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Labor force dynamics and economic performance: A case of Nigeria, India, and China

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Abstract

Aim/purpose – This study investigated the nexus between labor force dynamics and economic performance in Nigeria, India, and China.

Design/methodology – The study used annual time series data spanning from 1991 to 2021 obtained from World Development Indicators (WDI). After the unit root stationarity test, the Autoregressive Distributed Lag Model (ARDL) was used for the analysis.

Findings – Findings from the study support a positive short-run relationship between labor force participation and economic growth in all three countries. However, in China, population growth impacts the economy positively in the long run, while life expectancy at birth negatively impacts the economy in the short run. This is because China's population is aging. In India, employment in the industrial and service sectors positively impacts the economy in the long run. In the short run, life expectancy at birth influences the economy negatively. Furthermore, in Nigeria, the industrial and service sector employment impact the economy negatively in the long run, though there are positive effects in the short run.

Research implications – The Indian government needs policy reforms in the areas of education and health to take advantage of the potential of its youthful population. The Nigerian government requires implementing a wide range of education, investment, and employment-generating policies to foster tangible economic growth. These reforms could help both India and Nigeria take advantage of the potential for demographic change. The Chinese government, already having policy reforms in place, is geared

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towards improved fertility and population growth for economic growth in the near future. These policies, coupled with the study's findings, could provide a more comprehensive understanding of the implications of demographic change on economic performance.
Originality/value contributions – This analysis explored and compared the demographic potentials of two young countries (India and Nigeria) and an aging, wealthy economy (China) from the working class. Policy lessons for the attainment of demographic dividends are borrowed from China.

Keywords: labor force, economic performance, demographic change, population dynamics, ARDL model.

JEL Codes: J10, J11.

1. Introduction

Labor force dynamics considerably impacted some economies' economic growth and development (Cung & Hung, 2020; Soava et al., 2020; Wijaya et al., 2021). Economic experts have asserted that the combination of copious resources, technology, effective growth policies, and the right amount of labor force is certain to produce positive results to expected economic growth (Ajakaiye et al., 2016; Omolola et al., 2023; World Bank, 2021). The influence of the labor force on the growth and development of the economy is still very relevant in low-income and developing economies of the world today. These areas are deficient in automation and robotization of production process processes, which has substituted the use of humans in production in some developed economies of the world. Moreover, developing economies have the number and structure of human population, which can easily fall into the working-class category and aid economic transformation.

Economic growth denotes increases in an economy's gross domestic product (GDP) or per capita income. This is a resultant effect of the increase in the capacity of an economy to produce goods and services within a period of time. It is measured in nominal or real terms, whereas in nominal terms, it is adjusted for inflation (Investopedia Team, 2023). Policymakers generally use growth in real GDP – the total value of economic output adjusted for inflation – to understand changes in economic output over time. Failing to adjust for inflation would typically result in an overstatement of the economy's output as prices rise. Therefore, real GDP is used to accurately compare economic growth over time (CRS Reports, 2023; Feinstein, 1987).

However, economic fluctuations refer to the short-term changes and processes taking place in the labor market and concerning concern a population that may accelerate or hamper economic growth in the long-run long run. McDermott and Hall (2023) posited that the economic performance of countries is assessed by looking at long term long-term outcomes in an economy, such as sustainable growth and development, or short-term outcomes and how long an economy takes to stabilize after a sudden, unpredictable event. Macroeconomic economic performance indicators include Gross Domestic Product (GDP), consumption, investment, economic stability, and international trade. Economic performance is, therefore, a long-term phenomenon that appears later in the economy.

Other reason for significant downturns in the economies of developing nations is the high proportion of the unemployed in the labor force who are still dependent and not contributing to the national gross domestic product. According to the literature, the national labor force refers to the number of individuals who are able-bodied and well enough to work and fall within the age range 15 years and above, but this may vary from country to country based on national laws and practices (ILOSTAT, 2023). Whereas labor force participation rate refers to the percentage of the working working-age population who are actually working or contributing to a nation's output (Aaronson et al., 2006; Adeosun & Popogbe, 2021). Therefore, we can rightly deduce that labor force participation is a major key to economic growth in many developing countries.

In this article, India, China, and Nigeria are studied together because they are three of the most populous countries of the world, with India ranking first. China is second, and Nigeria ranked sixth among the ten most populous countries in the world (Worldometer, 2024). China and India have been leading the world population for over five decades, and Nigeria is the most populous nation in Africa. India, China, and Nigeria are also an extremely heterogeneous set of countries varying significantly in terms of population size, labor force participation, economic growth, and stage of development but homogenous owing to their size of population relative to the rest of the world (Feng, 2010; Tan et al., 2022). These countries are among the world's first seven most populous countries (Worldometer, 2021). China, which used to be the most populous country in the world until the end of 2022, has an estimated population of 1.4257 billion people, while the Indian population is now about 1.4286 billion people. This is in line with recent United Nations statistics, which accurately predicted that India would surpass China in population by April 2023 (United Nations, 2023; World Population Review, 2022). The population in these two countries is rapid-

ly aging as persons above the age of 65 years are expected to nearly double in China and increase by more than twofold in India. Nonetheless, the growth of the older population in India will be much slower than in China (United Nations, 2023; World Population Review, 2021).

The population dynamics witnessed in these two Asian countries are expected to have far-reaching consequences on labor force participation and economic growth in the next few decades (Bloom et al., 2003; World Bank, 2021). China has experienced a significant turning point in its economic development to achieve the demographic dividend, which has propelled China as one of the leading economic world powers. The one-child policy of the 1980s and its related aging population have been responsible for China's demographic evolution to sluggish population growth (Golley & Tyers, 2006).

