

SOME ECONOMIC CONSEQUENCES OF GLOBAL AGING

A Discussion Note for the World Bank

Ronald Lee, Andrew Mason and Daniel Cotlear



December 2010



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Health, Nutrition and Population (HNP) Discussion Paper

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Health, Nutrition and Population (HNP) Discussion Paper

Some Economic Consequences of Global Aging: *A Discussion Note for the World Bank*

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Abstract: The note describes the importance of population aging world-wide, clarifying its prevalence among middle- and low-income countries, which suggests that many developing countries are getting old before they are growing rich. The note then asks in what way population aging is an economic problem and what are the specific challenges facing developing countries in this process. The note argues against the common “time-bomb perception”, and clarifies how a simplistic extrapolation from the impact of aging on single programs such as public pensions gives a misleading impression about the more general macroeconomic consequences of population aging, where numerous elements contribute to a more nuanced result. The note briefly discusses various topics of importance in the population aging debate, including: intergenerational flows, social contracts, the risk management element of old-age policies, and the impact of aging on health care costs. The note seeks to share a number of counterintuitive or simply non-intuitive facts, including: (i) the large impact of declines in fertility on population aging (often more important than increases in longevity); (ii) the impact of increased life expectancy on working age populations (often larger than among old age populations); (iii) the *positive* impact of aging on capital intensity; (iv) the need to include education in assessments of intergenerational equity (these often simply look at who pays for old-age pensions and health services); (v) the role of long-term care programs as insurance for risks faced by *young* adults.

Keywords: global aging, intergenerational flows, National Transfer Accounts, support ratio, retirement behavior

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PREFACE

This note was produced as part of a broader project to produce tools and disseminate concepts from the economic literature on demographic change to facilitate the work of World Bank staff and other interested parties in the area of Population Aging.

The note describes the importance of population aging world-wide, clarifying its prevalence among middle- and low-income countries, which suggests that many developing countries are getting old before they are growing rich. The note then asks in what way population aging is an economic problem and what are the specific challenges facing developing countries in this process. The note argues against the common “time-bomb perception”, and clarifies how a simplistic extrapolation from the impact of aging on single programs such as public pensions gives a misleading impression about the more general macroeconomic consequences of population aging, where numerous elements contribute to a more nuanced result. The note briefly discusses various topics of importance in the population aging debate, including: intergenerational flows, social contracts, the risk management element of old-age policies, and the impact of aging on health care costs. The note seeks to share a number of counterintuitive or simply non-intuitive facts, including: (i) the large impact of declines in fertility on population aging (often more important than increases in longevity); (ii) the impact of increased life expectancy on working age populations (often larger than among old age populations); (iii) the *positive* impact of aging on capital intensity; (iv) the need to include education in assessments of intergenerational equity (these often simply look at who pays for old-age pensions and health services); (v) the role of long-term care programs as insurance for risks faced by *young* adults.

POPULATION AGING IS A GLOBAL ISSUE

Population aging is a global issue that is affecting or will soon affect virtually every country around the world. Changes in age structure are driven primarily by the decline in birth and death rates that characterize the demographic transition. The classic demographic transition begins with a decline in infant and child mortality that leads to a large increase in the number of surviving children and a corresponding rise in the child share of the population. The timing varies from setting to setting, but in most cases birth rates eventually begin to decline several decades after the start of mortality decline, leading to a decline in the number of children and in the percentage of population in the child ages. The large birth cohorts generated by the onset of the demographic transition have dramatic effects on age structure as time proceeds. First, they increase the share of the population in the working ages and, then, the share of population at older ages. It is primarily the historical decline in birth rates that is leading to the increase in the share of the population at older ages. Continued decline in death rates reinforces the effects of fertility decline because the gains in survival are increasingly concentrated at older ages.

Population estimates and projections from the United Nations can be used to chart the three important phases of the global age transition. Each of the 228 countries has been classified depending on whether the greatest change in population over a specified period was experienced by the 0-24 population, the 25-59 population, or the 60+ population. The increase in the child population dominated the changes in age structure between 1950 and 1975. The increase in the working-age population (25-59) is the dominant change in age structure between 1975 and 2015. After 2015, the increase in the 60+ population will be greatest in just over half of the world's countries (Figure 1). Thereafter, the increase in the 60+ population will be the most important change in population age structure throughout the world.¹

¹Compared to other methods, this approach gives a conservative view of the importance of population aging. Some researchers compare the growth rates of population at each age but this tends to exaggerate population aging because the oldest age groups are starting from a very small base. An alternative would be to consider countries that are experiencing any increase in the percentage of the elderly population. This would lead to a larger count than the one provided here. Broader age groups are used here than is typical for reasons that will be explained below.

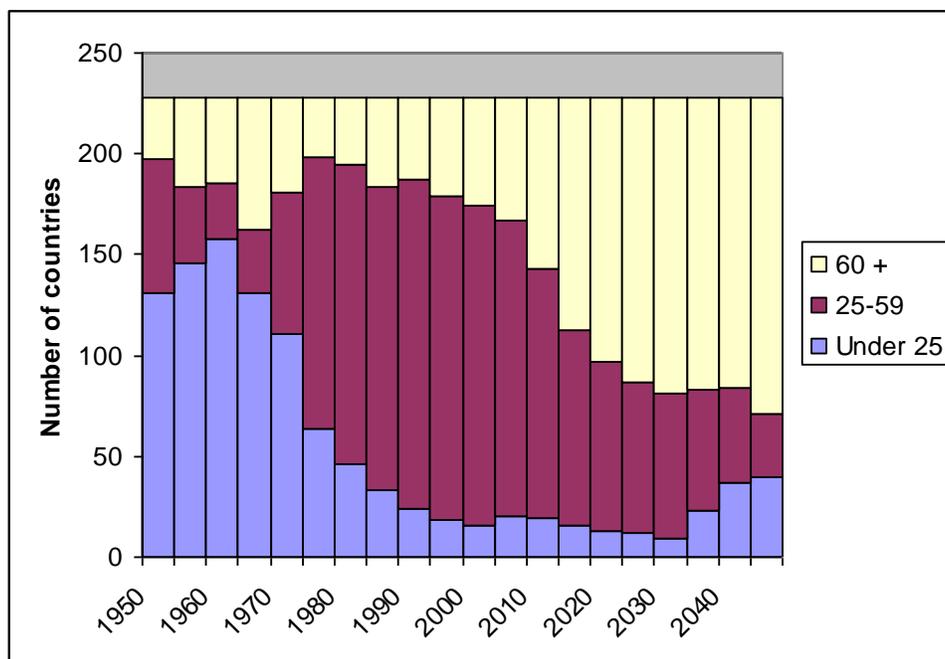


Figure 1. Distribution of countries by phase in age transition. Countries classified based on age group with greatest increase in population.
 Source: UN Population Division (2009).

