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Population Aging and the Global Economy: Weakening Demographic Tailwinds Reduce Economic Growth

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Authors: David Baxter, Gretchen Donehower, William H. Dow, Ronald D. Lee

Abstract

Expansion of the working age population has been a powerful engine of the global economy in recent decades, with the resulting demographic "tailwinds" accounting for 48% of annual economic growth from 1990-2015. These tailwinds will slow, however, as the global population ages 20-64 will grow less than half as fast from 2015-2040 as compared to the prior 25 years, while the age 65+ population will grow five times faster than the working age population.

Building on detailed country-specific economic models and data on age profiles of labor income, consumption and savings from the National Transfer Accounts project, we estimate how population changes will affect national incomes to 2040 under likely future demographic scenarios. We predict that slowing population growth and rapid aging of the populations in the United States and other leading economies around the globe will cause global demographic tailwinds to be only 31% as strong in the 2015-2040 period as compared to 1990-2015. Tailwinds that added 1.3% per year to global economic growth during 1990-2015 will drop to only 0.4% per year from 2015-2040. Cumulatively, this projection implies that the global economy in 2040 will be 20% smaller under projected 2015-2040 population trends than it would have been if the population trends of 1990-2015 had continued.

In the United States, tailwinds will drop by 0.8% per year, only slightly better than the 0.9% drop in other high income countries. Many low and middle income countries will experience similar slowdowns to economic growth, although countries earlier in the demographic transition will see rising demographically-driven economic growth, such as a 0.4% increase in Nigeria's tailwind. A major exception is China, which we project will transition from a 1.5% annual tailwind to a 0.6% headwind as China's working age population actually began to shrink in 2016. An upcoming report will present more detailed estimates by country and year, while future research by the Berkeley Forum on Aging and the Global Economy (BerkeleyAGE) will further explore effects on different aspects of the economy, including effects on per capita income and consumption.

Populations are Aging across the Globe

Global demographics are now at a tipping point. We are transitioning out of a decades-long period of strong growth in younger populations, and entering a new era of unprecedented population aging. Across the world's major economies, slowing population growth will reduce national and hence global economic growth. In high income countries, the population age 65+ will escalate while the proportion of working age will diminish, leading to slower growth in national incomes. In some low-income countries, by contrast, the population share in the working ages will rise, generating a demographic dividend and raising per capita income and consumption.

The rapid population aging in many countries during the next several decades is driven by three major demographic forces. First is falling mortality rates: worldwide life expectancy increased from 47 years in 1950 to 67 years in 2000, and continues to rise. Second, total fertility rates fell dramatically, slowing the growth of younger populations. The number of children per woman almost halved between 1950 (when women had on average five children) and 2000 (when women had on average 2.6 children). Finally, a surge in fertility rates in the middle of the 20th century, observed largely in North America, parts of Europe, and Australia, created a "baby boom," a population bulge now entering the older ages.

As a result of these trends, the percent of worldwide population that is age 65+ is projected to increase from 8.3% to 14.2% between 2015 and 2040 (Figure 1). Meanwhile, the growth in the working age population (age 20-64) will slow drastically. While the working age population increased 56% between 1990 and 2015, this age group will grow just 22% between 2015 and 2040 (Figure 2). During this same 2015-2040 period, the age 65+ population will increase globally by 114%. In fact, the percent of global population of working age peaked in 2012 at 66%, and will slowly decline over the next several decades. Meanwhile, the old age dependency ratio—the number of people age 65+ per every 100 people age 20-64 will jump from 14.4 in 2015 to 25.2 in 2040.

Population Changes: A Tale of Two Worlds (and a Very Big Exception)

