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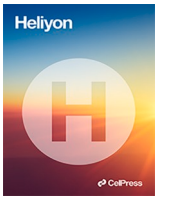

Transformative role of educational funding in shaping national development across SAARC countries in the 21st century: A panel NARDL approach

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ABSTRACT

Since the beginning of this century, there has been evidence of a rise in educational funding among the South Asian Association for Regional Cooperation (SAARC). However, there has been a decline in recent years despite South Asia being a highly populated and poverty-ridden region. Thus, the present study comes to assess how well the countries are doing in relation to the effect of educational funding on national development indicators, namely economic growth, human capital development, and the unemployment rate among the SAARC countries in the 21st century using Panel Nonlinear Autoregressive Distributed Lag (PNARDL) model formulated in Salisu and Isah (2017). The findings revealed that the impact of educational funding on economic growth and the unemployment rate is an asymmetry in the long run and symmetry in the short run but on the human development index, it is an asymmetry in both terms. However, educational funding is influencing economic growth in the long run, but in the short run is not. Furthermore, educational funding influences human capital development in both terms, but in the long run is negligible. Moreover, educational funding is negligibly discouraging the unemployment rate in both terms.

1. Introduction

Education is widely recognized as a key driver of economic and social development, as it plays a critical role in equipping individuals with the skills, knowledge, and capabilities needed to succeed in the workforce and society [1,2]. Therefore, adequate funding of education is essential to ensure that all individuals have access to quality education and to support the development of a strong and productive workforce [3,4]. However, for emerging countries like the South Asian Association for Regional Cooperation (SAARC), education could momentously impact their national development, including economic growth, human capital development, and unemployment rate. The SAARC was founded in 1985 to increase cooperation amongst South Asian countries where the members are seven South Asian countries, including Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka as shown in Fig. 1.

The SAARC member countries are all post-colonial developing countries, and this geopolitical organization was seen as ushering in

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a new era of collective growth through economic cooperation and regional integration. However, poverty, energy, and terrorism are just a few issues affecting the member states. All SAARC countries share an identical higher education structure in terms of entry standards, age, course duration, and instructional management system. Youth have a significant desire for international qualifications and have a pressing demand for higher education. In this field, opportunities are limited, with gross enrolment ratios ranging from less than 5%–10% in SAARC nations. The educational system is of poor quality. Education spending ranges from 112% to 4% of GNP, less than the UNESCO target of 6% for underdeveloped countries. The private company's involvement, a relatively new phenomenon, is limited to market-oriented, professional, and technical education [5].

Educational funding in South Asian Association for Regional Cooperation (SAARC) countries has significant implications. It is worth noting that countries such as Pakistan face educational challenges that highlight the importance of prioritizing and investing in education to improve the overall development and well-being of its population. Conversely, the Maldives has achieved exceptional literacy rates of over 100% and a high enrollment rate in primary schools. Bhutan's adult literacy rate is just 67%, and the country has one of the highest numbers of primary school children who are not attending school, despite allocating around a quarter of government expenditure on education. Nepal has achieved favorable primary education outcomes due to its focus on primary education, with more than half its education budget spent on it. However, according to several education indicators, in India, Pakistan, Sri Lanka, and Bangladesh, government spending on education is less than 4% of their respective GDPs. Sri Lanka spends the least in the region but has some of the best achievements, particularly in literacy and school attendance, as well as meager rates of out-of-school children. Bangladesh, for example, has the lowest educational investment in the region while having greater literacy and school enrollment rates than the regional average. India spends nearly the same amount on education as the rest of the region. Nevertheless, there is still much opportunity to improve primary education results, especially given many out-of-school children in lower secondary school. Pakistan's condition is particularly concerning: school enrollment, and literacy rates are both exceedingly low. Approximately a quarter of Pakistan's children are not enrolled in school. Pakistan is home to over half of South Asia's over 20 million primary and lower secondary school-aged out-of-school children [6].

In this century, when looking at the trend of educational funding in the SAARC countries, there is evidence of a rise in educational funding as shown in Fig. 2. However, there is declining in recent years despite South Asia being a highly populated and poverty-ridden region of the world [7].

Fig. 2 depicts the total government funding for education in SAARC Countries as a % of GDP from 2000 to 2018. According to the figure, though the funding fluctuates throughout, there is a considerable rise in the funding over the periods except recently in 2018. In 2000, 2004, 2008, 2012, and 2016, the funding rose from 2.555012% to 2.55604%, 2.74623%, 2.84188%, and 2.95291%, respectively, but there is a fall in 2018 to 2.1119%, according to the World Bank collection of development indicators. The lowest funding happened in 2018, while the highest was in 2017.

Therefore, considering the substantial spending on education, does educational funding significantly affect the economic growth of SAARC countries in the 21st century? To what extent has educational funding contributed to human capital development in SAARC countries during this period? Is educational financing helping SAARC countries reduce the unemployment rate in the 21st century? Based on existing studies, the gaps and contributions of this study, as well as its novelty and originality, can be deduced. It is evident that while several studies have examined the impact of educational funding on economic growth, there is a scarcity of empirical research specific to the SAARC countries, especially in relation to national development encompassing economic growth, human capital development, and the unemployment rate. Furthermore, an essential contribution of this study lies in its focus on the specific context of the SAARC countries. While previous research has explored the relationship between educational funding and economic

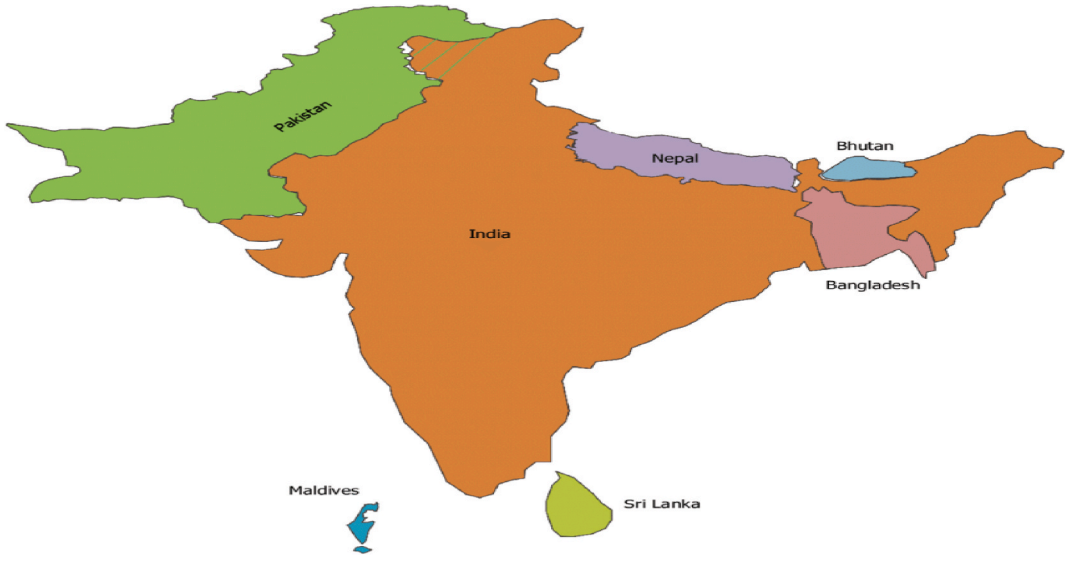

Fig. 1. Map of the South Asian Association for Regional Cooperation (SAARC) Countries, *by thailandtvnews*.

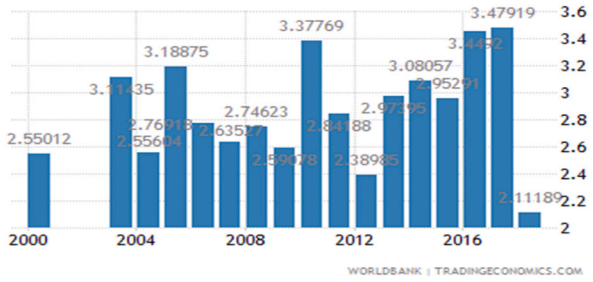

Fig. 2. SAARC countries – educational funding, total (% of GDP).

development in various regions, this study fills a crucial gap by examining this relationship specifically within the SAARC countries. By considering the unique characteristics, challenges, and opportunities of these countries, the findings of this study can provide valuable insights and policy recommendations tailored to the SAARC context. This localized approach enhances the relevance and applicability of the study's findings, making it a significant contribution to the literature on education, economic growth, and human capital development in SAARC countries. Moreover, this study is one of the few that investigates such relationships within the SAARC countries, specifically focusing on the 21st century. This time frame is particularly significant due to the numerous adjustments and improvements made in the educational sector, which are crucial for societal development. The study by Hussaini [8] demonstrated a positive long-term correlation between higher education and economic growth in South Asian countries. Consequently, it becomes imperative to explore whether the allocation of educational funding impacts the development of these nations. Besides, this study adopts the application of the Panel Nonlinear Autoregressive Distributed Lag (PNARDL) model to investigate these relationships as formulated by Salisu [9]. This modeling approach is novel in addressing the research objectives and offers several advantages over other techniques. It accounts for inherent heterogeneity among panels, provides more accurate results for small sample datasets like ours, and is suitable when the stochastic order of integration of variables comprises a mixture of I (0) and I (1) or purely I (0) or I (1) [10,11]. Additionally, it allows for both linear and nonlinear composition of variables, enabling the capture of potential asymmetries in the relationship. Therefore, the study comes to its broad objective to investigate the effect of educational funding on the national development of the SAARC countries in the 21st century. However, the specific objectives are:

i. To assess the effect of educational funding on the economic growth of SAARC countries in the 21st century;
ii. To ascertain the effect of educational funding on the human development of SAARC countries in the 21st century;
iii. To examine the effect of educational funding on reducing the unemployment rate of SAARC countries in the 21st century.

