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Impact of Demographic Dividend on Economic Growth in Developing Countries

Mohammad Yaqoob[*]
School of Business and Economics Universiti Putra Malaysia
Yasmin Bani
School of Business and Economics Universiti Putra Malaysia
Suryati Ishak
School of Business and Economics Universiti Putra Malaysia
Anitha Rosland
School of Business and Economics Universiti Putra Malaysia

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Abstract

This study investigates the impact of demographic dividends on economic growth by employing the dynamic common correlated effect (DCCE) as a panel data estimation technique. The analysis encompasses 71 developing countries from 1980 to 2019, further divided into lower- and higher-income countries. This study found that the demographic dividend, measured as the ratio of the working-age group in the population, significantly and positively influenced the economic expansion of overall developing countries and lower-income countries; however, the demographic dividend has an insignificant effect on higher-income countries. The results further demonstrate that the young population has a significant negative impact, and the elderly population positively affects economic growth. In addition to that, the study also found that physical capital per capita is negative, while human capital and trade openness offer a favourable outcome for economic growth. These results underscore the potential benefits of demographic change in most developing countries. However, investment in developing human and physical capital can enhance and promote the favourable effect of the working-age population ratio, fostering rapid economic growth.

Keywords: Demographic dividend, working-age population, economic growth, developing countries, DCCE
JEL Classifications: J11, F43

[*] **Corresponding author**: Email: yaqoobmohammad75@gmail.com

1. Introduction

The world's population is still rising, and a significant rise in population is taking place in developing countries. The developing nations have already entered a demographic transition process, due to which the fertility rate has been declining slowly, and a significant portion of the increasing population is being added to working-age and young-age groups. In the next three decades, the population will remain relatively middle-aged in less developed countries (United Nations, 2022). In the process of demographic transition, when the proportion of the working-age grows faster than the dependent population, there will be a potential economic benefit. This economic benefit has been recognised as the demographic dividend, which creates the possibility of significant economic expansion (Bloom & Williamson, 1998).

Since developing nations entered the demographic transition later than developed nations in Western Europe and East Asian countries, it is therefore important to recognise that the demographic transition in developing countries differs in timing and speed in comparison to their developed counterparts in Western Europe and East Asian countries (Choudhry & Elhorst, 2010). As a result, it is anticipated that a more significant concentration of the population will be in productive age groups (World Bank, 2019). In addition to the variations in the rate of demographic transition, developing nations differ from industrialised nations in a wide range of areas, including capital stock size, health, and education (Ahmad & Khan, 2019).

There is a mechanism through which the demographic dividend can play its part in boosting economic growth. Firstly, it achieves this by increasing labour supply when the dependency ratio falls and the working-age population expands (Bloom & Finlay, 2009). This change results in a larger and potentially more productive workforce. However, entering the vast majority of the population into the workforce may adversely affect the labour market, leading to a drop in wages and unemployment (Mason, 2003). The second channel is an increase in savings. With more people of working-age, there will be more savings, which fosters higher levels of investment in capital goods and infrastructure.

The third channel involves investments in education and training to enhance workforce skills and productivity. The demographic shift has an impact on investment in human capital. Investments in education rise as fertility rates and family sizes drop. Because of the lower child dependency ratio, parents can afford to finance human capital investments. In contrast to developed countries, developing countries are also different in their educational systems. It is because educational institutions in underdeveloped countries are not accessible to all people due to poverty and poor infrastructure. Additionally, there are not enough state-level incentives or subsidies to support education in underdeveloped nations (Mallick et al., 2016).

If the population structure shifts toward a higher dependency level, it will go along with a drop in saving rates, impeding economic prosperity (Le & Park, 2020). The growing youth population will require a nation to spend more on education, health, and infrastructure, and an increase in the ratio of older people may burden elderly care and pension expenditures (Choudhry & Elhorst, 2010). An increase in the youth population and population ageing might result in stagnation in the economy since it will result in a smaller labour force due to the diminishing proportion of working-age people. The working-age population earns more than it consumes and, as a result, has greater savings than the young and elderly populations, which spend more than they produce. As people get older, they tend to be more frugal and save money for retirement. This mechanism encourages economic growth by increasing savings. Savings are utilised to invest capital, and a rise in capital stock is required for economic expansion and, consequently, to generate a second dividend (Kim et al., 2020). However, given extended family networks, a different scenario would be possible in underdeveloped countries. Savings during the prime working years could be used to feed large families. In addition, many people in developing countries continue to work well into old age.

