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School Enrollment Ratios and Their Optimality Towards the Economic Growth of Middle East Countries in the Twenty-First Century: PSTR Analysis

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Abstract
Education is crucial for economic growth as well as the emergence and spread of new products. Thus, a deeper understanding of educational growth is needed, which can be achieved by increasing school enrollment at various educational levels—primary, secondary, and tertiary. Despite extensive debates on the impact of education, the determination of an optimal school enrollment level remains crucial for enhancing economic growth. This study examines school enrollment ratios and their optimality toward economic growth in Middle Eastern countries (MEC) in the twenty-first century using the panel smooth transition regression (PSTR) model, utilizing data from 2000 to 2020. The results revealed that primary and secondary school enrollments have a positive impact on economic growth, with growth rates of 2.702% and 3.351% in gross enrollment ratios, respectively. However, tertiary school enrollment does not seem to contribute significantly to the growth rate. Furthermore, a school enrollment level that can be adjudged as capable of improving the economic growth is determined to be 4% for primary and secondary schools, whereas there is no discernible threshold for tertiary school enrollment. Moreover, primary and secondary school enrollments are at an optimal level for economic growth, while tertiary school enrollment is below optimal.

Keywords Education · School enrollments · Economic growth · Twenty-first century · Middle Eastern countries

JEL Classification I20 · I21 · I23

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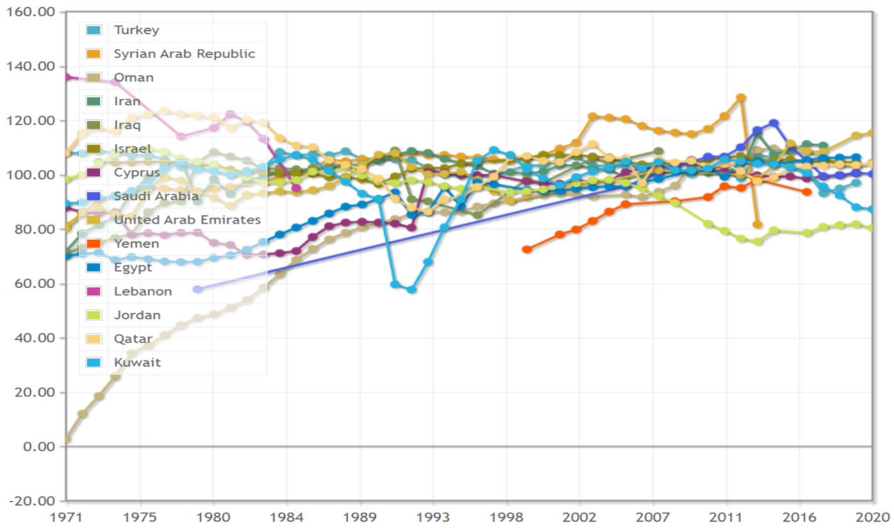

Fig. 1 School enrollment, primary (% gross) in MEC

Introduction

Education is widely regarded as a crucial element for the development and progress of a country (Caplan, 2018; Fägerlind & Saha, 2016; Liu & Lee, 2022). It plays a crucial role in driving economic development, maintaining social stability, and empowering individuals (Engida, 2021). To achieve these goals, the enrollment of students in schools has become a key measure of a country's commitment to providing education for all its citizens. The connection between school enrollment rates and economic growth is complex and vital for long-term societal progress (Ansong et al., 2018; Deininger, 2003; Khalid & Tadesse, 2023). School enrollment rates cover primary, secondary, and tertiary education and offer valuable insights into a country's educational framework (Gumus & Kayhan, 2012; Kono et al., 2018). These rates show the percentage of eligible students attending educational institutions, which reflects how accessible and inclusive the education system is. Importantly, these rates go beyond mere numbers; they symbolize a country's determination to equip its people with the necessary tools for personal growth and collective advancement (Aldawsari, 2022).

In this context, the Middle Eastern presents an intriguing case. According to the World Bank Development Indicators (2021), the region exhibited a gross enrollment ratio of approximately 94.6% for elementary education in 2020. This figure suggests a significant majority of students in the region are enrolled in primary schools, and this is further illustrated in Fig. 1. However, the adjusted net enrollment rate in 2018 was lower, at 85.5% (IndexMundi, 2018), indicating that some students within the primary school age bracket are not enrolled or attend schools without official recognition. This discrepancy highlights variations in educational access and quality across the Middle Eastern and North Africa region (MENA) (Bouhlila, 2011; Ridge et al., 2019).

The diversity in enrollment rates becomes more evident when examining individual countries within the MENA region (Tzannatos et al., 2016). Nations like Bahrain, Qatar, and Kuwait exhibit nearly full primary school enrollment, while Yemen, Syria, and Iraq report considerably lower rates (United Nations Children's Fund, 2020; Indexmundi, 2021). Similar disparities are observed in secondary education, with the gross enrollment ratio in the Middle Eastern around 77.6% in 2020, but with significant differences between countries (Akkari, 2015; Buckner, 2011). Tertiary education enrollment is even more varied, with only 34.8% of the eligible age group enrolled in higher education in 2020, again demonstrating substantial differences across the region (World Bank Development Indicators, 2021; Yu & Delaney, 2016).

These statistics not only highlight the achievements in primary and secondary education in the Middle Eastern but also emphasize the challenges, particularly in tertiary education. The disparity in enrollment rates at different education levels has significant implications for economic growth. While primary and secondary school enrollments have seen considerable improvements, many countries in the region lag in expanding tertiary education. This gap raises crucial questions about how these varying enrollment levels affect a country's development and what the ideal enrollment rate might be to maximize this development. Determining whether the enrollment levels meet this ideal is essential. Insights into these issues could be invaluable for policymakers, especially in strategizing economic growth through human capital investment.

The Present Study

This study investigates the relationship between school enrollment ratios and economic growth in MEC. While previous studies have examined the nexus between education and economic growth (see, Khan et al., 2023; Qi et al., 2022; Ziberi et al., 2022; Sun, 2021; Marquez-Ramos & Mourelle, 2019; Benos & Zotou, 2014; Hanushek & Woessmann, 2010), however, there are noticeable gaps in the current research. Specifically, the investigation of school enrollment in relation to economic growth in MEC has often been ignored. In addition, answers to some critical questions that could be garment in educational policies for a better economy are still scarce in the MEC. For example, the level of school enrollment that can be adjudged as capable of improving the economic growth; and whether the level of school enrollment is at an optimal level for the economic growth of MEC. To achieve this, our study employs the PSTR model, a cutting-edge approach. The PSTR model is uniquely suited to effectively examine potential nonlinear relationships and threshold effects between school enrollment and growth. Furthermore, unlike previous studies that relied on linear models, our use of the PSTR allows for a more flexible and data-driven approach to capture potential regime changes and asymmetries in the enrollment-growth nexus. Moreover, our empirical analysis utilizes an extensive dataset covering 15 MEC over the period 2000 to 2020, providing robust estimates across different time periods and country settings. To the best of our knowledge, this is the first study to apply the PSTR methodology to analyze such relationships across MEC. This innovative approach not only extends the academic discourse on education and economic growth but also offers practical insights for policymakers aiming to influence education as a tool for sustainable economic development in MEC.

The remainder of the study is structured into five distinct sections: a review of relevant literature, the methodology employed to meet the study's goals, the presentation of findings, discussion of these findings, and final concluding remarks.

Literature Review

The role of education in economic growth has been extensively debated, with distinct perspectives emphasizing its economic and social implications. The discussion on education reform has increasingly integrated a key ideology: the human capital theory. While these perspectives have often been considered conflicting, recent research suggests a more integrated view, recognizing the multifaceted contributions of education to individual empowerment and economic growth (Choi, 2024).

Human Capital Theory in Education

Human capital theory posits education as a critical investment for economic growth and development. Empirical evidence supports the notion that education enhances labor productivity, increases economic returns, and contributes to higher national productivity levels (Colclough, 1982; Wößmann, 2003). This perspective emphasizes the instrumental role of education in improving individual skill sets, thereby boosting economic productivity and fostering innovation. On a broader scale, the aggregation of educated individuals within an economy stimulates innovation, enhances efficiency, and drives economic growth. Becker's seminal work on human capital theory articulates how investments in education lead to a more competent and adaptable workforce, capable of driving technological advancements and productivity gains. This is particularly relevant in today's knowledge-based economies, where the demand for skilled labor is high, and the economic returns to education are substantial. Moreover, the theory posits that education leads to externalities that benefit society at large. More educated populations tend to have lower crime rates, better health outcomes, and higher levels of civic participation (Lochner, 2011; Lochner & Monge-Naranjo, 2011). These social benefits further justify public investment in education as a means to achieve not only economic but also social development goals.