The remaining sections of this study is organized as follows: Section 2 includes a literature review covering both theoretical and empirical reviews; Section 3 explains the methodology, encompassing data source, and estimation techniques; Section 4 present the results; Section 5 present the discussion of the results; and the final Section 6 offers conclusion and policy recommendation.

2. Literature review

Lichman [12] and Markovitz [13] as a society that has succeeded in providing a means of subsistence for the majority of its citizens characterize national development. Human development, employment opportunities, food, housing, and clothing are prioritized in such a society. In this study, the concept of national development is proxied by economic growth, the human development index, and the unemployment rate. This aligns with the modernization paradigm's definition of development, which sees development as a multifaceted process that continually elevates the entire society and social system towards better human living, as defined by Todaro and Smith [14] and Chikalipah and Okafor [15]. Education is considered a driving force for long-term transformation and progress. It provides the necessary workforce for national growth, as noted by Afolabi and Loto [16]. An educated society has sufficient workers, each contributing to the community's growth. Education prepares individuals to become valuable members of society and meet national progress needs. Engineers, teachers, and medical doctors, for example, are all educated individuals [17]. Therefore, without education, a nation cannot obtain the necessary human resources for material growth and citizen enlightenment. However, it is argued that education should not be entirely in the hands of private firms, as this would raise the cost beyond the reach of ordinary people, even while private participation is welcomed. Adam Smith's theory supports this that one of the three government roles in an economy is public development work [18], termed government expenditure. Government expenditure can be productive or unproductive, with productive government expenditures such as health and education financing leading to economic growth, while unproductive expenditures include consumption expenditures and expenditures on white elephant projects that do not contribute to the economy's productive capacity, according to Barrow [19]. It further stated that increasing productive public spending on sectors such as education leads to economic growth, human capital development, and poverty reduction. Therefore, educational funding promotes economic growth, human development, and a reduction in unemployment. Specifically, education funding will assist the country in achieving appropriate or sustainable economic growth [20–27]. That is because every human being is a resource for society, and spends on training human beings to gain various skills and knowledge, which positively influences national development.

Educational funding plays a pivotal role in driving economic growth. Increased investment in education leads to the development

of a skilled workforce, higher tax contributions, reduced government expenditure, and a more inclusive economy. In addition, targeted funding for disadvantaged students and districts can help bridge educational gaps and promote economic equality. Policymakers must recognize the long-term benefits of educational funding and prioritize it as a key driver of economic growth and societal progress [28]. Furthermore, educational funding plays a critical role in developing human capital, which is essential for economic growth and societal progress. Adequate investment in education enhances learning opportunities, reduces educational disparities, promotes teacher development, prepares individuals for the workforce, and fosters economic growth and innovation. Recognizing the importance of educational funding as a driver of human capital development is crucial for policymakers and stakeholders to ensure that every individual has access to quality education, ultimately benefiting the economy and society [29]. Moreover, educational funding is vital in reducing unemployment rates and driving economic growth. Governments and societies can bridge the gaps between socioeconomic groups, ensure equal opportunities for all students, and foster social mobility by investing in quality education. Adequate funding benefits individuals by preparing them for the workforce and contributes to increased productivity, efficiency, and competitiveness, leading to economic advancement [30]. By recognizing the impact of educational funding on unemployment, societies can prioritize and allocate resources to create a skilled and employable workforce, benefiting both individuals and the economy as a whole.

However, numerous empirical studies are available on the impact of education financing on economic growth, human capital development, literacy, and poverty reduction worldwide. While some studies have concluded that education spending positively impacts these development factors, others have argued against it. For instance, Riasat [31] used an unrestricted error-correction model to analyze the impact of educational spending on economic growth in Pakistan between 1972 and 2010, which showed a significant positive impact of education expenditure on economic growth. Maitra and Mukhopadhyay [32] used an unrestricted vector autoregressive model to investigate the relationship between public education investment and economic growth in several Asia-Pacific countries from 1981 to 2011. They found that education spending positively impacted GDP in Bangladesh, Fiji, Kiribati, Maldives, Nepal, Singapore, Sri Lanka, Tonga, and Vanuatu. However, education spending did not significantly affect the GDP of Malaysia and South Korea. Idrees and Siddiqi [33] used the Panel Fully Modified Ordinary Least Square (PFMOLS) model to study the impact of education spending on economic development in developed and developing countries from 1990 to 2006. The findings showed that education expenditure has a greater impact on economic growth in developing countries than in developed ones, indicating a catching-up effect in developing countries. Abdylmenaf and Besime [34] studied the relationship between public education expenditure and economic growth in Macedonia from 2005 to 2015 using OLS regression analysis, and found a negative correlation between education spending and economic growth. Although this finding is peculiar, it could be due to corruption and sabotage in the sector increasing with higher funding or reaching a point of diminishing returns regarding the sector's size. Karaçor et al. [35] used one-way and two-way Fixed Effects (FE) models to analyze the connection between education spending and economic development in OECD countries from 1998 to 2012 and discovered that increasing individual achievement through higher education results in economic growth. Hanif and Arshed [36] examined the relationship between education and economic growth in SAARC countries from 1960 to 2013 using Pooled Ordinary Least Squares (POLS) and Fixed Effect (FE) models. They found that education has an economic impact, with higher education enrollment having the greatest effect compared to basic and secondary education enrollment. Mallick et al. [37] used the Fully Modified Ordinary Least Square (FMOLS) model to study the impact of educational spending on economic growth in major Asian countries from 1973 to 2012. The study showed that educational spending promotes economic growth, and the education sector is a significant driver of growth in all 14 major Asian nations. Appiah [38] used the GMM estimator system to investigate the effect of education spending on per capita GDP in developing countries from 1975 to 2015. The results showed that increasing education spending in developing countries positively affects per capita GDP, which is similar to the findings in Sub-Saharan African countries. Tabar et al. [39] utilized the Autoregressive Distributed Lag (ARDL) model to study the relationship between educational expenditure and economic growth in Iran from 1981 to 2012. They concluded that education spending had an impact on real GDP. Trabelsi [40] employed the Hansen [74,75] threshold model to analyze the quality education threshold effect on the relationship between education spending and economic development in 50 countries from 1980 to 2010. The results indicated that education spending has a positive impact on growth when the quality of education is higher, while it has a negative impact when the quality of education is lower. Using the Johansen cointegration test and the Vector Error Correction Model, Nuhu and Ali [41] examined the impact of educational funding on national development in Nigeria from 1986 to 2015. The findings showed that education financing did not stimulate economic growth, which could be due to corruption, excessive theft, and diversion of public funds. However, human capital development is essential for progress. Amaghionyeodiwe [42] studied the effect of education spending on economic growth in West African countries from 1990 to 2016 using the Vector Error Correction Model (VECM). The results revealed that government educational spending positively impacted economic growth because it influenced human capital. Hussaini [8] examined the relationship between higher education and economic growth in South Asian countries from 1960 to 2016 using the Johansen cointegration test. The study found a positive long-term correlation between higher education enrollment and economic growth in South Asian countries. Shafuda and De [44] used a Vector Autoregressive (VAR) model to investigate government investment in human capital and growth in Namibia from 1980 to 2015. The findings revealed that education spending positively impacts GDP growth as it improves human resources. Bukhari et al. [7] analyzed whether education can reduce poverty in SAARC countries from 1983 to 2016 using the Fully Modified Ordinary Least Square (FMOLS) model. The study found that primary enrollment increases poverty, while an increase in secondary enrollment initially raises poverty but eventually decreases it. An increase in university enrollment initially reduces poverty, but poverty eventually increases. Can et al. [44] examine whether renewable energy consumption and green trade openness matter for human well-being for 25 European Union (EU) member states from 2003 to 2016. The findings demonstrated that green trade openness increases human well-being in all quantiles (0.1–0.90), while renewable energy consumption significantly and positively affects human well-being across quantiles (0.1–0.90). Yürük and Acarolu [45] studied the relationship between education investment and economic growth in Turkey from 1980 to 2015 using the NARDL (Nonlinear Autoregressive Distributed Lag) model. The

results showed that positive education spending shocks have favorable consequences on economic growth in both the short and long term. However, negative shocks have negative results, primarily in the short term. The study concluded that education has a positive externality. Sebki [46] used dynamic panel data estimators to examine the impact of education on economic growth in 40 developing countries from 2002 to 2016. The study found that the proportion of students enrolled in tertiary education had a significant positive effect on economic growth, while the proportion of students enrolled in secondary education had a significant negative impact on economic growth. Meanwhile, Qi et al. [47] investigated the link between the academic growth of college students in Chinese higher education and various mixed financial aid programs. The study used a logistic regression model on data collected from a questionnaire survey given to students at 11 colleges and universities. The findings suggested that receiving National Scholarships, National Encouragement Scholarships, and National Student Loans had a significant and positive correlation with receiving excellent grades, whereas receiving National Grants and work-study positions had a significant and negative correlation with receiving excellent grades. Ziberi et al. [48] conducted an empirical analysis of the impact of education on economic growth in North Macedonia and found that a one-point increase in public expenditures on education will positively affect economic growth in North Macedonia.

Going from the literature review, it is evident that while several studies have examined the impact of educational funding or related variables on economic growth, there is a scarcity of empirical research specific to the SAARC countries, especially in relation to national development encompassing economic growth, human capital development, and the unemployment rate.

Table 1 provides a comprehensive overview of studies that have examined the relationship between education spending and economic development. It includes details such as the authors' names, the year of publication, the countries or regions studied, the period covered in the analysis, the methodology used, and the main outcomes of each study.