An important factor affecting demographic change and dividends is the fertility rate, which can vary with different income levels (Lee & Mason, 2010). Therefore, income is significant in influencing the demographic dividend. It is also evidence that countries with varying income levels have different demographic trends. Consequently, it is meaningful to segregate the developing countries into lower and higher-income. Numerous studies have claimed that trade openness and unobserved components have led to cross-sectional dependence across nations. Due to increased trade opportunities in this era of modernisation and economic development, the countries have a substantial impact on one another (Ali et al., 2020). Therefore, trade openness is crucial for determining the economic benefits of demographic dividends. Considering this, an approach to assessing the influence of demographic dividends on economic development should be corrected for cross-sectional interdependence and common shocks. This study provides additional inputs in the literature since it applies a dynamic common correlated effect estimator called the second-generation panel data technique to capture the dynamic relationship while accounting for the problems in the long panel data estimation problems such as cross-section dependency, structural breaks, and heterogenous slope coefficients. Most of the studies have combined developed and developing countries into one sample. In contrast, we also run separate regressions for lower- and higher-income countries in this study. In addition, this study differs from other studies in that it is one of the few studies on the relationship between demographic change and the demographic dividend. Moreover, this study is based on continuous annual data rather than the five-year interval data used in previous studies and thus provides better results. Lastly, this study used the human capital index for human capital, a broad measure of human development that combines years of schooling and educational attainment compared to other human capital proxies.

The latter part of the study is arranged as; Section 2, which is the literature review. Section 3 outlines the data and estimation method. Section 4 contains the estimated results and their discussion, and lastly, Section 5 consists of the conclusions and policy implications.

2. Literature Review

For the last two centuries, researchers have argued whether population growth could increase, decrease, or be ineffective for economic development (Ehrilich & Holdren, 1971; Ester, 1981; Kuznets, 1967; Simon, 1986). However, recently, the emphasis has shifted to population dynamics (Kelley & Schmidt, 1995; Bloom & Williamson, 1998; Choudhry & Elhorst, 2010; Crespo Cuaresma et al., 2014; Cruz & Ahmed, 2018). The researcher and policymakers observed that regardless of the population's size and growth, the population's composition, such as its age distribution, keeps changing over time and thus may have a varying effect on the economy. The analysis of Bloom & Williamson (1998) discovered that population dynamics provided substantial contributions to East Asia's economic miracle. Roughly demographic change contributed nearly 33 % to perceived economic development. Bloom et al. (2010) investigated how demographic shifts could explain China's and India's economic growth between 1960 and 2000. The study reveals that the working-age population and the quality of institutions had a favourable and substantial influence on the economy's growth. Their combination had a supportive role in increasing economic output. Choudhry & Elhorst's (2010) study included 70 developing and developed nations. According to the findings, the working-age population is favourably correlated with aggregate production growth, whereas the young and old dependent populations are adversely correlated.

In addition, the working-age population moves to older ages, which may accumulate more savings, and thus, economic growth further accelerates (Mason et al., 2004). This economic advantage is also termed the second demographic dividend (Lee & Mason, 2010). An increase in savings is possible when the young dependency ratio falls. Croix et al. (2009) stressed how lowering the population's age dependency stimulated economic development in the post-war era. Cruz & Ahmed (2018) demonstrated that the positive economic effect of working age was attributed to the decline in the youth-dependency ratio. They used data from 180 countries between 1950-2010 and applied the fixed effect, random effect, and GMM methods. Le & Park (2020) applied a panel threshold estimator to reveal a considerable distinction between the change in age dependency on economic advancements from OECD and non-OECD member nations. They observed that an increase in the proportion of the elderly population is responsible for the economic stagnation in OECD economies. In contrast, increasing the share of young people in non-OECD nations has been found to impair economic growth. Pham & Vo (2019) analysed the effects of ageing on economic expansion in developing nations between 1971 and 2015 using quantile regression. According to their findings, the proportions of young and old people substantially impact the economy's expansion over the long term. While the old population was found to have a favourable effect on economic performance over the long term, the proportion of young people had an adverse impact on economic development. Lai & Yip (2022) also demonstrated an unfavourable effect of ageing on the economic development of developing nations, while they claimed that the participation of older people in labour force counterbalanced the adverse effect.

