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On the Impact of Demographic Change on Growth, Savings, and Poverty

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Abstract

Changing population age structures are shaping the trajectories of development in many countries, bringing opportunities and challenges. While aging has been a matter of concern for upper-middle and high-income economies, rapid population growth is set to continue in the poorest countries over the coming decades. At the same time, these countries will see sustained increases in the working-age shares of their population, and these shifts have the potential to boost growth and reduce poverty. This paper describes the main mechanisms through which demographic change may affect economic outcomes, and estimates the association between changes in the share of working-age population with per capita growth, savings, and poverty rate. An increase of one percentage point in the working-age population share is found to be associated with an increase in gross domestic product per capita growth by more than one percentage point, with similarly positive effects on savings and poverty reduction.

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On the Impact of Demographic Change on Growth, Savings, and Poverty

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1. Introduction

This paper analyzes the effects of demographic change on economic growth, savings, and poverty. We first describe the main mechanisms of how demographic change impacts economic outcomes based on the concepts of first and second demographic dividends. We then estimate the effects of changes on the share of working age population on per capita GDP growth, savings as a share of GNI, and poverty rate.[3] We use changes in the share of working age population as a measure of demographic change. The data are for about 160 countries between 1950 and 2010, and come from different sources.[4] Overall, we find that on average an increase in the share of working age population can benefit countries on boosting per capita growth, increasing savings, and reducing poverty.

Demographic patterns are becoming increasingly diverse across economies. Many developing countries, especially in Sub-Saharan Africa and South Asia, are expected to see continued growth in the proportion of working-age people for several decades, even as the working-age population share declines in high-income countries and many middle-income countries (Lee 2003, World Bank 2015a).[5] These demographic changes can affect economic prosperity in several ways. First, changes in the working-age share of the population impact income growth and savings, by changing the relative number of people in the economy that are able to work. Second, changes in the age-structure at the household level can disproportionally benefit poorer families, which usually tend to have higher child dependency ratios.

The development impact of changes in age structure is usually decomposed as either a first or a second demographic dividend (Lee and Mason, 2006). The first dividend is a direct and immediate consequence of the rise in the working-age share of the population. The effect is straightforward, since a larger share of working age people means that the economy would have proportionally more people able to produce at the most productive stages of their lives. The second demographic dividend arises if changes in age structure create space for higher savings and lead to increasing investments on human and physical capital. Thus, the paper focuses on how changes in age structure may affect growth per capita, savings, and poverty, as key outcomes associated with the first and second demographic dividends.

We examine the impact of the share of the working-age population on several economic outcomes (per capita growth, savings, and poverty) using a common framework and econometric techniques to deal with endogeneity issues. Addressing the endogeneity issue is critical since changes in income per capita are known to affect fertility, mortality, and migration, and may thus affect

[3] Gross domestic product (GDP); gross national income (GNI).

[4] The database includes information from the World Development Indicators, Penn World Table, Barro and Lee (2013), and World Population Prospects.

[5] Throughout this paper, high-income, middle-income, and low-income will refer to the income per capita–based country classification used by the World Bank Group for FY 2016.

demographic change. The paper features a system generalized method-of-moments (GMM), in the spirit of Loayza et al. (2000), Rajan and Subramaniam (2008), and Murtin (2013), aiming to address potential endogeneity issues. While the previous literature on the effects of the dependency ratio on savings used a similar econometric approach (Loayza et al., 2000), the GMM estimation is less present in the analysis of demographic change focusing on growth and poverty. In addition, many studies across these dimensions use different demographic variables (e.g. dependency ratio). Moreover, we extend the time horizon of the empirical analysis covering the period from 1950 until 2010 and test for the interaction effect between demographic change and improvements in education on per capita growth.

Our results suggest that an increase of 1 percentage point in the working-age population share is associated with an increase of 1.5 percentage points in GDP per capita growth, on average. These results are robust across different specifications and estimators, and are broadly consistent with the literature on the effects of demographic change on growth (Higgins and Williamson, 1997; Kelley and Schmidt, 1995, 2007, Bloom and Williamson, 1998; Bloom and Canning, 2004, Eastwood and Lipton, 2011). The results are also robust if we use changes in the share of children instead of working age population as a measure of demographic change.[6] Moreover, by interacting changes in the share of working age population with years of schooling, we find that the effect can be larger as the average years of schooling in the economy increases.[7]

We also find that an increase of 1 percentage point in the share of working-age population is associated with an increase of 0.8 percentage point in savings as a share of GDP. This outcome is related to the second demographic dividend, where declining dependency ratios, led by a lower share of children in the population, tend to boost domestic savings and investment. These results are also robust for different specifications and estimators and in line with previous literature on the effects of demographic changes on savings (Mason, 1988; Johnson and Lee, 1986, Loayza et al., 2000, Kinugasa and Mason, 2007).

Finally, using similar specifications and methods previously described to analyze poverty, the results suggest that an increase of 1 percentage point of the working age population share is associated with a reduction of about 0.76 percentage point in the poverty rate. To the best of our knowledge, we are the first to empirically examine the impacts of age-structure changes on poverty reduction using the most recent international poverty line of $1.90 international dollars (World Bank, 2015a), based on the 2011 purchasing power parity (PPP).

The next section describes the mechanisms through which demographic change may affect growth, savings, poverty and shared prosperity. Section 3 explains the methodology used in the

[6] A reduction of 1 percentage point in the share of children is associated to an increase by 0.43 percentage point in per capita GDP. This outcome is consistent with the fact that on average those countries in the sample were benefiting from the first demographic dividend.

[7] However, the results on the interaction term are not robust using the GMM estimation.

econometric estimations. Section 4 describes the data, trends, and descriptive statistics. Section 5 discusses the results for income per capita growth and savings as a share of GDP, and Section 6 examines the impacts of demographic change on poverty. The final section provides concluding remarks.

2. Mechanisms of how demographic change impacts growth, savings, and poverty

The development impact of changes in age structure can be classified as either a first or a second demographic dividend (Lee and Mason, 2006). The first dividend is a direct and immediate consequence of the rise in the working-age share of the population. If a larger share of the population is working, average standards of living will be higher.[8] The potential benefits for poverty reduction are twofold: First, in low-income households that reduce their fertility, standards of living will rise by increasing the number of effective producers per household member. Second, improvements in public finances resulting from an increase in the number of workers in the economy will allow more resources to be devoted to low-income households. The second dividend arises when faster growth of the working-age population leads to greater savings in the short-run and higher investment in human capital and investment per worker in the long run.

The first demographic dividend could persist for decades but is ultimately transitory. As fertility rates decline, child dependency ratios fall both within households and within a population, while the share of the working-age population rises and remains high for a few generations. If the increasingly larger working-age population is productively employed, there is potential for an increase in economy-wide living standards. The first dividend is in large part a consequence of a given (growing) labor force supporting fewer children. For some countries, estimates suggest that the contribution of the first demographic dividend explains between 9.2 to 15.5 percent of their per capita economic growth over the 1960–2000 period (Mason and Kinugasa, 2008).

