Population and Economic Progress in Nigeria

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Background Research report submitted to Harvard School of Public Health on the Nigerian Generation Next project

February 2010

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Population and Economic Progress in Nigeria

Nigeria is about to experience very substantial changes in its population that could have very important implications for economic prospects. The driving force behind population change is the decline in Nigeria's total fertility ratio (TFR) which will lead to an immediate decline in the share of children in the population and an increase in the share of the working-age population. The course that the economy will follow will depend on choices made by the people of Nigeria and their policymakers. But changes in age structure will present a set of options that are preferable to those currently available.

Changes in age structure matter because of a fundamental feature of all economies – the economic lifecycle. People consume considerably more than they produce through their labor over extended periods at the beginning and the end of their life. Fertility decline leads to a decline in the number of children relative to the number in the working ages. This phenomenon is often referred to as a demographic dividend, because even with no other changes in the economy income per person will increase.

The demographic dividend is quantified here using the economic support ratio – the ratio of the number of workers adjusted for age-specific variation in work effort and productivity to the number of consumer adjusted for age-specific variation in needs. Over the demographic transition the support ratio rises to a high and favorable peak and then declines as the population ages. In most developing countries around the world the support ratio has already increased considerably in recent decades and in some cases is nearing its peak. In Sub-Saharan Africa and Nigeria, this process is just beginning, but over the next 50 years or more the economic support ratio will increase. How rapidly the support ratio increases and how high a peak it reaches in Nigeria will depend on the specifics of demographic change and on key features of the economic lifecycle.

The support ratio will increase more rapidly in Nigeria if fertility decline is more rapid. The support will also increase more rapidly if fewer young adults emigrate in search of better economic opportunities. Of these two forces, however, fertility decline is the more important.

Nigeria's economic lifecycle is broadly similar to those found in other developing countries based on a new system of accounts, National Transfer Accounts, being developed to improve information about age dimension of economies. In Nigeria, as elsewhere, children, young adults, and the elderly are not producing as much from their labor as they are consuming. A distinctive feature of Nigeria, however, is that labor income of even those in their late 20s and early 30s is insufficient to provide what is needed for consumption. If this feature of Nigeria's economic lifecycle does not change, the economic support ratio will rise more slowly than has been the case in other developing countries. Hence, an important policy issue is how to increase job opportunities and raise labor income for young adults.

One option for Nigeria is to use the rise in the economic support ratio to increase consumption. No doubt this is an appealing option given the low standards of living that prevail. By pursuing this path, per capita consumption at every age could increase by about 40% over the next 30 to 40 years. The drawback of this option is that eventually the economic support ratio

will decline as Nigeria's population ages. Given the experience elsewhere, it is likely that the support ratio will eventually decline to levels similar to those found today. Unless the increase in the support ratio can be converted into some lasting benefit – greater human capital, greater physical capital, improvements in technology, and so forth – the economic gains will dissipate with no lasting benefits realized.

The Support Ratio and the Dependency Ratio

The support ratio (SR) and the dependency ratio (DR) are similar measures of population age structure. In some studies the support ratio is defined purely in demographic terms as the population in the working ages relative to the population in the consuming ages, equivalent to the total population. The dependency ratio is the population in the non-working ages relative to the population in the working ages. The working ages are often considered to be 15-64 but the exact definition varies from study to study. These two demographic measures are closely and inversely related: $SR = 1/(1+DR)$. Which demographic measure is employed is often a matter of analytic convenience with the support ratio being a more convenient measure when considering the macroeconomic effects of changes in age structure.

The support ratio and the economic support ratio are used interchangeably in this paper and differ from the population support ratio in important ways. The numerator in the economic support ratio is the effective number of producers that incorporates age variation in labor productivity due to differences in labor force participation, hours worked, unemployment, and productivity. The denominator incorporates age variation in consumption needs reflecting the reduced materials needs of young children, the high health care needs of the elderly, and other age-variation in consumption.

The advantage of the economic support ratio is that it provides an empirically determined measure of dependency that reflects observed economic conditions rather than assumptions about the ages at which individuals are working. It allows for a refined and continuous measure of dependency. It also allows analysis of how changes in the economic lifecycle of production and consumption interact with age structure to influence the economy. This proves to be a particularly important issue in the case of Nigeria because the labor productivity of young adults is very low.

A second option is to increase investment in human capital as fertility declines. This is an option that other countries have pursued with success. Investing more in the education and health of children means that standards of living will at first rise more slowly. However, the next generation of young workers can realize higher wages and improved standards of living. Moreover, by continuing to invest in human capital, higher standards of living can be sustained even after the economic support ratio has declined.

A third option is to increase saving. This path is similar in many respects to investment in human capital. Increased saving and investment sacrifice growth in current consumption so that higher standards of living can be realized in the future. Greater saving will lead to higher asset income and, if invested domestically, higher wages and labor income. There are a range of policies that can be pursued to encourage higher rates of saving. One potentially important possibility is that population aging increases the demand for retirement income. In many countries large-scale public transfer programs have been implemented. In others, the elderly have relied on familial transfers for old age support. But by relying to a significant degree on assets to fund retirement, the age transition provides a powerful incentive to accumulate assets.

Population and Economic Fundamentals

Nigeria is the most populous country and one of the three largest economies in Africa. The economy of the country revolves around crude oil exports which account for more than 80 percent of export earnings and the total federally-collected revenue of the government in 2006 (CBN, 2006). Given the oil-dependent nature of the country, standards of living are tied to fluctuations in the international oil market. This has consistently shaped the nature of economic growth of the country. Favourable oil market prices in last few years have led to improved economic growth during the last decade or so. In the same vein, poverty has declined considerably from 65.7 percent in 1996 to 54.5 per cent in 2004. Despite the reduction in poverty incidence, the number of people living in poverty has been on the increase. For example, the poverty figure for the period 1996/2004 shows that the number of people living in poverty increasing from 66 million in 1996 to 78 million in 2004. The growth in poverty is in line with the increase in population which is growing at 2.8 percent per annum.

Nigeria's Age Transition[1]

The high population growth rate is a consequence of lower death rates and a total fertility ratio that has remained high. The fertility ratio was 5.67 births per woman in 2000-05. This is expected to fall over the next few years to 4.79 in 2010-15 and 2.41 in 2045-2050. The high fertility ratio is reflected in the shape of Nigeria's population pyramid (figure 1) but as fertility declines and the young population grows older; the population pyramid is expected to show an increasing proportion of Nigerians within the working population. Life expectancy in Nigeria is currently low being just 46.7 years in 2000-05. It is expected to increase to about 62.5 years in 2045-50. [2]
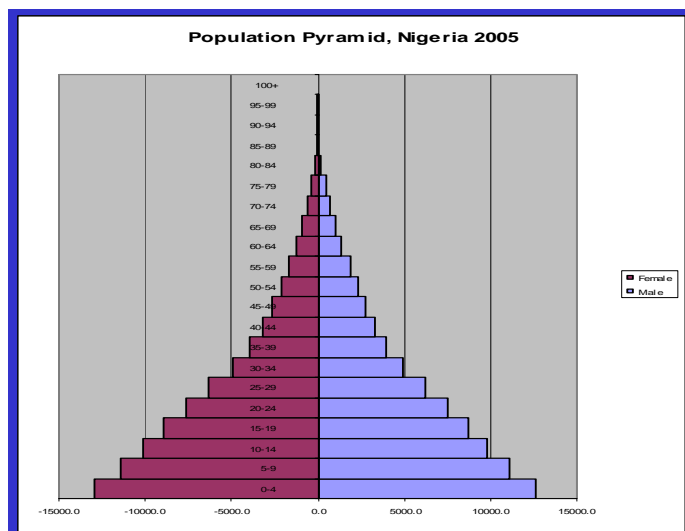

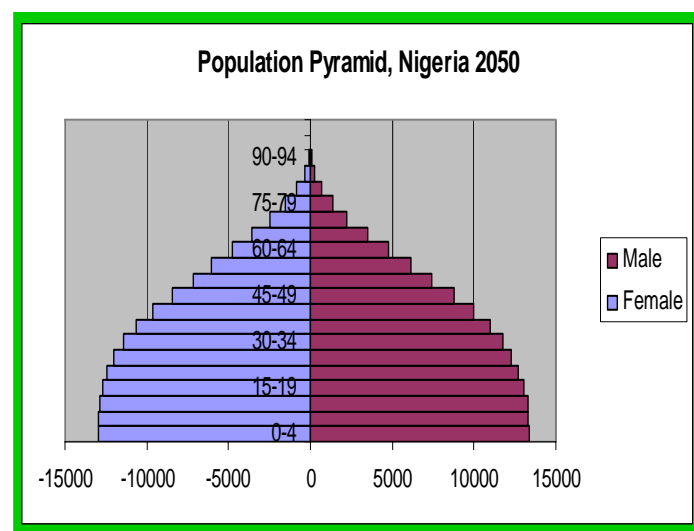Figure 1: Population Pyramid. Nigeria, 2006

Figure 2: Population Pyramid, Nigeria, 2050

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[1] For an extensive discussion of population issues see study by Holly Reed.

[2] Estimates in this section based on Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2008 Revision*, http://esa.un.org/unpp, Tuesday, January 19, 2010; 2:55:19 PM.

Nigeria and many other African countries have young populations with relatively many children and young adults. The percentage of the population under the age of 25 reached record levels in 1995 and has since declined by just a few percentage points. The UN estimates that in 2010, 62.4% of the population will be under the age of 25. A relatively small percentage of the population is 60 and older – 4.9% in 2010. But with the combined size of the two "dependent" age groups so large, less than one-third of Nigeria's population falls in the prime working ages of 25-59.

Nigeria's age structure is compared with that of other countries in the World in Figure 3. The countries are arrayed along a bow-shaped path. Those at the lower right are very young and mostly in Africa, while those at the upper left are mostly older, industrialized countries. Others are in the middle of a transition from young to old. An important distinguishing feature of these countries is that a large share of their populations are in the prime working ages as compared with young countries like Nigeria or old countries like Japan. China with the largest population is a case in point. Nearly half of its population is in the 25-59 age group as compared with Nigeria's one-third.
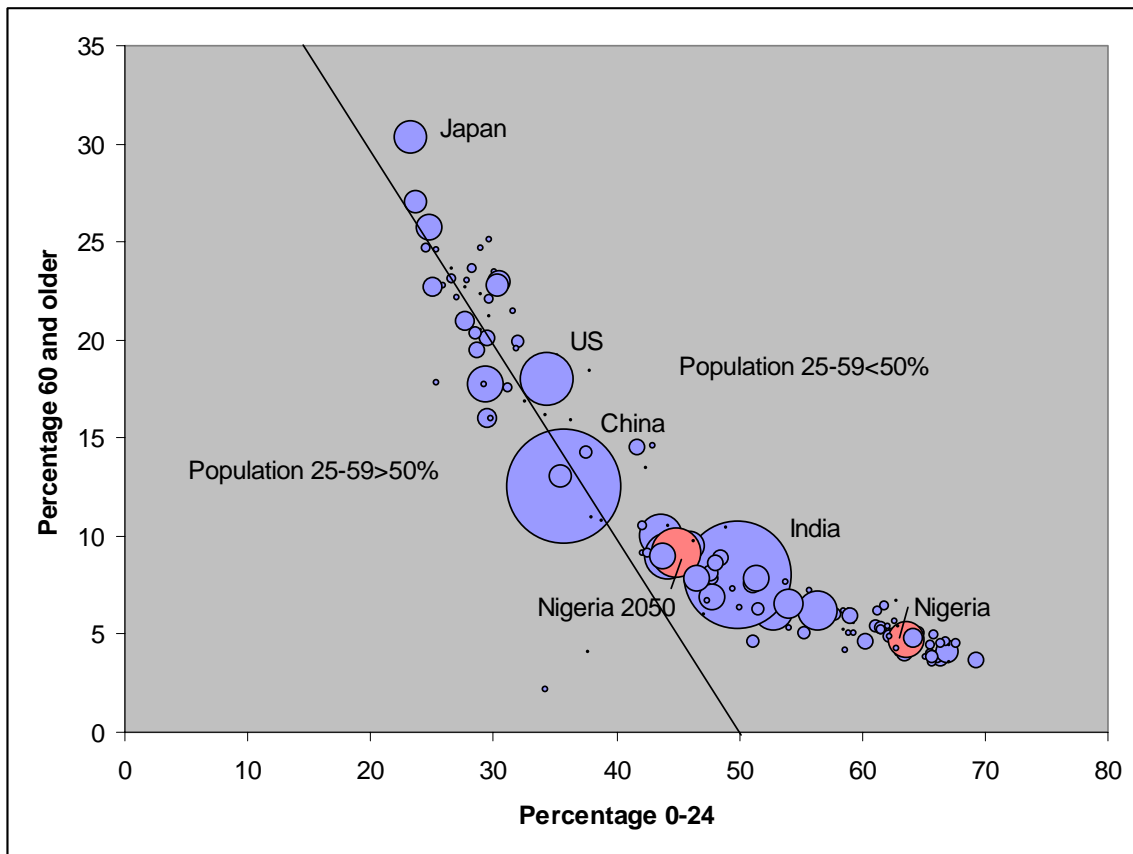

Figure 3. Age Structure, Nigeria and Other Countries of the World, 2010; Nigeria 2050 (medium scenario). Area of bubbles represents population size. Source: United Nations (2007).

Nigeria is moving along the path mapped out by the countries of the world in Figure 3. If the medium population projection prepared by the United Nations proves to be accurate, a much smaller share of Nigeria's population will fall below age 25 in 2050 – about 45%. The

percentage 60 and older will have increased almost to 10%. The share in the 25-59 year old age group, will have increased substantially – from about one-third of the population in 2010 to over 45% in 2050. The age structure that will actually characterize Nigeria four decades in the future cannot be foretold with complete confidence, however.. The outcome will depend primarily on the trend in fertility with changes in mortality and immigration playing a secondary role. The medium UN scenario anticipates that by 2045-50 Nigeria will have almost reached replacement fertility with a net reproduction rate of 1.04. Should fertility decline more rapidly following the low fertility scenario prepared by the UN, the percentage aged 25-59 will rise to almost half of the population in 2050.

Selecting "cut points" to define broad age groups – the young, prime-aged, and the old – is in many respects an arbitrary exercise. The relationship between age and economic measures varies over time, across cultures, societies, and political and economic systems, and with the variable in question. Moreover transitions from childhood to adulthood to old age are not discrete events but more continuous in nature. Neither individuals nor cohorts become economically sufficient at a particular age, just as they age and become less productive at different rates. As a consequence, it is essential to explore empirically how key economic measures vary with age in each political-social-economic setting.

Nigeria's Economic Lifecycle

Although many economic activities and flows vary with age, we emphasize the broad economic lifecycle that is a common feature of all contemporary societies. Extended periods at the beginning and end of life during which members of the population on average consume more than they produce through their labor bracket a period during which labor income substantially exceeds consumption. Although economists have understood the importance of the economic lifecycle for many years, methods for estimating the economic lifecycle have been developed and applied only very recently. Nigeria is one of 30 countries worldwide that is participating in this effort by constructing National Transfer Accounts (NTA). Doyin Soyibo directs the Nigerian project and Lanre Olaniyan has been extensively involved in efforts to construct Nigerian accounts under the auspices of the African Economic Research Consortium (Soyibo et al., 2009a). A discussion of the concepts and methods are presented in Lee, Lee, and Mason (2008) and Mason, Lee, et al. (2009) and also on the NTA website: www.ntaccounts.org[3]. This study represents the first application of NTA to a comprehensive analysis of development issues in Nigeria.

Nigeria's economic lifecycle measured in per capita terms is presented in Figure 4[4]. Labor income is an estimate of all returns to labor normally measured in National Income and

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[3] The NTA framework is increasingly seen as a powerful tool for interpreting both the current relationship between age structure and wealth flows, on the one hand; and a rich source of data for understanding the manner in which societies utilize different mechanisms for allocating resources of different types across age groups. NTAs also permit estimation of the magnitude of the potential for the so-called demographic dividend, that is, an increase in economic growth and a reduction in poverty associated with changes in age structure. Using the life cycle approach, and combined with the estimation of lifecycle deficit, it is possible to cover the different risks over the life cycle, first by identifying age-specific risks and then through the resource flows over the life cycle, it should be possible to design appropriate policies, programmes for mitigating the occurrence and impact of the risks if and when they occur at different stages of human lifecycle

[4] The underlying data for figure 4 can be found in Appendix Table A1.

Product Accounts including wages, employee benefits, and a portion of self-employment income estimated to be a return to labor before any taxes have been assessed. Household surveys have been used to estimate labor income by age. In 2004, labor income was relatively low for children and young adults, reached a plateau of about 160,000 Naira a year for those in their late forties and fifties, and began to decline fairly rapidly near age 60. There are several important points about this age profile to keep in mind. First, it is average labor income for all members of the population and is determined by variation in labor force participation, hours worked, unemployment, and wages and labor productivity. Second, it is a cross-sectional curve and not the path that any particular cohort will follow.

The second curve in Figure 4 is average consumption also measured in a comprehensive fashion. All consumption measured in National Income and Product Accounts, including both public and private consumption, has been allocated by age. Private consumption by age is estimated using the 2004 National Living Standard Survey conducted by the National Bureau of Statistics. Private consumption of education, health, and other consumption are estimated separately. Education and health are assigned to individuals within the household using regression methods. Other consumption is allocated to household members using equivalence scales[5]. Some public consumption, such as education and health, is assigned to the beneficiaries of those public services based on administrative records and regression methods. Non-assignable public consumption is assumed to flow equally to each member of the population.

The estimates of the economic lifecycle for Nigeria are limited by the quality of the underlying data on which the estimates are based – National Income Accounts and household survey data. Estimates of income and consumption in poor, rural areas are most problematic particularly where the non-monetized sectors are largest. The methods used in Nigeria have been tested and applied in other developing countries including Indonesia, India, and Kenya.

Per capita consumption in Nigeria increases substantially with age from birth until the mid-twenties. Thereafter, consumption is relatively flat neither rising nor falling substantially with age. In this regard, Nigeria is similar to other developing countries for which estimates are available. At older ages per capita consumption rises moderately and then declines sharply after age 80. Relatively few Nigerians fall into the oldest age group, however, and thus neither the consumption nor labor income profiles at the upper age ranges are estimated with a high degree of accuracy. But given the low percentage of Nigeria's older population, the relationship between age and the economy does not depend critically on estimates of values at advanced ages. Far more important are the behavior and circumstances of the young and prime-age adults.

