Quality Education for All

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Investing in future: education for sustainable growth in Egypt

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Abstract

Purpose – This paper investigates the relationship between education and economic growth in Egypt, with a particular focus on the role of education within the framework of Sustainable Development Goal (SDG) 4 (Quality Education). Given Egypt's demographic structure and development priorities, this study aims to evaluate how educational indicators contribute to economic performance and sustainable development.

Design/methodology/approach – This study adopts a mixed-methods approach. First, it assesses recent trends in key education indicators to evaluate progress toward SDG 4. Second, it uses the Autoregressive Distributed Lag model using quarterly-transformed time series data from 2002 to 2023 to empirically examine the long- and short-run relationships between education variables (enrollment rates and education expenditure) and economic growth, while controlling for investment and inflation.

Findings – The results reveal a statistically significant long-run relationship between education and economic growth. However, the impact varies across education levels: secondary education shows a negative effect, suggesting possible misalignment with labor market needs, while primary education has an insignificant but positive association. Moreover, government expenditure on education appears to have a marginally negative effect on growth, raising concerns about spending efficiency. These findings highlight persistent structural challenges in Egypt's education system, particularly regarding quality and financing.

Originality/value – This paper contributes to the literature by linking education quality and sustainable development within a country-specific context, using a robust time series econometric framework. It provides policy-relevant insights for Egypt and similar developing countries on how to better align education systems with national development goals and labor market demands.

Keywords Education quality, Economic growth, ARDL model, Sustainable Development Goals (SDGs), Egypt

Paper type Research paper

1. Introduction

Education plays a vital role in achieving economic development in both developed and developing countries, as it is a fundamental pillar for building human capital and thus achieving economic development. The importance of education was emphasized in Schultz's human capital theory and the theory of endogenous growth theory. Some economists, like Higgins, view education as both an input and output of the development process, and they consider investment in education an end in itself.

Despite the economic importance of education, the economics of education has not been a separate subject of scientific research for a long time. The concept of the economics of education emerged in the economic literature only in 1960s, introduced by the economics professor at the university of Chicago, Theodore Schultz, in a speech he delivered before the

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American Economic Association. This does not mean that no one had addressed the topic of education before; rather, it indicates that the study of the economic importance of education and its role in forming human capital began to spread and expand from that date.

The linkage of education to economic growth and development appeared in the writings of Adam Smith when he considered education and Knowledge acquirement a part of society's wealth. This idea also appeared in the work of Karl Marx, who regarded humans as the most valuable capital. Alfered Marshall considered education a form of national investment and emphasized the necessity for economists to pay attention to its role in economic development and the need for the state to bear the costs of education due to its valuable role.

The mechanism through which education contributes to economic growth and development can be identified both directly, through its impact on the productivity of labor force, and indirectly, through its economic, political and social externalities.

First, the Growth Effect of education on economic growth is through its direct contribution in increasing labor productivity and the technological capabilities of the country, thereby enhancing production. This is framed within the model of endogenous growth established by Robert Lucas in 1988, who was credited with incorporating human capital into the production function. Romer, in the same context, argued that the role of human capital is reflected in its direct impact on productivity by determining the ability of nations to innovate new technologies suitable for local production.

Second, the Income Distribution Effect refers to the changes in the private and social returns resulting from obtaining education, within the framework of a microeconomic analysis of private and social rate of return of education. This reflects the relationship between the cost of obtaining this education and the increase in expected income that results from an individual's enrollment in this educational level. This concept is referred to as the Mincer Earning Function, developed by Mincer and expanded upon by Becker, which estimates the earning functions where the dependent variable is income or wages, while the independent variable is the level of education. Thus, it expresses the increase in income resulting from an individual's education attainment.

Third, social and political externalities, which refer to nonmonetary benefits associated with increased rates of enrollment in education, as the enhancement of health indicators due to the awareness improved by education, as well as reduction in poverty rates and crime levels. In addition, many studies have linked education to increased political awareness, enhanced administrative capabilities.

New Growth theories meaning that human capital is a factor or Endogenous growth theories argue that education is considered as one of the main components of human capital. (Romer, 1990) and (Lucas, 1988) pointed out how education affects economic growth through its effect on labor productivity and on technological progress.