In India, recent UN projections are that the number of working-age adults will continue increasing both in number and as a proportion of the overall population, thus delivering opportunities for faster economic growth over the next few decades. However, projections for China indicate that the percentage of the population of people between the ages 25 and 64 will peak in the coming few years to close the window of opportunity created by the working age class, known as the demographic dividend (United Nations, 2023).

Nigeria, the most populous black nation in the world, now has a population of 222 million people (Worldometer, 2023). In the past few decades, the population in Nigeria has been increasing due to very high fertility and birth rates multiplying its population progressively to date. Population growth in Nigeria was fastest in the 1980s, after which child mortality dropped rapidly, and has slowed slightly since then as the birth rate has slightly declined. Today, the birth rate is relatively 35.2 births per 1000 population with a total fertility rate of an average of five children per woman (CIA, 2018; Kale & Doguwa, 2015; Swain, 2018; United Nations, 2015; World Population Review, 2021, 2023). Studies have revealed that the Nigerian population is very young with a high dependency ratio, with people of ages 0-15 years making up 44% of the total population and a dependency ratio of 88.2 dependants per 100 non-dependants (CIA, 2018; Lysonski & Durvasula, 2013; Tartiyus et al., 2015). About 53.2% comprise the working class and are between 15 and 65 years of age, while 2.8% are 65 years or older (World Population Prospects, 2019).

Against this background, this study was carried out to empirically ascertain and compare the impact of labor force dynamics on economic growth in China, India, and Nigeria. The selected countries are three of the most populous coun-

tries in the world, ranking first, second, and sixth. Findings from the study were compared and contrasted among the selected countries, and policy recommendations were provided based on the specific peculiarities of each economy. The study findings will to benefit policymakers, researchers, and economists in each of the selected countries to enhance economic growth.

The knowledge gap for the study is that few studies have compared the impact of the labor force on the economic growth of selected most populous countries in the world. This study intends to ascertain and compare the impact of the labor force on the economic growth of selected most populous countries of the world. In addition, according to world ranking, India, China, and Nigeria are ranked first, second, and sixth among the most populous countries globally and were selected for the study (Worldometer, 2024).

This paper is outlined as follows: Section 1 hosts the introduction, Section 2 provides information about the literature review, and Section 3 presents the methodology including the source of data, model specification, and model of data analysis. Section 4 presents the results of the data analysis, while Section 5 hosts the discussion of the results. Finally, Section 6 hosts the conclusion and recommendation from the findings.

2. Literature review

Scholars have argued over the years about the impact of population growth on economic growth, but the results have been inconclusive. Research intellectuals are at opposing ends due to research outcomes with divergent views. As early as the 19th century, population growth has been an issue of interest to early scholars. The Malthusian theory warns of possible hunger and famine in the world as available resources will not be able to sustain high population growth (Deliu & Ilea, 2018; Hendrixson et al., 2020). Nevertheless, contemporary economists are of divergent views identifying benefits of population growth, which include a large consumer market base for both marketable domestic and foreign products, which can lead to an influx of foreign direct investment and an increase in labor force participation rate which in turn will lead to increase in national output and economic growth (Bell et al., 2015; Erdogan & Unver, 2015; Nauman et al., 2016). Meanwhile, GDP per capita matters here since consumption growth is usually seen in the context of short-term economic growth. It is also worth noting that the Malthusian trap applies to countries that have not undergone the Industrial Revolution; his predictions affect many developing

economies that are not sufficiently industrialized. Sir Malthus did not include technical progress in his ominous predictions (Rathke & Sarferaz, 2014). Today, as a result of the Industrial Revolution in many developed countries the world, technological advancement with the use of robotics and artificial intelligence has almost completely replaced the use of human efforts in production activities.

In 2012, Adewole (2012) posited that population growth had a positive effect on economic growth. In contrast, Bucci et al. (2019) revealed a weak effect of population growth on economic growth from study outcomes from different countries from both the developed and developing regions of the world. He noted that the capacity of human capital utilization needs to be critically explored to birth rapid multidimensional development. Similarly, Ali et al. (2018) revealed that a key determinant of firm performance which spurs efficiency of growth and development in an economy is the human resource utilization in the country (Adewole, 2012; Ali et al., 2018; Cunningham, 2010; Okoye & Ezejiofor, 2013).

It is worthy of note that developing economies of the world are facing detrimental effects of population growth on the economy. Among such issues is a drastic fall in the standard of living due to overcrowding, the balance of payment deficits, and pressure on infrastructure and employment opportunities (Gatawa et al., 2018; Pandya & Sisombat, 2017). In contrast, some developed economies have problems with a reduced workforce due to issues of diminishing population growth and an aging economy. These countries have put forth incentives to encourage procreation and the migration of skilled human capital to balance the economy (Ahmed, 2017; Chae et al., 2018).

Similarly, Saghir and Santoro (2018) noted that one major challenge facing many world developed nations is the diminishing population growth. The reverse is the case with many developing nations, especially those in Sub-Saharan Africa, which are having population growth above economic growth, leading to situations of depravity, poverty, and hunger (Zahonogo, 2016).

In the last five decades, China witnessed remarkable economic growth and development, culminating in a significant demographic change from rapid down-turns in mortality and fertility rates and a resultant slower population growth to attain the demographic dividend (Golley & Tyers, 2010). The demographic dividend was achievable due to the impact of the working-age population on economic growth, so to say, the impact of the increased labor participation rate in the economy.