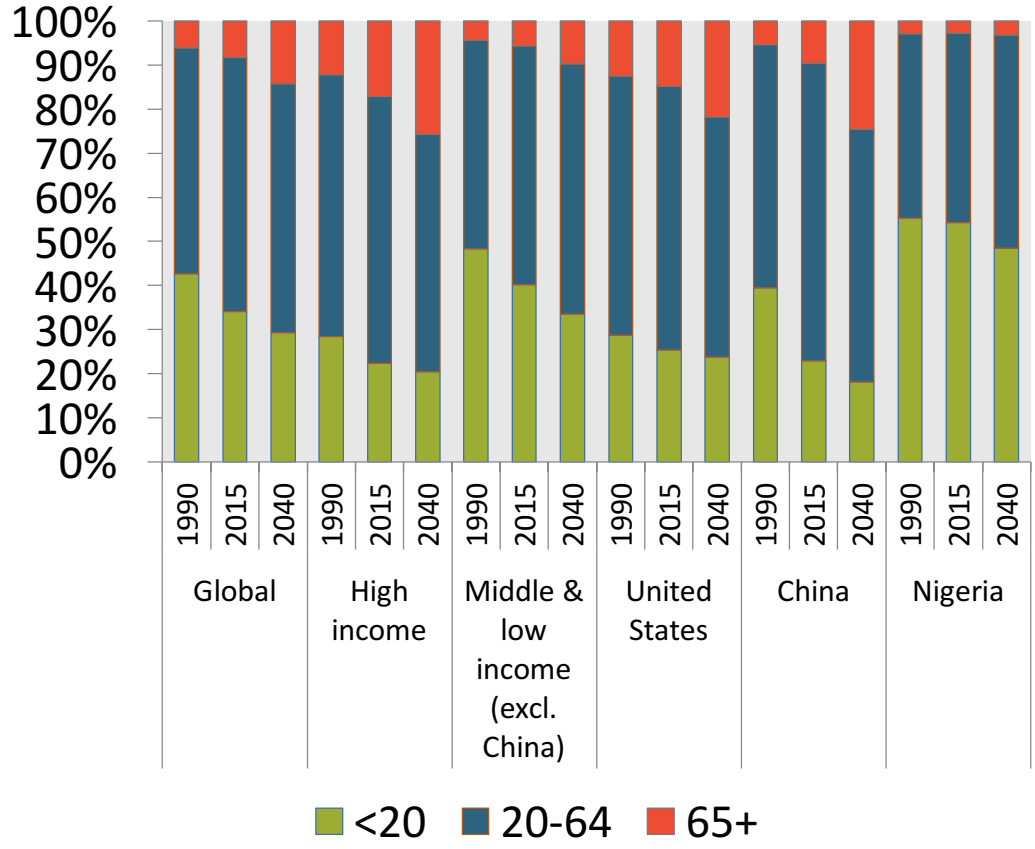
While the global portrait of population transformations is remarkable, trends on regional levels are even more complex and dramatic. In particular, there are stark differences between high income and lower income economies. While virtually all countries will experience substantial growth among their age 65+ populations, their accompanying changes in working age populations will be very different. One reason for this is that fertility rates among the high income regions began falling sooner than among middle & low income regions. Consequently, high income regions are the first to confront demographic "headwinds" as growth of their working populations slows at the same time that their older populations expand faster.

Among high income countries overall, the working age population (ages 20-64) will decline by 4% between 2015 and 2040 (Figure 2). In the United States, the working age population will instead increase (slightly) by 5% during this period (due in part to higher migration and fertility than in other high income countries), but this is still a sharp slowdown in the growth rate of the potential labor force as compared to the prior 1990-2015 period.

Among low and middle income countries there will also be a sharp slowdown in the growth rates of the working age population, but effects will be quite heterogeneous, depending on factors such as the timing and intensity of fertility decline. Among this group as a whole (but excluding China) the working age population will still grow a robust 42% from 2015-2040, but this growth is much slower than the 74% in the prior 25 years, which will imply diminishing tailwinds on economic growth in this group overall as well. This masks considerable variation though, as some countries earlier in the demographic transition will still experience accelerating working age population growth (and hence tailwinds); for example, Nigeria's working age population is projected to grow 102% from 2015-2040, a slight increase from the 95% growth in the prior period.

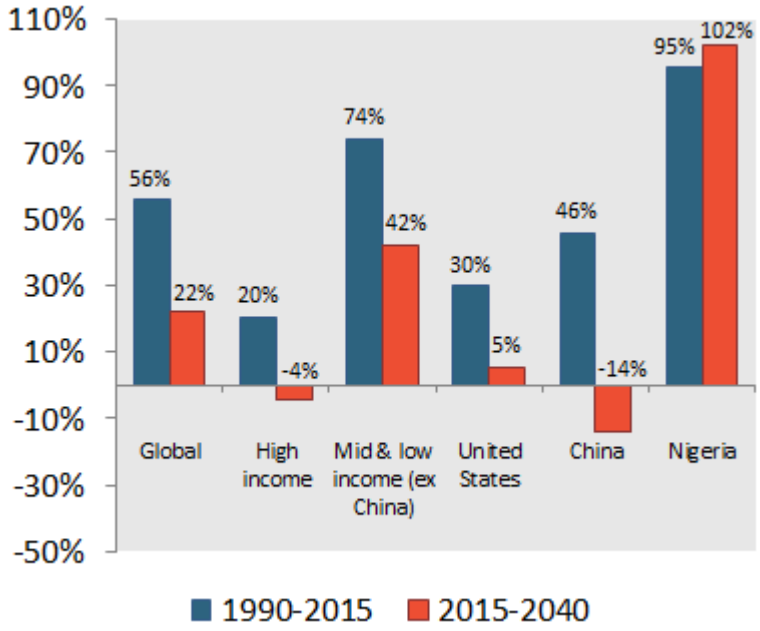
Among middle income nations, China is a particularly important exception. Due in part to the one-child policy, China will experience particularly rapid aging and decelerating population growth from 2015-2040. China's working age population began to shrink in 2016, and will drop by 14% from 2015-2040, as compared to a 46% increase in the prior period, implying that it will experience an especially large drop in demographic tailwinds on economic growth.