3. Methodology

3.1. Data source

This study utilizes panel data from SAARC countries: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The study examines various variables, including national development indicators such as GDP growth rate (GDP), human development index (HDI), and unemployment rate (UNEMP), which serve as dependent variables. Additionally, the study analyzes the total government expenditure on education as a percentage of total government expenditure (EDU) as the independent variable. However, agriculture (AGR) (percentage of GDP and industry (IND) (percentage of GDP) were included as control variables among the independent variables. These variables were chosen as control variables because education exposes the farmer's mind to knowledge, nonformal education provides hands-on instruction and better farming methods, and informal education keeps the farmer updated with changing conditions. At the same time, collaboration and partnership agreements with the industry can benefit higher education institutions. When industry and higher education institutions collaborate to achieve new knowledge heights, they constitute a potent engine for innovation and economic progress. Nevertheless, the data ranged from the beginning of the twenty-first century, i.e., 2000, to 2019, the most recent period for which such statistics are available for most countries studied. Furthermore, except for HDI, all series were acquired from the World Bank Development Indicators [49] statistical bulletin, while HDI was sourced from United Nations Development Programme [50]. Moreover, all of the series are in rates, so there is no need to take their log, and they are to be interpreted in rates, except HDI, which will be interpreted in an index.

3.2. Estimation techniques

The estimating procedures will begin with a graphical data analysis to comprehend the trend. Descriptive statistics are then used to describe the statistical properties of the data. The multicollinearity test is then performed using a correlation matrix. The Pesaran [51] Cross-section Dependence (CD) test in panels follows, which is the most often used test. The Pesaran [52] Cross-sectional augmented I'm, Pesaran, and Shin (CIPS) panel unit root test will be used for those panels where there is evidence of cross-sectional dependence; however, for those panels where there is no evidence of cross-sectional dependence, panel unit root tests such as Levin et al. [53], henceforth, LLC and Im et al. [54], henceforth, IPS based on traditional augmented Dickey-Fuller (ADF) test will be used. These tests were chosen because the former allows for heterogeneity in intercepts across panel members under the null hypothesis of the lack of a unit root, while the latter allows for heterogeneity in intercepts as well as slope coefficients [55]. As a result, where the two tests yielded inconsistent results, the latter will be used. Furthermore, the unit root tests were used to examine the order of integration of the series before model estimation to ensure that none of the variables are I (2) because ARDL model classes are not acceptable. The cointegration test comes after the unit root tests. Though Pedroni [56,57] proposes cointegration tests that allow for heterogeneous intercepts and trend coefficients across cross-sections, making it superior to others such as Kao [58], cointegration test, because the study has panels with cross-sectional dependence, Westerlund [59] panel cointegration tests will be preferred; additionally, it does not require prior knowledge of the order of integration of variables [60]. Subsequent is the execution of the Hausman test to determine which estimator should be used for the model estimation among the three prominent techniques used in the estimation of a dynamic heterogeneous panel data model, such as the Pooled Mean Group (PMG) estimator, the Mean Group (MG) estimator, and the Dynamic Fixed Effect (DFE) estimator where the PMG estimator is based on a combination of pooling and averaging. In contrast, the MG estimator is based on averaging the coefficients of N time-series regressions [61], whereas the DFE estimator is based on that the slopes are fixed. The intercepts are allowed to vary across countries. Moreover, it is the conduct of the asymmetry test to know the nature of the composition of each variable, whether it is linear or nonlinear, and thus, to know how the variable will enter the model. The last thing is the estimation of the Panel Nonlinear Autoregressive Distributed Lag (PNARDL) model formulated by Salisu and Isah [9] and

Table 1
Summary of studies on education spending and economic development.

Author & Year	Country	Period	Methodology	Outcomes
Riasat [31]	Pakistan	1972–2010	Unrestricted ECM	The significant positive impact of education expenditure on economic growth in Pakistan between 1972 and 2010.
Maitra and Mukhopadhyay [32]	Asia-pacific countries	1981–2011	Unrestricted VAR model	Education spending positively impacted GDP in multiple Asia-Pacific countries.
Idrees and Siddiqi [33]	Developed and developing countries	1990–2006	Fully Modified OLS model	Education expenditure has a greater impact on economic growth in developing countries compared to developed ones.
Abdylmenaf and Besime [34]	Macedonia	2005–2015	OLS regression analysis	Negative correlation between education spending and economic growth in Macedonia.
Karaçor et al. [35]	OECD countries	1998–2012	One-way and two-way Fixed Effects model	Increasing individual achievement through higher education results in economic growth.
Hanif and Arshed [36]	SAARC countries	1960–2013	Pooled OLS and Fixed Effect model	Education has an economic impact, with higher education enrollment having the greatest effect.
Mallick et al. [37],	Asian countries	1973–2012	Fully Modified OLS model	Educational spending promotes economic growth in major Asian countries.
Appiah [38]	Developing countries	1975–2015	System GMM estimator	Increasing education spending in developing countries has a positive effect on per capita GDP.
Tabar et al. [39]	Iran	1981–2012	ARDL model	Education spending had an impact on real GDP in Iran.
Trabelsi [40]	50 countries	1980–2010	Hansen threshold model	Education spending has a positive impact on growth with higher quality of education, but a negative impact with lower quality of education.
Nuhu and Ali [41]	Nigeria	1986–2015	Johansen cointegration test and VEC Model	Education financing did not stimulate economic growth in Nigeria.
Amaghionyeodiwe [42]	West African countries	1990–2016	VEC Model	Government educational spending had a positive impact on economic growth in West African countries.
Hussaini [8]	South Asian countries	1960–2016	Johansen cointegration test	Positive long-term correlation between higher education enrollment and economic growth in South Asian countries.
Shafuda and De [43]	Namibia	1980–2015	VAR model	Education spending has a positive impact on GDP growth as it improves human resources.
Bukhari et al. [7]	SAARC countries	1983–2016	Fully Modified OLS model	Impact of education level on poverty varies depending on the level (primary, secondary, university).
Sebki [46]	40 developing countries	2002–2016	Dynamic panel data estimators	Proportion of students enrolled in tertiary education positively affects economic growth, while secondary education negatively affects growth.
Yürük and Acarolu [45]	Turkey	1980–2015	Nonlinear ARDL model	Positive education spending shocks have favorable consequences on economic growth.

Note: ECM: Error-correction model; VAR: Vector autoregressive model; OLS: Ordinary Least Square; ARDL: Autoregressive Distributed Lag model; GMM: Generalized Method of Moments; VAR: Vector Autoregressive model; OECD: Organization for Economic Cooperation and Development; SAARC: South Asian Association for Regional Cooperation.

the post-estimation tests of the model for checking its statistical healthiness.

The study uses the panel nonlinear ARDL model over panel linear ARDL model because it can allow the estimations of the relationship whether the composition of a variable is linear or nonlinear since the model's estimation procedure accepts such. Hence, it can serve the panel linear ARDL model function while simultaneously capturing any possible asymmetric effect.[1] The selection of the Autoregressive Distributed Lag (ARDL) framework over other traditional panel estimators in this study is justified for several reasons. Firstly, the ARDL framework can accommodate the inherent heterogeneity among panels, which is crucial when dealing with diverse data sets. This allows for more accurate and reliable estimation of the model parameters. Secondly, the ARDL framework is particularly suitable for small sample sizes, which is applicable to this study. Traditional panel estimators may suffer from limited power and efficiency when working with small samples, whereas ARDL can provide more robust results even with a limited number of observations. Furthermore, the ARDL framework can handle different stochastic orders of integration among the variables. Whether the variables have a mixture of integrated of order 0 (I (0)) and order 1 (I (1)), or purely I (0) or purely I (1), the ARDL framework can effectively capture and model these dynamics. This flexibility is advantageous in capturing the complexities of real-world data. These reasons, supported by studies by Galadima and Aminu [10] and Rasool et al. [11] demonstrate the appropriateness of employing the ARDL framework in this study to achieve accurate and reliable results given the specific characteristics of the data set.

Being the independent variables are educational funding (*EDU*), agriculture (*AGR*), and industry (*IND*), and the dependent variable is national development which was designed to be measured by three variables according to the objectives of the study, i.e., economic growth (*GDP*), human development index (*HDI*), and unemployment rate (*UNEMP*); the models will be specified based on each of the dependent variables.

[1] Asymmetric effect between one variable (x) and another (y) means an increase and decrease of x has unequal impact on y, while symmetric effect means an increase and decrease of x has equal impact on y. Therefore, asymmetric effect means nonlinear effect while symmetric effect means linear effect.

The Panel Nonlinear Autoregressive Distributed Lag (PNARDL) model assumed an asymmetric, thus, specifying a nonlinear relationship between the dependent and independent variables. Following Salisu and Isah [9] and Galadima and Aminu [10], the PARDL model specified in equations (1)–(3) as follows:

$$\Delta GDGGR_{it}=\theta_{0i}+\theta_{1i}GDPGR_{i,t-1}+\theta_{2i}^{+}EDU_{t-1}^{+}+\theta_{2i}^{-}EDU_{t-1}^{-}+\theta_{3i}^{+}AGR_{t-1}^{+}+\theta_{3i}^{-}AGR_{t-1}^{-}$$
$$+\theta_{4i}^{+}IND_{t-1}^{+}+\theta_{4i}^{-}IND_{t-1}^{-}+\sum_{j=1}^{p}\pi_{1ij}\Delta GDPGR_{i,t-j}+\sum_{j=0}^{q}\left(\pi_{2ij}^{+}\Delta EDU_{t-j}^{+}+\pi_{2ij}^{-}\Delta EDU_{t-j}^{-}+\pi_{3ij}^{+}\Delta AGR_{t-j}^{+}+\pi_{3ij}^{-}\Delta AGR_{t-j}^{-}+\pi_{4ij}^{+}\Delta IND_{t-j}^{+}+\pi_{4ij}^{-}\Delta IND_{t-j}^{-}\right)+\varepsilon_{it} \quad (1)$$

