www.journalofindexes.com

Journal of Indexes

SERIOUS IDEAS FOR SERIOUS INVESTORS

the new(er) normal

September / October 2013

A New 'New Normal' In Demography And Economic Growth

A look at some head winds to recovery

By Robert Arnott and Denis Chaves

In this paper, we show that the historically unmatched economic performance experienced by developed countries over the past 60 years was supported by temporary and abnormal demographic conditions: extraordinary growth in the working-age population supporting both a plunging roster of young people as well as a still-modest roster of senior citizens. In other words, we have experienced a *one-off* demographic dividend of massive proportions.

In the first half of the paper, we describe four phases in the role of demography on macroeconomic development. In the second half of the paper, we use the links between economic growth and different age groups estimated in Arnott and Chaves [hereafter, AC/2012] to study the implications of the different demographic phases in terms of economic growth.

Phase I: The Old Steady State

Hobbes' famous quote from "Leviathan" [1651] is too often shortened to its closing words. But the full sentence vividly captures the challenges faced in the first demographic phase of human development:

"In such condition [wherein men live without other security than what their own strength, and their own invention shall furnish them] there is no place for industry, because the fruit thereof is uncertain, and consequently, no culture of the earth, no navigation, nor the use of commodities that may be imported by sea, no commodious building, no instruments of moving and removing such things as require much force, no knowledge of the face of the earth, no account of time, no arts, no letters, no society, and which is worst of all, continual fear and danger of violent death, and the life of man, solitary, poor, nasty, brutish, and short." [1]

Keep in mind that we refer to those times as a steady state, from a distant observer's point of view. Clearly, for someone living through war, disease and all the tragedies of the time, demographic profiles seemed far from stable. Further, it's also important to separate external shocks that created temporary deviations from internal forces—such as medical advances—that fundamentally altered demographic distributions.

While it's hard to imagine in our information-driven society, data on the distribution of populations by age was not precisely recorded and readily available until the 18th century. For instance, according to Bacaër [2011], the city of London published bulletins with baptisms and burials that contained the cause of death—mainly to inform citizens about plague epidemics—but not the age of death. Therefore, when John Graunt published his life table in 1662, it required a great deal of approximation and guesswork to infer the age of death from the cause of death.[2] Even considering the uncertainty in its figures, "the book was nevertheless very successful, with five editions between 1662 and 1676. Several cities in Europe had started to publish bulletins similar to that of London" [Bacaër, 2011, pg. 6].

The first reasonably accurate life table is attributed to Edmond Halley [1693].[3] Halley obtained data—including age of death—for the years 1687–1691 from the city of Breslau (currently Wroclaw in Poland, but then part of the Habsburg Empire) and proceeded to calculate detailed life tables and other important knowledge, such as mortality rates and life expectancies, that could be used for other cities in Europe. Even more impressive were his calculations of varying prices of annuities according to different ages, an innovation that essentially launched the life insurance industry.

Halley's work is particularly important for our purposes because, according to Ciecka [2008], "the Breslau data had the property that annual births were approximately equal to deaths, there was little migration in or out of the city, and age-specific death rates were approximately constant; that is, Breslau had an approximately stationary population." Therefore, it gives us a relatively precise picture of what steady state looked like before the Industrial Revolution.[4]

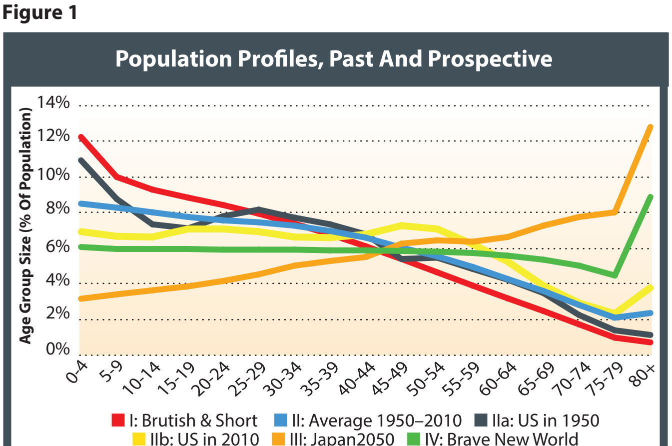
Figure 1 shows a plot of various demographic profiles in five-year age groups, including the one drawn from Halley's life table (his is the red line, which we refer to as "Brutish & Short"). Not surprisingly, mortality rates were much higher than those we're accustomed to today. In particular, infant mortality was so high that we observe a kink in the plot right after age group 0-4.[5] For instance, at birth, life expectancy was only 24 years. Of those who made it to age 1, half made it to age 33. Of those who reached 33, half made it to 59. Half of these died by 71. Half of the rest made it to 77. Half again made it to age 81. And so forth. The biblical "threescore and ten" only applied to those who never got ill or had a serious accident.

For obvious reasons, demographic evolution happened hand in hand with the Industrial Revolution, whose early seeds were sown in the 18th century. To cite only a few of the innovations, Jethro Tull invented the mechanical seed sower, vastly improving agricultural productivity; James Watt developed the first efficient steam engine; Edmund Cartwright built the first power loom; and Eli Whitney invented the cotton gin.

The pace of innovation accelerated in the 19th century, with Robert Fulton's steamboat, Faraday's electric motor, the steam locomotive, photography and the telegraph, in just the first half of the century. In less than a generation, the world was transformed. In 1830, the quickest way to convey a message from one place to another was on horseback; by 1844, less than a generation later, some communication was already taking place at the speed of light.