Ahmad & Khan (2019) studied the role of human capital in the nexus of demographic transition and economic growth in developing countries. Their Sys-GMM results exhibited that including human capital increases the benefits of demographic change on economic progress. Crombach & Smits (2022), focusing on the second demographic dividend and rural-urban comparison, showed the greatest economic growth occurred in regions with a lower dependency ratio. They further showed that investments in education result in more economic advantages from demographic shifts.

Crespo Cuaresma et al. (2014) claimed that the economic advantages of demographics are linked with human capital development. They found the favourable effect of the working-age population gets weaker as the model is controlled for human capital. Lutz et al. (2019) also found that the demographic advantage can only be materialised with an improvement in human capital. The study found that an increase in the share of the working age ratio was not marginally significant in bringing about economic expansion. A panel of 165 countries from 1980 to 2015 was used to conduct this study. The findings indicated that human capital is the driving force behind the demographic dividend. The results demonstrated the supremacy of education over age structure. When combined with low levels of education, declining young dependency ratios had detrimental effects on economic growth. Baerlocher et al. (2019) confirmed similar findings while focusing on the second dividend compared to the first dividend stress in the former two studies. They showed a second demographic dividend related to human capital. Almodovar-González et al. (2019) studied the role of the dependent population on economic and entrepreneurial activity in developing and developed countries in two different samples. They discovered a positive relationship between the share of older people in the population and GDP for less developed nations, while this relationship was negative for developed nations. However, the sign that the coefficient of the old population was negative for entrepreneurial activity was negative in both samples. The variable elderly and dependent populations had unfavourable effects on growth and entrepreneurship. (Jafrin & Masud,2021) confirmed the significant favourable impact of demographic dividends for SAARC countries. The authors pool means group estimation for five South Asian countries. They also found the result robust for the individual country analysis.

3. Methodology

3.1. Theoretical Framework

We follow the framework used by Bloom & Finlay (2009). This framework is based on the Solow growth model of conditional convergence. The Solow growth model has been modified to accommodate the demographic factors in the growth diagnostics. The model is a Cobb-Douglas production function as follows:

$$Y_{it} = AK_{it}^{\propto} L_{it}^{1-\propto} \tag{1}$$

In equation (1), Y is total output, A is total factor productivity, K is capital stock, and L is the labour force. Then per worker production function is as follows:

$$\frac{Y_{it}}{L_{it}} = A\left(\frac{K_{it}}{L_{it}}\right)^{\propto} \tag{2}$$

Bloom & Finlay (2009) transformed the link between per-worker output, labour force participation, and working-age share into the following output per capita model, which is equal to the output per working-age population times by labour force participation and times working-age population share.

$$\frac{Y_{it}}{P_{it}} = \frac{Y_{it}}{L_{it}} \frac{L_{it}}{WP_{it}} \frac{WP_{it}}{P_{it}} \tag{3}$$

P represents the population, L is the labour force, and WP is the working-age population. We have the following equation by taking in logs and putting the variables in the growth rate.

$$g_Y = g_Z + g_{WP} + g_L \tag{4}$$

where g_Y is output per capita growth, g_z growth of per-worker productivity, g_{WP} is the growth of the working-age population, which is also called the demographic dividend, and $g_L$is the growth of the labour force. The productivity growth per worker is assumed to be the function of X variables, that is $g_z = \propto_1 + bf(X)$ and growth of the labour force is fixed as, $g_L = \propto_2$, in which $\propto = \propto_1 + \propto_2$ would lead us to the following specification:

$$g_Y = a + bf(X) + g_{WP} + \varepsilon \tag{5}$$

where ε is the random variable.