AGE STRUCTURE: ROLES OF MORTALITY AND FERTILITY

In order to understand the economic implications of age structure, it is essential to appreciate the relative importance of mortality and fertility decline. Both life expectancy and the total fertility rate have changed dramatically over the last 60 years and further changes are expected. Life expectancy at birth increased by 11 years between 1950-55 and 2005-10 in the more developed regions, but the gains have been much greater in less developed regions (excluding the least developed countries) where life expectancy increased by twenty-six years and in the least developed countries where life expectancy increased by 19.5 years (Table 1.) Further gains are anticipated over the coming decades along with further convergence between more developed and less developed countries of the world.

Table 1. Total fertility rate and life expectancy at birth, 1950-55, 2005-10, 2045-50, major regions of the world.						
	Total Fertility Rate			Life-expectancy at birth		
	1950-55	2005-10	2045-50	1950-55	2005-10	2045-50
More developed regions	2.82	1.64	1.80	66.0	77.1	82.8
Less developed regions*	5.92	2.46	1.93	41.7	67.7	75.9
Least developed regions	6.62	4.39	2.41	36.4	55.9	68.5

*Excludes least developed regions. Source: United Nations Population Division 2009.

The connection between life expectancy and age structure is often misunderstood and erroneously believed to be the cause of population aging. Life expectancy is a synthetic cohort measure of current mortality conditions. It is equal to the average number of years that would be lived by a cohort subject to current age-specific death rates. It is straightforward and instructive to calculate the average number of years lived (person years lived) at each age given typical age-specific death rates for each value of life expectancy. This is done in Figure 2 for three broad age groups 0-15, 25-64, and 65.

Over most of the transition in life expectancy the greatest gains in years lived occur in the 15-64 age group. If we consider, for example, the increase from life expectancy 40 to life expectancy 60, about 5 of the 20 years gained were at 65 and older, about 2 years were gained in the 0-14 age span, and the remaining 13 years were gained in the 15-64 age span. Thus, the increase in life expectancy would lead to more years lived during the working years. For any fertility rate, the greatest change in population likewise would have been to those in the 15-64 age spans. For those countries with very high life expectancy, the greatest gains will be experienced at the end of life. Note that for a life expectancy of 75-80, where most of the developed countries currently fall, the gains at 65+ exceed the gains at 15-64.

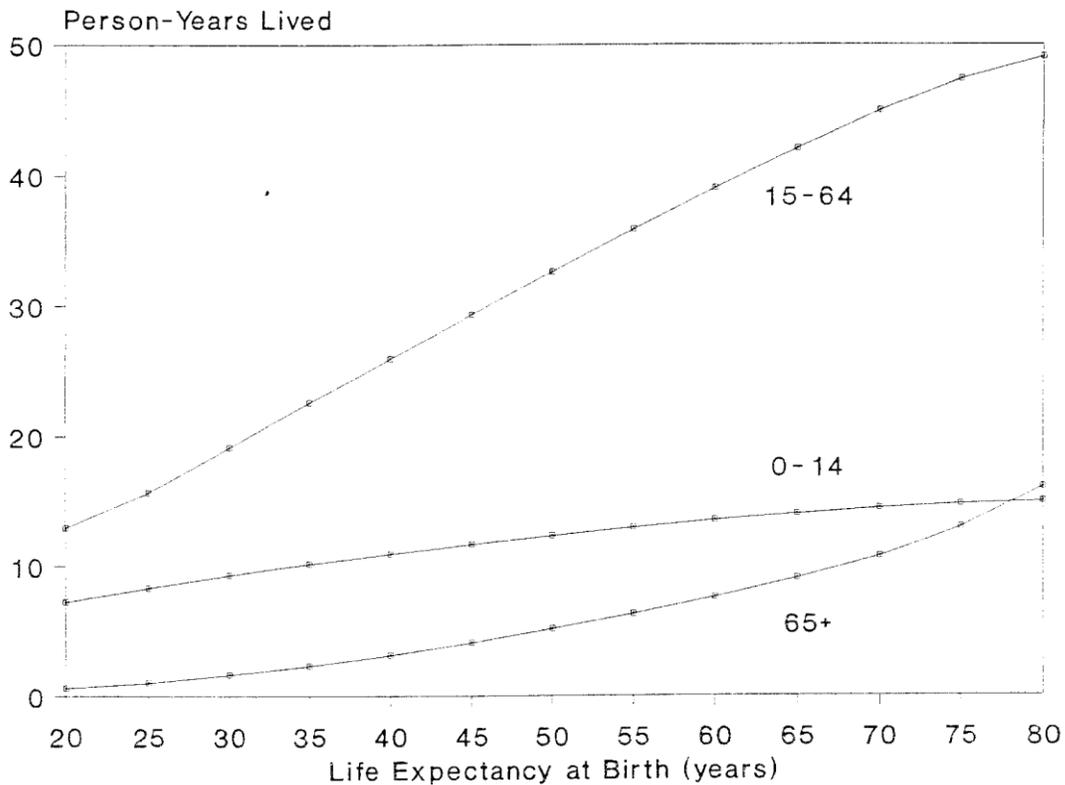


Figure 2. Person years lived in three broad age groups by level of life expectancy at birth.
Source: Lee (1994).