Recently, the new growth models and strategies such as sustainable growth and inclusive growth also indicate the importance of education in achieving sustainable and inclusive growth. Education is one of the main outputs of sustainable growth. As sustainable development aspects include social development and enhancing the standard of living which is highly correlated with enhancing education. Education could be considered also as an input and output for inclusive growth, which is the growth that is distributed fairly to society and creates opportunities for all. And one of the main measurements of offering these opportunities is education (Rabah AreKzi, 2012).

In this context, this paper aims to investigate the status of education indicators in Egypt and the link between education and economic growth in Egypt to identify the main factors affecting this link. The paper is divided into three sections beside an introduction and

conclusion, the first is reviewing the recent literature about the link between education and economic growth in section 2. Followed by an analysis of the main education indicator in Egypt in the context of sustainable development goals in section 3. The third section is the methodology used to analyze the link between education and economic growth in section 4.

2. Literature review

The relationship between education and economic growth has long occupied a central place in economic development literature. While early human capital theories posited a direct and positive link between education and national income levels, empirical findings over the past few decades have revealed a more complex and often inconclusive picture. Scholars have debated not only the strength of the education–growth nexus but also the channels through which education influences economic performance, the levels of education that matter most and whether the impact is immediate or delayed. These varying perspectives reflect underlying structural, temporal and contextual differences across countries and stages of development. To provide a clearer understanding of these divergent findings, the following review adopts a thematic approach, grouping the literature into three key subthemes:

(1) the significance of different levels of education in promoting growth;

(2) the mixed or temporally dependent nature of education's impact; and

(3) the role of structural constraints and nonlinearities in shaping the education–growth relationship.

2.1 The significance of education levels in economic growth

The literature reveals varying conclusions about which levels of education most significantly contribute to economic growth, particularly in the context of developing versus developed economies.

A number of studies suggest that not all levels of education have equal economic impact. For example, Abbass (2001) and Chi (2008) found that only secondary and higher education exert a significant influence on growth. In contrast, Petrakis (2002); Leoning (2010); and Pereira (2009) emphasized the importance of lower levels of education, particularly in developing countries, where foundational skills are often lacking and therefore more critical for basic productivity and sectoral development. These findings align with Gad (2025), who argues that primary education plays a more vital role in reducing unemployment, thereby indirectly enhancing growth in Egypt.

Conversely, a more inclusive view is supported by Gyimah-Brempong (2006); Lin (2006); Asteriou (2001); and Bah (2023), who find that all levels of education exert a positive effect on economic growth. This perspective suggests that educational investment at every level may yield economic returns, particularly when complemented by appropriate policy frameworks and labor market absorption.

2.2 Mixed or insignificant effects and the role of temporal dynamics

Despite widespread belief in the growth-enhancing effects of education, some studies question its direct significance, pointing to temporal and contextual variations.

Zhu (2014) and Acharya (2023) argued that education may not have any statistically significant impact on growth, regardless of level. This line of thought is further nuanced by Liao *et al.* (2019) and Mariana (2015), who propose that the relationship is bidirectional but largely confined to the short run. In the long run, the causal direction flows only from education to growth, suggesting a delayed and context-dependent return on educational investments.

In addition, Hojo (2003) introduces the notion of indirect effects, positing that education may not immediately boost economic growth but does so by improving productivity and generating social externalities – including better health outcomes and lower fertility rates – thus contributing to broader development outcomes over time.

2.3 Structural constraints and nonlinearities in the education–growth nexus

A more recent strand of the literature critiques the assumption of linearity in the relationship between education and economic growth, arguing for a threshold or conditional approach.

Ahsan (2017) and Roger (2008) contended that the positive effect of education on economic growth becomes evident only after a country surpasses a certain development threshold. In low-income or institutionally weak countries, structural constraints such as corruption, brain drain and black-market premiums may hinder the translation of educational investment into economic productivity.