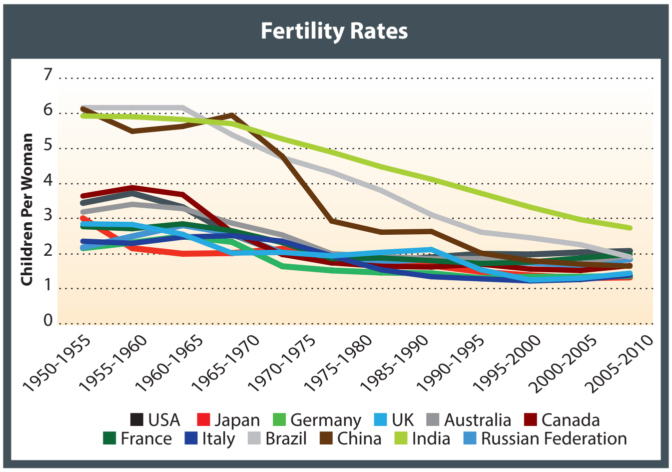
In the second half of the century, we saw the inven-

Figure 1



Source: Research Affiliates, based on data from the United Nations and Bacaër (2011)

Figure 2



Source: Research Affiliates, based on data from the United Nations

tion of the sewing machine (it's easy to underestimate the importance of this apparatus!), the elevator, a cost-effective steel-making process (Henry Bessemer), dynamite (Alfred Nobel), the telephone, the phonograph, the light bulb, the radio and, for the health-conscious, pasteurization (courtesy of Louis Pasteur), the X-ray and aspirin.

Even so, despite two centuries of remarkable innovation, life remained "nasty, brutish, and short." By the beginning of the 20th century, median life expectancy remained less than 50 years throughout the developed world, and mean life expectancy was even a notch shorter.[7] At the same time, fertility rates for women of childbearing age averaged roughly six children or more, all over the world.

This means that the typical family had a half-dozen or more children, many of whom didn't survive to adulthood; and two parents, one working and the other, of necessity, exclusively focused on child-rearing. That's one worker supporting a family of eight. "Dependency ratios" were awful, though there were typically no surviving senior citizens to support. Preoccupied by onerous responsibilities, the average worker was hard-pressed to focus on developing productivity enhancements or technological innovations.

Phases II And III: From Tail Wind (The Calm Before The Storm) To Head Wind

Phases II and III represent temporary periods in the transition from a steady state with very low life expectancies (Phase I) to an unknown future that we represent as a steady state with high life expectancies (Phase IV). Each phase spans multiple generations, with Phase II enjoying a demographic tail wind with light support ratios, and Phase III struggling with abnormally high support ratios. As we show below, both temporary periods are much more complex than a simple and gradual transition in terms of life expectancy.

We start with two of the main drivers of demographic changes: fertility rates and life expectancies. If we can understand the evolution of these two variables, we can better evaluate the magnitude of the demographic forces behind and ahead of us. We focus on countries of the G-8 (Australia, Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) and on the BRICs (Brazil, Russia, India and China), given their importance in both economic and demographic terms. The first group of countries provides a clear example of how fast demographic changes have occurred in the developed world, and what later stages of demographic evolution look like. The second group shows the current and somewhat-diverse demographic state of emerging countries.

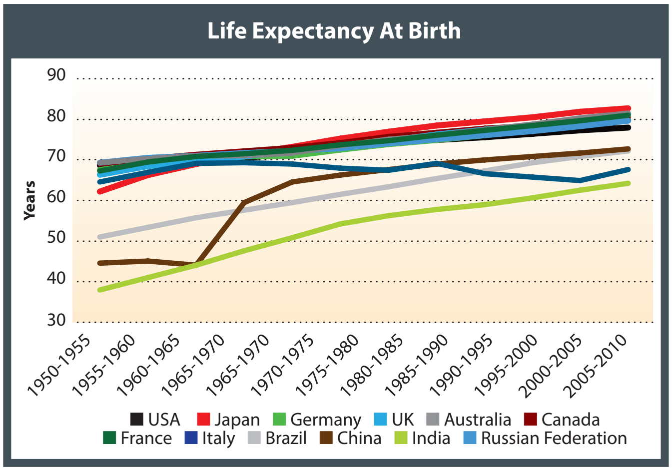
Figure 2 plots the fertility rate, measured as the average number of children per woman, over the last six decades. Two features are striking in this figure. First, it shows a drastic reduction in the number of newborns experienced by Brazil, China and India, which had fertility rates close to six in 1950-1955 but lower than two (Brazil 1.90, and China 1.64) over the last five years (2005-2010). These changes might look extreme, but we should recall that developed countries went through the same process only a few decades earlier.

Second, 11 of the 12 countries in our sample—the exception is India—currently have fertility rates below replacement rates; in some cases, far below. This sets the stage for a shrinking population once the boomers are out of the way, absent any large-scale immigration.[8] In the interest of space, we leave an analysis of these inflection points for a future study. We focus, instead, on demographic profiles, based on age groups as a fraction of total population.

Figure 3 shows the life expectancy at birth over the same time horizon, 1950-2010. We observe a steady and substantial improvement in life expectancies across all countries, with the sole, sorry exception of Russia. Brazil, China and India start the second half of the 20th century with lower life expectancies of 50, 44 and 37, respectively, and are catching up with other more developed countries, but not as fast as birth rates are falling (see Figure 2). Today a baby born in one of the developed countries is expected to reach the age of 80, on average, whereas he or she would be expected to reach the age of 64 in India or age 72 in China and Brazil.

The difference in the speeds of convergence between developed and emerging countries in Figures 2 and 3 merits a few comments. Starting with fertility rates, we note that family size is primarily driven by choice, as socioeconomic situa-

Figure 3



Source: United Nations

Figure 4

Demographic Profiles (1950-2010 Average, 2010 And 2050)