The second demographic dividend arises if changes in age structure create space for higher savings and lead to increased investment in human and physical capital. An increase in the share of workers in the economy with respect to the total population leads to higher production and more resources available in the economy, which at the same time can facilitate a rise of savings, investment and accumulation of physical and human capital. These decisions subsequently influence the productivity of the workforce. Providing capital for a growing labor force is costly, and as labor force growth declines, a given level of investment will lead to greater capital per worker. Demographic change pushes countries toward supplying more capital, further enhancing labor productivity (Birdsall, Kelley, and Sinding 2003). Because personal assets accumulate over the

[8] Assuming a constant output per worker, if the effective number of producers (workers) grows at the same rate as the number of effective consumers (total population) there would be no change in welfare in per capita terms. For example, developing countries with very high fertility rates might have a positive growth in their GDP that may not be paralleled by improvements in their welfare per capita, because the dependent population could be growing faster than the working-age population.

lifetime of individuals, per capita household wealth rises as a population ages. Moreover, gains in life expectancy have led to an extended period of retirement, providing a powerful incentive to accumulate assets in countries where the elderly rely on funded pensions and other assets to support at least part of their old-age needs. Table 1 summarizes the first and the second demographic dividends by explaining the transmission mechanisms.

Table 1 Demographic dividends in a nutshell

Channel	Transmission mechanisms	Demographic dividend
Labor force	Increase in the support ratio (ratio of effective labor to effective consumers) holding other factors, including saving and income per effective worker, constant.	First
Savings	Changes in saving and capital per effective worker influence income, from labor and assets, per effective worker.	Second
Human capital	Lower fertility and the quantity-quality trade-off lead to greater spending on health and education for children.	Second

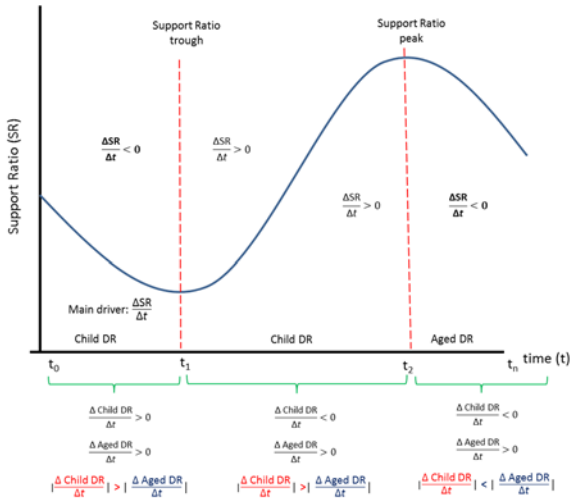
Source: Authors, based on Lee and Mason (2006)
Note: For both the first and second demographic dividends, changes in the factor given in the first column of the table, via the transmission mechanism described in the second column, results in a boost to growth.

Figure 1a describes the association between demographic transition and demographic dividends.[9] In countries with low levels of income and education, birth rates and mortality rates are relatively high, contributing to low life expectancy. In a first stage of the demographic transition, the increase in the number of children is proportionally larger than in the working age population, or the elderly people, leading to a decrease of the share of working age population driven by a rise in the share of children. As income and education improves, fertility and mortality rates decline, leading to an increase of the share of working age population, concomitantly to a reduction in the total dependency ratio. This is the stage of the demographic transition that provides the condition for the first demographic dividend. The third stage of demographic transition happens when the fertility rate is very low, usually below the replacement level, and the mortality rate is also low, which leads to high life expectancy. At this stage the growth of the elderly population more than compensates the reduction in the share of children, leading to an increase in the total dependency ratio, driven by a larger number of elderly people.

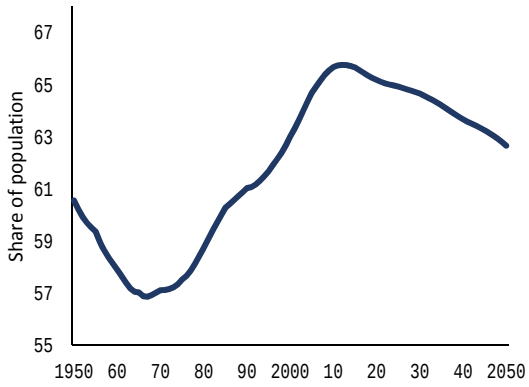
[9] This association can be linked to the Demographic Transition Model (DTM). The DTM describes the transition of populations from high to low fertility and mortality rates. This transition generally parallels the economic development of a country (Szreter 1993). The model consists of at least four distinct phases, with countries effectively moving from high fertility and low life expectancy to low fertility and high life expectancy as they move through the demographic transition. At the same time, they go from high proportions of children and few elderly to low proportions of children and many elderly.

Figure 1 Demographic transition and dividends

a) Demographic transition and dividends



b) Share in global population, aged 15–64, percent



Source: Authors and UN (2015)

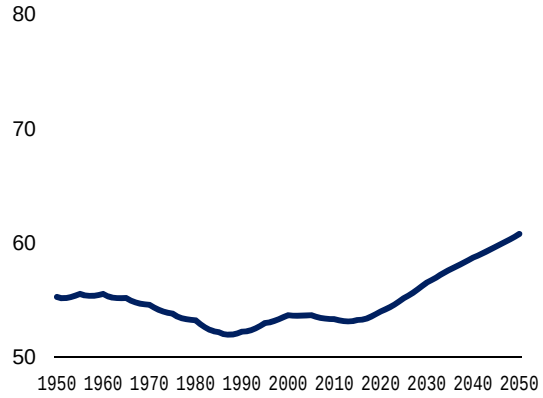
Note: Support ratio refers to ratio of effective labor, defined as people in the working age, to effective consumer. The trend of support ratio (SR) is very similar to the pattern of the share of working age population. ΔSR: Change in support ratio; Δt: change in time; ΔChild DR: Change in child dependency ratio, defined as the ratio of share of children (0-14 years of age) with respect to the share of working age population (15-64 years of age); ΔAged DR: Change in old dependency ratio, defined as the ratio of share of elderly (65 years of age or above) with respect to the share of working age population (15-64 years of age).

Figure 1b shows the behavior of the share of working age for the global population from 1950 to 2050, which is consistent with the patterns suggested by figure 1a. The peak of the global support ratio was achieved by 2012, when the share of working age population was around 66 percent. Although there is evidence that many countries follow a similar pattern of age-structure, countries differ in term of pace and stages of demographic transition across the world, as illustrated by Nigeria, India, China, and Japan (figure 2). Countries in the early stage of demographic transition, such as Nigeria, could be more concerned with how to realize the potential contribution of an increasing working age population shares to welfare. In contrast, countries such as Japan that are further along in the demographic transition process may be concerned with the effects of a shrinking working age population. Therefore, understanding the contribution of demographic change is relevant for countries across the demographic distribution.

