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Population Aging and Economic Growth

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Abstract

Between 2000 and 2050, the share of the population aged 60 and over is projected to increase in every country in the world; the same is true for the 80+ population in all but one country (Mali). Worldwide, the largest absolute increases are yet to come.

Although labor force participation rates are projected to decline from 2000 to 2040 in most countries, due mainly to changes in their age distributions, labor-force-to-population ratios will actually increase in most countries. This is because low fertility will cause lower youth dependency that is more than enough to offset the skewing of adults toward the older ages at which labor force participation is lower. The increase in labor-force-to-population ratios will be further magnified by increases in age-specific rates of female labor force participation associated with fertility declines. These factors suggest that economic growth will continue apace, notwithstanding the phenomenon of population aging.

For the OECD countries, the declines projected to occur in both labor force participation and labor-force-to-population ratios suggest modest declines in the pace of economic growth. But even these effects can be mitigated by behavioral responses to population aging – in the form of higher savings for retirement, greater labor force participation, and increased immigration from labor-surplus to labor-deficit countries. Countries that can facilitate such changes may be able to limit the adverse consequences of population aging. When seen through the lens of several mitigating considerations, there is reason to think that population aging in developed countries may have less effect than some have predicted. In addition, policy responses related to retirement incentives, pension funding methods, investments in health care of the elderly, and immigration can further ameliorate the effect of population aging on economic growth.

Population Aging and Economic Growth

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I. Introduction

The world is entering substantially uncharted waters in terms of the size of its elderly populations. Recent declines in fertility rates and increases in life expectancy, combined with the dynamic evolution of past variations in birth and death rates are producing a significant shift in the global age structure. The number of people over the age of 60 is expected to reach 1 billion by 2020 and almost 2 billion by 2050 (representing 22 percent of the world's population). The proportion of individuals aged 80 or over (the so-called "oldest old") is projected to rise from 1 percent to 4 percent of the global population by 2050.¹

There is also mounting evidence that the elderly are healthier than before. In a phenomenon referred to by demographers and health specialists as the "compression of morbidity", the length of healthy old-age appears to be increasing. Part of this increase is due to increases in the length of life, and part to even greater increases in the length of life free of chronic illness. The net effect is a decline in the lifetime burden of illness (as measured in years unwell).

Since different age groups have different economic needs and productive capacities, a country's economic characteristics may be expected to change as its population ages. A standard approach to assessing these changes is to assume constant age-specific behavior with respect to earnings, employment, and savings, and to assess the implications of changes in the relative size of different age groups for these fundamental contributors to national income. However, the simple application of this approach is likely to be misleading. Behavior changes induced by changing expectations about the life cycle and by predictable demographic shifts are likely to influence the economic consequences of aging. For example, individuals' expectation of living longer than previous generations may induce them to remain in work for longer and to begin to draw down savings at a later age. In addition, the links between population aging and macroeconomic performance are mediated by the institutional context (for example, retirement policy, pension and health care finance, the efficiency of labor and capital markets, and the structure of regional and global economic systems). The policy environment may itself be influenced by population aging, depending on the voting and other political behavior of an aging electorate whose needs and interests may differ from those of younger people.

This paper examines the effects of population aging on economic growth. It begins by presenting and analyzing descriptive statistics on the extent and pace of population aging. The paper then explores the overall effect of population aging on economic growth as well as the effects operating via two main channels through which growth can occur: labor supply and capital accumulation. Accounting effects of population aging on factor accumulation and economic growth are distinguished from behavioral effects. The final section highlights the important role played by the policy and institutional environment in mediating the economic growth effects of

¹ The United Nations makes several separate forecasts of population size, including ones based on low-, medium-, and high-fertility assumptions. This paper uses the UN's medium-fertility scenario except where otherwise stated.

population aging. This section also discusses a variety of demographic, behavioral, and policy forces pertinent to understanding and guiding the effect of population aging on economic growth.

II. Population Aging: Facts, Force, and Future

In this section, we lay out some of the key facts regarding past and projected future population aging, and briefly consider some of the policy implications that these facts highlight. The data will serve as anchors for the economic analyses that will be developed in subsequent sections. First we look at UN population projections. Next we examine the factors underlying the rise in the elderly population. We then take a brief look at how population trends will affect the options faced by policymakers.

Population data and projections

Population projections from the United Nations change as new estimates are published every two years. For example, forecasts of the total world population in 2050 declined from about 10 to 9 billion people between 1994 and 2006. One might have expected projections of the number of people aged 60 or above and 80 or above would be far more stable, since all those who will reach those ages in the next six decades have already been born, so unpredictable changes in fertility need not be taken into account. However, these projections have changed significantly, even in recent years, as shown in Exhibit 1. With each UN publication, the latest available data are taken into account. In some instances, a large amount of new census data is available, which can lead to significant differences in the estimate of future population size. The same is true of updated fertility and mortality data. The greatest proportionate differences shown here are for the forecasted size of the 80+ population in 2050. For the world, developed countries, and developing countries, the UN estimate of the size of this age group has risen by 20% or more since 1994. These figures show that population data are not sacrosanct; as the estimated sizes of current populations and age groups within them change, and as fertility and mortality rates change in a manner that is different from earlier predictions, population estimates of future population size will also change.

Exhibit 1 – Change in UN forecast of 2050 elderly population, from 1994 to 2006

	Forecast year	Population (billions)		
		Total	60+	80+
World	1994	9.83	1.97	0.33
	1996	9.37	1.94	0.32
	1998	8.91	1.97	0.37
	2000	9.32	1.96	0.38
	2002	8.92	1.91	0.38
	2004	9.08	1.97	0.39
	2006	9.19	2.01	0.40
	% change, 94-00	-5.2%	-0.3%	14.7%
	% change, 00-06	-1.4%	2.1%	6.0%
	% change, 94-06	-6.5%	1.9%	21.7%
Developed	1994	1.21	0.36	0.09
	1996	1.16	0.36	0.09
	1998	1.16	0.38	0.10
	2000	1.18	0.40	0.11
	2002	1.22	0.39	0.11
	2004	1.24	0.40	0.12
	2006	1.25	0.41	0.12
	% change, 94-00	-2.2%	9.5%	21.2%
	% change, 00-06	5.4%	2.7%	3.9%
	% change, 94-06	3.1%	12.6%	26.0%
Developing	1994	8.63	1.61	0.24
	1996	8.20	1.58	0.23
	1998	7.75	1.59	0.27
	2000	8.14	1.57	0.27
	2002	7.70	1.51	0.26
	2004	7.84	1.57	0.28
	2006	7.95	1.60	0.28
	% change, 94-00	-5.6%	-2.5%	12.2%
	% change, 00-06	-2.4%	2.0%	6.9%
	% change, 94-06	-7.9%	-0.5%	20.0%

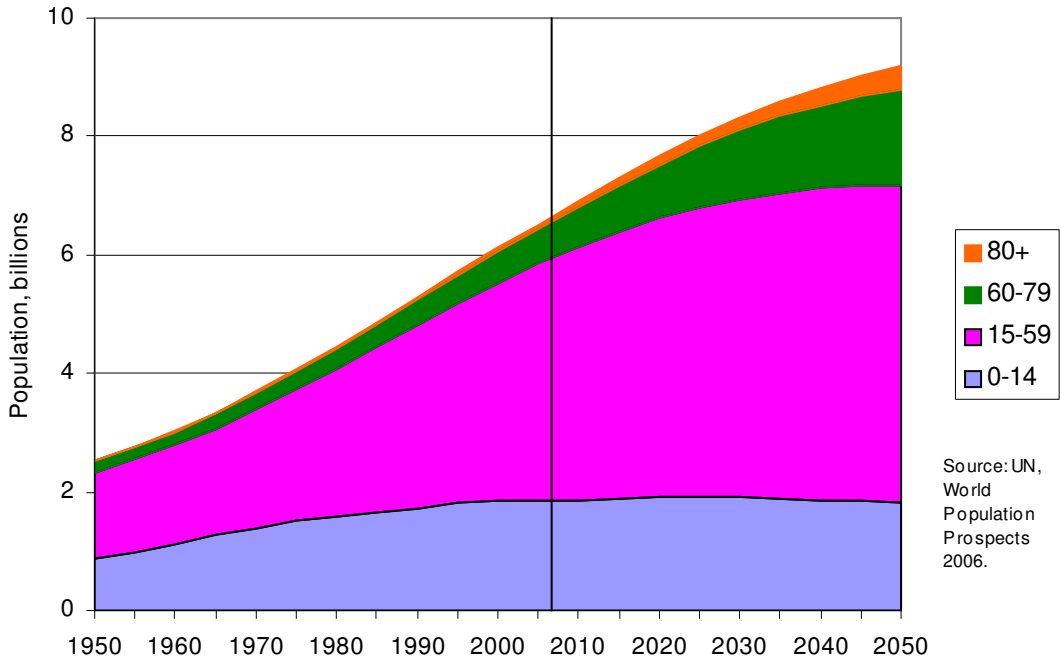
Source: Authors' calculations based on data in the 1994 through 2006 revisions of United Nations, *World Population Prospects*.

Demographic projections of population aging suggest the world is experiencing a historically unprecedented phenomenon.² The 60+ and 80+ age groups' shares of the total population are higher than at any time in history, and their growth is accelerating. The number aged 60 or over has increased from 200 million in 1950 to around 670 million today. By 2050, it is projected to reach 2 billion (see Exhibit 2). The number aged 80+ has risen from 14 million in 1950 to nearly

² For a detailed analysis of several measures of population aging, see Lutz, Sanderson, and Scherbov (2008).

90 million today, and by 2050 it will have passed 400 million if current projections are borne out. Older age cohorts, moreover, are beginning to account for a substantial proportion of the total population. Indeed, all countries and other entities are forecast to see a higher share of people aged 60+ in 2050 than in 2000, with the percentage-point increase ranging from 0.3 in Benin to 33 in Macao. (By contrast, numerous countries experienced large drops in this fraction between 1950 and 2000.)

Exhibit 2 – World, population by age group



These projections are based on the UN's medium-fertility scenario. If fertility rates in the coming decades are lower than the "medium scenario" estimate, the share of elderly in the population will rise. Exhibit 3 shows how this source of uncertainty leads to a range of predictions regarding elderly share. The variation in 2050 is about one-third of the medium-scenario elderly share. This is not a huge range, and all three scenarios point in the same direction. But this source of uncertainty is in addition to that reflected by the change over time in UN estimates of the future size of the elderly population.

Exhibit 3 – Share of population that is at least 60 years old, by UN fertility assumption