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[5] The details of the methods used in estimation is discussed in details in Soyibo et al (2009a)
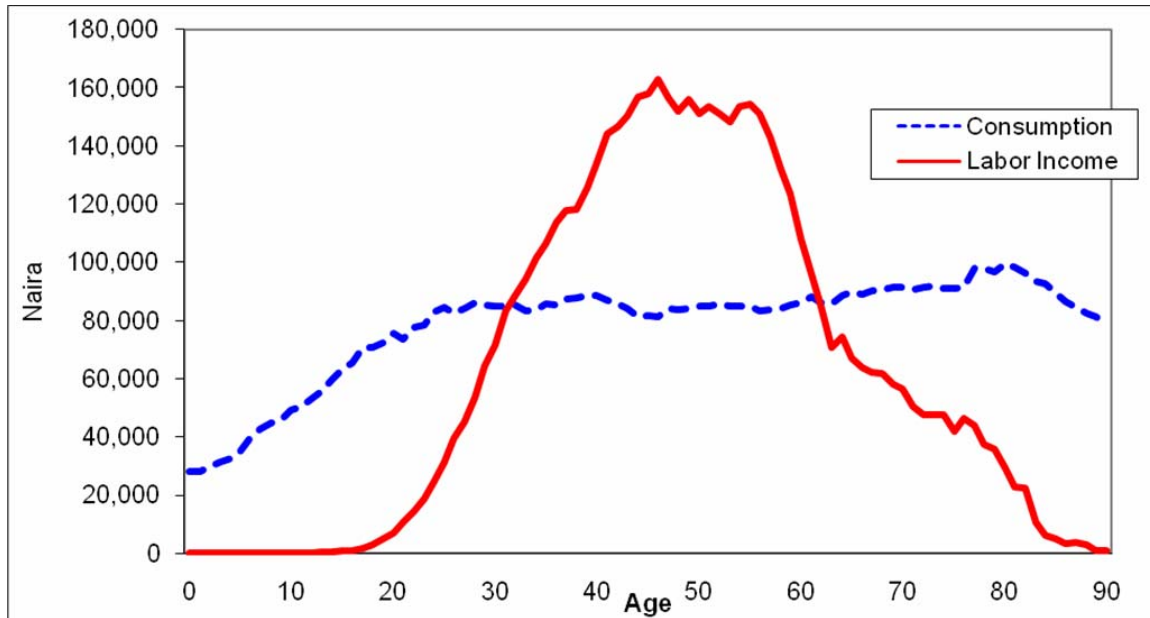
Figure 4. Economic Lifecycle for Nigeria, Per Capita Values, 2004. Source: Soyibo et al. 2009a.

Based on these cross-sectional estimates Nigerians are consuming more than they are producing through their labor during the first 33 years of their lives. For the next 30 years of their lives their labor income exceeds their consumption. After age 63 Nigerians produce less than they consume, on average, over the remainder of their lives. Apart from Kenya that has the same 30 years span during which labor income exceeds consumption, the span for other developing countries are higher with 35 in India, 34 in Indonesia and Philippines and 37 in China (Mason, 2007). Combining population data with the per capita profiles of consumption and labor income as shown in Figure 5 provides an important tool for understanding from a generational perspective some of the important macroeconomic issues that Nigeria faces.

The large lifecycle deficit for the young, i.e., the gap between consumption and labor income, is the dominant feature of the aggregate economic lifecycle. The deficit at young ages is equal to 4.5 billion Naira or 87% of total labor income. In comparison the old-age deficit is 0.165 billion Naira or 3.2% of total labor income. The lifecycle surplus, the excess of labor income over consumption between the ages of 30 and 65 is 1.3 billion Naira or 26% of total labor income.
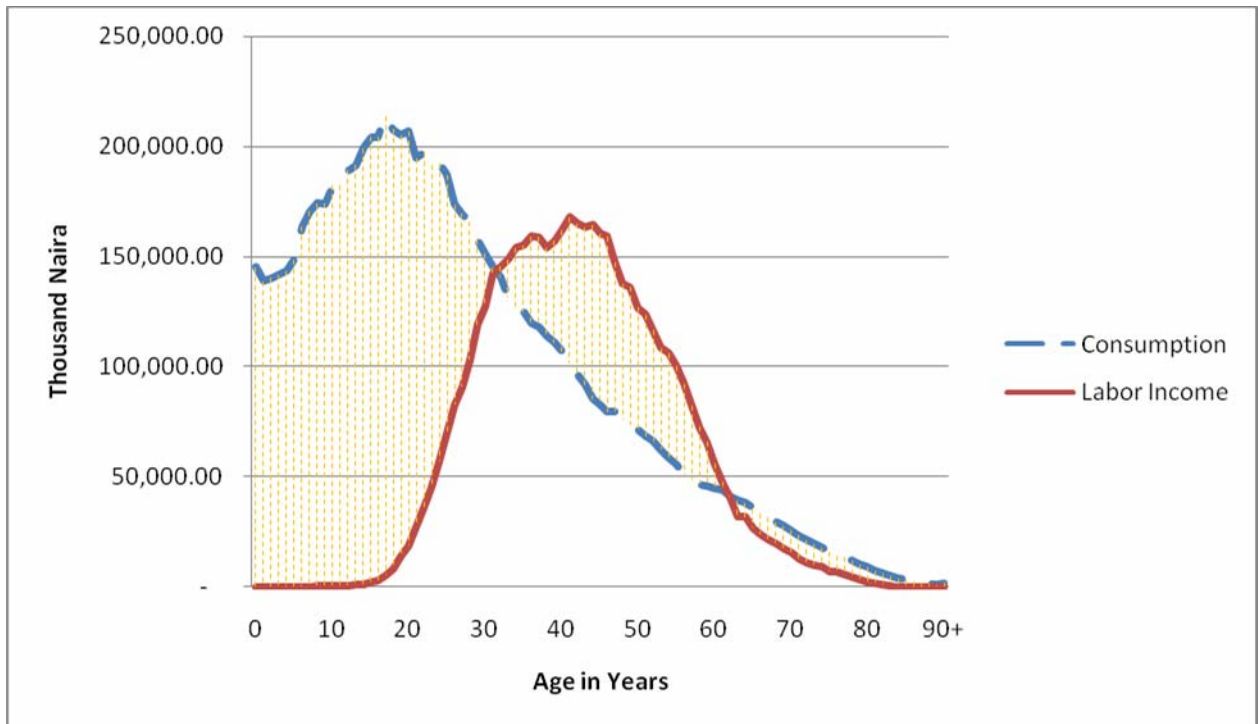
Figure 5. Economic Lifecycle for Nigeria, Aggregate Values, 2004. Source: Soyibo et al, 2009a.

In general, lifecycle deficits are funded in two ways: through intergenerational transfers and by relying on assets, but the relative importance of these two mechanisms are very different for the young and for the old. The lifecycle deficits of the young are funded almost exclusively by transfers in all countries. Children depend on public transfers[6], cash or in-kind, to fund education, health, and other public goods and services that children consume. In every country for which estimates are available private transfers, especially intra-household intergenerational transfers, are more important to children than public transfers. Typically, about one-third to forty percent of the lifecycle deficit of children is funded by public transfers and two-thirds to sixty percent is funded by private (familial) transfers.

Assets play a relatively minor direct role in funding the lifecycle deficit for the young. In general, minor children do not own assets and, hence, can not rely on asset income or dis-saving to fund their consumption. They may rely to a limited extent on public assets to fund their consumption. Royalties from publicly owned natural resources, for example, may fund consumption by children. Or the government may fund transfers to children by accumulating debt. Young adults may rely to some extent on private assets to fund their lifecycle deficits. They may be able to rely on inheritances or other capital transfers, e.g., dowry. And they may be able to rely on consumer credit – credit cards, education loans, and other forms of consumer credit – to fund the gap between labor income and consumption. By and large, however, the lifecycle deficit at young ages is funded overwhelmingly through public and private transfers.

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[6] Public transfers are broadly conceived here to include all cash transfers and all public consumption.

The means by which the lifecycle deficit for the old is funded varies widely from country to country. In industrialized countries and many Latin American countries, the elderly rely heavily on public transfers, through public pensions and health care in particular, to support their consumption. In at least some parts of developing Asia (Thailand, South Korea, and Taiwan, for example), the elderly rely on transfers from their adult children. The elderly also rely heavily on assets to fund their consumption. They rely on personal savings, pension funds, businesses, farms, and owner-occupied residences to varying degrees. Although some forms of assets, e.g., pension funds and financial savings, are more important in industrialized countries, the elderly in low income countries often rely on assets to fund their consumption to a greater degree than in industrialized countries.

The role of asset accumulation in funding retirement, as envisioned by the lifecycle saving model, has been emphasized in many economic studies and its importance to asset accumulation is widely debated. In addition to funding retirement needs, however, assets play another very important role in the generational economy that has received little attention. In this context, the discrepancy between Nigeria's entire lifecycle surplus and the lifecycle deficit of children is important and striking (Figure 5). If the entire lifecycle surplus were transferred to children it would fund only 30% of the child deficit. The remainder must be funded indirectly relying on assets. Public transfers to children can be funded by taxing assets or asset income, using income from public assets, e.g., oil revenues, or by increasing public debt or disposing of public assets. Families can rely on private asset income, borrowing, or dis-saving to fund their transfers to children. Thus, Nigeria's large child deficit must be funded relying on both the lifecycle surplus of prime-age adults, shown in Figure 5, and on public and private assets.

The public component of the funding comes from public transfer income and asset income. The funds for public expenditure and transfers come from the tax and asset income of the country. Table 1 presents the total government income in 2004 for all tiers of government. Since the government revenue profile contains all sources of revenue we have reclassified these sources into four which are direct tax income, indirect tax income and asset income and grants from the rest of the world. (details of the classification is contained in Soyibo et al, (2009 c)[7].

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[7] Nigeria is a federal country so taxes collected by the different tiers are added together to derive total government revenue. We have thus included all the sources of revenue for all the three tiers of government. In order to avoid double counting we first deducted the federally collected revenue component from the incomes of the different tiers of government and added the internally generated revenue of the different tiers of government based on the classification of whether the funds can be regarded as asset or tax income.

Table 1: Profile of Government Revenue (All tiers of Government)

Government revenue	Amount in Billion Naira
Asset income	1,481.16
Indirect Tax	417.10
Direct Tax	956.05
Total ROW	115.55

Government revenue	Amount in Billion Naira
ASSET INCOME	
Crude Oil/gas export	1,043.50
Domestic crude sales	358.20
Other oil revenue	3.00
Independent revenue of federal government	58.90
State government non-tax	17.55
Total Asset Income	1,481.15
INDIRECT TAX	
Custom and excise	217.20
VAT	159.50
Custom levies	40.40
TOTAL Indirect Tax	417.10
DIRECT TAX	
Companies income tax	113.00
Individual Income Tax	134.19
Education tax	17.10
Property Tax (Tenement rates)	4.85
Petroleum Profit Taxes	686.90
	956.05
Grants and Rest of the World (ROW) Inflows	115.55

The Basic Growth Identity

There are three important channels through which population and other factor influence standards of living and economic growth. The first is the saving rate which determines the amount of current income used to satisfy current needs versus the amount used to achieve more rapid economic growth and future needs. The second is income per worker which depends on the overall productivity of the workforce and non-labor income including the returns to natural resources. The third is the share of the population that is productive. These three channels are distinguished by the basic growth identity:

$$\frac{C}{N} = (1-s)\frac{Y}{L}\frac{L}{N} \qquad\qquad (1)$$

The left-hand-side term C/N is consumption per effective consumer. The number of effective consumers is the population adjusted for age variation in "consumption needs". The adjustment is accomplished by using the per capita consumption age profile to weight the population (Figure 4). If the age profile of consumption increases by a given percentage at every age, consumption per equivalent adult will increase by the same percentage. The first factor that determines consumption per equivalent consumer is 1 – the saving rate, i.e., the ratio of saving to total income. Current standards of living can be raised by reducing current saving rates. By doing so, however, future standards of living are diminished.

The second term is aggregate income (*Y*) per effective worker (*L*). The number of effective workers is calculated by weighting the population using the per capita labor income profile thus controlling for age-specific variation in labor productivity, wages, participation, and work effort (Figure 4). This term reflects changes in the productivity of the labor force due to improvements in technology and greater human and physical capital and changes in non-labor income. The third term (*L/N*) is the economic support ratio: the effective number of producers divided by the effective number of consumers. This term captures the direct effects on consumption per equivalent consumer that arise because changes in age structure lead to changes in the concentration of the population in the ages at which individuals produce a great deal or very little relative to their consumption.

The growth counterpart of equation 1 is useful. The rate of growth of consumption per equivalent consumer is the sum of the rates of growth of the three right-hand-side components:

$$gr\left\{\frac{C}{N}\right\} = gr\left\{(1-s)\right\} + gr\left\{\frac{Y}{L}\right\} + gr\left\{\frac{L}{N}\right\} \text{ or}$$

$$gr\left\{\frac{C}{N}\right\} = gr\left\{(1-s)\right\} + gr\left\{\frac{Y}{L}\right\} + gr\left\{L\right\} - gr\left\{N\right\} \qquad (2)$$

The growth identity has been used in two ways to analyze how population influences economic growth, econometric models and simulation models, although the econometric literature has analyzed per capita income rather than per capita consumption (Bloom and Canning, 2001, Bloom and Canning, 2003a, Bloom and Canning, 2003b, Bloom et al., 2002).

The Economic Support Ratio

Given the saving rate and income per effective worker, changes in the growth rate of the support ratio yield identical changes in the growth rate of consumption per equivalent consumer. Equivalently the elasticity of consumption per equivalent consumer with respect to the economic support ratio is 1. This relationship is an identity (equation 2) that holds by construction, not as a consequence of hypothesized behavior of economic variables.

The support ratio for Nigeria from 1950 to 2050 is displayed in Figure 6. The ratio is expressed as an index with the value for 2003 set to 100. This year was selected because Nigeria's support ratio reached a low point in this year. Starting from 1950 the support ratio declined very gradually as a consequence of the increase in the share of children in the population. The cumulative effect was to reduce consumption per effective consumer by about 10 percent. After 2003, however, the support ratio is expected to increase quite steeply as birth rates decline and the share of the working-age population increases. The cumulative effect is

very substantial producing an increase in consumption per equivalent consumer of 40 percent by 2050.
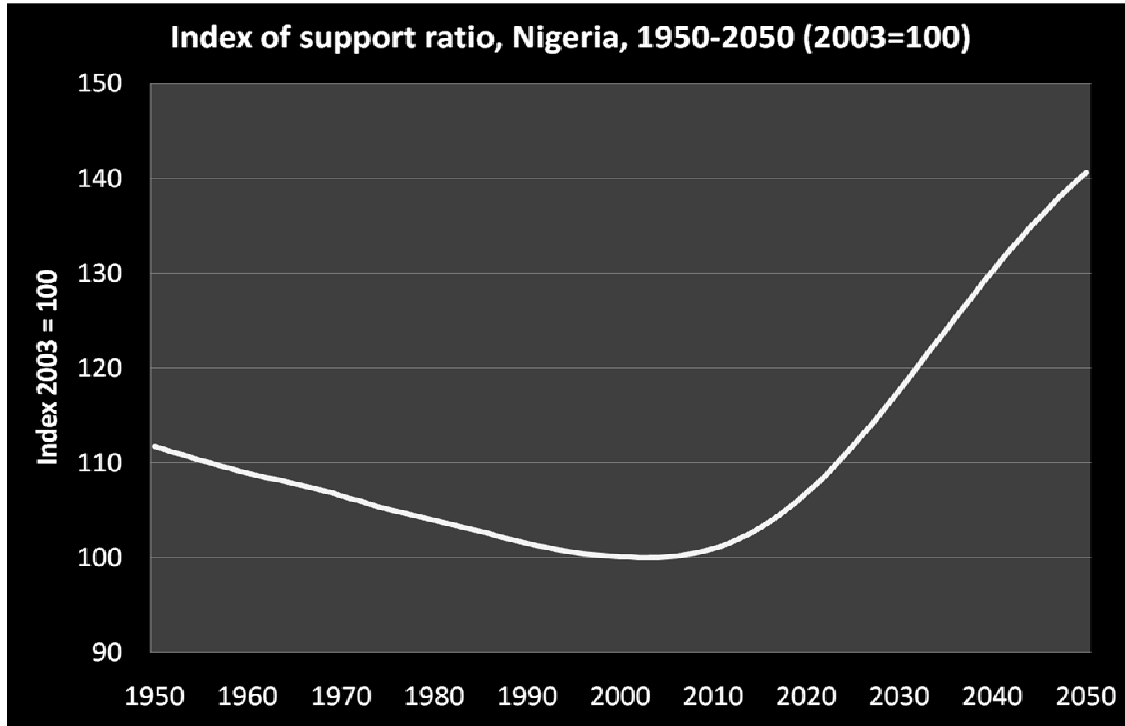

Figure 6. Nigeria's Support Ratio, 1950-2050. Scaled so that 2003 equals 100. Source: Soyibo et al, (2009a).

The annual effect of the support ratio can be seen by computing its annual growth rate as shown in Figure 7. Also shown are the growth rates of the effective number of producers and the effective number of consumers. Between 1950 and the end of the 20th Century, the rate of growth of the effective number of consumers and the effective number of workers increased, but the gap between the two was relatively constant. This produced a very stable decline in the support ratio of well below 1 percent per year. In 2003, however, the growth rates of L and N crossed as the rate of growth of the effective number of consumers declined while that of the effective number of producers continued to increase. This effect is just beginning to be felt in Nigeria, but it is expected to increase and reach close to 1 percent per year for about two decades. In 2040 the annual effect will begin to decline, but it will remain positive through 2050.

