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

Marcio Cruz[1] and S. Amer Ahmed[2]

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Abstract

Changing population age-structures are shaping the trajectories of development in many countries, bringing both opportunities and challenges. 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 shares of their population that are of working-age, and these shifts have the potential to boost growth and poverty reduction. 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 of the GDP per capita by more than one percentage point, with similarly positive effects on savings and poverty reduction.

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[1] The World Bank and Federal University of Paraná. Email: marciocruz@worldbank.org.
[2] The World Bank. Email: sahmed20@worldbank.org.

1. Introduction

This paper analyzes the effects of demographic change on growth, savings, and poverty. We first describe the main mechanisms of how demographic change impact 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 our main measure of demographic change. Our database covers about 160 countries between 1950 and 2010, and includes several data 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 have larger share of child dependency ratio.

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 people in working age 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. Yet, decomposing the distinct economic impacts of the two dividends is not straightforward, since they may happen simultaneously. Thus, in the empirical part of this paper we rather focus on how changes in age structure may affect growth per capita, savings, and poverty, as key outcomes associated with the first and the 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 technique

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[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) the 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.

to deal with endogeneity issues. Changes in income per capita are known to affect fertility, mortality, and migration, and as such may affect demographic change. The paper features a system-Generalized Method of Moments, 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 dependency ratio on savings had used a similar econometric approach (Loayza et. al., 2000), the GMM estimations 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 on 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 on 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; Kelly and Schmidt, 1995, 2007, Bloom and Williamson, 1998; Bloom and Canning, 2005, Eastwood and Lipton, 2011).[6] 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.[7] Moreover, by interacting changes on 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 increase.[8]

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 is line with a previous literature on effects of demographic changes on savings (Mason, 1987; Johnson and Lee, 1986, Loayza et. al., 2000, Kinugasa and Mason, 2005).

Finally, using similar specifications and methods previously described to analyze poverty, our 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 on 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, 2015), based on the 2011 purchasing power parity (PPP) .

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[6] We present a meta-analysis of demographics and growth literature in the Annex (table A3).
[7] A reduction of 1 percentage point in the share of children is associated to an increase by 0.43 percentage point on 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.
[8] However, the results on the interaction term is not robust using the GMM estimation.

The next section describes the mechanisms through which demographic change may affect growth, savings, poverty and sharing prosperity. Section 3 explains the methodology used in the econometric estimations. Section 4 describes the results on income per capita growth and savings as a share of GDP, while Section 5 examines the impacts of demographic change on poverty. The final section provides concluding remarks.

2. The mechanisms of how demographic change impact 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.[9] 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 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.

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[9] Assuming a constant output per worker, if the effective number of producers (workers) grow 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.

Demographic change pushes countries toward supplying more capital, further enhancing labor productivity (Birdsall, Kelley, and Sinding 2003). Because personal assets accumulate over the 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 and the stage of demographic transition in which they would lead to benefit in terms of economic welfare.

Table 1 Demographic dividends in a nutshell

Channel	Transmission mechanisms	Demographic dividend	Stage of demographic transition
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	Early stage (high fertility and mortality rates)
Savings	Changes in saving and capital per effective worker influence income, from labor and assets, per effective worker.	Second	Late stage (late- and post-dividend countries)
Human capital	Lower fertility and the quantity-quality trade-off lead to greater spending on health and education for children.	Second	Late stage (late- and post-dividend countries)

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.[10] In countries with low level 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 increasing 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

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[10] 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.