$$\Delta HDI_{it}=\theta_{0i}+\theta_{1i}HDI_{i,t-1}+\theta_{2i}^{+}EDU_{t-1}^{+}+\theta_{2i}^{-}EDU_{t-1}^{-}+\theta_{3i}^{+}AGR_{t-1}^{+}+\theta_{3i}^{-}AGR_{t-1}^{-}$$
$$+\theta_{4i}^{+}IND_{t-1}^{+}+\theta_{4i}^{-}IND_{t-1}^{-}+\sum_{j=1}^{p}\pi_{1ij}\Delta HDI_{i,t-j}+\sum_{j=0}^{q}\left(\pi_{2ij}^{+}\Delta EDU_{t-j}^{+}+\pi_{2ij}^{-}\Delta EDU_{t-j}^{-}+\pi_{3ij}^{+}\Delta AGR_{t-j}^{+}+\pi_{3ij}^{-}\Delta AGR_{t-j}^{-}+\pi_{4ij}^{+}\Delta IND_{t-j}^{+}+\pi_{4ij}^{-}\Delta IND_{t-j}^{-}\right)+\varepsilon_{it} \quad (2)$$

$$\Delta UNEMP_{it}=\theta_{0i}+\theta_{1i}UNEMP_{i,t-1}+\theta_{2i}^{+}EDU_{t-1}^{+}+\theta_{2i}^{-}EDU_{t-1}^{-}+\theta_{3i}^{+}AGR_{t-1}^{+}+\theta_{3i}^{-}AGR_{t-1}^{-}$$
$$+\theta_{4i}^{+}IND_{t-1}^{+}+\theta_{4i}^{-}IND_{t-1}^{-}+\sum_{j=1}^{p}\pi_{1ij}\Delta UNEMP_{i,t-j}+\sum_{j=0}^{q}\left(\pi_{2ij}^{+}\Delta EDU_{t-j}^{+}+\pi_{2ij}^{-}\Delta EDU_{t-j}^{-}+\pi_{3ij}^{+}\Delta AGR_{t-j}^{+}+\pi_{3ij}^{-}\Delta AGR_{t-j}^{-}+\pi_{4ij}^{+}\Delta IND_{t-j}^{+}+\pi_{4ij}^{-}\Delta IND_{t-j}^{-}\right)+\varepsilon_{it} \quad (3)$$

where EDU^{+}, EDU^{-}, AGR^{+}, AGR^{-}, IND^{+}, and IND^{-} denote the positive (+) and negative (−) changes of the variables respectively. However, the long-run coefficients for the positive and negative charges are calculated as $-\frac{\theta_{2i}}{\theta_{1i}}$, $-\frac{\theta_{3i}}{\theta_{1i}}$, and $-\frac{\theta_{4i}}{\theta_{1i}}$. So, the short-run estimate obtained as π_2^{+}, π_2^{-}, π_3^{+}, π_3^{-}, π_4^{+}, and π_4^{-}. The error correction mechanism versions of equations (1)–(3) yield equations (4)–(6):

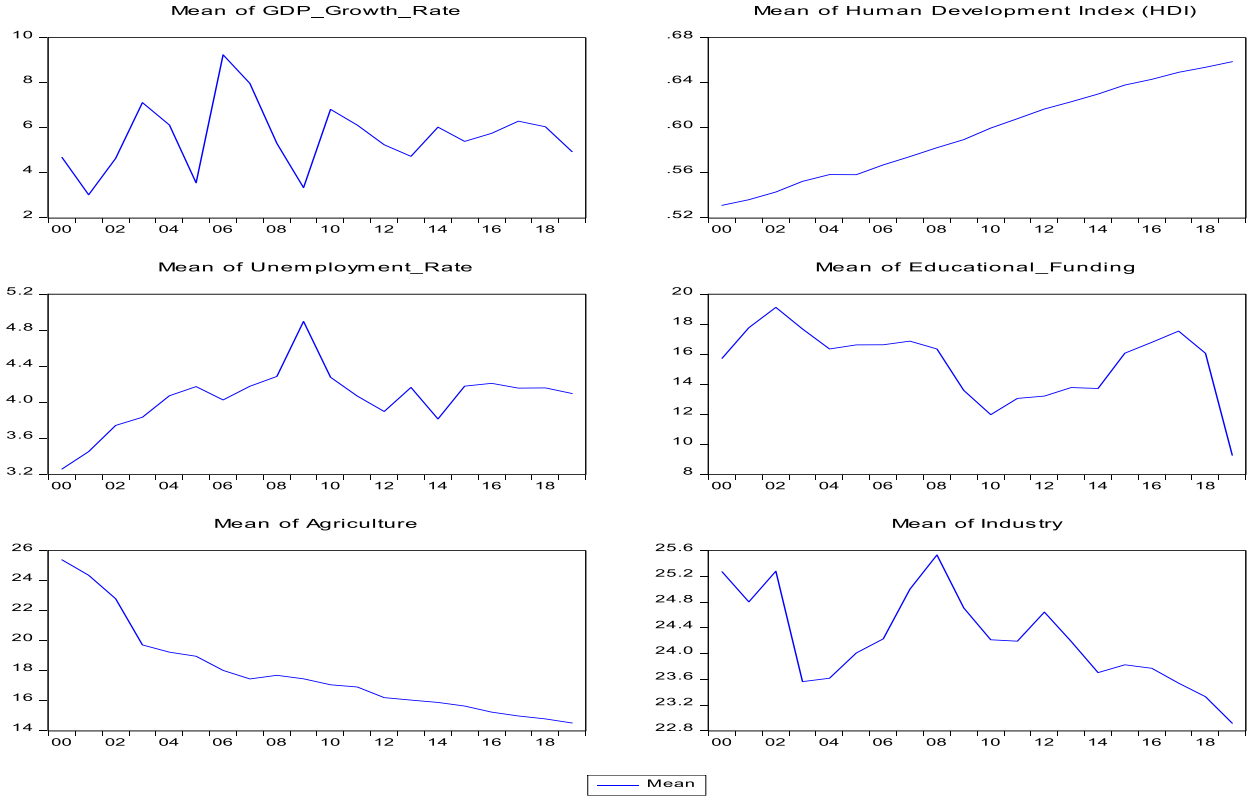

Fig. 3. Panel graphical representation of economic growth, human development index, unemployment rate, educational funding, agriculture, and industry are shown.

$$\Delta GDGGR_{it} = \delta_i ECT_{i,t-1} + \sum_{j=1}^{p} \pi_{1ij} \Delta GDPGR_{i,t-j} + \sum_{j=0}^{q} \left(\pi^{+}_{2ij} \Delta EDU^{+}_{t-j} + \pi^{-}_{2ij} \Delta EDU^{-}_{t-j} + \pi^{+}_{3ij} \Delta AGR^{+}_{t-j} + \pi^{-}_{3ij} \Delta AGR^{-}_{t-j} + \pi^{+}_{4ij} \Delta IND^{+}_{t-j} + \pi^{-}_{4ij} \Delta IND^{-}_{t-j} \right) + \varepsilon_{it} \quad (4)$$

$$\Delta HDI_{it} = \delta_i ECT_{i,t-1} + \sum_{j=1}^{p} \pi_{1ij} \Delta HDI_{i,t-j} + \sum_{j=0}^{q} \left(\pi^{+}_{2ij} \Delta EDU^{+}_{t-j} + \pi^{-}_{2ij} \Delta EDU^{-}_{t-j} + \pi^{+}_{3ij} \Delta AGR^{+}_{t-j} + \pi^{-}_{3ij} \Delta AGR^{-}_{t-j} + \pi^{+}_{4ij} \Delta IND^{+}_{t-j} + \pi^{-}_{4ij} \Delta IND^{-}_{t-j} \right) + \varepsilon_{it} \quad (5)$$

$$\Delta UNEMP_{it} = \delta_i ECT_{i,t-1} + \sum_{j=1}^{p} \pi_{1ij} \Delta UNEMP_{i,t-j} + \sum_{j=0}^{q} \left(\pi^{+}_{2ij} \Delta EDU^{+}_{t-j} + \pi^{-}_{2ij} \Delta EDU^{-}_{t-j} + \pi^{+}_{3ij} \Delta AGR^{+}_{t-j} + \pi^{-}_{3ij} \Delta AGR_{t-j} + {}^{-} + \pi^{+}_{4ij} \Delta IND^{+}_{t-j} + \pi^{-}_{4ij} \Delta IND^{-}_{t-j} \right) + \varepsilon_{it} \quad (6)$$

where *ECT* is the error correction term that stands for the long-run equilibrium in the PNARDL δ as its associated coefficient measures the speed of adjustment of the model, i.e., how long it takes the model to converge to its long-run equilibrium in the event of a shock.

4. Results

The analysis started with a graphical representation of the trends in GDP growth rate, human development index, unemployment rate, educational funding, agriculture, and industry for the countries in the sample, as presented in Fig. 3. Following the figure, the economic growth rate of the countries fluctuated high with a dangling trend and is relatively the same, but in recent years, the rate has been declining. The human development index shows an upward trend throughout the time horizon, and it is at increased even in recent years. The unemployment rate somehow behaves relatively the same way as the economic growth rate, and in recent years, the trend has shown a declining trend. Educational funding fluctuates moderately, with a declining trend in recent years. The agriculture as a share of economic growth displays a downward-sloped trend and is at decline even in the recent years. Finally, industry as a share of economic growth fluctuated with a declining trend in recent years.