Figure 1: Age Distribution of Populations in 1990, 2015, and 2040



Source: United Nations World Population Prospects, 2015 revision

Figure 2: Percent Change in Population Ages 20-64: 1990-2015 and 2015-2040



Source: United Nations World Population Prospects, 2015 revision

How Population Changes Impact Economic Growth

Unprecedented global population aging and slowing population growth will have widespread consequences for economic growth over coming decades. These population changes alter aggregate economic growth through multiple mechanisms, with our model emphasizing the two most important ones: labor force size and capital availability. As greater shares of the population leave traditional working ages and enter retirement, particularly in low fertility environments, the size of the labor force will experience slowing growth and possibly shrinkage, which will directly lower economic growth. This phenomenon can be partially ameliorated by increased capital availability since older adults have higher accumulated savings than younger adults: to the extent that these savings are re-invested in the economy, this will raise capital per worker and hence productivity and economic growth.

Economies will also be affected by demographic change in other ways beyond the direct drivers of economic growth. For example, as population ages there will be changes in the average market basket of goods consumed. Furthermore, government decisions about financing of pensions and health care for the elderly can have dramatic consequences for relative economic well-being of different generations.

Limited previous research has estimated the potential effects of aging on global economic growth.[1] These studies generally fall into two groups—complex modeling exercises with multiple feedback systems tailored to one or two contexts, or simplified models which can be applied across the globe but which focus more narrowly on ratios of one age group to another. Here we use the National Transfer

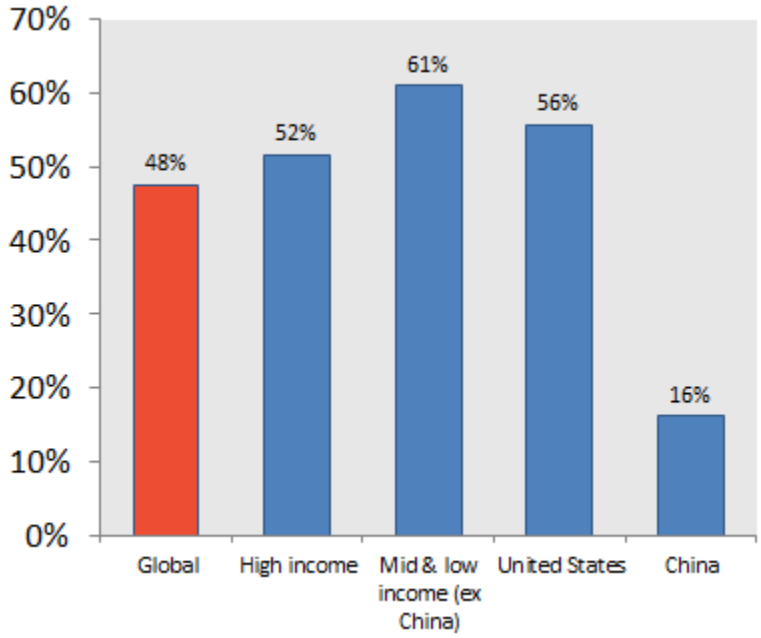
Accounts database, that is comprehensive both in geographic coverage and in types of economic flows measured, and which allows us to strike a balance between complexity and coverage. We model countries individually using a uniform methodology, then produce global estimates by aggregating detailed country-level analyses.

We expand upon existing estimates of the economic impact of population changes by employing comparable macroeconomic models for each country, together with country-specific population and economic data. Our new economic data are drawn from the National Transfer Accounts (NTA) Project that now includes teams in over 80 countries, of which over 60 have estimated at least partial accounts. For this analysis, data from 31 countries were used as the basis for modeling the complex interaction between population aging and economic growth (see Appendix for methodological details); these 31 countries account for 76% of the world economy, with supplementary data allowing imputation of effects for remaining countries as well. These NTA data decompose standard National Accounts by age to analyze country-specific life course age profiles of labor income, consumption, savings, and asset income. We evaluate these age profiles using changing populations to estimate the changing size of the labor force (weighted by earnings at each age), the stock of assets, the private saving rate, and the changing consumption of the population. Labor and assets are entered into a production function to analyze changes in output, wages, and interest rates. To allow for varying levels of international capital flows we explore models with both open and closed economies; because economic growth conclusions are not particularly sensitive to this modeling choice, we present results assuming economies are midway between open and closed. With this overall approach, we are able to estimate the increase in capital per worker that population aging will bring, which will raise output, labor productivity, and wages, while reducing interest rates. In this way the NTA data and models provide the interface between the population and the economy, to enable projections of the changing economic headwinds and tailwinds from changing population growth and aging.