for the first demographic dividend. The third stage of demographic transition happens when fertility rate is very low, usually below the replacement level, and mortality rate is also low, which leads to high life expectancy. At this stage the growth or elderly population more than compensate that reduction in the share of children, leading to an increase in the total dependency ratio, driven by a larger amount of elderly.
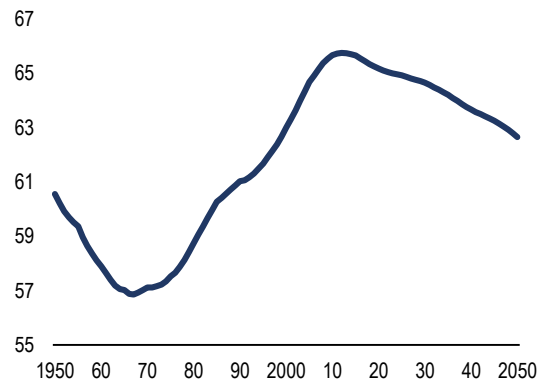
Figure 1 –Demographic transition and dividends

a) Demographic transition and dividends
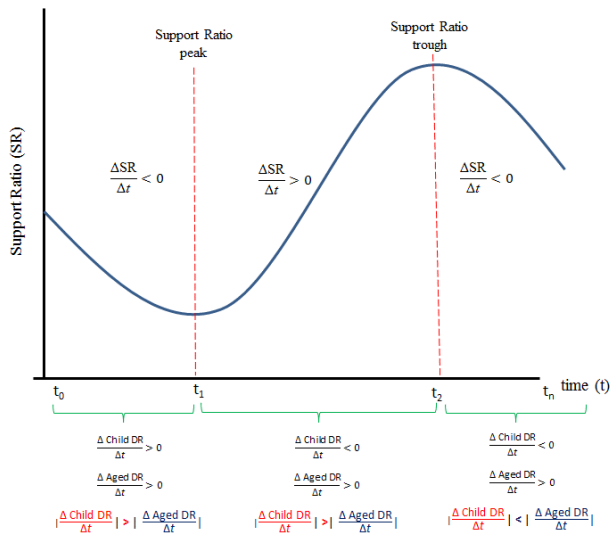
b) Share in global population, aged 15–64, percent

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 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 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%. 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 (figure 2). Countries in 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 on 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

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contribution of demographic change is relevant for countries across the demographic distribution.

Figure 2 – Panel of 4 countries (different typology) showing different demographic transition

Share of working age population, percent

a) Nigeria (Pre-dividend)
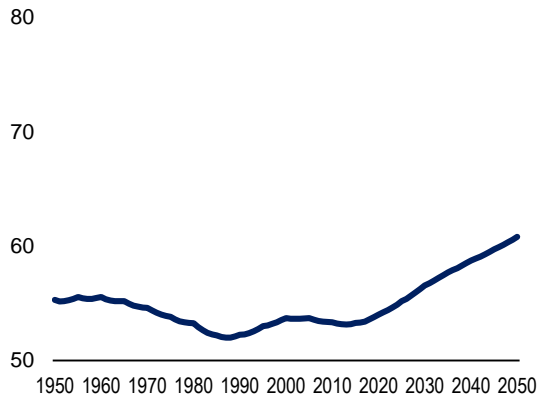
b) India (Early-dividend)
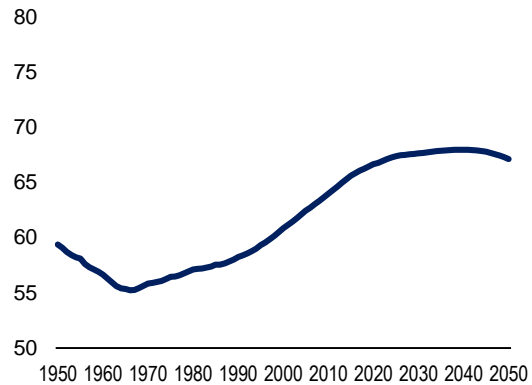
c) China (Late-dividend)
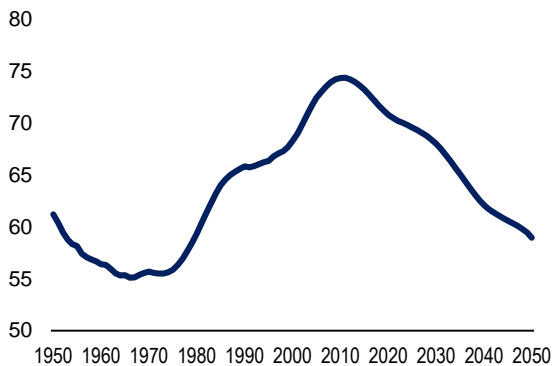
d) Japan (Post-dividend)
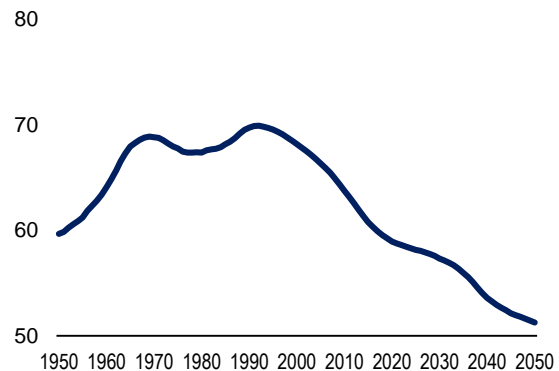
Source: UN (2015)