Inclusion of the young and elderly population ratios

$$g_Y = a + bf(X) + g_{YP} + g_{OP} + \varepsilon \quad (6)$$

Based on (5) and (6), the following empirical models are adopted

$$GDP_{it} = \beta_0 + \beta_1 LWP_{it} + \beta_2 LPC_{it} + \beta_3 LHC_{it} + \beta_4 LEL_{it} + \beta_5 LTO_{it} + \varepsilon_{it} \quad (7)$$

$$GDPG_{it} = \beta_0 + \beta_1 LYP_{it} + \beta_2 LOP_{it} + \beta_3 LPC_{it} + \beta_4 LHC_{it} + \beta_5 LTO_{it} + \varepsilon_{it} \quad (8)$$

GDP_{it} is the growth of real GDP per capita, LWP represents the demographic dividend, measuring the population aged 15-64 divided by the overall population. LYP is young and LOP is old. PC_{it} represents per head capital stock constant 2017 (mil. 2017US$), HC_{it} is the human capital index, developed on schooling years and returns to education. LTO_{it} is trade openness, which is described as the sum of exports and imports to GDP. The data includes 71 developing countries and covers 40 years from 1980 to 2019. We further divided the developing countries into lower-income and higher-income countries. The lower-income group comprises low and lower-middle-income countries, and the higher-income group comprises upper-middle-income and high-income countries. The income groups are made following the World Bank's income classification of the countries. The number of developing countries selected for this study is based on the availability of data. The data on age groups of the population were acquired from World Development Indicators (WDI), and data on GDP, physical capital, human capital and trade openness were obtained from Penn World Table version 10.0 (PWT 10.0).

Table 1: Variables Descriptions and Sources

Variable	Description	Sources
GDP per capita growth	Growth of real GDP per capita	PWT-10.0
Working-age population	Population age 15-64 divided by the total population	WDI
Old age population	Population age 0-14 divided by the total population	WDI
Young-age population	Population age 65 and above divided by the total population	WDI
Human capital	The human capital index	PWT-10.0
Physical capital	Per capita capital stock at constant 2017 (mil. 2017US$)	PWT-10.0
Employed labour	Total labour force employed divided by population 15-64	WDI
Trade openness	The sum of exports and imports to GDP	PWT-10.0

Source: Authors' formulation

3.2 Estimation Strategy

The estimation process begins with pre-estimation tests such as a cross-sectional dependency test (CSD). In the case where CSD prevails, the application of an estimator which is not corrected for CSD may generate unreliable estimates. This study applies the CSD test by Pesaran (2004), which is suitable when both the cross-section and time dimension of panel data are large. The panel unit root test is carried out in the subsequent stage. The unit root test (URT) applied is called the cross-sectionally dependent URT and the second-generation URT. This URT was presented by Pesaran (2007), which considers the panel data's CSD. Thirdly, a co-integration test is applied to confirm that the series is jointly integrated in the long run. In most panel studies, cross-sectional dependency prevails (Ali et al., 2020). The co-integration test provided by Westerlund (2007) is used to check the co-integration of series and is best suited for cross-sectional dependence (Anochiwa et al., 2023; Westerlund, 2007). Additionally, this test is capable of handling brief intervals and structural breaks. This test is normally distributed and sufficiently broad to allow for cross-sectional dependencies, country-specific intercepts, country-specific trends, and slope components.

The final step in the estimation process is employing the dynamic common correlated effects (DCCE) estimator Chudik & Pesaran (2015) developed. The application of DCCE is based on the evidence of CSD and slope heterogeneity tests. Other panel data techniques, such as GMM and System GMM, do not consider specific problems: cross-section dependence and structural breaks (Ali et al., 2020). The DCCE estimations were also corrected for slope heterogeneity (Pesaran & Smith, 1995). Lastly, the DCCE method is suitable for dynamic relationships among variables. DCCE is an extension of the common correlated effect (CCE) technique by Pesaran (2006). Since CCE is a static estimator and, therefore, cannot be applied to the dynamic nature of variable relations. Chudik & Pesaran (2015) extended the CCE method to be suitable for specifications that incorporate lagged values of dependent variables as explanatory variables and weakly exogenous explanatory variables. DCCE uses lags of the cross-section averages, which can effectively tackle the problem of endogeneity (Chudik & Pesaran, 2015; Okumus et al., 2021), as follows:

$$GDP_{it} = \varphi_i GDP_{it-1} + \beta_i x_{it} + \sum_{P=0}^{P\tau} \delta_{xip} \bar{x}_{t-p} + \sum_{P=0}^{P\tau} \delta_{yip} \overline{GDP}_{t-p} + e_{it} \quad (9)$$

where, GDP_{it} represents GDP growth per capita, x_{it} refers to the set of independent variables included in this study, such as working-age, old-age and young-age populations, human capital, physical capital, employment, and trade openness. $P\tau$ is a variable included to account for the number of lags included in cross-section averages.