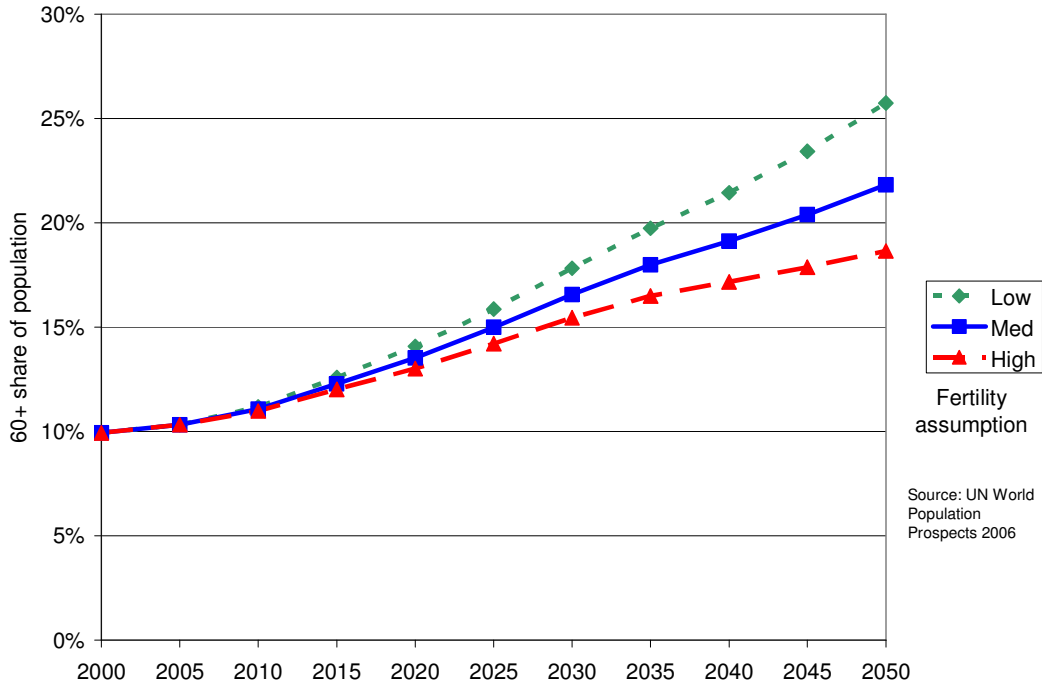
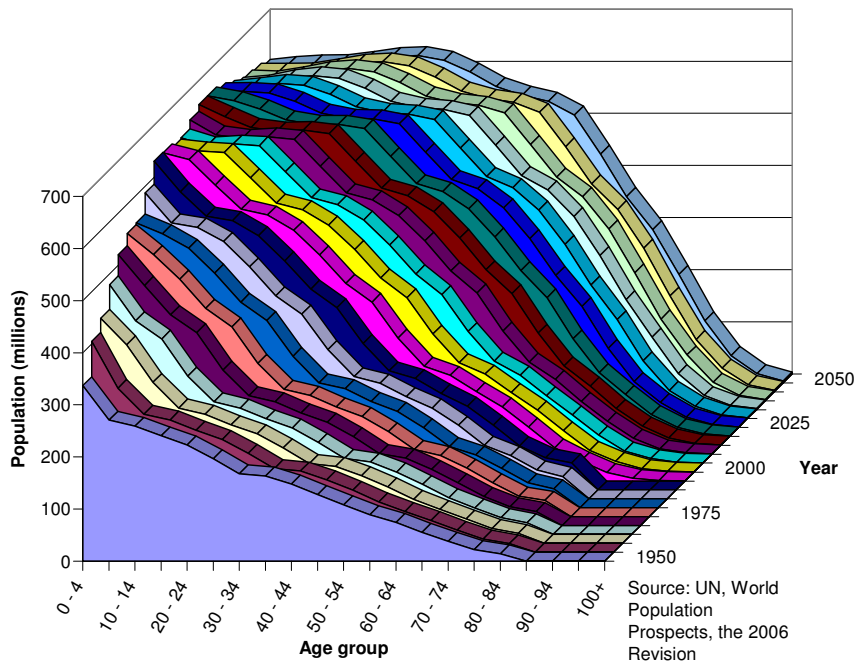


Exhibit 4 is another way of viewing the change in the age structure of the world's population over time. Each colored slice shows the age distribution at one point in time. The elderly share will be much higher in 2050 than it is now.

Exhibit 4 – World, population by five-year age group



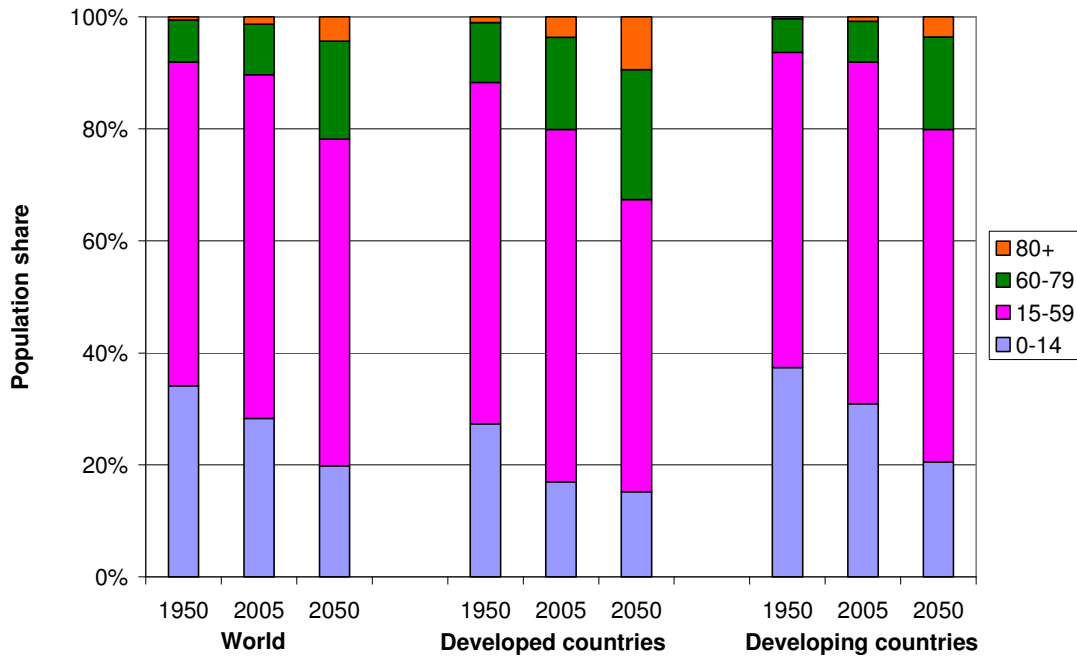
The phenomenon of population aging, of course, is not uniform across countries. In addition, the extent of aging varies considerably between the developed and the developing countries (see Exhibits 5 and 6) and across regions (see Exhibit 7).

Exhibit 5 – World and development-group age structure changes (table)

		Population (millions)		
		1950	2005	2050
World				
	0-14	866	1,845	1,824
	15-59	1,464	3,997	5,361
	60-79	191	585	1,604
	80+	14	88	402
	Total	2,535	6,515	9,191
Developed countries				
	0-14	223	207	190
	15-59	496	764	650
	60-79	87	200	289
	80+	9	44	117
	Total	814	1,216	1,245
Developing countries				
	0-14	644	1,638	1,635
	15-59	968	3,233	4,712
	60-79	104	385	1,315
	80+	6	43	284
	Total	1,722	5,299	7,946

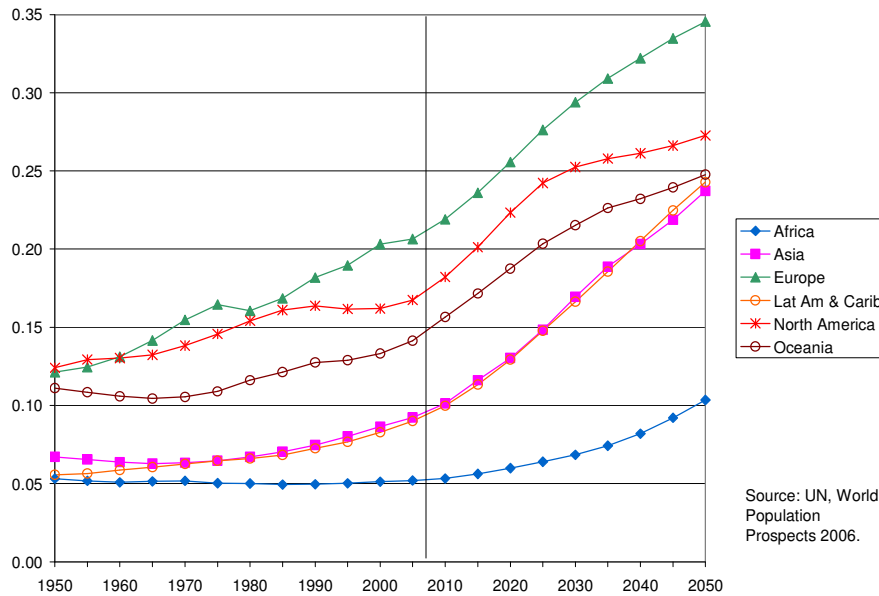
Source: Authors' calculations based on data in United Nations, *World Population Prospects: The 2006 Revision*.

Exhibit 6 – World and development-group age structure changes (graph)



Source: Authors' calculations based on data in United Nations, *World Population Prospects: The 2006 Revision*

Exhibit 7 – Share of 60+ population by region

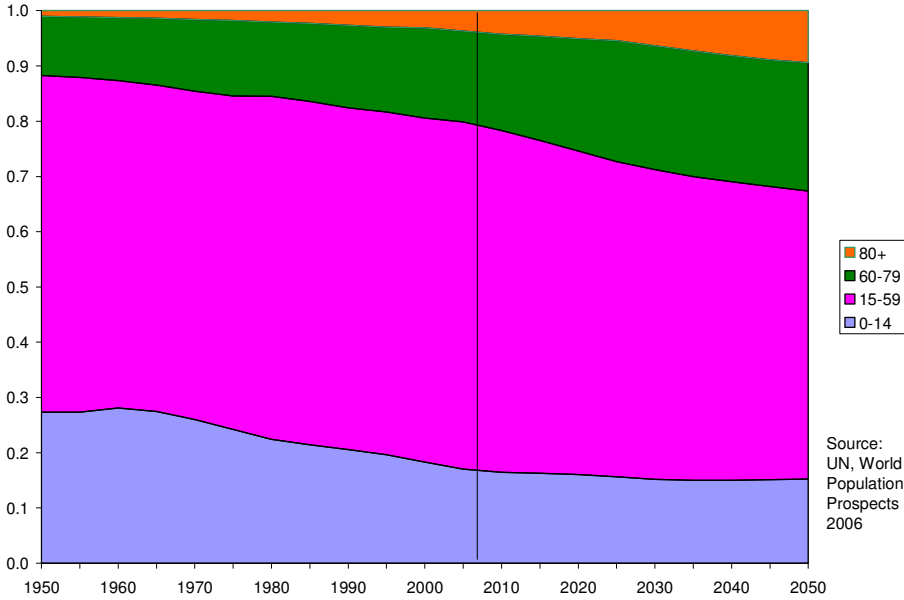


Source: UN, World Population Prospects 2006.

Much of the developed world already has large elderly cohorts. Twenty per cent of the population of developed countries is aged over 60 today, and this will rise to over 30 per cent in the next four decades (see Exhibit 8). In the developing world, less than 10 per cent of the population is aged over 60. By 2050, however, the proportion is expected to more than double,

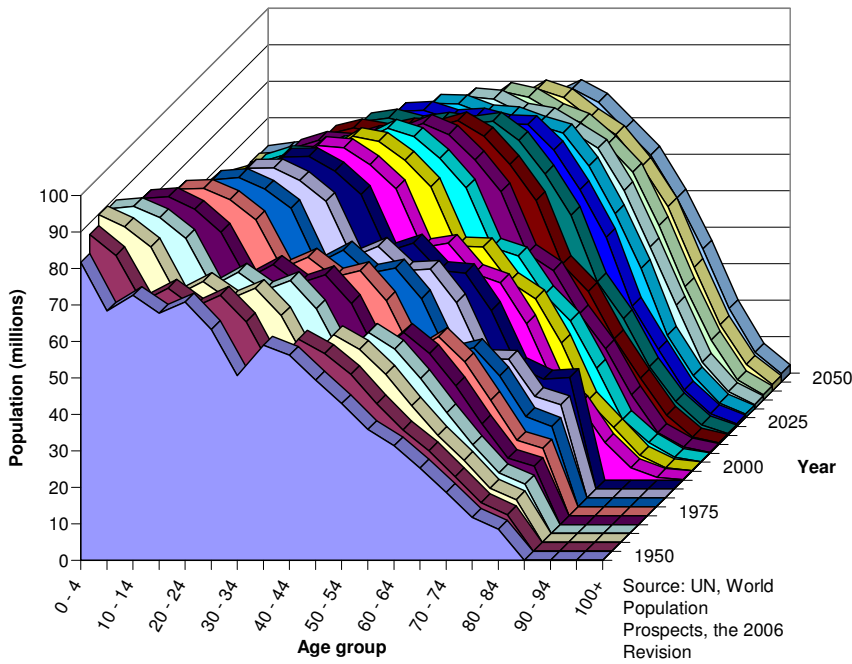
and the 60+ age group will comprise 20 per cent of India's population and 30 per cent of China's by the middle of this century – a total of over 760 million people.

Exhibit 8 – Developed countries, population share by age group



As above, Exhibit 9 offers another view of the same data.

Exhibit 9 – Developed countries, population by five-year age group



Countries will also undergo aging at very different rates. Exhibit 10 focuses on two sets of countries: those that are forecast to have the highest share of 60+ individuals in 2050, and those with the largest percentage point increase in that share between 2000 and 2050. (Only countries with current populations greater than 2 million are considered.)