Note: These countries are classified in different stages of demographic transition based on the potential to generate demographic dividends according to the typology presented in 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) highlights 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.[11] 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 on growth rate. Bloom and Canning (2005) finds that 1 percentage point

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[11] Using a 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.

growth in the share of working age population leads to an increase by 1.4 percentage point growth in income per capita.[12] Kelley and Schimdt (2005) developed a framework to explain the 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 youth dependency ratio, have accounted for approximately 20% 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

Percentage point change in the share of the working-age population, 1960-2014

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; Kelly and Schmidt, 1995, 2005, 2007), including its important role in Asia's growth between 1965 and 1990 (Bloom et. al., 2000) and improvements on the accuracy of growth projections by taking age structure into account (Bloom et. al., 2007). The evidence of 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 points in per capita income growth across stats 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

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[12] The OLS estimates of Bloom and Canning (2005) suggest that an increase of 1 percentage point on the share of working age population leads to 1.0 percentage point increase on income per capita. When they instrument the growth in the share of working-age population by

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.[13] Loayza et. al. (2000) find that both young and old dependency ratios have a significantly negative impact on the private saving rate.[14]

However, the effect of aged dependency ratio on savings is less consensual. 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 (Zucman, 2015). So this is a positive effect on savings associated with aging and could lead to capital deepening. However, the empirical literature generally support 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 (2001) summarizes some previous literature on the link between household demographics and welfare, particularly on the positive correlation between household size and poverty (Lipton, 1983).[15] Paes de Barros et. al. (2015) show that demographic change has led to a continuous reduction in poverty in Brazil, equivalently 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% 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. (2014, forthcoming) show that an increase in the share of working age population, particularly with improvements on education, can play an important role in reducing poverty rates in Sub-Saharan Africa even in the near future.

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[13] Please see Mason (1987), Johnson and Lee (1986) Kelley and Schmidt (2005), Higgins and Williamson (1997), and Kinugasa and Mason (2005).

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

[15] Most of the references presented by Merrick (2001) do no address the causal relationship between household's size and poverty.

3. Empirical strategy

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

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

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 of the 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 is 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; Kelly 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 forty 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 analyzes 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 into them. The simple fact of a larger share of working age population may have an effect on growth though 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).[16] 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.

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[16] Murtin (2013) suggests that increasing access to primary education leads to a reduction on fertility rate.

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 (2014). 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).[17]

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% 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% in 1950 to 16.7% in 2015.

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[17] See tables A1 and A2 in the annex.

Table 1 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 2 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.

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% for OECD countries between 2000 and 2010 (Table 1). 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 1980s. Table 2 shows that not only the share of working age population been larger in higher income countries, but also the human capital has been higher.

Table 3 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.

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 on education, based on years of schooling. For low income countries, most of them in SSA and SAR region, the improvements on years of schooling can be seen to be still well below the average for other groups of countries. Table 3 shows the average income per capita ($ international dollars, 2005 PPP) across regions and income groups over the 1950-2010 period.