Country	Year	0-19	20-64	65+
Australia	***1950-2010 Average***	***32.6%***	***57.2%***	***10.2%***
	Std. Dev.	*4.5%*	*2.7%*	*2.0%*
	1950	33.4%	58.5%	8.2%
	2010	25.7%	60.8%	13.4%
	2050	23.7%	53.3%	23.1%
Canada	***1950-2010 Average***	***32.8%***	***57.2%***	***10.0%***
	Std. Dev.	*6.9%*	*4.7%*	*2.4%*
	1950	37.5%	54.8%	7.7%
	2010	23.1%	62.8%	14.1%
	2050	21.5%	53.5%	24.9%
France	***1950-2010 Average***	***29.3%***	***57.0%***	***13.7%***
	Std. Dev.	*3.3%*	*1.9%*	*1.9%*
	1950	30.2%	58.4%	11.4%
	2010	24.3%	58.9%	16.8%
	2050	23.3%	51.7%	24.9%
Germany	***1950-2010 Average***	***25.5%***	***60.0%***	***14.6%***
	Std. Dev.	*4.3%*	*2.4%*	*3.1%*
	1950	30.4%	59.9%	9.7%
	2010	18.6%	61.1%	20.4%
	2050	19.4%	49.8%	30.9%
Italy	***1950-2010 Average***	***27.5%***	***58.9%***	***13.6%***
	Std. Dev.	*6.1%*	*2.2%*	*4.1%*
	1950	35.4%	56.5%	8.1%
	2010	18.9%	60.7%	20.4%
	2050	19.0%	48.3%	32.7%
Japan	***1950-2010 Average***	***30.5%***	***58.5%***	***11.0%***
	Std. Dev.	*9.1%*	*4.3%*	*5.9%*
	1950	45.7%	49.4%	4.9%
	2010	18.1%	59.2%	22.7%
	2050	17.9%	46.6%	35.6%

Country	Year	0-19	20-64	65+
United Kingdom	***1950-2010 Average***	***27.9%***	***58.0%***	***14.1%***
	Std. Dev.	*2.7%*	*1.7%*	*2.0%*
	1950	28.8%	60.4%	10.8%
	2010	23.7%	59.7%	16.6%
	2050	22.9%	53.5%	23.6%
United States	***1950-2010 Average***	***32.5%***	***56.6%***	***10.9%***
	Std. Dev.	*4.4%*	*3.0%*	*1.7%*
	1950	34.1%	57.6%	8.3%
	2010	27.1%	59.9%	13.1%
	2050	25.0%	53.8%	21.2%
Brazil	***1950-2010 Average***	***46.8%***	***48.8%***	***4.3%***
	Std. Dev.	*6.6%*	*5.4%*	*1.3%*
	1950	51.6%	45.5%	3.0%
	2010	33.9%	59.1%	7.0%
	2050	20.0%	57.5%	22.5%
China	***1950-2010 Average***	***41.6%***	***52.9%***	***5.5%***
	Std. Dev.	*7.7%*	*6.3%*	*1.5%*
	1950	43.7%	51.8%	4.5%
	2010	27.3%	64.5%	8.2%
	2050	18.2%	56.3%	25.6%
India	***1950-2010 Average***	***47.8%***	***48.5%***	***3.7%***
	Std. Dev.	*3.3%*	*2.8%*	*0.6%*
	1950	47.7%	49.2%	3.1%
	2010	40.4%	54.7%	4.9%
	2050	25.7%	60.8%	13.5%
Russian Federation	***1950-2010 Average***	***31.4%***	***59.2%***	***9.5%***
	Std. Dev.	*5.7%*	*3.2%*	*2.7%*
	1950	38.6%	55.3%	6.2%
	2010	20.8%	66.4%	12.8%
	2050	22.2%	54.7%	23.1%

Source: Research Affiliates, based on data from the United Nations

tions change over time. The impact of plunging birth rates on support (or dependency) ratios is felt very quickly, as a rapid drop in fertility ratios immediately affects the number of children. Fast-rising life expectancy, on the other hand, takes decades to affect our support ratios, for the obvious reason that it takes decades for a child to become a senior citizen.

Medical advances are the most important contributor to the sharp increases in longevity we have seen over the last century. These changes impact our support ratios at a slow pace, as more and more people survive to become senior citizens. On the other hand, medical advances have a modest effect on child-support ratios: Infant mortality in developed countries was already at very low levels a half-century ago, and fertility treatments still have limited applications.[9]

Let's go back to Figure 1 and take a look at the 1950 U.S. population profile (Phase IIa, the dark gray line). We can clearly see a high fraction of children aged 0-4—in fact, almost as high as Halley's profile—followed by a sharp drop (a local valley) between the ages of 5 and 19, as a consequence of the Great Depression and World War II. Consequently, in the decades after 1950, the United States received a generous demographic dividend: The baby boomers—and later their children—entered the work force with little need to provide for previous generations and little competition for jobs from older age groups.

To see this strong tail wind at work, the 2010 U.S. profile (Phase IIb, the yellow line) shows that we have fewer children and fewer young adults (as a share of the overall population) than we did in 1950; and we have more mature adults and more senior citizens than in 1950 (or ever before, for that matter). Indeed, for people age up to 54, this demographic profile looks an awful lot like a steady state: There's about 7 percent of the population in *each* of these 11 age cohorts.

In the coming decades, the still-low fraction of senior citizens aged 65 and above will swell. The baby boomers born right after 1945 are just reaching retirement age, which will put strong upward pressure on support ratios in the next two or three decades. Just imagine the 2010 curve moving to the right with the passage of time. First, the baby-boom bump boosts the senior citizen roster. Then, three decades later, the echo of the baby boom (the smaller bump from age 15-30) boosts the roster of senior citizens a bit further. In the second half of the paper, we show that the past strong tail wind becomes a comparable head wind—for some countries, like Japan, a *severe* head wind—over the coming decades. This next transitory period (Phase III) will likely impose a "demographic tax" before we can reach a new steady state.

The green line in Figure 1 shows the steady-state profile that applies for a population with life expectancy of 80 years. On our current trajectory, once fertility rates return to replacement levels, this is our eventual demographic profile. In the interim, if birth rates remain low, we go through a phase in which senior citizen support ratios soar. The orange line in Figure 1 shows the projected profile for Japan in the United Nations database. Our own Phase III should be considerably less extreme, but this shows what happens when birth rates fall far below replacement levels and remain there. Of the 12 countries in our study, half (Canada, China, Germany, Italy, Japan and Russia) have fertility ratios below 1.6; absent immigration on a large scale, the Japan scenario will be visited on all six nations in the coming century.