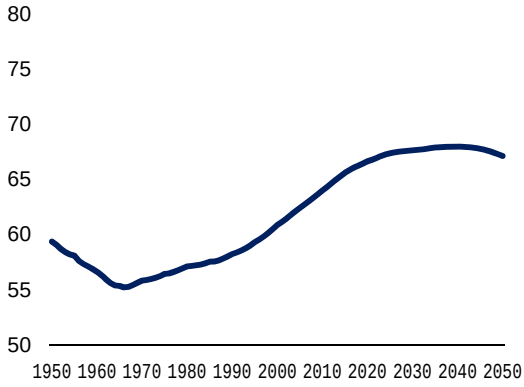
Figure 2 Panel of 4 countries showing different stages of demographic transition

Share of working age population, percent

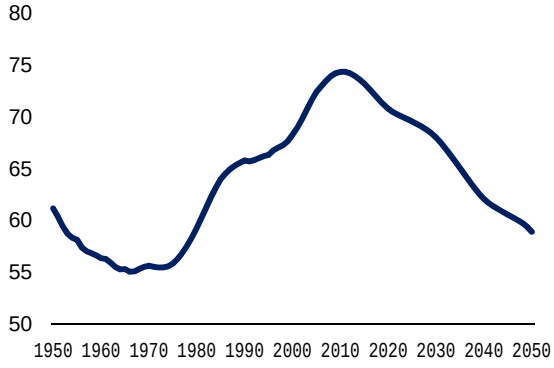
a) Nigeria



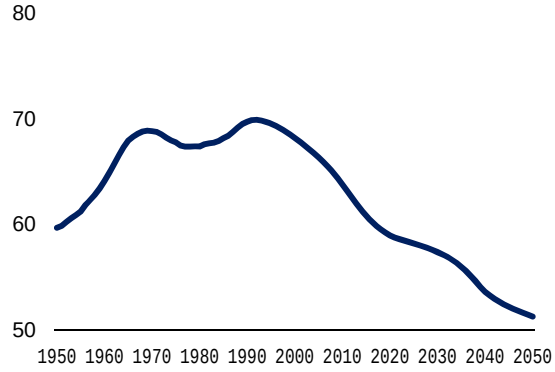
b) India



c) China



d) Japan



Source: UN (2015)

Note: These countries are classified in different stages of demographic transition (World Bank, 2015a).

More generally, growth in the working-age share is associated with higher per capita income growth (Figure 3). Bloom and Williamson (1998) highlight that changes in the growth of labor force per capita and the savings rate are plausible channels through which a changing age structure might affect the rate of economic growth.[10] That paper's results suggest that an increase of 1 percentage point in the growth of the working age population is associated with an increase of 1.4 to 2 percentage points in the growth rate. Bloom and Canning (2004) find that 1 percentage point growth in the share of working age population leads to an increase by 1.4 percentage points in growth in income per capita.[11] Kelley and Schmidt (2005) developed a framework to explain the

[10] Using cross-sectional data for 78 countries, from 1965 to 1990, Bloom and Williamson (1998) find that demographic forces appear to have contributed 0.6 percentage point to the East Asian miracle via labor inputs per capita and 1 percentage point via capital accumulation per capita.

[11] The OLS estimates of Bloom and Canning (2004) suggest that an increase of 1 percentage point in the share of working age population leads to 1.0 percentage point increase in income per capita.

contribution of demographic change towards output-per-worker growth and translate the results into per capita terms. The results suggest that over the period 1960-1995 demographic change, particularly due to changes in the youth dependency ratio, accounted for approximately 20 percent of per capita output growth impacts, with larger shares in Asia and Europe.

Figure 3 A rising working-age population share is positively correlated with GDP per capita growth

Source: Authors' estimates
Note: Data from World Development Indicators 2015 and UN (2015).

Overall, the positive effect of a larger share of working age population on growth is widely supported in the literature (Bloom and Williamson, 1998; Higgins and Williamson, 1997; Eastwood and Lipton, 2011; Kelley and Schmidt, 1995, 2005, 2007), including its important role in Asia's growth between 1965 and 1990 (Bloom et al., 2000) and improvements in the accuracy of growth projections by taking age structure into account (Bloom et al., 2007). The evidence of the positive impact of a larger share of working age population on growth is not limited to cross-country analysis. Mody and Aiyar (2011) suggest that a one standard deviation increase in the working age ratio is associated with an increase of about 0.6 percentage point in per capita income growth across states in India.

As part of the second demographic dividend, national private savings rates have been found to depend on the age composition of the population: individuals are typically net savers when they are working-age and continue to save in old age, on average, but tend to be predominantly consumers when they are children. Regarding the effect of demographic changes on savings, there have been many studies finding that lower child dependency leads to higher saving rates.[12] Loayza

[12] Please see Mason (1987), Kelley and Schmidt (2005), Higgins and Williamson (1997), and Kinugasa and Mason (2005).

et al. (2000) find that both young and old dependency ratios have a significantly negative impact on the private saving rate.[13]

However, there is less consensus on the effect of the aged dependency ratio on savings. Since people expect to live longer, they may save more during the economically active portion of their lives (Kinugasa and Mason, 2007; Attanasio and Szekely, 2000, and Mason et al., 2011). Gains in life expectancy lead to a longer duration of retirement and an increased demand for pension wealth. This will depend on the system of old age support, which is very policy dependent and varies a great deal around the world. In countries where funded pensions are important, pension assets have increased very substantially (Saez and Zucman, 2016). So this is a positive effect on savings associated with aging and could lead to capital deepening. The empirical literature generally supports this paper's finding that an increase in the working-age population share, occurring in parallel with shrinking children's population share, is favorable for savings.

In addition to the effects on growth and savings, there is evidence that changes in age structure impact poverty and inequality, although this strand of the literature is smaller. Merrick (2002) summarizes some previous literature on the link between household demographics and welfare, particularly on the positive correlation between household size and poverty (Lipton, 1983).[14] Paes de Barros et al. (2015) show that demographic change has led to a continuous reduction in poverty in Brazil, equivalent to an additional 0.4 to 0.5 percentage point in annual growth in per capita income. They estimated a direct impact of the demographic transition on poverty close to 15 percent of the corresponding impact of economic growth. Moreover, using a combination of a global computable general equilibrium model and micro-simulation tools, Ahmed et al. (2016) show that an increase in the share of working age population, particularly with improvements in education, can play an important role in reducing poverty rates in Sub-Saharan Africa even in the near future.

3. Empirical strategy

The basic association between demographic changes and growth is described by Bloom and Canning (2004) through an accounting identity:

$$\frac{Y}{N} = \frac{Y}{L}\ \frac{WAP}{N}\ \frac{L}{WAP} \qquad (1),$$

[13] They suggest that an increase of 1 point in the old-age dependency would lead to a reduction of 0.66 percentage point in the ratio between gross private savings and gross private disposable income, based on their preferable (GMM) specification. An increase of 1 point in the young dependency ratio would lead to reduction of 0.3 percentage point, using a similar specification.

[14] Most of the references presented by Merrick (2002) do not address the causal relationship between household size and poverty.

where (Y) is income, (N) is total population, (WAP) is the working-age population, and (L) is number of workers. Equation (1) shows that income per capita (Y/N) equals output per worker (Y/L) times the share of the working-age population (WAP/N) times the participation rate (L/WAP). The equation suggests that, everything else constant, an increase in output per worker (Y/L), or an increasing in the share of working-age population (WAP/N), or in the participation rate (L/WAP) is associated with higher GDP per capita. By taking the log of the variables in (1) and presenting the relation in terms of growth, it leads to:

$$g_y = g_z + g_w + g_l \qquad (2),$$

where g_y is income per capita growth, g_z productivity growth per worker, g_w is the growth of the share working-age population, and g_l is the growth in the labor force participation rate.