4. Result and Discussion

Table 2 entails descriptive statistics. Table 3 shows the correlation coefficients among variables. The working-age population, old-age population, human capital, and trade openness have positive correlation coefficients with the dependent variable per capita GDP growth, while the young-age population, employed labour, and physical capital have negative coefficients. Among explanatory variables, the working-age population has a positive correlation with human capital and trade openness. The young-age population and employed labour have negative correlations with other explanatory variables. The rest of the explanatory variables have positive correlation coefficients.

Table 2: Descriptive Statistics

Variable	Mean	S.D.	Min	Max	N
GDP per capita growth (GDP)	0.0151	0.0547	-0.6701	0.5765	2,769
Working-age population (WP)	57.3964	5.931635	46.6962	73.2656	2,840
Young-age population (YP)	38.18246	7.510776	16.8235	50.7577	2,840
Old age population (OP)	4.421139	2.014355	1.92626	14.9412	2,840
Physical capital (PC)	25960.74	26380.52	348.182	207,690	2,840
Human capital (HC)	1.923516	0.521373	1.01421	3.61277	2,840
Employed labour (EL)	0.759895	0.738487	0.030378	5.932826	2,840
Trade openness (TO)	0.998881	0.19727	0.19271	1.66915	2,840

Source: Authors' estimation

Table 3: Correlation Analysis

	GDP	WP	YP	OP	PC	HC	EL	TO
GDP	1							
WP	0.1651	1						
YP	-0.1454	-0.9594	1					
OP	0.1018	0.7808	-0.8772	1				
PC	-0.0098	0.5735	-0.5757	0.5474	1			
HC	0.1013	0.7464	-0.7217	0.627	0.654	1		
EL	-0.0551	-0.1151	0.0839	-0.0517	-0.1715	-0.0503	1	
TO	0.1528	0.3697	-0.3659	0.2077	0.0829	0.3285	0.0336	1

Source: Authors' estimation

Table 4 exhibits the findings of the CSD test. Psarian's (2004) CSD test was used in this investigation. The null hypothesis of the CSD test is formulated as there is no cross-sectional dependency among the cross-section units of this study. The significant results shown by the t-statistics reject the null hypothesis. The results in Table 4 demonstrate the existence of high interdependence among the cross-section units. The same results were also observed using the scaled LM test and the biased-corrected LM test.

Table 4: Cross Section Dependence Test (Pesaran (2004) CD Test)

Variables	Pesaran CD	Pesaran scaled LM	Biased-corrected Scaled LM
GDP per capita growth	30.0342***	37.1106***	36.2003***
Working-age population	211.893***	922.783***	991.883***
Young-age population	207.430***	1027.340***	1024.430***
Old-age population	80.8848***	1001.269***	1000.359***
Physical capital per capita	87.8019***	736.5941***	735.6838***
Human capital	294.872***	1224.881***	1223.971***
Employed labour	2.1077**	414.5614	413.6511***
Trade openness	44.5333***	209.2684***	208.3838***

Note: (***), (**), & (*) show a 1, 5, & 10 % significance level

Source: Authors' estimation

The results of the unit root test for the second generation are provided in Table 5. All variables are stationary at this level except for the young-age population and employed labour to the working-age ratio, which is stationary at the first difference.

Table 5: Panel Unit Root Test (CIPS)

Variable	Level	First Difference
GDP per capita growth	-4.3353***	-5.9934***
Working-age population ratio	-2.6710**	-3.5191***
Young-age population	-2.7364	-2.8782***
Old-age population	-2.2679**	-3.1717***
Physical capital per capita	-2.8732***	-3.1319***
Human Capital	-5.9130***	-8.9991***
Employed labour	-2.3664	-6.4206***
Trade openness	-3.1911***	-3.1158***

Note: (***), (**), & (*) show a 1, 5, & 10 % significance level
Source: Authors' estimation

Table 6 displays the results of the Westerlund co-integration test. Table 6 displays the group t-statistic and panel t-statistic used in Westerlund (2007) co-integration. The Gt and Ga show the overall panel co-integration, while Pt and Pa indicate individual country co-integration. We reject the null for Gt and Pt in all cases. Rejecting the null hypothesis indicates that long-run co-integration exists among the variables in all specifications.