This aligns with earlier findings by Petrakis (2002) and Self (2004), who argue that nonlinearity is also evident in the varying returns across different levels of education, especially in developing contexts. Here, primary education may offer higher marginal returns than higher education, due to its foundational role in labor-intensive and low-skill economies.

Although a substantial body of literature has examined the relationship between education and economic growth, much of this work focuses narrowly on enrollment rates or years of schooling, often overlooking the crucial dimension of education quality. Moreover, these studies tend to prioritize economic growth as a unidimensional outcome, with limited engagement with the broader concept of sustainable development, as outlined in the Sustainable Development Goals (SDGs). In the case of Egypt, empirical research remains fragmented and inconclusive regarding which aspects of education most effectively support sustainable and inclusive growth. While some studies highlight the role of primary or secondary education in driving economic performance, others argue for the primacy of higher education or a more balanced, multilevel approach. However, few studies have rigorously analyzed how the quality of education, rather than mere quantity, contributes to Egypt's long-term development objectives.

This paper addresses this critical gap by investigating the nexus between education quality and economic growth in Egypt, situated within the broader context of the SDGs, particularly Goal 4 (Quality Education) and its interlinkages with economic sustainability. Using the Autoregressive Distributed Lag (ARDL) model, the study empirically examines the dynamic relationship between education quality indicators and economic growth over time, while accounting for Egypt's institutional and developmental context. By integrating a time series econometric approach with a sustainability-oriented analytical framework, this paper offers a more nuanced understanding of how improvements in education quality can support Egypt's pursuit of inclusive and sustainable development, in line with Egypt Vision 2030 and global development commitments.

3. Education indicators in Egypt

Quality education is the fourth goal in SDGs that are developed by United Nations to provide a shared blueprint for peace and prosperity for people and the planet, now and into the future. Quality education goal aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This goal supports the reduction of disparities and inequities in education, both in terms of access and quality. It recognizes the need to provide quality education for all, and most especially vulnerable populations, including poor children, children living in rural areas, persons with disabilities, indigenous people and refugee children.

This goal is of critical importance because of its transformative effects on the other SDGs. Sustainable development hinges on every child receiving a quality education. When children

are offered the tools to develop to their full potential, they become productive adults ready to give back to their communities and break the cycle of poverty. Education enables upward socioeconomic mobility.

The Quality Education goal is divided into ten subgoals to capture all the dimensions measuring all aspects of educational process including available inputs and the quantity and quality of outputs (Table 1).

In Egypt, however, the available data (Table 1) does not cover all subtargets and indicators of Quality Education, it gives a clear picture of the status of education in Egypt and highlighted its strength and weakness points as follow:

- Public expenditure on education in Egypt, either measured as a percentage of GDP (1.9%) or a percentage of government expenditure (7.7%), is relatively low and even lower than the targeted percentages stated in the Egyptian constitute (4% of GDP). Education expenditure per student as a percentage of GDP per capita for primary education (9.8%) is lower than the world average (15.6%), and even low compared to its average levels in low- and middle-income countries (11.5%), or Middle East and North Africa (13.7%) [1].
- Although the enrollment rates especially in early levels of education is relatively high in Egypt (Figure 1), the completion rates are also high compared to world average (98% and 88%, respectively), or low- and middle-income countries (87%), the quality of this education measured by the student proficiency rates at all educational levels are low.
- The education gender gap measured by completion rate Gender parity indices indicate some mixed results. While there is almost no gender gap in gross enrollment ratios across different levels of education in Egypt, data on completion rates reveal that the gender gap widens at higher levels of education. Specifically, the gap reaches 6.8 at the secondary level, compared to near gender parity at the primary level (1.1), indicating that a significant proportion of girls drop out of school before completing secondary education.
- The indicators of education basic facilities in different levels of education are high, and there is a significant improvement in these facilities in Egypt in recent years. But the rate of improvement is still lower than the rate of increase of student numbers. Egypt's average classroom density of 47.5 students/classroom in the primary stage is higher than the average in countries such as India and China. More than 75% of Egyptian students are in classrooms that have over 40 students (APS, 2019).
- Although Egypt has a high ratio of qualified teachers, but the number of teachers comparing to the actual needs is relatively low, especially in primary education. The average student–teacher ratio in public primary school is currently 38.7:1 and drops to 28:1 in secondary level. The ideal student–teacher ratio does not have a set, universally accepted number, but experts agreed that an ideal student–teacher ratio is 18:1 while the targeted ratio in ministry of education strategy is 26:1 in primary level meaning that, the public schooling system in Egypt will still need 136,221 more primary teachers by year 2035 (UNICEF, 2024).