Assuming that productivity growth per worker is a function of X variables, such that $g_z = a_1 + b\,f(X)$ and growth of labor force participation is constant, such that $g_l = a_2$, where $a = a_1 + a_2$, this leads to the following functional form:

$$g_y = a + b\,f(X) + g_w + \varepsilon \qquad (3).$$

where ε is the error term.

Equation (3) suggests that, keeping everything else constant, an increase in the working-age population share leads to higher GDP per capita growth. The main issue behind this association is that, as (3) is derived from an accounting identity, a set of strong assumptions are necessary to suggest a causal relationship between changes in the share of working-age population and growth.

Over a short- to medium-term horizon, it might be reasonable to assume that the working-age population is given in absolute terms, and that it is a function of past and current fertility, mortality and migration rates. However, the current fertility rate also affects g_w, by changing the size of the total population (N). Increasing life expectancy and migration also affect N. An issue in the estimation of (3) is that unobservable factors (omitted variables) that affect income per capita growth can simultaneously affect the share of working age population or productivity growth per worker, leading to an endogeneity issue. This problem is particularly relevant for the variable of interest because shocks that affect total population (N) can simultaneously affect, by construction, the denominator in both sides of the equation. In addition, it might be that changes in income per capita lead to demographic changes instead, a reverse causality problem.

Several studies attempt to analyze the effect of demographic change on economic growth (Bloom and Canning, 2004; IMF 2004, Eastwood and Lipton, 2011; Kelley and Schmidt, 2005, 2007). Overall, their findings converge on a positive association between GDP per capita growth and the share of working-age population. These studies adopted different approaches to address the potential endogeneity issues, previously described. One such approach is to use the lag of the change of the share of working-age population $g_{w(t-1)}$ as an instrument for g_w. The intuition is

that current income per capita growth does not affect the growth rate of the share of working-age population in the past. Although it can be argued that this approach deals with reverse causality, it does not necessarily address the omitted variable problem.

This paper uses different approaches to dealing with the problem of endogeneity. First, it shows the association between g_w and g_y by providing the results based on a first-difference estimation. Then, in order to deal with time-invariant unobservable factors that could simultaneously affect g_y and g_w, a panel fixed effects estimation is used. Finally, to deal with other potential endogeneity issues related to omitted variables that could simultaneously affect g_y and g_w, a system-GMM estimation strategy, with the share of working age population lagged up to 40 years, is used to identify a causal relationship between international aid and growth, in the spirit of Loyaza et al. (2000), Rajan and Subramanian (2008), and Murtin (2013). Similar approaches were adopted to estimate the effect of change in the share of the working-age population on growth, savings, and poverty. Yet, particularly for the analyses on per capita growth, the coefficients related to the changes in the share of working age population should be interpreted cautiously.

Another important component of the effect of a larger share of working age population relates to the human capital embedded in them. The simple fact of a larger share of working age population may have an effect on growth through the channel of labor supply, as previously discussed. But an increase in the share of working age population may occur in parallel with human capital accumulation, which may affect workers' productivity (g_z).[15] Therefore, the paper's estimations incorporate years of schooling as a proxy for human capital in order to control for its effect on productivity growth per worker. Years of schooling are also interacted with the working age population share in order to capture information related to quality of labor supply.

Since the demographic determinants of growth may also affect savings and poverty, we simply replace the GDP per capita growth dependent variable with changes in the domestic savings as a share of GDP and poverty rate, in order to analyze the effects of demographic change on these on savings and poverty.

4. Data, trends, and descriptive statistics

Several data sources covering the 1950-2010 period are combined in order to analyze the effect of demographic change on growth per capita and savings. First, the UN World Population Prospects 2015 Revision is used to provide cross-country information on population by different age groups. We use information on GDP per capita from the World Bank (WDI) and the Penn World Table (version 8.1). We also use average years of schooling by country, provided by Barro and Lee

[15] Murtin (2013) suggests that increasing access to primary education leads to a reduction in the fertility rate.

(2013). The data cover 180 countries, from all World Bank Group country groups: developing East Asia and Pacific (17), developing Europe and Central Asia (19), high-income OECD (31), high-income non-OECD (26), developing Latin America and Caribbean (23), developing Middle East and North Africa (12), South Asia (8), and Sub-Saharan Africa (44). It also has a broad coverage in terms of income levels: high-income OECD (31), high-income non-OECD (26), low-income (29), lower-middle income (46), and upper middle income (48).[16]

The world population is growing more slowly and aging at unprecedented speed. While the global population has tripled since the post-war "baby boom" era, population growth is slowing markedly. After increasing for five decades, the proportion of people ages 15 to 64—the typical working-age population—reached a peak of 66 percent of global population in 2012 and is now starting to fall. The rise in the share of dependents is driven mainly by an increase in the share of elderly in high-income and upper-middle income economies. These global trends—slower population growth and population aging—have been shaped by a steady decline in fertility rates and a rapid improvement in life expectancy. In the 1950s, total fertility rates were more than five births per woman, but since then they have steadily declined to 2.45 births per woman in 2015. In parallel, average life expectancy at birth has risen from 47 years in 1950 to 67 years in 2000, while infant mortality has declined.

Demographic change has a profound impact on the share of the global working age population that lives in developing countries, particularly lower-income countries. In 1950, 33 percent of the global working age population lived in high-income countries. Developing East Asia and the Pacific—the region with some of the most rapid fertility declines and life expectancy improvements in recent years—accounted for 28.5 percent of the working-age population, while Sub-Saharan Africa—the region with the most modest improvements—accounted for only 6.7 percent. By 2015, this distribution had shifted substantially: high-income countries accounted for just 19 percent of the global working age population and Sub-Saharan Africa for 11.2 percent. If we take into consideration the global population between 20 and 40 years of age, the share of high-income countries dropped from 32 percent in 1950 to 16.7 percent in 2015.

The working-age population share increased across all groups of countries between 1950 and 2010. Thus, despite the evidence of positive association between an increase in the share of working age population and GDP per capita growth, there are very few cases of countries with a shrinking working age population share over this period. High-income countries have on average a larger share of working age population, peaking at around 67 percent for OECD countries between 2000 and 2010 (Table 2). At the same time the working-age population share in low-income economies is still below the levels observed even in upper middle-income countries before the 1980s. Table 3 shows that not only has the share of working age population been larger in higher income countries, but also the human capital has been higher.

[16] Tables A1, A2, and A3 in the annex provide additional descriptive statistics.

