paying for pensions and for delayed, but ultimately increasing, health care costs.

In the mid-1950s the global average life expectancy was fifty years. Today it is seventy with the average for high-income countries even higher at seventy-eight years. With advances in medical technology, it may be possible that a child born in Europe could expect to live to almost ninety years by 2035 with upper-middle-income countries also reaching close to the same longevity levels.

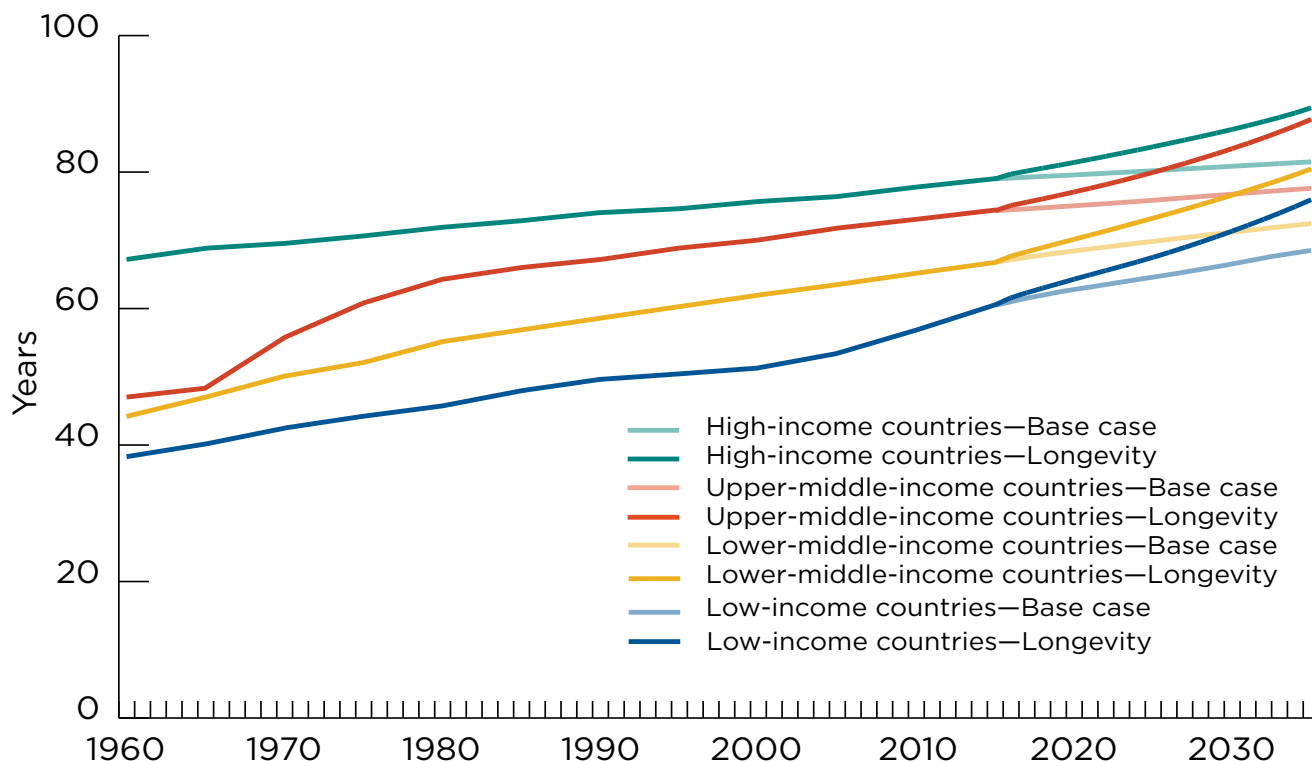
In this scenario we have simulated a reduction in the burden of heart disease, cancers, as well as some other chronic diseases (not including HIV/AIDS, diarrhea, malaria, and respiratory infections). While such prospects are exciting, they will exacerbate the challenge for governments in meeting demand for pensions and delayed but ultimately greater health care costs.

France serves as a useful case study with an already elderly population. In 2010, when the French government raised the retirement age from sixty to sixty-two, 17 percent of the country’s population was sixty-five or older. By 2020, the share of France’s elderly population will grow to around 20 percent. By contrast, only about 9 percent of the Chinese population is sixty-five years or older today. Only in the early 2030s will China’s elderly population reach France’s 2010 level of 17 percent. But then in 2030, China’s rate of aging will accelerate at a faster pace than France’s.