Bloom et al. (1999) examined the impact of demographic change on Asian economic growth. They found that age structure, population density, and life expectancy had significant impacts on economic growth, but population growth

had little effect on economic performance. Furthermore, they found a robust indication of the response of higher income to population transformation through lower fertility. More findings from their study reveal that demographic effects explain Eastern Asia's economic miracle while benefitting from explosive income growth and fertility fall. Similarly, Becker et al. (1999) from their study also supported the view that the working-age population had a more positive impact on per capita output than the total population.

Young (2018) examined the relationship between labor force dynamics and Nigeria's economic growth between 1970 and 2015. He employed the bounds test approach to co-integration in his data analysis and found that labor force dynamics exhibited both significant and positive long-run and short-run effects on economic growth. He discovered that a one percentage increase in labor force dynamics will induce a 1.083 percent increase in per capita real GDP in the long run. The study recommended a need for the Nigerian government to implement a wide range of employment-generating policies aimed at fostering an increased real GDP growth rate.

Golley and Tyers (2006), in their study titled "China's Growth to 2030: Demographic Change and the Labour Supply Constraint," used the GTAP-Dynamic global economic model to discover the links between demographic change, labor participation rates, and growth performance in China. They found that China's secret with respect to economic growth is hinged on its relative abundance of production labor and its progressively secure investment economy. However, within the next ten years from 2006, China's working-class population will begin to dwindle. This event will delineate its economy from India, where there will be increased relative labor force abundance and subsequent investment returns.

Similarly, a study carried out by Feyrer (2008) examined the relationship between cumulative national production efficiency among OECD and low-income countries and workforce demographics. He discovered that changes in the age structure of the workforce were found to be significantly correlated with changes in aggregate productivity. Buttressing this view, Bloom et al. (2003), sequel to their research, found that increases in the size of the working-age population can produce a "demographic dividend" to economic growth. Harmoniously, Becker et al. (1999) carried out a similar study and found that the working age population had a larger positive influence on per capita gross domestic product than the total population of a country.

Bloom et al. (2007) carried out a similar study to ascertain the determinants of growth in different African countries. Findings from the study revealed that the effect of demographic structure is different in Africa due to the continent's negative demographic features compared to the rest of the world. However, they find that Africa is on the verge of obtaining a demographic dividend in the next five decades due to its relatively swelling labor force and young population.

Anyanwu et al. (2021) investigated the nexus between female labor participation and economic growth in Nigeria using time series data from 1981 to 2015. Ordinary Least Square (OLS) estimation was used for the analysis. Findings show an inverse relationship between female labor participation and economic growth in Nigeria. The study recommended active labor market policies to promote women's involvement in the country's national economic growth and development.

In summary, this literature review showcases empirical evidence of the nexus between labor force participation and economic growth in China, India, and Nigeria. However, few literatures exist that compare the scenarios in the selected countries in a single study.

3. Research methodology

3.1. Theoretical framework

This study is based on the Lewisian dual economy model, which shows that surplus labor plays a critical role in explaining different economic growth paths and structural changes in both developing and developed countries (Lewis, 1954; Villamil et al., 2018). The model demonstrates the effect of surplus labor on economic growth and economic welfare in developed and developing countries. Thus, in this study, we discuss economic growth under up to three different labor market structures and demonstrate the effects of surplus labor on economic growth.

3.2. Data and sources

Secondary data from World Development Indicators [WDI] (2021) on annual time series variables spanning periods between 1991-2021 was utilized for this study (WDI, 2021). WDI is the primary World Bank collection of development indicators, compiled from officially recognized international sources. It is the

World Bank's premier compilation of international statistics on global development. Drawing from officially recognized sources and including national, regional, and global estimates, the WDI provides access to almost 1,600 indicators for 217 economies, with some time series extending back more than 50 years (WDI, 2021).

Based on the works of Padhi and Motkuri (2021), Yakubu et al. (2020), and Du and Yang (2015), our dependent variable is the annual GDP growth rate (GDPgr) (proxy for economic performance) while explanatory variables are labor force participation rate (LABPART), Gross Capital formation (GCF), Population growth (POPgr), Service sector employment (SSEMPL), Industrial sector employment (INDSEMPL), Life expectancy (LEXP), Trade openness (TRADEOP) and Secondary school enrolment (SCHROL).

3.3. Model specification

The Autoregressive Distributed Lag Model (ARDL Model) was used to specify the relationship between the growth rate of real GDP and labor force participation rate, population growth, and the other explanatory variables that were useful to explain the relationship. The ARDL model has considerable advantages over other similar models because it provides estimates of both the long-run and short-run coefficients simultaneously (Pesaran et al., 1999, 2001).

$$GDP_{gr} = \gamma_0 + \gamma_1 LABPART + \gamma_2 GCF + \gamma_3 POPgr + \gamma_4 SSEMPL + \\ + \gamma_5 INDSEMPL + \gamma_6\, LEXP + \gamma_7\, TRADEOP + \gamma_8 SCHROL + \varepsilon_t \qquad (1)$$

where:
GDPgr = Annual GDP growth rate (%),
LABPART = Labor force participation rate (% of total population ages 15-64),
GCF = Gross capital formation (% of GDP),
POPgr = Population growth (annual %), i.e. annual population growth rate,
SSEMPL = Employment in services (% of total employment) or service sector employment,
INDSEMPL = Employment in industry (% of total employment) or industrial sector employment,
LEXP = Life expectancy at birth, total (years),
TRADEOP = Trade openness (Trade (% of GDP),
SCHROL = School enrollment, secondary (% gross),
ε_t = Error term.

In this case, the assumptions about the distribution of the error terms in Ordinary Least Squares regression for homoskedasticity (no heteroskedasticity), no autocorrelation, and zero conditional means of the error terms hold.

