



The demographic dividend is more than an education dividend

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The demographic dividend has long been viewed as an important factor for economic development and provided a rationale for policies aiming at a more balanced age structure through birth control and family planning. Assessing the relative importance of age structure and increases in human capital, recent work has argued that the demographic dividend is related to education and has suggested a dominance of improving education over age structure. Here we reconsider the empirical relevance of shifts in the age distribution for development for a panel of 159 countries over the period 1950 to 2015. Based on a flexible model of age-structured human capital endowments, the results document important interactions between age structure and human capital endowments, suggesting that arguments of clear dominance of education over age structure are unwarranted and lead to potentially misleading policy conclusions. An increase in the working-age population share has a strong and significant positive effect on growth, even conditional on human capital, in line with the conventional notion of a demographic dividend. An increase in human capital only has positive growth effects if combined with a suitable age structure. An increasing share of the most productive age groups has an additional positive effect on economic performance. Finally, the results show considerable heterogeneity in the effect of age structure and human capital for different levels of development. Successful policies for sustainable development should take this heterogeneity into account to avoid detrimental implications of a unidimensional focus on human capital without accounting for demography.

economic growth | age structure | population aging | human capital

The demographic dividend has played a prominent role in the debate about suitable policies to support the achievement of sustainable development goals and economic development around the world (1, 2). In its basic form, the dividend arises as a consequence of a secular decline in fertility in developing countries with high fertility rates. This decline leads to a shift in the age structure, reducing the youth dependency ratio and increasing the working-age population share, thus providing a boost of living conditions in terms of income per capita (3). The decline in fertility is typically closely linked to an increase in education attainment. From the perspective of unified growth theory, these fertility and education dynamics are triggered by a change in the demand for skills rooted in the economic and technological environment and complement each other in giving rise to the acceleration in growth during the economic take-off (4, 5).

Despite the conceptually close links between fertility, age structure, and education, empirical research on the demographic dividend has focused on isolating single dominant factors, and recent work has reported a clear dominance of human capital over age structure, arguing that the demographic dividend is mainly driven by education (6, 7). These results question the importance of demographic trends, in particular of shifts in the age distribution, for economic performance, although the analysis is severely limited in its ability to account for interactions between human capital and age structure as a consequence of a restrictive structural framework. Such interactions emerge in

different dimensions and refer to the overall education of the working-age population, to the age structure of the working-age population in light of heterogeneity in the age-productivity profile, and to the age structure of the education embodied in the population in light of changes in education quality and content.

Here we reassess the empirical relevance of age structure and human capital as components of the demographic dividend. The estimation is based on a more flexible version of empirical frameworks used in the earlier work already mentioned (7) that allows us to test for interactions between age structure and education composition. We estimate the reduced-form effect of the age structure based on the size of the working-age population as opposed to the size of the labor force because the latter raises concerns of endogeneity and reverse causality related to labor market participation. The estimates are obtained using national account data on income and capital from the Penn World Tables (8) and data on demographics and education attainment provided by the Wittgenstein Center (9).

The results document an unambiguously positive and significant effect of changes in the age structure—in terms of the working-age population as share of the total population—on growth, consistent with the predictions of the demographic dividend (Table 1). This effect is mirrored by a level effect of the working-age population share, which is significantly amplified by education (Fig. 1A). Similarly, the effect of education attainment in terms of postprimary education among the working-age population is significantly amplified by the population share of the working-age population (Fig. 1B), for example due to scale effects that work through the competitive allocation of labor across sectors of production and innovation as in models of endogenous growth. Hence, demography is an important element of the demographic dividend, above and beyond education. A minimum level of education is indispensable for economic growth, as is a sufficiently large working-age population share.

The results also reveal effect heterogeneity across countries. In Organisation for Economic Co-operation and Development (OECD) countries in which most of the population has acquired postprimary education, increases in education have substantially smaller effects on growth than in less-developed countries. This suggests that the education dividend is limited by the scope for extending education in the population, complementing earlier results on the limited possibilities to compensate the effect of population aging by enhancing education attainment (10) and the associated decline in growth dynamics (11).