The support ratio effect may seem modest at first, but it is not. Technological progress in advanced industrialized countries, for example, is typically believed to yield growth of 1 to 2 percent per year. Real per capita income growth in Nigeria between 2003 and 2007 has averaged 7.5 percent per year (NBS 2007). And the cumulative effect of the increase in the support ratio, a 40 percent increase in consumption per equivalent consumer, is obviously substantial.
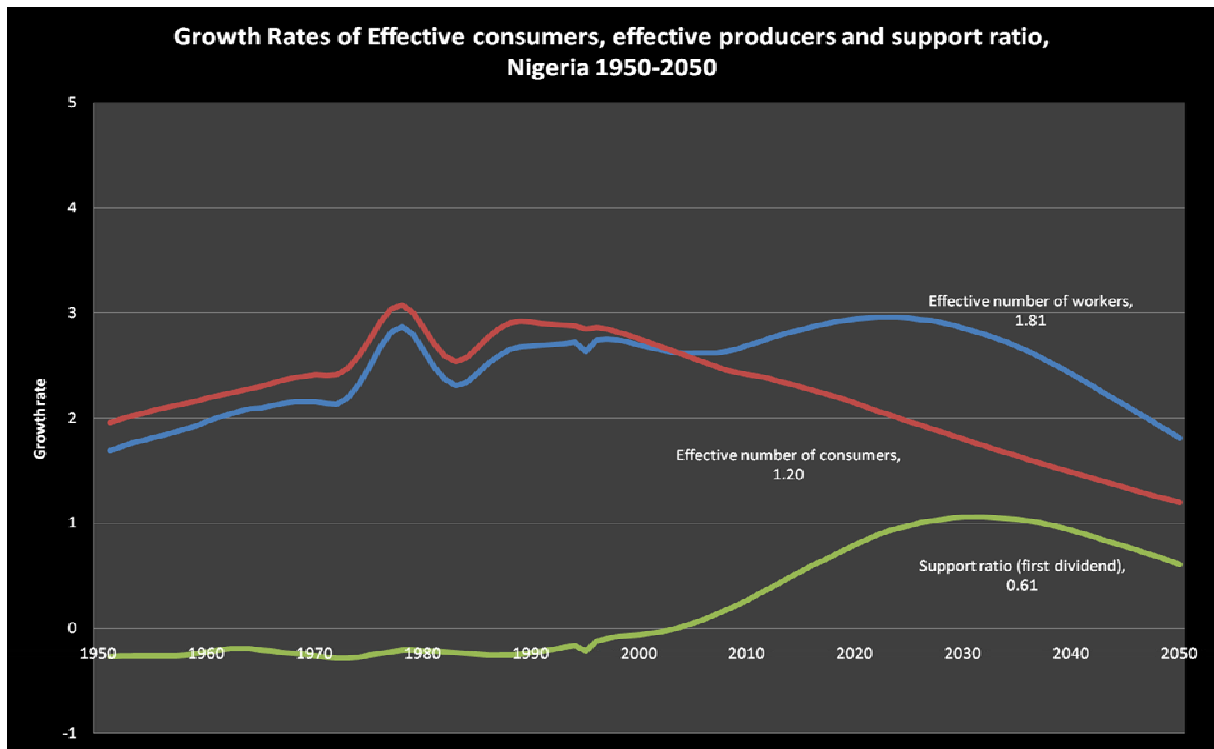
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Figure 7. Growth rates of the effective numbers of workers, consumers, and the support ratio, 1950-2050. Source: Soyibo et al. 2009a.

The changes in Nigeria's support ratio are similar to those in many LDCs. Figure 8 shows the support ratio for six developing countries from 1950 to 2100 for Brazil, China, India, Niger, Nigeria, and South Korea. Average developing country age profiles of consumption and labor income have been used to construct the values, including those for Nigeria, so that the differences across countries is due entirely to differences in population age structure. The timing obviously differs among these countries because the demographic transition occurred earlier in Asia and Latin America than in Africa. Moreover, there are differences in the amplitude of the swings in the support ratio. The change from trough to peak in China and South Korea is greater than in India. The change in Niger is even greater (in percentage terms) than those in China and South Korea primarily because the support ratio in Niger reached such low levels due to its very young population. Nigeria is following an intermediate course between Niger and the other developing countries shown in Figure 8.

There is one other important feature of the economic support ratio that should be noted. Consider the case of China – its support ratio in 2100 is actually below its value of 1950 although somewhat above the minimum value of the early 1970s. The support ratio effect is not permanent. By the time that the age transition is completed it largely disappears. This is not apparent for Nigeria because the projection of population change extends "only" to 2100. If we followed Nigeria through to the end of its age transition we would see that its support ratio would also decline until it was very near the level of 1950. This naturally leads to important questions that are addressed below. Are the gains from the favorable support ratio

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sustainable or do they inevitably dissipate over time? If the gains are sustainable, how can this be accomplished?
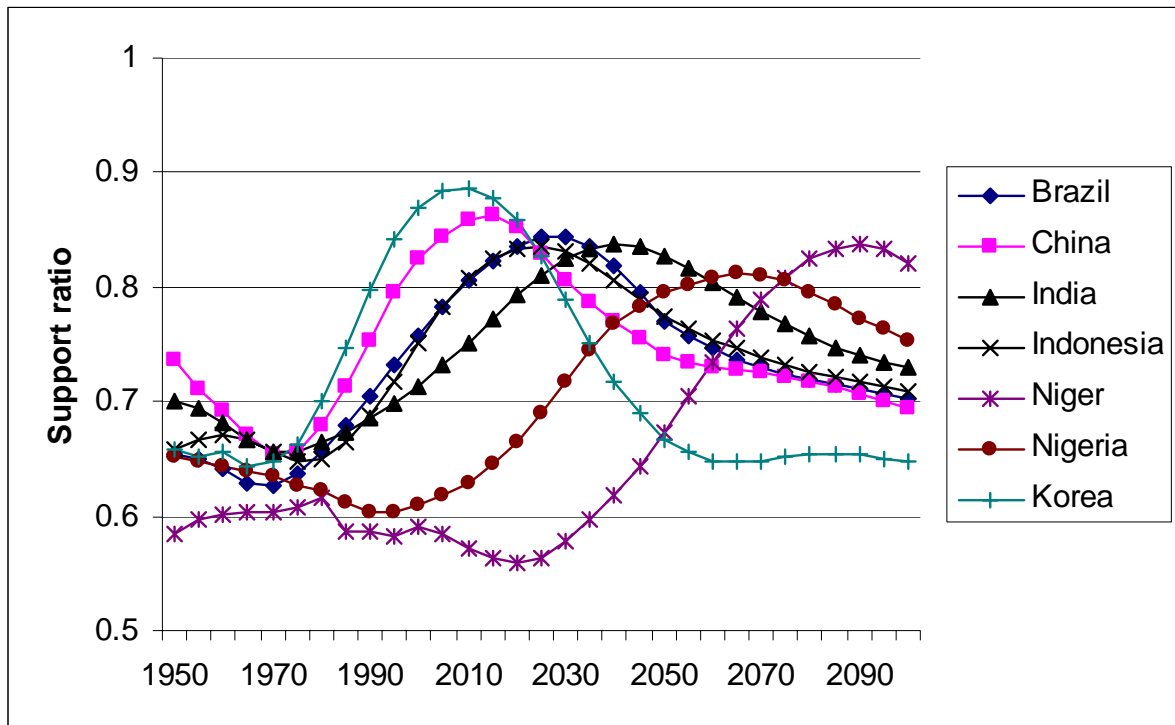

Figure 8. Support ratios for six developing countries, 1950-2050. Population projections from United Nations; NTA age profiles of consumption and labor income are average of estimates for seven young countries (www.ntaccounts.org).
Source: Update of Lee and Mason 2010 forthcoming.

Human Capital Investment and Economic Growth

In this section we discuss several issues. First, we discuss the role of human capital investment in economic growth and poverty reduction based on recent research. Second, we review the status of human capital investment in Nigeria. Third, we consider how human capital investment is likely to evolve as economic development occurs and fertility declines. Finally, we consider the implications for sustaining economic growth over Nigeria's age structure transition.

Nigeria's Human Capital Investment

There is wide-ranging evidence about the importance of human capital to economic development and poverty reduction. Until recently much of the interest concentrated on investment in education, but investment in health is also important.

Education in Nigeria
The primary importance of education is to provide people with knowledge and the ability to apply that knowledge. Education is generally regarded as the best way to bring large numbers

of people out of poverty because there are more employment opportunities and higher wages for skilled workers. Furthermore, education can shape children's attitudes and let them grow up with social values that are more beneficial to the nation and themselves. Table 2 presents some education indicators in Nigeria and selected African countries.

Table 2 : Indicators of Education in Selected African Countries Including Nigeria

	Adult literacy rate (% aged 15 and older)		Youth literacy rate (% aged 15-24)		Net Primary enrolment rate (%)		Net secondary enrolment rate (%)		Percentage of grade 1 students reaching grade 5	
	1985-1994	1995-2005	1985-1994	1995-2005	1991	2005	1991	2005	1991	2004
Uganda	56.1	69.8	69.8	76.6	..	..	..	15	36	49
Tanzania	59.1	69.4	81.8	78.4	49	91	..	..	81	84
Nigeria	55.4	69.1	71.2	84.2	58	68	..	27	89	73
Cote d'lvoire	34.1	48.7	48.5	60.7	45	56	..	20	73	88
Senegal	26.9	39.3	37.9	49.1	43	69	..	17	85	73
Malawi	48.5	64.1	59	76	48	95	..	24	64	42
Developing Countries	68.2	77.1	80.2	85.6	80	85	..	53	..	..
Sub-Saharan Africa	54.2	59.3	64.4	71.2	52	72	..	26	..	..

Source: UNDP (2008) Human Development Report 2007/2008 Fighting Climate Change: Human solidarity in a divided world

Available evidence indicates that Nigeria has made progress on literacy and enrolment rates and generally the country has performed better than the SSA average for literacy and enrolment rates. Adult and youth literacy rates improved from 55 percent to 69 percent and 71% to 84% between 1985-1994 and 1995-2005 respectively. Also primary and secondary enrolment rates were 68 and 27 percent respectively in 2005. While the country's primary enrolment rate of 68% was worse than the SSA average of 72%, the country's secondary enrolment rate at 27% was higher than the SSA average of 26%.

The increase in net enrolment may be connected to the establishment of the Universal Basic Education (UBE) programme in 1999. Main objectives of the UBE among others are to prescribe a minimum standard of basic education throughout Nigeria and also to monitor, supervise and coordinate the implementation of specific programmes for the attainment of UBE. In order to make educational policy in tune with current dispensations, the national policy of education was revised in 2003, with greater funding provided by the federal government. Since the start of the 2000s enrolment has risen sharply at all levels. Primary school enrolment increased by about 36% from 19,246,000 in 2001 to 26,160,000 in 2005 while enrolment in secondary schools has increased from 3.9 million in 1998 to about 6 million

in 2005. In the same vein, enrolment at the tertiary level increased by about 34% from 696,000 in 2001 to 930,000 in 2005 (Table 3).

Table 3: Some Indicators of Performance in the Educational Sector

Sub-Sector Indicator	1998	1999	2000	2001	2002	2003	2004	2005
Adult Literacy Rate[8]	57.0	57.0	57.0	57.0	57.0	57.0	62.0	62.0
No. of Pupils per Teacher (Primary)	54	52.0	54.0	56.0	55.0	53.0	52.0	40
No. of Pupils per Teacher (Secondary)	40	38.0	41.0	32.0	30.0	34.0	30.0	27
No. of Pupils per Primary School	506	518.0	528.0	543.0	545.0	498.0	428.0	
No. of Pupils per Secondary School	960	985.0	985.0	789.0	685.0	595.0	505.0	
No of Students per School (Tertiary Institutions)	2,476.0	2,847.0	2932.0	2840.0	2681.0	2437.0	1941.0	
Number of Educational Institutions								
(i) Primary	45,621.0	47,902.0	48,860.0	49,306.0	50,518.0	55,824.0	57,582.0	59,340
(ii) Secondary	7,801	8,113.0	8,275.0	8,275.0	9,401.0	10,570.0	11,590.0	12,610
(iii) Tertiary	138.0	144.0	144.0	124.0	128.0	128.0	128.0	128
Number of Enrolments at School								
(i) Primary	22,473,886.0	23,709,949.0	24,895,446.0	19,246,000	19,353,000	24,768,000	25,464,000	26,160,000
(ii) Secondary	5,795,807.0	6,056,618.0	6,359.449.0	4,601,000	4,866,000	6,152,000	6,343,000	6,534,000
(iii) Tertiary	941329.0	983689.0	1032873.0	696,000	746,000	846,000	888,000	930,000

Source: Central Bank Nigeria Annual Report and Statement of Accounts, 2005

The number of educational institutions has also increased in recent years. The number of primary school institutions increased from 50,518.0 in 2001 to 59,340.0 in 2005 while the number of secondary school institutions increased from 10,570.0 in 2003 to 12,610.0 in 2005. The relative improvement in performance of the sub-sector could be attributed to the large sums of money spent by government at all levels in building and marketing infrastructure and the acquisition of learning tools. The rehabilitation of schools under the Universal Basic Education (UBE) Programme could also be said to be responsible for this modest result. In addition, the encouragement of greater private sector participation in the educational sector can be attributed to the increased number of private primary, secondary and tertiary institutions. However, the pupil/teacher ratio in both primary and secondary school has been fluctuating. In order to increase retention, government introduced the home grown school feeding programme which aims at providing breakfast to all primary school pupils in the country through the Home Grown School Feeding and Health Programme (HGSFHP). The programme was however cancelled in 2008 due to some implementation bottlenecks

One measure of quality in schools is the number of pupils to a teacher and when the Obasanjo regime came to power in 1999, the Student Teacher Ratio (STR) for both primary and secondary schools were well above the standard of 40 and 30, respectively, as stated in the National Policy on Education. The pupil/teacher ratio in both primary and secondary schools between 1998 and 2001 showed contrasting results. While the increase was from 54 to 56 pupils per teacher in primary school within the period, the ratio declined from 40 to 32 over the same period for secondary school. The marginal reduction recorded in the secondary school ratio could be that a substantial number of teachers were employed during the period. In more recent years, however, the government had been able to attain the standard STR for both

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[8] The figures for adult literacy rate is often derived from household surveys in Nigeria. Hence when a new survey (National Living Standard Measurement Survey was conducted in 2004, the rate was revised for the year and is assumed to be the same in the following years..

primary and secondary schools in the country. In 2005, the STR was 40 and 27 pupils per teacher in primary and secondary schools respectively (See Figure 9)
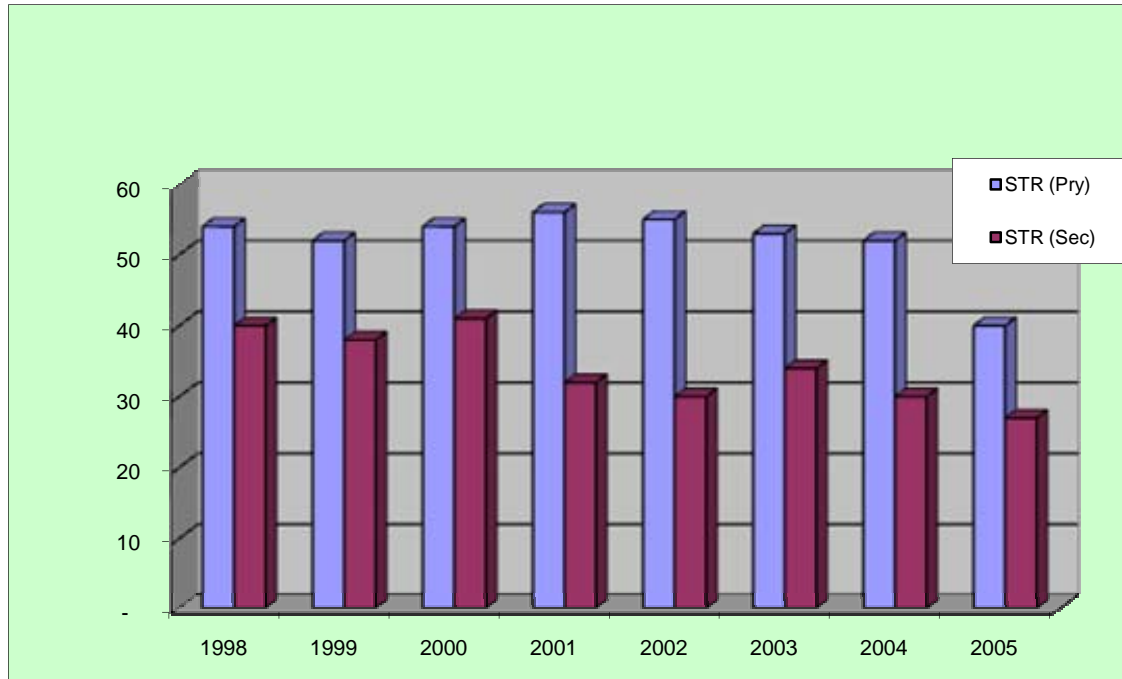

Figure 9: Student Teacher Ratio (STR) in Primary and Secondary Schools 1998-2005

To further ensure quality in primary and secondary schools in the country, the Federal Ministry of Education late in 2006 embarked on comprehensive supervision of all schools in the country. One of the findings of the programme was that more than 10 percent of schools have not been supervised in the past 10 years. In addition, the Ministry also employed UBE teachers to intervene since many primary and secondary schools in the States do not have an adequate number of qualified teachers. This is to ensure that there is adequate nationally acceptable standard in all the schools. Recently the ministry has embarked on institutional reforms in the form of decentralisation and giving of autonomy to Federal government secondary schools

Health in Nigeria
One of the basic ways of improving human capital is to reduce the morbidity and mortality due to communicable diseases to the barest minimum, reverse the increasing prevalence of non-communicable diseases, meet global targets on the elimination and eradication of diseases, and significantly increase the life expectancy and quality of life of people. Ensuring good health not only requires the availability of medical treatment and citizen's ability to pay for this treatment; it also requires that government regulate industry and individuals to limit the levels of pollution. After an initial decline, the number of qualified nurses and doctors has increased relative to the size of the population in recent years according to official estimates. Between 1999 and 2005 the population:doctor ratio and the population:nurse ratio improved from 3376:1 to 3,059:1 and from 1082:1 to 714:1 respectively (Figure 10).
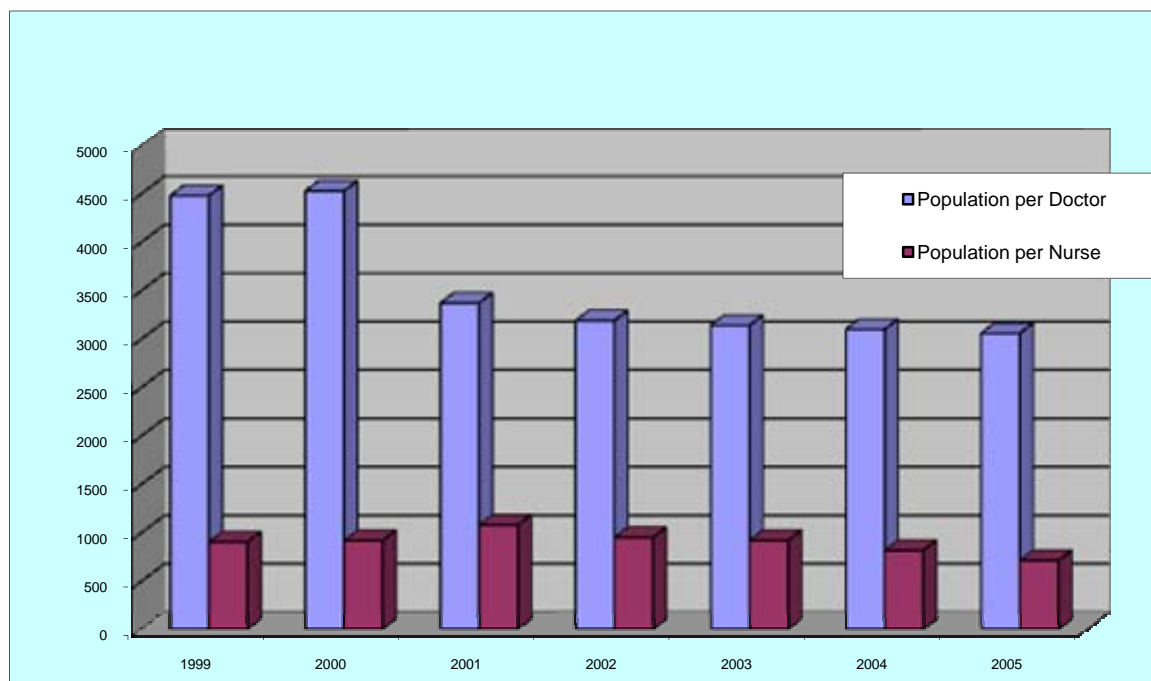
Figure 10: Adequacy of Health Manpower, 1999 - 2005

Although the Federal government budget allocation to health has increased in absolute value (for example, it increased from N11,291.9 million in 1998 to N40,741.1 million in 2001), the percentage share of the health sector in the annual Federal budget remains quite low. None the less, the increased commitment to health care on the part of the government, has contributed to a substantial reduction in the rate of notifiable disease as well as fatality rate due to notifiable disease (NBS, 2007).