4. Methodology

4.1 Model specification

This study adopts an extended version of the Solow Growth Model, following the frameworks developed by Acharya (2023); Cooray (2014); and Dauda (2013), to examine the relationship between education and economic growth in Egypt. The model incorporates

Table 1. Indicators of quality education in Egypt

Targets and indicators	Value	Year
1.a: Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, to provide adequate and predictable means for developing countries to implement programs and policies to end poverty in all its dimensions		
Government exp. on education (%gov. expenditure)*	7.7%	2023
Government exp. on education (%GDP)*	1.9%	2023
4.1: Ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes		
Percentage of students achieve at least a minimum proficiency level in Arabic, (primary)	44.6	2021
Percentage of students achieve at least a minimum proficiency level in mathematics, (secondary)	26.8	2019
Completion rate, primary	94.3	2019
Completion rate, secondary	84.7	2019
4.2: Ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education		
Adjusted net enrolment rate, one year before the official primary entry age	32.5	2021
4.3: Ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university		
Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months	0.4	2022
4.4: Substantial increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship		
Proportion with ICT skills, copy and paste	56.6	2020
Proportion with ICT skills, programming language	10.7	2020
Proportion with ICT skills, install software	64.3	2020
4.5: Eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable		
Upper secondary completion rate adjusted gender parity index	1.1	2017
Gender gap in upper secondary completion rate	6.8	2017
Expenditure on education per student (percentage of GDP per capita), primary; secondary	9.8	2017
Expenditure on education per student (percentage of GDP per capita), secondary	13.8	2017

(*continued*)

Table 1. Continued

Targets and indicators	Value	Year
4.a: Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all		
Computers for pedagogical purposes, primary	84.1	2021
Computers for pedagogical purposes, secondary	89.1	2021
Handwasher basic facilities	100	2016
Electricity, primary	100	2016
Electricity, secondary	85.7	2020
Internet for pedagogical purposes: Primary	71.3	2020
Internet for pedagogical purposes: Secondary	91	2019
4.b: Substantially expand globally the number of scholarships available to developing countries for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programs, in developed countries and other developing countries		
Volume of official development assistance flows (millions US$)	14.2	2022
4.c: substantial increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states		
Proportion of teachers with the minimum required qualifications, primary	86.9	2021
Proportion of teachers with the minimum required qualifications, secondary	84.6	2021

Source(s): UNESCO: SDG 4: Egypt Country Profile, at: https://uis.unesco.org/sites/default/files/country-profile/Egypt.pdf *World Bank data, at: https://data.worldbank.org/indicator/SE.XPD.PRIM.PC.ZS

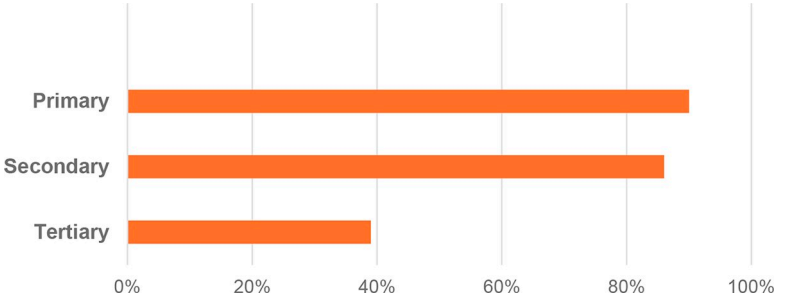

Figure 1. Gross enrollment ratios in Egypt, 2023
Source: World Bank data, at: https://data.worldbank.org/indicator/SE.XPD.PRIM.PC.ZS

key education indicators – government expenditure on education, primary and secondary education enrollment – alongside relevant macroeconomic control variables. The functional form of the model is expressed as follows:

$$\ln GDP_t = \beta_0 + \beta_1 \ln exp\_gov_t + \beta_2 \ln EnrolP_t + \beta_3 \ln EnrolS_t + \beta_4 \ln Inf_t + \ln INV_t + \xi_t$$

where:
GDP = Annual GDP growth rate;
INV = gross capital formation (percentage of GDP);
enrolP = gross enrollment in primary education;
enrolS = Gross enrollment in secondary education;
Exp_gov = government expenditure on education (%gov. exp.);
Inf = inflation rate; and
ξ_t = error term.

4.2 Data sources and transformation

The study uses secondary time series data spanning the period from 2002 to 2023, extracted from the World Bank's World Development Indicators database. The data set used in this paper is publicly available at https://zenodo.org/records/17413890. Given the relatively small number of annual observations (22), and to meet the sample size requirements for time series econometric analysis, the data were transformed from annual to quarterly frequency using interpolation techniques in EViews 13. This transformation enhances the statistical power of the estimation, particularly when applying the ARDL model, which benefits from a larger number of observations for identifying both short- and long-run dynamics. The interpolated quarterly series maintains the original data's trend and cyclical properties.

4.3 Descriptive statistics and preliminary analysis

Table 2 presents the descriptive statistics for the logarithmic form of all variables. The variables display relatively low levels of dispersion, and skewness and kurtosis values are within acceptable ranges for time series data. The correlation matrix (Table 3) shows modest correlations among education, investment and macroeconomic variables, suggesting the absence of multicollinearity. These statistics serve as a diagnostic check before proceeding to econometric estimation.

Table 2. Descriptive statistics

Indicator	LNENROL_P	LNENROL_S	LNEXP_GOV	LNGOWTH	LNINF	LNINV
Mean	4.541951	4.356944	1.226429	1.391817	2.275541	2.833544
Median	4.546581	4.380075	1.297963	1.450004	2.309319	2.836788
Maximum	4.602668	4.449597	1.598504	1.967991	3.522966	3.108602
Minimum	4.498885	4.155519	0.530628	0.567908	1.006950	2.555318
Std. dev.	0.031186	0.072161	0.294623	0.400025	0.591204	0.142512
Skewness	0.182954	−1.594834	−0.813725	−0.357951	0.074893	−0.115143
Kurtosis	2.070274	5.201813	2.793057	2.307307	3.133484	2.379190

Source(s): Calculated by the researcher using Eviews-13

Table 3. Correlation matrix

Variables	LNENROL_P	LNENROL_S	LNEXP_GOV	LNGOWTH	LNINF	LNINV
LNENROL_P	1	−0.00468	−0.35898	0.05415	0.04155	−0.04125
LNENROL_S	−0.00468	1	−0.3339	0.11589	−0.08306	−0.19961
LNEXP_GDP	−0.1444	−0.23984	0.85185	−0.14458	−0.48628	0.3218
LNEXP_GOV	−0.35898	−0.33386	1	−0.168186	−0.414768	0.1875
LNGOWTH	0.054148	0.11589	−0.16819	1	0.33647	0.56125
LNINF	0.04155	−0.083066	−0.41477	0.336467	1	−0.0892
LNINV	−0.04125	−0.19961	0.1875	0.561251	−0.0892	1

Source(s): Calculated by the researcher using Eviews-13

4.4 Unit root testing and model selection

To determine the stationarity properties of the variables, the augmented Dickey–Fuller (ADF) test was applied. The results indicate that all variables are integrated of order one [I(1)], except for inflation, which is stationary at level [I(0)]. This mix of integration orders validates the use of the ARDL bounds testing approach, which allows for a combination of I(0) and I(1) regressors. The optimal lag length for the ARDL model was selected using the Akaike Information Criterion (AIC), resulting in a lag structure of ARDL (1, 1, 4, 0, 1, 4) [2].