What about other countries? Figure 4 shows a summary of their demographic changes over the last 60 years represented by three distinct age groups: children (0-19); working-age adults (20-64); and senior citizens (65+). The first and second rows report the average and standard deviation of each age group size, measured as fractions of the total population, from 1950 through 2010. Each country has its own idiosyncrasies, but shared patterns are clear. These numbers serve as an important reference point, against which we can compare past (1950), current (2010) and future (2050) values.

With tumbling fertility rates, the fraction of children in the population decreases in 2010 and 2050, when compared with historical averages. On average over the past 60 years, children comprised 25-33 percent of developed countries' populations and 41-48 percent of emerging countries' populations (excluding Russia, where the demographic profiles more resemble developed economies, even if their life expectancy does not). In 2010, these fractions range from 18-27 percent in developed countries and from 27-40 percent in emerging countries (again, excepting Russia). In 2050, they decrease further, to an average of 21.6 percent in developed countries, *and the same in emerging countries.*

Among senior citizens, we observe the opposite effect. As life expectancies have increased over the last century—and will likely continue to increase in the coming decades—the fractions of senior citizens in the populations soared. Their averages from 1950-2010 are roughly 10-15 percent in developed countries and Russia, and a scant 4-5 percent in the remaining emerging countries; by 2010, they ranged between 13-23 percent in the developed countries plus Russia, and between 5-8 percent in emerging countries. Continuing the trend, in 2050, these numbers jump to 21-36 percent and 14-25 percent in developed and emerging countries, respectively. Note that the demographic profiles in emerging countries in 2050 will be very similar to those of the developed world today.

To get a hint of how severely out-of-sample these numbers are, notice in Figure 4 that the fraction of senior citizens in the United States in 2050 will be more than six standard deviations away from its 1950-2010 historical average ([21.2 percent-10.9 percent]/1.7 percent). Other countries will experience a similar magnitude of transition in future years; in some cases, more extreme.

The most interesting effects occur in the working-age populations, which we define as spanning the age group 20-64. We see an increase in most countries' factions of working-age adults when comparing 2010 with both 1950 and the historical averages (1950-2010). By 2050, the trends revert and the fractions start to decline. India and Brazil are the only two exceptions because their fractions continue to rise after 2010, but China and Russia show the same pattern as developed countries. In some cases, these changes from 2010 to 2050 are impressive; the fraction goes from 63 to 53 percent in Canada, from 59 to 46 percent in Japan, from 61 to 48 percent in Italy, and from 61 to 50 percent in Germany.

This erosion in the work force, as a share of the population, is exactly Japan's circumstance today, and for at least the next three decades, regardless of what happens to fertility rates in the interim. Even if Japan's fertility rate were to soar past replacement rates tomorrow, births today are not part of the work force for roughly another 20 years; so the profile of seniors, relative to the working-age population, is more or less preordained for the coming 20 to 40 years. Western Europe faces a like circumstance, albeit a bit less daunting than Japan's.

For those readers who currently think that the demographic head winds that we're already seeing in Japan and Europe won't get much worse, we borrow an expression from vaudeville: "You ain't seen nothin' yet." At some future date, however, births must approximately match deaths.[10] This stage is likely to be reached—globally—around the middle of this century. Especially for countries that experience fertility rates below the replacement level of 2.1 children per woman, Phase III will be a daunting transition to the new steady state.

Phase IV: The New Steady State

The objective of this section is not to provide accurate forecasts of long-term demographic profiles; that's a quixotic task. Instead, we hope that this exercise provides a reference point against which one can compare the previous phases. Further, our claims that Phases II and III are temporary might seem too abstract if we don't offer a long-term endpoint, even if it's speculative and surrounded by uncertainty.

Estimating steady-state demographic profiles is not an easy task, because one needs to estimate future age-specific mortality rates and then simulate the size of the different age groups. Fortunately for us, the United Nations has on its Web page a series of model life tables for different life expectancies.[11] These tables "are commonly used to derive a variety of mortality indicators and as underlying mortality patterns for estimation and projection by the United Nations and the demographic research community at large." Thus, using data from the table denominated "Survivors to exact ages by sex, model life, and level of life expectancy," we construct hypothetical demographic profiles for different life expectancies.

Figure 5 reports the United Nations projections for life expectancy in 2045-2050 and 2095-2100. By 2050, most developed countries will have a life expectancy close to 85! Brazil and China are catching up quickly and are expected to reach 79 years. By the end of the century, the United Nations expects another jump: 90 years for developed countries and 85 for China and Brazil. Of course, all of this is conjecture; but the trends of the past century would certainly support these expectations, if not more.

Going back to Figure 1, the solid green line ("Brave New World") shows an example of a steady-state demographic profile for a life expectancy of 80 years—roughly the current one in the United States.[12] This curve is remarkably flat on the left-hand side of the graph and starts to decline only at age 50 or 60. Over the last 60 years, the roster of young people under age 20 averaged 32 percent of the population (see Figure 4). That plunges to 24 percent in the steady-state age profile. The roster of senior citizens (65-plus) averaged 10.9 percent of the population. This more than doubles to 23.7 percent. If life expectancy ratchets up to 90 or more, these changes only become more pronounced.