The *Nexus* Between School Enrollment and Economic Growth

Economists have been interested in the topic of economic growth and its sources since Adam Smith and David Ricardo. The first set of economic growth theories, on the other hand, did not emerge until the 1950s and 1960s. As it was termed at the time, the neoclassical approach to growth theory had a number of flaws. Furthermore, economists have discovered that educational infrastructure is a crucial indicator of economic growth (Démurger, 2001; Hanushek, 1986; Perna & Titus, 2005). Moreover, researchers have sought to quantify the economic returns of education, with Psacharopoulos and Patrinos (2004) providing comprehensive evidence of the high rates of return on investment in education across different countries and education levels. Their analysis confirms that primary and secondary education offers the highest returns, emphasizing the importance of ensuring access to basic education for all as a foundation for lifelong learning and economic productivity (Marquez-Ramos & Mourelle, 2019; Ridho & Razzaq, 2018; Perna & Titus, 2005; Hanushek, 1986; Toda & Yamamoto, 1995; Okuneye & Maku, 2014). Following this, the school enrollment is crucial for national educational attainment and economic growth (Obradović et al., 2009; World Bank Development Indicators, 2021). Higher enrollment rates correlate with improved economic growth, productivity, and reduced poverty, as they equip children with vital skills for the workforce (Hanushek & Wößmann, 2007). However, enrollment alone is insufficient; the quality of education is critical for ensuring students acquire necessary skills for success and contribute positively to society, reducing disparities and enhancing social mobility (Adu-Agyem & Osei-Poku, 2012; Arshed et al., 2018). High educational enrollment rates are associated with economic progress, better health outcomes, and social integration, emphasizing the importance of high-quality education for all children (Anderson et al., 2007; Craigwell et al., 2012; United Nations Children's Fund, 2020).

The empirical investigation into the relationship between education and economic growth has uncovered recurring themes that warrant scholarly attention. Scholars across various geographical contexts and temporal frames have consistently identified positive correlations between investments in education and economic development (Gumus & Kayhan, 2012; Hassan & Ahmed, 2007; Nnyanzi & Kilimani, 2018; Okuneye & Maku, 2014). Specifically, primary and secondary school enrollment rates have emerged as robust predictors of economic growth, emphasizing the pivotal role of foundational education in fostering human capital accumulation and enhancing labor force productivity (Lilian, 2020; Marquez-Ramos & Mourelle, 2019). Furthermore, governmental expenditure in the educational sector has been recognized as a key determinant in shaping economic growth trajectories (Ogbeba, 2015). Studies consistently emphasize the positive impact of increased state investment in education, coupled with enhancements in educational effectiveness, on economic outcomes. This highlights the urgent need for policy interventions aimed at improving educational accessibility and quality, particularly in resource-constrained regions. However, a more comprehensive assessment of the relationship between tertiary education enrollment and economic growth reveals a more complicated section. While some studies suggest positive correlations between tertiary enrollment rates and economic development (Dahal, 2010; Hanif & Arshed, 2016), others emphasize contextual nuances such as educational quality and labor market dynamics that influence this relationship (Maneejuk & Yamaka, 2021; Onwioduokit, 2020). These findings indicate that merely increasing tertiary enrollment rates is not sufficient to guarantee economic growth. Instead, the quality of education and its alignment with labor market needs are crucial factors. Moreover, examining the broader educational field, Goczek et al. (2021) extended Hanushek and Woessmann's model, using PISA data to confirm that higher quality education and cognitive skills significantly enhance GDP growth. They emphasized the importance of primary and secondary education quality. Glewwe and Muralidharan (2016) analyzed how increased enrollment in primary education in developing countries contributes to economic growth by improving literacy and numeracy skills, which are essential for workforce productivity. In India, Hota (2023) found significant investments in educational infrastructure and expenditure have led to higher enrollment rates. Improved facilities, teacher training, and access to learning resources have contributed to better educational outcomes. These advancements have, in turn, fueled economic development by creating a more skilled and productive workforce. Abbasi et al. (2023) used the ThSVAR model to analyze global data 2000 to 2019 on education and health budgets and environmental footprints. They found that education and health budgets support economic growth and reduce unemployment, while environmental footprints hinder growth. Akcigit et al. (2024) examined the synergistic effects of integrating education and innovation policies on economic growth. They highlight that while education enhances human capital and innovation drives technological advancements, their combined implementation leads to superior economic outcomes. The study employs cross-country data and case studies to demonstrate that countries aligning education with innovation need to experience higher growth rates. In the context of Southeast European countries, Baltova and Vutsova (2024) emphasize the critical role of education quality in driving economic growth. They revealed that countries with better educational outcomes, measured by student performance and institutional quality, experience faster GDP growth and higher productivity levels. The evidence also shows that investments in teacher training, curriculum development, and educational infrastructure significantly enhance education quality, subsequently boosting economic growth. Furthermore, improved education quality is linked to greater innovation and competitiveness in the global market. Zamir et al. (2023) used data from 2000 to 2019 and a PNARDL model to assess the impact of educational funding on national development in SAARC countries. They found that educational funding influences economic growth asymmetrically in the long run and symmetrically in the short run. Osisanwo et al. (2024) indicated that targeted investments in education, such as enhancing infrastructure, improving teacher quality, and expanding access, lead to substantial economic benefits. Evidence shows that such investments result in a more skilled workforce, higher productivity, and increased innovation, which collectively drive economic growth. Moreover, studies emphasize that improving educational outcomes can reduce poverty and inequality, further contributing to sustainable development. In Bhutan, Akita and Lethro (2024) showed that educational improvements have significantly contributed to reducing poverty and enhancing economic opportunities in rural areas. Increased access to quality education has empowered individuals with the skills needed for better employment prospects and higher incomes. Educational initiatives have also supported agricultural productivity and diversification, further driving rural economic growth. These findings motivated further study on school enrollment ratios and their optimality towards economic growth in MEC.

Fig. 2 Geographic representation of Middle East countries

Method and Material

Data and Variables

The primary objective of this study is to investigate the relationship between school enrollments and the economic growth of MEC. To achieve this, the study utilizes panel data from MEC, as provided by the World Population Review (2021), as shown in Fig. 2. The member countries of this region include Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Egypt, Turkey, United Arab Emirates, and Yemen. The independent variables are primary school enrollment (PER) (gross enrollment ratio), secondary school enrollment (SER) (gross enrollment ratio), and tertiary school enrollment (TER) (gross enrollment ratio). The dependent variable is economic growth, measured by the GDP growth rate (GDPGR). Labor (L) (total labor force) and capital (K) (proxied by gross capital formation (% of GDP) were added as control variables in the augmentation of Solow's growth model. The data were sourced from the World Bank Development Indicators (2021) statistical bulletin. However, school enrollment data for Iraq and Lebanon were unavailable. Similarly, data on tertiary school enrollment for Turkey and the United Arab Emirates were missing. Furthermore, capital data for Syria and Yemen were not available. The study focuses on the twenty-first century, covering the period from 2000 to 2020, to provide a comprehensive analysis of the most recent and relevant data. Moreover, the study applied the natural logarithm to the school enrollments and labor data to facilitate efficient estimation.