Table 2 Average share of the working age population by World Bank region and income group classification

Region/Income groups	1950	1960	1970	1980	1990	2000	2010	2015
EAP	55.8	53.8	52.5	54.7	57.4	59.4	63.1	63.8
ECA	61.3	59.3	58.0	61.6	62.9	64.5	68.4	68.3
LAC	54.1	51.4	50.5	53.6	56.8	59.7	63.7	65.5
MENA	56.0	53.1	51.3	51.3	53.1	58.7	63.7	63.6
SAS	55.7	56.1	54.2	54.5	54.4	57.2	61.7	63.6
SSA	55.5	54.2	52.7	51.7	51.5	52.8	54.4	55.2
Low income	55.6	54.8	53.3	52.5	51.7	52.4	53.8	54.7
Lower-middle income	56.2	54.3	52.6	53.4	54.6	56.8	60.5	61.5
Upper-middle income	56.6	54.3	53.2	56.0	58.7	62.0	65.9	66.4
High income: OECD	64.5	62.6	62.9	64.3	66.4	67.2	67.4	65.9
High income: non- OECD	59.7	56.9	57.9	61.7	64.0	66.1	70.1	69.9
Total	58.2	56.2	55.5	57.1	58.7	60.6	63.5	63.7

Source: United Nations (2015).

Note: HIC refers to high-income countries; EAP refers to low and middle-income East Asia and the Pacific; ECA refers to low and middle-income Europe and Central Asia; LAC refers to low and middle-income Latin America and the Caribbean; MNA refers to low and middle-income Middle East and North Africa; SAR refers to low and middle-income South Asia; and SSA refers to low and middle-income Sub-Saharan Africa.

Table 3 Average years of schooling by World Bank region and income group classification

Region/Income groups	1950	1960	1970	1980	1990	2000	2010
EAP	1.77	2.32	3.03	4.09	5.06	6.16	7.49
ECA	3.59	4.33	5.52	7.06	8.49	9.80	10.60
LAC	2.66	3.08	3.68	4.66	5.79	6.99	8.08
MENA	0.51	0.74	1.28	2.22	3.55	4.98	6.58
SAR	1.32	1.52	2.14	2.69	3.53	4.47	5.47
SSA	0.96	1.24	1.68	2.36	3.26	4.02	4.99
Low income	0.48	0.66	0.96	1.50	2.23	2.92	3.84
Lower-middle income	1.66	2.03	2.68	3.56	4.49	5.51	6.44
Upper-middle income	2.37	2.87	3.62	4.75	6.11	7.39	8.77
High income: OECD	6.11	6.66	7.70	8.81	9.71	10.77	11.71
High income: non- OECD	3.05	3.77	4.87	5.94	7.33	8.65	9.80
Total	2.88	3.35	4.13	5.11	6.18	7.26	8.34

Source: Barro and Lee (2013).

Note: HIC refers to high-income countries; EAP refers to low and middle-income East Asia and the Pacific; ECA refers to low and middle-income Europe and Central Asia; LAC refers to low and middle-income Latin America and the Caribbean; MNA refers to low and middle-income Middle East and North Africa; SAR refers to low and middle-income South Asia; and SSA refers to low and middle-income Sub-Saharan Africa.

Among EAP countries and those currently classified as upper-middle income, there was a combination of rapid increase in the share of working age population and improvements in education, based on years of schooling. For low-income countries, most of them in the SSA and SAR regions, the improvements in years of schooling can be seen to be still well below the average for other groups of countries. Table 4 shows the average income per capita ($ international dollars, 2005 PPP) across regions and income groups over the 1950-2010 period.

Table 4 Average per capita GDP

Region/Income groups	1950	1960	1970	1980	1990	2000	2010
EAP	282	403	587	952	1,762	3,332	6,355
ECA	2,681	2,687	4,041	5,831	4,898	5,552	8,304
LAC	2,589	3,415	5,022	6,644	6,480	7,323	8,641
MENA	841	2,323	4,272	3,854	4,153	5,002	6,058
SAR	622	754	879	1,065	1,382	1,921	3,085
SSA	1,266	1,237	1,499	1,516	1,356	1,502	1,838
Low income	389	581	697	683	631	679	896
Lower-middle income	744	895	1,067	1,308	1,707	2,156	3,152
Upper-middle income	755	1,174	1,919	2,549	3,254	4,861	7,896
High income: OECD	8,800	1,545	16,453	19,963	25,202	31,424	33,567
High income: non- OECD	5,210	6,129	8,647	9,962	11,457	12,363	18,509
Total	3,136	3,610	4,856	5,542	6,580	7,955	9,654

Source: Penn Table (2015).

Note: HIC refers to high-income countries; EAP refers to low and middle-income East Asia and the Pacific; ECA refers to low and middle-income Europe and Central Asia; LAC refers to low and middle-income Latin America and the Caribbean; MNA refers to low and middle-income Middle East and North Africa; SAR refers to low and middle-income South Asia; and SSA refers to low and middle-income Sub-Saharan Africa. Income classifications are based on the official World Bank Group classifications for FY16.

5. Results

The results under different specifications, using five-year averages for the 1950-2010 period, suggest that an increase in the share of working age population has a positive effect on per capita GDP growth (Table 5). Three different methods are tested: first-difference, panel fixed-effects, and generalized method of moments (GMM). For each method different specifications - S1, S2, and S3 - are tried, differing according to the inclusion of specific covariates. S2 includes initial per capita GDP as a control variable to capture income convergence across countries, S3 includes initial per capita GDP, log of years of schooling, a set of geographical variables (latitude and a dummy identifying landlocked countries), and a set of institutional variables (dummy variables for

countries that were not former colonies, former British colonies and former French colonies). All estimations control for year fixed effects and regional or country fixed effects.

Table 5 Growth of the working-age share of the population can increase real GDP per capita

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of WAP	1.61***	1.53***	1.71***	1.36***	1.096**	1.66***	1.87**	1.96**	1.55**
	-0.453	-0.425	-0.396	-0.511	-0.456	-0.394	-0.845	-0.799	-0.641
Initial GDP-pc		-0.489**	-0.533**		-2.321***	-2.213***		-0.0257	-0.353
		-0.207	-0.227		-0.406	-0.514		-0.545	-0.539
Schooling (years)			0.618**			-0.162			0.965
			-0.242			-0.538			-0.987
British colony			0.295			-			1.011
			-0.277			-			-1.43
French colony			-0.0886			-			-0.266
			-0.329			-			-1.989
Non-colony			0.344			-			-0.997
			-0.39			-			-1.542
Landlocked			-0.273			-			-0.0828
			-0.288			-			-0.521
Latitude			-0.00014			-			0.00296
			-0.0102			-			-0.0203
Observations	1,796	1,776	1,307	1,796	1,776	1,427	1,796	1,776	1,307
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Authors' estimations.

Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

Additional covariates were tested (e.g. openness for trade) and results are robust. In the GMM specification (S1), lags 2 to 8 of changes in the share of working age population were used. In the GMM specifications (S2) and (S3), lags 2 to 8 of changes in the share of working age population and the initial per capita GDP were used. Geographic and time variables were used as instruments. Results are also significant when reducing the number of instruments. Using the GMM estimation as a baseline (S3), the results suggest that an increase of 1 percentage point in the share of working age population would lead to an increase in GDP per capita of approximately 1.5 percentage

points.[17] These results are in line with Bloom and Canning (2004), which suggest an increase of 1 to 1.4 percentage points for growth of the working age population over total population.