Estimated Economic Impact of Population Changes: 2015-2040

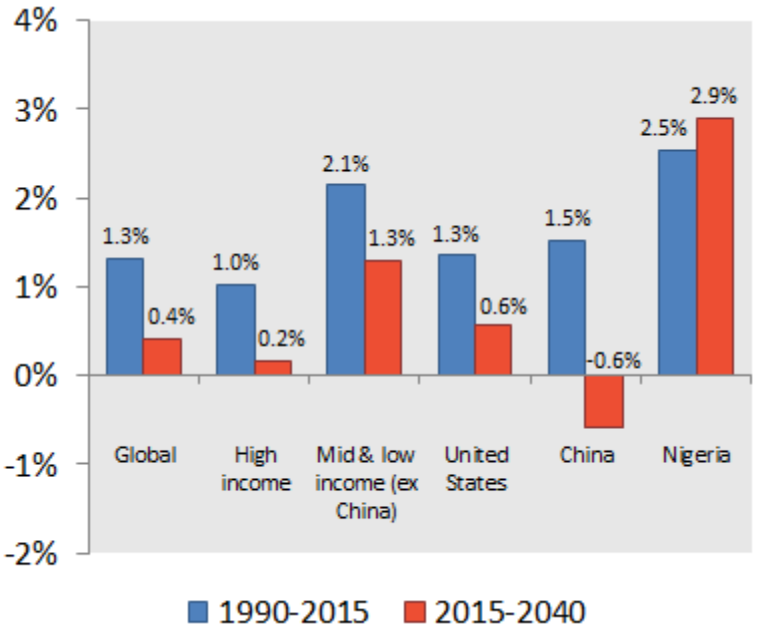
To better interpret our main results on future economic growth, Figure 3 first presents estimates of the portion of economic growth from 1990-2015 that was due to changing population. To do so we estimated the demographic tailwind effects on economic growth during this period, and divided this by the average increase in national income during this time period. This analysis reveals that population trends can statistically account for 43% of the global economic growth over this prior 25-year period. Positive demographic tailwinds explained much less of the impact in China (only 16%) where many other factors such as increasing productivity were involved.

Figure 3: Percent of Economic Growth Associated with Population Trends, 1990-2015