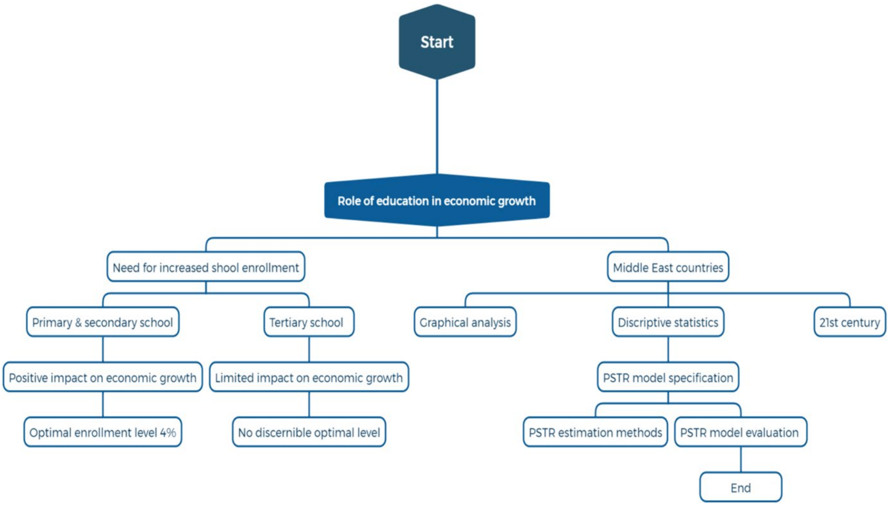

Fig. 3 Study workflow diagram

The decision to focus on MEC is driven by their shared characteristics and the insights these can provide. Geographically proximate, these nations often have similar economic structures, making them ideal for a cross-sectional study. There is a regional emphasis on education, as seen in the proactive enrollment rates, which aligns with the study's focus. Despite being predominantly Arab, the Middle Eastern offers a homogenous cultural context with diverse socio-economic conditions, creating a unique setting for analyzing the impact of school enrollment on economic growth. This combination of factors justifies the selection of the Middle Eastern for a comprehensive analysis that considers both shared characteristics and individual country dynamics. Figure 3 presents a detailed flowchart of our study.

Model Framework

In order to encourage growth, production elements such as capital and labor are used in varying proportions. However, optimal usage of these resources for increased output necessitates well-trained staff. Education is the primary means of acquiring training and skills. Therefore, following Pritchett (2001), this study augments the Solow (1956) aggregate production framework (where output is a function of labor, capital, and technical change) to introduce educational capital as the technical change factor. Hence, the model is specified as follows:

$$GDPGR_{it} = \beta_0 + \beta_1 L_{it} + \beta_2 K_{it} + \beta_3 PER_{it} + \beta_4 SER_{it} + \beta_5 TER_{it} + e_{it} \tag{1}$$

where GDPGR is economic growth, PER is the primary school enrollment, SER is the secondary school enrollment, TER is the tertiary school enrollment, β_0 is constant, β_1, β_2, β_3, β_4, and β_5 are the coefficients of the parameters *L*, *K*, PER, SER, and

TER, e_{it} is the error term, i and t mean a given country i at year t. The theoretical a priori expectations are PER > 0, SER > 0, TER > 0, $L > 0$, and $K > 0$.

Estimation Method

The estimation method will be executed in several steps. First, we will commence with a graphical analysis to examine the trends of the variables. Second, the series' descriptive statistics will be estimated to understand the statistical characteristics of the variables. Finally, the PSTR model will be estimated. This model's implementation involves three stages: specification, which determines if the data aligns more with a linear or nonlinear model; estimation, which concerns the determination of the model's parameters; and evaluation, where the statistical adequacy of the model is tested.

The decision to employ the PSTR model in this study is rooted in its unparalleled capabilities. One of the primary objectives of this study is to capture regime changes and thresholds—details that traditional linear model, such as OLS, simply cannot grasp. Instead of settling for an approximation, it is imperative for the study's integrity and accuracy to employ a nonlinear model. While a numerous of nonlinear models exists that can estimate regime changes and thresholds, the PSTR model is preeminent due to its advanced techniques and precision in handling these specific challenges. Hence, this study employs a nonlinear model to achieve its objectives. Furthermore, the selection of the PSTR model is not arbitrary. To the author's knowledge, this study stands as a pioneering endeavor in leveraging the PSTR model to decipher the complexities of educational relationships in MEC. This is not just an academic exercise; the PSTR model holds the potential to unearth insights that are indispensable for policymakers. Especially in the context of the Middle Eastern, where education (particularly school enrollment) is intrinsically linked to economic growth, the model's ability to provide substantive answers to crucial questions could be transformational.

The PSTR model is a nonlinear model developed by González et al. (2005). The authors of this model generalized the smooth transition regression (STR) model by allowing the regression coefficients to change smoothly when moving from one "extreme" regime or state to another, i.e., low and high regimes. In this study, the low regime is during low or less school enrollment, while the high regime is during high school enrollment. The benefits, or rather the reasons, for employing the PSTR model are as follows: first, it allows the regression coefficients to change for each of the provinces in the panel along with time, thereby providing more consistent estimators. Second, PSTR modeling enables a smooth rather than abrupt transition between extreme regimes, a more flexible and reliable framework. Third, the threshold value is not given a priori but is calculated in the model. Fourth, it captures nonlinearities and regime switching. Fifth, PSTR allows coefficients to vary continuously with transition variables, effectively ensuring the continuity of regime transitions. Sixth, in a PSTR model, regression coefficients might take on a small number of different values depending on the value of another observable variable. To put it another way, the observations in the panel are divided into a small number of homogeneous groups, or "regimes," each with its own set of coefficients (Bi et al., 2019; Heidaria et al., 2015). The PSTR paradigm can be stated as follows:

$$y_{it} = \mu_i + \beta_0 x_{it} + \beta_1 x_{it} g\left(q_{it};\gamma, c\right) + u_{it} \tag{2}$$

for $i=1$, 2,...... N, and $t=1$, 2,...... T, where N and T represent the panel's cross-section and time dimensions, respectively, y_{it} denotes an explained variable, x_{it} denotes a k-dimensional vector of time-varying explanatory variables, μ_i denotes individual fixed effects, and u_{it} denotes error term. The transition variable is q_{it}, the slope parameter is γ, the location parameter is c, and the regression coefficients are β_0 and β_1. The transition function $g(\bullet)$ is a continuous function of the observable transition variable q_{it} normalized to be between 0 and 1. Granger and Terasvirta (1993) and Terasvirta (1994) describe the transition function using the logistic specification as follows:

$$g\left(q_{it};\gamma, c\right) = \left(1 + exp\left(-\gamma \prod_{j=1}^{m} \left(q_{it} - c_j\right)\right)\right)^{-1}, \gamma > 0, c_1 \leq c_2 \leq \cdots \cdots cm \tag{3}$$

where c_j is a location parameter, m is the number of location parameters, and the slope parameter γ controls the transition's smoothness. The function's limitations are set solely for identification. The regression coefficients in the above PSTR model are made up of the linear element β_0 and the nonlinear element $\beta_0 \bullet g(\bullet)$, and they fluctuate between β_0 and $\beta_0 + \beta_1$ as the threshold variable q_{it} increases, with the fluctuation centered at c_j. Compared to a threshold model, a PSTR model allows the regression coefficients to alter gradually as observations travel from one group to the next. This assumption is more plausible, which is why the PSTR model is gaining popularity (Bi et al., 2019). Nonetheless, running the PSTR model comprises three steps—specification (testing for linearity), parameter estimation, and evaluation.

Descriptive Results

Graphical Analysis

This part presents the results of the analysis. It starts with the graphical representations of the series, namely, primary school enrollment, secondary school enrollment, tertiary school enrollment, labor, capital, and economic growth as shown in Fig. 4. From the figure, lnPER portrayed a fluctuating trend and witnessed a decline in recent years, which means primary school enrollment is not stable and is weakening. lnSER displayed a trend similar to that of lnPER, except it is proportionately high and has been declining in recent years. Secondary school enrollment is not stable but is partially growing. lnTER declined around the beginning of the century, precisely between the year 2002 and 2004, and then continued to increase and thus display an upward trend over the period, even in recent years, which means tertiary school enrollment is on the increase. ln$L$ displayed an upward trend throughout the period, even in recent years,

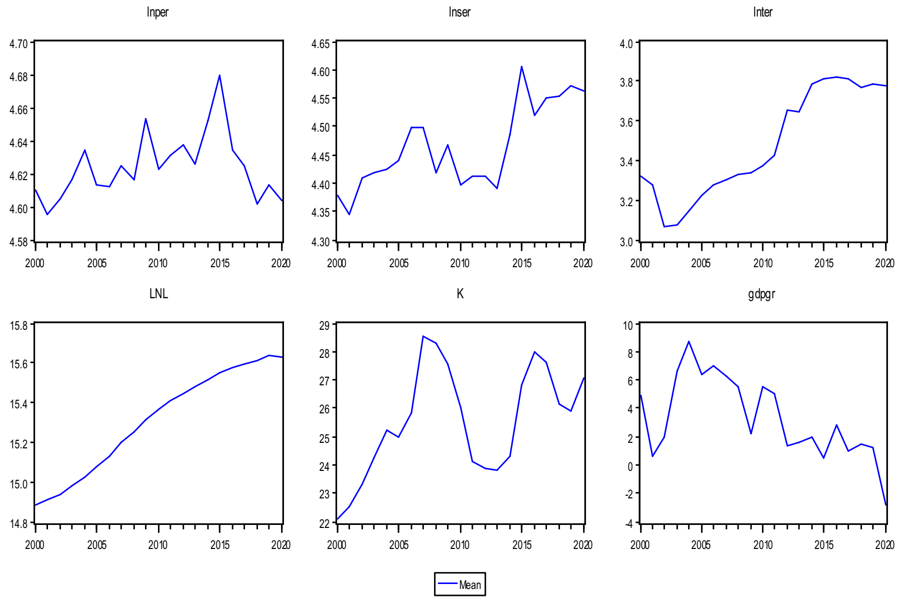

Fig. 4 Panel graphical representations

which means the labor force is increasing. ln*K* displayed a fluctuating trend, but the trend has been increasing in recent years, so capital is increasing. GDPGR reports a fluctuating trend with a massive decline in recent years; thus, economic growth is falling.