Table 6: Panel Cointegration Test (Westerlund) Cointegration)
H_0: no co-integration

	Gt	Ga	Pt	Pa
GDP=f (WP, PC, HC, EL, TO)				
Developing countries	-4.804***	-6.523	-32.968***	-8.615
Lower-income countries	-4.600***	-5.862	-21.474***	-5.362
Higher-income countries	-5.118***	-7.539	-23.212***	-11.310
GDP=f (OP, YP, PC, HC, TO)				
Developing countries	-4.925***	-5.865	-31.965***	-7.250
Lower-income countries	-4.795***	-4.953	-22.134***	-6.981
Higher-income countries	-5.124***	-7.265	-21.675***	-7.776

Note: (***), (**) & (*) shows 1, 5 & 10 % significance level
Source: Authors' estimation

The DCCE estimates are shown in Tables 7, 8, and 9. The first specification in Table 7 displays the results for developing countries (total sample). The lag coefficient of the dependent variable is negative and significant at one percent, which shows the dynamic relationship among the variables in this study. The working-age population's coefficient is positive and significant at five percent. This result proves that the demographic dividend benefits economic growth, which means that the window of opportunity in developing countries is still open, and they can benefit from the rise in the population in working-age countries.

On the other hand, physical capital per capita is negative and significant because the number of people in developing countries is still rising sharply, and capital intensity is not growing. In comparison, slower population growth will lead to capital deepening (Lee & Mason, 2010). The human capital coefficient is positive but insignificant for the economic growth. Benhabib & Spiegel (1994) showed that human capital is insignificant for per capita income, while the traditional contributing role of human capital can be witnessed through factor productivity. The insignificant role of human capital in economic growth of developing nations indicates that human capital in these nations is underutilised. The employment-to-working-age ratio is positive, but not significant. This evidence means the labour market in developing countries is capable enough to accommodate the growing working-age population. This result is in contrast with Lutz et al. (2019), who showed a negative coefficient of the employed labour to working-age ratio. Trade openness has insignificant coefficients. Therefore, trade openness has negligible outcomes for output growth in this study. Theoretically, trade openness should increase economic growth, whereas in these cases, the countries are not equal in terms of the level of technology and endowment; as a result, gains from economic integration here may not be noticeable (Grossman & Helpman, 1991). These outcomes are consistent with research by Gries et al., (2011) and Berthele & Varoudakis(1996).

The second specification in Table 8 displays the results for lower-income nations. For lower-income countries, the effect of the demographic dividend (population at working-age) is positive and marginally significant. This outcome proves that the demographic dividend in lower-income countries significantly influences economic progress because the population of working-age people in lower-income nations is rising faster than in higher-income nations. As a result, the young population and the economically active age group are growing. Similarly, the elasticity of human capital is positive. The coefficient of trade openness in lower-income nations is positive.

Table 7: DCCE Estimates

Long-run coefficients	**Developing countries**	**Lower-income countries**	**Higher-income countries**
GDP per capita growth (-1)	-1.1436***	-1.2241***	-1.1125***
	(0.0299)	(0.0394)	(0.0436)
Demographic dividend (log)	1.3659**	1.9957**	0.0584
	(0.6503)	(0.7803)	(1.3798)
Physical capital per capita (log)	-0.3476***	-0.3399***	-0.7151***
	(0.0850)	(0.1056)	(0.2269)
Human capital (log)	0.0715	2.0409	0.0612
	(0.5752)	(1.5233)	(0.9655)
Employed labour (log)	0.0102	0.0444	0.2559*
	(0.0706)	(0.0761)	(0.1434)
Trade openness (log)	-0.0793	0.0059	-0.0216
	(0.0642)	(0.0568)	(0.1226)
Constant	2.7458	10.2782	12.0594*
	(3.9436)	(7.1407)	(6.4561)
No of groups	71	43	28
No of observations	2627	1591	962

Note: (***), (**) & (*) show 1, 5 & 10 % significance level. In the parentheses are standard errors.