5. Results and discussion

5.1 Bounds test for cointegration

The ARDL bounds testing approach was used to examine the presence of a long-run equilibrium relationship between education and economic growth. The calculated *F*-statistic exceeds the upper bound critical value, confirming the existence of cointegration among the variables. This implies that education variables, alongside macroeconomic factors, are jointly significant in explaining long-run fluctuations in economic growth in Egypt.

5.2 Long-run coefficient

To test the cointegration between education and economic growth, Bound test is adopted to confirm the existence of a long-run relationship (Table 4). The results confirm the existence of a long-run correlation between the variables because the *F*-statistic is above the upper critical values of Bounds test (Table 5).

Table 4. ARDL estimates

Variable	Coefficient	Std. error	*t*-Statistic	Prob.*
LNGOWTH(−1)	0.716403	0.062529	11.45706	0.0000
LNEXP_GOV	−0.136252	0.075927	−1.794523	0.0772
LNINV	2.269093	0.257032	8.828070	0.0000
LNINV(−1)	−1.530048	0.371027	−4.123812	0.0001
LNINV(−2)	−2.36E-12	0.345544	−6.83E-12	1.0000
LNINV(−3)	2.63E-13	0.345544	7.62E-13	1.0000
LNINV(−4)	−0.666777	0.286005	−2.331345	0.0228
LNENROL_S	−1.419500	0.521524	−2.721829	0.0083
LNENROL_S(−1)	0.799676	0.682586	1.171538	0.2455
LNENROL_S(−2)	−9.97E-12	0.677263	−1.47E-11	1.0000
LNENROL_S(−3)	2.55E-11	0.677263	3.76E-11	1.0000
LNENROL_S(−4)	0.989763	0.518977	1.907144	0.0608
LNENROL_P	1.029191	1.253982	0.820738	0.4147
LNENROL_P(−1)	−1.728743	1.275512	−1.355333	0.1799
LNINF	0.086037	0.058875	1.461355	0.1486
LNINF(−1)	−0.129648	0.058086	−2.231981	0.0290
C	2.050545	3.269669	0.627141	0.5327
R-squared	0.913691	Mean dependent var		1.416600
Adjusted *R*-squared	0.893080	SD dependent var		0.385062
F-statistic	44.33002	Durbin–Watson stat		1.941884

Source(s): Eviews-13 estimation results

Table 5. Bound test results

Bounds test						
Null hypothesis:			No levels relationship			
Number of cointegrating variables:			5			
Trend type:			Rest. constant (Case 2)			
Sample size:			84			
Test statistic			Value			
F-statistic			4.850977			
Bounds critical values						
Sample size	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
80	2.303	3.154	2.550	3.606	3.351	4.587
Asymptotic	2.080	3.000	2.390	3.380	3.060	4.150

Note(s): *I(0) and I(1) are respectively the stationary and nonstationary bounds*
Source(s): Eviews-13 estimation results

The estimated long-run coefficients provide important insights into the differentiated effects of education on growth (Table 3). Notably, secondary education enrollment (LNENROL_S) has a significant negative impact on economic growth ($p < 0.01$), suggesting that secondary education may be misaligned with labor market demands or suffering from quality deficiencies. Primary education enrollment (LNENROL_P), on the other hand, is positively associated with growth, but the effect is statistically insignificant, implying a limited role in driving long-term economic outcomes under current conditions.

Government expenditure on education (LNEXP_GOV) shows a negative and marginally significant effect ($p \approx 0.077$), raising concerns about efficiency and return on public education spending. These findings point to possible structural inefficiencies or allocation mismatches within Egypt's education sector. Investment (LNINV) exerts a strong and highly significant positive influence on growth, highlighting its central role in capital accumulation and productive capacity expansion.

The ARDL model is estimated as follows:

5.3 Short-run dynamics and adjustment speed

The Error Correction Model estimates the short-run dynamics (Table 6). The error correction term (COINTEQ) is negative and highly significant (−0.283; $p < 0.01$), confirming the presence of a stable long-run equilibrium. The coefficient implies that approximately 28.3% of any deviation from the long-run path is corrected each quarter, indicating a moderate speed of adjustment toward equilibrium.