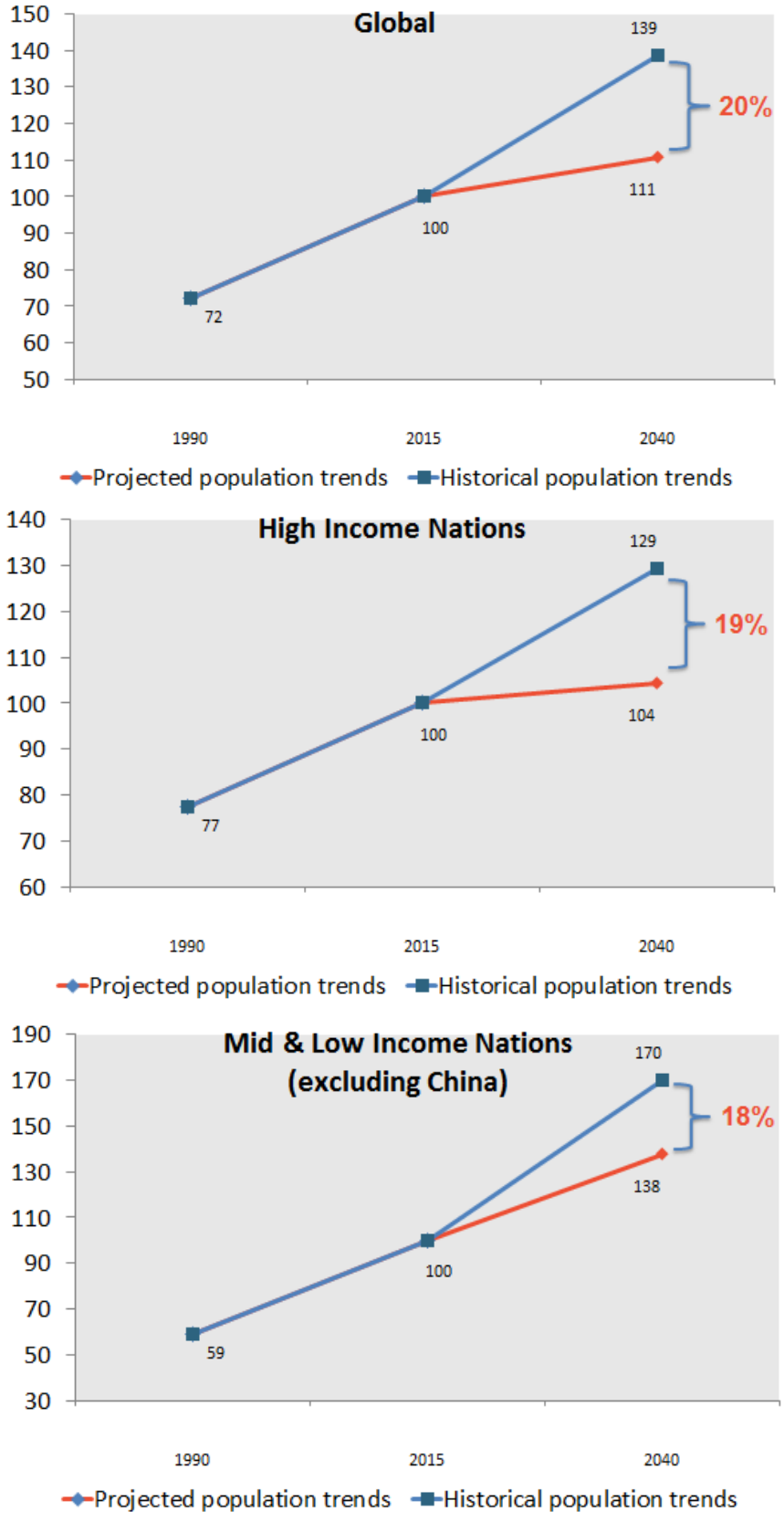
Next, Figure 4 shows the impact of changing population on the *annual* growth rate of National Income in the prior period 1990-2015 as compared to the upcoming 2015-2040 period. The global economy benefited from a 1.3% annual tailwind due to demographic changes from 1990-2015, but this tailwind is projected to fall by two-thirds to just 0.4% per year from 2015-2040. The economic tailwind among high income countries will drop from 1% per year to 0.2%; in the U.S. demography remains slightly more beneficial, but there will still be a substantial drop from a 1.3% to a 0.6% tailwind per year. Middle and low income countries (excluding China) will experience a strong tailwind deterioration also, from 2.1% to 1.3% per year, but again these effects vary greatly by country. Nigeria will experience an increasing tailwind, rising from 2.5% to 2.9%, but China will experience a dramatic shift from a 1.5% tailwind to a 0.6% annual *head*wind. Actual rates of economic growth will of course also depend critically on non-demographic factors such as productivity growth, but the implication of the drops shown in Figure 4 is that we project a substantial demographically-driven slowing of economic growth in much of the globe in the coming decades, relative to what it would have been had population trends remained as favorable as in the prior 25 years.

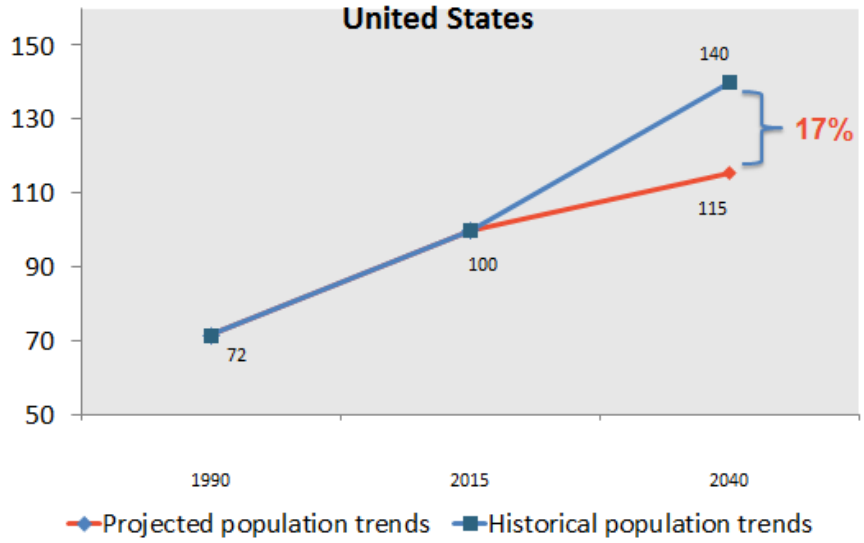
Figure 4: Annual Percent Change in National Income due to Population Trends