The total fertility rate shown in Table 1 for regions of the world is equal to the number of children the average woman would bear during her lifetime given current age-specific birth rates. To understand the implications of fertility for population age structure assume for the moment that all persons survived to age 80 and then died. If women had a total fertility rate of 2, or more generally had replacement level fertility², each generation exactly replaces itself. The age distribution of the population would be uniform with equal numbers at each age. If instead the TFR is 4, each couple is replacing itself with four offspring. Taking a typical generation length of 30 years, the population of age x will be twice as large as the population age $x+30$ and only half the size of the population age $x-30$. In other words, the population will be very young. If we were to consider the case of extremely low fertility, a TFR of only 1, the population of each successive generation is only half of the preceding and the result will be a very old population. The relationship between the TFR and age structure described here holds given a more realistic age-specific mortality schedule. Given age-specific death rates, a halving of the TFR will reduce the surviving offspring of each generation by half with very substantial implications for population age structure.

ARE NATIONS GROWING OLD BEFORE THEY ARE GROWING RICH?

At the present time, aging countries are primarily wealthy and industrial. In three countries, Japan, Italy, and Germany, 20 percent or more of the population is projected to be 65 and older in 2010. Among the 24 countries in which 15 percent or more of the population is 65 and older (2010 projection), a handful are middle-income countries: Bosnia and Herzegovina, Bulgaria, Latvia, Lithuania, and Ukraine. In many low- and middle-income countries, however, fertility rates have dropped to low levels and, in the absence of some dramatic reversal in birth rates, their populations will age rapidly.

Based on the medium scenario from the UN population projections, the percentage of the population 65 or older will exceed 15% in 2050 for 42 countries with a per capita income of less than \$10,000 in 2005 (Table 2). Of these, 13 countries had a per capita income of under \$5,000 in 2005. Myanmar is projected to reach this aging benchmark despite a 2005 per capita GNP of only \$800. Almost one-quarter of China's population is projected to be 65 and older by 2050.

² Because there are about 105 male births per 100 female births in a population with no sex selective behavior (e.g. sex selective abortion), replacement level fertility would be 2.05 births per woman if there were zero mortality. Taking mortality into account, replacement level fertility will be slightly higher than this when mortality is low.

Table 2 Rapidly aging low income countries.

	Per Capita GDP, 2005	Percentage 65+, 2050		Per Capita GDP, 2005	Percentage 65+, 2050
Myanmar	838	18.9	Peru	6452	16.5
Vietnam	2143	19.2	Ecuador	6737	17.5
Moldova	2190	22.0	Thailand	7061	23.3
Mongolia	2609	17.4	Jamaica	7189	16.9
Indonesia	3209	18.6	Suriname	7279	21.6
Guyana	3278	21.8	Macedonia, FYR	7394	26.9
Sri Lanka	3420	21.9	Montenegro	7450	22.3
Georgia	3520	26.0	Turkey	7786	18.4
Morocco	3554	16.6	Panama	8439	17.5
Bhutan	3649	16.2	Brazil	8474	19.4
China	4088	23.7	Belarus	8541	26.5
Armenia	4162	24.0	Serbia	8644	22.6
Azerbaijan	4575	19.5	Kazakhstan	8699	17.1
Dominican Republic	5214	15.2	Costa Rica	8712	19.9
El Salvador	5439	16.1	Uruguay	9266	21.4
Albania	5465	21.0	Iran, Islamic Rep.	9314	17.8
Ukraine	5583	27.6	Bulgaria	9328	31.8
Colombia	5867	18.7	Romania	9368	30.2
Bosnia and Herzegovina	5949	29.4	Lebanon	9545	17.7
Algeria	6062	17.6	Venezuela, RB	9877	16.4
Tunisia	6382	20.8	Mauritius	9975	20.7

Notes: GDP per capita, PPP (constant 2005 international \$) from World Development Indicators; Percentage 65+ is United Nations Population Division Medium Scenario.

The prospect of population aging in low and middle income countries is a source of concern for two reasons. The first is that achieving high-income status may be more difficult for countries with large elderly populations. The second is that meeting the needs of a large elderly population may be exceedingly difficult in low- and middle-income countries. This is not just a matter of income, but also a matter of building economic and social institutions that are needed to realize income security, adequate health care, and other needs of the elderly.

The first issue is a question of whether countries can achieve rapid economic growth over the next three or four decades. For the second issue, however, building appropriate institutions for an aging society cannot wait because those reaching old age in 2050 are already entering the workforce today. Decisions they make over their entire adult life will be framed by the social and economic institutions, expected and actual, that influence economic security in old age.

IS POPULATION AGING A PROBLEM?

Population aging is an important issue because of individual-level features of the aging process and social and economic institutions that arise as a consequence (see also the final section of this paper on **policy issues**). Consider the individual-level features. As people grow older, the chances that they will experience health crises, physical disability, cognitive impairment, and death all increase. In very traditional settings and contemporary low-income countries these risks are less heavily concentrated at older ages. But in high-income countries, with relatively long life expectancies, these risks are increasingly compressed and primarily affect those at older ages.

One implication is that average human capital and productivity decline rapidly at older ages. The extent of decline in the 50s and 60s is subject to some dispute, but the eventual decline at older ages is beyond question. The effects of physical and cognitive decline are reinforced by (1) the natural obsolescence of skills and knowledge acquired at a much earlier age; (2) pervasive disincentives inherent to support systems – mandatory retirement, high tax rates, poorly designed pension systems (Gruber and Wise 1999); and (3) an increase in the demand for end-of-life leisure driven by higher incomes (Costa 1998). Because of these forces, a universal feature of contemporary societies is that labor income at old ages is insufficient to meet material needs.

Health has another important implication for the individual economics of old age. In many high income countries, consumption increases rapidly at old ages because spending on health care and long-term care increase. Again this reflects, in part, underlying demand for these goods and services and, in part, market inefficiencies, e.g., moral hazard and heavy subsidization of these services by the public sector. The bottom line is that average consumption greatly exceeds average labor income in aging societies for reasons that are, in part, a consequence of fundamental features of aging and, in part, a consequence of features of the political and economic institutions employed to deal with the problems of individual aging.