Exhibit 10 – Countries with highest 2050 elderly population or rapid change from 2000-2050

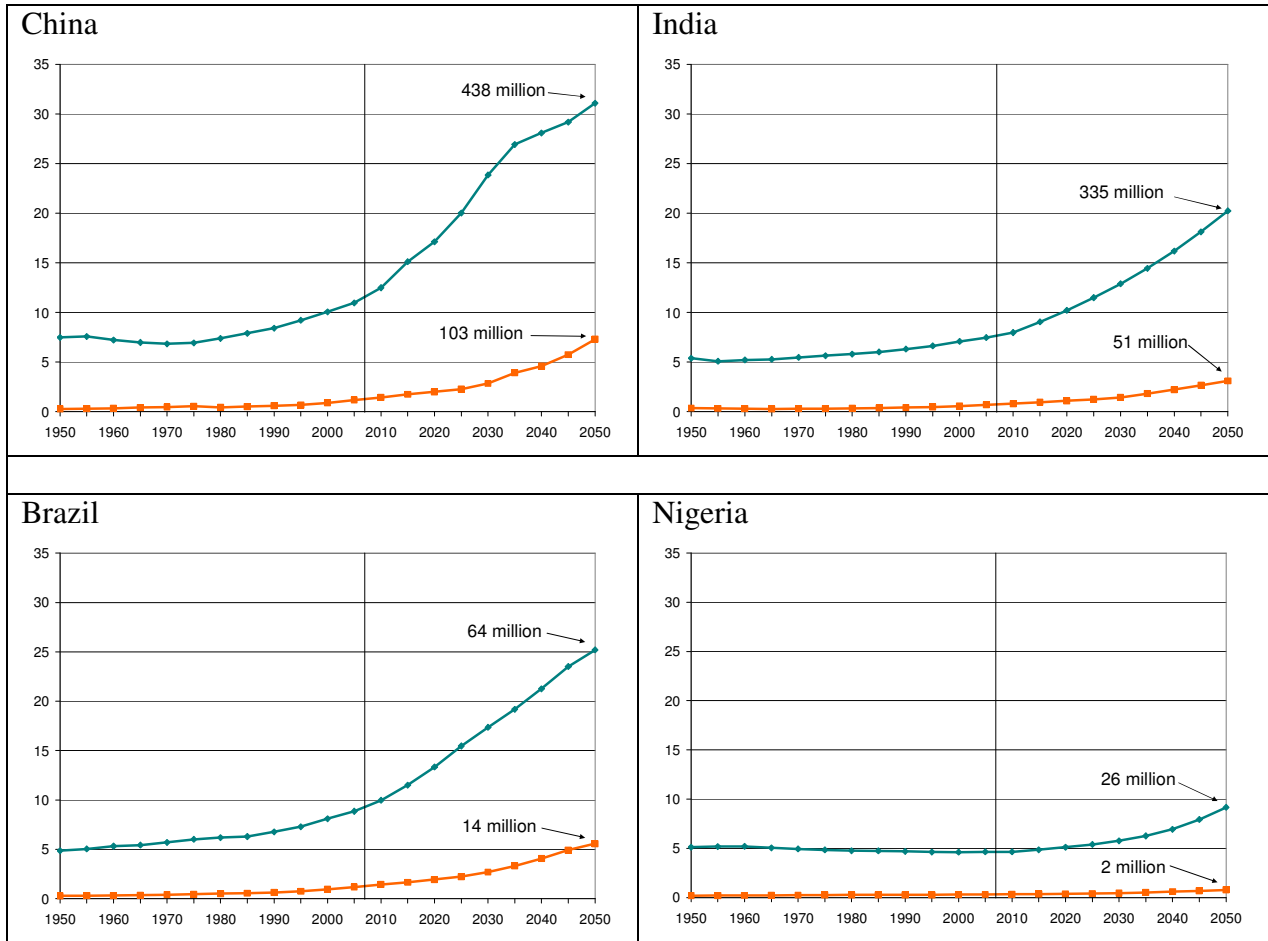
% 60+ in 2050		Percentage point increase in 60+ share, 2000-2050	
Japan	44.0	South Korea	30.7
South Korea	42.2	Singapore	29.3
Slovenia	40.5	Cuba	24.5
Bulgaria	40.2	Poland	22.9
Singapore	39.8	Kuwait	22.3
Poland	39.6	Slovakia	22.2
Cuba	39.3	UAE	22.1
Romania	39.1	Slovenia	21.1
Spain	39.0	China	21.0
Czech Republic	38.6	Japan	20.7

Source: Authors' calculations based on data in United Nations, *World Population Prospects: The 2006 Revision*.

Exhibit 11 shows the expected growth of the elderly population for four large developing countries. In three of them, population aging will be a major demographic trend between now and 2050.

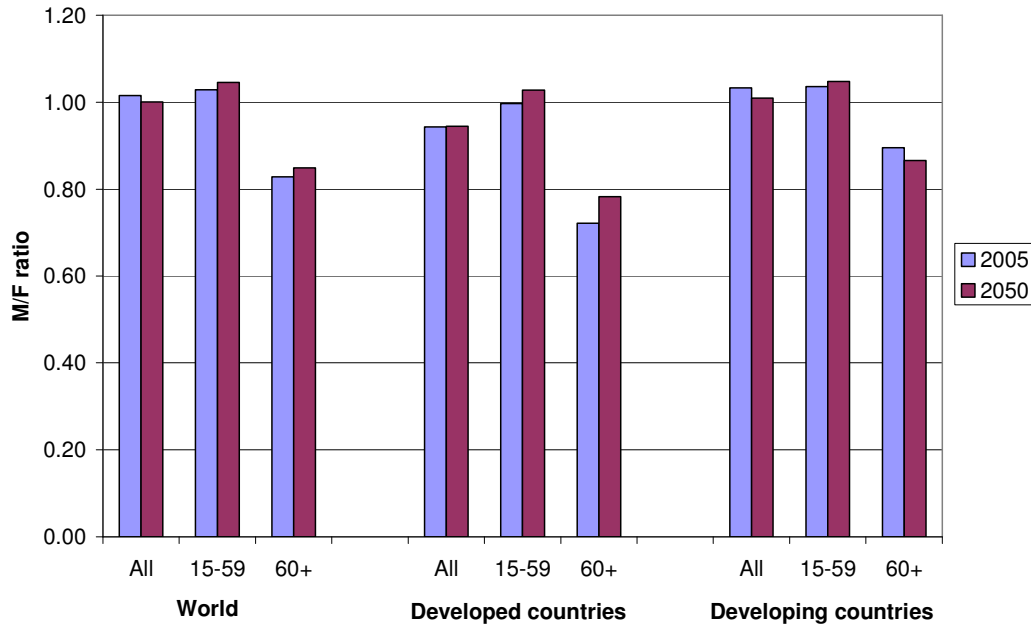
Population aging will be accompanied by changes in the sex composition of the population. (Gerland 2005 notes that in most countries, the decades-long divergence in adult survival between men and women has decreased since 1980, "caused by both a deceleration/leveling of female survival and an acceleration of male survival".) More male than female babies are born, but the death rate of male babies and of adult men has long been higher than that of their female counterparts. This led to the longstanding and widely recognized phenomenon of the predominance of women among the elderly. Better health at all ages is causing this disparity in longevity to diminish. Exhibit 12 shows the UN's forecasts of male/female ratios in 2050 as compared to the present. In 2050, among 15-59 year-olds, males will slightly outnumber females in both developed and developing countries. Among the elderly, females will continue to outnumber males, in both developed and developing countries.

Exhibit 11 – Elderly share (%) in selected developing countries (60+ is teal, and 80+ is orange)



Source: Authors' calculations based on data in United Nations, *World Population Prospects: The 2006 Revision*.

Exhibit 12 – Change in M/F ratio, for total, 15-59, and 60+ population, by level of development



Source:

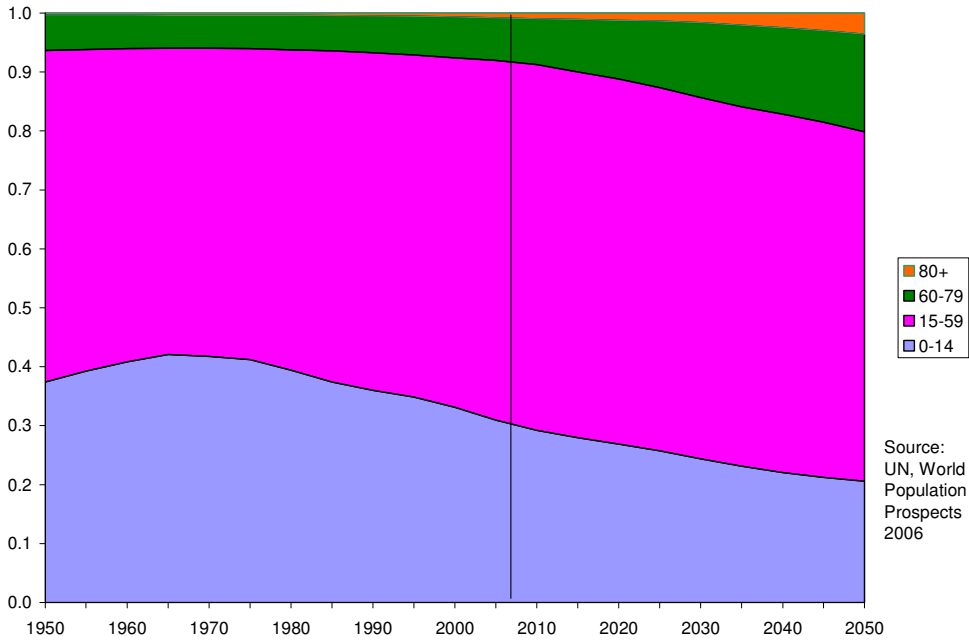
Authors' calculations based on data in United Nations, *World Population Prospects: The 2006 Revision*

The drivers of aging

There are three main factors behind the past and projected changes in the share of the global population aged 60+ and 80+. First, declining fertility rates in recent decades have reduced the number of young people and pushed up the share of the elderly. The total fertility rate fell from approximately 5 children per woman in 1950 to just over 2.5 in 2005. It is expected to fall to 2 children per woman by 2050.³ Most of this decline has occurred in the developing world – as Exhibit 13 shows, this will contribute to a near halving of the share of children in the population of developing countries between 1965 and 2050.

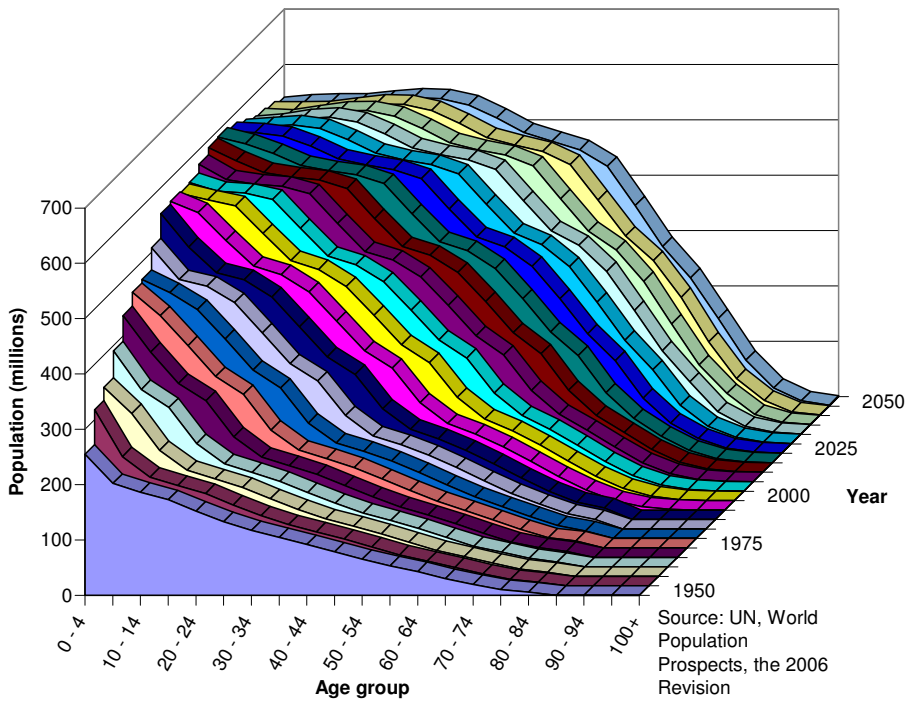
³ UN Population Division (2005).