Descriptive Statistics

Table 1 shows the descriptive statistics of the series under investigation, i.e., lnPER, lnSER, lnTER, ln*L*, *K*, and GDPGR. From the table, the skewness shows that the elements of the variables lnPER, lnSER, and lnTER are negatively skewed, while those of ln*L*, *K*, and GDPGR are positively skewed. However, the distribution of all the variables, except for lnSER, significantly departs from a normal distribution based on the significant *P*-values in the Jarque–Bera test.

Table 2 reports the multicollinearity test results for explanatory variables in the study. The VIF values for each variable lnPER, lnSER, ln*L*, and *K* are all below the commonly used threshold of 10 and even below a more conservative threshold of 5, indicating no significant multicollinearity issues among the variables. The specific VIF values range from 1.00 to 1.86, with the Mean VIF calculated as 1.46, further confirming the low level of multicollinearity. This suggests that the explanatory variables in the study are reasonably independent in the regression model.

Table 1 Descriptive s tatistics

	lnPER	lnSER	lnTER	ln*L*	*K*	GDPGR
Mean	4.624798	4.014737	3.634449	15.15974	26.03506	4.433110
Median	4.644833	4.497676	3.719601	14.86207	24.14706	4.099240
Maximum	4.754163	4.766117	4.303539	17.21580	45.99879	26.17025
Minimum	4.350103	4.153120	2.338046	12.78677	12.21837	−7.444557
Std. Dev	0.073926	0.131525	0.467987	1.336641	7.891657	4.511036
Skewness	−1.581433	−0.349790	−0.530432	0.275818	0.541665	1.716400
Kurtosis	5.844128	2.759428	2.384827	1.726782	2.306069	8.888542
Jarque–Bera	82.92527	2.508403	6.892744	8.824692	7.586072	212.9373
Probability	0.000000	0.285304	0.031861	0.012127	0.022527	0.000000
Sum	508.7278	496.6210	399.7894	1667.572	2863.856	487.6421
Sum Sq. Dev	0.595689	1.885568	23.87230	194.7405	6788.329	2218.090

Table 2 Multicollinearity test results for the explanatory variables

Variable	VIF	1/VIF
LnPER	1.86	0.537323
LnSER	1.78	0.560715
Ln*L*	1.06	0.941940
K	1.00	0.996706
Mean VIF	1.46	

Estimation Results

Estimation of the PSTR on School Enrollments and Economic Growth

Tables 3, 4, and 5 display the results of the linearity (homogeneity) test for testing the null hypothesis of the linearity effect between lnPER and economic growth, lnSER and economic growth, and lnTER and economic growth as well as a sequence of homogeneity test for selecting the number of switches 'm' of the selected transition variables (i.e. lnPER, lnSER, and lnTER) (i.e., where economic growth is the dependent variable). From Tables 3 and 4, the LM tests based on the transition variables lnPER and lnSER indicate that the most decisive rejection of the null hypothesis of linearity in the relationships (i.e., the bolded) is where $m=1$ and 2 for the Tables 3 and 4, respectively, at the 1% level of significance, as evidenced by the *P*-values of the LM_*X* and LM_*F* tests. More so, the sequence of homogeneity test for selecting the number of 'm' switches is 1 for both the Tables 3 and 4 at the 1% level of significance. However, from Table 5 when lnTER is the transition variable, the tests reject the null hypothesis of linearity and valid switch. These results mean a nonlinear relationship exists between lnPER and economic growth and between lnSER and economic growth. This

Table 3 Results of the linearity (homogeneity) tests where *lnPER* is the transition variable

LM tests based on transition variable "lnPER"'								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	**24.34***	**0.0001868**	**4.378**	**0.0008943**	**7.414**	**0.1916**	**1.334**	**0.2523**
2	28.24*	0.0016530	2.465*	0.0089710	9.049	0.5275	0.790	0.6384
Sequence of homogeneity tests for selecting number of switches "*m*":								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	**24.340***	**0.0001868**	**4.3780***	**0.0008943**	**7.414**	**0.1916**	**1.3340**	**0.2523**
2	4.476	0.4831000	0.7815	0.5644000	5.570	0.3504	0.9725	0.4363

Note: * denote significance at 1% level, respectively. Moreover, the bold denotes significance order of *m*

Table 4 Results of the linearity (homogeneity) tests where *lnSER* is the transition variable

LM tests based on transition variable "lnSER"								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	15.23*	0.009437	2.739**	0.020830	6.041	0.3022	1.0870	0.3695
2	**28.50***	**0.001501**	**2.488***	**0.008364**	**9.010**	**0.5312**	**0.7866**	**0.6417**
Sequence of homogeneity tests for selecting number of switches "*m*":								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	**15.23***	**0.009437**	**2.739****	**0.02083**	**6.041**	**0.3022**	**1.0870**	**0.3695**
2	14.43**	0.013070	2.520**	0.03148	4.591	0.4678	0.8017	0.5500

* and ** denote significance at 1% and 5% levels, respectively. Moreover, the bold denotes significance order of *m*

Table 5 Results of the linearity (homogeneity) tests where *lnTER* is the transition variable

LM tests based on transition variable "lnTER"								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	6.151	0.2918	1.106	0.3588	6.261	0.2816	1.1260	0.3483
2	12.760	0.2376	1.114	0.3547	10.370	0.4085	0.9054	0.5296
Sequence of homogeneity tests for selecting number of switches "*m*":								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	6.151	0.2918	1.106	0.3588	6.261	0.2816	1.1260	0.3483
2	6.828	0.2337	1.192	0.3152	3.972	0.5535	0.6935	0.6291

suggests the appropriateness of using the PSTR model in estimating such relationships in MEC. However, there is a linear relationship between tertiary school enrollment and economic growth, which suggests the need for using the linear panel regression (LPR) model in estimating such a relationship in the MEC. In

Table 6 Hausman test for selecting between random effect and fixed effect models

Test:Ho:difference in coefficients not systematic
chi2(5) = (b-B)'[(V_b-V_B)^(− 1)](b-B)
= 26.23
Prob > chi2 = 0.0001

Table 7 Results of the PSTR estimation where *lnPER* is the transition variable

Parameter estimates in the low regime (0)					
	lnPER	lnSER	lnTER	ln$L$	K
Est	− 26.56	− 3.351*	0.2228	− 0.2046	− 4.318*
s.e	20.00	1.109	0.3081	0.1569	1.072
Parameter estimates in the high regime (1)					
	lnPER	lnSER	lnTER	ln$L$	K
Est	5.132	1.307	0.1294	0.2124	5.221*
s.e	9.809	1.318	0.3089	0.2167	1.647
Gamma (γ) c_1 (c)					
Est 0.6789* 4.000*					
s.e. 0.0962 1.232					

*denote significance at 1%, level, respectively

selecting the LPR model, the paper conducts a Hausman test on whether to use the fixed or random effect models, as shown in Table 6.

In Table 6, the Hausman test shows how to choose the right model between random and fixed effects. According to the P-value of the Chi^2, which is significant at the 1% level, the null hypothesis, which states that the difference in coefficients of fixed effect and random effect is not systematic, is rejected. Thus, the suitable model is the fixed effect model for estimating the relationship between tertiary school enrollment and economic growth.