4. Results

The results under different specifications suggest that an increase in the share of working age population has a positive effect on per capita GDP growth (Table 4). 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 4 Growth of the working-age share of the population can increase real GDP per capita

Variables	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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 was 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 of GDP per capita of approximately 1.5 percentage points.[18] These results are in line with Bloom and Canning (2004), which suggest an increase of 1 to 1.4 percentage points for a growth of working age population over total population.

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

Variables	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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* Schooling (years)	1.073**	1.073**		1.226**	1.219**		0.43	1.05	
	-0.52	-0.52		-0.56	-0.55		-0.83	-0.72	
Δ share of WAP* Δ Schooling (years)			-3.91			-2.75			-9.19
			-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.

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[18] 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 the share of 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 points. Assume a coefficient of 1.5, changes in the working-age population share would have contributed to about 0.3 percentage points, which is about 11% of the average growth observed over this period.

Table 6 Effects of changes on the share of children (0-14) on the population on real GDP per capita growth

Variables	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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	1.048	0.549	0.0147				0.510	-0.393	0.504
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.

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 lead to a higher impact on per capita GDP growth, given that these results are usually driven by younger and better educated cohorts.

Table 5 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 7 Growth of the working-age share of the population can increase savings

Variables	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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.

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 rising shares 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 6.

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 7, 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 on domestic savings as a share of the Gross National Income (GNI).

5. The implications of demographic change for poverty and shared prosperity

The macroeconomic dividends previously described, which can affect poverty reduction by boosting economic growth (Dollar et. al. 2002, 2015). However, there are also direct channels through which demographic change directly 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 income distribution are disproportionally benefited by an increase of 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 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 2000 and 2010 (World Bank 2013b). 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
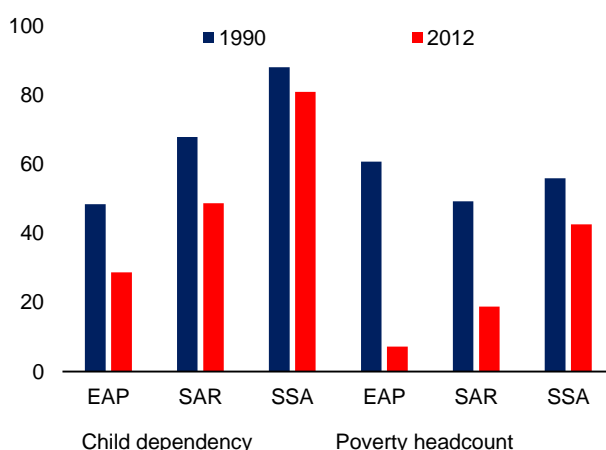
Source: Authors' estimates
Note: Data are from United Nations (2015) and PovcalNet. The poverty headcount rate is based on the $1.90 a day poverty line.