Our choice of measures of education was chosen for compatibility with ref. 7. Similar results emerge with alternative measures

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Table 1. Estimation results

Dependent variable	Growth rate of income per capita		
	Full sample	OECD countries	Non-OECD countries
	(1)	(2)	(3)
Growth of capital per worker	0.50*** (0.05)	0.58*** (0.06)	0.50*** (0.05)
Growth of working-age population /total population	0.69*** (0.25)	0.71** (0.26)	0.69** (0.31)
Postprimary education attainment	2.69*** (0.53)	1.12 (0.74)	4.43*** (0.72)
Log of working-age population /total population	-0.45** (0.20)	-0.15 (0.41)	-0.53** (0.24)
Log income per capita (<i>t</i> - 1)	-0.14*** (0.03)	-0.15*** (0.04)	-0.12*** (0.03)
Postprimary education attainment × working-age/total population (<i>t</i> - 1)	2.40*** (0.46)	1.07* (0.58)	2.98*** (0.57)
Postprimary education attainment × log income per capita (<i>t</i> - 1)	-0.18*** (0.04)	-0.08 (0.06)	-0.32*** (0.05)
Country-fixed effects	✓	✓	✓
Year-fixed effects	✓	✓	✓
R ²	0.48	0.61	0.48
Adjusted R ²	0.41	0.55	0.41
Countries	159	35	124
Observations	1,679	404	1275

Estimation results for a panel of countries *i* in year *t*. The baseline specification of the empirical framework is given by

$$\Delta \ln y_{it} = \phi_1 \Delta \ln k_{it} + \phi_2 \Delta \ln \frac{W_{it}}{N_{it}} + \phi_3 H_{it} + \phi_4 \ln \frac{W_{it-1}}{N_{it-1}} + \phi_5 \ln y_{it-1} + \phi_6 H_{it} \times \frac{W_{it-1}}{N_{it-1}} + \phi_7 H_{it} \times \ln y_{it-1}.$$

The dependent variable is the growth rate of income per capita, with *y* = income per capita, *k* = physical capital per capita, *W* = working-age population (age 15 to 64 y), *N* = total population, and *H* = share of individuals with postprimary education (completed secondary or tertiary education) in the working-age population. All regressions include country-fixed effects and time-fixed effects. Clustered standard errors are reported in parentheses. Asterisks indicate significance levels: **P* < 0.1; ***P* < 0.05; ****P* < 0.01.

of education, such as the share with tertiary education attainment or years of schooling, when restricting the sample period to 1980 to 2015 as in ref. 7, or with extended specifications that include controls for institutional quality.

Another channel through which changes in the age structure affect growth is associated with variation in age-specific productivity. It is well documented that experience and the accumulation of work-related knowledge imply a peak in life-cycle productivity around age 40 to 54 y (12, 13). Estimation results based on more flexible specifications that account for variation in the age structure of the working-age population confirm this conjecture: The size of the working-age population share has a particularly strong effect on growth if related to the size of the most productive age group (Fig. 2A).

The age structure of human capital constitutes yet another channel through which age structure and human capital interact in affecting economic growth. Increasing education attainment at the expense of the most productive age group 40 to 54 y has a positive effect on growth only if the working-age share is small enough; growth can even slow down if the working-age share is too high (Fig. 2B). It may be that the growth effect of higher education among the young at the expense of the prime-age group is negative for large working-age shares

because the less-productive human capital of the young cannot fully compensate the more-productive human capital of the more experienced prime-age group. This implies a significant role of demography even for the direct effects of human capital on growth and indicates considerable heterogeneity along the process of development, with amplified effects for less-developed countries.

Together, the results show that the demographic dividend is not a mere education dividend but the result of a complex interplay between shifts in the age structure and education composition. An overly narrow focus on education that neglects these contingencies might thus lead to sub-optimal policy outcomes. Rather than putting an exclusive focus on the education dividend, global population policies should adopt a comprehensive approach reflecting the insights from unified growth theory that development requires a demographic transition with fertility reductions, the associated changes in the age structure, and enhanced education attainment.