In the short run, secondary education continues to exert a negative and significant effect on economic growth across multiple lags. This persistent negative influence raises concerns about education system effectiveness, quality of learning outcomes and labor market absorptive capacity. In contrast, primary education remains statistically insignificant, and inflation's short-term effects are mixed. Investment variables maintain strong positive effects, reinforcing their importance in driving near-term economic performance.

5.4 Model stability and diagnostic tests

To verify the model's robustness, CUSUM and CUSUM of Squares tests were conducted. As shown in Figure (2), both tests confirm that the model's parameters are structurally stable over time, and there is no evidence of parameter instability or heteroskedasticity. The Durbin–Watson statistic is close to 2, indicating the absence of serial correlation in residuals.

Table 6. Error correction model

Variable	Coefficient	Std. error	*t*-statistic	Prob.
COINTEQ*	−0.283597	0.046625	−6.082578	0.0000
D(LNENROL_P)	1.029191	1.153043	0.892587	0.3750
D(LNENROL_S)	−1.419500	0.462990	−3.065938	0.0030
D[LNENROL_S(−1)]	−0.989763	0.486796	−2.033220	0.0457
D[LNENROL_S(−2)]	−0.989763	0.486796	−2.033220	0.0457
D[LNENROL_S(−3)]	−0.989763	0.486796	−2.033220	0.0457
D(LNINF)	0.086037	0.052597	1.635772	0.1062
D(LNINV)	2.269093	0.235614	9.630556	0.0000
D[LNINV(−1)]	0.666777	0.258477	2.579641	0.0119
D[LNINV(−2)]	0.666777	0.258477	2.579641	0.0119
D[LNINV(−3)]	0.666777	0.258477	2.579641	0.0119
R-squared	0.650190	Mean dependent var		0.005389
Adjusted *R*-squared	0.602271	SD dependent var		0.191268
Log likelihood	64.37006	Hannan–Quinn criter		−1.142753
F-statistic	13.56847	Durbin–Watson stat		1.941884
Prob(*F*-statistic)	0.000000			

Source(s): Eviews-13 estimation results

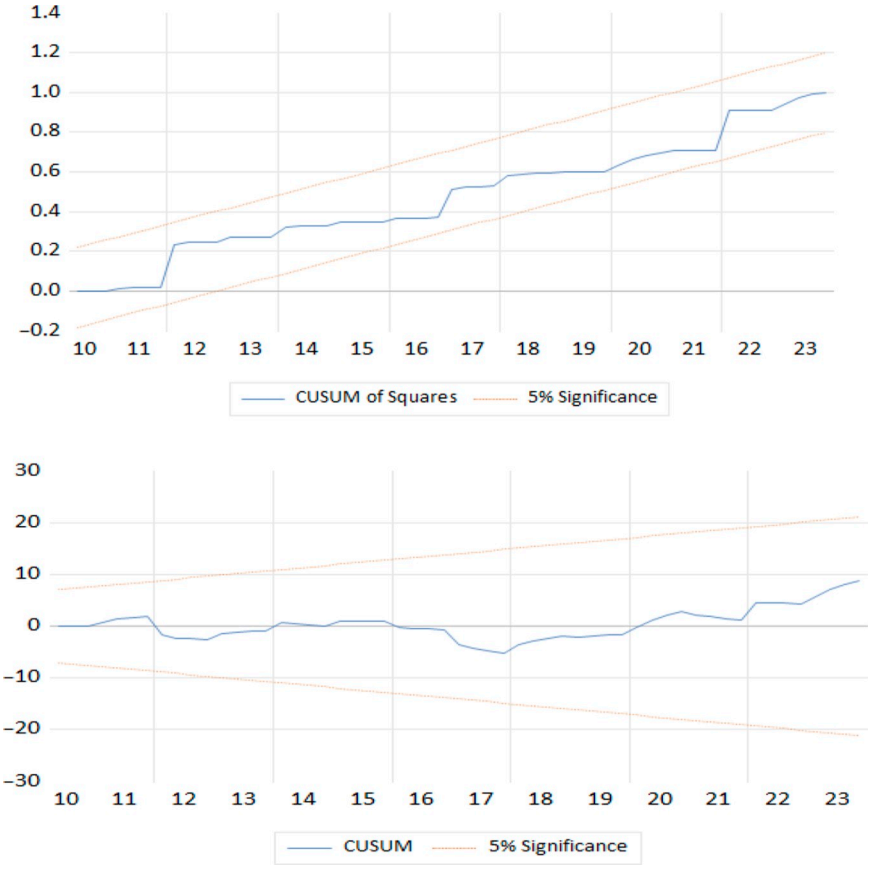

Figure 2. CUSUM test and CUSUM of square tests
Source: Eviews-13 estimation results