Source: Authors' estimation

The third column in Table 8 shows the evidence for higher-income countries. It is evidenced that the impact of the working-age population, although positive, is less effective in boosting economic output. Compared to lower-income nations, the higher-income nations are ahead in the demographic transition process, where the fertility rate is declining, the young cohort is decreasing, and the growth of the population in the working-age group is slowing down. The countries in this sample are also sometimes classified as emerging countries with no substantial favourable economic growth outcomes. For the higher-income countries, our sample includes countries mainly from

Latin America and Caribbean, East Asia, and Southeast Asia. These countries are near the final phase of the demographic transition. And their demographic window of opportunity will close soon. The effect of physical capital is significant and negative.

Similarly, the coefficient of human capital is positive. The ratio of employment to working age is positive and significant. The coefficient of trade openness for the lower middle-income group bears a favourable effect on the economic expansion of these countries.

Table 8: DCCE Estimates

Long-run Coefficients	**Developing countries**	**Lower-income countries**	**Higher-income countries**
GDP per capita growth (-1)	-1.1915***	-1.2524***	-1.1836***
	(0.0298)	(0.0355)	(0.0407)
Old-age population (log)	0.9354	-0.4462	0.1230
	(0.7278)	(0.7208)	(0.8244)
Young-age population (log)	-1.3027**	-1.2771*	1.1320
	(0.5660)	(0.7513)	(1.2381)
Physical capital per capita (log)	-0.5084***	-0.3006***	-0.5819***
	(0.1166)	(0.1048)	(0.2165)
Human capital (log)	0.1070	0.4690	0.1431
	(0.1070)	(1.2372)	(1.2648)
Trade openness (log)	0.0107	0.0040	0.0278
	(0.0598)	(0.0568)	(0.1100)
Constant	3.7451	1.2747	-2.8778*
	(4.7380)	(5.6898)	(10.4575)
No of groups	71	43	28
No of observations	2627	1591	962

Note: (***), (**) & (*) show 1, 5 & 10 % significance level. In the parentheses are standard errors.

Source: Authors' estimation

The results in Table 9 are drawn to ascertain the second demographic dividend. We found the youth population's negative and significant effect on economic development in developing and lower-income nations. This result means an increase in the youth population will significantly reduce economic growth. In other words, the reduction in the youth population has contributed to economic progress over the past few decades. Therefore, a greater reduction in the youth population will be in favour of developing countries. While the coefficient of the youth population is positive and non-significant for higher income, meaning that child dependency is non-adversely related to economic growth. The size of the coefficient will also become smaller as we move from lower-income to higher-income countries.

The share of population in the old-age population has positive coefficients for the overall sample and higher-income countries, while it is negative for lower-income countries. However, it is non-significant. Therefore, the increased elderly population will not adversely affect developing countries' economies. This evidence differs from Hu et al. (2021), who showed the hazardous and significant impact of ageing on aggregate output. An & Jeon (2006) and Pham & Vo (2019) demonstrated the significant beneficial impact of ageing on GDP growth. Severe ageing is not observed in developing countries; therefore, it does not affect economic progress. In lower-income countries, the prevalence of ageing is relatively lower and has no adverse effect on the economy. These countries can benefit from their demographic dividend more by reducing the youth population's negative effects. The old-age population's coefficient is positive for higher countries. The higher-income countries are reaching an ageing population earlier than the lower-income countries. So, the higher income countries should be prepared for an ageing population to avoid its negative consequences on the economy and society.

To make sure that including old-age and young-age populations in a single specification may not disrupt the current modelling process and results, we run separate regressions for the old and young-age populations outlined in Table 9. We find that the results in Table 9 are similar to the results in Table 8.