Exhibit 13 – Developing countries, population share by age group



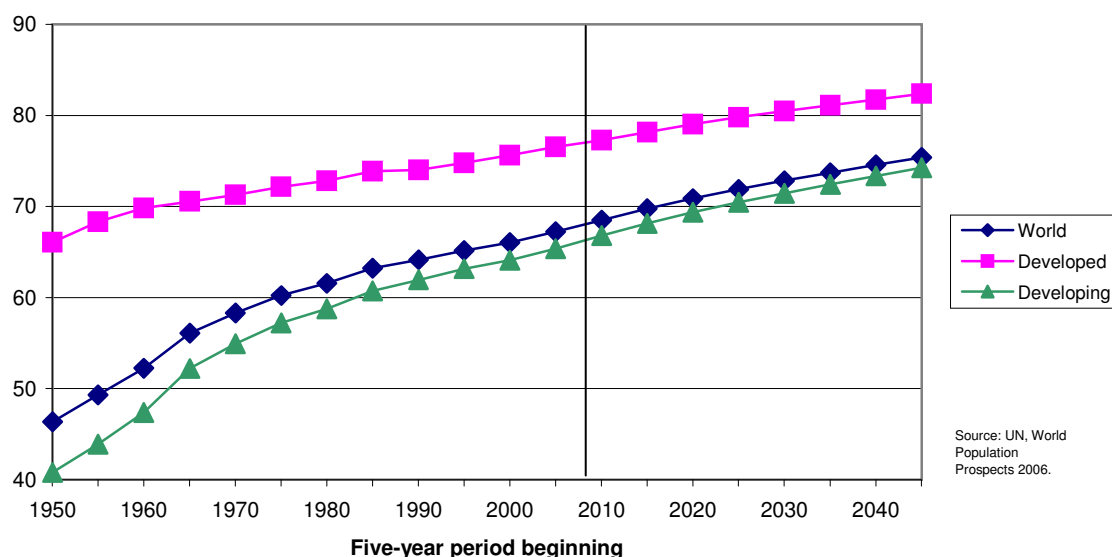
And as before, Exhibit 14 gives a three-dimensional view of the same data.

Exhibit 14 – Developing countries, population share by five-year age group



The second key factor relates to recent increases in life expectancy. We calculate, for example, that one-fifth of the rise in India's 60+ population projected between 2000 and 2050 is due to rising life expectancy during that period. The corresponding figure for China is one-seventh.⁴ Global life expectancy has increased from 47 years in 1950 to over 65 today. It is projected by the UN Population Division to reach 75 years by 2045.⁵ Both developed and developing countries are seeing rises in life expectancy, despite HIV/AIDS reversing the trend in some low- and middle-income countries (Exhibit 15). As many more people survive into their 60s and beyond, the absolute number of elderly will soar. Combined with fertility declines, this will also result in a sharp increase in the share of elderly in the overall population.

Exhibit 15 – Life expectancy, by level of development



There is much debate about whether there is a limit to increases in life expectancy. Some have forecast that life expectancy in the wealthy industrial countries will surpass 100 years before 2100 as anti-aging and medical technologies become more widespread and sophisticated and as lifestyles become healthier, for example via declines in smoking and alcohol abuse, improvements in diet, universal use of seatbelts, etc. Others are less optimistic, believing that life expectancy will plateau at 85 years. The latter school of thought holds that past increases are due mostly to declines in infant and child mortality that are not repeatable and thus will not contribute to further increases in life expectancy. It argues too that major new threats, such as avian flu, climate change, and obesity, will hold life expectancy down. Although the likely extent of increases is disputed, the fact that life expectancy will continue to rise is widely accepted.

⁴ This calculation was made by comparing projections of India's population and age distribution from 2000 to 2050 using (a) linearly interpolated values of the UN Population Division's assumptions of the TFR and life expectancy in 2000 and 2050, and (b) linearly interpolated values of the UN Population Division's assumptions of the TFR with life expectancy held constant at its 2000 level. A similar calculation was made for China, except that life expectancy for women was fixed at 80 beyond the year 2035, due to a restriction imposed by the software package DemProj.

⁵ UN Population Division (2005).

Past variations in birth and death rates are the third factor behind population aging. For example, baby booms that occurred in rich countries after World War II are now shifting population structure as the swollen cohort of boomers, which resulted from increased – and not decreased – fertility, passes the age of 60. In parts of the developing world too, where fertility temporarily increased as health improvements reduced child mortality, elderly populations have been and will continue to be boosted as those high-fertility cohorts age.

Policy implications

From a policy perspective, the aging of the world's population presents a number of major challenges. Its unprecedented nature, moreover, means that we cannot look to earlier historical episodes for guidance on how this demographic upheaval will play itself out, nor on how best to manage it. On the other hand, population aging in most countries will not be noticeable for another ten to twenty years. As the charts above show, the most rapid increase in aging has not yet occurred. This gives policymakers a window of opportunity in which to prepare for the change. Initiating action early can leave countries better positioned to deal with the social, economic, and political effects of an altered population structure in the future.

People aged 60 or above tend to have different needs and different behaviors than younger generations. Older individuals, for example, tend to work and save less, meaning that less labor and capital will be available to economies. They also require more health care and, in many countries, rely on social pensions for a large part of their income. Politically, therefore, it might become more difficult to adopt certain policies, such as cutting health and pension benefits, as elder populations become politically more potent. Economically, there will be increased stress on working populations, whose taxes pay for the health care and pensions of their elders but whose numbers relative to those elders will be reduced.

Those aged 80 or over also have different needs. Their health is generally weaker than that of people aged between 60 and 80, they have a greater need for full-time care, and their financial needs may be greater due to the costs of care and because they have had longer to draw down savings. As their numbers increase, they place further demands on government resources, familial resources, and personal savings.

That a greater share of elderly will put societies and economies under intolerable strain is not inevitable, however. Increased life expectancy has historically been strongly associated with increased per-capita income.⁶ Changes in age-specific health profiles are important for characterizing the phenomenon of population aging. If people moving into their 60s and 70s are healthier than preceding generations, the demands for health care will be less intense and many will be able to work, and contribute to economies, for longer.⁷ If they remain no healthier than earlier cohorts, on the other hand, they will have to endure more years of poor health and their societies will be burdened with additional years of health care costs. Studies on whether increased life expectancy is accompanied by a “compression of morbidity”, where the relative or

⁶ SH Preston (1975): The Changing Relation between Mortality and Level of Economic Development. *Population Studies*, 29(2): 231-248

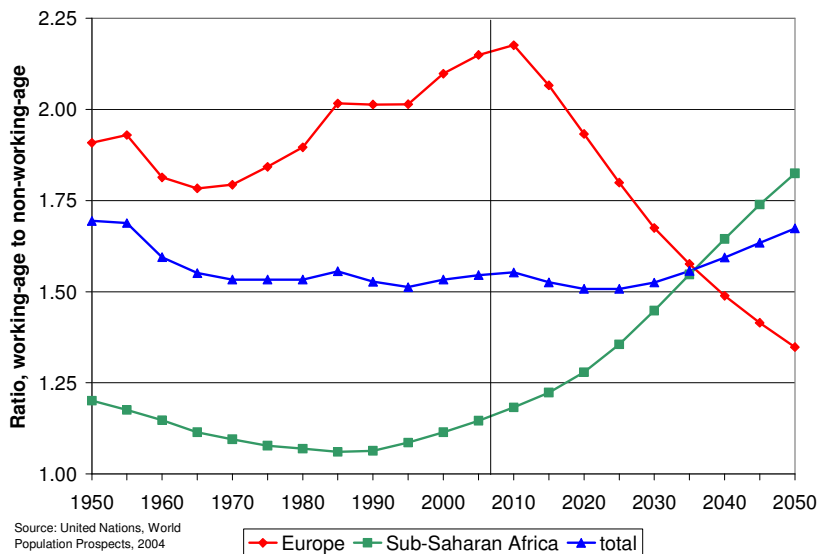
⁷ Kulish M, K Smith and C Kent (2006), ‘Ageing, Retirement and Savings: A General Equilibrium Analysis’, Reserve Bank of Australia Research Discussion Paper No 2006-06.

absolute length of life spent in chronic ill-health falls, have mainly focused on the United States. Most suggest that compression of morbidity does indeed occur, meaning that the burden of aging is reduced.⁸ Those over 60 can work more productively for longer and place fewer demands on public resources.

Cross-country differences in the timing of the aging process may also mitigate the negative impacts. Because rich countries are aging faster than poor ones, the former can draw on labor from the latter to compensate for the retirement of their own people. The large cohorts of working-age people in developing countries, in turn, are likely to be keen to fill the vacancies created.

Migration to the developed world could therefore theoretically slow the latter's shift toward an aged population and ease the pressure on economies. Migration, however, can bring with it social pressures and unrest, and many wealthy countries are already grappling with the difficult balance between the need for labor and the importance of taking account of immigration's social effects. Some have observed the different – but highly complementary – age structures of developed and developing regions and suggested that "replacement migration" might serve the purposes of both sets of regions. Europe, for example, with a high percentage of elderly people and few children, needs workers, which Sub-Saharan Africa could readily supply. Exhibit 16 shows the ratio of working-age to non-working-age people in Europe and Sub-Saharan Africa separately, as well as the ratio for the two regions added together. The time path of the working-age ratio for the two regions taken together is steadier than that of either region.

Exhibit 16 – Complementary working-age ratio of Europe and Sub-Saharan Africa



⁸ Fries, J. (1980), Aging, Natural death and the Compression of Morbidity, *New England Journal of Medicine* 303, 130-135; Fries, J (1989): The compression of morbidity: near or far? *Milbank Quarterly* 67, 208-32; Crimmins, E. (2004). Trends in the Health of the Elderly. *Annual Review of Public Health*, 25, 79-98; Crimmins, E., Saito, Y., & Ingegneri, D. (1997). Trends in disability-free life expectancy in the U.S.: 1970-1990. *Population and Development Review*, 23(3), 555-572; Costa, DL. 2002. Changing chronic disease rates and long-term declines in functional limitation among older men. *Demography* 39(1): 119–137.

Notwithstanding the theoretical soundness of the idea of replacement migration, we have calculated that it would take more than a 30-fold increase in the current level of migration from Sub-Saharan Africa to Europe – which would need to last for 25 years – to achieve this smoothing.⁹ This is hardly realistic, especially given the social and political tensions that even current rates of African migration to Europe raise. The goal of “replacement migration” thus appears to be much more interesting in theory than in practice. Given the massive increase in migration that would be needed to appreciably offset the impacts of population aging in Europe, international migration offers at best a partial solution to the problem – and one that comes with potentially great social and political costs.

Increased capital flows are an alternative way of addressing this same issue (i.e., exporting jobs instead of importing workers), although the demand for services that require physical proximity (e.g., gardeners, hair stylists, and security guards, as opposed to call center operators, investment analysts, and radiologists) would appear to place some limits on this market-based channel for adjusting to population aging.

In the next section of the paper, we examine more closely some of the impacts of aging discussed above and in particular their implications for economic growth.

III. The Economic Impacts of Population Aging

The importance of age structure

The academic literature is overflowing with models and perspectives on the determinants of economic growth. Some frameworks highlight the importance of sectoral shift (that is, the reallocation of labor from the low productivity agricultural sector to the higher productivity industry and service sectors) and the improvement of productivity within all sectors. Others emphasize the contribution to growth of technological progress, human capital, institutions and governance, macroeconomic and trade policies, and random shocks. Still others stress feedback effects that run from economic growth to technical progress and human capital accumulation, which in turn influence economic growth.¹⁰

The key premise of this paper is that changes in population age structure may exert a significant influence on economic growth. We adopt a life cycle perspective, based on the fact that people’s economic needs and contributions vary over the life cycle. Specifically, the ratio of consumption to production tends to be high for the youth and elderly and low for working-age adults. This

⁹ See Bloom, Canning, and Sevilla (2002).