In the case of health, prevention is always better than cure, and one way of preventing diseases is through immunization. The government has adopted a policy of providing immunisation services and potent vaccines free to all populations at risk from vaccine-preventable disease. The immunisation programme has benefited Nigerians immensely. It should be noted that the success of the programme is largely dependent on international donors. National Programme on Immunization (NPI) has been able to expand its activities in recent years. The number of children who receive immunization increased from 55.1% in 1998 to 72.1% in 2001 and stood at 75.0% in 2002. The increased immunization rate was due to repeated house-to-house visits by medical staff to immunize children against the six childhood killer diseases such as tuberculosis, poliomyelitis, and measles among others. There were however no major changes in the number of children who received vaccinations between 2002 and 2005. The overall percentage of children vaccinated increased slightly from 73.3% in 2001 to 75.0% in 2002 and has remained constant since then. Figure 11 shows that a higher proportion of children were immunised in 2005 than 1999.
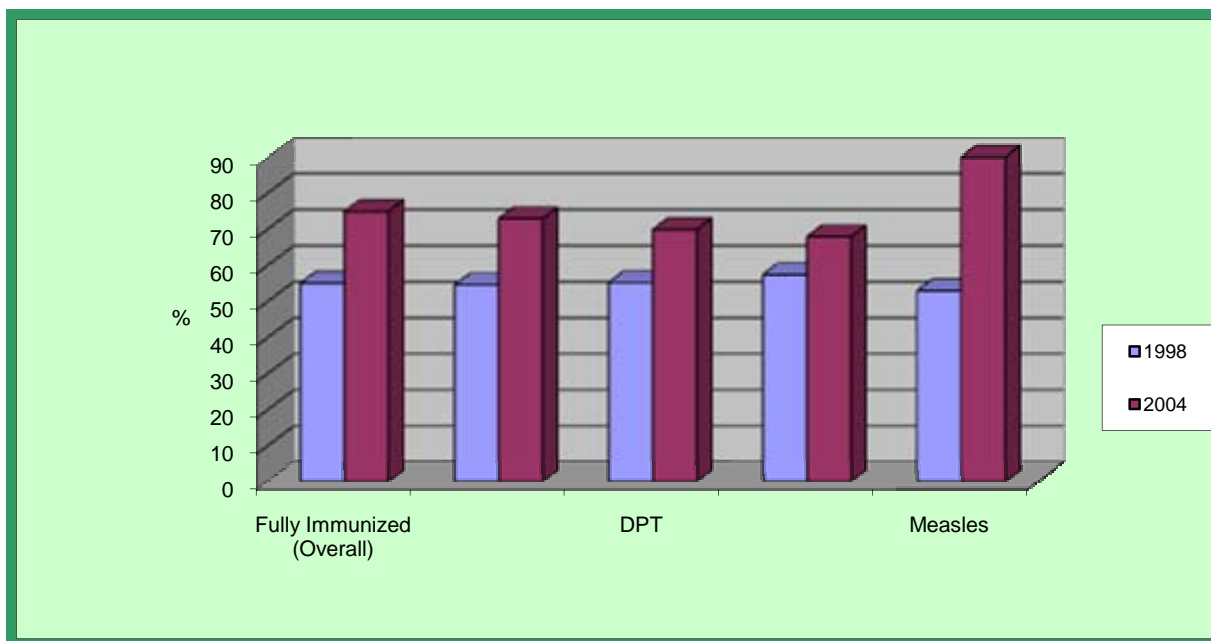
Figure 11: Children Immunisation in Nigeria

The literature attributes one of the causes of the poor performance of the national health system in Nigeria to a lack of clarity or consensus about which level of government is responsible for what function. The Nigerian Constitution, 1999 is ambiguous on the roles and responsibilities for health care delivery except the vague reference made to the Local Governments' responsibility for health. Under the present health care delivery arrangements, the mandates of the FMOH and other tiers of government are not captured in either the constitution or in any law.

The lack of a clear distinction between the roles of the different levels of government and service agencies does not promote efficient use of resources. There is a lack of policy direction and planning in some service areas, while in others the different tiers of government and service agencies are excessively involved in policy formulation, planning, and service delivery. In some programmes, the state and federal governments formulate policies and finance and operate parallel services, with little formal relation to each other. The current situation is confusing because the basis for the split of responsibilities appears to be inconsistent.

There is no stable structure for harmonizing the financing and programming of service delivery by both the federal and state governments. The National Council on Health (NCH), which is supposed to streamline service delivery efforts, lacks the requisite institutional capacities to function efficiently. Under the current dispensation, there are detailed plans for health management through joint health service delivery and administration by the federal and state governments. In some cases, the Federal Government is to play a monitoring role to ensure that state health service plans are consistent with federal objectives for specified funds.

Some of the health sector reform programmes have provision for joint planning to deal with problems that may arise from the involvement of both federal and state, and sometimes, local

governments in financing, administration and service delivery. Such mechanisms are more effective in dealing with federal/state interests and friction than any structural or constitutional resolution of the roles of both tiers of government. With the present parallel funding arrangements for some programmes, joint planning and management mechanisms are inevitable to achieve the desired health sector objectives.

The importance of funding to the health sector can therefore not be over emphasized. Many countries have tried to detail health expenditure in many African countries using the National Health Accounts approach. For example, in Nigeria, Soyibo et al (2009b) found that in 2004, Nigeria spends ₦661.6 billion on health which translated to 7.96 percent of GDP on health and $44.67 per capita. This proportion of total health expenditure as a percentage of GDP in Nigeria falls within the African range. Total health expenditure as percentage of GDP ranges between 4% and 11 % in other African countries. The corresponding per capita expenditure is however a reflection of the strength of the economy. For example, while 7.2 percent translates to 33.3 dollars in Malawi, and 7.96 % translate to $44.67 in Nigeria, 7.5% translates to $709 in South Africa (see Soyibo et al, 2009b for details). However, given the performance of African countries on health expenditure South Africa is an outlier while Nigeria is within the range of other African countries.

Table 4 presents the resource envelope for health for the period 2003 to 2004. In the health accounts space, *sources* are entities that mobilize and *directly* own health resources like government at levels, households, firms and development partners. They contrast with *financing agents* which are entities that receive funds from the sources, manage them and/or use them to pay for health services received from health care providers. Financing agents include, ministries of health and other government departments and agencies that spend significantly on health, out-of-pocket expenditure of households, health departments of firms, health insurance companies and non-governmental organizations. The table reveals that most of the expenditures on health in Nigeria are from private sources with households accounting for 74 percent and 66 percent of total health funds in 2003 and 2004 respectively

Table 4 : Source of Health Expenditure in Nigeria: 2003-2005 (million Naira)

SOURCES	2003		2004		2005	
	Amount	%	Amount	%	Amount	%
Total Government	123,681.78	18.69	208,207.86	26.40	254,174.42	26.02
Fed Govt.	*47,026.82*	*7.11*	*115,068.86*	*14.59*	*130,760.24*	*13.39*
State Govt.	*48,022.77*	*7.26*	*56,963.53*	*7.22*	*78,778.28*	*8.07*
Local Govt.	*28,632.19*	*4.33*	*36,175.47*	*4.59*	*44,635.90*	*4.57*
Households	489,785.11	74.02	518,409.62	65.73	656,545.51	67.22
Firms	20,323.11	3.07	26,068.46	3.31	29,670.97	3.04
Development. Partners	27,872.16	4.21	36,037.98	4.57	36,296.70	3.72
TOTAL	661,662.16	100.00	788,723.91	100.00	976,687.60	100.00

Source Soyibo et al 2009b

Table 5 shows that the highest proportion of health expenditure is channeled through out-of-pocket expenditure of households, indicating high burden of poor households who do not always have cash. This becomes a constraint to access health care. To lessen this burden the government established the National Health Insurance Scheme (NHIS). The objectives of the Scheme are to ensure that every Nigerian has access to good health care services; protect families from the financial hardship of huge medical bills; limit the rise in the cost of health care services; ensure equitable distribution of health care costs among different income groups; maintain high standard of health care delivery services within the Scheme; ensure efficiency in health care services; improve and harness private sector participation in the provision of health care services; ensure equitable distribution of health facilities within the Federation; ensure appropriate patronage of all levels of health care; and ensure the availability of funds to the health sector for improved service

Table 5 : Health Expenditure in Nigeria by Financing Agents, 2003-2005 (N million)

	2003		2004		2005	
	Amount	%	Amount	%	Amount	%
Government financing agents	149,384.13	22.58	241,949.21	30.68	287,562.54	29.44
Out-of Pocket (household financing agents	492,497.37	74.43	521,280.39	66.09	660,181.24	67.59
Health insurance (pooled funds	15,655.54	2.37	18,788.97	2.38	21,335.38	2.18
Others including firms and NGOs	4,125.11	0.62	6,705.34	0.85	7,608.45	0.78

Source: Soyibo et al 2009b

Funding is shared among employees of public and private sectors and employers in public and private sectors of the Nigerian economy. The import of this is that NHIS have high potentials of being self-sustaining. Since their main sources of income is through the contributions of members and investment income. If its income is well-invested and such investment profile is effectively and efficiently managed, then the agency is likely to be sustainable in the long run so long as there are continuing contributions by its members. In this way, it will be autonomous in its decision-making, financial administration and management from government interference.

Human Capital Investment over the Economic Lifecycle
Although all spending on children is counted as consumption in national accounts and in Figures 4 and 5, above, there is widespread appreciation that a portion of consumption is actually human capital investment.   Human capital spending as we use the term here consists of public and private spending on health and education. Per capita estimates of these four components broken down by single year of age are shown in Figure 12. These are National Transfer Account estimates constructed by Soyibo et al, 2009a. At very young ages, almost all human capital investment is privately funded health spending. Education begins to play a more important role at age 7, again with privately funded spending dominant. Private education

continues to increase in importance peaking in the late teens at a relatively high plateau and then declining slowly.
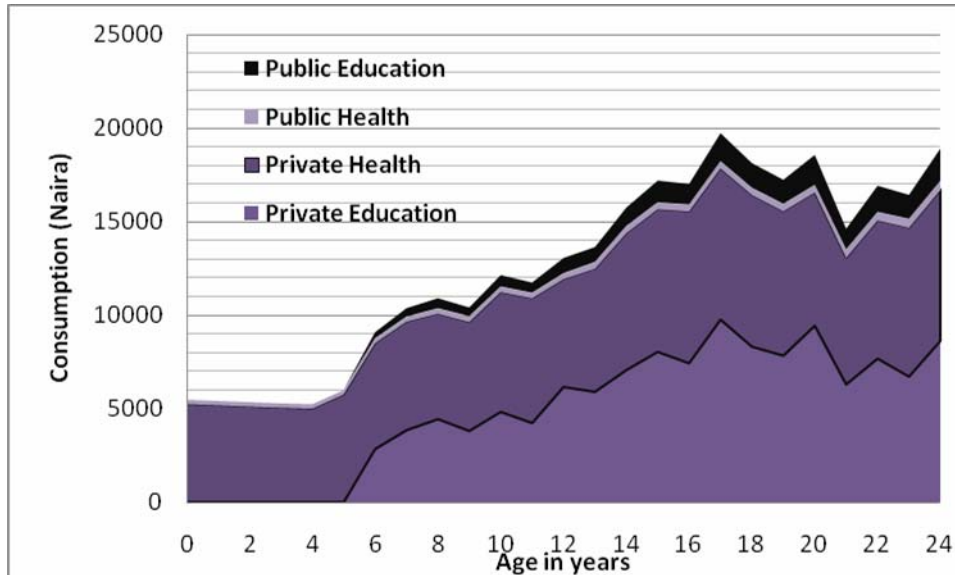

Figure 12. Per Capita Human Capital Spending, Single Years of Age (0-24), Nigeria 2004. Source: Soyibo et al. 2009a[9].

These data are cross-sectional data for 2004 and do not represent the human capital investment that any birth cohort will receive during its youth. Those who were in their early 20s in 2004 likely received less investment than shown in the figure, and those who were very young will hopefully receive more than shown in the figure. None the less, we can cumulate spending across these ages as a convenient and intuitive way of describing the amount invested in children in 2004. In calculating this total, education spending includes all spending up to and including age 24. Only health spending up to age 17 is included in the total, however, because it is preferable to not include spending on childbearing given the ambiguity as to whether this should be considered human capital investment in the mother or the child[10]. Following this approach per capita lifetime human capital investment in Nigeria in 2004 for a synthetic cohort was approximately 258,000 Naira. Over 90 percent was privately funded while under 10 percent was publicly funded[11]. Education and health were of similar importance. Public and private education combined comprised 55% of human capital investment, but it should be kept in mind that no health spending after age 17 is included in the calculation (Table 6).

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[9] The underlying data for this figure can be found in appendix table A2 of this paper.

[10] This figure shows that on per capita basis government spends very little on health, up to age 17. This contrasts with the result in table 3 of the NHA which gives total health expenditure and is not distributed by age. Besides it includes capital expenditure which is excluded in NTA estimation. Similarly per capita spending on education ,in the figure and table A2, is much higher at older ages because of the more expensive nature of education at older ages, particularly tertiary education.

[11] It should be noted that estimation procedures of the NTA and NHA are different which explains the differences in the calculated figures. However, the substance of the matter is that a very high proportion of social expenditure in Nigeria is by the private sector.

Table 6 also reports values normalized by dividing by the average labor income earned by all members of the population, employed or not, between the ages of 30 and 49. This normalization serves two purposes. First, it provides a useful metric for comparing countries with greatly different standards of living. Second, it controls in a crude fashion for variation across development level in the cost of labor, a dominant input in human capital investment. The total normalized human capital investment in Nigeria was essentially 2.0. Given current spending levels, the lifetime human capital investment per child was two years worth of labor income. If we take the net reproduction rate, estimated at 1.91 for Nigeria for 2000-05 (UN 2008), as a measure of the number of children raised per parent, then the typical couple could expect to invest 3.8 years of their labor in the human capital of their children given current rates of childbearing, child survival, and human capital spending.

Table 6: Human Capital Spending, Nigeria, 2004, Synthetic Cohort Measures

	Actual	Distribution (%)	Normalized
Education, Public	18,931	7.33	0.149
Education, Private	123,091	47.63	0.971
Health, public	5,189	2.01	0.041
Health, private	111,228	43.04	0.877
Total	258,439	100.00	2.039
Total Public	24,121	9.33	0.190
Total Private	234,318	90.67	1.848
Source: Soyibo et al. 2009a.			

We will return to a more thorough analysis of human capital below in which we compare Nigeria to other countries and consider the implications of human capital investment for economic development.

Future of Human Capital Investment

As discussed above a high level of human capital is one of hallmarks of high income countries which invest more in the education and health of their children. There are a variety of explanations for this. Some theoretical models conceptualize spending per child as a normal consumer good. If it is income elastic its share of the budget will increase with income. Others treat spending on children as an investment. The demand for and returns to human capital increase with development because of structural changes in the economy that increase the returns to mental ability relative to physical ability, and because of reductions in mortality that reduce the probability that investment in a child will be lost through premature death.

An influential idea advanced by Becker, Willis and others is that there is a quality – quantity tradeoff for children (Becker and Lewis, 1973, Willis, 1973). As the number of children declines, the price of achieving a desired quality per child also declines. (Montgomery et al., 2000, Montgomery and Lloyd, 1996, Ahlburg and Jensen, 2001, Jensen and Ahlburg, 2001, Willis, 1973, Becker and Lewis, 1973)

The quantity – quality tradeoff underlies Figure 13 which shows the Total Fertility Rate plotted against normalized lifetime human capital investment for 24 economies. These values were

constructed in a fashion identical to the synthetic measure of Nigeria reported above (Lee and Mason, 2009a). Both total and public human capital investment are plotted on the figure with the vertical distance between the two points equal to private human capital spending.

There is a strong relationship between the TFR and human capital investment evident for these 24 economies. Normalized investment in low fertility countries is substantially higher than in high fertility countries. The highest rates of investment are in Sweden, Japan, and Taiwan which are among a group investing more than 5 years worth of labor income per child. Kenya and India have the lowest rates of investment followed by China, Indonesia, and Nigeria. When it comes to public investment in human capital, Nigeria is ranked last among the 24 economies. Indeed Nigeria is investing less than one-third of the normalized public human capital investment found in Kenya (0.61), China (0.67), and India (0.88). It is important to understand that because these values are normalized on mean labor income of those 30-49, they indirectly control for the level of development. Thus, the low levels of investment do not arise as a more or less automatic feature of low income.

Also shown on the figure are two fitted lines that show the relationship between the TFR and human capital investment. These are iso-elastictic curves - along these lines the percentage change in the TFR is a constant proportion of the percentage change in human capital investment.[12] A special case of interest is an elasticity of -1 which would imply that the human capital investment in all children combined does not decline with the number of children. The same investment would simply be spread over fewer children. The estimated elasticity for total human capital investment is -0.81 and for public human capital investment -1.42. Thus, these estimates imply that human capital investment rises sharply as the Total Fertility Rate declines. This is entirely a consequence of public human capital investment. The estimated elasticity for private human capital investment is positive, small, and not significantly different from zero.

Before proceeding a word of caution is in order. It is important to understand that the fertility – human capital tradeoff portrayed in Figure 13 does not represent any particular causal relationship. The two variables are inter-dependent and mutually determined by a host of factors. The key point here is that they have a strong tendency to move together. In high fertility countries investment in human capital tends to be low while in low fertility countries investment in human capital tends to be high. The relationship reported here is based on cross-sectional data but it holds, with high negative elasticities, for the few time series data that have been analyzed, Japan 1984-2004 and Taiwan, 1978-2004 (Ogawa et al., 2009) and the United States, 1960-2004 (Lee and Mason, 2009b). Also it is important to understand that after controlling for TFR and indirectly for development through the normalization process, a considerable amount of the variation in human capital investment is unexplained. The TFR "explains" 57% of the variation in total human capital investment and 64% of the variation in public human capital investment. Other factors not analyzed here, including public policy decisions, must have a very important impact on human capital investment as well.