Tables 7, 8, and 9 present the results of the PSTR estimations for the relationships between primary school enrollment and economic growth, secondary school enrollment and economic growth, and the PLR estimations for the relationships between tertiary school enrollment and economic growth (i.e., where economic growth is the dependent variable) in the MEC.[1] From Table 7, where lnPER served as the transition variable, in the low regime, the coefficients of lnPER, lnTER, and ln$L$ are not significant, but that of lnSER and K are significant at a 1% level and are negatively related to the growth rate of the economy which shows that a 1% reduction in lnSER and K will decline the growth rate of the economy by 3.351% and 4.318%, respectively. In the high regime, none of the coefficients is significant except that of K,

[1] It is important to note that interpretation of this model traditionally relied on low and high regimes, where the low regime indicates a decreasing impact of the variable, and the high regime signifies an increasing impact.

Table 8 Results of the PSTR estimation where *lnSER* is the transition variable

Parameter estimates in the low regime (0)					
	lnPER	lnSER	lnTER	ln*L*	*K*
Est	−2.702***	−6.443	0.7031	−0.09821	−3.864*
s.e	1.606	11.420	1.1620	0.26760	1.418
Parameter estimates in the high regime (1)					
	lnPER	lnSER	lnTER	ln*L*	*K*
Est	5.388*	13.130	−0.1542	0.1741	7.223*
s.e	1.570	8.648	0.9475	0.3141	2.767
Gamma (γ) c_1 (c)					
Est 0.3033* 4.0000*					
s.e. 0.1245 0.1945					

* and *** denote significance at 1%, and 10% levels, respectively

Table 9 Results of the PLR based on fixed effect model for *lnTER*

	Coef	Std. Err	*Z*	*P*>*z*
lnTER	0.1338726	0.3368293	0.40	0.691
lnPER	0.2028745	0.2869261	0.71	0.480
lnSER	0.1336525	0.3184082	0.42	0.675
ln*L*	0.0738104	0.0787886	0.94	0.350
K	4.853397*	1.237213	3.92	0.000

Note: * denote significance at 1% level, respectively

which is significant at a 1% level and is positively related, where a 1% increase in *K* will raise the economy's growth rate by 5.221%. Therefore, when primary school enrollment is the transition variable in both regimes, only secondary school enrollment impacts the countries' economy, while primary and tertiary school enrollments are not. The lower bottom of the table contains the threshold results of the estimation, which shows that the estimated threshold level was found to be 4.000 and is significant at a 1% level. Hence, the level from which the primary school enrollment will start to impact the growth rate of the country's economy. This means e^4 (i.e., 55) of the percentage gross primary school enrollment ratio. By implication, any percentage of the gross enrollment ratio of the primary school enrollment that is below 55 is a low regime while above it is a high regime, and it is from that level of the primary gross enrollment ratio that the economy will start to fill the impact of the primary school enrollment. Furthermore, the estimated slope parameter is 0.6789 and is significant at a 1% level, and this supports the smoothness of the primary school enrollment from a low regime to a high regime. Moreover, according to Table 1, the mean of primary school enrollment is 4.624798 of the percentage gross enrollment ratio, and this value is greater than the threshold value, which is 4.000. It means that there is no under-enrollment of primary school enrollment in the countries; that is, considering the economic growth rate of the countries, the primary school enrollment level is at optimal.

From Table 8, where lnSER served as the transition variable, in the low regime, the coefficients of lnSER, lnTER, and ln$L$ are not significant, but that of lnPER and K are significant at 10% and 1% levels, respectively, in which both are negatively related with the growth rate of the economy which shows that a 1% reduction in lnPER and K will decline the growth rate of the economy by 2.702% and 3.864%, respectively. In the high regime, as in the low regime, only lnPER and K are significant at a 1% level and are positively related to the growth rate of the economy, where a 1% reduction in lnPER and K will raise the growth rate of the economy by 5.388% and 7.223%, respectively. Therefore, in both regimes, when secondary school enrollment is the transition variable, only primary school enrollment impacts the countries' economy, while secondary and tertiary school enrollments are not. The lower bottom of the table contains the threshold results of the estimation, which shows that the estimated threshold level was found to be 4.000 (as for primary school enrollment) and is significant at a 1% level. Hence, the level from which the secondary school enrollment will start to impact the growth rate of the countries' economy. This means e^4 (i.e., 55) of the percentage gross secondary school enrollment ratio. By implication, any percentage of gross enrollment ratio of the secondary school enrollment that is below 55 is a low regime while above it is a high regime, and it is from that level of the secondary gross enrollment ratio that the economy will start to fill the impact of the secondary school enrollment. Furthermore, the estimated slope parameter is 0.3033 and is significant at a 1% level, and this supports the smoothness of secondary school enrollment from a low regime to a high regime. Moreover, based on Table 1, the mean of secondary school enrollment is 4.014737 of the percentage gross enrollment ratio, and this value is greater than the threshold value, which is 4.000. Therefore, it suggests that there is no under-enrollment of secondary school enrollment in the countries; that is, considering the economic growth rate of the countries, the secondary school enrollment level is at optimal.

In Table 9, where the study did not find evidence of a nonlinear relationship between tertiary school enrollment and economic growth, which means the impact of the decrease and increase of tertiary school enrollment on the growth rate of the countries' economy has no significant difference; thus, a linear relationship which makes the study to employ a PLR model through the use of the fixed-effect model as suggested by the Hausman test in Table 6. According to the table, none of the coefficients of lnPER, lnSER, lnTER, and ln$L$ is significant, though they are all positively related to the growth rate of the countries' economy, which means negligible impact, but that of K is significant at a 1% level and positively related with the growth rate of the countries' economy where a 1% increase in K causes an increase in the growth rate by 0.67%.

Therefore, primary and secondary school enrollments, i.e., PER and SER, respectively, positively contribute to the economic growth of the countries, while that of the tertiary school enrollment, i.e., TER is negligible. Furthermore, the level of PER and SER that can be adjudged as capable of improving the country's economy is e^4 (i.e., 55) of the percentage gross enrollment. Moreover, considering the average gross enrollments of primary and secondary schools, there are important observations related to their respective threshold values and economic growth. The enrollment value for primary schools is 4.624798, while for secondary schools it is

Table 10 Results of the evaluation tests: parameter constancy and no remaining nonlinearity tests where PER is the transition variable

Parameter constancy test								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	14.03	0.171400	1.188	0.30260	8.998	0.5323	0.7617	0.6654
No remaining nonlinearity (heterogeneity) test								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	H_F	*P*-value
1	10.69	0.3819	0.9052	0.5299	9.000	0.5321	0.7619	0.6652

Table 11 Results of the evaluation tests: parameter constancy and no remaining nonlinearity tests where SER is the transition variable

Parameter constancy test								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	15.55	0.1132000	1.316	0.22570	9.001	0.5320	0.7620	0.6651
No remaining nonlinearity (heterogeneity) test								
M	*X*	*P*-value	*F*	*P*-value	*H_X*	*P*-value	*H_F*	*P*-value
1	23.70	0.348320	2.007	0.14582	8.997	0.5324	0.7616	0.6654

Table 12 Results of the evaluation tests: heteroscedasticity, autocorrelation, and endogeneity tests for *lnTER*

Heteroscedasticity:	2.3723 (0.3423)
Autocorrelation:	13.0000 (0.3010
Endogeneity test:	1.3472 (0.5104)

4.014737. Both of these values are greater than the threshold of 4. This suggests that the primary and secondary school enrollments are not below the optimal level for the economic growth of the countries.

Tables 10, 11, and 12 report the evaluation test results of the estimated PSTR model, where lnPER and lnSER served as the transition variables, and the evaluation test results of the estimated PLR model for checking the statistical adequacy of model where economic growth is the dependent variable. For the PSTR model, two different types of evaluation tests, namely, parameter constancy over time and no remaining nonlinearity or no remaining heterogeneity (Eitrheim & Teräsvirta, 1996), were considered. From Tables 10 and 11, none of the tests reject the null hypothesis of parameter constancy, as none of the tests' *P*-values are significant. Similarly, the test's null hypothesis of no remaining heterogeneity/nonlinearity cannot be rejected as none of the tests' *P*-values are significant. Table 12 shows three evaluation tests: heteroscedasticity, autocorrelation, and

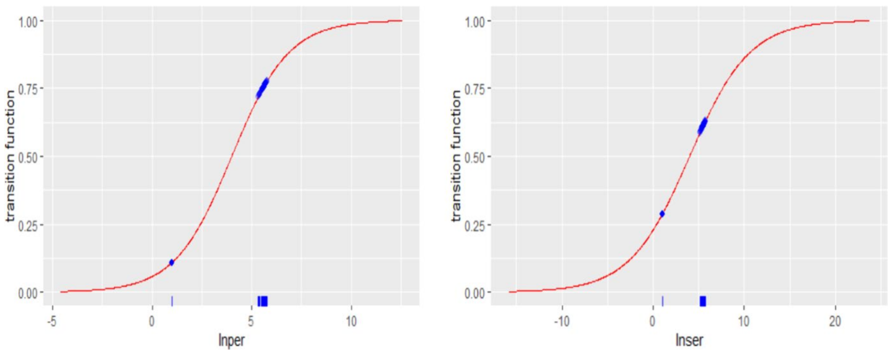

Fig. 5 **a** Transition function using lnPER. **b** Transition function using lnSER

endogeneity for the PLR estimate, where the *P*-values of the test statistics for all three tests are insignificant. Hence, the estimates of the PSTR and PLR are statistically robust.