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

Child dependency ratios in LIC countries

Child dependency ratios in LMC countries

Child dependency ratios in UMC countries

Child dependency ratios in HIC countries
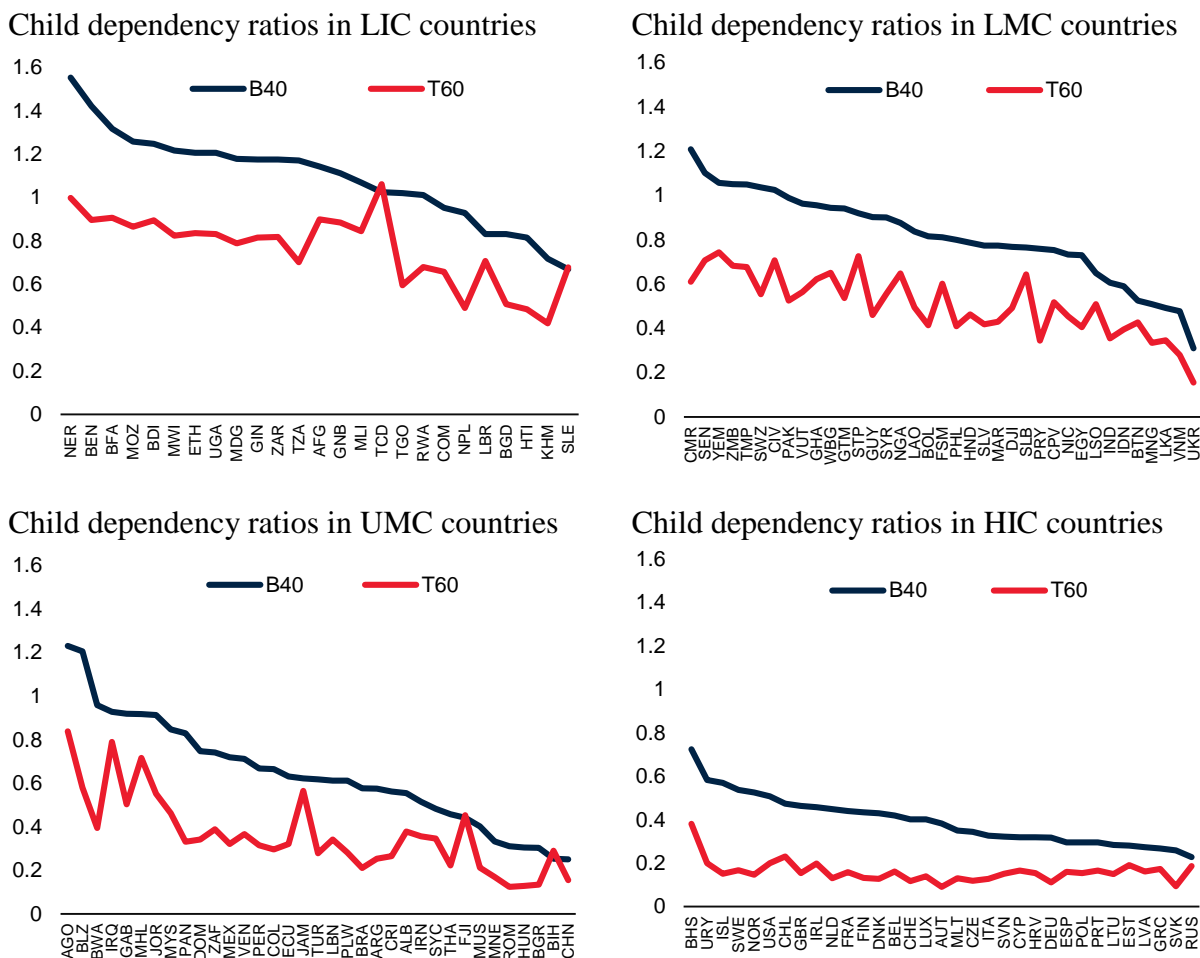
Source: World Bank staff based on data from household surveys, circa 2007 but spanning 2001–10.

Note: The sample covers 33 high-income (HIC), 35 upper-middle-income (UMC), 37 lower-middle-income (LMC), and 25 low-income countries (LIC). Classification of 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.

Table 8 – Demographic patterns and sharing prosperity

		1. Share of females aged 15-19 who are mothers, percent (See Figure 18)		2. Women's median age at first birth (See Figure 19)	
		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 (See Figure 20)		4. Share of women who do not want to become pregnant again but not using contraception, percent (See Figure 21)	
		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. Please see appendix C.2 for additional details. 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. Data are from Demographic and Health Surveys. Please see appendix C.2 for additional details. Unmet need for family planning is defined as the percentage of women who do not want to become pregnant but are not using contraception

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 of the distribution (T60). The B40 households are also seen to have higher rates of teenage parents than T60 households (Table 8). 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 Impact of changes in the share of WAP on poverty

Variables	First-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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. *** $p<0.01$, **$p<0.05$, *$p<0.1$.

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 9). 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 results are similar (Table 10). Results are also consistent if an alternative poverty line is considered.[19]

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

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

Variables	Fist-Difference			Panel Fixed-effects			Generalized Method of Moments		
	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. *** $p<0.01$, **$p<0.05$, *$p<0.1$.