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[12] These lines were constructed by regressing the natural log of normalized total human capital investment and normalized public human capital investment on the natural log of the total fertility rate.
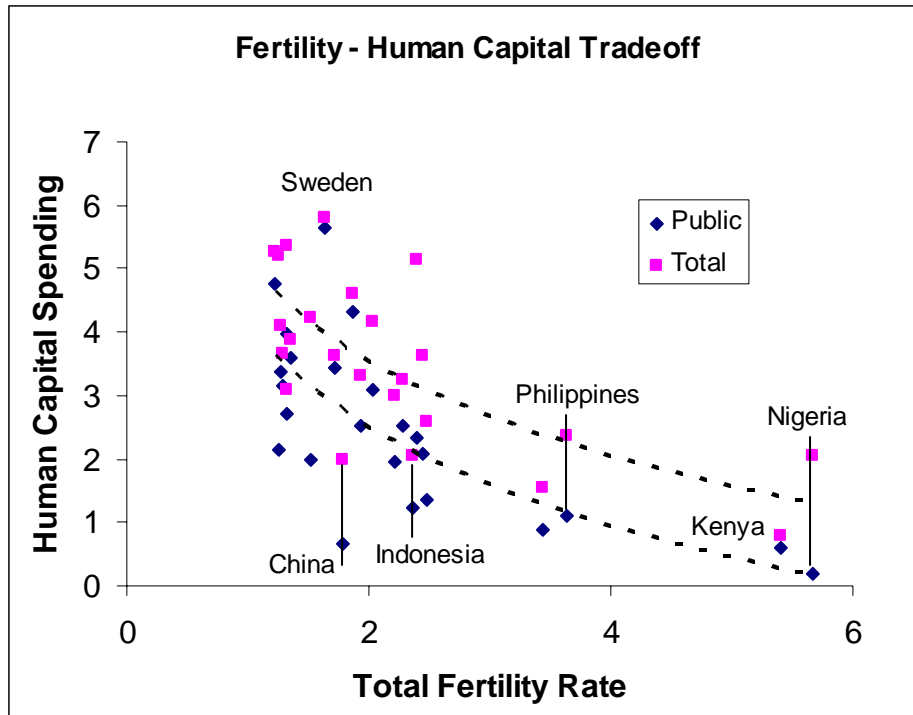
Figure 13. Tradeoff between human capital investment (synthetic measure) and the Total Fertility Rate, estimates for 24 economies, recent year. Updated from Lee and Mason 2009. See Table A.3 for public and private human capital spending for each country.

Human Capital Investment as a Means for Sustaining Economic Growth

As fertility continues its decline in Nigeria, as we and others expect to happen, the economic support ratio will increase and current per capita consumption can rise for an extended period, but eventually the support ratio will decline. Holding all else constant, a few fortunate generations will have enjoyed higher standards of living during their lives, but no benefits will remain for the generations that follow. Alternative outcomes are possible, however. The first we want to explore is that favorable demographics may be accompanied by greater investment in human capital. Using a highly stylized model, we show that standards of living can be permanently raised if the fertility – human capital tradeoff operates with sufficient force.

The analysis presented here is based on a model of human capital investment recently developed by Lee and Mason (2009). The results presented here are based on the same theoretical framework, but model parameters have been updated and fine-tuned to fit the circumstances in Nigeria. The model treats population in a more stylized way than in the discussion of population age structure, the economic support ratio, and economic growth elsewhere in this paper. However, the model is conceptually consistent with the framework presented as equation 1. In addition to considering only changes in the support ratio (*L/N*), however, we also consider investment in human capital which will influence income per worker (*Y/L*).

26

In terms of the growth framework an increase in human capital investment leads to a reduction in current consumption because the saving rate is higher. (Investment in human capital is treated as a form of saving not consumption). The payoff comes, however, in that income per worker (*Y/L*) will be higher as children with more human capital enter the labor force, are more productive, and earn higher labor income. In the Lee and Mason human capital model the population is characterized by three age groups: children (N_t^0), workers/parents (N_t^1), and retirees (N_t^2). The number of children in period t depends on the fertility rate (F_t), or the net reproduction rate to be more precise, and the number of workers/parents in year t. A period in this model is equal to a generation length – about 30 years. The number of workers in year t is equal to the number of children in the preceding period. And the number of retirees in year t depends on the number of workers in the preceding period and the proportion surviving to old age (s_t):

$$N_t^0 = F_t N_t^1$$
$$N_t^1 = N_{t-1}^0 \qquad \qquad (3)$$
$$N_t^2 = s_t N_{t-1}^1$$

The total population is designated N_t.

The annual wage earned by workers (W_t) depends on the worker's human capital (H_t):

$$W_t = g(H_t) \qquad \qquad (4)$$

Human capital is acquired during childhood and depends on human capital investment by parents during the preceding period:

$$H_t = h(F_{t-1})W_{t-1} \qquad \qquad (5)$$

where $h(F_{t-1})$ is the fraction of the parents wage invested in human capital per child.

Although investment in physical capital is considered below, human capital is the only form of investment available in this simple model. Hence, workers support both children and retirees through some combination of public and private transfers. Total income and wage income are equal and can be used to support current consumption or to invest in the human capital of the next generation. The worker generation is indirectly funding consumption during its retirement by investing in the human capital of its children. Designating per capita consumption by X_t and the relative price of consumer goods by P_t (and setting the price of human capital investment to 1), the social budget constraint is:

$$W_t N_t^1 \geq P_t X_t N_t + H_{t+1} N_t^0 \qquad \qquad (6)$$

Investment in human capital is not considered part of consumption. Consumption includes all other spending on children and consumption by workers and retirees.

The budget constraint from the perspective of the average or representative worker or decision-maker in this model is:

$$W_t \geq P_t X_t / SR_t + H_{t+1} F_t \qquad \qquad (7)$$

where $SR_t = N_t^1 / N_t$ is the support ratio and $F_t = N_t^0 / N_t^1$ is the number of children per parent.

The two key parameters in the model are the effect on productivity of human capital and, hence, the average wage (equation (4)). In this case we follow Lee and Mason who assume that the elasticity of output with respect to human capital is 0.33.[13] The second key parameter is the effect of fertility on human capital (equation (5)). Here we rely on the updated estimate of the elasticity of the quantity – quality tradeoff (-0.81) (Table 7) discussed above and based on cross-sectional estimates for 24 countries presented in Figure13.

Table 7 : Elasticity of Human Capital Spending - Total Fertility Rate Tradeoff	
Total Human Capital Spending	-0.81
Public Human Capital Spending	-1.42
Private Human Capital Spending	0.14

Based on regression of ln HK on ln TFR, 24 countries, update of Lee and Mason 2009. Private coefficient is not statistically significant.

Demographic variables are exogenously specified in the model: the net reproduction rate (NRR) and the proportion of the population surviving from the working ages to old age. The demographic variables were selected to conform closely to Nigeria's demographic experience where period 0 is matched to 1980, period 1 is matched to 2010, and period 2 is matched to 2040. Thereafter, the NRR is assumed to stabilize at 1.0 (replacement rate) and the old-age survival rate at 0.8. No immigration is incorporated into this model, although the more general implications of immigration are considered below. Several other demographic variables generated by the model, the population growth rate, the age distribution of the population, and the support ratio, are reported in Table 8.

A selection of the corresponding demographic data for Nigeria is reported in Table 9 . The NRR in the baseline simulation was selected based on the corresponding estimates and projections from the UN and, thus, the baseline values and the corresponding estimates are identical. The population growth rates for the baseline simulation and the estimates are similar as are the age distributions. The matches are by no means exact and an inevitable consequence of the stylized nature of the simulation model and that period in the simulation model refers to a generation, whereas the period demographic variables for Nigeria are for five-year periods.

Table 8 . Demographic Variables, Baseline Simulation

Period	NRR	Survival to old age	Population Growth rate	Percent of population			Support ratio
				Children	Workers	Elderly	
0	2.3	0.3	2.51	66.3	28.8	4.8	0.432
1	1.7	0.5	2.20	58.3	34.3	4.8	0.484
2	1.1	0.8	1.35	42.8	38.9	7.5	0.495
3	1.0	0.8	0.51	36.7	36.7	18.3	0.449
4	1.0	0.8	0.09	35.7	35.7	26.7	0.435
5	1.0	0.8	0.00	35.7	35.7	28.6	0.435
6	1.0	0.8	0.00	35.7	35.7	28.6	0.435

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[13] See Lee and Mason (2009) for an extensive discussion of the literature and the evidence in support of this assumption.

The basic features of Nigeria's demographic transition are represented in the baseline simulation.

Table 9 : Nigeria, Demographic Variables for Comparison to Baseline Simulation.

Period	NRR*	Growth rate	% <30	30-59	% 60+
1980	2.3	2.67	70.6	24.6	4.8
2010	1.7	2.12	70.5	24.6	4.9
2040	1.1	1.16	58.3	34.4	7.4

*NRR and growth rates are for the subsequent five-year interval, medium scenario, UN 2008.

The key results for the baseline simulation are reported in Figure 14. Fertility decline produced an increase in the support ratio that was concentrated between period 0 and 1, but increased modestly until period 2. After period 2 the support ratio declined and stabilized at a level essentially equal to the support ratio in period 0. In the absence of a response in human capital investment, consumption per equivalent adult would exactly track the support ratio. Those who were alive in periods 1 and 2 would enjoy higher consumption, but there would be no lasting demographic effects. If, on the other hand, fertility decline produced a response in human capital investment along the lines assumed in the baseline model, consumption per equivalent adult would have increased between periods 0 and 1 and, again, between periods 1 and 2. Consumption would be lower under these conditions, because resources previously used to fund consumption are being diverted to human capital investment. (Recall that human capital investment is not included in consumption in the model.) The benefits of this response become evident period 2. In period 3 and all subsequent periods, those shown but also future periods not shown, consumption is higher by more than 20 percent. Again this is a permanent increase not a transitory gain.

The gain in GNP per capita is even greater – stabilizing at about 50 percent more after the demographic transition than before. This overstates the gains in welfare associated with greater human capital investment because the gain in per capita GNP is realized, in part, by diverting economic resources away from consumption to investment in human capital. The importance of using consumption to measure the economic gains is clearly evident. To the extent that there are benefits of human capital investment beyond its pure productivity effects, however, average consumption understates the welfare gains from increased human capital investment.
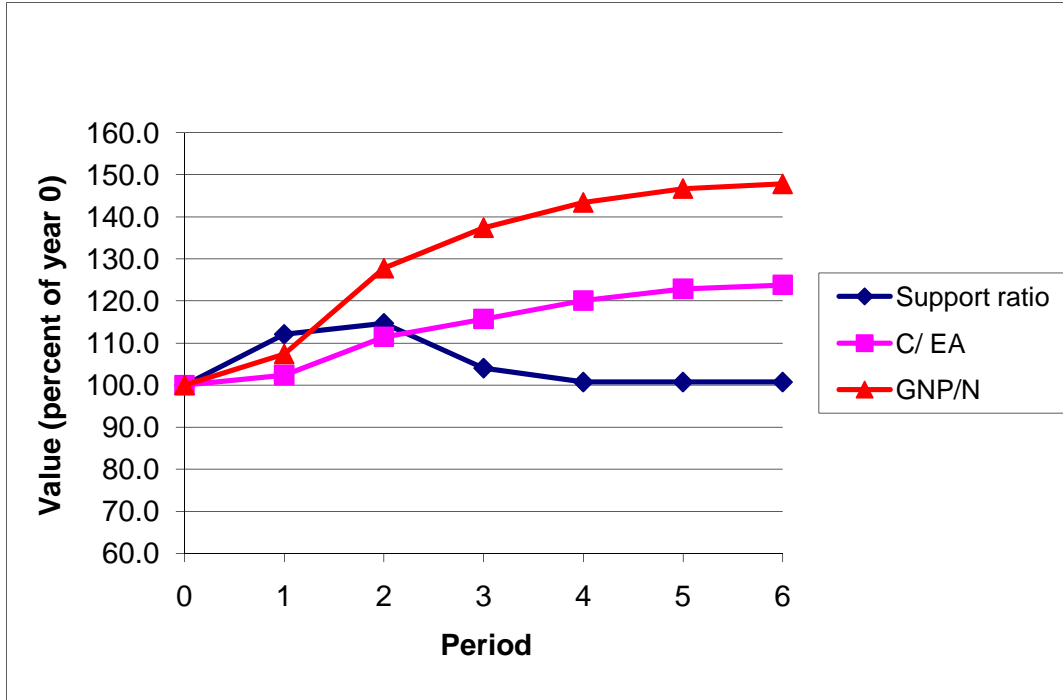
Figure 14. Macro Indicators: Baseline Results (Impact of Demographic Transition on Consumption per Equivalent Adult and GNP/N from Human Capital – Fertility Tradeoff).

Information about human capital spending and its impact on wages is provided in Table 10 . Human capital spending per child as a share of wages nearly doubles over the demographic transition – increasing from about 7% of wages in period 0 to 14% of wages in period 3 and thereafter. Human capital spending per child more than doubles because wages are also increasing during this period. A virtuous circle is created because greater human capital spending leads to greater human capital, greater wages, and still more human capital spending. Human capital spending as a share of GDP declines slightly during the period. The human capital investment rate drops because the elasticity of the quantity-quality tradeoff is -0.81. If it were constant, the human capital investment rate would have remained constant.

Table 10 . Human Capital Variables

Period	Human capital spending per child/Wage	Wage	Human capital spending child	Average human percapital workers	Human capital ofspending/ GDP
0	0.072	0.319	0.023	0.031	0.166
1	0.092	0.288	0.027	0.023	0.157
2	0.131	0.302	0.040	0.027	0.144
3	0.142	0.345	0.049	0.040	0.142
4	0.142	0.369	0.052	0.049	0.142
5	0.142	0.378	0.054	0.052	0.142
6	0.142	0.381	0.054	0.054	0.142

Human Capital Investment and Immigration

Investing in human capital is insufficient to guarantee a skilled and productive labor force because workers are mobile and will seek out better economic opportunities when they are lacking in their home country. As at 2006, the Core Welfare Indicator Questionnaire (CWIQ) survey, indicates that the total active population as at 2006 was 67.6%, while the percentage of the inactive population was 32.4%. With national unemployment rate being 5.3 percent and is higher for the urban areas, underemployment is a more prevalent situation in the country with one out of five members of the active population being underemployed (see NBS, 2006) Although unemployment is slightly lower in the rural areas, the area experienced higher under-employment rates.

The large, and perhaps growing, number of unemployed youth is one of the most staggering problems facing the country. And unemployment is the major reason for emigration by Nigerian youths. On the average, for every one unemployed adult, there are two unemployed young ones. Between 1996 and 2004, more than 85 percent of all employed persons in the country are youths whose ages fall between 15 and 44. In fact between 2003 and 2004, more than half of the unemployed are actually younger than 25 years old (CBN (2004) and NBS, 2007). According to the World Bank (2006) only an estimated 5 – 10% of the 6 million new entrants onto the labour market find a job and unemployment of youths aged between 15-29 years old is estimated at about 60 percent. One of the main causes is the unprecedented expansion of investment in youth education in that is not being matched by higher employment levels for this cadre of the population. The implication is that unemployment in Nigeria is largely a youth phenomenon. As a result many of the youths and often the highly educated ones seek to emigrate from the country for economic reasons.

Based on estimates for 2000 Nigeria is one of the African countries heavily affected by brain drain. Table 11 indicates that 36 percent of tertiary educated Nigerians have emigrated out of the country. The issue becomes more pronounced when skilled professionals in key areas such as health are also involved. By 2005, 14% and 12% of trained physicians and nurses have emigrated out of the country.

Table 11: Percentage of tertiary educated who emigrated out of the country

Country	Percentage of skilled who migrate
Cape Verde	69.1%
Gambia	64.2%
Seychelles	58.6%
Somalia	58.6%
Mauritius	48.0%
Eritrea	45.8%
Ghana	42.9%
Mozambique	42.0%
Sierra Leone	41.0%
Liberia	37.4%
Nigeria	36.1%

Source: http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/SSA.pdf (Accessed, November 2009)

By 2005, the stock of emigrants from Nigeria had reached 836,000 persons which was 0.6 percent of the population. Although the percentage of the population emigrating from SSA was higher at 2.1 percent, Nigerian emigrants accounted for 5.3 percent of total emigrants from SSA. Nigeria is also an important destination for immigrants from elsewhere, with immigrants into Nigeria represent 6.2 percent of all SSA immigrants (Table 12).

Brain drain in many key social sector including health care and higher education is thus real in Nigeria and it imposes significant costs on the country. Emigration of highly skilled personnel creates shortages in the country thus reducing the access to and range of their services, in particular in education and health sectors. This has an inhibiting effect on the achievement of the millennium development goals by the country. Additionally, there is loss of human capital investment and of the huge public resources given higher education which is mainly publicly funded and subsidized with the expectation that the beneficiary will utilise the skills acquired within the country – even with the establishment of many private universities. This is also lost to emigration and may discourage further investment.

However, there are gains to the country through the remittances and transfers received by the emigrants. The net benefit can be substantially higher in many cases since, it is likely that the emigrants might be unemployed or underemployed if they had remained in the country.

Table 13 displays remittances flows to and from Nigeria. Remittances are becoming an important source of income and growth in Nigeria (World Bank, 2006). Interestingly, most remittances started as a means by which family members outside the country assist their poorer siblings and relatives in Nigeria. Today remittances serve as a major source of poverty alleviation for relatives and siblings in the country. Nigeria is the largest remittance recipient in

Table 12 : Immigration Flows in Nigeria and Sub-Saharan Africa

	Nigeria	Sub-Saharan Africa
Stock of emigrants (2005)		
Number	836,832	15.9m
Percent of population	0.6%	2.1%
Destination (5 highest destinations)	USA, Chad, United Kingdom, Cameroon, Benin	Identified destinations: high-income OECD countries (25.2%), high-income non-OECD (2.9%), intra-regional (63.2%)
Stock of Immigrants (2005)		
Number	971,450	15.7m
Percent of population	0.7%	2.1%
Percent female	48%	47.9%
Percent refugee	0.8%	7.1%
Top sources	Benin, Ghana, Mali, Togo, Niger	Cote d'Ivoire, Ghana, South Africa, Nigeria, Tanzania

Source:
   a.   http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/Nigeria.pdf
http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/SSA.pdf

Africa and she receives an estimated 65% of the total official remittance inflows within Sub-Saharan Africa and 2 per cent of formal global remittances flows (Orozco, 2003). The World Bank (2004) reports that total inflows to Nigeria in 2006 were US$3.3 billion. The high level of remittances reflects, in part, the confidence in the economy of the Nigerian Diaspora.[14]

Table 13 Remittances Flows in Nigeria 2000-2007

	2000	2001	2002	2003	2004	2005	2006
Inward remittances flows (US $ billions)							
Nigeria	1.4	1.2	1.2	1.1	2.3	3.3	3.3
Sub-Saharan Africa	4.6	4.7	5	6	8	9.3	10.3
All developing countries	84.5	95.6	115.9	143.6	161.3	191.2	221.3
Outward remittances flows (US $ billions)							
Nigeria	.001	.001	.001	.012	.021	.018	.018
Sub-Saharan Africa	2.5	2.3	2.5	2.8	3	3.3	2.9
All developing countries	11.5	13.6	20.4	23.8	30.9	36	44.2

Sources: http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/Nigeria.pdf
         http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/SSA.pdf
         http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/Developing.pdf

The reported uses of remittances points to their potential importance for poverty reduction. Shah (2005) identified the common uses cited for remittances as housing improvement and construction, school fees, care for elderly relatives and siblings, a source of income for

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[14] Giveback Programme of NAPEP is encouraging Nigerian citizens living abroad to provide assistance to Nigerians at home.

unemployed relatives, investment income for traders and other small business ventures, funerals, weddings and pilgrimages.