The ARDL model equation is hereby specified as follows:

$$\Delta GDP_{gr} = \beta_0 + \sum_{i=1}^{a} \beta_{1i}\, \Delta GDPgr_{t-i} + \sum_{i=1}^{b} \beta_{2i}\, \Delta LABPART_{t-i} + \\ + \sum_{i=1}^{c} \beta_{3i}\ \Delta GCF_{t-i} + \sum_{i=1}^{d} \beta_{4i} \Delta Popgr_{t-i} + \sum_{i=1}^{e} \beta_{5i} \Delta\, SSEMPL_{t-i} + \\ + \sum_{i=1}^{f} \beta_{6i} \Delta INDSEMPL_{t-i} + \sum_{i=1}^{g} \beta_{7i} \Delta LEXP_{t-i} + \sum_{i=1}^{h} \beta_{8i} \Delta TRADEOP_{t-i} + \\ + \sum_{i=1}^{j} \beta_{9i} \Delta SCHROL_{t-i} + \delta_1 GDPgr_{t-i} + \delta_2 LABPART_{t-i} + \\ + \delta_3 GCF_{t-1} + \delta_4 Popgr_{t-i} + \delta_5 SSEMPL_{t-i} + \delta_6 INDSEMPL_{t-i} + \delta_7 LEXP_{t-i} + \\ + \delta_8 TRADEOP_{t-i} + \delta_9 SCHROL_{t-i} + \varepsilon_t \qquad (2)$$

Equation 2 above is an ARDL model having orders (a to i) showing that economic growth is determined by its lag and the lag values of the increase in labor participation rate (LABPART), which is the proxy for labor force dynamics, gross capital formation (GCF), population growth (Popgr), service sector employment (SSEMPL), industrial sector employment (INSEMPL), life expectancy (LEXP), trade openness (TRADEOP), and secondary school enrolment (SCHROL) which is proxy for human capital.

The δ captures the long-run effects, while the β captures the short-run effects of the model. The Δ signifies the first difference operator, and the β_0 is the intercept while the ε_t is the error term.

The null hypothesis for the study is $H0$: Labour force participation rate does not have a significant impact on economic performance in Nigeria, China, and India.

The alternative hypothesis is $H1$: The labor force participation rate has a significant impact on economic performance in Nigeria, China, and India.

After the confirmation of long run relationship which is the stage where the F statistics exceed the upper bound limit of the bounds test, we proceed to estimate the error correction model (ECM). The error correction depiction of the ARDL model is represented as follows;

$$\Delta GDP_{gr} = \sum_{i=1}^{a} \beta_{1i}\, \Delta GDPgr_{t-i} + \sum_{i=1}^{b} \beta_{2i}\, \Delta LABPART_{t-i} + \sum_{i=1}^{c} \beta_{3i}\ \Delta GCF_{t-i} + \\ + \sum_{i=1}^{d} \beta_{4i} \Delta Popgr_{t-i} + \sum_{i=1}^{e} \beta_{5i} \Delta\, SSEMPL_{t-i} + \sum_{i=1}^{f} \beta_{6i} \Delta INDSEMPL_{t-i} + \\ + \sum_{i=1}^{g} \beta_{7i} \Delta LEXP_{t-i} + \sum_{i=1}^{h} \beta_{8i} \Delta TRADEOP_{t-i} + \sum_{i=1}^{j} \beta_{9i} \Delta SCHROL_{t-i} + \\ + \lambda ECM_{t-i} + \varepsilon_t \qquad (3)$$

Where λ is the speed of adjustment from short run to long run equilibrium and ECM_{t-1} is the residuals from the estimated cointegration model. The error correction term captures the deviations of GDP growth rate from the long-run

equilibrium and steadily returns the economy back to its long-run growth path (Collier & Goderis, 2012; Young, 2018).

Before we go ahead to determine if there is a cointegration or long-run relationship among the variables, we first investigate the incidence of unit root among the variables using Augmented Dickey–Fuller (ADF) unit root test (Dickey & Fuller, 1981). The unit root test helps to detect the level of stationarity in the model as the ARDL model is not applicable in situations where variables are of order 2 or I (2); ARDL is most applicable in situations where variables are only of orders I (0) and I (1).

4. Results

4.1. Results of summary statistics

The summary results of descriptive statistics are presented in Table 1. The result reveals that the average GDP growth rate (GDPgr) for China, India, and Nigeria is 9.29%, 6.33%, and 4.08%, respectively. This buttresses the assertion that China has a higher GDP growth rate than India and Nigeria. The average population growth rate is highest in India with 5.81% and lowest in China with 0.70% growth. This result is also backed by literature as follows (Bucci et al., 2019; Golley & Tyers, 2010; World Bank, 2012; WDI, 2017; World Population Review, 2021). China has the highest average labor force participation rate of 79.10%, while India has the lowest labor force participation rate of 55.61%. In terms of life expectancy at birth, Chinese people live longer, with an average life expectancy of 74.02 years, while in Nigeria, life expectancy at birth is relatively low at 49.25 years. In terms of human capital, the percentage gross of secondary school enrolment was highest in China with 71.33% and lowest in Nigeria with a record of 35.73%. These assertions are also true with Johnston (2023). Average gross capital formation was highest in China with 41.08% and lowest in Nigeria with 28.03%.