As suggested by the descriptive statistics, the increase in the share of working age population was also followed by an increase in years of schooling. It might be the case that having a larger share of working age population with additional years of education leads to a higher impact on per capita GDP growth, given that these results are usually driven by younger and better educated cohorts. Table 6 shows that the interaction effect between changes in the share of working age population and years of schooling is positive for first-difference and panel fixed-effects. However, the result does not seem robust under the GMM specification.

Table 6 Growth of the working-age share of the population can increase real GDP per capita

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of WAP	0.02	0.02	2.18***	-0.30	-0.27	1.99***	0.56	-0.18	2.49***
	-0.93	-0.93	-0.52	-0.98	-0.98	-0.50	-1.50	-1.34	-0.89
Initial GDP-pc	-0.58***	0.58***	-0.54**	-2.27**	2.28***	2.22***	-0.73	-1.26**	-1.04
	-0.21	-0.21	-0.21	-0.51	-0.52	-0.52	-0.47	-0.60	-0.67
Schooling (years)	0.73***	0.73***	0.65**	0.16	0.17	-0.06	1.13**	1.17*	1.18**
	-0.25	-0.25	-0.26	-0.57	-0.57	-0.54	-0.48	-0.60	-0.58
Δ Schooling (years)		-0.06	0.01		0.77	0.91		2.04	1.05
		-1.23	-1.21		-1.39	-1.37		-3.04	-2.38
Δ share of WAP*	1.073**	1.073**		1.226**	1.219**		0.43	1.05	
Schooling (years)	-0.52	-0.52		-0.56	-0.55		-0.83	-0.72	
Δ share of WAP*			-3.91			-2.75			-9.19
Δ Schooling (years)			-4.04			-3.94			-7.74
Observations	1,796	1,776	1,307	1,796	1,776	1,427	1,796	1,776	1,307
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Author's estimations.

Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

[17] Using a similar specifications of savings, an increase of 1 percentage point in the share of working-age population is found to be associated with an increase by 0.6 to 0.8 percentage point in savings as a share of GDP.

What do these results mean? The magnitude of the coefficient seems to be large if we take into consideration the elasticity of growth per capita with respect to changes in the share of the working age population. However, change in age structure is a low frequency process. For example, between 1950 and 2010 the average per capita growth in Brazil was about 2.77, while the share of working age population increased by 0.2 percentage point. Assuming a coefficient of 1.5, changes in the working-age population share would have contributed to about 0.3 percentage point, which is about 11 percent of the average growth observed over this period.

Another issue regarding the share of working age population is that it might be driven by changes in the share of children or elderly in the total population. The descriptive statistics suggest that the rising share of the working age population is driven by a decrease in the share of children in most of countries. So, using a similar specification with share of children instead of working-age population, negative and significant coefficients should be expected, as presented in Table 7.

Table 7 Effects of changes on the share of children (0-14) on the population on real GDP per capita growth

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of CHD	-0.384***	-0.351***	-0.387***	-0.304***	-0.253***	-0.338***	-0.506**	-0.431***	-0.428***
	(0.108)	(0.0963)	(0.0814)	(0.100)	(0.0892)	(0.0727)	(0.197)	(0.159)	(0.123)
Initial GDP-pc		-0.506***	-0.536**		-2.342***	-2.260***		-0.0973	-0.705
		(0.177)	(0.217)		(0.401)	(0.506)		(0.536)	(0.576)
Schooling (years)			0.569**			-0.201			0.932*
			(0.257)			(0.546)			(0.550)
British colony			0.349						1.035
			(0.306)						(1.483)
French colony			-0.0618						-1.737
			(0.312)						(1.521)
Non-colony			-0.234						-0.333
			(0.308)						(0.577)
Landlocked			0.328						-0.778
			(0.315)						(1.376)
Latitude			-0.000910						0.00459
			(0.0122)						(0.0168)
Observations	1,796	1,776	1,307	1,796	1,776	1,427	1,796	1,776	1,307
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Authors' estimations.

Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

In addition to the effect of demographic change on per capita growth, similar specifications are tested to analyze savings. Based on the GMM method with several co-variates (Table 8, GMM, S3), it is estimated that an increase of 1 percentage point in the share of working-age population is associated with an increase of 0.78 percentage point in domestic savings as a share of the gross national income (GNI).

Table 8 Growth of the working-age share of the population can increase savings

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of WAP	0.551**	0.698***	0.725***	0.578**	0.852***	0.753***	0.897**	0.628*	0.780***
	(0.227)	(0.264)	(0.244)	(0.250)	(0.229)	(0.272)	(0.364)	(0.332)	(0.296)
Initial GDP-pc			-0.0191	-2.063		-1.374		-0.949	2.023
			(0.888)	(2.806)		(3.383)		(1.151)	(1.613)
Schooling (years)			-0.180			-0.614			-1.099
			(0.277)			(0.464)			(0.826)
British colony			-0.00680						-0.766
			(0.981)						(0.886)
French colony			-0.0343						0.265
			(0.900)						(1.333)
Non-colony			-0.903						-2.142
			(1.325)						(2.103)
Landlocked			0.0143						0.0399
			(0.0356)						(0.0530)
Latitude	0.551**	0.698***	0.725***	0.578**	0.852***	0.753***	0.897**	0.628*	0.780***
	(0.227)	(0.264)	(0.244)	(0.250)	(0.229)	(0.272)	(0.364)	(0.332)	(0.296)
Observations	1,796	1,776	1,307	1,796	1,776	1,427	1,796	1,776	1,307
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Authors' estimations.
Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World *Development* Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

6. Implications of demographic change for poverty and shared prosperity

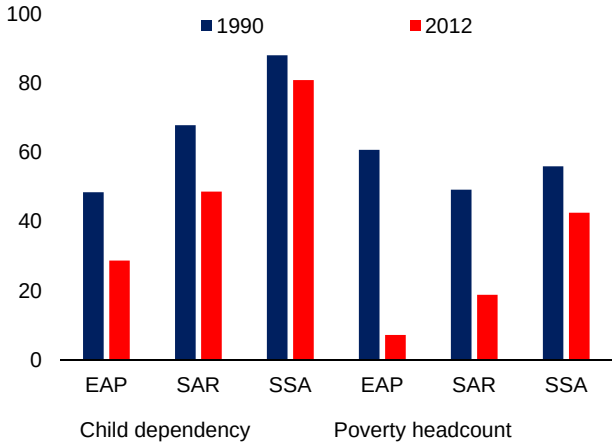
The macroeconomic dividends previously described can affect poverty reduction by boosting economic growth (Dollar et. al. 2002, 2015). However, there are also direct channels through which demographic change affects households in the bottom of the income distribution. Particularly, due to the positive association between fertility rate and income level, it is likely that

households in the bottom of the income distribution disproportionally benefit from an increase in the number of workers in their families, as they move towards fertility transition.