In this scenario, reducing mortality rates from the chronic diseases affecting elderly populations does not translate into interim savings in health care costs for France. And, over the longer run, China also faces greater fiscal pressures. Already before 2015 health care costs in France had exceeded government spending on health, and the spending gap was increasing. This gap widens even more rapidly as the elderly and very elderly populations grow relative to the working-age population.

19 Michael Teitelbaum, “Political Dimensions of Demographic Change: An Address,” Conference Series, Proceedings 46, Federal Reserve Bank of Boston.

Figure 10. Life Expectancy for World Bank Income Groups (in years)



Life expectancy for World Bank income groups, showing historical data, Base Case, and Longevity scenario forecasts. Note that the upper-middle-income average is largely dominated by China, recognizable by the Great Leap Forward during the 1960s.

Source: International Futures model, Pardee Center for International Futures, University of Denver.

For China, the decline in the spending gap—both for Base Case and Longevity scenarios—changes direction by 2030. The gap grows rapidly as a larger cohort of pensioners begins to require higher levels of medical attention at a time when China’s elderly cohort is exploding. Those sixty-five and older constituted 9.5 percent of the population in 2015 whereas they will constitute near 25 percent in 2035, making it harder for the deferred health care costs to be financed. In any population, reducing the relative risk of one disease means greater exposure to another later in life.

In the Longevity scenario, the annual consumption needs of all French retirees as a share of GDP increases by over 14 percent by 2035 as compared to the Base Case (see below). In a more rapidly aging China, the life expectancy increase in the Longevity scenario could drive an over 20 percent increase in consumption needs by 2035, which translates to a 190 percent increase in retirees’ consumption needs (as a share of GDP) from 2015 to 2035. Besides the increases in health care costs, annual Chinese retirement needs

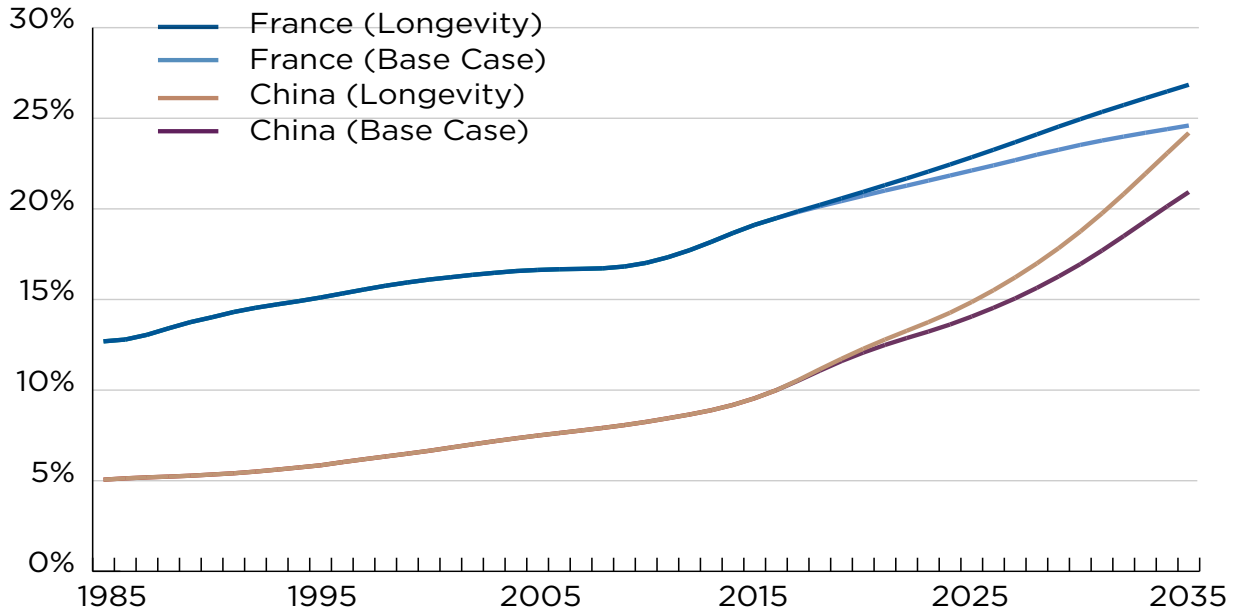
would grow in the Longevity scenario. Currently \$200 billion, they grow to near \$1.4 trillion by 2035 in the Base Case, but would increase to over \$1.8 trillion in the Longevity scenario.