Figure 5

Life Expectancy Forecasts, G-8 And BRIC Countries

Country	2045-2050	2095-2100
Australia	86.0	91.0
Canada	85.0	90.1
France	85.8	90.8
Germany	84.9	90.0
Italy	85.7	90.6
Japan	87.4	92.3
United Kingdom	84.3	89.4
United States	83.0	88.2
Brazil	79.4	84.0
China	79.1	84.2
India	73.7	79.5
Russian Federation	75.5	81.8

Source: United Nations

Figure 6

Steady-State Population Distribution, At Life Expectancies From 75-90

	Life Expectancy			
Age Group	75	80	85	90
0-19	25.9%	24.6%	23.3%	22.1%
20-64	55.7%	53.8%	51.6%	49.3%
65+	18.4%	21.7%	25.2%	28.6%

Source: Research Affiliates, based on data from the United Nations

To get an idea about stable profiles at other life expectancies, Figure 6 shows a summary of steady-state distributions for four common values: 75, 80, 85 and 90 years. The fraction of individuals aged 65-plus increases quickly as life expectancies go up, while the other two age groups (0-19 and 20-64) decrease accordingly.[13]

Suppose we compare these hypothetical steady-state distributions with actual distributions from countries that currently have very similar life expectancies. The best examples are Canada, France, Germany and the United Kingdom, whose life expectancies in 2005-2010 are within one year of 80. Figure 4 shows that the current fraction of individuals in age group 20-64 is roughly 58 percent, well above the expected value of 53.8 percent for a life expectancy of 80 years. The other two age groups, 0-19 and 65-plus, are currently below their expected values of 24.6 and 21.7 percent, respectively. Note that current demographic profiles have relatively lower support ratios than steady-states ones. The steady-state involves higher support ratios than today's demographic profiles. Before we reach a new steady state, as we have shown above, during Phase III we will experience strong head winds that are worse than the eventual steady state.

We hope that this summary of past and future demographic phases clearly suggests that demography is driving many of the drastic changes in the economic profile of developed and emerging countries, and that these changes are poised to accelerate in the coming years. We now turn our attention to the impact that demography may be expected to have on economic growth.

Implications For The Economy

Our previous discussion about the four phases of demographic development invites a few important questions:

1. How much of a *tail wind* did we enjoy during Phase II?
2. How much of a *head wind* can we expect during Phase III?
3. Assuming that a (Phase IV) steady state will eventually be reached, what can we expect in terms of economic growth?

In answering these three questions, we end up magnifying one troubling attribute of our earlier work: With the sharp increase in the roster of senior citizens in steady state, the implied real GDP growth derived from the relationships in AC/2012 is actually negative if life expectancy rises beyond current levels. This is not plausible: Steady state, even with no technological innovations that boost future productivity would, of necessity, be a world of zero real GDP growth, not negative growth.

This result is less disturbing than it seems, however, when we realize that our previous work was built on a foundation of data drawn from 1950-2010, a period of remarkably benign demography. Moreover, steady state is quite radically out-of-sample, so we are no longer interpolating within past data; instead, we are *extrapolating* to estimate the results in profoundly different circumstances. Tacitly, we are also assuming that a series of socioeconomic circumstances remain the same, even with fast-rising longevity: The retirement age doesn't change, employment policies and resulting productivity don't change, entitlement programs don't change, and so forth. So, the final question we try to answer is the following one:

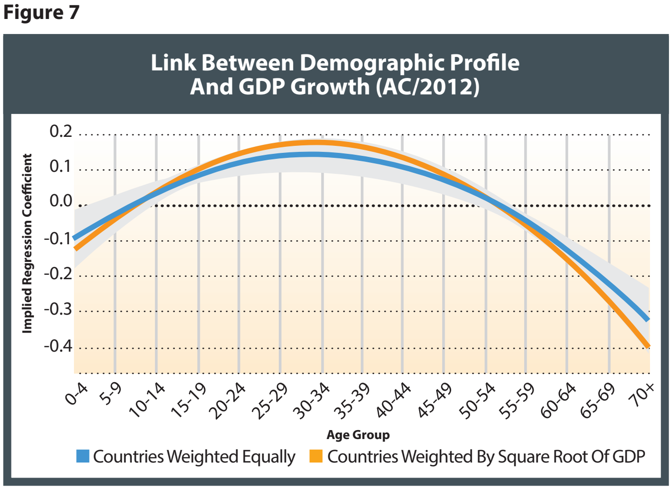
4. Given that these data implausibly point to negative real per capita GDP growth with any steady-state population, if there's any increase in life expectancy at all, what do we make of these findings?

What Are We Measuring And What Is Our Method?

Our measure of interest is growth in real per capita GDP, following AC/2012. We normalize total GDP by the size of the population, which allows us to remove the effects of total population growth and to focus on the structure of the population. After all, if GDP grows no faster than the population, then for the average citizen, that's no growth at all! Real *per capita* GDP (RPC GDP) is also a more interesting measure of prosperity than simple GDP, because it is an approximate measure of productivity, or output per person (or, reciprocally, consumption of goods and services, per person).

Our strategy is to forecast potential (past or future) growth in RPC GDP, by combining the rich data set of (past and future) demographic profiles published by the United Nations with the relationship between demographic changes and economic growth that we estimated in the AC/2012 study. In that study, we used 60 years of historical data for 22 countries to estimate a joint regression of growth in RPC GDP on each age group.[14] The result of that estimation is reproduced in Figure 7, which shows the effects of the size of each age group, as a share of the total population, on economic growth; a second regression (not shown) derives the RPC GDP impact of changes in the size of each age group. In this paper, we are agnostic to which curve better represents the relationship between demography and economic growth. For this reason, and in the interest of space, we report only the average of the two sets of forecasts.

Figure 7



Source: Arnott and Chaves (2012)
Note: Shaded area around trend lines represents 95% confidence interval.

Our results show that children have a slightly negative effect on economic growth, but young adults start to positively contribute as they join the work force. Skeptics might argue that wages and productivity peak later in life, typically in one's 40s and 50s. This is generally true, and helps to explain why the most prosperous nations often have a larger proportion of mature adults than the less prosperous nations. However, the definition of a peak, whether for productivity or anything else, is that we stop rising and start falling. When we reach peak productivity, our growth in our productivity is zero! It's the young adults, in their 20s and 30s, who have the most rapid rate of change in their productivity. One might say that mature adults are terrific for GDP, but not for GDP growth, and that young adults are terrific for GDP growth, but less so for GDP.