III. Population Age Structure and the Economic Lifecycle: A Closer Look

If fertility declines in Nigeria, as anticipated by UN Population Projections and many other experts, the number of children will decline relative to the number of adults. Given the economic lifecycle that characterizes all societies, the economic support ratio will inevitably rise with favorable economic effects. The magnitude by which the economic support ratio rises, will depend on the particular features of Nigeria's economic lifecycle. Either current standards of living will increase or investment in physical or human capital will increase or some combination of the two.

Nigeria's Economic Lifecycle in Comparative Context

Estimates of average consumption and labor income by age for Nigeria in 2004 were presented in Section I. Four other African countries are currently constructing National Transfer Accounts, but those estimates are not yet available. Hence, we can not at this point compare Nigeria's economic lifecycle to those of other African nations. Estimates are available for a number of non-African countries that have relatively young age structures and relatively low per capita income, although not populations as young nor incomes as low as in Nigeria. As a basis of comparison, however, we will draw on estimates for the seven economies with the youngest populations that are currently available: Chile, China, Costa Rica, Mexico, South Korea, Taiwan, and Thailand. We refer to the average economic lifecycle of these seven countries as the standard lifecycle. It should be kept in mind that the lifecycle is different in some important ways from the economic lifecycle of the industrialized economies.

Nigeria's age profile of labor income is quite different than the standard profile (Figure 15). Per capita labor income is very low for young adults and relatively high for older adults. The per capita income of a thirty year-old, for example, is only 56% of the average per capita income of those in the 30-49 age group. In the standard profile, a thirty-year-old has an average labor income of 88% of the per capita value for those in the 30-49 age group. The other striking feature of labor income in Nigeria is that it remains at a high level for so long and declines relatively slowly in old-age.
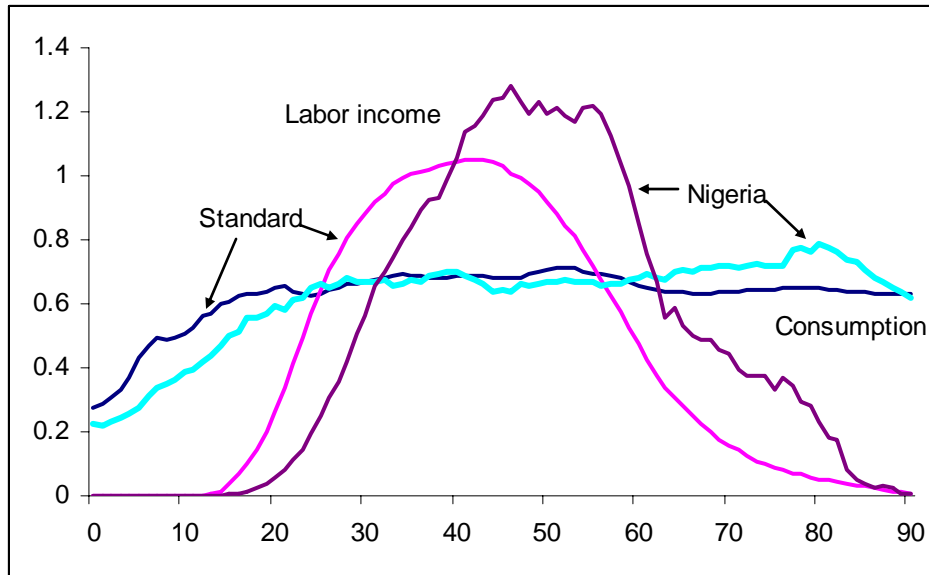
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Figure 15. Per capita labor income and consumption by age. Values are relative to average labor income for persons 30-49. Nigeria estimates for 2004. Standard is simple average of normalized values for seven economies: Chile, China, Costa Rica, Mexico, South Korea, Taiwan, and Thailand.

We explore the implications of Nigeria's distinctive lifecycle using a simple, but instructive, analysis. Suppose Nigeria could realize an enhanced economic lifecycle in which the labor income for adults under the age of 40 could be increased to the standard profile levels. How then would the economic support ratio in Nigeria be affected? The results from the analysis are shown in Figure 16 where the adjustment to the labor income profile was realized over a ten year period from 2010 to 2020.

A feature of Nigeria's support ratio is that the take-off is very slow. Part of the slow take-off is a consequence of the relatively slow speed of fertility decline and, hence, the gradual changes in population age structure. This point can be seen by comparing the speed of the rise the support ratios in Nigeria, China, and Korea in Figure 8. In those calculations, the standard profile was used for all countries. Fertility decline was much more rapid in China and Korea than projected for Nigeria. But another reason for the slow takeoff is the very low levels of labor income for young adults in Nigeria. If an enhanced economic lifecycle could be realized, the support ratio would grow much more rapidly over the next ten years and remain at a much higher level over the following decades.
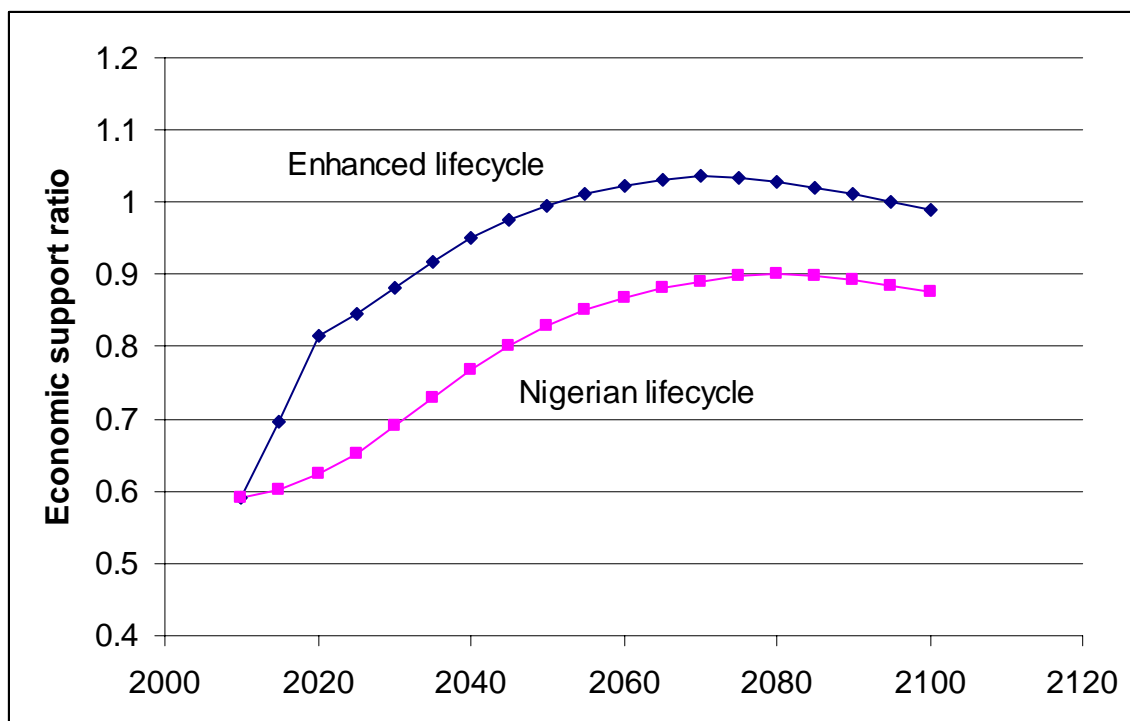
Figure 16. Economic support ratio based on Nigerian and enhanced economic lifecycles. See text for details. Source: Calculated by authors.

A host of factors can account for the depressed levels of labor income at young ages:

- Poor employment opportunities particularly for educated, highly-skilled workers
- Low female labor force participation
- Low investment in human capital
- Emigration of educated workers
- Poor health amongst young adult

Note that many of these factors are inter-related and self-reinforcing. The lack of employment opportunities leads to emigration of skilled workers and undermines incentives to invest more in human capital. The lack of highly skilled workers undermines opportunities to foster economic growth and create jobs for highly-skilled workers. High rates of childbearing increase the opportunity cost of employment for women and reduce their labor force participation. Moreover, high rates of childbearing increase the cost of raising the average educational attainment of the next generation of workers.

As changes in age structure continue and the 40-plus population increases its share, the Nigerian economic lifecycle (and the enhanced profile) is preferable to the standard profile because labor income of those 40 and older have such high labor income.   If this feature of labor income in Nigeria persists the economic support ratio will remain at a substantially higher level than produced by the standard labor income profile, because a population concentrated in the 40s and 50s is highly beneficial as compared with the standard result.

Whether this feature of Nigeria's labor income profile will persist into the distant future is very difficult to say. High levels of work activity at old ages tend to characterize countries with low per capita income, small formal sector employment, and limited public systems of support for the elderly. If Nigeria is successful in its development efforts, it is quite possible that labor income at older ages will decline relative to labor income among prime age adults. A second and important explanation for relatively low labor income at younger ages in the standard lifecycle is that the human capital of young workers is much greater than that of older workers. If human capital investment is increasing rapidly, wages of younger, more highly-skilled workers will be higher relative to older, less highly-skilled workers. Thus, rapidly expansion of education systems increases the gains from a young work force and reduces the gains from an older work force. Some decline in the relative labor income of older workers may, thus, be inevitable. At the same time policies that discriminate against older workers or create incentives to withdraw from the workforce can be avoided. Moreover, investing in the human capital of older workers may also help to maintain relatively high productivity among these important contributors to economic success.

Nigeria's Lifecycle Deficits and Saving

In the aggregate economic lifecycle for Nigeria, shown in Figure 5 for 2004, the lifecycle deficit for the young, the gap between their consumption and labor income, is substantial while the deficit for the old is much smaller. The child deficit is almost 80% of total labor income while the old-age deficit is about 3% of total labor income. The lifecycle surplus is only 14% of total labor income and, hence, the combined deficit including the surplus of prime-age adults is almost 70% of total labor income. How can Nigeria fund such a large lifecycle deficit? And how will the economy be affected as changes in age structure affect the size of the lifecycle deficit? We consider each of these questions, in turn.

The lifecycle deficit (LCD) can be funded in only three ways: net transfers from abroad, asset income, and dis-saving. Any economy is governed by a fundamental flow constraint that must hold in every period – the lifecycle deficit plus saving must equal net transfers from the rest of the world plus asset income. In algebraic form, we have:

$$\text{LCD}_t + S_t = \tau_t + Y_t^A \qquad (8)$$

First, Nigeria is funding its lifecycle deficit, in part, by relying on net transfers from the rest of the world. Nigeria receives remittances from Nigerians living and working abroad as described above. Moreover, Nigeria receives foreign aid some of which is used to support current consumption. Second, Nigeria is relying on asset income. An important form of asset income is income from oil exports. In 2005, oil revenue was ₦4,762.4 billion, which increased to ₦5,287.6 billion in 2006, and dropped to ₦4,463billion in 2007 (NBS,2008). Asset income also includes income produced from privately owned capital. Any excess of net transfers from ROW and asset income over the lifecycle deficit is saved. On the other hand, dis-saving must occur if the lifecycle deficit exceeds net transfers from ROW plus asset income.

In a purely algebraic way, the aggregate lifecycle deficit is a product of the population in each age group and the per capita deficit at that age. The lifecycle deficit is defined as $d(x) = c(x) - y^l(x)$ with $d(x)<0$ for $x<x1$ and for $x>x2$. The aggregate lifecycle deficit for the young as a share of total labor income (D1) is given as:

$$D1 = \frac{\sum_{x=0}^{x1} d(x)N(x)}{\sum_{x=0}^{\omega} y^l(x)N(x)} \tag{9}$$

and the aggregate lifecycle deficit for the old as a share of total labor income (D2) is:

$$D2 = \frac{\sum_{x=x2}^{\omega} d(x)N(x)}{\sum_{x=0}^{\omega} y^l(x)N(x)} \tag{10}$$

where $N(x)$ is the population age x. The lifecycle surplus, which is earned between ages $x1+1$ and $x2-1$ inclusive, as a share of total labor income is:

$$Surplus = \frac{\sum_{x=x1+1}^{x2-1} d(x)N(x)}{\sum_{x=0}^{\omega} y^l(x)N(x)} \tag{11}$$

The aggregate lifecycle deficit calculated over all ages is the sum of these three components. The per capita lifecycle deficit for Nigeria in 2004 is displayed in Figure 17.
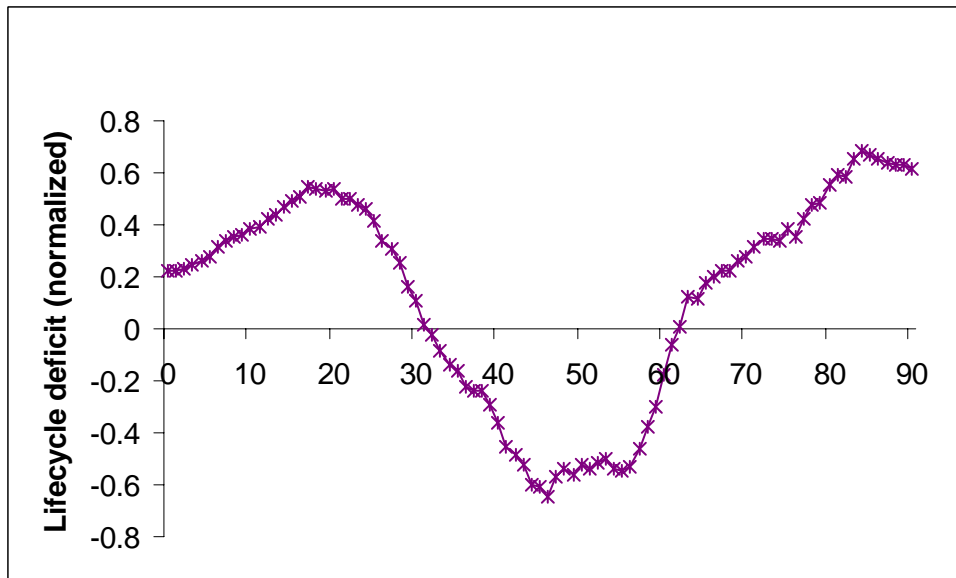

Figure 17. Per capita lifecycle deficit of Nigeria 2004 normalized on per capita labor income for those aged 30-49. Source: Calculations by authors.

The implications of changes in age structure depend on whether the per capita lifecycle deficits shift or remain constant. Consider the case when the per capita LCD remains in place. The aggregate deficits can be calculated directly using Nigeria's projected population. The results are presented in Figure 18.

The child deficit is projected to decline immediately. The old age deficit changes very little. The surplus is relatively constant until 2020 and then begins to increase (the surplus is measured as a negative value, a negative deficit, here). The net lifecycle deficit declines with increasing speed and drops from almost 70% of total labor income in 2005, to 52% of total labor income in 2025, and to 20% of total labor income in 2050.
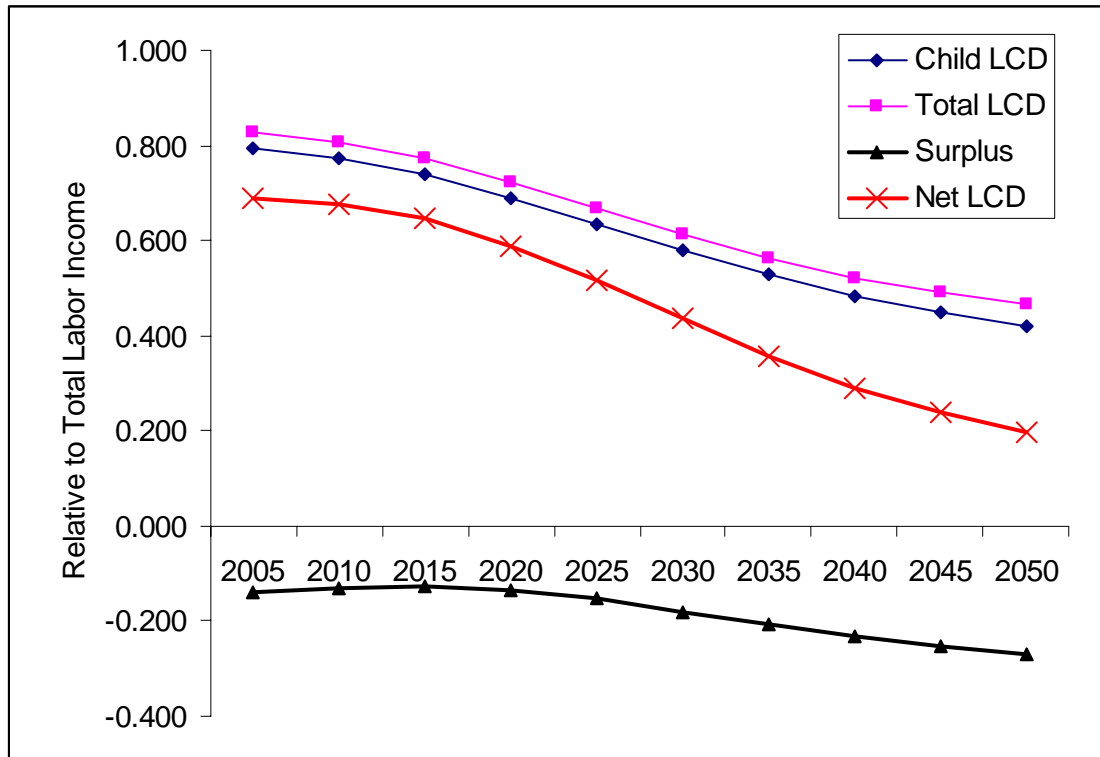

Figure 18. Projected aggregate lifecycle deficits and surpluses holding per capita lifecycle deficit at 2004 level.