¹⁰ Tyers and Shi (2007) introduce demographics (population size and its age, sex, and skill composition) into a dynamic computable general equilibrium model of the world economy with exogenously-determined age patterns of labor force participation, consumption, and savings. Their work indicates that accelerated population aging (via lower fertility) tends to enhance real per capita income growth in regions with very young populations and slows it in regions with older populations and low rates of labor force participation among the elderly (e.g., Western Europe). Based on a model that is similar in spirit, though demographically less fine-grained, McKibbin (2006) reaches qualitatively similar conclusions, but also highlights the implications of global demographic change for international trade and capital flows and therefore for domestic economic performance.

means that aggregate labor supply, productivity, earnings, and savings – all key drivers of economic growth – will tend to vary depending on where most people are in the life cycle. Among these factors, it is well established that labor supply and savings are higher among working-age adults than among those aged 60 or above. Other things equal, therefore, a country with large cohorts of youth and elderly is likely to experience slower growth than one with a high proportion of working-age people.

The value of this approach can be seen in an analysis of the impact of changing age structure on East Asia's remarkable economic growth in the second half of the 20th century.¹¹ Rapid declines in infant and child mortality in the region began in the late 1940s. These declines triggered a subsequent fall in fertility rates – the crude birth rate dropped from over 40 births per 1,000 population in 1950 to just over 20 by 1980. During the lag between falling mortality and fertility, a “baby boom” generation was created, which was larger than the cohorts that preceded and followed it. As this generation reached working age, it boosted savings rates and also the size of the labor force; from 1965 to 1990, the working-age population grew by 2.6 per cent annually and the dependent population by just 1.0 per cent. Bloom and Williamson (1998), and Bloom, Canning, and Malaney (2000) estimate that this “demographic dividend” explains up to one-third of East Asia's economic miracle between 1965 and 1990.

Accounting effects

If age-specific behavior with respect to labor supply and savings were fixed, labor supply and savings per capita – and hence income growth – would tend to decline with a rising elder share of the population. Based on this view of the link between population aging and economic growth, rapid aging has the potential to induce a correspondingly sharp reduction in the pace of growth. This frame of reference appears to underlie the rather alarmist views of commentators such as Peter Peterson, who has argued that, “global aging could trigger a crisis that engulfs the world economy [and] may even threaten democracy itself.”¹² Ken Dychtwald, too, has raised concerns that, “we're going to have a self-centered generation just sucking down all the resources”,¹³ and former U.S. Federal Reserve Chairman Alan Greenspan has warned that aging in the United States “makes our social security and Medicare programs unsustainable in the long run.”¹⁴

In order to assess the potential magnitude of the impact of an increase in the share of elderly, we estimate the pure accounting effect of population aging on labor supply. We do this by applying International Labor Organization (ILO) estimates of age- and sex-specific labor force participation rates to UN projections of the corresponding distributions of population by age and sex for the year 2040. We then compare these numbers to the actual rates of labor force

¹¹ Bloom, David E. and Jeffrey G. Williamson, "Demographic Transitions and Economic Miracles in Emerging Asia", *World Bank Economic Review*, 1998, Vol. 12, No. 3, 419–55.

¹² PG Peterson (1999): *Gray Dawn: The Global Aging Crisis*. Foreign Affairs, January/February.

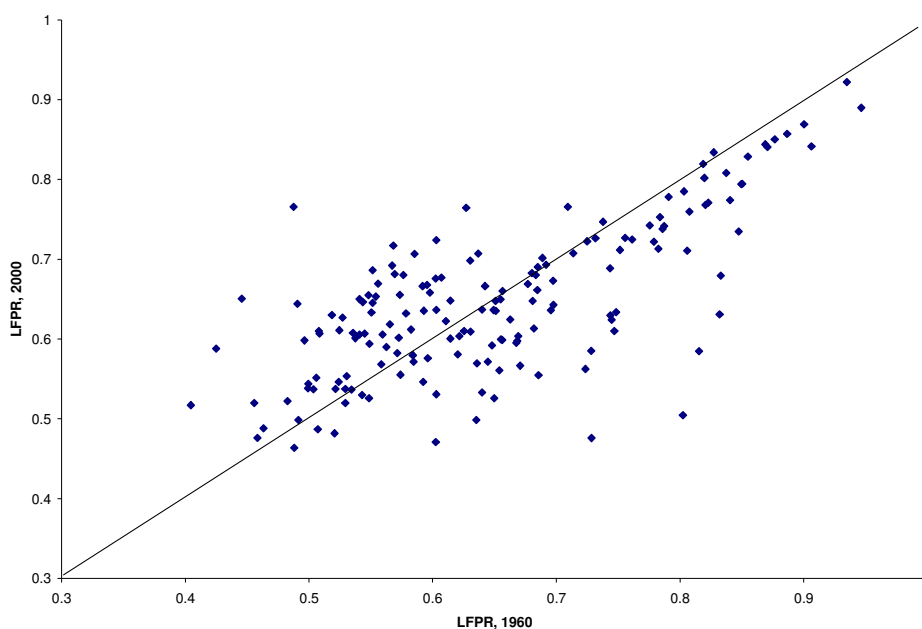
¹³ San Francisco Chronicle (1999): Ken Dychtwald on the Future. November 15. Available at: <http://sfgate.com/cgi-bin/article.cgi?file=/gate/archive/1999/11/15/dychtwaldtalk.DTL>

¹⁴ Testimony of Chairman Alan Greenspan, “Aging global population”, before the Special Committee on Aging, U.S. Senate February 27, 2003

participation (LFPR) in 2000.¹⁵ The results for the 174 countries in the ILO database are shown in Exhibits 17 and 18, where we plot actual LFPR in 1960 versus actual LFPR in 2000, and actual LFPR in 2000 versus projected LFPR in 2040. For convenience, we show the 45-degree line, which corresponds to static rates of labor force participation.

Exhibit 17 shows that LFPR increased in slightly more countries than it decreased in from 1960 to 2000, corresponding to the demographic transition in developing countries and the post-World War II baby booms in the developed countries. The scatterplot also reveals a demographic cycle of sorts, with high (low) LFPR in 1960 tending to correspond to lower (higher) LFPR in 2000. Rising rates of labor force participation create the potential for higher rates of economic growth.

Exhibit 17 – Labor force participation – 1960 versus 2000



However, the situation looks rather different going forward. Exhibit 18 projects that changes in the age distribution – and also in the sex distribution – of the population will, under the assumption of constant age- and sex-specific LFPR, cause the aggregate LFPR to decrease in more countries than it will increase in from 2000 to 2040. In Singapore and Hong Kong, China, for example, LFPR is projected to decline from around 60% to 45%. Spain, Austria, Germany, and the Netherlands are projected to experience similar declines. For the 174 countries taken as a whole, LFPR is projected to decline from 66.4% in 2000 to 62.1% in 2040 (Exhibit 19).

¹⁵ The calculations are carried out as follows: We use male and female labor force participation rates from the ILO for each 5 year age group between 14-19 and 60-64, and an average for the population 65plus. We match these data to the UN data on population stocks, which provides data on the number of males/females in each corresponding 5-year age group. Multiplying each age group with the participation rate gives us the total number of people working. We then sum these, and divide by the population ages 15 plus. For the years 1960 and 2000, we use actual participation rates. For the year 2040, we use the participation rates from 2000 and the age structure forecast from the World Population Prospects United Nations (2007). World Population Prospects: The 2006 Revision. CD-ROM Edition - Extended Dataset. United Nations.

Although this is a shift from the 1960-2000 experience (during which LFPR barely changed -- from 67.4% to 66.4%), the 4.3 percentage point decline represents less than half of a standard deviation (9.5 percent) in the cross-country distribution of LFPR for 2000.

Exhibit 18 – Labor force participation – 2000 and 2040

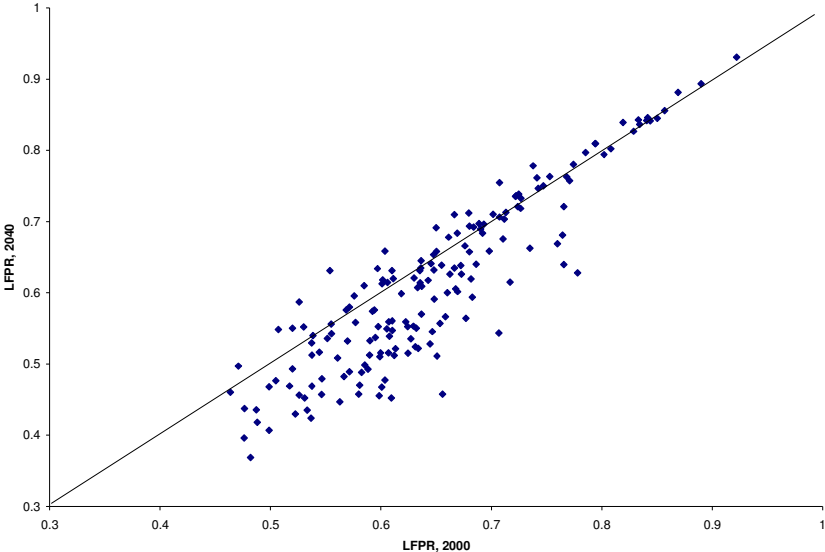


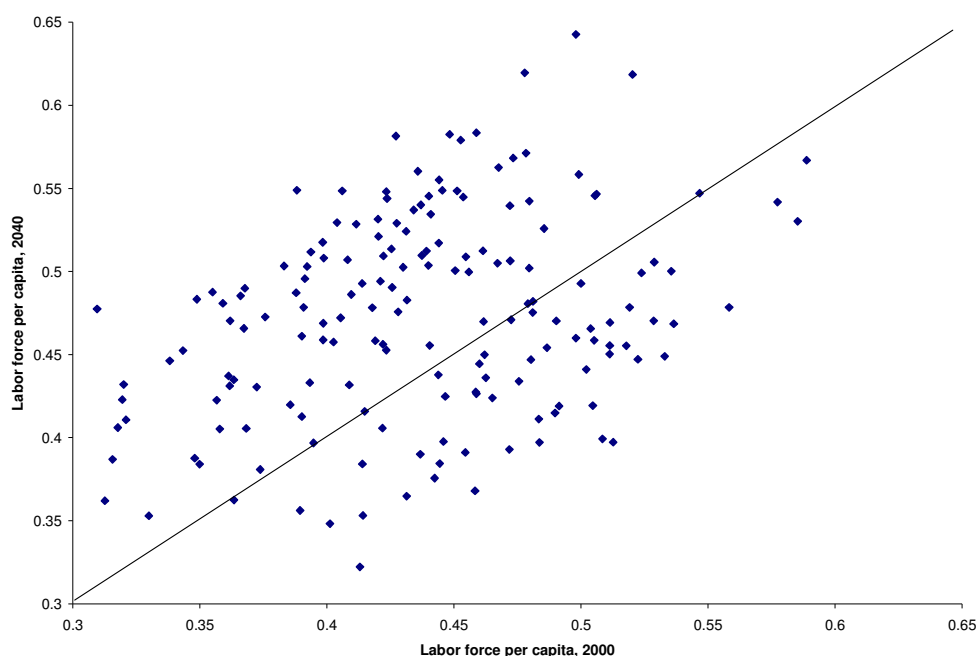
Exhibit 19: Global Labor Force: 1960, 2000, and 2044

	1960 Actual	2000 Actual	2040 Projected*
LFPR (labor force/pop15 +)	67.4	66.4	62.1
LFTP (labor force/pop)	42.4	46.5	48.6

* 2040 projections are based on medium-fertility population projection and age- and gender-specific participation rates in 2000. Averages are population weighted.

To draw further attention to the small magnitude of the shift of demography from boon to bane with respect to economic growth, Exhibit 20 plots ratios of labor force-to-population (LFTP) in 2000 and 2040 (the numbers for 2040 again being projected under the assumption that age- and sex-specific LFPR will remain constant at their 2000 levels). The striking result here is that increases outnumber decreases with respect to LFTP. In other words, projected fertility declines imply that the fall in youth dependency is more than enough to offset the skewing of adults toward the older ages at which labor force participation is lower. For the 174 countries taken as a whole, the calculation of LFTP actually projects a rise from 46.5% to 48.6% between 2000 and 2040 (Exhibit 19).

Exhibit 20 – Labor force-to-population ratio – 2000 versus 2040



Note: 2040 projections are based on medium-fertility population projection and age- and gender-specific participation rates in 2000.