The average contribution to GDP growth becomes negative between 55 and 60. Again, this does not mean that people begin to consume more GDP than they produce after age 55, only that—on average—mature workers above age 55 have passed their peak in productivity. One can readily infer from this graph that the average 60-year-old is more productive than the average 40-year-old, but not so relative to the average 55-year-old. At ages 60 and above, the coefficients decline much more sharply: The mature worker exhibits falling productivity, but in retiring, a worker's productivity simply falls off a cliff!

Measuring The Phase II Tail Wind

To estimate the strength of the tail winds experienced over the last 60 years in developed markets, we use a relatively simple strategy. We compare the historical growth implied by the actual demographic profile with the growth implied by a *steady-state* demographic profile with exactly the same life expectancy. For instance, the 1960 U.S. life expectancy was very close to 70 years, so we compare (a) the growth implied by the actual 1960 U.S. demographic profile with (b) the growth implied by a hypothetical steady-state demographic profile that corresponds to a life expectancy of 70 years. This approach allows us to measure how much weaker (or stronger) a country's growth in RPC GDP might have been if it had not experienced a demographic dividend.

In Figure 8, we show the average difference between actual and life-expectancy-equivalent forecasts over the entire time period 1950-2010. Not surprisingly, all countries experienced significantly higher growth than they would have without the demographic dividend. France, Germany, Italy and the United Kingdom—countries that were older countries in 1950—experienced the lowest average demographic tail winds: RPC GDP growth was roughly 1 percent per year faster than would have been likely with a steady-state demographic

Figure 8

Average Estimates for the Phase II Tailwind

Relative Real Per Capita GDP, Comparing Actual Demography vs. Steady State at the Same Life Life Expectancy, G-8 and BRIC Countries, 1950-2010

Country	Average Forecast 1950-2010
Australia	-1.9%
Canada	-2.0%
France	-1.1%
Germany	-0.9%
Italy	-1.1%
Japan	-1.6%
United Kingdom	-1.0%
United States	-1.6%
Brazil	-1.8%
China	-1.8%
India	-1.3%
Russian Federation	-1.4%

Sources: Research Affiliates, based on data from the United Nations, Penn World Table and Global Financial Data

profile. All other countries—relatively young in 1950, and aging fast during those six decades, but with temporarily mild support ratios—experienced the highest average tail wind, with a 1.3 to 2.0 percent demographic boost, relative to steady state at the same average life expectancy.

The summary of these numbers is simple: The benign demography of the past six decades, with few children *and* few seniors to support, contributed 1-2 percent annually to GDP growth in the developed world during that span. *Given that RPC GDP growth was barely faster than this, do we believe these results?* Directionally, yes. In magnitude, no.[15]

First, keep in mind that the coefficients used to make these forecasts (see Figure 7) have some uncertainty about them. Second, even though our steady-state demographic profiles have the same life expectancies observed in each country at the time, they represent decidedly out-of-sample conditions. Third, because these coefficients were obtained as an average response across 22 countries, the forecasts for countries with outlier demographic profiles might be less accurate. Fourth, it is hard to imagine a world with vastly more senior citizens and vastly fewer young adults in which employment and retirement policies, entitlement programs and so forth, would be unaltered.

Regardless of all these points, the forecasted trends leave little room for doubt: All countries enjoyed a significant boost in growth due to benign demographic conditions. The implications are clear: Real GDP growth of 3 percent was the "old abnormal"; it is not, and never was, "normal."

'Forecasting' The Phase III Head Winds

Making forecasts for Phases III and IV is undoubtedly the most challenging part of our exercise; hence, the quotation marks in the above section subhead, for a very simple reason: The demographic profiles in the coming decades are unlike anything the world has seen before. Consider, for instance, the estimated GDP impact associated with a rise in the fraction of age group 65-plus. As we can see in Figure 7, its link with GDP growth is roughly negative 0.3, implying that every 1 percent increase in the size of this age group, relative to historical norms, should reduce growth in RPC GDP by almost 0.3 percent per year (holding everything else constant). Taking Japan as an example, its fraction of 65-plus citizens is expected to grow from an average of 11 percent of the population between 1950 and 2010 to 36 percent by 2050. Therefore, our "demographic shares" model would suggest that the growth in this age group alone should cut Japan's RPC GDP growth by about 7.5 percentage points ([36 percent–11 percent]×0.3) from its historical norm. Of course, the "demographic changes" model presents a far more benign picture, very nearly cutting this figure in half. Even so, despite robust growth in the last six decades, subtracting 4 percentage points from that growth, as Figure 9 would suggest, would mean a protracted period of sharp contraction. Possible? Perhaps. Plausible? Not really.

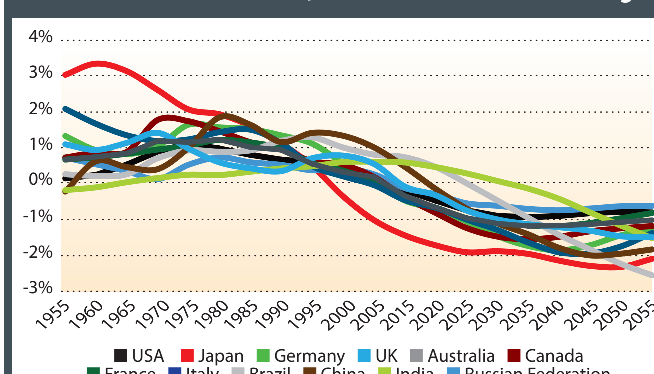
There is no reason to expect that future per capita real GDP declines should ever exceed the shrinkage in the fraction of the working-age population, *ceteris paribus*. For Japan, that decline is from 59.2 percent in 2010 to 46.6 percent in 2050, or 21.3 percent ([59.2–46.6]/59.2–1). Spread over 40 years, that amounts to 0.5 percent per year. In our view, that's the floor; the worst-plausible erosion in RPC GDP. Even this worst-case scenario does not allow for the benefits of future technological innovations.