To fully understand the economic implications of the change in age structure, it is important to delineate the possible options and these are clear from the macroeconomic flow constraint – equation (8). First, the lifecycle deficit may not decline in response to favorable changes in age structure because the consumption profile shifts upward or the labor income profile shifts downward. To the extent that consumption increases current standards of living will be higher and current welfare enhanced. A downward shift in the labor income profile due, for example, to a reduction in work and increase in leisure seems like a relatively unlikely possibility. Second, saving could increase. Current standards of living would not be enhanced, but economic growth and future standards of living will be higher. Higher saving will lead to greater assets and asset income in the future. If the additional saving is invested domestically, wages and labor income will be higher. Third, the decline in the lifecycle deficit could lead to a decline in net transfers from abroad. As economic conditions improved foreign aid might decline or Nigerians working abroad may reduce their remittances to family members who are

better off. Asset income, the fourth component of the macro constraint (equation 8), is only be influenced indirectly through changes in the saving rate.[15]

Whether Nigeria follows one of these paths, or some intermediate path, will have profound implications for the development consequences of changing population age structure. This will depend, in turn, on a combination of public policy and private behavior.   The issues are explored further in the following section.

IV. Capital, Age Structure, and Economic Growth

In Section II we considered the potentially important role of human capital over the transition in age structure.   In that section we show that if increased investment in human capital accompanies fertility decline, permanently higher wages and standards of living can be realized. In the final part of Section III, we show how favorable changes in age structure essentially change the tradeoff between current per capita consumption and aggregate saving. With the favorable changes in population age structure that are coming in Nigeria, aggregate saving and per capita consumption can both increase.   To the extent that aggregate saving increases, standards of living can be lifted to permanently higher levels. To the extent the current per capita consumption is increased, current standards of living will rise but at some cost to economic growth.   What will actually happen in Nigeria and how the outcome might be influenced by policy are exceedingly complex issues. In this section we will explore these issues further.

In general, the elderly must rely either on transfers, including transfers from their family members, or assets to fund their lifecycle deficit – the gap between what they consume and what they produce through their labor. As population aging occurs, the old age lifecycle deficit increases very substantially with implications that vary depending on the support system characterizing the society.   In many industrialized countries, public transfers play a very important role. Continued reliance on these programs will require substantial expansion of these programs and increases in taxes required for that expansion. In some traditional societies, familial transfers play a very important role. If that approach is to continue, then the burden on the descendants of the elderly will necessarily increase.

The alternative to relying on transfers is to rely on assets to fund retirement. In this case, the increase in the old-age lifecycle deficit leads to an increase in the demand for assets. These assets can vary in form but include pension funds, personal saving, owner-occupied housing, consumer durables, family businesses and farms, and so forth. An important feature of assets is that they play a dual role.   They provide a way of funding old-age, but they also facilitate economic growth. Greater capital yields higher income to those who own the capital, but also higher income to wage earners whose productivity is enhanced by capital deepening.

An important point to bear in mind is that relying on saving to support retirement requires a long-term perspective.   Typically pensions are accumulated over the entire work span and,

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[15] Population change could influence rates of return to capital in a closed economy but is unlikely to have much affect in Nigeria.

hence, the rise in the demand for assets will precede the increase in the old age deficit by several decades. This makes it critical that the regulatory and institutional framework for supporting asset accumulation is established as early as is feasible.

The growth implications of higher saving are of obvious importance to any country aspiring to higher standards of living for its citizens. The old-age security implications may appear to be less relevant to Nigeria or other countries with very young populations. The vast majority of countries fall into one of two groups, however. Young countries that are postponing careful development of policies towards old-age security, and old countries that regret their failure to act while still young.

The remainder of this section is devoted to a detailed simulation analysis of how population aging and policies with regard to old age support influence development. The model used here was first developed and is described in Mason and Lee (2007) and extended to consider immigration issues in Mason, Lee, and Lee (2010 forthcoming, 2008). The results presented here use population projections and economic parameters for Nigeria.

Before discussing the results, we will briefly describe the economic model whose selected assumptions and parameters are contained in Table 14. More detailed information is available in the papers mentioned in the preceding paragraph. The population and its detailed age structure are exogenously determined using age-specific fertility rates, mortality rates, and migration rates that are based on the most recent United Nations population projections (United Nations Population Division, 2009). The baseline simulation uses the UN medium scenario.[16]

Table 14. Selected Assumptions and Parameters for Nigeria Simulations.	
Consumption and labor income age-profiles	Baseline: NTA estimates for Nigeria (Figure 2). Alternative: Enhanced economic lifecycle.
Productivity growth	Labor augmenting growth of 1.5% per year
Total Fertility Rate	UN Projections - 2005-10: 5.32; 2045-50: 2.41
Life expectancy at birth (both sexes combined)	2005-10: 47.8; 2045-50: 62.5
Net migration	Baseline simulation: -60,000 per year; No migration simulation: 0 per year.
Old-age support	Baseline simulation (low transfers): 33% from transfers; 67% from assets. High transfer simulation: 67% from transfers; 33% from assets.

Output is determined by labor, adjusted for age-specific variation in productivity and employment, capital, and exogenous technological change. The economy is open to

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[16] The model generates the population projection so that fertility, mortality, and migration rates can be varied in ways not available in the UN projections. The forty year time horizon of the UN projections is also insufficient to consider many of the issues addressed here. Thus, the projections have been extended beyond 2050 in a manner consistent with the approach taken in UN projections.

international capital flows so that interest rates are determined in global financial markets. Hence, the accumulation of assets by residents affects their income but not interest rates nor the capital intensity of the domestic economy. Additional assets either displace foreign capital invested in the domestic economy or is invested abroad.

There are no bequests. The only motive for accumulating assets is to fund the old-age lifecycle deficit. The strength of this motive depends on the exogenously determined policy towards old-age transfers with no distinction drawn between public and private transfers to the elderly. A distinctive and important feature of the model is the way in which consumption is modeled. We assume that altruistic links are sufficiently strong that the shape of the age profile of consumption does not change, but its level shifts upward (downward) as a consequence of overall economic progress (decline). In conventional economic models, that we find to be inconsistent with observed empirical patterns around the world, consumption of each cohort depends on the lifetime income of that cohort. In the model used here every cohort (and its members) face a lifetime budget constraint, as they must, but intergenerational transfers vary so as to maintain the shape of the existing age profile of consumption. Aggregate consumption is governed by a social budget constraint that guarantees that aggregate consumption and saving do not exceed national income.

Reduced immigration and age structure

There are many reasons why immigration influences Nigeria's economic performance. As explained in some detail above, young immigrants are often well educated with great potential given the right economic circumstances at home. By immigrating they are often able to realize higher incomes to their own benefit. Moreover, to the extent that their success abroad feeds remittances in Nigeria, those who remain at home prosper.

The particular analysis carried out here, however, is concerned with the possibility that migration affects macroeconomic performance by perturbing population age structure. To explore this issue we compare the UN standard population projection to one in which there is no immigration at all. Given even this extreme assumption we find that the population age structure is not influenced to a great degree and that the support ratio is largely unaffected by migration. In Figure 19 we compare the support ratio using Nigeria's actual lifecycle and the enhanced or alternative lifecycle. In neither case, does immigration make a discernible difference.
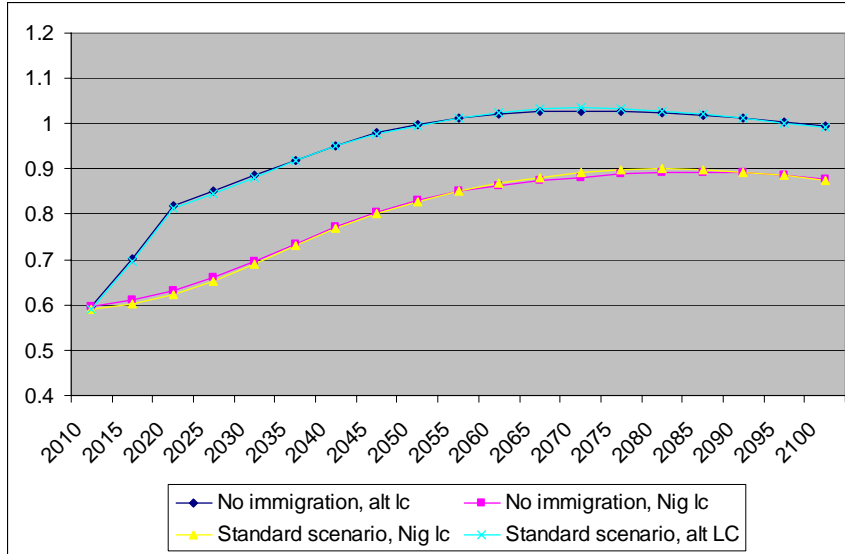
Figure 19. Economic support ratio given no immigration and standard scenarios populations; Nigerian and alternative economic lifecycles.

## *Baseline simulation and variation in economic lifecycle and old-age transfer system*

In this section we compare the baseline simulation with alternative variants in which the enhanced economic lifecycle is compared with the Nigerian economic lifecycle and high reliance on transfers is compared with low reliance on transfers to provide old-age security.

In the baseline scenario we assume that the old-age support relies heavily on the accumulation of assets rather than on transfers. In the low transfer case, two-thirds of the lifecycle deficit of those 65 and older is funded relying on assets and one-third is funded from familial and public transfers. This has a major impact on consumption and saving patterns as shown in Figure 20. Given heavy reliance on assets to fund old-age needs, the share of national income that is consumed (C/Y) drops and the saving rate (1-C/Y) increases starting in 2020. The saving rate increases from less than 4% of income to around 12% of income for the high asset variant.

The timing of this increase is very important to note. Although Nigeria will still have a relatively young population in 2020, higher saving for retirement will be needed at that point. Once a nation's population has become old, it is too late to prepare. It must begin many decades earlier.

The substantial increase in saving rates leads to a much higher level of wealth. Given high transfers and low reliance on assets to fund retirement, the ratio of assets to total labor income increases very sloly and barely exceeds 1 by the end of the simulation in 2100. Given low transfers and high reliance on assets, the ratio of assets to aggregate labor income rises to over 5 by 2100.

Figure 20. Results from four simulations: low and high transfer scenarios, and Nigerian enhanced economic lifecycles.
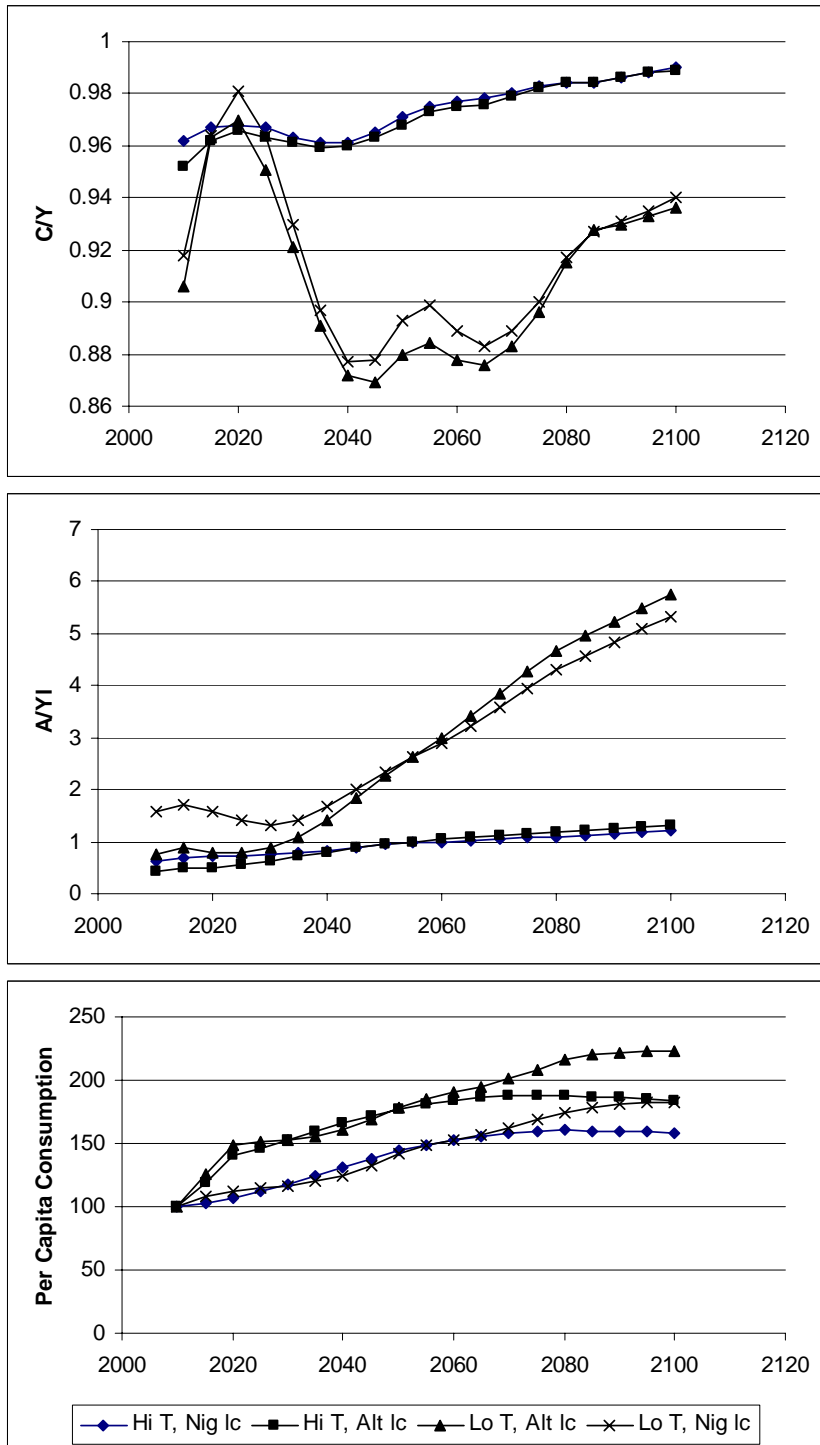
Notes: Transfer share equal to 0.33 (Lo T) or 0.66 (Hi T) of lifecycle deficit of the elderly (65+). Economic lifecycle is Nigerian (Nig lc) or enhanced (Alt lc). See text for additional details. Source: Calculations by authors.

Whether the Nigerian economic lifecycle or the enhanced lifecycle persists has a relatively small effect on the saving rate or wealth. The reason is that the demand for wealth in retirement is heavily affected by the size of the lifecycle deficit at older ages. The enhanced lifecycle does not differ with regard to this feature from the estimated lifecycle for Nigeria. The differences between the two scenarios occur only at young ages.

The increase in assets for the low transfer scenario results in higher asset income and higher total income. Because we have assumed that Nigeria's economy is open to international capital flows, the increase in assets does not affect the level of domestic capital or wages. But total income is nonetheless higher because of the increase in asset income. This gain is offset to some extent because the saving rate must be higher in order to realize and then to sustain higher levels of assets. The gap between saving rates is particularly great between 2020 and 2040 so that consumption given the low transfer scenario is less than the high transfer scenario. But eventually the low transfer scenario yields substantially higher levels of consumption. Note that the consumption trend shown in Figure 20 is that due entirely to the effects of population aging. Consumption also increases because of technological progress but this effect has been controlled for in Figure 20. An important difference between these two variants occurs after 2100. Consumption given the high transfer variant will continue to decline from its peak while consumption given the low transfer variant will remain at a relatively high level. Thus, the transitory increase in the support ratio yields a permanently higher standard of living due to affects on wealth.

Although the enhanced lifecycle has little effect on asset accumulation, it has a very substantial and persistent effect on consumption simply by virtue of the higher per capita labor income realized. This benefit is realized early and it persists in the long-run.

V. Policy Issues and Conclusions

Many countries in Asia and Latin America have already completed the transition to low fertility and experienced changes in age structure that have accelerated economic growth. Nigeria and other countries in Sub-Saharan Africa are just beginning the transition to low fertility. The economic support ratio in South Korea, for example, has peaked while in Nigeria the economic support ratio is near its trough and is not expected to peak for another 40 years or more. The experience of countries that have already enjoyed a demographic dividend may be instructive for Nigeria. Thus, it is important to understand the general lessons that can be drawn from the experience of other countries. At the same time, Nigeria has its own unique features that will distinguish its development experience. Only by developing a clear understanding of how Nigeria differs from other countries will it be possible to frame policies that will be successful in the Nigerian context.

First, the transition to low fertility throughout the developing world is leading to a decline in the relative number of children in the population and an increase in the share of the population in the working ages. As a consequence, per capita income can be expected to grow more rapidly over an extended period of time, four or more decades. The boost to income growth will rarely exceed 1 percent per year and will typically be much less. But over the entire

dividend period, changes in age structure produce an increase in per capita income of perhaps 40 percent.

Nigeria is just beginning to experience the demographic dividend, because like other SSA countries fertility rates have only recently begun to decline. The total impact on per capita income should be similar to that experienced in other developing countries. However, Nigeria's take-off is relatively slow. This is true because fertility rates are declining more slowly in Nigeria than in many other developing countries and because Nigeria's economic lifecycle cycle is not conducive to a fast take off. In particular, low labor income among young adults is a serious problem. If fertility decline is more rapid than anticipated and if labor conditions improve for young adults, then the economic support ratio will rise more rapidly and Nigeria will enjoy a larger demographic dividend over the next decade or two.

Second, the demographic dividend is a transitory phenomenon. At some point in the future, low fertility will lead with a lag to a smaller workforce and a decline in the economic support ratio. An important issue, then, is how to transform the demographic dividend into higher standards of living in a sustainable way.

One policy option is to increase investment in human capital per child as birth rates decline. Whether we compare across countries with different levels of fertility or track the experience of individual countries, there is a strong tradeoff between the total fertility rate and human capital spending per child. For this policy to be successful, it is essential that two conditions be met. The first is that spending on education and health be effective in raising the human capital of children. The second is that economic opportunities allow more highly skilled adults to find highly productive and highly paid employment. The general experience is that these conditions are met *on average* and that investment in human capital is an effective tool for achieving higher standards of living that are sustainable. But this cannot be taken for granted.

Two features of Nigeria seem to be particularly relevant to these issues. The first is the lack of economic opportunities in Nigeria for highly skilled workers. This must have accounted for the long child dependency period in Nigeria compared to other countries, as shown in the country's LCD graph (Fig. 4). This unique feature of the Nigerian LCD has resulted in the situation in which the period for which people of working age earn more income than their consumption expenditure is the shortest among comparator countries in the NTA estimation group. In the absence of those opportunities, therefore, emigration combined with remittances offer a means by which education can be used to raise standards of living of Nigerians living at home and abroad. But the lack of job opportunities in Nigeria is an obvious source of concern. The benefits of emigration have their costs with the attendant loss of experts who could have improved the quality of life of the Nigerian population in many sectors, particularly in health and education, resulting in low quality of life. The second feature is the very low level of public human capital spending in Nigeria. Although private spending is quite high, the international experience is that public spending plays a critical role; particularly in the area of tertiary education.