Figure 5a, b shows the graphs of the transition functions when the transition variables are lnPER and lnSER. The *S* shapes of the functions show how enrollment in primary school and economic growth are linked. The number of people in secondary school and the economy's growth both follow logistic functions. Because of this, a nonlinear relationship moves slowly from one regime to another. From Fig. 5a, the transition parameter is 0.6789 of the primary school percentage gross enrollment, and the threshold value is 4.000 of the primary school percentage gross enrollment. According to the graph, about 13% of the gross enrollment ratio of the primary school is in the low regime, while about 87% of the gross enrollment ratio of the primary school is in the high regime, which means that primary school enrollment is quite high in promoting economic growth in the MEC. This vindicates the earlier claim that the primary school enrollment level promotes the countries' economic growth. From Fig. 5b, the transition parameter is 0.3033 of the secondary school percentage gross enrollment, and the threshold value is 4.000 of the secondary school percentage gross enrollment. According to the graph, about 34% of the gross enrollment ratio of secondary school is in the low regime, and about 66% is in the high regime, which means that secondary school enrollment is quite high in promoting economic growth in the MEC. This justifies the earlier claim that the secondary school enrollment level is influencing the countries' economic growth.

Figure 6a, b illustrates the graphs of the marginal effects of lnPER on economic growth and lnSER on economic growth. From Fig. 6a, it can be observed that the effect is *u*-shaped and thus nonlinear. Furthermore, the effect in Fig. 6b is concave, thus suggesting a nonlinear relation between the variables. These results confirmed the earlier assertion of the study that those relations, i.e., lnPER and lnSER, are nonlinear.

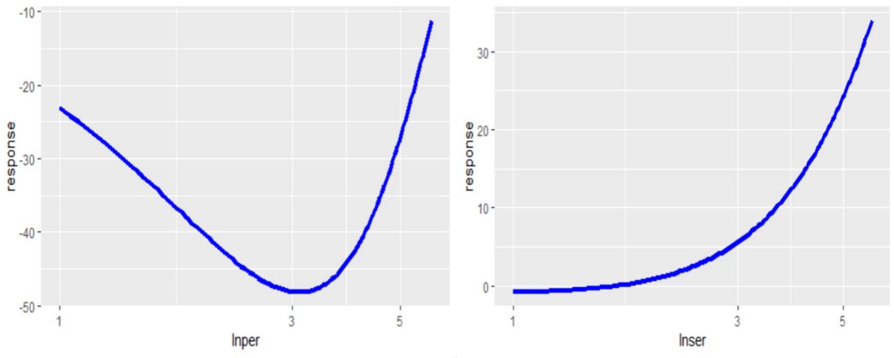

Fig. 6 **a** Response of the economic growth to lnPER. **b** Response of the economic growth to lnSER

Discussion

This study was conducted to investigate the level of school enrollments that can be adjudged as capable for economic growth. It also aimed to determine whether the level of school enrollment is at an optimal level for economic growth and the nature and rate to which school enrollment affects the economic growth of the MEC at low and high regimes in the twenty-first century. The school enrollments were observed in three pieces—primary, secondary, and tertiary school enrollments. The finding has shown that primary and secondary school enrollments are found to be positively developing the growth rate of the economic growth among the MEC at the rate of 2.702% of the gross enrollment ratio of the primary school enrollment and 3.351% of gross enrollment ratio of the secondary school enrollment, while tertiary school enrollment is not helping its growth. However, the level of school enrollment that can be adjudged as capable of improving the economic growth of the MEC is 4% of the gross enrollment ratio of primary and secondary school enrollments, but there is no valid level for such tertiary school enrollment. Furthermore, the level of school enrollment in primary and secondary school is at an optimal level for the economic growth among the MEC while that of tertiary school is below optimal. The affirmations of this study remain consistent with the broader academic consensus (Obradović, et al., 2009; Wirba, 2021). It strengthens the economic principles highlighted by the World Bank Development Indicators (2021), which contends that nations with higher school attendance rates typically experience elevated levels of economic development. Moreover, these findings imply that school enrollments are promoting the economic growth of the MEC, but enrollments of secondary and tertiary schools need to be increased. School enrollment is a significant factor in human development because education can result in increased productivity, innovation, and consumer expenditure, all of which can contribute to economic growth (Olayiwola et al., 2021; Orón Semper et al., 2019; Soeonline, 2020). More so, it is in line with Inside Higher Education (2015), Magin and Simmons (2018), and Bureau of Labor Statistics (2022) who viewed the positive influence of school enrollment on economic development through the reduction of unemployment. In addition, it is consistent with the findings of Ruiz-Eugenio et al. (2023) and Sánchez-Ibáñez et al. (2021) on the view that education can lead to increased productivity, innovation, and consumer expenditure, stimulating economic growth and generating job opportunities. Empirically, the findings of this study are in line with Hassan and Ahmed (2007) in Sub-Saharan Africa, Gumus and Kayhan (2012) in Turkey, Okuneye and Maku (2014) in Nigeria, Ogbeba (2015) in 23 OECD countries, Hanif and Arshed (2016) in SAARC countries, Nnyanzi and Kilimani (2018) in Sub-Saharan African countries, Ridho and Razzaq (2018) in two major groups of countries in the world: Islam and the West, Marquez-Ramos and Mourelle (2019) in Spain, Onwioduokit (2020) in Nigeria, and Maneejuk and Yamaka (2021) in ASEAN-5 countries. However, the findings are in contrast with that of Lilian (2020) in Uganda.

Conclusion and Policy Recommendation

Education is considered an essential component of human capital accumulation and a critical determinant in predicting endogenous growth. Human capital is crucial for long-term economic growth; nevertheless, the most significant contribution is invested in the quality and quantity of education. However, investing in education, in general, implies that we will profit from it. It is not simply putting money into education but also identifying where and what to invest. Our study found that primary and secondary school enrollments significantly contribute to economic growth, with growth rates of 2.702% and 3.351%, respectively. This indicates that increasing gross enrollment ratios at these educational levels can effectively enhance economic development. However, tertiary school enrollment does not exhibit a positive impact on the growth rate, suggesting that current tertiary education policies or systems may need reevaluation. We also found that a gross enrollment ratio of 4% for primary and secondary schools is optimal for stimulating economic growth, while no optimal level is identified for tertiary education. This suggests the importance of focusing on improving enrollment and educational quality at the primary and secondary levels to drive economic progress.

Based on our findings, the following policy recommendations are as follows. First, school enrollments—primary, secondary, and tertiary—are promoting the economic growth of MEC. However, secondary and tertiary enrollments need to be increased. Authorities should maintain and improve current primary school enrollment strategies to sustain economic growth. Furthermore, they should re-evaluate and enhance their approach to secondary and tertiary enrollments to further boost economic progress. Second, there is a need for improving both the primary and secondary school enrollments in the Middle Eastern which require a multi-faceted approach that addresses the various factors that contribute to low enrollment rate at primary and secondary levels, including the construction of additional educational institutions and the enhancement of transportation infrastructure. Third, another strategy involves improving educational quality through investments in teacher training and curriculum development. Fourth, cultural obstacles that hinder girls' school attendance should be addressed. Financial incentives could be provided to families to encourage them to enroll. Lastly, with respect to tertiary school enrollment, the improvement could be achieved by offering vocational training programs that provide students with marketable skills, encouraging private sector investment in education, and providing scholarships and other financial incentives to high-achieving students.

Limitations and Direction for Future Studies

The limitation of this research is that the school enrollment data of both Iraq and Lebanon is not available; thus, these countries were dropped, and the policy implication and recommendations of the findings of this study did not concern them. Furthermore, tertiary school enrollment data of Turkey and the UAE are not available, which means that these countries should not be concern about the policy implication and recommendations of the findings of this study on tertiary school enrollment because the elements of these countries with respect to tertiary school enrollment have not been captured and generalization on that could lead to spurious policy. Thus, future research can be developed on these shortcomings. Moreover, considering the diversity in economic structure, social, and culture of the MEC, the findings of this study may not be applicable to other regions.