Major Uncertainty #2: Will Migration Solve Aging?

In aging countries where births have fallen below replacement rate, migration can significantly shape population growth, offsetting the 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.

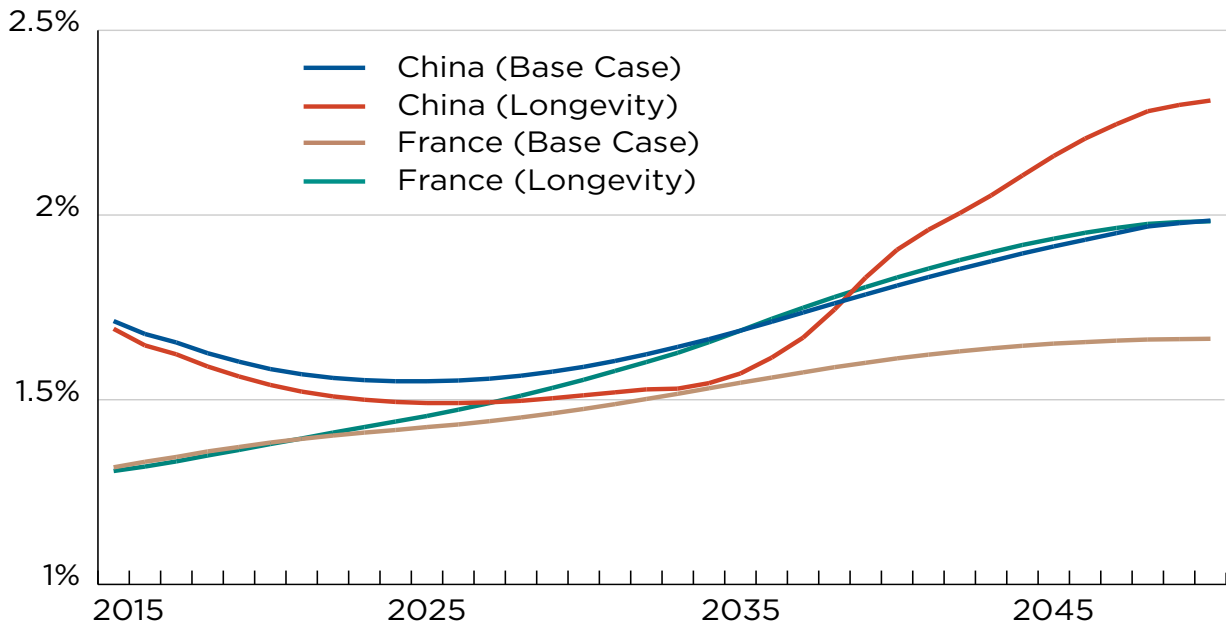
The conflict in Syria has forced over three million people to flee the country. While most of these refugees have sought asylum in neighboring countries, many have made their way to the European Union, with

Figure 11. Population 65+ as Share of Total Population in France and China, History and Forecast (percent of total population)



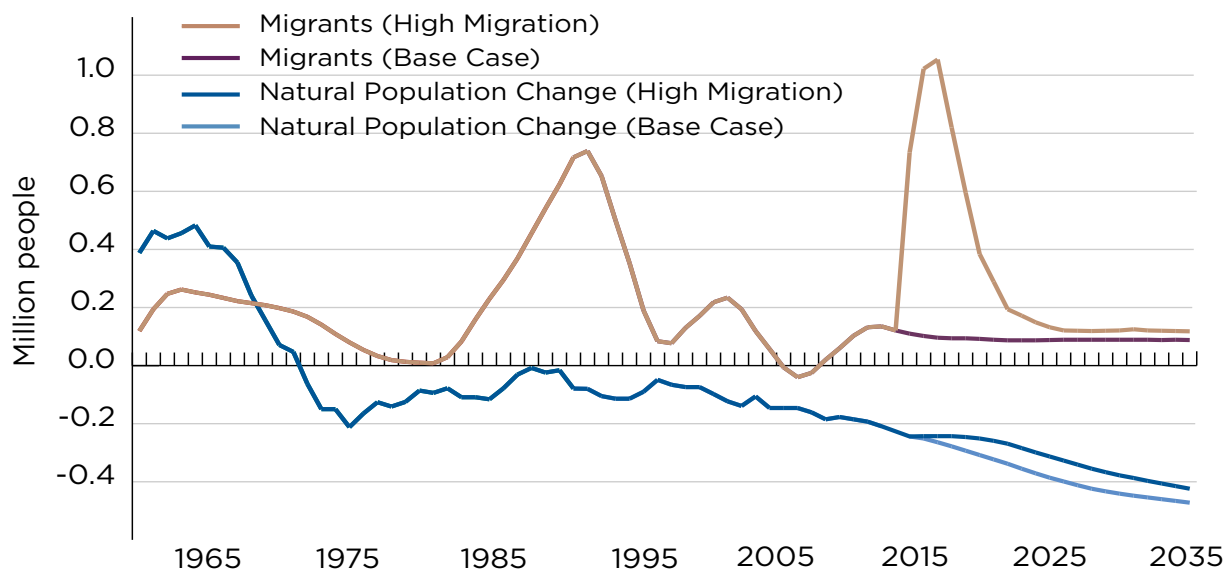
Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 12. Consumption Needs of All Retirees per Year in China and France (percent of government health spending)



Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 13. Population Change in Germany, History and Forecast



Source: International Futures model, Pardee Center for International Futures, University of Denver.

85 percent of these resettling in Germany. In 2015, the German Federal Office estimated that up to 1.1 million refugees seeking to escape conflict in Syria and other war-torn countries had entered Germany.²⁰

This scenario simulates this influx of migrants leaving conflict-stricken countries (particularly Syria) and low-income countries with limited economic opportunity, and entering the European Union, particularly Germany. While our analysis in this scenario does not model the social implications of migration, we do forecast the economic benefits that countries like Germany might ultimately receive from the influx of working-age migrants into an otherwise declining population.

Like other aging countries, Germany will experience greater difficulty meeting the demand for pensions and health care as the working-age population declines relative to the number of retirees. The figures above show how increasing the flow of migrants to Germany can help mitigate this problem by increasing the size of the economically active and net-producing population. This presumes that migrants can be integrated into the economy and become as productive as the average German worker.

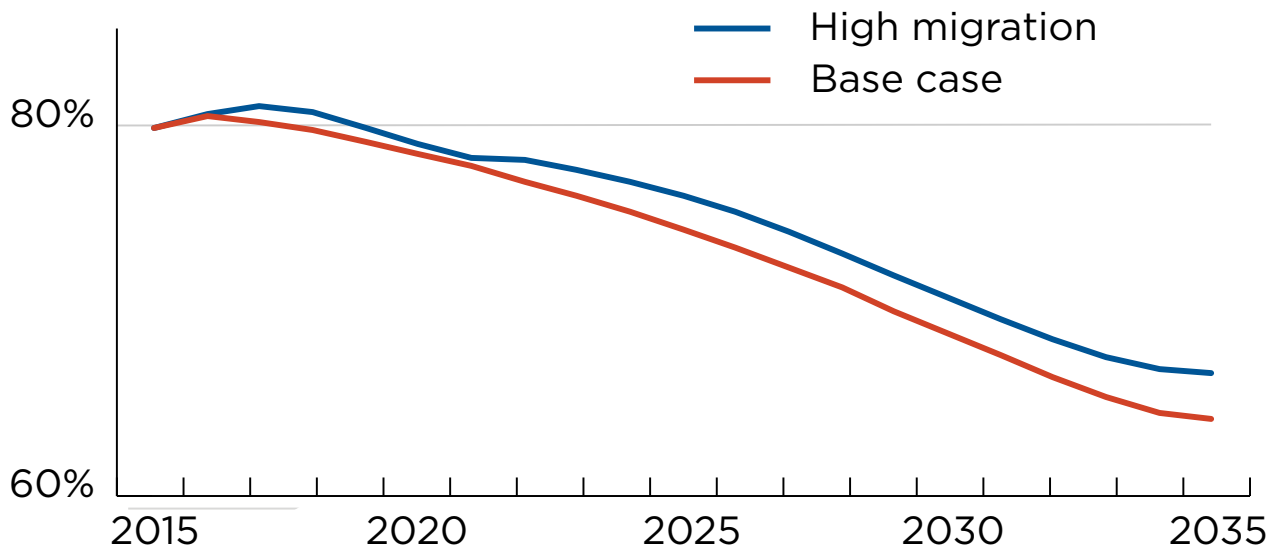
Perhaps most important is the direct contribution to economic growth that migration can provide for aging countries where the labor force is already in decline. Since migrants are primarily younger, working-age adults they help offset the growing labor deficit in these countries, and, in turn, mitigate the loss to economic growth attributed to labor. In the Base Case, 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 twenty years. In the High Migration scenario, the inflow of migrants actually 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.