The twin problem of lack of employment opportunities and loss of highly qualified Nigerians to emigration combine to inhibit the raising of wholesome and creative Nigerians for the next generation. Apart for losses in monetary terms, there are other areas of concern which have

monetary outcomes in the final analysis. One important area is the deleterious effect on culture and traditions. Emigrants and their children tend to be easily assimilated by the cultures of their host countries. Nigerian languages, for example, are hardly spoken by young children nowadays in schools even in Nigeria and there has been recurring calls for the reversal of this trend. Thus, it will be even more difficult for emigrants and their children to continue speaking them. Languages constitute the vehicles for transmitting the cultures of peoples.

Hope is not lost, however, if the country can creatively use opportunities offered by information and communication technologies which have made the world a global village. In this connection, the practice of teaching Nigerian languages in schools that was very popular in the 1970s and 1980s[17] will have to be revisited in addition to diversifying the media of instruction and transmission using a medium like the television. The international program of the Nigerian Television Authority or any other similarly powerful medium comes in handy in reaching Nigerians in the Diaspora, in this regard.

Continuation of the current trend is particularly worrisome for the advancement of the arts in Nigeria. Currently, Nigerian youths are making waves in the entertainment industry; music and film industry. In music, they are creating an emerging genre of poetry and musical composition. For, example, rap artistes are creating rhymes in Nigerian languages. What existed earlier were recourse to using *puns* or play-upon-words as Nigerian languages are very tonal. This creative development, which deserves serious academic study, will be lost if care is not taken because a number of the successful artistes in the current dispensation were raised abroad under watchful eyes of parents who prize their indigenous language. In fact the Nigerian film industry, *Nollywood* is the third largest in the world next to *Hollywood* and *Bollywood* of India. Indeed, the Nigerian film and music industry have a significant share of the African market. A continuation of the current situation in Nigerian languages are relegated to the background, will be inimical to the development of Nigerians at home and in the Diaspora and will hinder creativity, innovation and entrepreneurship, resulting in a worsening employment environment in the country.

Related to the foregoing is the need to improve the quality of Nigerian human capital by improving the employability of graduates of Nigeria's educational system. Employers have alleged in the popular press in Nigeria that graduates of Nigerian universities lack employable skills, including life and leadership skills. Related to this is the very weak link between the universities and other tertiary institutions and society represented by the private sector. However, efforts are already in place to promote university-private sector collaboration and introduce university students to concepts of entrepreneurship and innovation with the twin objective of making all students *imbibe* entrepreneurial and enterprising attitudes and making some of them who have characteristics of entrepreneurs become entrepreneurs. With this, creation of enabling environment will not be left to government alone because entrepreneurs as people of passion create markets where they do not exist and thus can create the enabling

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[17] In the 1970s and 1980s, there was a very popular television program hosted by the Nigerian Television Authority; *WaZoBia* for teaching the three main Nigerian languages, Yoruba, Hausa. and Igbo Its title was borrowed from a popular *highlife* tune of the 1960s built around the word *come* which is *wa* in in oruba, *zo* in Hausa and *bia* in Igbo. The program from casual empiricism appears successful, though we are not aware of any formal evaluation.

environment for their activities. In addition staff and students of universities and other tertiary institutions are now being introduced to the concept of commercializing their research through exposure to the concept and use of intellectual property (IP) to improve the quality of life in the society. Indeed, the National Office for Technological Acquisition and Promotion (NOTAP), in conjunction with the World Intellectual Property Organization (WIPO), has established Intellectual Property and Technology Transfer Offices in 13 Nigerian tertiary institutions and research centers as a way of enhancing university-private sector collaboration and promoting entrepreneurship (Soyibo, 2009). Though a good start, it will need to broadened and deepened.

Another complementary approach to achieving sustainably higher standards of living is to channel some of the gains from the demographic dividend into saving and investment. The age transition itself will lead to an increased demand for assets as Nigerians live longer and the expected duration of their retirement increases. Although labor income is relatively high at older ages at the current time, this may well decrease as standard of living improve and the demand for leisure increases and as more are employed in the formal sector. Nigeria launched its Public Pension System in 2005 with the passage of the National Pension Commission (PENCOM) Act of 2004. However, it needs to be deepened and enhanced to involve more participants. Many Latin American countries adopted large, PAYGO pension systems at relatively early stages of development. These systems have proved to be unsustainable and they have undermined saving incentives by providing generous pensions. In Asian developing countries, public pension systems have played a much less important role and familial transfers have been more important especially for the very old.

From, the simulation aspect of our study, however, it is found that Nigeria can do a lot concerning promoting savings by people in the working age so that they can have assets rely upon during old age dependency period. From the study we learn that enhanced low transfer option in which the old age dependency is financed by two-thirds of asset reallocation and one-third of familial transfer has higher return and per capita consumption and so is preferred. The turning point for these variables, is the year 2020. It is instructive that this coincides with the year Nigeria plans to be in the league of the top 20 industrial economies. To ensure that this preferred alternative materializes, a lot of complementary policy initiatives will need to be in place well before this time. Among these are the deepening and widening of the Nigerian financial markets to allow for more creative instruments for investment and providing adequate legal institutional framework for dispute resolution, among others.

Whether Nigeria should begin to concern itself with the social security of the elderly is open to question and there may be more pressing issues. However, those who are just entering the workforce will not reach retirement age until mid-century. They may face an extended retirement at that time with a support system that is not up to the task. Thus, Nigeria must consider how its financial system can be improved and retirement saving encouraged among today's workers.

Appendix Table A1:Underlying data for Figure 4: Age profile of Labor Income and Consumption (Naira)

Age	Total Consumption	Labor Income
0	28,149	0
1	28,084	0
2	29,609	2
3	31,134	8
4	32,678	10
5	35,017	14
6	39,675	30
7	42,550	49
8	44,670	86
9	45,770	104
10	49,089	138
11	50,298	146
12	53,388	202
13	55,597	254
14	59,709	381
15	63,152	685
16	65,192	917
17	70,530	1,686
18	70,795	2,809
19	72,196	4,920
20	75,419	6,874
21	73,524	10,359
22	77,420	14,029
23	78,505	18,519
24	82,644	24,519
25	84,328	31,442
26	82,328	39,202
27	84,161	45,138
28	86,091	53,429
29	85,045	64,163
30	84,912	71,579
31	84,691	83,190
32	85,266	88,346
33	83,153	94,103
34	83,628	101,402
35	85,501	106,248
36	85,125	113,468
37	87,419	117,559

38	87,571	118,200
39	88,388	125,274
40	88,376	133,858
41	86,979	144,030
42	85,502	146,589
43	84,160	150,179
44	81,173	156,768
45	81,465	158,036
46	81,084	162,739
47	83,966	156,234
48	83,570	151,605
49	84,191	155,837
50	84,705	151,070
51	84,770	153,367
52	85,460	150,816
53	84,969	148,320
54	84,733	153,450
55	84,996	154,096
56	83,320	150,996
57	83,730	142,690
58	84,040	131,862
59	85,248	123,190
60	86,107	108,129
61	88,041	95,749
62	85,970	84,783
63	85,842	70,668
64	88,684	74,303
65	89,655	66,994
66	88,965	63,558
67	90,262	62,062
68	90,316	61,682
69	91,387	57,957
70	91,506	56,336
71	90,534	50,120
72	91,198	47,445
73	91,642	47,570
74	90,938	47,579
75	90,719	41,703
76	91,446	46,353
77	97,651	43,725
78	97,992	37,359
79	96,733	35,648

Age		
80	99,434	29,215
81	98,209	22,895
82	96,357	22,393
83	93,363	10,444
84	92,688	6,237
85	89,385	4,882
86	86,593	3,336
87	84,542	3,573
88	82,491	2,842
89	81,100	796
90+	78,389	757

Table A2: Underlying data for Figure 12 Per capita Human Capital Spending for ages 0 – 24 in year 2004 in Nigeria(Naira).

Age	Private Expd on Education	Private Expd on Health	Govt Expd on Health	Govt Expd on Education
0	0	5,269	237	0
1	0	5,203	237	0
2	0	5,137	238	0
3	0	5,072	239	0
4	0	5,022	243	0
5	0	5,775	240	0
6	2,837	5,682	244	320
7	3,846	5,825	250	446
8	4,435	5,656	278	529
9	3,805	5,843	295	465
10	4,823	6,426	285	604
11	4,228	6,692	275	541
12	6,152	5,788	306	807
13	5,892	6,603	348	795
14	7,053	7,341	373	982
15	8,025	7,650	366	1,153
16	7,421	8,137	356	1,101
17	9,748	8,106	379	1,494
18	8,301	8,130	378	1,314
19	7,825	7,742	388	1,281
20	9,423	7,149	399	1,597
21	6,291	6,787	440	1,104
22	7,666	7,411	443	1,398
23	6,704	7,981	470	1,277

24	8,615	8,083	491	1,720

Table A.3. Human capital spending, synthetic cohort values for selected countries.
Values reported in Figure 13.

	Total Fertility Rate	Human capital, private	Human capital, public	Human capital, total
Austria, 2000	1.36	0.28	3.59	3.87
Brazil, 1996	2.45	1.55	2.07	3.62
Chile, 1997	2.21	1.05	1.95	3.00
China, 2002	1.78	1.31	0.67	1.98
Costa Rica, 2004	2.28	0.72	2.52	3.24
Finland, 2004	1.72	0.18	3.44	3.61
France, 2001	1.87	0.27	4.33	4.60
Germany, 2003	1.32	0.36	2.72	3.08
Hungary, 2005	1.30	0.52	3.15	3.67
India, 1999	3.43	0.65	0.88	1.54
Indonesia, 2005	2.37	0.81	1.22	2.04
Japan, 2004	1.33	1.40	3.97	5.37
Kenya, 1994	5.40	0.17	0.61	0.78
Mexico, 2004	2.40	2.81	2.32	5.13
Nigeria, 2004	5.67	1.85	0.19	2.04
Philippines, 1999	3.64	1.24	1.11	2.35
Slovenia, 2004	1.22	0.50	4.76	5.26
South Korea, 2000	1.51	2.22	1.99	4.21
Spain, 2000	1.27	0.72	3.36	4.09
Sweden, 2003	1.64	0.16	5.65	5.81
Taiwan, 2003	1.25	3.07	2.13	5.20
Thailand, 2004	1.93	0.80	2.51	3.31
US, 2003	2.04	1.10	3.08	4.18
Uruguay, 1994	2.49	1.22	1.35	2.58

Note. All values are normalized on per capita labor income of those 30-49 years old.
Source: Lee and Mason 2009, updated to include Nigeria.

Table A.4. Support ratio 2008 UN Projection + Long range projection							
	Brazil	China	India	Indonesia	Niger	Nigeria	Korea
1950	0.655	0.737	0.701	0.658	0.584	0.653	0.659
1955	0.651	0.711	0.693	0.667	0.596	0.648	0.652
1960	0.640	0.693	0.681	0.671	0.601	0.644	0.656
1965	0.629	0.672	0.667	0.666	0.604	0.640	0.644
1970	0.627	0.654	0.657	0.656	0.603	0.634	0.648
1975	0.638	0.656	0.657	0.648	0.607	0.627	0.662
1980	0.657	0.680	0.664	0.651	0.617	0.622	0.701
1985	0.680	0.714	0.674	0.664	0.586	0.611	0.747
1990	0.705	0.753	0.685	0.687	0.586	0.604	0.797
1995	0.732	0.795	0.698	0.718	0.582	0.604	0.841
2000	0.758	0.825	0.714	0.752	0.591	0.610	0.868
2005	0.783	0.843	0.732	0.783	0.585	0.619	0.883
2010	0.806	0.859	0.752	0.808	0.572	0.630	0.886
2015	0.822	0.863	0.772	0.824	0.562	0.645	0.877
2020	0.835	0.851	0.792	0.833	0.559	0.664	0.858
2025	0.843	0.829	0.810	0.836	0.564	0.689	0.827
2030	0.844	0.806	0.824	0.832	0.577	0.717	0.789
2035	0.835	0.786	0.834	0.821	0.597	0.744	0.751
2040	0.818	0.770	0.838	0.806	0.619	0.767	0.717
2045	0.795	0.754	0.835	0.790	0.644	0.784	0.689
2050	0.770	0.740	0.826	0.775	0.674	0.795	0.667
2055	0.757	0.733	0.816	0.763	0.704	0.803	0.655
2060	0.746	0.730	0.804	0.754	0.735	0.808	0.649
2065	0.737	0.727	0.791	0.746	0.764	0.811	0.647
2070	0.729	0.725	0.779	0.739	0.789	0.811	0.649
2075	0.723	0.721	0.767	0.732	0.809	0.805	0.652
2080	0.719	0.718	0.757	0.726	0.824	0.796	0.654
2085	0.715	0.713	0.748	0.722	0.834	0.784	0.655
2090	0.711	0.707	0.741	0.717	0.837	0.773	0.653
2095	0.707	0.700	0.735	0.713	0.833	0.763	0.651
2100	0.703	0.693	0.731	0.709	0.822	0.753	0.648

Table A.5. Economic Lifecycle, Developing Country Standard and Nigeria (2004), Values normalized on average labor income of those 30-49

| | Developing Standard | | | | Nigeria 2004 | | |
| | | Labor | Lifecycle | | | Labor | Lifecycle |
Age	Consumption	income	deficit		Consumption	income	deficit
0	0.278	0.000	0.278		0.222	0.000	0.222
1	0.288	0.000	0.288		0.222	0.000	0.222
2	0.305	0.000	0.304		0.234	0.000	0.234
3	0.330	0.000	0.330		0.246	0.000	0.246
4	0.370	0.000	0.370		0.258	0.000	0.258
5	0.428	0.000	0.428		0.276	0.000	0.276
6	0.466	0.000	0.466		0.313	0.000	0.313
7	0.495	0.000	0.495		0.336	0.000	0.335
8	0.485	0.000	0.485		0.352	0.001	0.352
9	0.493	0.000	0.493		0.361	0.001	0.360
10	0.505	0.001	0.504		0.387	0.001	0.386
11	0.523	0.001	0.522		0.397	0.001	0.396
12	0.560	0.002	0.559		0.421	0.002	0.420
13	0.571	0.004	0.567		0.439	0.002	0.437
14	0.598	0.014	0.584		0.471	0.003	0.468
15	0.608	0.038	0.570		0.498	0.005	0.493
16	0.624	0.068	0.556		0.514	0.007	0.507
17	0.631	0.103	0.528		0.556	0.013	0.543
18	0.633	0.145	0.488		0.558	0.022	0.536
19	0.635	0.197	0.437		0.570	0.039	0.531
20	0.650	0.261	0.389		0.595	0.054	0.541
21	0.653	0.335	0.319		0.580	0.082	0.498
22	0.635	0.413	0.222		0.611	0.111	0.500
23	0.628	0.493	0.135		0.619	0.146	0.473
24	0.626	0.571	0.055		0.652	0.193	0.459
25	0.632	0.642	-0.010		0.665	0.248	0.417
26	0.642	0.704	-0.061		0.649	0.309	0.340
27	0.650	0.759	-0.109		0.664	0.356	0.308
28	0.661	0.805	-0.144		0.679	0.421	0.258
29	0.664	0.847	-0.184		0.671	0.506	0.165
30	0.668	0.881	-0.213		0.670	0.565	0.105
31	0.676	0.917	-0.241		0.668	0.656	0.012
32	0.680	0.945	-0.266		0.673	0.697	-0.024
33	0.688	0.974	-0.286		0.656	0.742	-0.086
34	0.692	0.992	-0.300		0.660	0.800	-0.140
35	0.686	1.004	-0.317		0.674	0.838	-0.164
36	0.685	1.011	-0.326		0.672	0.895	-0.224
37	0.680	1.020	-0.340		0.690	0.927	-0.238
38	0.678	1.030	-0.352		0.691	0.932	-0.242
39	0.681	1.039	-0.358		0.697	0.988	-0.291
40	0.686	1.045	-0.359		0.697	1.056	-0.359
41	0.688	1.050	-0.362		0.686	1.136	-0.450
42	0.690	1.052	-0.362		0.675	1.156	-0.482
43	0.685	1.048	-0.363		0.664	1.185	-0.521

44	0.682	1.042	-0.360	0.640	1.237	-0.596
45	0.681	1.029	-0.347	0.643	1.247	-0.604
46	0.678	1.009	-0.331	0.640	1.284	-0.644
47	0.683	0.991	-0.308	0.662	1.232	-0.570
48	0.694	0.974	-0.280	0.659	1.196	-0.537
49	0.700	0.949	-0.249	0.664	1.229	-0.565
50	0.708	0.918	-0.210	0.668	1.192	-0.524
51	0.711	0.883	-0.172	0.669	1.210	-0.541
52	0.713	0.847	-0.134	0.674	1.190	-0.516
53	0.711	0.809	-0.098	0.670	1.170	-0.500
54	0.703	0.768	-0.065	0.668	1.211	-0.542
55	0.697	0.721	-0.025	0.671	1.216	-0.545
56	0.692	0.674	0.018	0.657	1.191	-0.534
57	0.687	0.627	0.060	0.661	1.126	-0.465
58	0.678	0.575	0.103	0.663	1.040	-0.377
59	0.668	0.525	0.144	0.673	0.972	-0.299
60	0.659	0.474	0.185	0.679	0.853	-0.174
61	0.650	0.425	0.225	0.695	0.755	-0.061
62	0.643	0.377	0.266	0.678	0.669	0.009
63	0.639	0.338	0.301	0.677	0.557	0.120
64	0.640	0.307	0.333	0.700	0.586	0.113
65	0.639	0.278	0.360	0.707	0.528	0.179
66	0.634	0.249	0.385	0.702	0.501	0.200
67	0.632	0.223	0.409	0.712	0.490	0.222
68	0.634	0.198	0.436	0.712	0.487	0.226
69	0.635	0.176	0.458	0.721	0.457	0.264
70	0.637	0.159	0.477	0.722	0.444	0.277
71	0.639	0.142	0.496	0.714	0.395	0.319
72	0.642	0.125	0.516	0.719	0.374	0.345
73	0.643	0.109	0.534	0.723	0.375	0.348
74	0.645	0.097	0.547	0.717	0.375	0.342
75	0.646	0.088	0.558	0.716	0.329	0.387
76	0.649	0.079	0.570	0.721	0.366	0.356
77	0.649	0.071	0.577	0.770	0.345	0.425
78	0.648	0.066	0.583	0.773	0.295	0.478
79	0.647	0.058	0.589	0.763	0.281	0.482
80	0.647	0.052	0.594	0.784	0.230	0.554
81	0.644	0.047	0.597	0.775	0.181	0.594
82	0.642	0.043	0.599	0.760	0.177	0.583
83	0.639	0.038	0.600	0.737	0.082	0.654
84	0.638	0.034	0.604	0.731	0.049	0.682
85	0.637	0.029	0.608	0.705	0.039	0.667
86	0.633	0.024	0.609	0.683	0.026	0.657
87	0.632	0.020	0.612	0.667	0.028	0.639
88	0.632	0.015	0.616	0.651	0.022	0.628
89	0.630	0.011	0.619	0.640	0.006	0.633
90+	0.628	0.009	0.620	0.618	0.006	0.612

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