Table 1. Summary results of descriptive statistics

CHINA	GDPgr	GCF	INDSEMP	LABPART	LEXP	POPgr	SCHROL	SSEMPL	TRADEOP
Mean	9.29	41.08	25.60	79.10	74.02	0.70	71.33	33.28	42.42
Median	9.25	42.06	25.99	78.75	74.63	0.61	74.06	32.30	38.96
Maximum	14.23	46.66	30.30	83.80	78.21	1.36	88.17	47.41	64.48
Minimum	2.24	33.57	21.40	73.08	68.17	0.09	38.98	18.90	24.07
INDIA	GDPgr	GCF	INDSEMP	LABPART	LEXP	POPgr	SCHROL	SSEMPL	TRADEOP
Mean	6.33	31.74	19.92	55.61	65.20	5.81	57.84	26.34	36.37
Median	6.65	30.96	19.37	56.47	65.41	5.52	54.88	25.53	39.96
Maximum	8.85	41.95	25.37	59.31	70.91	6.10	77.98	33.24	55.79
Minimum	1.06	22.72	14.92	50.19	59.06	0.80	43.04	21.58	16.98
NIGERIA	GDPgr	GCF	INDSEMP	LABPART	LEXP	POPgr	SCHROL	SSEMPL	TRADEOP
Mean	4.08	28.03	11.48	59.34	49.25	2.60	35.73	44.49	6.33
Median	4.23	27.50	11.46	60.11	49.73	2.57	34.96	44.69	7.02
Maximum	15.33	48.41	12.66	60.51	52.91	2.76	57.03	52.29	53.28
Minimum	–2.04	14.90	10.14	55.24	45.49	2.41	23.55	36.72	16.35

Source: Author's own computations.

4.2. Stationarity test result

Tables 2a, b, and c present the result of the unit root analysis using the Augmented Dickey–Fuller (ADF) test for China, India, and Nigeria. The result reveals that the variables exhibit a mixed order of integration in the three countries. While some of the variables have a unit root at I (0), others were at I (1). Based on this result, we employed the ARDL model, the most suitable cointegration technique in this case, to establish whether there is a long-run relationship among the specified variables.

Table 2a. Result of the Augmented Dickey–Fuller Unit Root Test (China)

Augmented Dickey–Fuller (ADF) test								
Variable	Level				First Difference			
	t statistic	Critical values 5%	P-values	Remarks	t statistic	Critical values 5%	P-values	Remarks
GDPgr	–2.1322	–2.964	0.234	NS	–6.0255	–2.9678	0.000***	I (1)
LABPART	–3.638	–3.595	0.0459**	I (0)	–9.3924	–3.5742	0.000***	I (1)
GCF	–1.6133	–2.9678	0.4632	NS	–3.8856	–3.5742	0.026**	I (1)
POPgr	0.1405	–2.9678	0.9635	NS	–4.6869	–3.9678	0.051**	I (1)
SSEMPL	–3.73	–3.9678	0.047**	I (0)	–2.5757	–2.9677	0.109	NS
INDSEMPL	–1.5376	–2.9678	0.5008	NS	–2.0284	–3.9658	0.037**	I (1)
LEXP	–3.936	–2.9639	0.0052***	I (0)	–4.4778	–2.9678	0.0014***	I (1)
TRADEOP	–1.2213	–3.5683	0.8877	NS	–4.1309	–2.9677	0.0033***	I (1)
SCHROL	–3.8613	–3.081	0.0120***	I (0)	–3.6251	–3.0988	0.019**7	I (1)

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

Table 2b. Result of the Augmented Dickey–Fuller Unit Root Test (India)

Augmented Dickey–Fuller (ADF) test								
Variable	Level				First Difference			
	t statistic	Critical values 5%	P-values	Remarks	t statistic	Critical values 5%	P-values	Remarks
GDPgr	–5.427	–2.964	0.0001***	I (0)	–5.5644	–2.9719	0.0001***	I (1)
LABPART	0.2894	–3.5684	0.7470	**NS**	–4.3445	–2.9678	0.0019***	I (1)
GCF	–1.818	–2.9639	0.3649	NS	–7.7059	–2.9678	0.0000***	I (1)
POPgr	5.8568	–4.981	0.0023***	I (0)	–1.5198	–2.981	0.5080	NS
SSEMPL	–5.3132	–3.622	0.0015***	I (0)	–3.5451	–2.9678	0.0138**	I (1)
INDSEMPL	–0.132	–2.9639	0.9369	NS	–4.8449	–2.9678	0.0005***	I (1)
LEXP	–12.597	–1.9529	0.0000***	I (0)	11.2838	–2.9678	1.0000	NS
TRADEOP	–1.1602	–3.5683	0.9008	NS	–4.6263	–2.9678	0.0009***	I (1)
SCHROL	–1.8393	–3.5683	0.6602	NS	–5.2985	–2.9677	0.0002***	I (1)

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

Table 2c. Result of the Augmented Dickey–Fuller Unit Root Test (Nigeria)

Augmented Dickey–Fuller (ADF) test								
Variable	Level				First Difference			
	t statistic	Critical values 5%	P-values	Remarks	t statistic	Critical values 5%	P-values	Remarks
GDPgr	–2.8742	–2.9639	0.0603	NS	–7.6046	–2.9677	0.0000***	I (1)
LABPART	–3.1236	–3.5742	0.1198	NS	–4.0332	–2.9718	0.0044***	I (1)
GCF	–2.2913	–2.998	0.1828	NS	–4.4918	–3.5742	0.0065***	I (1)
POPgr	–1.9585	–2.9862	0.3019	NS	–4.2727	–2.9862	0.0420**	I (1)
SSEMPL	–3.9533	–2.967	0.0035***	I (0)	–2.0639	–2.9677	0.2598	NS
INDSEMPL	–1.9794	–2.9677	0.2937	NS	–3.1582	–2.9718	0.0336**	I (1)
LEXP	–0.3564	–2.9639	0.9045	NS	–3.2835	–3.5742	0.0021***	I (1)
TRADEOP	–2.6996	–2.9639	0.0859	NS	–5.2857	–3.5806	0.0010***	I (1)
SCHROL	–4.1382	–3.5875**	0.0156**	I (0)	–5.2293	–2.9678	0.0002***	I (1)

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

4.3. Cointegration test result

The result of the bounds test in Table 3 reveals that the variables used for China, India, and Nigeria are cointegrated, as the F statistics of 8.41, 13.59, and 7.36 exceed the upper bound test values at 10%, 5%, 2.5%, and 1%. After confirming the long-run relationship among the variables, we proceed to estimate their long-run and short-run parameters, and the results are presented in Tables 4, 5, 6, 7, 8, and 9.