Major Uncertainty #3: Rapid Fertility Drop in Low-Income Countries

Many countries across Equatorial Africa have been left behind in the otherwise global secular decline in fertility. Today, the average African woman is expected to give birth to five children or so, twice the average fertility rate for the rest of the world. These historically high birth rates have maintained a relatively high youth bulge and delayed the onset of the demographic dividend in the region. Decreasing fertility rates beyond the expected trajectory would lessen youth dependency, accelerating the onset of the demographic dividend for many high fertility

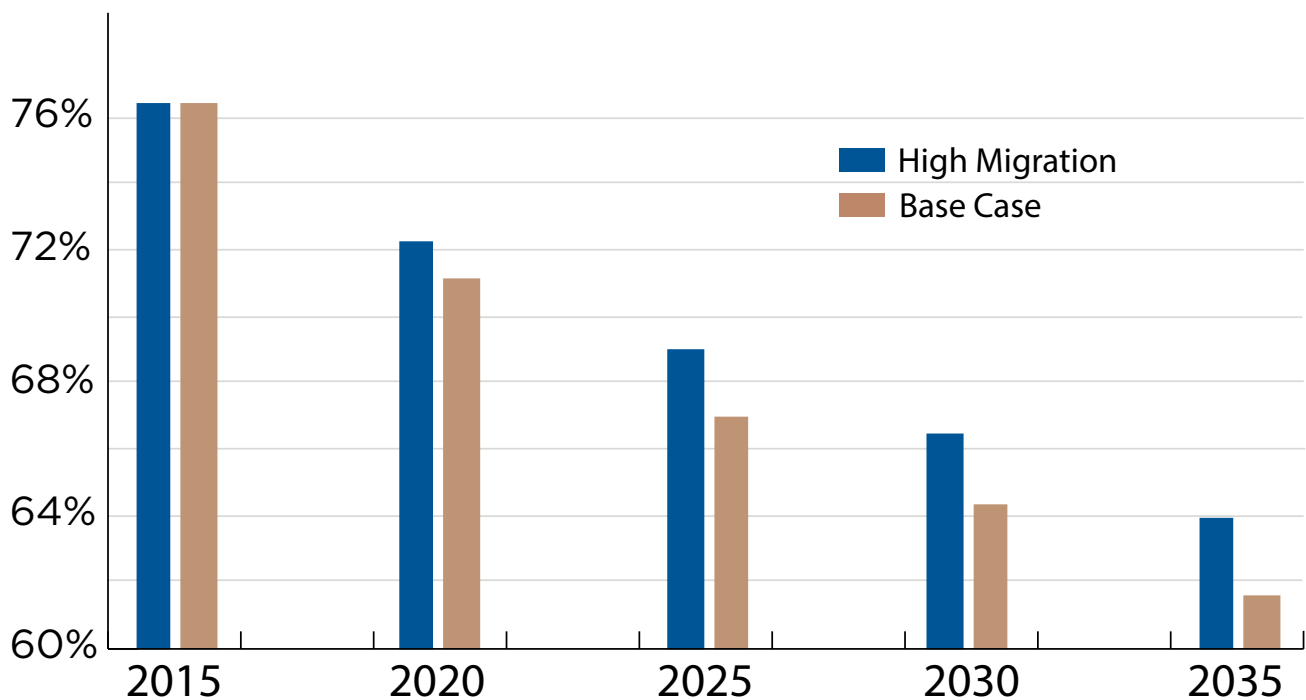
²⁰ Data derived from Federal Statistical Office website, https://www.destatis.de/EN/FactsFigures/_CrossSection/Refugees/Refugees.html.