The realization of the first demographic dividend, led by reductions in child dependency ratios, could facilitate the eradication of global poverty (figure 4). In 1990, East Asia had a higher average poverty headcount than South Asia. However, poverty headcount rates in East Asia decreased from 61 percent to only 7.2 percent between 1990 and 2012. This poverty reduction was paralleled by sharp reductions in child dependency ratios in the region. For a country perspective, evidence from Bangladesh suggests that demographic factors, including age-structure, gender, and regional distributions of populations, accounted for a quarter of the rapid reductions in poverty between 2000 and 2010 (World Bank 2013). Bangladesh halved its fertility rate between 1971 and 2004, going from more than 6 children per woman to about 3, and is on track to reach replacement rates in the coming decades.

Figure 4 Lower child dependency ratios are associated with lower poverty rates

Poverty rate and child dependency ratio, percent



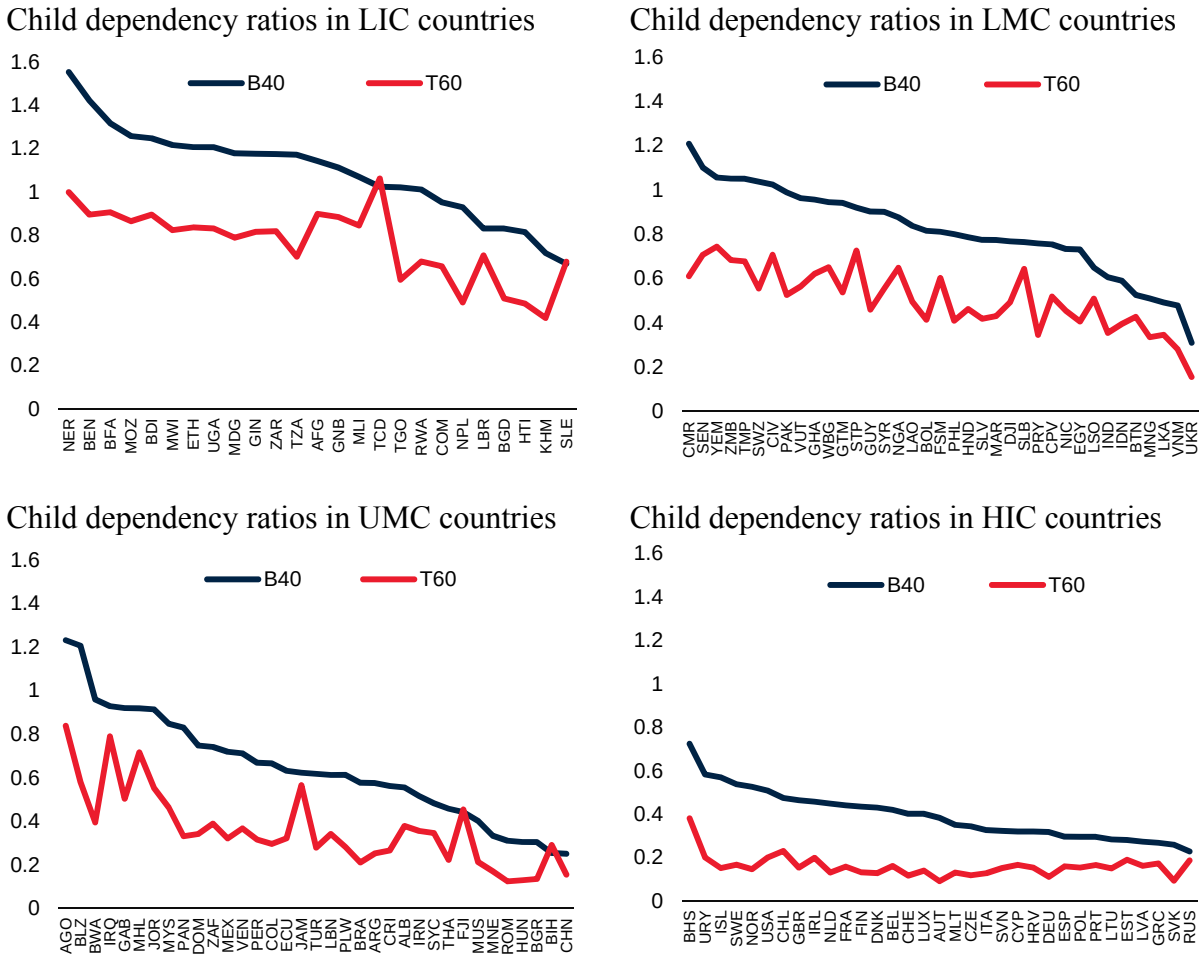
Source: Authors' estimates

Note: Data are from United Nations (2015) and PovcalNet. The poverty headcount rate is based on the $1.90 a day poverty line.

Because of the association between fertility and education, income, and life expectancy, households in the top 60 percent of the income distribution tend to have lower child dependency ratios and to pass through the demographic transition before households in the bottom 40 percent in almost all countries for which data are available (figure 5). As fertility rates fall, the demographic structures of the households change and directly affect poverty and shared prosperity, particularly in poor households. Households in the top of the income distribution tend to have lower child dependency ratios and to pass through the demographic transition before households

in the bottom percentiles in almost all countries, due to the association between fertility and education, income, and life expectancy.

Figure 5. Top 60 percent households tend to have lower child dependency ratios than bottom 40 percent households in countries in all income categories



Source: World Bank staff based on data from household surveys, circa 2010 but spanning 2001–10.
Note: The sample covers 33 high-income (HIC), 35 upper-middle-income (UMC), 37 lower-middle-income (LMC), and 25 low-income countries (LIC). Classificationof households into the top 60 and bottom 40 percent are based on the income distribution.

These findings suggest that there might be important distributional effects associated with demographic transition. The labor-market implications of rising levels of education, particularly for women, influence fertility. While higher educational attainment (especially of females) and higher household income are both associated with declines in fertility, the importance of education

(particularly primary education) in affecting fertility seems to be more robust in analyses that aim to identify a causal relationship between fertility and education.

Increasing the educational attainment of girls also reduces fertility rates by increasing the age of marriage and first birth. First, more highly educated girls marry later and have lower fertility. Second, higher educational enrollment rates may increase the opportunity cost of children for household work and thereby reduce the desire for large families. Improvements in female education are positively associated with lower rates of teenage pregnancy. Households in the bottom 40 percent of the income distribution (B40) tend to have lower female educational attainment than households in the top 60 percent of the distribution (T60). The B40 households are also seen to have higher rates of teenage parents than T60 households (Table 9). Higher education also increases the opportunity cost of having a child due to the potential for income from work, and so there is a delay in the first birth and marriage. A delay in the age at first birth has the effect of reducing lifetime fertility. Women living in households in the top 60 percent of the income distribution tend to have a higher median age at first birth than households in the bottom 40 percent. Delaying the age at first birth also has immediate benefits beyond reducing fertility rates, such as improving maternal health (U.S. National Research Council 1989).