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Author Contribution Babar Nawaz Abbasi conceived of the presented idea, designed the model, analyzed the data, carried out the implementation, and drafted the manuscript. All authors discussed the results and contributed to the final manuscript.

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Data Availability The data of this study is available upon request.

Declarations

Ethical Approval This article does not contain any studies with human participants performed by any of the authors.

Informed Consent This article does not contain any studies with human participants performed by any of the authors.

Competing Interests The authors declare no competing interests.

Declaration of AI Assistance After the completion of this paper, the author(s) employed ChatGPT for the final polishing of language and enhancement of readability. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

Abbasi, B. N., Luo, Z., Sohail, A., Yang, L., Huimin, L., & Rongrong, C. (2023). Global shocks of education, health, and environmental footprint on national development in the twenty-first century: A threshold structural VAR analysis. *Journal of the Knowledge Economy*, 1–37. https://doi.org/10.1007/s13132-023-01115-0

Adu-Agyem, J., & Osei-Poku, P. (2012). Quality education in Ghana: The way forward. *International Journal of Innovative Research and Development,1*(9), 164–177.

Akcigit, U., Pearce, J., & Prato, M. (2024). Tapping into talent: Coupling education and innovation policies for economic growth. *Review of Economic Studies*, rdae047. https://doi.org/10.3386/w27862

Akita, T., & Lethro, D. (2024). Pro-poorness of rural economic growth and the roles of education in Bhutan, 2007–2017. *Journal of the Asia Pacific Economy,29*(2), 762–788.

Akkari, A. (2015). Education in the Middle East and North Africa. *International Encyclopedia of the Social & Behavioral Sciences.* (2nd Edn). https://www.sciencedirect.com/referencework/9780080970875/international-encyclopedia-of-the-social-and-behavioral-sciences. Accessed 20 Jul 2023.

Aldawsari, M. I. (2022). *Relationships of the overall globalization index growth, economic performance and education system in Saudi Arabia*. Robert Morris University.

Anderson, J. A., Wright, E. R., Smith, J. S., & Kooreman, H. E. (2007). Educational profiles of students at enrollment in a system of care. *Remedial and Special Education,28*(1), 9–20.

Ansong, D., Renwick, C. B., Okumu, M., Ansong, E., & Wabwire, C. J. (2018). Gendered geographical inequalities in junior high school enrollment: Do infrastructure, human, and financial resources matter? *Journal of Economic Studies,45*(2), 411–425.

Arshed, N., Anwar, A., Kousar, N., & Bukhari, S. (2018). Education enrollment level and income inequality: A case of SAARC economies. *Social Indicators Research,140*, 1211–1224.

Baltova, A., & Vutsova, A. (2024). Quality of education and economic growth–evidence from Southeast European countries. *Economic Alternatives,1*, 86–98.

Benos, N., & Zotou, S. (2014). Education and economic growth: A meta-regression analysis. *World Development,64*, 669–689.

Bi, C., Jia, M., & Zeng, J. (2019). Nonlinear effect of public infrastructure on energy intensity in China: A panel smooth transition regression approach. *Sustainability,11*, 629. https://doi.org/10.3390/su11030629

Bouhlila, D. S. (2011). The quality of secondary education in the Middle East and North Africa: What can we learn from TIMSS'results? *Compare,41*(3), 327–352.

Buckner, E. (2011). The role of higher education in the Arab state and society: Historical legacies and recent reform patterns. *Journal of Comparative & International Higher Education, 3*(Spring), 21–26. https://ojed.org/index.php/jcihe/article/view/809

Bureau of Labour Statistics. (2022). *College enrollment and work activity of recent high school and college*. https://www.bls.gov/news.release/pdf/hsgec.pdf. Accessed 10 Jul 2023.

Caplan, B. (2018). The case against education: Why the education system is a waste of time and money. USA: Princeton University Press.

Choi, M. (2024). Human rights and human capital discourse in national education reforms, 1960–2018. *Comparative Education Review,68*(1), 000–000. https://doi.org/10.1086/728394

Colclough, C. (1982). The impact of primary schooling on economic development: A review of the evidence. *World Development,10*, 167–185. https://doi.org/10.1016/0305-750X(82)90008-0

Craigwell, R., Bynoe, D., & Lowe, S. (2012). The effectiveness of government expenditure on education and health care in the Caribbean. *International Journal of Development Issues,11*(1), 4–18.

Dahal, M. P. (2010). Higher educational enrollment, school teachers and GDP in Nepal: A causality analysis. *Economic Journal of Development Issues,11*(12), 69–91.

Deininger, K. (2003). Does cost of schooling affect enrollment by the poor? Universal primary education in Uganda. *Economics of Education Review,22*(3), 291–305. https://doi.org/10.1016/S0272-7757(02)00053-5

Démurger, S. (2001). Infrastructure development and economic growth: An explanation for regional disparities in China? *Journal of Comparative Economics,29*(1), 95–117.

Eitrheim, O., & Teräsvirta, T. (1996). Testing the adequacy of smooth. *Journal of Econometrics,74*(1), 59–75. https://doi.org/10.1016/0304-4076(95)01751-8

Engida, Y. M. (2021). The three-dimensional role of education for women empowerment. *Journal of Social Sciences,17*(1), 32–38.

Fägerlind, I., & Saha, L. J. (2016). *Education and national development: A comparative perspective*. Pergamon Press.

Glewwe, P., & Muralidharan, K. (2016). Improving school education outcomes in developing countries. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the Economics of Education* (Vol. 5, pp. 653–743). https://doi.org/10.1016/B978-0-444-63459-7.00010-5

Goczek, Ł, Witkowska, E., & Witkowski, B. (2021). How does education quality affect economic growth? *Sustainability,13*(11), 6437.
González, A., Teräsvirta, T., van Dijk, D., & Yang, Y. (2017). *Panel smooth transition regression models* (Working Paper No. 2017:3). Uppsala University, Department of Statistics. Available at https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-332277
Granger, C. W., & Terasvirta, T. (1993). *Modeling nonlinear economic relationships*. Oxford University Press. https://EconPapers.repec.org/RePEc:oxp:obooks:9780198773207. Accessed 12 Nov 2023.
Gumus, S., & Kayhan, S. (2012). The relationship between economic growth and school enrollment rates: Time series evidence from Turkey. *Educational Policy Analysis and Strategic Research,7*(1), 24–38.
Hanif, N., & Arshed, N. (2016). Relationship between school education and economic growth: SAARC countries. *International Journal of Economics and Financial Issues,6*(1), 294–300.
Hanushek, E. A. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature,24*(3), 1141–1177.
Hanushek, E. A., & Woessmann, L. (2010). Education and economic growth. *Economics of Education,60*(67), 1.
Hanushek, E. A., & Wößmann, L. (2007). *The role of education quality for economic growth* (Policy Research Working Paper No. 4122). World Bank. https://documents1.worldbank.org/curated/en/260461468324885735/pdf/wps4122.pdf
Hassan, S., & Ahmed, H. (2007). Education's contribution to the economic growth of Sub-Saharan Africa. *Southwestern Economic Review*, *35*, 175–190.
Heidaria, H., Katircioglu, S. T., & Saeidpour, L. (2015). Economic growth, CO2 emissions, and energy consumption in the five ASEAN countries. *Electrical Power and Energy Systems,64*, 785–791. https://doi.org/10.1016/j.ijepes.2014.07.081
Hota, S. P. (2023). Education infrastructure, expenditure, enrollment & economic development in Odisha. *India. International Journal of Educational Development,103*, 102903.
IndexMundi. (2018). *Primary school enrollment rate (net %) – Country rankings*. Retrieved August 17, 2023, from https://www.indexmundi.com/facts/indicators/SE.PRM.TENR/rankings
Indexmundi. (2021). https://www.indexmundi.com/. Accessed 18 Aug 2023.
Inside Higher Education. (2015). *The unemployment rate, community college enrollments, and tough choices*. https://www.insidehighered.com/views/2015/08/27/unemployment-rate-community-college-enrollments-and-tough-choices-essay. Accessed 04 Jun 2023.
Khalid, S., & Tadesse, E. (2023). Understanding primary school enrollment in the free education era through large-scale from Punjab, Pakistan: Roadblocks to meeting the sustainable development goal. *Child Indicators Research*, 1–26. https://doi.org/10.1007/s12187-023-10102-5
Khan, M., Sarwar, K., & Niazi, G. R. (2023). The impact of education system on economic growth: An empirical evidence from developing economy. *Administrative and Management Sciences Journal,1*(2), 94–102.
Kono, H., Sawada, Y., & Shonchoy, A. S. (2018). Primary, secondary, and tertiary education in Bangladesh: Achievements and challenges. In *Economic and social development of Bangladesh: Miracle and challenges* (pp. 135–149). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-63838-6_7
Lilian, N. (2020). *Master's thesis impacts of higher education enrollment on economic growth in Uganda. A master thesis presented to Ritsumeikan Asia Pacific University in partial fulfillment of the requirements for the degree of master of international cooperation policy specializing in development economics*. https://ritsumei.repo.nii.ac.jp/record/13253/files/51218005.pd
Liu, Y. S., & Lee, L. (2022). Evaluation of college admissions: A decision tree guide to provide information for improvement. *Humanities and Social Sciences Communications,9*(1), 1–12.
Lochner, L. (2011). *Non-production benefits of education: Crime, health, and good citizenship*. NBER Working Paper No. 16722. National Bureau of Economic Research.
Lochner, L. J., & Monge-Naranjo, A. (2011). The nature of credit constraints and human capital. *American Economic Review,101*(6), 2487–2529.
Magin, S., & Simmons, S. (2018). *A look at the correlation between enrollment and unemployment*. https://iushorizon.com/22822/news/a-look-at-the-correlation-between-enrollment-and-unemployment/. Accessed 21 Jul 2023.
Maneejuk, P., & Yamaka, W. (2021). The impact of higher education on economic growth in ASEAN-5 countries. *Sustainability,13*, 520. https://doi.org/10.3390/su13020520
Marquez-Ramos, L., & Mourelle, E. (2019). Education and economic growth: An empirical analysis of nonlinearities. *Applied Economic Analysis,27*(79), 21–45. https://doi.org/10.1108/AEA-06-2019-0005