Averages tell only part of the story, however. Risk management is also a major issue for the elderly. Health shocks lead to unexpected retirement and lost labor income, high consumption, and the depletion of personal wealth. As a consequence, health shocks are often impoverishing. In addition, uncertainty about the age of death adds great complexity to financial planning for the elderly. Retirees and those who are nearing retirement are vulnerable to financial crisis as are those who are accumulating wealth in anticipation of retirement. In many countries, women are at higher risk because they tend to outlive men, spending a number of years as widows, and because pensions may go to their husbands, and to die with them, leaving their widows in poverty. Finally, demographic randomness may mean that some elders have no surviving family to assist them, and some working age children without siblings may have an exceptionally heavy burden of support for multiple aging parents.

Large lifecycle deficits³ and high risk profiles at old ages give rise to intergenerational flows between working ages and the elderly. As populations age, the relative numbers of those two age groups change. The support ratio, i.e., the number of workers per retiree, drops by one-half or more. This basic change underlies many of the concerns about the effects of population aging:

- Slower economic growth
- Poverty among the elderly
- Generational equity
- Inadequate investment in physical and human capital
- Inefficiency in labor markets
- Sub-optimal consumption profiles
- Unsustainable public transfer systems

Whether or not population aging will lead to these outcomes will depend to a considerable degree on the economic systems and the institutions which channel intergenerational flows – and the policies that influence their development. All intergenerational flows come in one of two forms: transfers or asset-based flows. All flows are mediated by either public institutions (governments) or private institutions (families, financial institutions, markets) (Table 3). An international project covering more than 30 countries on six continents is developing National Transfer Accounts (NTA) designed to measure economic flows across age groups. The NTA are described in Box 1.

The systems on which societies rely vary widely and change as economies develop. Currently the elderly in many countries in Europe and an important group of countries in Latin America rely primarily on public transfer systems that provide pensions, health care, and other public goods and services. As compared with Western European countries, the elderly in Japan and especially the United States rely less on public transfers (Mason and Lee 2009).

Table 3. A Classification of Economic Mechanisms for Intergenerational Flows.			
	Asset-based reallocations		Transfers
	Capital	Property	
Public	Negligible	Public debt Student loan programs Sovereign wealth funds Currency stabilization funds	Public education Public health care Unfunded pension plans Transfers to governments from ROW
Private	Housing Consumer durables Corporate profits Partnerships and sole proprietorships	Consumer debt Land Sub-soil minerals	Familial support of children and parents Bequests Charitable contributions Remittances
Source: Mason, Lee et al. (2009); adapted from Lee 1994.			

³ The lifecycle deficit is defined as the difference between consumption and labor income at each age.

Private (familial) net transfers to the elderly are small and relatively unimportant in Western industrialized countries. In developing countries, familial transfers are relatively important but the direction of those flows varies with age and the economic circumstances of the elderly. In general, net familial transfers received by the elderly increase with their age in both Asia and Latin America. In many instances young elderly

The elderly can rely on assets in two ways to fund the gap between what they consume and what they produce through their labor. One possibility is that they can dis-save, but as an empirical matter they do not do so in any country for which estimates are currently available. The second possibility is to rely on asset income. This is very important in many countries. Among the industrialized countries for which estimates are currently available, the elderly in the US rely most on assets to fund their lifecycle deficit. In Germany and Sweden, with their large social welfare systems, the elderly rely hardly at all on assets to meet retirement needs. Among the developing countries, the picture is more complex. In Thailand, South Korea, and Mexico, the elderly are relying heavily on assets to fund their retirement. In Taiwan, Brazil, and several other Latin American countries the elderly rely on assets to fund a third or less of their lifecycle deficit.

Box 1. National Transfer Accounts

National Transfer Accounts (NTA) is a system designed to measure economic flows across age groups in a manner consistent with National Income and Product Accounts. NTA measures how each age group produces, consumes, shares, and saves resources. The goal is to provide comprehensive measures of the economic lifecycle and the economic mechanisms and systems used to reallocate economic resources across generations. The accounts provide comprehensive estimates by single years of age of: (a) public and private consumption and key components, e.g., health and education; (b) labor income including earnings and an estimate of the return to labor of self-employed and unpaid family workers; (c) public transfers including both inflows and outflows (taxes) for pensions, health care, education, and other public programs; (d) private transfers including both inter- and intra-household transfers; and (e) asset-based flows—public and private asset income and saving.

NTA is used to address many important issues that have become increasingly salient as population age structures have changed in many countries around the world. One use is to assess how changes in population age structure will influence economic growth and other important macroeconomic indicators, e.g., consumption, saving, and interest rates. The accounts are being used to assess the sustainability of public transfer systems including transfer programs for the elderly, for children, and for prime-age adults.

The accounts also provide estimates of private transfer systems that operate primarily within the family. Many of the concerns raised about public-sector transfers are just as important for private transfer systems, particularly in many developing countries. The accounts provide comprehensive estimates of how demographic groups such as the elderly are funding their consumption—by relying on continued work, public transfers, familial support, asset income, and dis-saving. Another important use of the accounts is to compare standards of living of children, prime age adults, and the elderly at a point in time. Because the accounts are being constructed for countries that vary with respect to their population age structures, levels of development, social and economic institutions, political systems, and other important dimensions, they should yield new insights about how policy should be formulated in light of the dramatic changes in age structure that will occur over the coming decades.

The accounts are being constructed by national research teams consisting of senior scholars and graduate students in more than 30 countries on six continents. The lead NTA institutions are the Center for the Economics and Demography of Aging, University of California at Berkeley, and the Population and Health Studies Program, East-West Center. For more information, see the project website at www.ntaccounts.org.

SOCIAL CONTRACTS, INCENTIVES, AND POPULATION AGING

The social contract can be broadly conceived to encompass mutual obligations that are mediated by social institutions – the nation state, the community, the tribe, or the family – as contrasted with individual obligations that are mediated by markets and formal contracts. In many contexts, the social contract might be construed more narrowly but for our purposes a broad approach that encompasses family obligations that are perpetuated by or depend on social norms is useful. But our interest is primarily restricted to intergenerational contracts because these are of particular relevance to issues of population aging.