In Figure 9, we apply the coefficients from Figure 7 into forecasts for economic growth, in order to assess the possible magnitude of head winds during Phase III. We also show the in-sample (1950-2010) estimates, for comparison purposes, and then normalize each country by its average demographic profiles over the full sample period (1950-2050). A few important conclusions can be drawn from this graph:

- The most pronounced effects are visible in Japan. The Japanese "economic miracle" of the 1960s to the 1980s got a huge boost from demography. Confirming the evidence in

Figure 9

Abnormal GDP Growth, Attributable To Demographics, For G-8 And BRIC Countries, Relative To 1950-2050 Averages



Source: Research Affiliates, based on data from the United Nations, Penn World Table and Global Financial Data

Figure 8, Figure 9 suggests that their demographic dividend may have peaked at roughly 3 percent per year, relative to the average demographic profile of the full century from 1950 to 2050. Now the youngsters of the late 1940s and early 1950s are approaching retirement, and the baby bust from about 1980 onward is delivering an ever-smaller roster of new entries into the labor force. With comparatively few young workers to replace retiring boomers, Japan's prospective demographic head wind may be more than 2 percent per year. Even if changes in policies and entitlements can cut these figures in half, it's a daunting head wind.

• All 12 countries will experience varying levels of demographic head winds in the coming decades, first in the developed economies, then in the older emerging economies (China and Russia) and then finally in the younger emerging economies (Brazil and India). These head winds get stronger over time and seem to level off in the developed world and the older emerging economies only after 2040. For the younger emerging economies, the demographic head winds do not become severe until perhaps 20-30 years hence.

• All 12 countries enjoyed demographic tail winds during the last 60 years, so these head winds will feel worse than they are. Human nature conditions us to consider our past experience to have been "normal," so we benchmark subsequent events against this self-referential "norm." If the people of Japan consider this past tail wind of 2-3 percent to be "normal," then a future 2 percent head wind will feel like a crushing 4-5 percent hit, relative to expectations. The average country in this analysis enjoyed benign demographic profiles that boosted GDP growth by around 1 percent per year during much of the past six decades.

• The first few decades of the sample were particularly beneficial to developed countries. China and Brazil seem to have experienced their peak demographic dividend recently. That said, a 2 percent erosion in high-single-digit growth is hardly a pessimistic forecast. Meanwhile, India will continue to enjoy a demography-fueled tail wind over the next decade or two.

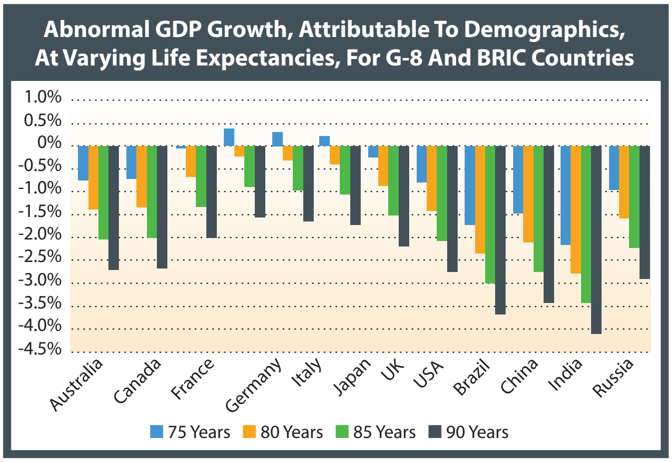
• All of these figures are measured relative to the 100-year norms from 1950 to 2050. For the emerging economies, beginning in poverty and emerging to relative prosperity, a drop from a 1 percent tail wind to a 2 percent head wind may merely represent a transition from robust growth to moderate growth, though it will still dismay the citizenry.[16]

'Forecasting' Steady-State (Phase IV) Growth

Before diving into the results, recall that the generic demographic profiles in Figure 6 are, by construction, not country-specific. As a consequence, any differences in forecasts across countries will be caused by differences in historical demographic profiles (i.e., whether recent decades were more or less favorable when compared with other countries).

Figure 10 shows the results for the same four hypothetical life expectancies discussed before: 75, 80, 85 and 90 years. The implications for future steady-state economic growth are sobering. The forecasts are reported relative to each country's 1950-2050 norms, to make them comparable with Figure 9, and useful as trend indicators. Obviously, if a country currently has a life expectancy of 80, it doesn't make much sense to

Figure 10



Sources: Research Affiliates, based on data from the United Nations, Penn World Table and Global Financial Data

look at forecasts for a life expectancy of 75, but these numbers help us understand some of the forces behind them.

Starting with a comparison across the four life expectancies for each country, it is not surprising that older-age profiles result in weaker growth. A longer life expectancy means a larger cohort of retirees, consuming goods and services that they no longer produce. Comparing across countries, the main finding is that we see strongly negative (and arguably implausible) forecasts of 2 to 4 percent for ages 80-90, which the United Nations projects as the most common life expectancies at the end of the century (see Figure 5).

Silver Linings

Our main goal in presenting these results is to correct the common misconception that developed countries went through a "normal" period of high growth, as if we are entitled to growing prosperity. A more realistic view is that the favorable demographic dividends of the last few decades were atypical, temporary and are now losing steam. Either way, the coming decades are going to be very different from the recent past, in terms of demography and, if our results are correct, economic growth.

Conclusion

Past is not prologue. The developed world has enjoyed several decades of benign demographic conditions. The population of children tumbled, leading to less distraction for their parents, at a time when: (1) the work force was dominated by young adults, honing their skills and rapidly ramping up their productivity; and (2) the roster of senior citizens was small, drawing only modestly on the GDP produced by the mostly young work force. Human nature conditions us to extrapolate from our own experience. So, we think of this demographic dividend as "normal."

The developed world is entering a new phase in which the low fertility rates of past decades lead to slow growth (or, in many countries, no growth) in the young adult population, which is the dominant engine for GDP growth. Meanwhile, the large rosters of mature adults, many of whom are at or near their peak productivity, are poised to retire, creating an impressive surge in the rolls of senior citizens. These newly minted senior citizens, transitioning from near-peak productivity to retirement in a single step, will be drawing on the economy while no longer producing goods and services. The unequivocal good news of a steady rise in life expectancy means that these retirees will create a very substantial drag on GDP growth.