Nnyanzi, J. B., & Kilimani, N. (2018). Estimation of disaggregated impacts of education expansion on economic growth in Sub-Saharan Africa. *Modern Economy,9*(12), 2119–2149. https://doi.org/10.4236/me.2018.912132

Obradović, J., Long, J. D., Cutuli, J. J., Chan, C. K., Hinz, E., Heistad, D., & Masten, A. S. (2009). Academic achievement of homeless and highly mobile children in an urban school district: Longitudinal evidence on risk, growth, and resilience. *Development and Psychopathology,21*(2), 493–518. https://doi.org/10.1017/S0954579409000273

Ogbeba, E. P. (2015). *Role of education on economic growth: The quality and quantity measures*. A Master Thesis submitted to Institute of Graduate Studies and Research in partial fulfillment of requirement for the degree of Masters of science in Economics. http://hdl.handle.net/11129/3907. Accessed 06 Jul 2023.

Okuneye, B. A. O., & Maku, L. (2014). Primary enrollment and economic growth in Nigeria. *Developing Country Studies,4*(5), 49–59.

Olayiwola, S. O., Adeyemi, F. O., & Ajudua, E. I. (2021). Schooling and economic growth in Nigeria. *Journal of Economic School and Sustainable Studies,18*(1), 114–126.

Onwioduokit, E. (2020). Education, inclusive growth and development in Nigeria: Empirical examination. *Bullion,* 44(2), 3–30. https://dc.cbn.gov.ng/bullion/vol44/iss2/1. Accessed 09 Jun 2023.

Orón Semper, J. V., Akrivou, K., & Scalzo, G. (2019). Educational implications that arise from differing models of human development and their repercussions on social innovation. *Frontiers in Education,4*, 477–495. https://doi.org/10.3389/feduc.2019.00139

Osisanwo, B. G., Babasanya, A. O., Okutimiren, A. O., & Daniel, T. T. (2024). Strategic investment in education: A catalyst for accelerated economic growth in Nigeria. *Economic Insights-Trends & Challenges*, *13*(1). https://doi.org/10.51865/eitc.2024.01.08

Perna, L. W., & Titus, M. A. (2005). The relationship between parental involvement as social capital and college enrollment: An examination of racial/ethnic group differences. *The Journal of Higher Education,76*(5), 485–518.

Pritchett, L. (2001). Where has all the education gone? *The World Bank Economic Review,15*(3), 367–391. https://doi.org/10.1093/wber/15.3.367

Psacharopoulos, G., & Patrinos*, H. A. (2004). Returns to investment in education: A further update. *Education Economics, 12*(2), 111–134.

Qi, D., Ali, A., Li, T., Chen, Y. C., & Tan, J. (2022). An empirical analysis of the impact of higher education on economic growth: The case of China. *Frontiers in Psychology,13*, 959026.

Ridge, N. Y., Kippels, S., & Bruce, E. R. (2019). Education and philanthropy in the Middle East and North Africa: A comparison of GCC and non-GCC states. *Philanthropy & Education,3*(1), 47–72.

Ridho, S. L. Z., & Razzaq, A. (2018). Secondary school enrollment impact on the economic as an essential input of civilization. *Jurnal Ekonomi dan Studi Pembangunan, 10*(2), 202 – 207. https://doi.org/10.17977/um002v10i22018p202

Ruiz-Eugenio, L., Munte-Pascual, A., Khalfaoui, A., & Serradell, O. (2023). Dialogic scientific gatherings with mothers and teachers from a primary school: Raising awareness about the impact of gender and education research. *Humanities and Social Sciences Communications,10*(1), 1–11.

Sánchez-Ibáñez, R., Guerrero-Romera, C., & Miralles-Martínez, P. (2021). Primary and secondary school teachers' perceptions of their social science training needs. *Humanities and Social Sciences Communications,8*(1), 1–11.

Soeonline. (2020). *Understanding the economic impact of education on economic growth*. https://soeonline.american.edu/blog/impact-of-education-on-economic-growth/. Accessed 24 Jul 2023.

Solow, R. M. A. (1956). Contribution to the theory of economic growth. *The Quarterly Journal of Economics,70*, 65–94. https://doi.org/10.2307/1884513

Sun, Z. (2021). An empirical study on the relationship between education and economic development based on PVAR model. *Scientific Programming,2021*, 1–13.

Terasvirta, T. (1994). Specification, estimation and evaluation of smooth transition autoregressive models. *Journal of American Statistical Association,89*, 208–218. https://doi.org/10.1080/01621459.1994.10476462

Toda, H. Y., & Yamamoto. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics, 66*, 225–250. https://doi.org/10.1016/0304-4076(94)01616-8

Tzannatos, Z., Diwan, I., & Ahad, J. A. (2016). *Rates of return to education in twenty-two Arab countries: An update and comparison between MENA and the rest of the world*. Economic Research Forum: Working Paper 1007. Economic Research Forum.

United Nations Children's Education Fund (UNICEF) (2020). Education: Working to ensure that all children in the region have equitable opportunities to quality and relevant education. https://www.unicef.org/mena/education#_ftnref2. Accessed 5 Aug 2023.

Wirba, A. V. (2021). Transforming Cameroon into knowledge-based economy (KBE): The role of education, especially higher education. *Journal of the Knowledge Economy,1–31*, 1. https://doi.org/10.1007/s13132-021-00776-z

Wößmann, L. (2003). Specifying human capital. *Journal of Economic Surveys,17*, 239–270. https://doi.org/10.1111/1467-6419.00195

World Bank Development Indicators. (2021). *Statistical bulletin*. https://data.worldbank.org/. Accessed 13 May 2023.

World Population Review. (2021). https://worldpopulationreview.com/country-rankings/middle-east-countries. Accessed 10 May 2023.

Yu, P., & Delaney, J. A. (2016). The spread of higher education around the globe: A cross-country analysis of gross tertiary education enrollment, 1999–2005. *Educational Policy,30*(2), 281–321.

Zamir, S., Abbasi, B. N., Yu, L., Sohail, A., & Yang, C. (2023). Transformative role of educational funding in shaping national development across SAARC countries in the 21st century: A panel NARDL approach. *Heliyon*, *9*(10). https://doi.org/10.1016/j.heliyon.2023.e20417

Ziberi, B. F., Rexha, D., Ibraimi, X., & Avdiaj, B. (2022). Empirical analysis of the impact of education on economic growth. *Economies,10*(4), 89.