Table 3. ARDL bounds test result for China, India, and Nigeria

t statistic	Value			I 0 bound values	I 1 bound values	Decision
	China	India	Nigeria			
F-Statistics	8.41	13.59	7.36		8	
Critical Value Bounds				I 0	I 1	
Significance						
10%				1.9	2.9	Co-integration
5%				2.1	3.2	Co-integration
2.5%				2.3	3.4	Co-integration
1%				2.6	3.8	Co-integration

Source: Authors' own computation.

4.4. Long run and short run results for China

Table 4 reveals that population growth and industrial sector employment positively influence economic growth in the long run. However, the labor force participation rate is negative and does not significantly influence economic growth in the long run. In the same vein, results of the short-run estimates in Table 5 reveal that the labor force participation rate has a significant positive relationship with economic growth. However, life expectancy at birth negatively impacts economic growth. The speed of adjustment to long-run equilibrium was negative (–0.9838) and highly significant (0.000), as expected.

Table 4. Long-run estimates for China

Variable	Coefficient	Std. Error	t statistic	Probability
GCF	0.1354	0.216	0.6269	0.5401
INDSEMP	6.6758***	2.1126	3.16	0.0065
LABPART	–0.1005	0.4991	–0.2014	0.8431
LEXP	13.0434***	3.5564	3.6675	0.0023
POPGR	76.7204**	29.17389	2.6298	0.0189
SCHROL	–0.2716	0.3748	–0.7247	0.4797
SSEMPL	–12.588***	3.2015	–3.9319	0.0013
TRADEOP	–0.5866***	0.197	–2.9784	0.0094
C	–724.3119	241.4639	–2.9997	0.009
R-squared	0.960319			
Adjusted R-squared	0.923284			
Log likelihood	–23.05261			
F-statistic	25.92994			
Prob(F-statistic)	0.0000			

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

Table 5. Short-run estimates for China

Variable	Coefficient	Std. Error	t statistic	Probability
D(INDSEMP)	0.0831	0.5798	0.1433	0.8879
D(LABPART)	1.5628***	0.3349	4.6652	0.0003
D(LEXP)	–10.5085***	0.7693	–13.6604	0.0000
D(POPGR)	–3.2749	4.7338	–0.6918	0.4996
D(SSEMPL)	–0.8912	0.7332	–1.215	0.243
CointEq(-1)*	–0.9838	0.0667	–14.7439	0.0000

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

4.5. Long run and short run results for India

Table 6 presents the results of the long run estimates for India. Results reveal that industrial sector employment and service sector employment positively impact economic growth in the long run in India. However, the labor force participation rate was found to have no significant relationship with economic growth only in the long run. Nevertheless, the percentage of gross enrolment in secondary school was found to impact economic growth negatively. Correspondingly, short-run results reveal that labor force participation rate and trade openness positively impact economic growth, whereas life expectancy at birth negatively influences growth.

Table 6. Long-run estimates for India

Variable	Coefficient	Std. Error	t statistic	Probability
D(INDSEMP)	0.0831	0.5798	0.1433	0.8879
D(LABPART)	1.5628***	0.3349	4.6652	0.0003
D(LEXP)	–10.5085***	0.7693	–13.6604	0.0000
D(POPGR)	–3.2749	4.7338	–0.6918	0.4996
D(SSEMPL)	–0.8912	0.7332	–1.215	0.2430
CointEq(-1)*	–0.9838	0.0667	–14.7439	0.0000

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

Table 7. Short-run estimates for India

Variable	Coefficient	Std. Error	t statistic	Probability
D(GCF)	–0.0593	0.0662	–0.8952	0.3848
D(LABPART)	1.2398***	0.2005	6.1838	0.0000
D(LEXP)	–28.2110***	2.575	–10.9556	0.0000
D(SSEMPL)	0.1929	0.1455	1.3259	0.2047
D(TRADEOP)	0.0875***	0.0268	3.2574	0.0053
CointEq(-1)*	–0.9313	0.0802	–11.6027	0.0000

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

4.6. Long run and short run results for Nigeria

Tables 8 and 9 present the long and short-run results for Nigeria. Long-run results reveal that labor force participation rate and life expectancy at birth impact economic growth in the long run at 5% and 1% level of probability, respectively. However, industrial sector employment, service sector employment, and gross capital formation have a negative relationship with economic growth. In the same vein, short-run results reveal that labor force participation and life expectancy at birth had a significant positive relationship with economic growth. Furthermore, 1 unit increase in gross capital formation and industrial sector employment will impact economic growth positively in Nigeria.