6. Conclusion

This paper analyzes the effects of demographic change, measured by changes on 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 on GDP per capita growth, an increase of 0.78 percentage point on savings and a decrease of about 0.75 percentage point on 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

between 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, savings and reducing poverty rate, while child dependence ratio 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 increasing 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)

Table A3 – Meta-analysis of demographics and growth literature

Author	Region	Data	Period	Est.	Main questions	Main finding
Bloom and Williamson (1998)	global (78 countries)	WDI	1965 to 1990	OLS, IV	What is the impact of changes in age structure on GDP per capita growth?	Their results suggest that an increase of 1 percentage point in the growth of the working age population is associated to an increase between 1.4 to 2 percentage points on per capita growth rate.
Bloom, Canning and Malaney (2000)	global (70 countries)	WDI	1966 to 1990	OLS, IV	What is the effect of demographic variables on the pace of economic growth	Log ratio of WAP would result in 4.0-6.1 percent increase of average percentage growth rate of real GDP per capita.
Bloom and Canning (2004)	global	Penn World Tables and UN	1965 to 1995	OLS, 2SLS	What is the implication of demographic change for macroeconomic performance?	WA/Ngr is significantly impact on Growth rate of Income per Capita as 0.996-1.394 increase ceteris paribus
Bloom, Canning, Fink and Finlay (2007).	global (67 countries)	Penn World Tables and UN	1960 to 2000	Bayesian methods	whether age structure can be used to forecast long-run economic growth	Adding the age structure to the growth model significantly improves the forecast accuracy.
Bloom, Canning, Hu, Liu, Mahal and Yip, W. (2010)	China and India	WDI, China Yearbook and Indian National Sample Employment–Unemployment Surveys	1960 to 2000	OLS, 2SLS	What are the miracle of economic growth in China and India?	Log share of working age population is estimated as 5.79 to 6.57 impact on growth rate of income per capita
Bloom , Canning, and Fink (2010)	global (171 countries)	World Population Prospects (UN) and ILO	1960 to 2005		What is the effect of population ageing on economic growth?	Economic growth rates would have been 1.75 per cent per year under the counterfactual assumption of the less favorable demographic environment (population and LFTP had undergone the change they are expected to undergo between 2005 and 2050) anticipated for the period 2005–50.

Acemoglu, and Johnson (2006)	global (75 countries)	Demographic Yearbook (UN) and League of Nations Reports	1940 to 2000	OLS, GMM	What is the effect of general health conditions on economic growth	Population to changes in life expectancy will lead around 1.7 decrease in Log per capita GDP, and 1.8 decrease in log GDP per WAP.
Ahmed, Cruz, Go, Maliszewska and Osorio-Rodarte (2014).	global (128 countries)	GIDD, GTAP Database, UN WPP (2013)	2007	CGE	What are the effects of the demographic dividend on Africa's future savings, investment, growth and poverty reduction?	Demographic change can clearly boost aggregate growth through the model's labor and savings channels. Also, poverty reduction is sensitive to demographic change.
Mody and Aiyar (2011).	India	COI, NSDP of India	1991 to 2001	GMM, IV	What is the impact of demography on per capita growth focusing on India?	An increase of 0.01 in the log of the initial working age ratio (i.e. a 1 percent increase in the working age ratio) is associated with a 0.2 - 0.4 percentage points increase in annual average per capita income growth.
Ashraf, Weil and Wilde (2013).	global	UN and ILO	2005	OLS, IV	What is the effect of reductions in fertility in a developing country?	A rise in income per capita of an increment to growth of 0.225 percent per year when the change in fertility from the medium to the low variant.
Bar and Leukhina (2010).	England	diverse resources for England such as Clark(2001a) and Maddison(1995)	1560 to 1860		what factors were responsible for these economic changes and to what extents	Beyond changes in the productivity, changes in young-age mortality were an important driving force behind the demographic transformation in England.

Sources: Elaborated by the authors based on the respective references.