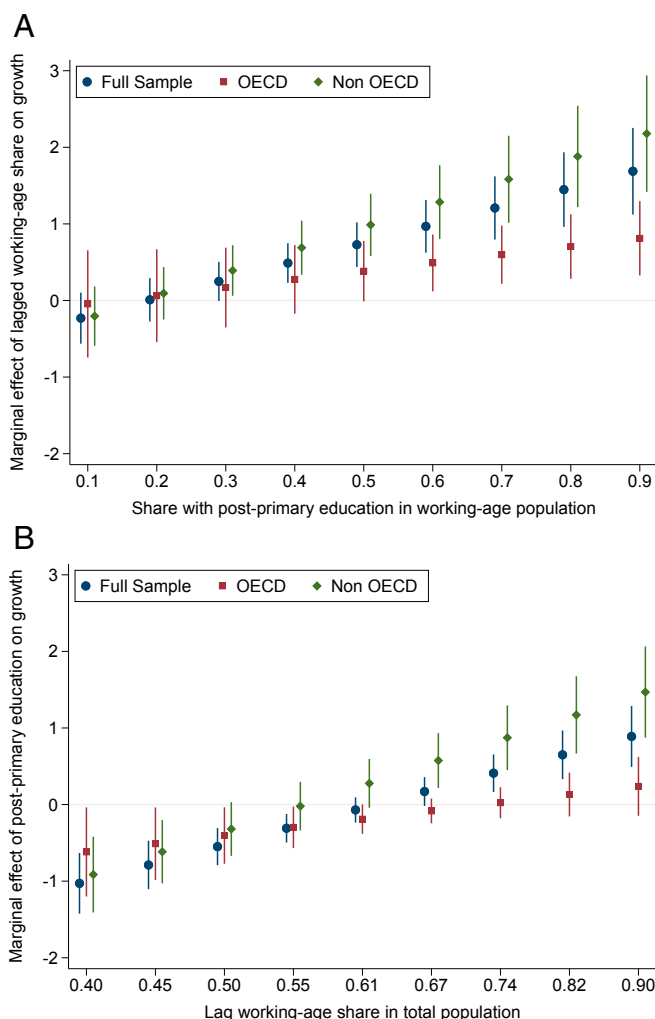


Fig. 1. Population age structure, education, and the demographic dividend. The results in A and B are based on the empirical estimates in Table 1. (A) The marginal effect on growth of the working-age population share, conditional on different levels of postprimary education among the working-age population. (B) The marginal effect on growth of postprimary education among the working-age population, conditional on different levels of the working-age population share.

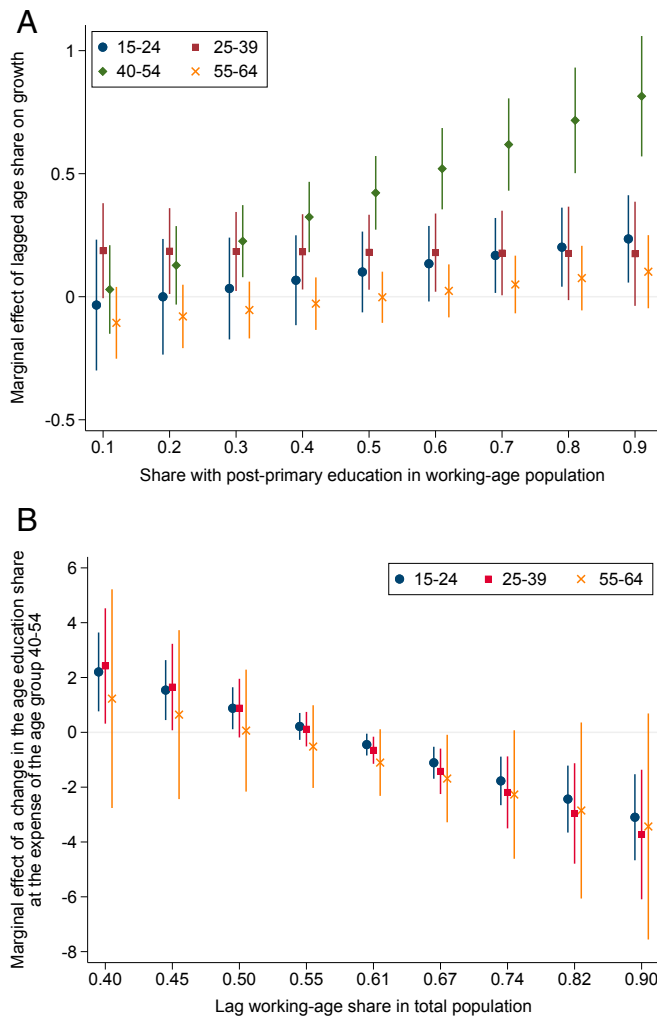


Fig. 2. Heterogeneity across age structure and education age composition. The empirical model underlying the results in *A* and *B* is given by more flexible specifications of the baseline model estimated in Table 1. The empirical model underlying *A* accounts for potential heterogeneity in the coefficients related to the population shares of different age groups relative to the total population, replacing W_{it} in the baseline specification by $\sum_{k=1}^4 W_{it}^k$ with $k = 1, 2, 3, 4$ reflecting age groups 15 to 24, 25 to 39, 40 to 54, and 55 to 64 y and expanding the corresponding set of estimated coefficients. The empirical model underlying *B* accounts for potential heterogeneity in the coefficients related to education attainment by different age groups relative to the age group 40 to 54 y, replacing H_{it} in the baseline specification by $\sum_{m=1}^3 H_{it}^m$ with $m = 1, 2, 3$, reflecting the education attainment in terms of postprimary education of age groups 15 to 24, 25 to 39, and 55 to 64 y, with the age group 40 to 54 y as reference group, and expanding the corresponding set of estimated coefficients.

Data Availability. Country-level data and replication code have been deposited in Harvard Dataverse (<https://doi.org/10.7910/DVNN/ECPNQG>).

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