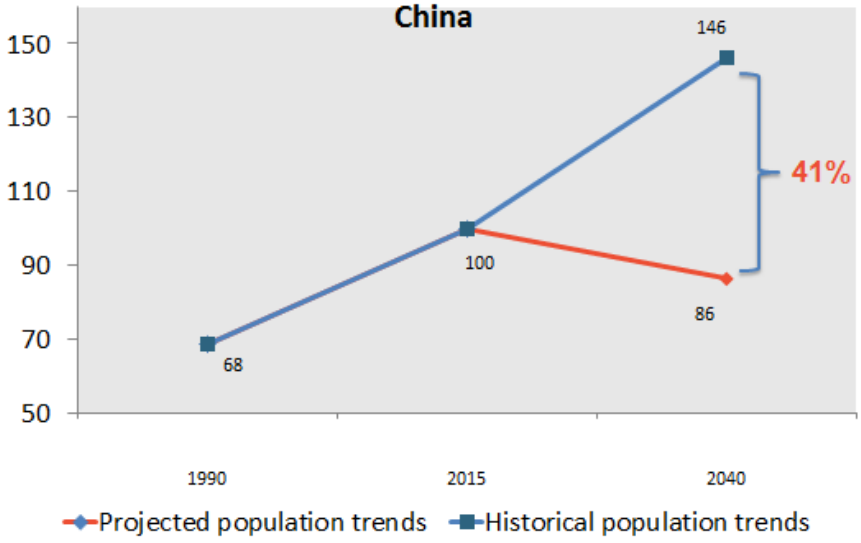


To better illustrate this, Figure 5 shows the demographically-driven portion of economic growth in the prior 1990-2015 period, then shows the naive projection of future demographically-driven growth if the past demographic trends were incorrectly assumed to continue in 2015-2040 (blue line), and compares it to our improved estimate of demographically-driven growth in 2015-2040 (red line). By comparing the naïve (blue) estimate with our improved (red) estimate, we find that in 2040 the global economy is projected to be 20% smaller than if we had ignored the upcoming changes in the rate of population growth and aging between 1990-2015. High income economies, which are transitioning to a period of accelerated aging and slowing population growth, have a 19% reduction in predicted growth. The reduction will be only slightly smaller in the United States, at 17%. Middle and low income economies, which are transitioning from a period of very high population growth to lower growth, will experience an 18% reduction in the size of the 2040 economy compared to what it would have been if their 1980-2010 demographic trends continued, though again this will differ in countries such as Nigeria which is predicted to have 9% higher growth in our model as compared to the naïve model. Once again the most dramatic difference is in China: we project a Chinese economy in 2040 that will be 41% smaller than under naïve backward-looking projections that ignore the effects of China's slowing population growth and rapid aging.

Figure 5: Difference in Size of Economy under Historical and Projected Population Trends (2015=100)




United States
150
130
110
90
70
50
140
115
100
72
17%
1990
2015
2040
Projected population trends
Historical population trends


China
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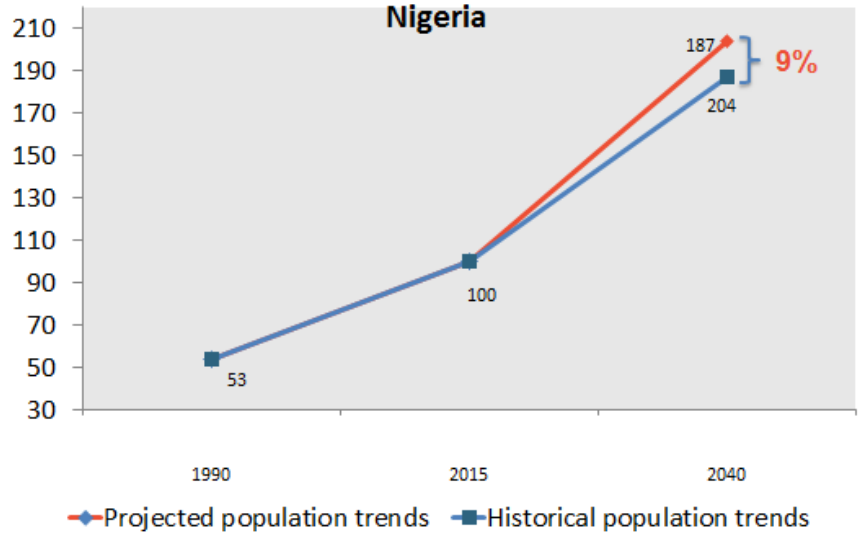
Projected population trends
Historical population trends


Nigeria
210
190
170
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130
110
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30
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53
9%
1990
2015
2040
Projected population trends
Historical population trends

The above analysis projects only the population impact on *overall* economic growth. Population aging will have major impacts also on the systems of public transfers, among which the most important are pensions, health care, long term care, and education. In high income countries the elderly receive much more in costly benefits than they pay in taxes, and in many countries population aging will destabilize public budgets. Within some countries aging will have distinct regional characteristics as well, exacerbated by internal migration: some regions will thrive by attracting young people while other sub-national regions will age more rapidly and struggle to pay obligations to the seniors who remain. Addressing these public budgetary challenges will require difficult political decisions to cut benefits and/or raise taxes to achieve long run fiscal balance. These adjustments may leave the elderly with insufficient provision for old age expenses, or alternatively will lead to heavy taxes and the distortions these bring to labor supply and many other economic behaviors. These problems of population aging, fiscal instability, and policy responses will be the subject of upcoming BerkeleyAGE reports.