Exhibit 21 plots actual annual growth rates of per capita income from 1960 to 2000 for 97 countries against counterfactual growth rates during that period. The counterfactual is constructed by taking note of the fact that income per capita equals income per worker times workers per capita. In terms of growth rates, this means that the growth rate of income per capita equals the sum of the growth rates of income per worker and workers per capita¹⁶. The simulation makes the assumption that income per worker grew at the actual 1960-2000 rate, but that the growth rate of workers per capita followed the expected 2000-2040 trajectory, instead of the actual growth rate in workers per capita observed during 1960-2000. Exhibit 21 thus provides a crude indication of the impact of demographic change on economic growth. The comparison is crude for a variety of reasons: it does not allow demographic change to affect behavior with respect to labor supply or savings, nor does it account for any changes in institutions or policies. OECD countries, whose populations are aging faster than the rest of the world, appear in red.

There are two key features of Exhibit 21. First, the data points are evenly scattered around the 45 degree line, which implies that the shift in age structure will, on average for the world, have little effect on economic growth. Indeed, for the 97 countries for which the requisite income data are available for both 1960 and 2000, the average actual growth rate during 1960-2000 is 1.9%, which is identical to the average counterfactual growth rate. The largest deviation from the 45 degree line is for Singapore. Its actual growth rate of 5% from 1960 to 2000 occurred partly on

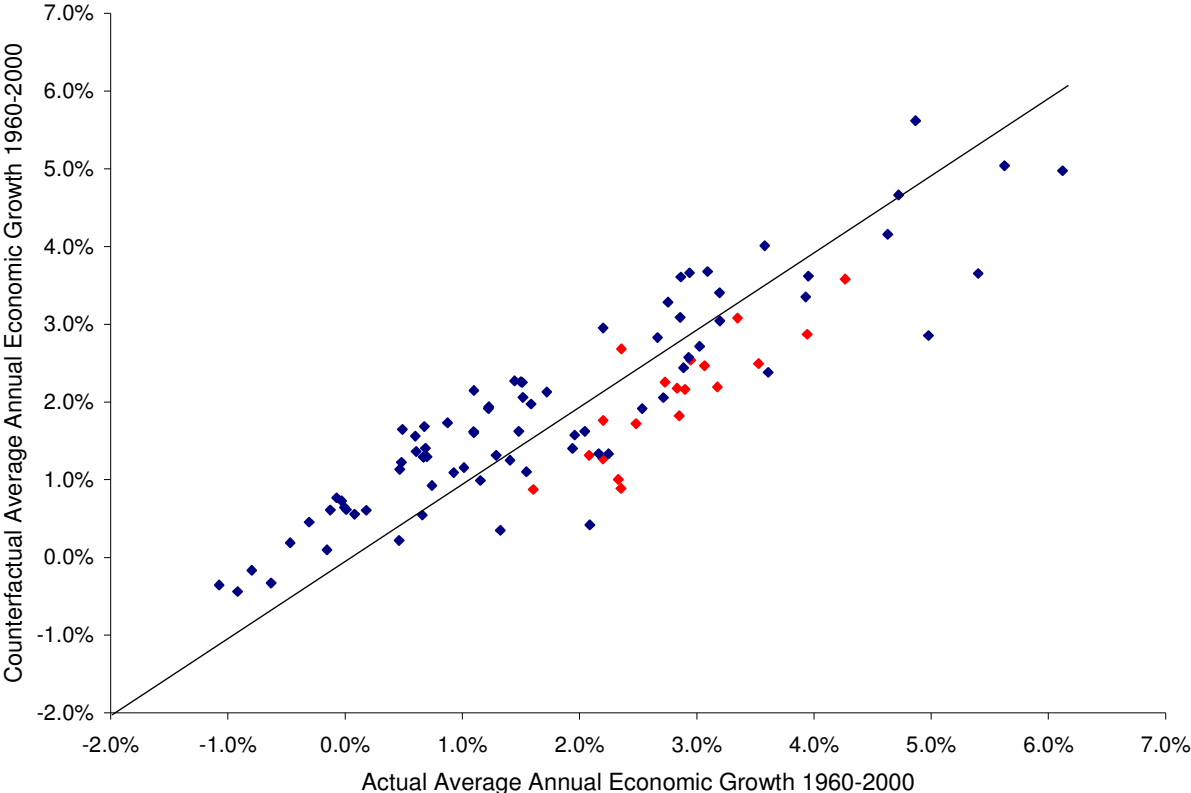
¹⁶ Using a logarithmic approximation, the growth in GDP per capita between period t and period t+1 is given by $\ln(\text{GDP per capita}_t) - \ln(\text{GDP per capita}_{t-1})$. Since $\text{GDP per capita} = \text{GDP per worker} \times \text{workers per capita}$, it is easy to show that growth can be expressed as $\ln(\text{GDP per worker}_t / \text{GDP per worker}_{t-1}) + \ln(\text{workers per capita}_t / \text{workers per capita}_{t-1})$.

the strength of an 18 percentage point rise in labor force per capita from 33% to 51%. But in the counterfactual calculation, Singapore’s labor force per capita will decline by 11 percentage points, a very pessimistic assumption. In fact, taking the period 1960 to 2000 as a whole, Singapore’s labor force per capita is expected to rise from 33% to 40%, which means that the net demographic contribution to the growth in income per capita is actually positive over the full sample period.

Second, with the sole (unsurprising) exception of Turkey, all of the OECD country points lie below the 45 degree line, indicating that the direction of population aging will be to depress economic growth. Yet, even among the original OECD countries, the average actual growth rate during 1960-2000 is 2.8%, which is only modestly reduced to 2.1% in the counterfactual. It is worth stressing that the counterfactual is likely to overestimate the real effect of the demographic shifts, since it essentially compares growth rates with very favorable demographic shifts to growth rates with very unfavorable demographic shifts without taking any behavioral changes into account. Taken as a whole, this very basic analysis implies that population aging does not represent an economic problem for the world economy. Rather, it is at most a modest issue for particular economies.

Exhibit 21 – Actual and Counterfactual Annual Growth Rates of Income per Capita, 1960-2000

(counterfactual assumes 2000-2040 growth rate of labor force per capita; original OECD countries are shown in red)



The role of behavior change

These calculations, however, reflect pure accounting effects, assuming constant age-specific behavior. They are likely to represent upper bounds on the magnitude of the effect of aging on labor supply and, since they neglect behavior change in response to rising longevity, may therefore be misleading.

Behavioral responses to population aging can occur in the form of higher savings for retirement, greater labor force participation, and increased immigration of workers (primarily from developing to developed countries). Countries with the institutional flexibility to facilitate these behavioral changes will be in a position to mitigate the adverse consequences of population aging.

Individuals faced with the prospect of increased life expectancy, where instead of dying in their 50s or 60s they can now expect to live well into their 80s, have a number of choices to smooth their financial path. First, they can rely on social security payments, although these may be imperiled by demographically induced stress on government finances.

Second, they can work longer to finance consumption in later years. Bloom, Canning, and Moore (2007) have shown that the theoretically optimal response to an exogenous rise in life expectancy is to increase working life proportionately, without increasing savings rates.¹⁷ In an environment where lengthened life expectancy is accompanied by compression of morbidity, people will have greater ability to work productively for longer, without decreasing the amount of years spent in retirement. According to Kulish, Smith, and Kent (2006), they also *desire* to work longer; individuals surveyed in Australia wish to spend a similar proportion of their lives in retirement as life expectancy increases.¹⁸ In practice, however, most countries with social security systems penalize those who wish to work beyond “retirement age”. Mandatory retirement is the most extreme of these penalties but, as Gruber and Wise (1998) have shown, there are many other social security arrangements that provide strong incentives to retire rather than continue working.¹⁹ The large spike in retirement at age 62 in the United States (the earliest age at which Social Security benefits can be claimed), and another spike at age 65 (an age at which new retirees have access to even larger benefits) show that people respond to these incentives.²⁰ This behavioral response to social security arrangements is evidenced in Bloom, Canning, Fink, and Finlay (2007a) which shows that institutional settings have strong effects on male labor supply for the 55-plus age groups in a broad sample of countries.²¹

¹⁷ Bloom, David E., David Canning, Rick Mansfield and Michael Moore (2007): “Demographic Change, Social Security Systems, and Savings”, *Journal of Monetary Economics*, Vol. 54(1), pp 92-114.

¹⁸ Kulish et al (2006) op cit.

¹⁹ Gruber, Jonathan and David Wise. 1998. "Social Security and Retirement: an International Comparison. *American Economic Review* 88(2): 158-163

²⁰ Burtless, G., and R.A. Moffitt 1984. The effect of Social Security benefits on the labor supply of the aged. Pp. 135–174 in H.J. Aaron and G. Burtless, eds., *Retirement and Economic Behavior*. Washington, D.C.: Brookings Institution. 1985.

²¹ Bloom, David E., David Canning, Guenther Fink, and Jocelyn Finlay, 2007, “Demographic Change, Institutional Settings and Labor Supply, mimeo.

The difficulty of working beyond national retirement ages and the precarious prospects for social security payments often mean individuals resort to a third option – saving more to finance consumption later. Although the theoretically optimal response to longer life would be to work longer and not increase savings, the empirical evidence suggests that in fact people base decisions on the assumption of longer periods of retirement, and savings therefore rise. Bloom, Canning, and Graham (2003) find that increased life expectancy is associated with higher savings rates.²² More recent work suggests that savings rates increase with life expectancy in countries with universal pension coverage and retirement incentives, but not in countries with pay-as-you-go systems and high replacement rates.²³ Economic incentives to promote greater immigration are also likely to strengthen as populations age; outsourcing work is also likely to become an increasingly attractive option.²⁴

A fourth way for societies to adjust to aging is via increased labor force participation. The reduced fertility that contributes to the shift towards an older age structure allows more women to enter the labor force, as highlighted in Bloom, Canning, Fink, and Finlay (2007)²⁵, which can potentially compensate somewhat for the retirement of the elderly. We show the magnitude of these effects in Exhibit 22. The bottom row of the exhibit shows the actual labor force to population ratios in 2000 for females only (column 1), and the total population (column 2), respectively. In the upper part of the table, we show the predicted values of female and total LFTP between 2000 and 2040. As in Exhibit 19, we keep age- and gender-specific participation rates constant at their 2000 levels and impute the resulting LFTP in 2040. While the results displayed in Exhibit 19 are exclusively based on the medium-fertility population scenario, we now also show results for the alternative low- and high-fertility scenarios.²⁶ As can be seen in the upper part of Exhibit 19, fertility rates critically shape the LFTP in 2040. Under the low-fertility scenario, the fraction of workers to the total population goes up from 0.465 in 2000 to 0.509 in 2040. Under the high-fertility scenario, the fraction slightly declines to 0.464. Higher fertility rates imply higher future youth dependency ratios and thus lower expected LFTP in 2040. This difference is even more pronounced when behavioral changes are taken into account. In the second part of Exhibit 22, we calculate “counterfactual” female labor force participation under the assumption that female labor supply responds to changes in fertility. Bloom et al. (2007)²⁷ estimate the labor supply response for each age group; we use their point estimate and then calculate female labor force participation based on the original 2000 rates plus the estimated adjustment to changing fertility rates. Under the low-fertility scenario, this behavioral response is largest, leading to an increase in LFTP from 46.5% in 2000 to 53.6% in 2040. Under the high-fertility scenario this effect is less pronounced, but still implies an increase in LFTP relative to 2000, rather than the decrease expected in the absence of behavioral change.

²² Bloom, David E., David Canning, and Bryan Graham, 2003, “Longevity and Life-cycle Savings,” *Scandinavian Journal of Economics*, Vol. 105, September.

²³ Bloom, David E., David Canning, Rick Mansfield and Michael Moore (2007): “Demographic Change, Social Security Systems, and Savings”, *Journal of Monetary Economics*, Vol. 54(1), pp 92-114.

²⁴ Blinder, Alan S., “Offshoring: The Next Industrial Revolution?” *Foreign Affairs*, March/April 2006.

²⁵ Bloom, David E., David Canning, Guenther Fink, and Jocelyn Finlay, 2007, “Fertility and Female Labor Force Participation” NBER Working Paper #13583. Available at www.nber.org/papers/w13583

²⁶ The United Nations publishes population forecasts under three different scenarios: low fertility, medium fertility and high fertility.

²⁷ Bloom, David E., David Canning, Guenther Fink, and Jocelyn Finlay, 2007, *op cit*.