Social contracts may arise as a collective expression of altruistic feelings, as in public sector need-based programs. They can also arise because of failures related to private contracts. Two problems are particularly salient with respect to population aging. The first is information asymmetries leading to adverse selection and moral hazard and, thereby, undermining some insurance markets, e.g., the markets for long-term care or annuities. The second is that individuals have a fixed lifespan and for some part of that not fully enfranchised. Those not yet born and minors cannot commit to private contracts and, thus, depend on the family and the state to represent their interests. Our mortality may lead to private market failures to the extent that economic behavior has consequences that extend beyond our own lifespan. Under some strong conditions, the altruistic family offers an adequate institutional framework to deal with these failures, but more generally the state plays an important role.

Defining the social contract is also important in periods of reform that may become more frequent as populations age. Changes in public policy inevitably create winners and losers, but it is unclear at what point changes might be viewed as an abrogation of the social contract. This surely depends on a shared notion of generational equity that is not easily defined.

Social contracts offer important economic gains by pooling risks – health crises, longevity risk, investment risk, and so forth. But social contracts can come with substantial costs because they create disincentives to work, to save, and to maintain a healthy lifestyle. The disincentive effects are minimized by relying on family contracts, either because of altruism or more effective monitoring. However, risk pooling is also minimal when relying on family contracts.

DECOMPOSING THE AGING PROBLEM: EARLY RETIREMENT, RISING CONSUMPTION, LOW SUPPORT RATIOS

When we talk of an “aging problem” the fundamental concern is that elderly are dependent on working age people for care and consumption, and the ratio of working age people to the elderly (the “support ratio”) declines as the population ages. We have already discussed the pace, extent, and demographic sources of population aging. However, the support ratio also depends on age patterns of individual consumption and labor income. These patterns differ substantially from country to country and change over the course of economic development.

First consider labor supply. In poor countries, the elderly tend to have quite high labor force participation. In the rich industrial countries, labor supply at older ages was much greater in 1900 than it is today. In the US, for example, the median age at which the labor force participation rate of men reached 50% was around 75 years in 1900 and it fell to 63 in 1980, a pattern found in European nations as well. This decline in labor supply at older ages reflects a variety of influences: rising incomes and a positive income elasticity for leisure, some of which is taken in old age; the incentives built into public and private pension structures; a rise in the range of recreational activities for the elderly. In developing countries like Taiwan, labor supply at older ages has also dropped dramatically. In every country for which National Transfer Accounts (NTA) have been constructed, labor income almost always drops below consumption by the late 50s or early 60s, and sometimes much earlier. This reduction in old age labor supply has deepened the economic dependence of the elderly and thereby made population aging more costly. However, the low fertility that is the primary cause of population aging is also associated with increased female labor force participation, and this may to some extent offset the decline in male labor supply at older ages.

In most developing countries, NTA finds that average cross-sectional consumption by age is quite flat across all adult ages, from the early 20s up to the oldest ages reported in surveys. In a few low income countries with strong public pension programs like Brazil and Uruguay, consumption rises with age, and in some low income countries consumption is somewhat lower in old age, but overall the flatness of the curve is striking. In countries growing very fast, such as China or India, the income benefits of growth can be tilted toward the young. This is likely due to higher education levels among the young, and their higher propensity to migrate and benefit from higher-wage opportunities. The flat consumption curves by age suggest that intergenerational transfers can be large enough as to partly balance the tilt toward the young in the wage curves.

In most developed countries, however, consumption has a strong upward tilt, increasing with age from the early 20s to the highest observed age, in the cross-section. The US is the most extreme case, with consumption about two thirds higher at age 85 than at age 25, and even higher thereafter. In the US, this consumption tilt has emerged in recent decades, coincident with the rise of public pension coverage and benefit generosity, and with public spending on health care and long term care. In the 1960s, the consumption age profile was flat or declining with age as in developing countries. This upward tilt in

consumption makes population aging more costly in the advanced economies than in developing economies.

Thus population aging generates falling support ratios, as the proportion of elderly rises. The changes in age patterns of labor supply and consumption in the rich industrial nations exacerbate the economic pressure due to population aging.

We must also note that when population ages, the proportion of children in the population falls, as does the ratio of children to working age adults. Since children also consume much more than they produce, their shrinking share of the population may lead to savings by families and the public sector. However, as we will discuss later, the lower fertility that is the main cause of population aging is also associated with increased investment in children's human capital, particularly public and/or private education, which somewhat reduces the savings.

National Transfer Accounts generate comprehensive measures of consumption and labor income by age that reflect these government programs but also include other government programs and private consumption and labor income. These estimated age profiles can then be used to project the effects of changing population age distributions for different countries. This could be done using the particular age profiles of each country, or averages across countries could be used, on grounds that the current age profiles in each country are unlikely to remain fixed, and that this average may give a better picture of the general tendencies in coming decades.

When this is done using average profiles and UN population projections to 2050, we find the following rates of change in the support ratio for selected countries:

Table 4. Rate of change of support ratio, 2008-2050.⁴

Country	Rate of change (percent per year)
Kenya	+.6
S. Korea	-.6
China	-.4
India	+.2
Spain	-.8
United States	-.2
Japan	-.7
Germany	-.5

The Kenya fertility decline began relatively recently, and age distributions changes will raise the support ratio over the next four decades. India will experience a more slowly

⁴ Population projections from the United Nations, 2008. Age profiles for the industrial countries are the average of Japan, the US, Sweden and Finland. Age profiles for the lower income countries are the average for Kenya, India, Indonesia and Philippines.

rising support ratio because it is farther through its fertility transition. China, and even more so S. Korea, are just about at the end of their phase of rising support ratios, and are about to begin a period of falling ratios due to population aging. Among the industrial nations, the US has relatively high fertility so its population will not become as old as elsewhere, and its support ratio will decline at only .2% per year. In Japan and even more so Spain, however, aging will be rapid and severe, and support ratios will decline more rapidly. The German case is intermediate. These rates of change in support ratios are, of course, based on current age patterns of private and government provided consumption and on current labor income.