Figure 14. Government Pension Transfer as Percent of Retirement Needs in Germany



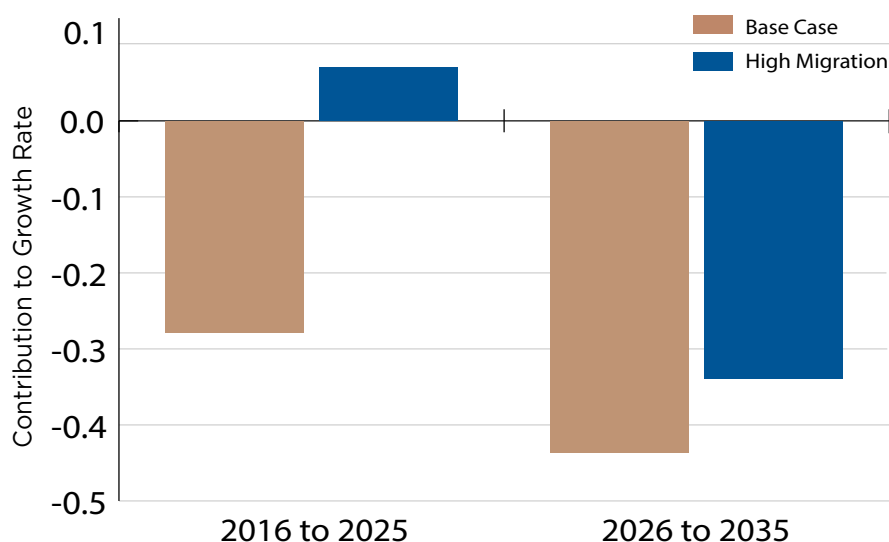
Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 15. Government Spending on Health as Share of Total Health Costs in Germany



Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 16. Labor Contribution to Growth in Germany



Source: International Futures model, Pardee Center for International Futures, University of Denver.

countries. If used properly, this demographic window of opportunity offers higher growth potential for countries.

Examples in history show that dramatic fertility reductions are indeed possible, the most famous being the cases of China, where total fertility rates dropped from 6 births per woman to 2 in just twenty years, and Iran, where rates dropped from 6 births to 1.5 over thirty-five years. In this scenario we explore the implications of a similar reduction in Equatorial Africa. Across the region today, average total fertility rates are around 5.2 births per woman. The IFs Base Case forecasts this to decline to 3.8 over the next twenty years, though this may actually be too optimistic in view of the current path. The Low Fertility scenario changes the trajectory, so that by 2035 average total fertility rates reach 2.3, just above replacement level. This would provide an immediate benefit in reducing the share of economically dependent cohorts within the population.

Even in the Base Case, there will be a substantial reduction in the potentially dangerous youth bulge. In the Low Fertility scenario the decline would be dramatic.

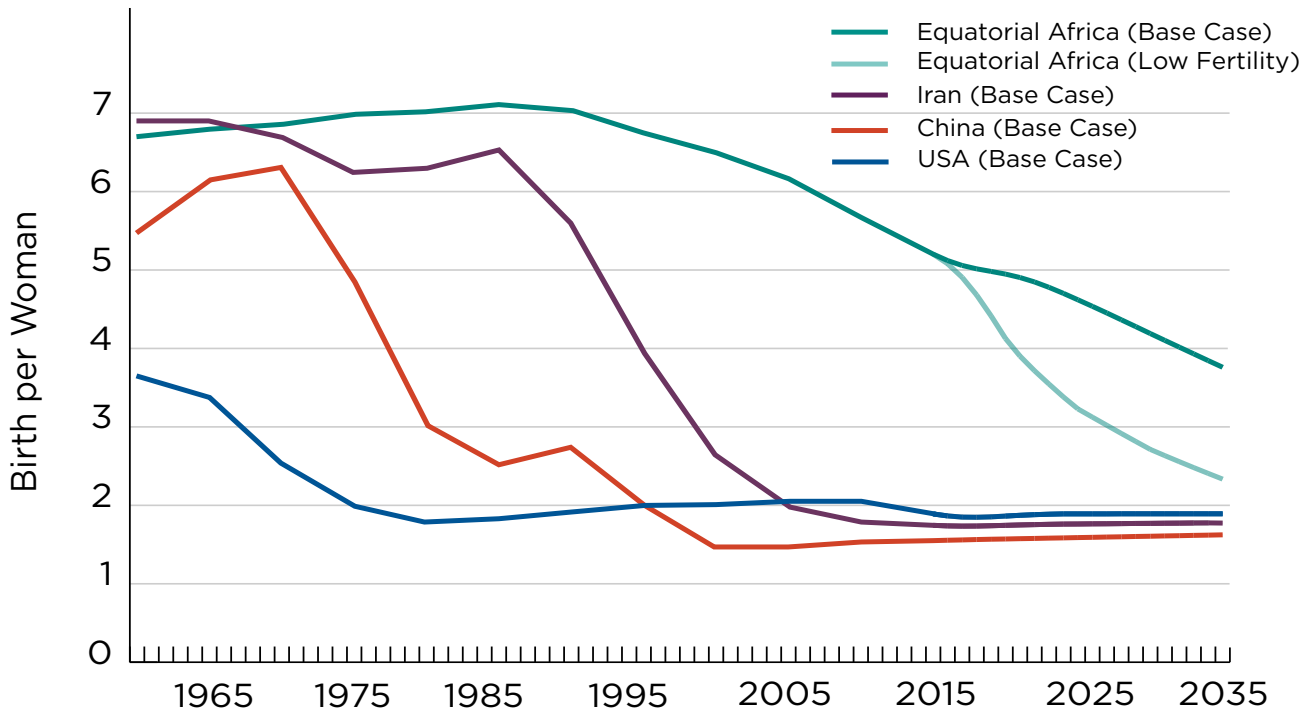
On today’s path, the demographic dividend in Equatorial Africa is expected to increase at a very