Table 9 Demographic patterns and sharing prosperity

		1. Share of females aged 15-19 who are mothers, percent		2. Women's median age at first birth	
		B40	T60	B40	T60
1	LIC	24.23	16.94	19.73	20.18
2	LMC	19.33	10.51	19.90	21.24
3	UMC	16.08	8.09	21.08	22.39
		3. Average number of births per woman		4. Share of women who do not want to become pregnant again but not using contraception, percent	
		B40	T60	B40	T60
1	LIC	6.12	4.68	27.39	24.95
2	LMC	4.74	3.14	24.27	19.29
3	UMC	3.97	2.52	18.87	13.24

Source: World Bank staff.
Note: Data are from Demographic and Health Surveys. B40 refers to households in the bottom 40 percent of the wealth distribution, while T60 refers to households in the top 60 of the wealth distribution. Unmet need for family planning is defined as the percentage of women who do not want to become pregnant but are not using contraception

As the household's child dependency ratio falls and the share of working-age people increases, per capita income is likely to increase. This in turn relaxes the social and household budget constraints. Families who have fewer children will have more per capita resources at their disposal for consumption as well as investment. An increase of 1 percentage point in the share of working age population is estimated to be associated with a reduction of 0.75 percentage point in the poverty rate (Table 10). Yet, results are significant only at 90 percent of confidence in one of the GMM

specifications. If fertility declines are concentrated among the B40, the economic benefits of lower dependency rates and more income earners as a share of the population will accrue to the poorest. The effect of changes in the share of children, instead of the share of working-age population, is also tested and the results are similar (Table 11). The results are also consistent if an alternative poverty line is considered.[18]

Table 10 Impact of changes in the share of WAP on poverty

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of WAP	-0.873**	-0.656**	-0.727**	-1.086**	-0.619	-0.324	-0.714	-0.712	-0.752*
	(0.377)	(0.324)	(0.308)	(0.531)	(0.399)	(0.364)	(0.607)	(0.466)	(0.393)
Initial GDP-pc		1.614	2.441*		1.451	1.173		1.010	-0.602
		(0.997)	(1.302)		(2.210)	(2.142)		(2.809)	(2.632)
Schooling (years)			0.265			1.698			1.145
			(2.125)			(4.351)			(5.201)
British colony			-0.416						-3.236
			(2.194)						(6.111)
French colony			0.353						-7.909*
			(1.435)						(4.798)
Non-colony			0.681						-1.440
			(1.212)						(2.260)
Landlocked			-1.211						-6.113
			(1.647)						(7.396)
Latitude			-0.0347						0.0136
			(0.0367)						(0.0980)
Observations	350	341	298	350	341	302	350	341	298
Countries	105	104	82	105	104	86	105	104	82
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Author's estimations.
Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

[18] Estimates based on a poverty rate of $3.10, instead of $1.90, where the results are shown to be qualitatively similar.

Table 11 Impact of changes in the share of Children on poverty

	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
Variables	S1	S2	S3	S1	S2	S3	S1	S2	S3
Δ share of WAP	0.802**	0.546*	0.619**	1.095**	0.627	0.389	0.814	0.900**	0.750*
	(0.349)	(0.321)	(0.301)	(0.525)	(0.400)	(0.374)	(0.644)	(0.456)	(0.402)
Initial GDP-pc		1.726*	2.520*		1.297	1.154		0.790	-0.714
		(1.021)	(1.324)		(2.214)	(2.146)		(2.702)	(2.532)
Schooling (years)			0.343			1.889			0.997
			(2.144)			(4.363)			(4.199)
British colony			-0.543						-0.0850
			(2.178)						(5.575)
French colony			0.281						-6.921
			(1.438)						(4.266)
Non-colony			0.449						-1.578
			(1.199)						(1.957)
Landlocked			-1.294						-6.117
			(1.635)						(7.199)
Latitude			-0.0281						0.0248
			(0.0370)						(0.0910)
Observations	350	341	298	350	341	302	350	341	298
Countries	105	104	82	105	104	86	105	104	82
Fixed Effects									
Year (time)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes				Yes	Yes	Yes
Country				Yes	Yes	Yes			

Source: Author's estimations.

Note: First-difference Ordinary Least Square (FD); Panel Fixed Effects (FE); Generalized Method of Moments (GMM). Data are from Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014). Standard errors clustered at the country level are reported in parentheses. *** p<0.01, **p<0.05, *p<0.1.

7. Conclusion

This paper analyzes the effects of demographic change, measured by changes in age structure, on GDP per capita growth, savings and poverty. A range of alternative econometric specifications and techniques are applied to examine the impact of demographic change on growth, savings, and poverty reduction, while also addressing potential endogeneity between demographics and development outcomes. The analysis suggests that, on average, an increase of 1 percentage point in the share of working-age population is associated with an increase of 1.5 percentage points in GDP per capita growth, an increase of 0.78 percentage point in savings, and a decrease of about 0.75 percentage point in the poverty rate. Of these results, the growth and savings impacts are found to be the most robust across different specifications. The results also suggest a positive association on the interaction between changes in the share of working-age population and years of schooling with GDP per capita growth.

An important policy implication based on these results is that demographic transition may provide an important opportunity for countries to boost their welfare, by increasing per capita GDP growth and savings, and reducing the poverty rate, while child dependency ratios are shrinking. This may provide opportunities particularly for countries in Sub-Saharan Africa and South Asia that expect an increase in the share of working-age population, as they continue to undergo demographic transition and as their fertility rates continue to fall. However, additional policies that could affect labor participation and labor productivity may be necessary in order to guarantee the potential gains from an increase in the share of working age population for these countries. In addition, these results may not provide sufficient guidance on the effects of reduction in the share of working age population in aging countries, as this effect could be non-linear, when compared to an increase in the share of working-age population driven by reduction in the share of children.

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ANNEX

Table A1- Number of countries in the sample by region

Region	Freq.	Percent	Cum.
East Asia & Pacific	17	9.44	9.44
Europe & Central Asia	19	10.56	20
High income: OECD	31	17.22	37.22
High income: nonOECD	26	14.44	51.67
Latin America & Caribbean	23	12.78	64.44
Middle East & North Africa	12	6.67	71.11
South Asia	8	4.44	75.56
Sub-Saharan Africa	44	24.44	100
Total	180	100	

Sources: Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014)

Table A2 Number of countries in the sample by income group

Income Group	Freq.	Percent	Cum.
High income: OECD	31	17.22	17.22
High income: non-OECD	26	14.44	31.67
Low income	29	16.11	47.78
Lower middle income	46	25.56	73.33
Upper middle income	48	26.67	100
Total	180	100	

Sources: Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014)

Table A3 Descriptive statistics – Variables used in the growth analysis

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Real GDP pc growth	1,858	1.96	4.23	(34.34)	40.89
Changes in share of WAP	2,470	0.08	0.37	(1.97)	1.98
Log of real GDP pc	1,867	8.30	1.30	5.24	11.82
Average years of schooling	1,833	5.29	3.35	0.02	13.26
Former colony (UK)	2,520	0.33	0.47	0	1
Former colony (France)	2,548	0.17	0.42	0	2
Landlocked country	2,240	0.21	0.41	0	1
Non-former colony	2,534	0.13	0.33	0	1
Latittude	2,464	25.49	17.01	0	64

Sources: Penn World Tables, UN (2015), World Development Indicators, Treisman (2007), and Barro and Lee (2014)