Strategies to Prepare for the Economic Growth Impact of Population Trends

We predict that slowing population growth and rapid population aging will substantially slow the demographically-driven component of economic growth from 2015-2040, lowering economic growth by about 0.9% per year as compared to the population-driven effects in the prior 1990-2015 period. Projections that do not properly account for these demographic changes will substantially overestimate future global growth, though by different degrees in different countries.

It is also important to note that the actual economic growth effects will depend on public policy responses to the challenges of an aging society. For example, slowing demographic tailwinds could be mitigated by policies that raise employment rates. These could include policies that remove incentives for older workers to retire at particular ages such as 65, policies that reduce barriers to female employment, and policies that address low employment rates among youth and other underemployed segments of the population. Policies that invest in human capital of young people may have dual advantages of increasing their employment as well as their productivity. Other researchers have also considered the benefits of pro-fertility and pro-immigration policies, although these may have limited benefits for increasing long-run economic growth and per capita well-being. Finally, if fiscal consequences of population aging arising from pension, health care and long term care programs are not addressed, then growing government debt could crowd out some of the capital accumulation that we model.

Upcoming Expanded BerkeleyAGE Report

Building on these initial findings, an upcoming expanded report from the Berkeley Forum on Aging and the Global Economy (BerkeleyAGE) will explore the economic dynamics of population aging in greater detail, including country-by-country projections of expected magnitude and timing of major economic transitions.

APPENDIX

Our approach is built on empirical "age profiles", which are estimates of the amount of labor income, consumption, asset income, or private savings at each age, taken from National Transfer Accounts (NTA, http://ntaccounts.org) data which break down national accounts by age (for further details see Lee and Mason, 2011, and United Nations, 2013). [2] The NTA project now includes research teams in 80 countries (http://ntaccounts.org/web/nta/show/NTA Countries) covering 80% of world population, estimating these accounts using common methods, and subject to centralized quality control to insure comparability. The estimates reported here are based on 31 of these countries which have all the necessary data. [3] Labor income includes before-tax values of wages and salaries, fringe benefits, and 2/3 of self-employment ("mixed") income. Consumption includes private household consumption expenditures allocated to household members based on survey data for health and education and for other expenditures, in proportion to weights that start at .4 at age 0 and rise linearly to 1.0 at age 20 and above. In addition, consumption includes in-kind government transfers by age, such as public education, and publicly provided healthcare and long term care. Asset income includes interest, dividends, rents, operating surplus of corporations, one third of self-employment income, and imputed rent on owned housing (not including interest paid on mortgages, auto loans, etc.). Private saving includes saving by households and non-profit institutions serving households, by nonfinancial corporations, and by financial businesses. These definitions are all consistent with the national accounts, and the profiles are all adjusted to be consistent with the baseline national account totals when multiplied by the population age distribution. NTA also estimates private transfers: flows of resources from earners to consumers within each household (e.g. child rearing) and between households, information not included in ordinary national accounts. This distinctive feature of NTA is not used in the analysis here, but will be helpful in future analyses building on this report.

To estimate the effects of population change on the macroeconomy, we hold these baseline age profiles constant and interact them with the growing population and its changing age distribution. We use population data from the United Nations (2015) [4] to generate aggregate quantities of labor (weighted by wages and hours supplied, and called "effective workers"), assets, consumption needs (called "effective consumers") and saving for each past and future calendar year. We use a Cobb-Douglas production function to translate aggregate amounts of labor and capital (assuming assets are held in the form of capital; similar results are found if housing is excluded) into output or Net National Income (NNI), and into marginal products of labor and capital, hence wages and interest rates, in the closed economy scenario. In an open economy scenario, wages and interest rates are invariant. Aggregate consumption is found as output times one minus the saving rate. Consumption per effective consumer can then be calculated, providing a better measure of economic well-being than per capita income or per capita consumption, because it takes into account the greater consumption needs of the elderly relative to children or younger adults. We calculate both closed and open economy scenarios for impact of population on NNI and present the average of those two scenarios as the final result.

Where we reference actual historical NNI, those data are drawn from the World Bank's World Development Indicators database. [5] The particular series used is the Gross National Income (formerly known as Gross National Product) series in constant 2010 US dollar value at market exchange rates, less estimated consumption of fixed capital.

NTA provides age profiles for asset income, but not for the stock of assets or net worth. To construct our estimates here we assume that asset income is the same proportion of assets at all ages. For the US, this proportion is about 5 percent, but this value does not affect the results because we use only proportional changes in asset holdings, not the actual levels. For the United States, we have compared the changes in the stock of assets obtained in this way to the changes we would have obtained instead using age profiles of net worth taken from the Survey of Consumer Finances, and found the results to be similar.