moderate rate compared with the historical growth rates of lower- and upper-middle-income groups. However, in this Low Fertility scenario, drastically reducing the share of younger cohorts potentially gives the region a bigger demographic dividend by the mid-2030s.

Some of the high educational costs linked to large youth populations would also be spared. In the Base Case, for example, the primary education spending gap, or the cost of educating all primary students at high-income country spending-per-student levels, is expected to grow from around \$8.5 billion annually in 2015 to \$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.

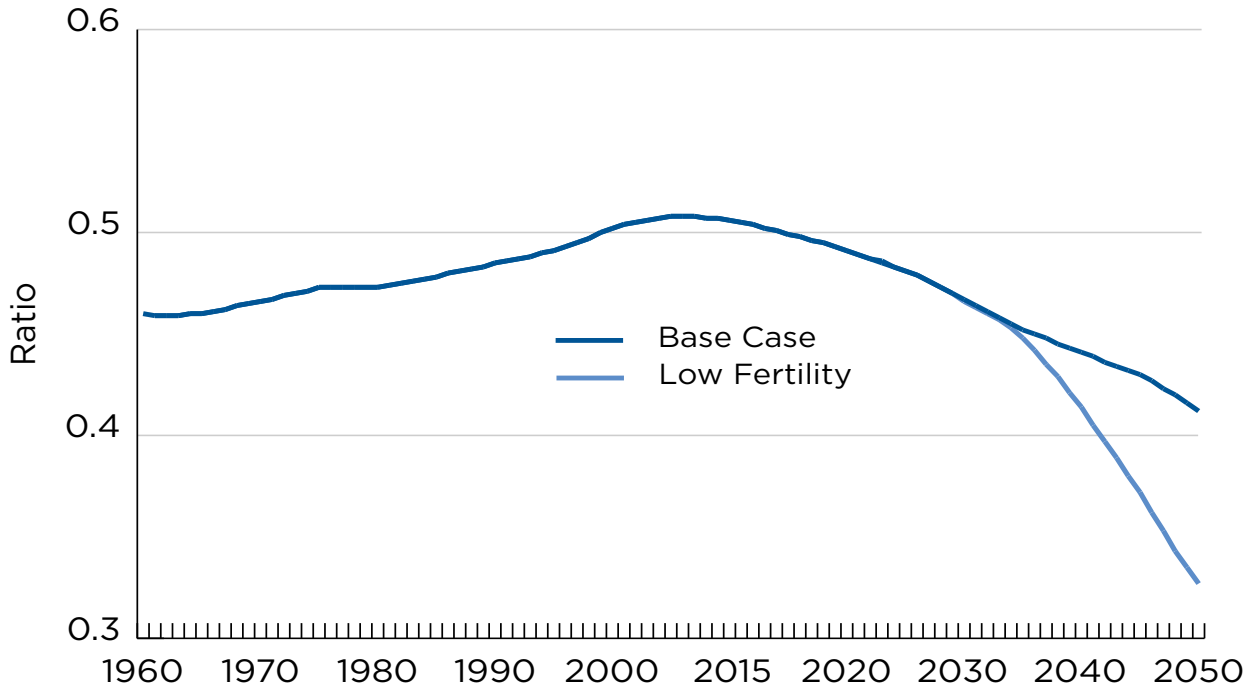
Another benefit that comes out of a reduction in fertility rates is an increase in per capita GDP. This is not attributed between now and 2035 to any substantial increases in labor productivity—it takes a full generation or more for changes in birth rates to affect educational levels of a working-age population—but instead comes from the simple reduction in overall population.