These patterns will surely change. Nonetheless, these simple projections give a useful picture of the extent of the impact of population aging. We can see that in some countries the effects of population aging (or other changes in population age distribution) in the next four decades will be relatively minor, as in the US and India. In some other countries, such as Spain, Japan, or S. Korea, population aging will pose a greater problem. In still other countries, such as China and Germany, population aging will have an intermediate effect on the support ratio.

THE END IS NIGH? (AVOID MECHANISTIC PESSIMISM)

If we focus on specific government programs targeted to the elderly, like pension programs, health care for the elderly (like Medicare in the US), or long term care, it appears that the population aging projected through 2050 will have a devastating impact since program costs rise so much more rapidly than the tax payments that fund them. While these very large projected adverse effects may be correct for specific programs, they give a misleading impression about the more general macroeconomic consequences of population aging, because these programs are only a fraction of government activities, and government is only a fraction of total economic activity. The rates of change in the support ratio that were discussed above give a more accurate and comprehensive assessment of the severity of the growing dependency burden.

There are also potential beneficial changes, induced by population aging or the forces behind it, that tend to offset the rise in dependency as summarized by the declining support ratio. Here are some of them:

- It is quite possible, and perhaps likely, that population aging will lead to lower aggregate saving rates, since the proportion of dissaving or low-saving elderly rises relative to the proportion of working age people saving for retirement. However, it is important to realize that declining aggregate saving rates do not translate into declining capital per worker, even in an economy closed to foreign investment. This is because the growth rate of the working age population slows and perhaps turns negative in an aging population, so saving rates do not need to be so high to maintain or increase the capital labor ratio.
- It is more enlightening to think in terms of stocks, rather than flows. Population aging tends to raise the aggregate demand for wealth, partly because the elderly – who hold the greatest amount of wealth—grow as a proportion of the population, and partly due to behavior change (see section V.A. below).

- Population aging is caused primarily by low fertility, which is in turn associated with increased investments in human capital of children. The direction of causality can go in either direction, or both may be driven by a common factor such as rising incomes (Becker, Murphy and Tamura 1988). Population aging, therefore, is typically accompanied by increased investments in human capital, which raise labor productivity. This is discussed in more detail below; also see Lee and Mason 2009.
- Low fertility is also typically accompanied by higher female labor force participation. Once again, causality may flow in either direction or from a third factor, but this does not affect the conclusion that increased female labor force participation helps to offset declining support ratios (Bloom et al 2009).
- There are also subtle issues to consider in relation to intergenerational equity and high or rising public sector pension transfers to the elderly.
 - In measures of intergenerational equity in public spending, it is important to take public education into account in addition to the items usually included, that is public debt, and future obligations for spending on pensions, health care and long term care. In calculations of the net present value of life time public transfers, transfers received in old age are discounted six times more heavily than public education which comes much earlier in the life cycle, without even taking declining survival into account. (This calculation assumes that public education is received, on average, at age 10, while old age transfers are received, on average, at age 70, with a real discount rate of .03 per year: $\exp(.03*60)=6$.) See Bommier et al 2010.
 - When workers are taxed to provide public transfers to the elderly, the elderly may either consume these transfers (which is certainly the case with medical care or long term care) or they may at least partially return the public transfers to their children or grandchildren through either inter vivos transfers or end of life bequests (this appears to be happening in many industrial nations and some Latin American countries). Conversely, a reduction in public transfers to the elderly may be reversed through increased private transfers (this may be happening in Chile). Private transfers to the elderly may also be used as a way to preserve the assets of the elderly which will later be returned to the adult children as bequests.

SOME TOPICS OF DEBATE IN THE FIELD

A. LABOR INCOME, SAVINGS AND INVESTMENT

Most analyses of the economics of aging emphasize labor income at older ages because of the important linkages between labor supply and aging-related institutions, e.g., public pension programs. An important point, however, is that changes in labor income at any age are potentially valuable for meeting the economic challenges of aging. Gains in labor income during the prime working ages can increase the lifecycle surplus at these ages and be channeled into transfers, improving the sustainability of transfer systems, or into saving increasing assets, asset income, and resources available in old-age through asset-based mechanisms. The linkages between population aging and investment, including investment in human capital, are of particular importance.

Because individuals accumulate wealth over their lifetime, population aging can raise aggregate wealth and asset holdings through a mechanical compositional effect. Across the demographic transition, fertility declines, mortality declines, and population ages, with fewer young people and more elderly. Low fertility, rising life span, and older populations are also projected for the future. Even if there are no changes at all over an individual life cycle in saving behavior or asset holdings for individuals, asset holdings per capita in the population will increase as the population ages. This happens because asset holdings rise with age over the life cycle, with older people holding the most wealth. In an older population there is a higher proportion of these wealth-holding old people, and therefore the amount of wealth per capita is also higher. This is a purely mechanical compositional effect.

In addition, with fewer children and longer expected life, it is likely that individuals will increase their savings rates and asset holdings over the life cycle. At a minimum, any funded pensions, public or private, will require greater contributions in return for a given annual benefit level as life expectancy rises. However, even if individual savings are higher when fertility is lower and life longer, nonetheless population aging will mean that a larger proportion of the population is at older ages which may have lower savings rates than the working age population, and the combined effect on aggregate savings rates is unclear.

Does it matter whether the elderly finance their life-cycle deficit through public or private transfers, or through assets, since these involve equivalent acts of saving by working age adults? If earlier generations had prepared for their future retirement through saving and asset accumulation, with assets held in the form of domestic capital, then the capital labor ratio would be higher than otherwise, and the productivity of labor would be raised. However, if earlier generations had prepared for their future retirement by paying taxes to support a PAYGO public pension plan, then there would be no increase in assets and the capital-labor ratio, and no boost to productivity. Even if all the incremental wealth is held in foreign investments, these would still generate a flow of asset income that raises per capita income. (Cutler et al 1990; Kinugawa and Mason 2007; Mason et al 2008; Lee and Mason forthcoming). The asset scenario avoids distortionary taxes on labor, which most would view as an advantage. But some see the lack of taxes as a disadvantage since the

diversion of output to the elderly through asset income is less transparent (Barr, 2001:98). Aside from the relative merits of a transfer program versus an asset program, there is also controversy about whether the painful transition from an unfunded pension program to some sort of funded arrangement would solve any problems (Barr, 2001).