Table 9: DCCE Estimates

Long-run Coefficients	**Developing countries**		**Lower-income countries**		**Higher-income countries**	
GDP per capita growth (-1)	-1.1432***	-1.1506***	-1.1784***	-1.1046***	-1.0463***	-1.0675***
	(0.0286)	(0.0297)	(0.0391)	(0.0434)	(0.0342)	(0.0481)
Old-age population (log)	0.0847		-0.0426		0.1963	
	(0.4528)		(0.4810)		(0.3970)	
Young-age population (log)		-1.8716**		-1.1606**		1.1193
		(0.9148)		(0.5620)		(1.3805)
Physical capital per capita (log)	-0.4158***	-0.4235**	-0.2350**	-0.3004**	-0.5532***	-0.4560**
	(0.1256)	(0.1858)	(0.1152)	(0.1206)	(0.1299)	(0.2137)
Human capital (log)	1.12271	1.2565	0.0694	1.9757	0.8424	0.1345
	(0.8461)	(0.8860)	(0.5854)	(1.2473)	(0.5207)	(0.8496)
Trade openness (log)	-0.0277	-0.0196	0.0050	0.0490	-0.0120	-0.1746
	(0.0771)	(0.1061)	(0.0469)	(0.0461)	(0.0872)	(0.1833)
Constant	-4.4472	8.7455*	1.8536	1.7193	-3.0906	-14.943
	(4.7380)	(4.6258)	(1.1841)	(3.4443)	(5.8065)	(15.8859)
No of groups	71	71	43	43	28	28
No of observations	2627	2627	1591	1591	962	962

Note: (***), (**), (*) show 1, 5 & 10 % significance level. In the parentheses are standard errors.
Source: Authors' estimation

5. Conclusion

This research inquires about the influence of demographic dividends on economic development in panel data from 71 developing countries between 1980 and 2019. We employed the DCCE estimation to come up with robust results while facing the problem of cross-sectional dependency in the sample. This study explores the importance of demographic dividends in growth diagnostics since the world is undergoing a demographic transition, specifically in developing nations where the growth of the fertility rate is dampening and the population of working-age people is rising. Based on the DCCE estimation, the demographic dividend can boost economic growth, and it is robust in developing countries (overall) and lower-income nations but not in higher-income nations. Moreover, the population in developing economies is ageing moderately, and these nations can still benefit from demographic dividends. The adverse effects of population ageing were not seen. This viewpoint is supported by the elderly population's coefficient, which is reported as positive. The stated results further showed that the youth population has an adverse effect on developing countries' economies.

The governments and policymakers in these countries may opt for some measures to turn their demographic change in favour of economies in light of the evidence presented in this study. The young-age population is adversely related to economic growth; therefore, the reduction in youth dependency further accelerates economic progress. Moreover, to best acquire the benefit of the demographic dividend, the government must increase its education expenditure, making the expanding working-age group more productive, because we found human capital positively related to economic output but insignificantly. This study's measure of human capital is based on educational attainments in years. So, we recommend that, besides schooling, policymakers should also focus on vocational training to accommodate the young population in the job market promptly. Besides human capital development, the expenditure on infrastructure development by the government is also necessary to better accommodate the growing youth in the labour market. Since the demographic dividend is less strong in higher-income countries, these countries are experiencing slower working-age population growth and should be prepared for the ageing population. To better reap the economic benefits associated with the demographic dividend, lower-income countries should address their high fertility rates and prioritise investing in providing health and education for the growing young population.

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APPENDIX

List of countries

Lower-income countries			Higher-income countries		
Low income	**Lower Middle-come**		**Upper Middle-income**		**High income**
Burkina Faso	Algeria	Iran, Islamic Rep.	Argentina	Mexico	Chile
Burundi	Bangladesh	Kenya	Belize	Paraguay	Panama
Central African Republic	Benin	Lesotho	Botswana	Peru	Saudi Arabia
Congo, Dem. Rep.	Bolivia	Mauritania	Brazil	South Africa	Trinidad and Tobago
Gambia, The	Cameroon	Morocco	China	Thailand	
Madagascar	Congo, Rep.	Myanmar	Colombia	Turkey	
Malawi	Cote d'Ivoire	Nepal	Costa Rica		
Mali	Egypt, Arab Rep.	Nicaragua	Dominican Republic		
Niger	El Salvador	Nigeria	Ecuador		
Rwanda	Eswatini	Pakistan	Fiji		
Sierra Leone	Ghana	Philippines	Gabon		
Sudan	Haiti	Senegal	Guatemala		
Togo	Honduras	Sri Lanka	Iraq		
Uruguay	India	Tunisia	Jamaica		
Zambia	Indonesia	Zimbabwe	Malaysia		

Source: Authors' selection