Table 2 displays the analysis of the statistical characteristics of the variables under the study. From the table, the mean and standard deviation of *GDPGR*, *HDI*, *UNEMP*, *EDU*, *AGR*, and *IND* of the countries is 5.5%, 0.6, 3.8%, 12.3%, 18.3%, 22.6%, and 3.9%, 0.09, 2.2%, 4.3%, 8.9%, 9.6% respectively. The maximum and minimum statistics of *GDPGR*, *HDI*, *UNEMP*, *EDU*, *AGR*, and *IND* of the countries are 26.1%, 0.8, 11.7%, 26.5%, 38.2%, 44.3%, and −13%, 0.4, 0.4%, 8.3%, 5.2%, 8.1% respectively. The skewness shows that the elements of each of the variables are positively skewed. At the same time, the kurtosis ranges between 15 and 2.3%, which gives an insight that the distribution of the variables is likely explosive. However, the *p*-value of the Jarque-Bera statistic is significant for at least 5%, except for AGR. Thus, the distribution of all the variables is explosive and thus volatile, except in the case of AGR.

The correlation matrix presented in Table 3 shows no significant multicollinearity among the independent variables (EDU, AGR, and IND) used in each model. The weak correlations observed between each pair of independent variables, as indicated by the bold values in the last three columns of the table, suggest that there is no strong linear relationship or multicollinearity among them. This indicates that the independent variables can be included together in a model without encountering issues related to multicollinearity. As a result, they can be effectively utilized collectively in the model to analyze and explain their individual effects on each dependent variable (GDPGR, HDI, and UNEMP) without significant interference from multicollinearity. Therefore, the correlation matrix

Table 2
Descriptive statistics of economic growth, human development index, unemployment rate, educational funding, agriculture, and industry are shown.

	GDP	HDI	UNEMP	EDU	AGR	IND
Mean	5.487619	0.586226	3.833333	15.25409	18.29719	22.63118
Median	5.293295	0.568000	3.780000	14.13973	17.59570	21.29881
Maximum	26.11149	0.779000	11.70000	26.35213	38.24390	44.27249
Minimum	−13.12905	0.447000	0.400000	8.270790	5.190605	8.058403
Std. Dev.	3.909758	0.092919	2.239681	4.326474	8.819343	9.604640
Skewness	0.165240	0.651012	0.908988	0.598644	0.229306	0.598400
Kurtosis	15.86629	2.359833	4.292044	2.693018	2.270069	2.688099
Jarque-Bera	641.8961	8.157191	19.27584	5.919975	2.879605	5.927257
Probability	0.000000	0.016931	0.000065	0.051820	0.236975	0.051631
Sum	510.3486	54.51900	356.5000	1418.630	1701.639	2104.700
Sum Sq. Dev.	1406.331	0.794320	461.4879	1722.091	7155.835	8486.918
Observations	140	140	140	140	140	140

Note: GDPGR stands for GDP growth rate as a proxy of economic growth, HDI stands for human development index, UNEMP stands for the unemployment rate, EDU stands for educational funding as a % of total government expenditure, AGR stands for agriculture as % of GDP, and IND stands for industry (*IND*) as % of GDP.
Source: Author's Computation

Table 3
Correlation matrix.

	GDP	HDI	UP	EDU	AGR	IND
GDP	1.000000	0.084590	0.110831	−0.108079	−0.183867	0.110525
HDI	0.084590	1.000000	0.548176	−0.361671	−0.822199	0.043942
UNEMP	0.110831	0.548176	1.000000	−0.340627	−0.704301	−0.163793
EDU	−0.108079	−0.361671	−0.340627	1.000000	**0.453004**	**0.022720**
AGR	−0.183867	−0.822199	−0.704301	**0.453004**	1.000000	**−0.124040**
IND	0.110525	0.043942	−0.163793	**0.022720**	**−0.124040**	1.000000

Source: Author's Computation

Table 4
Pesaran (2004) test for cross-section dependence in panels.

Panels	Statistic	d.f	Prob.
GDP	1.366377	21	0.1718
HDI	19.46855	21	0.000*
UNEMP	−1.515136	21	0.1297
EDU	0.410499	21	0.6814
AGR	11.02568	21	0.000*
IND	0.036018	21	0.9137

Notes: The symbol * denotes significance at the 1% level.
Source: Author's Computation

confirms that the independent variables can be worked together in a model to explore their respective impacts on each dependent variable without posing problems in explaining their individual effects on national development.

Table 4 presents the Pesaran test results for panel cross-sectional dependence. The analysis indicates that the HDI and AGR variables reject the null hypothesis of no cross-section dependence among the countries in each panel, suggesting the presence of such dependence. However, the other variables, namely GDPGR, UNEMP, EDU, and IND, do not reject the null hypothesis and indicate that the countries are cross-sectionally independent in relation to these variables. As mentioned earlier in section 3.2, in panels with evidence of cross-sectional dependence, the Pesaran [52] panel unit root test in the presence of cross-section dependence will be employed. Conversely, for panels where no evidence of cross-sectional dependence is found, panel unit root tests such as the Levin et al. [53] test (LLC) and the Im et al. [54] test (IPS), based on the traditional augmented Dickey-Fuller (ADF) test, will be utilized. This approach ensures the appropriate selection of unit root tests based on the presence or absence of cross-sectional dependence in the panel data.

Table 5 presents the Pesaran CIPS panel unit root test results for panels with cross-sectional dependence, focusing on the HDI and AGR variables. The findings indicate that HDI is non-stationary at the level but becomes stationary after differencing, as evidenced by the rejection of the null hypothesis at the first difference with a 1% significance level. On the other hand, AGR is found to be stationary, as the null hypothesis of homogeneous non-stationarity at the level is rejected at a 1% significance level. These results provide valuable insights into the stationarity properties of the variables in the panel analysis, highlighting the need to consider differencing for HDI and suggesting the stationary nature of AGR.

Table 6 presents the results of the panel unit root tests conducted on the variables included in the study. The findings reveal that the unit root hypotheses of the LLC and IPS tests were rejected for all the variables except for EDU, which was rejected only by the LLC test. However, the final decision will not be based solely on the LLC test due to the limitations mentioned in subsection 3.2. Instead, the IPS test, which considers heterogeneity in both intercepts and slope coefficients, will be used when there are conflicting results between the two tests, as previously mentioned. Hence, all the variables did not reject the null hypothesis of unit root at level, but all the variables reject it at the first difference and at 1% significance level. Therefore, considering the results presented in Tables 4 and 5, AGR is integrated of order I (0), while HDI, UNEMP, EDU, and IND are integrated of order I (1). Those, the variables in this study are a mixture of I (0) and I (1).

Table 7 presents the results of the Westerlund panel cointegration test for the three models representing different aspects of national development: economic growth (GDP), human development index (HDI), and unemployment rate (UNEMP). The findings indicate that the null hypothesis of no cointegration is rejected for all the models at different significance levels. Specifically, in Model 1 (GDPGR = f

Table 5
Pesaran (2007) CIPS panel unit root test results.

CIPS	Lags	Decision
−3.832*	1	I (1)
−2.372*	4	I (0)

Notes: The symbols * denotes significance at the 1% level.
Source: Author's Computation

Table 6
Panel unit root test results.

Variable	LLC	At first difference	IPS	At first difference	Decision
	At level		At level		
GDPGR	−3.44006	4.23712*	−301411	5.34623*	I (1)
UNEMP	−1.36434	−5.44898*	−0.53576	−6.22761*	I (1)
EDU	−2.30731**	–	0.07518	−2.84455*	I(I)
IND	0.54978	−10.8472*	2.07908	−8.06979*	I (1)

Table 7
Westerlund panel cointegration test results.

Models	Statistic	*p*-value
Mode 1: *GDPGR = f (EDU, AGR, IND)*		
Variance ratio	−2.4447	0.0251**
Mode 2: *HDI = f (EDU, AGR, IND)*		
Variance ratio	3.4696	0.0003*
Mode 3: *UNEMP = f (EDU, AGR, IND)*		
Variance ratio	2.0718	0.0191**

(EDU, AGR, IND)), the null hypothesis is rejected at a 5% significance level. In Model 2 (HDI = f (EDU, AGR, IND)), the null hypothesis is rejected at a 1% significance level. Lastly, in Model 3 (UNEMP = f (EDU, AGR, IND)), the null hypothesis is rejected at a 5% significance level. These results suggest the presence of cointegration among the variables in each model, supporting the estimation of the Panel Nonlinear ARDL (PNARDL) model for further analysis.

To estimate the models, the Hausman test was conducted among the Pooled Mean Group (PMG) estimator, the Mean Group (MG) estimator, and the Dynamic Fixed Effect (DFE) estimator for each of the three models, as shown in Table 8. For model 1, the test reveals PMG to be a better estimator than MG, but between MG and DFE, MG was found to be better. Therefore, being PMG is better than MG, and MG is better than DFE means PMG is a better estimator for model 1. For model 2, the test reveals MG to be a better estimator than PMG; also, between MG and DFE the MG was found to be better. Therefore, the study proceeds to estimate model 2 using the MG estimator. Finally, for model 3, the test reveals PMG to be a better estimator than MG, but between DFE and PMG, DFE was a better estimator between MG and DFE the MG was found to be a better estimator be better. Logically, this shows that the three models are

Table 8
Hausman test results to select model among MG, PMG and DFE.

GDPGR = f (EDU, AGE, IND)			
Ho: difference in coefficients not systematic	MG and PMG	DFE and PMG	MG and DFE
Chi2 (3)	3.65	−1.70	2.72
p-value	0.3016	The asymptotic assumptions of the Hausman test fails to meet	0.4362
Decision	Difference in coefficients not systematic	Inconclusive	Difference in coefficients not systematic
Which model is Good?	PMG	Inconclusive	MG
HDI = f (EDU, AGE, IND)			
Ho: difference in coefficients not systematic	MG and PMG	DFE and PMG	MG and DFE
Chi2 (3)	23.61	−24.41	0.0000
p-value	0.0000	The asymptotic assumptions of the Hausman test fails to meet	1.0000
Decision	Difference in coefficients not systematic	Inconclusive	Difference in coefficients not systematic
Which model is Good?	MG	Inconclusive	MG
UNEMP = f (EDU, AGE, IND)			
Ho: difference in coefficients not systematic	MG and PMG	DFE and PMG	MG and DFE
Chi2 (3)	0.54	14.39	0.10
p-value	0.9106	0.0024	0.9917
Decision	Difference in coefficients not systematic	Difference in coefficients not systematic	Difference in coefficients not systematic
Which model is Good?	PMG	DFE	MG

Source: Author's Computation

Table 9
Asymmetry test.