Table 8. Long-run estimates for Nigeria

Variable	Coefficient	Std. Error	t statistic	Probability
GCF	–0.7682***	0.1815	–4.2314	0.006
INDSEMP	–7.5449***	1.533	–4.9215	0.003
LABPART	2.7453**	0.8257	3.3246	0.016
LEXP	15.7834***	2.0572	7.6722	0.003
POPGR	–24.3639	13.1	–1.8598	0.112
SCHROL	0.0598	0.1508	0.3966	0.705
SSEMPL	–8.2206***	0.9929	–8.2786	0.004
TRADEOP	0.0497	0.0403	1.2335	0.264
C	–399.1751	73.3529	–5.4418	0.002

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

Table 9. Short-run estimates for Nigeria

Variable	Coefficient	Std. Error	t statistic	Probability
D(GCF)	–0.2090*	0.0992	–2.105	0.0799
D(GCF(-1))	0.7541***	0.0994	7.5811	0.0003
D(INDSEMP)	–11.3165***	2.5023	–4.5223	0.004
D(INDSEMP(-1))	33.1555***	3.7633	8.8102	0.0001
D(LABPART)	4.7159***	0.745	6.3294	0.0007
D(LABPART(-1))	3.0348***	0.8249	3.6786	0.0103
D(LEXP)	14.9583***	1.9016	7.8659	0.0002
D(POPGR)	–139.4474***	14.7434	–9.4582	0.0001
D(POPGR(-1))	–64.0310***	11.9584	–5.3544	0.0017
D(SCHROL)	–0.4557***	0.0875	–5.2044	0.002
D(SCHROL(-1))	–0.7535***	0.08698	–8.6627	0.0001
D(SSEMPL)	–13.2814***	1.56468	–8.4882	0.0001
D(SSEMPL(-1))	–10.6889***	1.34164	–7.967	0.0002
CointEq(-1)*	–2.3595	0.17389	–13.5685	0.0000

*, **, and*** represents 10%, 5%, and 1% level of significance.

Source: Author's own computations.

4.7. Residual diagnostic statistics

The residual diagnostic statistics results in Table 10 show that the variables are not heteroskedastic and that there is no autocorrelation in the error term of the variables. Jaque–Bera's statistics showed normality in the data, and the Cusum sum of squares test showed stability in the data. The results are, therefore, useful for policy implications.

Table 10. Results of residual diagnostic tests

Diagnostic test	Country	F statistics	Probability
Breusch–Godfrey serial correlation test	China	2.82	0.1153
	India	1.78	0.2075
	Nigeria	4.41	0.0974
Heteroskedasticity test	China	1.56	0.2013
	India	0.78	0.668
	Nigeria	1.53	0.8726
Jaque–Bera Statistics	China	2.4	0.3004
	India	1.4	0.4961
	Nigeria	1.55	0.4603
Cusum Sum of squares test	Nigeria	Stable	
	India	Stable	
	China	Stable	

Source: Author's own computations.

5. Discussion of results

The summary results of descriptive statistics show that China has a higher GDP growth rate than India and Nigeria. Despite China's huge population, the economy has been steered to achieve the status of the second-largest economy in the world after the United States due to effective policy reforms (Johnston, 2023). Further findings reveal that India has the highest population growth but the lowest labor participation rate. This result is in support of Padhi and Motkuri's (2021) assertion that the Indian growth in the labor and workforce is declining. They noted that this is due to the demographic transition in India which has resulted in a decelerated population's contribution to growth in the labor force. Though there should have been a greater workforce and labor force participation rate since the year 2000 due to this demographic transition and the resultant bulge in the working-age population, in reality, there has been a decline in the labor force, especially the women's share in the labor force since the 1990s.

There is also a substantial and alarming increase in the unemployment rate. Labor scholars note that the post-reform, high-growth trajectory of the Indian economy has resulted in jobless growth, contrary to what was expected, and studies have observed further job losses (Abraham, 2017).

Population growth has been curtailed in China, unlike situations in Nigeria and India where the population growth is higher and the population is younger. From the regression results, the labor force participation rate was found to have a significant positive relationship with economic growth in the short run in China, India, and Nigeria. Therefore, the null hypothesis of no significant relationship between labor force participation and economic growth is rejected and the alternative accepted. A similar study by Hicks et al. (2010), buttressing this fact, revealed that growth in China and India has been dominated by growth in labor productivity. They asserted that China's stronger labor productivity performance has resulted, until recently, from stronger growth in their capital/labor ratio. Consequently, the growth of China's total factor productivity, driven by a much stronger public investment in education, keeps them ahead of India and the rest of the world.

In this study, specific results for China indicate that an increase in population growth and industrial sector employment will increase economic growth in the long run. In the short run, the labor force participation rate will boost economic growth, while life expectancy at birth will reduce economic growth simply because China's population is aging. Similar assertions by Hicks et al. (2010) and Peng and Mai (2008), while buttressing this point, suggest that the resultant aging population in China and a drop in population growth will lead to a fall in China's labor force.

There is, therefore, the need for a numerical increase in younger able-bodied individuals in China's labor force for the next few decades. It is worthy of note that China has already put in policy reforms with respect to increased procreation and child policy which could be of help in the near future (Johnston, 2023). In a similar study, a divergent opinion by Golley and Wei (2015) revealed that sectoral change in China has made a significant positive contribution to both per capita income growth and aggregate productivity growth, stemming from its positive impact on agricultural productivity growth. However, the negative impact of sectoral change on productivity growth in the industrial and service sectors, combined with the negative impact of the growth of the Working Age Population ratio on both per capita income and aggregate productivity growth,

suggests that the benefits of China's population dynamics during the last three decades have been overstated.

In India, long-run results reveal that the labor force participation rate impacts economic growth positively, while life expectancy at birth influences growth negatively. Consequently, short-run results also reveal that labor force participation rate and trade openness positively impact economic growth whereas life expectancy at birth negatively influences growth. This could be because India's Population is growing without sufficient policy reforms capable of growing the economy in the areas of education, health and investment. India needs urgent policy reforms targeted at the working-age class to benefit from the demographic change in favor of the youth. This move could unleash the Indian economy to an era of unprecedented economic growth as we wait to see if India will obtain the demographic dividend as she takes advantage of the window of opportunity available for positive economic evolution.