The same low fertility that causes population aging is typically also associated with increased investment in human capital (Lee and Mason 2009), which we can interpret as a form of the “quantity-quality tradeoff”. This tradeoff can mitigate the adverse effects of population aging on the economic support ratio by raising the quality and productivity of the smaller workforce. Although the quantity-quality tradeoff is typically thought of as family-level behavior, public investment in human capital has actually played a more important role. This is by no means automatic, however. Moreover, a potential cause of concern is that competition for public resources between an increasing elderly population and a smaller child population may work against increased investment in human capital.

An increasingly important issue in aging societies is retirement behavior. As discussed above, the duration of retirement has increased in part because of longer life expectancy but also because of a shift to earlier retirement. In part, this is a consequence of mandatory retirement systems and disincentives built into tax and transfer policy that are amenable to public policy. But earlier retirement is also a feature of higher income and improved standards of living and, hence, the decline in retirement age may not be easily reversed. Of course, to the extent that people opt for more end-of-life leisure while understanding that this will result in a lower material standard of living, there is no obvious reason for policy intervention.

Another important consideration is productivity at older ages. Low labor income is a consequence of both labor supply and wages. Moreover, to the extent that wages of the elderly can be raised additional work may be induced. This is a challenging issue about which relatively little is firmly established. But lifelong education, flexible working arrangements, and other efforts may be a means by which labor income at older ages can be increased.

B. POVERTY IN OLD AGE

Rates of poverty vary across age and have been affected by changes in the economic support system. Asset-based systems of support are by definition not redistributive. Family transfer systems may have a redistributive impact, but it is limited to the extent that across family variation in income is a substantial portion of the total variation in individual income. Public transfer systems depending on their design can be highly redistributive.

The redistributive impact of public transfer systems depends on both the annual flows and the expected duration of those flows. Disadvantaged groups may receive old-age benefits over a shorter period of time because wealth influences life expectancy. Hence, programs which have a progressive impact when evaluated at a point in time may be regressive when evaluated from a lifetime perspective.

General competition for public transfers may lead to generational differences in poverty. In the US there is some evidence that expansion of public transfer programs for the elderly led to lower rates of poverty for the elderly, while poverty rates for children increased (Preston 1984). In Brazil, where public pension systems are very generous, poverty rates for the elderly are much lower than they are for children, although poverty rates have declined for both children and the elderly (Turra, Queiroz and Araujo 2009).

C. HEALTH CARE AND AGING

1. How does population aging affect health care needs?

A part of population aging is due to low or declining fertility. This component of population aging has a straightforward effect on the health care needs of the elderly: it simply means there are more elderly at each age relative to the working age population. The other main component of population aging is due to falling mortality and thus increasing longevity.

The impact of this component of aging on health care costs is less obvious. Some background will help. We know that the average annual costs of health care rise steeply with age. We can decompose the health care costs for those at a given age, say 75, into two components. The first component is the health care costs of those who are not near death, for example those who will survive at least for five more years⁵. It has been found that this component does not rise with age, to a first approximation. The second component is the health care costs for those who will die within the next five years. This component also does not rise with age. What makes average health costs rise with age is that *the proportion of the population at a given age that is close to death does rise with age*, which is obvious since mortality itself rises at about 10% per year of age in adulthood and up until 85 or so, and more slowly thereafter. See Miller (2001).

Now consider the effect on health care costs of declining mortality. On the one hand, the number of old people at any particular age will increase due to increased longevity. This will raise health care needs. On the other hand, with lower mortality, the proportion of the population at any given age that is near death will decline since survivorship has increased. Lee and Miller (2002) found that these two components were approximately offsetting for the United States, so that the effects of rising longevity on the projected cost of Medicare were very small.

To put this differently, declines in mortality result at least in part from improvements in underlying health. A healthy population requires less costly medical care. The argument just given is based on this point.

2. Is population aging a major driver of the increase in public health care expenditures?

⁵ Lee and Miller 2002 uses the detailed distribution of health care costs per person of a given age according to each time until death, from 0 years (death in current year) to ten years (death ten years after base year).

In all or certainly most rich industrial nations, the public costs of health care have been rising more rapidly than GDP, so that public health care expenditures comprise a rising share of GDP and of government budgets. It is often stated that this rising share of health care costs is due mainly to the increase in costs per covered person or enrollee, much more so than it is due to population aging. However, whether this claim is correct depends on how the question is framed. If we look only at the increase in expenditure on health care, rather than in its share of GDP, then it is correct that this increase is due mainly to increasing cost per person and not so much to population aging. But if we focus on the increased share of health care spending in GDP, then for the US, at least, population aging and rising costs per older person each accounts for about half of the increase.⁶

Hagist and Kotlikoff (2005) analyze the rise in health care spending from 1970 to 2002 in ten OECD countries, concluding that the increase in spending per person is much more important than population aging. However, they do not analyze projections over the coming decades which is when population aging will occur rapidly in these countries, so this cannot be taken as a guide to what we should expect in the future. Lee and Miller (2002) examine projections for the US and conclude that population aging and rising costs per enrollee are roughly equally responsible for the projected increase in public health spending relative to GDP.

D. LONG TERM CARE

As individuals age, they are at increasing risk of functional impairments and disability. Their state in this regard is generally measured by ADLs and IADLs, that is by questions assessing their degree of limitation in activities of daily living and instrumental activities of daily living, with the former indicating more profound limitations. Need for nursing home care or other intensive care is strongly related to the number of ADLs of an individual.