It should be noted that the potential growth effects generated by changes in LFTP are relatively small. Under the assumption that output per worker stays constant (or is not affected by LFTP), an increase in LFTP from 46.5% to 53.6% as predicted under the most optimistic low-fertility scenario with behavioral response leads to an annual increase of 0.36 percentage points in real GDP per capita over the whole period. Under the high-fertility scenario, these effects are close to zero. For the OECD countries the expected growth effects are slightly more negative, as summarized in Exhibit 23. Since fertility rates are expected to stay low under all scenarios, little change in total labor force participation is generated by the behavioral response. Nevertheless, even under the most pessimistic high fertility scenario, the expected decrease in annual real income growth is expected to be a relatively modest 0.39 percentage points.

Exhibit 22 – Labor force-to-population ratios 2000 and 2040 with and without female labor supply response

	Labor force per capita, females	Labor force per capita, males and females	Additional annual growth (percentage points) in real GDP per capita
No behavioral response			
Predicted 2040: Low-fertility scenario	0.384	0.509	0.23
Predicted 2040: Medium-fertility scenario	0.369	0.486	0.11
Predicted 2040: High-fertility scenario	0.354	0.464	-0.01
Behavioral response			
Predicted 2040: Low-fertility scenario	0.437	0.536	0.36
Predicted 2040: Medium-fertility scenario	0.401	0.502	0.19
Predicted 2040: High-fertility scenario	0.368	0.471	0.03
Actual 2000	0.373	0.465	

Notes: Based on 174 countries. All averages are population weighted.

Sources: United Nations (2007). *World Population Prospects: The 2006 Revision. CD-ROM Edition - Extended Dataset*. United Nations. ILO (2007): ILO Labor Statistics Online. <http://laborsta.ilo.org/>. Accessed November 2007. Own calculations.

Exhibit 23 – Labor force-to-population ratios 2000 and 2040 with and without female labor supply response: OECD members only

	Labor force per capita, females	Labor force per capita, males and females	Additional annual growth (percentage points) in real GDP per capita
No behavioral response			
Predicted 2040: Low-fertility scenario	0.375	0.448	-0.19
Predicted 2040: Medium-fertility scenario	0.368	0.436	-0.26
Predicted 2040: High-fertility scenario	0.360	0.424	-0.33
Behavioral response			
Predicted 2040: Low-fertility scenario	0.385	0.453	-0.17
Predicted 2040: Medium-fertility scenario	0.363	0.433	-0.27
Predicted 2040: High-fertility scenario	0.341	0.414	-0.39
Actual 2000	0.411	0.484	

Notes: Based on the 30 current OECD member countries. All averages are country weighted.

Sources: United Nations (2007). *World Population Prospects: The 2006 Revision. CD-ROM Edition - Extended Dataset*. United Nations. ILO (2007): ILO Labor Statistics Online. <http://laborsta.ilo.org/>. Accessed November 2007. Own calculations.

IV. Summary and Discussion

Population pessimism redux

For most of the 20th century the dominant issue in the field of demography was the explosion in population numbers caused by the lowering of mortality rates coupled with continuing high fertility rates. The predicted negative consequences of high population densities, and a high population growth rate, seem not to have been borne out. Many of the predictions made about the immiserizing effects of population growth seem in retrospect to have been unduly alarmist. For example, between 1960 and 1999, global population doubled, rising from 3 to 6 billion, but income per capita tripled, decisively refuting the predictions of population pessimists from Malthus to Ehrlich.^{28,29}

Following the 1986 National Academy of Sciences' report on population growth, the non-alarmist position came to dominate economists' thinking on population (Kelley (2000)). While rapid population growth posed problems, the report argued that market mechanisms and non-

²⁸ According to Malthus, who wrote around 1800, when world population first crossed the 1 billion mark, "...[population growth] appears ... to be decisive against the possible existence of a society, all the members of which should live in ease, happiness, and comparative leisure; and feel no anxiety about providing the means of subsistence for themselves and families." In a similar vein, Paul Ehrlich asserted in the late 1960s, that "The battle is over. In the 1970s hundreds of millions of people are going to starve to death."

²⁹ According to the Penn World Tables (version 6.2), total global GDP per capita in 2000 was US\$7565 (at 2000 purchasing power parity). The same number in 1960 was US\$2495, which means that global GDP per capita has increased by 202% (or tripled) over the period 1960-2000, at the same time as the total population doubled. In terms of growth rates, this corresponds to an average annual growth rate of 2.8%.

market institutions were usually sufficiently flexible to ameliorate those problems. In particular, projections of the effects of population growth based on unchanged behavior elsewhere in the economy might give a very bleak picture but in general would be very misleading. Changing incentives through price changes, and changing non-market institutional arrangements to promote new behaviors, could have large effects and produce responses that would alleviate the problems associated with population growth.

The population debate focused on population numbers and missed to a large extent the issue of age structure changes. Population growth caused by rising fertility, and population growth caused by falling mortality, are likely to have quite different economic consequences because they have different age structure effects. We have examined some of these consequences above. However, it is important to remember the lessons of the earlier debate. Analysis based on "accounting effects", in particular on the assumption that age-specific behavior remains unchanged as the age structure evolves, may be misleading. When this type of analysis predicts large reductions in welfare we should be particularly suspicious since these are exactly the conditions that will produce incentives for behavioral change.

This reasoning also applies to an assessment of the economic growth implications of continued improvements in health and reductions in mortality into old age, coupled with the aging of the baby boom generation. How well countries cope with the challenge of population aging will likely depend to a large extent on the flexibility of their markets and the appropriateness of their institutions and policies.

The preceding section explored the economic growth implications of population aging. The key premise of the inquiry is that labor supply, productivity, and savings vary over the life cycle. This implies that the age structure of a population may be consequential for its economic performance – as measured by income per capita. Large youth and elderly cohorts might slow the pace of economic growth, while large working-age cohorts might speed it. However, in addition to these "accounting" effects (assuming age-specific behavior remains unchanged we can simply calculate the consequences of age structure change mechanically) there are also behavioral effects. For example, increased longevity – a key driver of population aging -- can change life-cycle behavior, leading to a longer working life or higher savings for retirement.

One view is that population aging in the developed countries is likely to have a large effect, reducing income per capita, mainly through the fall in labor supply per capita that will accompany the reduction in the share of working-age population. However, even if this occurs, it may not be as harmful as it at first appears, for five reasons. First, as seen in the previous section, rough estimates of the magnitude of the effect of population aging on the rate of labor force participation, and the concomitant effect of changes in labor force participation on economic growth are, for most countries, of modest size.

Second, income per capita is not a welfare measure. Nordhaus (2003) estimates that over the 20th century improvements in longevity made a contribution to increasing welfare in the United States of roughly the same magnitude as the rise in consumption levels. The longer life expectancies that lead to aging can be thought of as improving welfare directly by expanding the population's lifetime budget set. Even if rising life expectancy were to lead to reduced

consumption levels per period, it is difficult to argue that the net effect of increased longevity on welfare will be negative.

Third, welfare depends on consumption, not income. Typically household income falls at retirement, but consumption may remain relatively high. It follows that we could have two populations, each enjoying the same consumption stream over the same lifespan, but the population with a larger elderly age cohort will have lower per capita income. For these populations, income per capita would vary with the age structure, but lifetime welfare would be equal. Thus, aging-induced declines in income per capita are not necessarily indicative of corresponding declines in welfare.

Fourth, while the consequences of a fall in per capita income may not be all that bad for welfare, it is not even clear that population aging will lead to a fall in per capita income. Increases in life expectancy in the United States over the last two centuries have been associated with reductions in the age-specific incidence of disease, disability, and morbidity (Costa 1998; Fogel 1994, 1997). Mathers and others (2001) show that health-adjusted life expectancy (each life year weighted by a measure of health status) rises approximately one for one with life expectancy across countries. Other studies, mostly for the US and other wealthy industrial countries, imply that the morbid years are compressed – both relatively and absolutely -- as life expectancy rises. Agents can respond to an expectation of longer healthy lifespans by working longer or saving more (i.e., consuming less). If they work longer they can keep their consumption levels high and need only save at the same rate as before for old age. If they decide to take extra leisure and retire at the same age as before they will have lower consumption levels throughout their life and will need higher savings rates while working. Bloom, Canning, and Moore (2004 and 2007) examine this issue theoretically and argue that when health improves and longevity rises the optimal response is likely to be a longer worker life, without the need for higher savings.³⁰ To the extent that working lives lengthen in response to longer lifespans there is no reduction in income levels. Indeed average income and consumption per capita can remain high. The assumption of fixed age-specific rates of labor force participation assumes no behavioral change when in fact such changes may occur.

Fifth, old age "dependency" is something of a misnomer. Lee (2000) shows that, in all pre-industrial societies for which he was able to assemble evidence, the flow of transfers is from the middle aged and old to the young. In developed countries, on the other hand, both the young and the old benefit from government transfers, and the net pattern of transfers is towards the elderly. However, at the household level in the United States, elderly households make significant transfers to middle aged households, undoing to some extent the effects of government policy. The dependency burden of the elderly is a function of the institutional welfare systems that are in place rather than an immutable state of affairs.³¹

³⁰ The tendency towards early retirement is explained by an income effect with people wanting more leisure time as incomes rise.

³¹ Mason et al. (2006) propose and investigate a National Transfer Accounts methodology to aid in understanding the extent and effect of intergenerational transfers.

Analysis of the effects of population aging on economic growth represents virgin territory. The size and nature of the current demographic shift is unprecedented, so past experience cannot provide a guide. Demographers and economists therefore need to rely on models.

Insofar as population aging leads to labor supply reductions that cause wages to rise, and given that different countries are in different phases of the demographic cycle, international migration flows are likely to be stimulated. Such flows will smooth the age distribution since working-age individuals account for a large proportion of international migrants. However, judging by historical experience, and in a context of widespread institutional and social constraints on immigration, the magnitude of the increases needed to smooth the age distributions is inordinately large and not, as a practical matter, likely to be a decisive response to population aging. Although migrants themselves benefit greatly, moreover, it is not yet well established whether immigration results in net economic benefits or losses to receiving countries. Lee and Miller (2000) finds only very small net fiscal impacts of immigration to the US over the next century.³²

The importance of policy

The policy environment is crucial in determining the effect of aging on economic growth. The problem of population aging is more a problem of rigid and outmoded policies and institutions than a problem of demographic change per se. Policies need to be developed that account for the natural incentives individuals have to adjust their behavior in the face of population aging.

Among the most commonly mooted policy changes is to alter retirement incentives so that people can fulfill their expressed desires to work longer in response to expectations of greater longevity. More flexible old-age pension arrangements combined with increases in the official retirement age will encourage prolonged workforce participation. Legal and cultural efforts to discourage age discrimination by employers may also be required. Lifelong education programs could assist in these efforts, by helping people adapt their skills and knowledge to the demands of a changing economy.

Investment in improving the health of those aged 60 or over is a further policy option. Not only does this reduce the burden on health care and social security systems, but by compressing morbidity into fewer years late in life, it also enables people to work for longer. As Zweifel, Felder, and Meiers (1999) have shown, health care costs appear to be concentrated in the last few years of life regardless of age, so population aging defers rather than increases costs.³³ In addition to easing strains on state finances, the compression of morbidity will enable older people to continue to contribute their expertise and knowledge to economies.

Policy should also encourage increased labor force participation. Laws against sex discrimination have helped open up the workplace to women in many wealthy countries – middle and low-

³² Ronald Lee & Timothy Miller, 2000. "Immigration, Social Security, and Broader Fiscal Impacts," *American Economic Review*, American Economic Association, vol. 90(2), pages 350-354, May.

³³ Zweifel S, Felder S, Meiers M. Ageing of population and health care expenditure: a red herring? *Health. Econ* 1999; 8: 485–496.

income countries with aging populations would likely benefit from similar measures. Upward pressure on wages is likely to increase women's participation in the workforce, and this can be complemented by policies that facilitate mothers combining work and family, such as state-funded childcare and more flexible working hours. The latter, of course, also incentivizes childrearing, with long-term impacts on the age structure.

The issue of immigration is also vital; policymakers in aging developed countries have not yet successfully made the case for increased immigration from the developing world, but demographic imbalances mean demand by employers is likely to intensify in the coming decades. Compensating those who lose out from the process (such as low-skilled receiving-country workers) might help make opening up to migration more politically feasible.