In a similar study where Barua (2017) carried out a book review on labor, employment, and economic growth in India. He noted that according to the World Bank assertion, by the end of 2030, India will have the largest working-age population in the world. This "demographic dividend" is expected to raise economic growth. However, such a demographic dividend can only take place if growth is driven by "structural change", i.e., the reallocation of labor from low-productive to high-productive sectors as opposed to the existing policy that is focused on service-driven growth. This is even more crucial when one observes that the share of services in total employment is quite low relative to its share in gross domestic product (GDP) (Ghose, 2017). With this background in mind, there is, therefore, the need for a shift in policy that would rely on labor-intensive manufacturing in the growth process in India (Hasan et al., 2015; Ghose, 2017).

Barua (2017), in a similar opinion, added that based on emerging economic thinking, emphasis should be placed not on increasing employment levels per se but on increasing high-quality, productive employment and improving the productivity of the working poor through skill development efforts. Better still, productivity increases through industrialized economies using automation and robotization processes will bring about the expected giant stride in growth processes.

With respect to the negative nexus between service sector employment and economic growth in India as indicated in long run result in this study, in support of our assertion, Barua (2017) posited that in Asian economies like India and China, openness to trade stimulated growth by motivating growth of manufacturing and not growth of services. He noted that the current Indian economic structure has over-reliance on the service industry with a diminishing role of agriculture and low levels of manufacturing productivity.

In a divergent opinion, Ghose (2017) revealed that India has experienced a situation of "jobless growth" where unprecedented growth in GDP in India in the post-1990 period has not been accompanied by commensurate growth in employment, indicating a weak relationship between employment and growth. She noted that there is an emphasis in the policy debate that jobless growth has been responsible for the disappointing results in the effectiveness of growth in reducing poverty in India.

In Nigeria, the labor force participation rate and life expectancy at birth impact economic growth in the long and short run positively. However, industrial sector employment, service sector employment, and gross capital formation has a negative relationship with economic growth in the long run. Though there are positive effects in the short run. In a similar study, Yakubu et al. (2020) found contrary results, which revealed that the labor force participation rate had a significant negative long-run relationship with economic growth while gross capital formation had positive link with economic growth in Nigeria. According to this study, the negative effect of labor force participation on economic growth can be attributed to the fact that there is a high rate of unemployment in Nigeria, further accompanied by inequality in employment opportunities.

In the short run, school enrolment has significant negative effects on economic growth. The implication of this result is that Nigeria needs sufficient policies in the areas of education, investment and the service sectors. These reforms could help Nigeria take advantage of the bulk of young ones to grow the economy in the near future.

The limitation of the research is that the author fails to examine the influence of automation and robotization in the economic growth of the countries selected. The influence of automation and robotization has been the strength of the growth of some developed economies lacking sufficient human capital in production processes. Another limitation is that issues about an economy's competitive advantage over another are not discussed, and when discussing employment in services, the author did not indicate whether specialist employment or trade employment influences economic growth.

6. Conclusions and recommendations

The main idea of this study is to investigate the nexus between labor force dynamics (proxied by labor participation rate) and economic growth (proxied by real GDP growth rate) in China, India, and Nigeria. The results were obtained using time series data from 1991 to 2021, and the autoregressive distributed lag model (ARDL model), which takes into account short-run and long-run effects of the variables, were applied to the data. Findings from the study support the short-run relationship between labor force participation and economic growth in all the three countries. We then conclude that the labor force participation rate has a direct positive impact on the economic growth of the three countries. However, in China, population growth impacts the economy positively in the long run, while life expectancy at birth negatively impacts the economy in the short run. This is because China's population is aging. Nevertheless, policy reforms are already underway to increase China's population through improved child policy reforms in favor of increased procreation.

In India, industrial and service sectors employment positively impacts the economy in the long run. In the short run, life expectancy at birth influences the economy negatively. This could be because the Indian economy is not growing sufficiently to exploit its youthful population. class group. Though the labor force participation rate has a positive link with economic growth in India, evidence from the literature reveals a situation of jobless growth leading to disappointing results in the effectiveness of growth. There is, therefore, a need for policy reforms in the areas of education and health especially for the working. To match China, India must increase education and workforce participation.

Furthermore, though labor force participation impacts the Nigerian economy positively both in the long run and short run, the industrial sector and service sector employment impacts the economy negatively in the long run. However, in the short run, industrial sector employment, service sector employment, gross capital formation, and life expectancy influence the economy positively. The implication of this result is that Nigeria needs sufficient policies in the areas of education, investment and the service sectors. The Nigerian government also needs to implement a wide range of employment-generating policies aimed at fostering an increased real GDP growth rate. These reforms could help Nigeria take advantage of the bulk of young ones capable of growing the economy in the near future.

The limitation of the research is that the author fails to examine the influence of automation and robotization on the economic growth of the countries selected. The influence of automation and robotization has been the strength of the growth of some developed economies lacking sufficient human capital in production processes. Another limitation is that issues about an economy's competitive advantage over another are not discussed, and when discussing employment in services, the author did not indicate whether specialist employment or trade employment influences economic growth. The findings from this research are useful for policy analysts, academics, researchers, and economists.

The issue of robotization and automation of production processes is a research limitation and a gap for further research in the selected countries. Issues of comparative advantage of the selected economies (China, India, and Nigeria) are also another limitation for further research. Finally, the influence of trade or specialist services on economic growth will be considered an issue for further research. It is important to note here that the study's findings are unique to developing economies that are not yet sufficiently industrialized with automation and robotization mechanics in place to replace human capital in production processes.

Disclosure statement

No potential conflict of interest was reported by the authors.

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