Dependent variable: GDPGR				Dependent variable: GDPGR			
Regressors	Chi2	*p*-value	Decision	Regressors	Chi2	*p*- value	Decision
EDU	4.28	0.0385**	Asymmetry	ΔEDU	0.77	0.3801	Symmetry
AGR	0.03	0.8554	Symmetry	ΔAGR	1.09	0.2960	Symmetry
IND	8.01	0.0046*	Asymmetry	ΔIND	2.63	0.1050	Symmetry
Dependent variable: HDI				Dependent variable: HDI			
Regressors	Chi2	*p*-value	Decision	Regressors	Chi2	*p*- value	Decision
EDU	4.52	0.0336**	Asymmetry	ΔEDU	10.78	0.0010*	Asymmetry
AGR	5.47	0.0194**	Asymmetry	ΔAGR	3.44	0.0635**	Asymmetry
IND	0.09	0.7675	Symmetry	ΔIND	0.71	0.3990	Symmetry
Dependent variable: UNEMP				Dependent variable: UNEMP			
Regressors	Chi2	*p*-value	Decision	Regressors	Chi2	*p*- value	Decision
EDU	3.19	0.074***	Asymmetry	ΔEDU	1.61	0.2044	Symmetry
AGR	31.19	0.000*	Asymmetry	ΔAGR	0.21	0.6460	Symmetry
IND	15.67	0.000*	Asymmetry	ΔIND	1.37	0.2420	Symmetry

Note: *, **, and *** stand for 1%, 5%, and 10% levels of significance respectively.
Source: Author's Computation

equal; however, when each of the three was used to estimate the model, PMG provided a better estimate than the remaining two estimators; hence, the study proceeds to estimate model 3 using the PMG.

Table 9 provides the results of the asymmetry test for each of the three models. In model 1, the impacts of EDU and IND on GDPGR are asymmetrical in the long run, while the impact of AGR is symmetrical. However, in the short run, all the impacts are symmetrical. In model 2, both in the long and short run, the impacts of EDU, AGR, and IND on HDI are asymmetrical, except for the impact of IND, which is symmetrical in both terms. In model 3, the impacts of all the variables on UNEMP are asymmetrical in the long run but symmetrical in the short run. Therefore, as explained earlier in subsection 3.2, each variable will enter the model based on whether its relationship with the dependent variable is linear or nonlinear, depending on whether the estimation procedure of the model allows for such specification.

Table 10 presents the findings of the PNARDL model. In model 1, with GDPGR as the dependent variable, the long-term effect of EDU on GDPGR, prior to the asymmetry test, were estimated as asymmetric. In the long run, an increase in EDU does not have a

Table 10
Presentation of the long-run coefficients and short-run coefficients from Panel Nonlinear ARDL model.

Dependent variable: GDPGR					Dependent variable: GDPGR				
Regressors	Coefficient	Stand Error	*t*-value	*p*-value	Regressors	Coefficient	Stand Error	*t*-value	*p*-value
EDU^+	−.098882	.1262681	−0.78	0.434	Δ*EDU*	−.951830	.7232232	−1.32	0.188
EDU^-	−.1203763	.061783	−1.95	0.051***					
AGR	.543067	.3575873	1.52	0.129	Δ*AGR*	2.34545	2.380202	0.99	0.324
IND^+	.222920	.1108237	2.01	0.044**	Δ*IND*	1.844918	1.019969	1.81	0.070***
IND^-	.3251433	.2398784	1.36	0.175					
					ECT (-1)	−.935948	.1315134	−7.12	0.000*
Dependent variable: HDI					Dependent variable: HDI				
Regressors	Coefficient	Stand Error	*t*-value	*p*-value	Regressors	Coefficient	Stand Error	*t*-value	*p*-value
EDU^+	.0032564	.002359	1.38	0.167	ΔEDU^+	.000543	.0001881	2.89	0.004*
EDU^-	−.001274	.0008208	−1.55	0.120	ΔEDU^-	−.0004025	.0001528	−2.63	0.635*
AGR^+	.0306218	.0105286	2.91	0.004*	ΔAGR^+	.007101	.0028267	2.51	0.012**
AGR^-	−.005055	.0056051	−0.90	0.367	ΔAGR^-	.002307	.0026873	0.86	0.391
IND	.008145	.0086675	0.94	0.347	Δ*IND*	−.000197	.0013596	−0.14	0.885
					ECT (-1)	−.436583	.0947916	−4.61	0.000*
Dependent variable: UNEMP					Dependent variable: UNEMP				
Regressors	Coefficient	Stand Error	*t*-value	*p*-value	Regressors	Coefficient	Stand Error	*t*-value	*p*-value
EDU^+	−.0332787	.018947	1.76	0.079***	Δ*EDU*	−.012725	.0160621	−0.79	0.428
EDU^-	.0064289	.0160882	0.40	0.689					
AGR^+	−1.227978	.2384559	5.15	0.000*	Δ*AGR*	−.153914	.1371922	−1.12	0.262
AGR^-	−.011133	.0413075	−0.27	0.788					
IND^+	−.091396	.0882804	−1.04	0.301	Δ*IND*	−.137526	.1234556	−1.11	0.265
IND^-	.4466411	.1202228	3.72	0.000*					
					ECT (-1)	−.258316	.0439853	−5.87	0.000*

Note: *, **, and *** stand for 1%, 5%, and 10% significance levels, respectively.
Source: Author's Computation

significant impact on GDPGR but a decrease in EDU is significant at a 10% level, indicating that a 1% decrease in EDU leads to a decrease in GDPGR by 0.12%; hence, it is influencing GDPGR in the long run. On the other hand, in the short run, the effect of EDU on GDPGR was estimated as symmetric and it has no significant impact and is negative. This means that educational funding only influences the economy in the long run. However, in both terms, the effect of AGR is symmetry and has no significant impact though positive. This means that the agricultural share of the economy is negligibly influencing the economy in both terms. Furthermore, in the long run, the relationship between IND and GDPGR exhibits asymmetry, where an increase in IND significantly enhances GDPGR at 5% level in which a 1% increase in IND results in a 0.22% increase in GDPGR. However, a decrease in IND does not significantly impact GDPGR though positive. On the other hand, in the short run, the effect of IND on GDPGR is symmetric and significantly improves GDPGR at a 10% level, where a 1% increase in IND leads to a 1.84% increase in GDPGR. The coefficient of ECT is negative and significant at 1% level, substantiating the earlier cointegration results among the variables and that the short-run divergences in GDPGR from long-run equilibrium are adjusted by 94% annually. This means that the industrial share of the economy influences the economy in both terms.

From model 2, where HDI is the dependent variable, prior to the asymmetry test, the impacts of EDU and AGR exhibit asymmetry but that of IND demonstrates symmetry. In the long run, increase and decrease of EDU are positively and negatively related to HDI, respectively, but none is significant. In the short run, an increase in EDU significantly affects HDI at a 1% level, whereas a 1% increase in EDU results in a 0.0005% increase in HDI, but the decrease has no significant effect. This means that educational funding is influencing the human development index in both terms, but that in the long run, is negligible. However, in the long run, the increase and decrease of AGR are positively and negatively related with HDI, respectively, but only the increase is significant at the 1% level, where a 1% increase in AGR will cause an increase in HDI by 0.3%. In the short run, an increase in AGR significantly affects HDI at a 5% level where a 1% increase in AGR results in a 0.007% increase in HDI, but the decrease has no significant effect. This means that the agricultural share of the economy influences the human development index in both terms. Furthermore, in both terms, IND has an insignificant impact on HDI though positive in the long run. This means that the industrial share of the economy is negligibly influencing the human development index in the long run, but in the short run, it has no impact. The coefficient of ECT is negative and significant at 1% level, which endorses the earlier cointegration results among the variables and that the short-run divergences in GDPGR from long-run equilibrium are adjusted by 44% annually.

In model 3, with UNEMP as the dependent variable, the impacts of EDU, AGR, and IND exhibit asymmetry test were estimated as asymmetric prior to the asymmetry test. In the long run, increase and decrease in EDU are negatively and positively related to UNEMP, but only the increase is significant where a 1% increase in EDU will lead to a decrease in UNEMP by 0.03%, but in the short run the impact is insignificant though negative. This means that educational funding is negligibly discouraging the unemployment rate in both terms. However, in the long run, increase and decrease in AGR are negatively related to UNEMP, but only the increase is significant where a 1% increase in AGR results in a substantial decrease in UNEMP by 1.23%, but in the short run, the impact is insignificant though negative. This means that the agricultural share of the economy is discouraging the unemployment rate but in the short run, the performance is negligible. Furthermore, in the long run, increase and decrease in IND are negatively and positively related to UNEMP, but only the decrease is significant, where a 1% decrease will lead to a 0.45% increase in UNEMP, but in the short run, the impact is insignificant though negative. This means that the industrial share of the economy is negligibly discouraging the unemployment rate in both terms. The coefficient of ECT is negative and significant at the 1% level, which certifies the earlier cointegration results among the variables and that the short-run divergences in UNEMP from long-run equilibrium are adjusted by 44% annually.