There is a great deal of interest, for obvious reasons, in whether the prevalence of ADLs and IADLs is rising or falling over time, after standardizing for the aging of the

⁶ If health care costs per enrollee of a given age rise at the same rate as productivity, then absent demographic change, we would not expect the public expenditure share of health care relative to GDP to rise. GDP and health care spending would rise at the same rate. This suggests that we compare the contribution of the growth rate of health care costs in excess of productivity growth to the role of population aging. When we do this, we find that each accounts for roughly half of the growing share of public expenditure on health care (see Lee and Miller 2002) It would be interesting to carry out this kind of calculation for other countries as well. Algebraically, health care costs and GDP are: $P_a C_a = \text{total health costs}$, $L y = \text{GDP}$, where P_a is the older population, C_a is the cost per older person, L is the working age population, and y is the output per working age person. The share of health care expenditures on the elderly is: $P_a C_a / L y$. Taking the time derivative of the log of this ratio, we find that the rate of change in this share equals the rate of change of P_a / L , which is the rate of population aging, and the rate of change of C_a / y , which is the rate of health cost increase per elder minus the rate of productivity growth.

population. The answer to this question is not entirely clear. In the US it appears that the prevalence of IADLs has been declining for a couple of decades at least at 1 or 2 % per year, but the prevalence of ADLs has been more nearly flat. The development and availability of assistive technology appears to play an important role here.

Population aging tends to raise the demand for long term care, other things equal. But trends in the healthiness of the older population appear to work in the opposite direction, at least in the US, so that long term care usage is declining in aggregate. However, it is difficult to disentangle the role of underlying need from the availability of funds to pay for nursing home care which is very expensive.

Long term care becomes a major factor for those in their 80s and older in rich industrial nations. This can be seen clearly in a sharp upturn in the public consumption per capita by the elderly in their 80s in the NTA estimated consumption age profiles. Less is known about this for developing countries, where care of the elderly is more likely to be in the hands of their families. Time use data would be needed to estimate and evaluate this care, and in the absence of such data and studies based on them, the strict money costs of publicly or privately provided long term care will overstate the true social cost of nursing home care. Publicly provided long term care could be viewed as a kind of social risk pooling that protects the adult children of long-lived, disabled parents.

SOME POLICY ISSUES

Externalities: Public sector transfers to the elderly are pervasive in the rich industrial nations which are also rapidly aging due to low fertility. These public sector programs reduce the needs for financial and other support from adult children, and it is possible that these programs contribute to low fertility. There is a small body of empirical research on this topic. The basic point is that in countries without such programs, this benefit of childbearing is internalized in the parental fertility decisions, and once these programs are in place, the importance of fertility to provide future old age support through public sector tax and transfer programs becomes a positive externality to childbearing (Lee and Miller 1990). Immigration and emigration also involve external fiscal effects that may be amplified by population aging.

Risk pooling: Increasing longevity and low fertility increase certain risks for adult children and for their elderly parents. Through cultural norms and altruistic linkages, risks for the parents become risks for their adult children. These risks include disability in older age requiring either financial support or intensive personal care, elders outliving their assets and requiring increased familial transfers, long term care in an institution which is very costly. In addition, many elderly will have no surviving children in a position to provide care and support, due either to the elders' low fertility, accidents of child mortality, or poverty of adult children. Thus elder reliance on familial old age support is risky. Furthermore, some adult children may have multiple elderly parents requiring care, which is a serious risk for the adult children, a risk magnified by longer life and lower fertility. Public transfer systems pool these kinds of individual risk.

Individual Planning failures: It has been shown repeatedly that humans do not behave rationally toward retirement saving and investment needs, hence there is a role for the government to compel appropriate saving or transfer behavior since it is the supporter of last resort.

Suboptimal institutional arrangements: Governments introduce policies and institutions which seem to make sense at the time. However, the economic, social and demographic environments change in such a way that these programs come to have major impacts on intergenerational income distribution and may contain undesired incentive structures for labor supply, health care seeking behavior, and so on. It is important that governments take a hard look at their current institutional structures, which may produce suboptimal effects in the context of severe population aging, e.g. a doubling or tripling of old age dependency ratios. In particular, entitlement programs for the elderly become increasingly costly and may crowd out other government programs and activities, including investment in the human capital of the younger generations.

Importance of early action: Individual aging, that is increasing longevity, requires ever more financial and life cycle planning on the part of individuals, who must decide how long to work before retiring, how much to save and consume throughout their working lives, whether to transfer wealth to their children, whether to annuitize their wealth, what kinds of health insurance and life insurance to buy, whether to buy long term care insurance, and so on. To plan effectively, individuals must have a realistic idea of future government policies in many domains, including pensions, long term care, health, and disability insurance. At the same time, many government programs are well-known to be fiscally unsustainable, so it is clear that structural reforms will be required, and often these reforms will involve some degree of privatization or move to a funded system of some sort. In other countries, there are plans to introduce new public pension systems of one kind or another. When any kind of funded system is introduced early enough, then workers begin to save (through public or private programs) at relatively young ages, and then population aging itself drives asset accumulation such that ratios of assets to working age population rises, and perhaps capital labor ratios rise.

Family policies: Government policies may be considered that are intended to affect female labor supply, e.g. through provision for child care. Such policies can help to offset the fiscal impact of population aging by raising the size of the labor force. At the same time, it should be realized that higher female labor force participation may compete with familial care of the elderly, and complementary policies related to elder care may be called for.

Demographic policies: We do not expect any government to treat health policy as an instrument for preventing population aging, so we can focus on fertility and immigration policy. Immigration makes less difference to population aging than is generally supposed. Immigrants grow old too, and eventually claim health, pension and long term care benefits. The old age dependency ratio is reduced by the typical age pattern of immigration, but these reductions are not large. The longer term effects of immigration will also depend particularly on the future trajectory of immigrant fertility. This may converge rapidly to the levels of the native born. The greatest potential leverage against

population aging comes from fertility, but government policies have typically not proved powerful against fertility levels, which in Western nations have remained stubbornly low despite government incentives to raise them. It is easier to advance the timing of births than to induce an increase in total number.

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