Figure 17. Total Fertility Rate, History and Forecast



Total fertility rate for China, Iran, United States, and Equatorial Africa, history and forecast. Source: International Futures model, Pardee Center for International Futures, University of Denver.

Figure 18. Youth Bulge in Equatorial Africa, History and Forecast



The youth bulge in Equatorial Africa, history and forecast. Note that by 2030 the youth bulge remains largely unchanged since the intervention has affected only the cohort of those under twenty, with a more pronounced impact on younger cohorts. Nevertheless, by 2050 the benefits of fertility reduction are quite obvious. Source: International Futures model, Pardee Center for International Futures, University of Denver

CONCLUSION: DEMOGRAPHY DOES NOT HAVE TO BE DESTINY

Political and economic measures can make a critical difference in whether we end up collectively poorer and more unstable, or able to fully enjoy the benefits of growing longevity.

- With the aging process in full swing, high-income countries face a particularly difficult task of raising retirement ages, implementing efficiencies in health care, and reforming pension systems if they are to avert an economic slowdown. Even with major reforms, there is a strong likelihood governments will not be able to fund increased health care and pension costs, forcing retirees to exhaust their personal savings. They need to begin implementing drastic pension reforms quickly, such as by switching to defined contribution pension schemes.
- Zurich Insurance has highlighted elsewhere the increasing Income Protection Gap that is exacerbated by the aging of the workforce. An older society already beleaguered by rising health care and pension spending will have fewer means to compensate workers who become disabled.²¹
- Middle-income countries have the opportunity to avoid the mistakes made by high-income countries in building pension and health care systems for an aging population. The United States, for example, pays 18 percent of its GDP on health care, much higher than the 10 percent that is typical for countries with a median age above forty.²² However, even countries spending at lower rates need to rapidly plan for and create greater efficiencies in health care systems.
- Migration can create many social problems, especially when cultural and socioeconomic differences with the host population are great. Yet migration into societies with a declining labor force can relieve many of the economic growth and financial pressures associated with those declines so long as migrants can be economically integrated and productive. Countries will need to

balance these issues carefully and make decisions that consider the longer term, not just the immediate impacts of migration.

- United Nations demographers and others worry that high fertility rates in sub-Saharan Africa may be too slow to decline, impeding economic development and stabilization of the world population. Civil conflict and instability—such as in the Middle East—are highly correlated with high birth rates and youth bulges. One hundred percent of the states marked as Very High Alert or High Alert on the Fragile States Index compiled by *Foreign Policy* and the Fund for Peace have very youthful age structures.²³

Firms have a special responsibility in managing pension schemes that take into account likely extensions in longevity. While raising the retirement age in many countries is politically explosive, firms can help encourage workers to remain in the workforce longer with more flexible workplace schemes. Income protection can form part of a suite of benefits that employers provide to boost retention of an aging workforce.

With upper-middle-income countries likely to increase education spending, firms have the opportunity to recruit a more skilled workforce. However, especially in rapidly aging countries, the reskilling of older workers will become more pressing as countries seek to encourage workers to stay longer in their jobs.

The squeeze in high-income countries on spending on education and government R&D could ultimately jeopardize firms' fortunes as numbers of highly skilled workers dwindle and basic science and technology research suffers.

For many individuals, living longer and healthier lives is a dream that is finally coming true. Avoiding a nightmare of slowing economic growth, dwindling pensions, fraying health care, and strained education capacity is the responsibility for governments, firms, and individuals alike.

21 See "Income Protection Gaps—A Growing Global Challenge," Zurich Insurance Group, November 17, 2015, <https://www.zurich.com/en/media/news-releases/2015/2015-1117-01>.

22 "Economic Case for Health Care Reform," US Government, <https://www.whitehouse.gov/administration/eop/cea/TheEconomicCaseforHealthCareReform/>.

23 Unpublished SFI research for National Intelligence Council, January 2016.

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