5. Discussion

Educational funding is often at the top of the list of issues for state policymakers and the electorate. Education has widespread support that crosses political, social, and economic divides. Regardless of its popularity, educational funding is rarely enough or equitable. Almost all recent educational funding challenges have resulted in court rulings in favor of plaintiffs, declaring state funding arrangements unlawful. In addition, numerous studies have examined the relationship between taxes, spending, and state economic development. These studies usually cover topics like the competitiveness of a state's tax system and the effects of higher productivity and higher quality labor on regional development [62–66]. Furthermore, some studies have found a strong bidirectional relationship between public education funding and economic growth [33,67,68]. Moreover, some studies have examined the impact of spending on education and economic growth and have reported negative associations [69,70], while Kakar et al. [71], found no statistically significant relationship between education and short-term economic growth in their study. However, the results of this study answered the research questions, which include how educational funding is related to the economic growth of the South Asian Association for Regional Cooperation (SAARC) countries in the 21st century? To what extent has educational funding contributed to human capital development in SAARC countries in the 21st century? Is educational financing helping SAARC countries reduce the unemployment rate in the 21st century?

Regarding the first question, the results revealed that the impact of educational funding on the growth rate of the economies is asymmetry in the long run and symmetry in the short run. However, educational funding is influencing the growth rate of the SAARC economies in the long run but in the short run is not; however, the impact is minimal, and as proved by the preliminary analysis that of recent years, the educational expenditure as a total share of the government expenditure is going down. The finding that educational funding is promoting the growth of the SAARC economies is in line with Riasat [31] in Pakistan, Maitra and Mukhopadhyay [32] in selected countries of Asia and the Pacific, Karaçor et al. [35] in OECD countries, Hanif and Arshed [36] in SAARC countries, Mallick et al. [37] in major Asian countries, Appiah [38] in developing countries, Tabar et al. [39] in Iran, Yürük and Acaroğlu [45] in Turkey but the contrast with the findings of Abdylmenaf and Besime [34] in Macedonia, Nuhu and Ali [41] in Nigeria.

Regarding the second question, the results revealed that, in both terms, the impact of educational funding on the human development index is asymmetry. However, educational funding is influencing the human development index of the SAARC countries in both terms, but that of the long run is negligible. The finding that educational funding influences the human development index is in line with Amaghionyeodiwe [42] (2019) in West African Countries, Shafuda and De [43] in Namibia, and Nuhu and Ali [42] in Nigeria.

Regarding the third question, the results revealed that the impact of educational funding is asymmetry in the long run but symmetry in the short run. However, educational funding is negligibly discouraging the SAARC countries' unemployment rate in both terms. The finding that educational funding is discouraging the unemployment rate is in line with Agboola et al. [72] in Nigeria and Selase [73] in selected African Countries.

6. Conclusion

This study examined the relationship between educational funding and national development indicators in South Asian Association for Regional Cooperation (SAARC) countries from 2000 to 2019 using the Panel Nonlinear Autoregressive Distributed Lag (PNARDL) model. The results showed that the effect of educational funding on economic growth is asymmetric in the long run, but symmetric in the short run, where educational funding is influencing the growth rate of the SAARC economies in the long run but in the short run is not. Furthermore, the impact of education funding on the human development index is asymmetric in both the short and long terms, where educational funding is influencing the human development index of the SAARC countries in both terms, but that of the long run is negligible. Moreover, the effect of education funding on the unemployment rate is asymmetric in the long run but symmetric in the short run, where educational funding is negligibly discouraging the unemployment rate of the SAARC countries in both terms.

Therefore, based on these findings, the paper recommended that, been the impact educational funding on economic growth and the rate of unemployment is asymmetry in the long run and symmetry in the short run but on the human development index, it is asymmetry in both terms; then, where there is asymmetry impact the government should not give equal attention or concern in handling the educational funding while where there is symmetry impact the government should not bother to give equal attention or concern in handling the educational funding. Furthermore, the paper recommended ways in which educational funding can be encouraged so that it can effectively promote economic growth, human capital development, and reduce the rate of unemployment in the countries. First, educational funding (as a share of the total expenditure) should be boosted or adequately funded, which can be done in several ways. For instance, there should be an increase in educational budgetary allocation by a handsome share of the total expenditure to provide the desired skilled human resources for the long-term national development of the countries. Therefore, educational funding should be the top priority for all countries in the SAARC region. Second, corruption is an endemic disease that can make any government ineffective; hence, there is a need to check some elements of corruption in the educational funding process to ensure that funds meant for the education sector are not diverted but judiciously appropriated and spent. Third, external aid to support educational funding can be mobilized through bilateral agreements with external bodies such as World Bank and United Nations Children's Education Fund (UNICEF), among others, to fund the region's educational sector through the SAARC organization.

For further research, it offers that an investigation could be carried out on the efficiency issue to discover the role corruption plays in the efficient use of government spending on education. In addition, the quality of education is also an essential aspect of research. In addition, the level of enrollment rate in different educational levels and its impact on economic growth could be investigated.

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Author contribution statement

Samina Zamir, Babar Nawaz Abbasi, Lin Yu, Ali Sohail and Chaojun Yang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data and Wrote the paper.

Data availability

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] UNESCO. Education financing, Retrieved from, https://en.unesco.org/themes/education-financing, 2021.
[2] World Bank, The Economic Impact of Investing in Education: Evidence from Developing Countries, 2018. Retrieved from, https://www.worldbank.org/en/topic/education/publication/the-economic-impact-of-investing-in-education-evidence-from-developing-countries.
[3] R.J. Barro, J.W. Lee, A new data set of educational attainment in the world, 1950-2010, J. Dev. Econ. 104 (2013) 184–198, https://doi.org/10.1016/j.jdeveco.2012.10.001.
[4] E.A. Hanushek, L. Wößmann, Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation, J. Econ. Growth 17 (4) (2012) 267–321.
[5] R. Nair, Educational services in saarc: a case for deeper integration, Nirma Univ. Law J. 3 (1) (2013) 19–49.
[6] United Nations Educational, Scientific and Cultural Organization, World Education Report, UNESCO, Paris, 2014.
[7] S. Bukhari, R. Kalim, N. Arshed, M.S. Hassan, Prevailing poverty in SAARC countries: can education help? Asia Pac. Soc. Sci. Rev. 21 (1) (2021) 156–171. https://www.researchgate.net/profile/RukhsanaKalim/publication/353923334_Prevailing_Poverty_in_SAARC_Countries_Can_Education_Help/links/611a08a21e95fe241ad4a34a/Prevailing-Poverty-in-SAARC-Countries-Can-Education-Help.pdf.
[8] N. Hussaini, Economic growth and higher education in South Asian countries: evidence from econometrics, Int. J. High. Educ. 9 (2) (2020) 118–125.
[9] A.A. Salisu, K.O. Isah, Revisiting the oil price and stock market nexus: a nonlinear Panel ARDL approach, Econ. Modell. 66 (2017) 258–271, https://doi.org/10.1016/j.econmod.2017.07.010.
[10] M.D. Galadima, A.W. Aminu, Positive and negative impacts of natural gas consumption on economic growth in Nigeria: a nonlinear ARDL approach, Afr. J. Econ. Sustain. Dev. 7 (2) (2019) 138–160, https://doi.org/10.1504/AJESD.2019.103549.
[11] H. Rasool, S. Maqbool, M. Tarique, The relationship between tourism and economic growth among BRICS countries: a panel cointegration analysis, Future Bus. J. 7 (1) (2021) 1–11, https://doi.org/10.1186/s43093-020-00048-3.
[12] W. Lichman, The Political Economy of Development, University of Califonia Press, Berkeley and Los Angeles, 1972, p. 57.
[13] I.L. Markovitz, Power and Class in Africa, Engel Wood Cliffs, N.J. Prentice-Hall, 1997, https://doi.org/10.1080/14662049808447766.
[14] M.P. Todaro, C.S. Smith, Economic Development, Pearson Education Limited, England, 2006.
[15] S. Chikalipah, G. Okafor, Dynamic linkage between economic growth and human development: time series evidence from Nigeria, J. Int. Dev. 31 (1) (2019) 22–38, https://doi.org/10.1002/jid.3390.
[16] F.O. Afolabi, A.B. Loto, Socio-political Vicissitudes and Bureaucratic Constraints on Educational Formulation and Implementation in Nigeria, 2012.
[17] A. Gegenfurtner, Reconstructing goals for transfer of training in faculty development programs for higher education teachers: a qualitative documentary method approach, Heliyon 5 (11) (2019), e02928, https://doi.org/10.1016/j.heliyon.2019.e02928.
[18] M. Zapp, Revisiting the global knowledge economy: the worldwide expansion of research and development personnel, 1980–2015, Minerva 60 (2) (2022) 181–208, https://doi.org/10.1007/s11024-021-09455-4.
[19] R.J. Barro, Determinants of Economic Growth: A Cross-Country Empirical Study NBER Working Paper No 5698, National Bureau of Economic Research, 1991, https://doi.org/10.3386/w5698.
[20] Z. Ahmed, B. Zhang, M. Cary, Linking economic globalization, economic growth, financial development, and ecological footprint: evidence from symmetric and asymmetric ARDL, Ecol. Indicat. 121 (2021), 107060.
[21] J. Clark, S.R. Das, A. Menclova, Evaluating the effectiveness of school funding and targeting different measures of student disadvantage: evidence from New Zealand, Econ. Rec. 93 (303) (2017) 576–599, https://doi.org/10.1111/1475-4932.12354.
[22] R. Banerjee, J.K. Wilson, Roles of education in productivity growth in Australia, 1860–1939, Econ. Rec. 92 (296) (2016) 47–66, https://doi.org/10.1111/1475-4932.12226.
[23] B.A. Cardak, Heterogeneous preferences, education expenditures and income distribution, Econ. Rec. 75 (1) (1999) 63–76, https://doi.org/10.1111/j.1475-4932.1999.tb02434.x.
[24] J. Creedy, P. François, Financing higher education: a general equilibrium public choice approach, Econ. Rec. 69 (1) (1993) 1–9, https://doi.org/10.1111/j.1475-4932.1993.tb01793.x.
[25] R. Whitley, J. Gläser, G. Laudel, The impact of changing funding and authority relationships on scientific innovations, Minerva 56 (1) (2018) 109–134, https://doi.org/10.1007/s11024-018-9343-7.
[26] P. Murphy, Education, educators and financing modalities: reflections on experience in Uganda, J. Int. Dev. 17 (1) (2005) 131–147, https://doi.org/10.1002/jid.1181.
[27] Z. Ahmed, M.W. Zafar, S. Ali, Linking urbanization, human capital, and the ecological footprint in G7 countries: an empirical analysis, Sustain. Cities Soc. 55 (2020), 102064.
[28] Review education policies - OECD, Economic & Social Outcomes, 2022. https://gpseducation.oecd.org/revieweducationpolicies/#!node=41761&filter=all.
[29] Understanding the Effects of School Funding, 2022. https://www.ppic.org/publication/understanding-the-effects-of-school-funding/.
[30] D. Vilorio, Education matters: career outlook. https://www.bls.gov/careeroutlook/2016/data-on-display/education-matters.htm, 2016.
[31] S. Riasat, A.R.M. Muhammad, K. Zaman, Measuring the impact of educational expenditures on economic growth: evidence from Pakistan, Educ. Res. 2 (13) (2011) 1839–1846.
[32] B. Maitra, C.K. Mukhopadhyay, Public spending on education, health care and economic growth in selected countries of Asia and the pacific, Asia Pac. Dev. J. 19 (2) (2012) 19–48.
[33] A.S. Idrees, M.W. Siddiqi, Does public education expenditure cause economic growth? Comparison of developed and developing countries, Pakistan J. Com. Soc. Sci. 7 (1) (2013) 174–183. http://hdl.handle.net/10419/188083.
[34] B. Abdylmenaf, M. Besime, Impact of Public Funding of Education on Economic Growth in Macedonia, BERG Working Paper Series, 2015. No. 98, http://hdl.handle.net/10419/107594.
[35] Z. Karaçor, B. Güvenek, E. Ekinci, Relationship with Education Expenditure and Economic Growth in OECD Countries, Original scientific paper, 2015. UDK: 37: 330.35, https://hrcak.srce.hr/187384.
[36] N. Hanif, N. Arshed, Relationship between school education and economic growth: SAARC countries, Int. J. Econ. Financ. Issues 6 (1) (2016) 294–300.
[37] L. Mallick, P.K. Das, K.C. Pradhan, Impact of educational expenditure on economic growth in major Asian countries: evidence from econometric analysis, Theor. Appl. Econ. 23 (2) (2016) 173–186. http://www.ebsco.ectap.ro/Theoretical_&_Applied_Economics_2016_Summer.pdf#page=173.
[38] E.N. Appiah, The effect of education expenditure on per capita GDP in developing countries, Int. J. Econ. Finance 9 (10) (2017) 136–144, 10.5539/ijef.v9n10p.136.
[39] F.J. Tabar, Z. Najafi, Y.S. Badooei, The Impact of Educational Expenditures, of Government on Economic Growth of Iran, 2017, pp. 217–235, https://doi.org/10.17230/ad-minister.30.11.
[40] S. Trabelsi, Public education expenditure and economic growth: the educational quality threshold effect, Région et Développement 45 (2017) 100–112.
[41] M. Nuhu, M. Ali, Impact of educational funding on national development in the 21st century Nigeria: co-integration and Granger causality, J. Econ. Environ. Edu. 3 (1) (2018) 105–123.
[42] L.A. Amaghionyeodiwe, Government Spending on Education and Economic Growth: A Case Study of West African Countries, Department of Business and Economics, New York, USA, 2019. York College, City University Of New York. Jamaica.
[43] C.P.P. Shafuda, U.K. De, Government expenditure on human capital and growth in Namibia: a time series, J. Econ. Struct. 9 (21) (2020) 1–14, https://doi.org/10.1186/s40008-020-00196-3.
[44] B. Can, Z. Ahmed, M. Ahmad, et al., Do renewable energy consumption and green trade openness matter for human well-being? Empirical evidence from European Union countries, Soc. Indicat. Res. 164 (2022) 1043–1059, https://doi.org/10.1007/s11205-022-02981-y.