A further important policy consideration is to address the funding gap caused by the intergenerational transfers implicit in pay-as-you-go health and pension systems.³⁴ In an aging society, these imply that small cohorts of working-age people will make transfers to large cohorts of elderly. But, even under a pay-as-you-go system, it is not inevitable that the old must depend on transfers from younger generations. Adjusting premiums and benefits or making a transition to full funding or a system of private accounts, whereby individuals effectively draw at least part of their pensions from investments made during their time in work, could help reduce old age "dependency". Fully funded systems mean that older workers who continue in employment benefit by having a larger sum to draw on when they eventually retire. Moving toward such a system would require robust institutions that can both attract sufficient savings and invest them productively and safely. There are some concerns that the increases in savings required to move away from a pay-as-you-go system will mean investment opportunities become scarcer and returns diminish. Although Poterba (2004) finds that the historic effect of demography on real rates of return has been small,³⁵ Turner (2006) injects some major cautionary notes into this discussion: (a) higher savings rates will tend to lower returns on investments; (b) when new generations are smaller, both pay-as-you-go and fully-funded pension systems will face falling asset prices, so the latter are not a cure-all for troubled pension systems; and (c) the performance of funded systems depends on global capital markets, not just those of any particular country. He concludes that fully funded systems will not necessarily provide a complete answer to demographic change and that pay-as-you-go systems can be adjusted to achieve "many of the supposed advantages of funded systems". Heller (2003) emphasizes the fact that the historically unprecedented commitments governments have already made to financial support of the elderly will play a major constraining role in future policymaking in this area.^{36, 37}

³⁴ Weil (2006) highlights the importance of this issue in saying, "The most important means by which aging will affect aggregate output is the distortion from taxes to fund PAYGO pensions."

³⁵ Poterba, 2004.

³⁶ Auerbach, Kotlikoff, and Leibfritz (1999) review the use of generational accounting as a means of studying these and broader questions about intergenerational transfers.

³⁷ Barr and Diamond (2006) systematically address many of the issues and controversies in the arena of pensions and their distributional effects, savings, and economic growth.

An uncertain future

Of course, humility is required when making decisions based on future demographic projections. The sources of uncertainty remain considerable. Population projections, for example, are not cast in stone. The possibility of changes in fertility behavior or health shocks could tilt the balance between young and old in unforeseen ways. As discussed above, projections of population size and structure can change quite significantly even over short periods. Longevity projections are also precarious and hotly debated. Trends in diet and lifestyle as well as medical and public health advances could combine to raise or lower life expectancy in future. Technology has a crucial role to play. The compression of morbidity occurring today is partly driven by new health technology, but it is uncertain whether technological advance will continue, diminish, or accelerate in future, and what cost implications it will have. Trends such as the obesity “epidemic” could dampen the positive effects of technology. The WHO projects that by 2025 300 million people will be obese; the WHO also notes that the health impacts of rising obesity prevalence could reverse life expectancy gains in some countries.³⁸ Non-health related events such as climate change or war could also have an unpredictable effect on longevity.

Nor is it clear whether the economic impacts of aging will be uniform across societies. In the developed world, longer lifespans have been accompanied by a shift in support for older generations from families to the state. In many developing countries, families remain pivotal to elder care and as the lifespan becomes longer there may be disruption to family structures, leading to a similar move towards public transfer systems and savings as that experienced in wealthier parts of the world.

Although drawing lessons from the past may not be possible for an aging future, we do know that some societies in the past century have coped well with the major demographic shift represented by population growth. The world economy has had the flexibility to absorb and in general benefit from dramatic increases in population numbers. If today’s policymakers take prompt action to prepare for the effects of aging, the next major shift is likely to cause much less hardship than many fear.

³⁸ T.L. Visscher and J.C. Seidell (2001): The public health impact of obesity, *Annu. Rev. Public Health* 22, pp. 355–375

References

- Auerbach, Alan J., Laurence J. Kotlikoff, and Willi Leibfritz, eds. (1999). *Generational Accounting around the World*. National Bureau of Economic Research Project Report.
- Barr, Nicholas and Diamond, Peter A., "The Economics of Pensions". *Oxford Review of Economic Policy*, Vol. 22, No. 1, pp. 15-39, 2006.
- Blinder, A. S. (2006). Offshoring: The Next Industrial Revolution? *Foreign Affairs*, March/April.
- Bloom, D.E., Canning, D., Fink, G., and Finlay, J. (2007). "Demographic Change, Institutional Settings and Labor Supply." Mimeo, PGDA, Harvard University.
- Bloom, David E., David Canning, Guenther Fink, and Jocelyn Finlay, 2007, "Fertility and Female Labor Force Participation" NBER Working Paper #13583. Available at www.nber.org/papers/w13583
- Bloom, D.E., Canning, D., Mansfield, R., and Moore, M. (2007). "Demographic Change, Social Security Systems, and Savings." *Journal of Monetary Economics* 54(1): 92-114.
- Bloom, D. E., Canning, D., Moore, M. (2004). The Effects of Improvements in Health and Longevity on Optimal Retirement and Saving, NBER Working Paper 10919.
- Bloom, D. E., Canning, D., Graham, B. (2003). Longevity and Life Cycle Savings, *Scand. J. of Economics*. 105 (3): 319-338
- Bloom, D. E., Canning, D., Sevilla, J. (2002). *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*, RAND, MR-1274, Santa Monica, Calif., 2002.
- Bloom, D. E. and J. G. Williamson (1998). "Demographic transitions and economic miracles in emerging Asia." *World Bank Economic Review* 12(3): 419-455.
- Broda, C. and D. E. Weinstein (2004). "Happy News from the Dismal Science: Reassessing the Japanese Fiscal Policy and Sustainability." National Bureau of Economic Research Working Paper Series No. 10988.
- Burtless, G. and R. A. Moffit (1984). The effect of Social Security benefits on the labor supply of the aged. *Retirement and Economic Behavior*. H. J. Aaron and G. Burtless. Washinton, D.C., Brookings Institution: 135-174.

- Costa, D. L. (1998). *The Evolution of Retirement: An American Economic History, 1880–1990*. National Bureau of Economic Research Series on Long-Term Factors in Economic Development. Chicago: University of Chicago Press.
- Costa, D. L. (2002). "Changing Chronic Disease Rates and Long-Term Declines in Functional Limitation among Older Men." Demography 39(1): 119-137.
- Crimmins, E. M. (2004). "Trends in the Health of the Elderly." Annual Review of Public Health 25(1): 79-98.
- Crimmins, E. M., Y. Saito, et al. (1997). "Trends in Disability-Free Life Expectancy in the United States, 1970-90." Population and Development Review 23(3): 555-572.
- Diamond, P. (2002). Social Security Reform, Oxford University Press.
- Dychtwald, K. (1999). Ken Dychtwald on the Future. San Francisco Chronicle. San Francisco.
- Fenge, R. and M. Werding (2003). Ageing and the Tax Implied in Public Pension Schemes: Simulations for Selected OECD Countries, SSRN.
- Fogel, R. W. (1994). "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy." *American Economic Review* 84: 369–95.
- Fogel, R. W. (1997). "New Findings on Secular Trends in Nutrition and Mortality: So Implications for Population Theory." In M. Rosenzweig and O. Stark, eds., *Handbook of Population and Family Economics*, vol. 1A. Amsterdam: Elsevier.
- Fries, J. F. (1989). "The compression of morbidity: near or far?" *Milbank Quarterly*(67): 208-32.
- Fries, J. F. (1980). Aging, natural death, and the compression of morbidity. 303: 130-135.
- Gerland, P. (2005). "From divergence to convergence in sex differentials in adult mortality in developed countries." PAA 2005 - Philadelphia, PA (March 31) Poster #11 - Session 1: Aging, Life Course, Health, Mortality, and Health Care.
- Gray, A. (2005). "Population Ageing and Health Care Expenditure." Ageing Horizons(2): 15-20.
- Greenspan, A. (2003). "Aging global population: testimony before the Special Committee on Aging, U.S. Senate, February 27, 2003." Speech.
- Gruber, J. and D. Wise (1998). "Social Security and Retirement: An International Comparison." The American Economic Review 88(2): 158-163.

- Heller, Peter S. (2003). *Who Will Pay: Coping with Aging Societies, Climate Change, and Other Long-Term Fiscal Challenges*. International Monetary Fund.
- Holzmann, R. (2000). "The World Bank Approach to Pension Reform." International Social Security Review 53: 11-34.
- Jagadeesh, G., R. P. Benjamin, et al. (1997). "Generational accounts for the United States: an update." Economic Review(Q IV): 2-23.
- Kelley, A. C. (2001). "The Population Debate in Historical Perspective: Revisionism Revised". In N. Birdsall, A. C. Kelley, and S. W. Sinding, eds. *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford University Press. 24–54.
- Lee, Ronald (2000) "A Cross-Cultural Perspective on Intergenerational Transfers and the Economic Life Cycle," in Andrew Mason and Georges Tapinos, eds., *Sharing the Wealth: Demographic Change and Economic Transfers between Generations* (Oxford University Press, Oxford), pp.17-56.
- Lee, R. and T. Miller (2000). "Immigration, Social Security, and Broader Fiscal Impacts." American Economic Review 90(2): 350-354.
- Lutz, W., W. Sanderson, and S. Scherbov (2008). "The coming acceleration of global population ageing." Nature 451: 716-719.
- Kulish, M., K. Smith, et al. (2006). *Ageing, Retirement and Savings: A General Equilibrium Analysis*, Reserve Bank of Australia.
- Mason, A., R. Lee, et al. (2006). "Population Aging and Intergenerational Transfers: Introducing Age into National Accounts." National Bureau of Economic Research Working Paper Series No. 12770.
- Mason, Andrew, Ronald Lee, An-Chi Tung, Mun-Sim Lai, and Tim Miller (2006). "Population aging and intergenerational transfers: Introducing age into national accounts." NBER Working Paper 12770. Available at <http://www.nber.org/papers/w12770>
- Mathers, C. D. et al. (2001). "Healthy Life Expectancy in 191 Countries, 1999." *Lancet* 357 (9269):1685–91.
- McKibbin, Warwick J. (2006). "The global macroeconomic consequences of a demographic transition," Centre for Applied Macroeconomic Analysis, The Australian National University. CAMA Working Paper 6/2006. Available at: http://cama.anu.edu.au/Working%20Papers/Papers/2006/McKibbin_62006.pdf

- Nordhaus, W. (2003). "The Health of Nations: The Contribution of Improved Health to Living Standards." In K. H. Murphy and R. H. Topel, eds., *Measuring the Gains from Medical Research: An Economic Approach*. Chicago: University of Chicago Press.
- Oeppen, J. and J. W. Vaupel (2002). Broken Limits to Life Expectancy. 296: 1029-1031.
- Peterson, P. G. (1999). Gray Dawn: The Global Aging Crisis. Foreign Affairs. January/February.
- Poterba, J. (2004). "The Impact of Population Aging on Financial Markets." In *Symposium Proceedings, Global Demographic Change: Economic Impacts and Policy Challenges*. Federal Reserve Bank of Kansas City. Jackson Hole, Wyoming August 26 - 28, 2004. Available at www.kc.frb.org/Publicat/sympos/2004/sym04prg.htm
- Preston, S. H. (2007). The changing relation between mortality and level of economic development. 36: 484-490.
- Seshamani, M. and A. Gray (2004). Ageing and health-care expenditure: the red herring argument revisited. 13: 303-314.
- Turner, Adair (2006). "Pension Challenges in an Aging World." Finance & Development 43(3):36-39.
- Tyers, R. and Q. Shi (2007). "Global demographic change, policy responses and their economic implications", The World Economy 30(4): 537-566, April.
- United Nations, Population Division (all editions from 1994 through 2006). World Population Prospects.
- Visscher, T. L. S. and J. C. Seidell (2001). The Public Health Impact of Obesity. 22: 355-375.
- Weil, David N. (2006). "Population Aging". NBER Working Paper No. 12147.
- Woo, J., T. Kwok, et al. (2002). Ageing in China: health and social consequences and responses. 31: 772-775.
- Zweifel, P., S. Felder, et al. (1999). Ageing of population and health care expenditure: a red herring? 8: 485-496.

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