ENDNOTES

1. Prior analyses include: World Bank Group (2016) *Global Monitoring Report 2015/2016: Development Goals in an Era of Demographic Change*, Washington, DC: World Bank; National Research Council (2012) *Aging and the Macroeconomy: Long-Term Implications of an Older Population*, Washington, DC: The National Academies Press; Manyika, J., J. Woetzel, R. Dobbs, J. Remes, E. Labaye, and A. Jordan (2015) *Global Growth: Can Productivity Save the Day in an Aging World?* New York: McKinsey Global Institute; Batini, N., T. Callen, and W. McKibbin (2006) "The Global Impact of Demographic Change," IMF Working Paper WP 06/09, International Monetary Fund, Washington, DC; McKibbin, W. J. (2006) "The Global Macroeconomic Consequences of a Demographic Transition," *Asian Economic Papers* 5 (1): 92–134; Tyers, R., and Q. Shi (2007) "Demographic Change and Policy Responses: Implications for the Global Economy." *World Economy* 30 (4): 537–66. Members of the BerkeleyAge team and the UC-Berkeley Center on the Economics and Demography of Aging (Lee, Mason, Donehower, and Auerbach) were centrally involved in the first two of these analyses listed above.

2. NTA methodological details are provided in: Lee, Ronald, and Andrew Mason (2011) *Population aging and the generational economy: A global perspective,* Cheltenham: Edward Elgar; United Nations, Department of Economics and Social Affairs, Population Division (2013) *National Transfer Accounts manual: Measuring and analysing the generational economy.* http://ntaccounts.org/doc/repository/NTA%20manual%202013.pdf. Accessed 3 October 2016.

3. The countries with complete NTA data used for this analysis are: Australia, Austria, Brazil, Cambodia, Chile, China, Colombia, Costa Rica, El Salvador, France, Germany, Hungary, India, Indonesia, Italy, Jamaica, Japan, Republic of Korea, Mexico, Nigeria, Philippines, Senegal, Slovenia, South Africa, Spain, Sweden, Taiwan, Thailand, United Kingdom, United States, and Uruguay.

4. United Nations, Department of Economics and Social Affairs, Population Division (2015) *World population prospects: The 2015 revision*. https://esa.un.org/unpd/wpp/. Accessed 3 October 2016.

5. World Bank (2016) *World Development Indicators*. http://data.worldbank.org/data-catalog/world-development-indicators. Accessed 11 November 2016.

AUTHOR BIOGRAPHIES

(Authorship is shared equally among the following alphabetized authors)

David Baxter, BerkeleyAGE Executive Advisor (Consultant) and CEO of Baxter Consulting Group, has overseen national and global research on demographic trends, generations, and population aging for the past 20 years. He has worked on strategy and marketing implications of aging with leading companies in the financial services, health care, housing, technology, travel, food, and entertainment industries.

Gretchen Donehower, Academic Specialist, UC Berkeley, is a demographer and statistician with Berkeley CEDA. She has been a global coordinator of the National Transfer Accounts project and other CEDA-affiliated research efforts for over 10 years and has been a consultant to projects at the United Nations, the National Academy of Sciences, and other organizations.

William H. Dow, BerkeleyAGE Director and Berkeley Center on the Economics and Demography of Aging (CEDA) Director, holds the Kaiser Permanente Endowed Chair on Health Policy Management at the UC Berkeley School of Public Health. He is also a Research Associate at the National Bureau of Economic Research, and previously served as Senior Economist at the White House Council of Economic Advisers. His research focuses on the economics of global health changes.

Ronald D. Lee, BerkeleyAGE Lead Researcher and CEDA Associate Director, is Edward G. and Nancy S. Jordan Family Professor Emeritus of Economics and Demography. An elected member of the National Academy of Sciences, he co-chaired its recent Committee on the Long-Run Macroeconomic Effects of the Aging U.S. Population.

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About BerkeleyAGE

Established by the Center on the Economics and Demography of Aging (CEDA) at UC Berkeley, directed by Professor William H. Dow, the Berkeley Forum on Aging and the Global Economy (BerkeleyAGE) is dedicated to translating demographic research into usable insights to help corporations, governments, nonprofits, industry groups, and the media understand, predict, and navigate the challenges of a new era of unprecedented population aging. BerkeleyAGE is closely related to the National Transfer Accounts (NTA) project which is under the joint sponsorship of CEDA and the East-West Center. NTA is directed by Ronald Lee and Andrew Mason with the cooperation of teams in over 80 countries around the world and support from numerous funders. In conjunction with leading organizations among both the private and public sectors, BerkeleyAGE will forecast the widespread economic implications of global population aging, and analyze potential strategies and solutions to prepare for an aging world. See BerkeleyAGE.berkeley.edu.