[45] B. Yürük, H. Acaroğlu, A non-linear analysis of the relationship between education expenditures and economic growth in Turkey, J. Yasar Univ. 16 (61) (2021) 1301–1317.
[46] W. Sebki, Education and economic growth in developing countries: empirical evidence from GMM estimators for dynamic panel data, Econ. Bus. 35 (2021) 14–29, https://doi.org/10.2478/eb-2021-0002.
[47] Shuyu Qi, Qiutong Ma, Xiaohui Ji, The influence of financial aid systems on student academic development in higher education in China, Sustainability 14 (21) (2022), 14068, https://doi.org/10.3390/su142114068.
[48] B.F. Ziberi, R. Donat, I. Xhemazie, A. Besnik, Empirical analysis of the impact of education on economic growth, Economies 10 (2022) 89, https://doi.org/10.3390/economies10040089.
[49] Word Bank Development Indicator, statistical bulletin, https://data.worldbank.org/indicator, 2020.
[50] Human Development Index, statistical bulletin, http://hdr.undp.org/en/indicators/137506, 2020.
[51] M.H. Pesaran, General Diagnostic Tests for Cross-Section Dependence in Panels, IZA Discussion Paper., 2004, p. 1240.
[52] M. Pesaran, A simple panel unit root test in the presence of cross-section dependence, J. Appl. Econom. 22 (2) (2007) 265–312.
[53] A. Levin, C.F. Lin, C.S.J. Chu, Unit root tests in panel data: asymptotic and finite-sample properties, J. Econ. 108 (1) (2002) 1–24.
[54] K.S. Im, M.H. Pesaran, Y. Shin, Testing for unit roots in heterogeneous panels, J. Econ. 115 (1) (2003) 53–74.
[55] R.P. Pradhan, P. Dasgupta, S. Finance Bele, Development and economic growth in BRICS: a panel data analysis, J. Quant. Econ. 11 (1–2) (2013) 308–322.
[56] P. Pedroni, Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressorsî, Oxford Bulletin of Economics and Statistics, 1999, pp. 653–670.
[57] P. Pedroni, Panel Cointegration, Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis, Econom. Theor. 20 (3) (2004) 597–625.
[58] C. Kao, Kao panel cointegration tests, J. Econom. 90 (1) (1999) 1–44.
[59] J. Westerlund, Testing for error correction in panel data, Oxf. Bull. Econ. Stat. 69 (2007) 709–748, https://doi.org/10.1111/j.1468-0084.2007.00477.x.
[60] P. Bhujabal, N. Sethi, P.C.I.C.T. Padhan, Foreign direct investment and environmental pollution in major Asia Pacific countries, Environ. Sci. Pollut. Control Ser. 7 (1) (2021) 1–11, https://doi.org/10.1007/s11356-021-13619-w.
[61] E.F. Blackburne, M.W. Frank, Estimation of nonstationary heterogeneous panels, STATA J. 7 (2) (2007) 197–208, https://doi.org/10.1177/1536867X0700700204.
[62] Timothy J. Bartik, The effects of state and local taxes on economic development: a review of recent research, Econ. Dev. Q. 6 (1992) 102–110, https://doi.org/10.1177/0891242492006001.
[63] Teresa Garcia-Mila, Therese J. McGuire, The contribution of publicly provided inputs to states' economies, Reg. Sci. Urban Econ. 22 (1992) 709–738, https://doi.org/10.1016/0166-0462(92)90013-Q.
[64] Jay Helms, The effect of state and local taxes on economic growth: a time series-cross section approach, Rev. Econ. Stat. 67 (4) (1985) 574–582, https://doi.org/10.2307/1924801.
[65] Michael Wasylenko, Taxation and Economic Development: the State of the Economic Literature, New England Economic Review, 1997, pp. 37–52.
[66] E.A. Boahen, K. Opoku, S. Schotte, Duration of pre-university education and labour market outcomes: evidence from a quasi-experiment in Ghana, J. Int. Dev. 33 (1) (2021) 208–232, https://doi.org/10.1002/jid.3519.
[67] J.L. Loening, Time series evidence on education and growth: the case of Guatemala, 1951-2002, Revista de Analisis Economico 19 (2) (2004) 3–40. https://ssrn.com/abstract=1244563.
[68] M. Fidlizan, A.R. Azila, M.Y.M. Hussin, Education expenditure and economic growth: a causal analysis for Malaysia, J. Econ. Sustain. Dev. 3 (7) (2012).
[69] S. Devarajan, V. Swaroop, H. Zou, The composition of public expenditure and economic growth, J. Monetary Econ. 37 (1996) 313–344.
[70] R. Levine, D. Renelt, A Sensitivity Analysis of Cross-Country Growth Regressions, The American economic review, 1992, pp. 942–963.
[71] Z.K. Kakar, B.A. Khiljiand, M.J. Khan, Relationship between education and economic growth in Pakistan: a time series analysis, J. Int. Account. Res. 11 (1) (2011) 27–32.
[72] S. Agboola, I. Musa, Z. Ibrahim, Relationship between educational expenditure and unemployment rate on economic growth in Nigeria, Sub. Edu. J. 1 (2018) 100–110, https://doi.org/10.31058/j.edu.2018.13007.
[73] A.E. Selase, Impact of disaggregated public expenditure on unemployment rate of selected African countries: a panel dynamic analysis approach, Am. J. Publ. Admin. 1 (9) (2019) 1–13. https://escipub.com/ajpa-2019-08-1805/.
[74] B.E. Hansen, Inference when a nuisance parameter is not identified under the null hypothesis, Econometrica 64 (2) (1996) 413–430.
[75] B.E. Hansen, Sample splitting and threshold estimation, Econometrica 68 (3) (2000) 575–603.