Some generations hence, we'll reach a new steady state, in which births equal deaths, with a far larger retirement roster than we have today (but likely smaller than we'll see in the coming 20-30 years). When we extrapolate from our 2012 research into these radically different demographic profiles, we find that this transition and the eventual steady state may be characterized by negligible (and perhaps negative) real per capita GDP growth. This odd result is a direct consequence of extrapolating from in-sample data spanning 22 countries over the last 60 years, to predict radically out-of-sample circumstances, with higher senior-citizen support ratios than the world has ever seen. These results are likely directionally correct, though the magnitude is dubious. A safe takeaway is that we should adjust our expectations to this "new normal," with materially slower GDP growth than we've enjoyed during the past 60 years.

The danger is not in the slower growth. Slow growth is not a bad thing; it's still growth. The danger is in an expectations gap, in which slower growth is believed to be unacceptable. If we expect our policy elite to deliver implausible growth, in an environment in which a demographic tail wind has become a demographic head wind, if we resist the necessary policy changes that can moderate these head winds, we risk magnifying their impact.

This is an abridged version of the original article. The full article can be found at http://www.indexuniverse.com/publications/journalofindexes.html

Endnotes

1 Hobbes, Leviathan, XIII.9. We took the liberty of converting the passage to modern spelling and punctuation.

2 Graunt's book, "Natural and Political Observations Made upon the Bills of Mortality," is considered a seminal work in both demography and statistic. Bacaër (2011) reports, however, that there's still some uncertainty today about who actually wrote the book, Graunt or William Petty, one of the founders of the Royal Society and his personal friend.

3 Halley's article is titled "An Estimate of the Degrees of the Mortality of Mankind, Drawn from Curious Tables of the Births and Funerals at the City of Breslaw, with an Attempt to Ascertain the Price of Annuities upon Lives" and was published in the "Philosophical Transactions of the Royal Society."

4 The population of some places like London might not be considered stationary, given the intensive migration in and out of the city, but that of larger areas and the world in particular were essentially at a steady state.

5 Indeed, throughout much of Europe at the time, naming a child was a special event, typically held on the first birthday.

6 Halley himself won the actuarial lottery of the 17th century, reaching age 85. His own tables gave him a 1.4 percent chance of living so long.

7 In Halley's statistics, half of all 4-year-olds lived to a median life span of 47 years, or another 43 years; they had survived the dangers of the first four years. But the *average* remaining span was shorter, at 40 years. The paradox is resolved when we realize that those who died before age 47 often died long before that age (on average, at age 26), while those who lasted to age 47 didn't last long (another 18 years).

8 At the risk of being provocative, we might observe that the sharpest drop in fertility in the developed world occurred in the decade from 1965-1975, matching the widespread availability of "the pill." We would note that those who can choose *not* to have children often make exactly that choice; even among those who choose to have children, it's no longer common to have three or more. If parents who want children have two, and parents who do not want children have none, then the fertility rate will be well under two. We strongly support reproductive freedom, the freedom to choose the size of our own families. Even those who disagree with this view can never stuff this genie back into the bottle. *To state an uncomfortable truth: There will be no transition to Phase IV unless the choice to have two or more children comes back into vogue at some stage!*

9 One could speculate about a future when fertility techniques might be a game changer in terms of increasing birth rates, but such a scenario is still part of science fiction books or movies. Our description of the Phase IV demographic profile as a "Brave New World" [Huxley, 1932] was no accident.

10 Consider 1 percent permanent population growth. Ignore the problems of feeding, waste management, heat dissipation and so forth. If each person requires 2 cubic meters of space, the human population would eventually constitute a ball of humanity many light years across. At 1 percent population growth, this would require just under 11,000 years.

11 http://esa.un.org/unpd/wpp/Model-Life-Tables/download-page.html.

12 Keep in mind that this profile is a generic one that could represent most countries with the same life expectancy and hence is not U.S. specific.

13 Of course, the threshold of 65 for senior citizens will come under intense pressure, as a diminishing roster of working-age people supports a soaring roster of seniors. This will become especially acute given the steady improvements in the health of senior citizens throughout the developed (and emerging) world. The work force will be supporting people who are entirely capable of continuing to work. Perhaps future research will deliver more compelling results with a longevity-dependent retirement age. As the saying goes, "70 is the new 50"!

14 Given the statistical challenge in using all the information from the numerous and highly correlated independent variables—age groups—in a regression setting, we borrowed from the methodology developed by Fair and Dominguez [1991] and Higgins [1998], to fit a polynomial across the regression coefficients of all age groups, thereby reducing the parameters in the model and extracting (much) higher statistical significance.

15 It's interesting to note that AC/2012 measured the impact of demography on RPC GDP growth in two ways, based on "demographic shares" (the size of each five-year age cohort, as a percentage of the overall population) and "demographic changes" (the five-year rate of change in the demographic shares). We do not show the graph for the linkage between "demographic changes" and RPC GDP; it's fair to say that it looks like a near-twin of Figure 7. These two approaches provide radically different results in both estimating the magnitude of the tail wind during Phase II, and the head wind we're likely to face in Phase III. Demographic shares would suggest a huge Phase II tail wind and a huge Phase III head wind; demographic changes would suggest much more benign tail wind and head wind. Of course, steady state has demographic changes pegged at zero, by definition. Comparing zero change with the actual demographic experience (moderate, steady change toward more seniors and fewer young people) will seem benign, while comparing Phase IV on Figure 1 with Phase II will seem very daunting. Because the reality is likely to be between these two outcomes, we present the average of the two "forecasts," with an array of obvious caveats.

16 It's interesting to note that the term "emerging markets" was coined in the early 1980s, to make "third world" investing more palatable. The term has become entirely descriptive in the past 20 years, as these economies have truly emerged from pervasive squalor to exhibit a blend of entrepreneurial energy, self-reliance and a burgeoning middle class.

References

See the online version of the paper for the complete list of references.