6. Conclusion and policy implications

This study set out to investigate the role of education in promoting economic growth in Egypt, with a particular focus on the quality and effectiveness of educational inputs in light of SDG4 (Quality Education). The analysis combined a review of key education indicators with an econometric assessment based on an extended Solow growth model using quarterly data from 2002 to 2023. The results highlight that, although Egypt has made notable progress in expanding access to education – especially at the primary and secondary levels – persistent structural challenges remain, particularly regarding education quality and the efficiency of public education spending.

The empirical findings from the ARDL model reveal a long-run relationship between education and economic growth. Notably, secondary education enrollment exerts a significant negative effect on growth, while primary education shows a positive but statistically insignificant relationship. These results suggest that education in Egypt, particularly at the secondary level, may not be sufficiently aligned with labor market needs. Inadequate skill development, outdated curricula and limited vocational and technical training may be undermining the ability of the education system to translate human capital investments into

economic productivity. Furthermore, the marginally negative impact of government expenditure on education points to possible inefficiencies in resource allocation and utilization.

Given these findings, several policy implications emerge:

- Shift the focus from access to quality: While increasing enrollment remains important, policy attention must prioritize improving learning outcomes, teacher training, infrastructure and curriculum relevance. Quality assurance frameworks should be strengthened to ensure that education translates into employable skills and productivity gains.
- Align secondary education with labor market needs: Reforming secondary education to include more technical, vocational and practical training is critical. Partnerships with the private sector can help identify skill gaps and develop tailored programs that enhance the employability of graduates.
- Improve the efficiency of public spending on education: Given fiscal constraints, Egypt must maximize the return on education investments by targeting spending toward high-impact areas such as teacher development, digital learning tools and marginalized regions. Enhancing governance and transparency in education financing will also help reduce resource leakage.
- Strengthen the education-growth feedback loop: Policies that integrate education with national economic planning – especially in high-employment sectors like industry, construction and services – can enhance the role of education as a driver of sustainable development. Cross-sectoral coordination between the Ministries of Education, Planning and Manpower is essential.
- Leverage international cooperation and financing: To overcome domestic funding constraints, Egypt should strengthen engagement with international development partners, tapping into global funds for education reform, particularly those aligned with SDG4 and inclusive growth.

In sum, this paper underscores that education alone is not sufficient to drive growth – its impact depends on quality, relevance and effective public policy. For Egypt to harness the full developmental potential of education, systemic reforms are required that go beyond increasing enrollment to focus on improving learning quality and aligning education outcomes with the country's sustainable development objectives.

Notes

[1.] Numbers from: world bank data, at: https://data.worldbank.org/indicator/SE.XPD.PRIM.PC.ZS

[2.] All Eviews test results could be found in the paper statistical Appendix.

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Appendix. (ADF) unit root test results

Table A1. Null hypothesis: D(LNGOWTH) has a unit root; exogenous: constant; lag length: 0 (automatic – based on SIC, maxlag = 4)

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−5.019163	0.0007
Test critical values	1% level	−3.808546	
	5% level	−3.020686	
	10% level	−2.650413	

Note(s): *MacKinnon (1996) one-sided *p*-values

Table A2. Exogenous: constant; lag length: 0 (automatic – based on SIC, maxlag = 4); augmented Dickey–Fuller test statistic

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−3.328983	0.0271
Test critical values	1% level	−3.808546	
	5% level	−3.020686	
	10% level	−2.650413	

Note(s): *MacKinnon (1996) one-sided *p*-values

Table A3. Exogenous: constant; lag length: 0 (automatic – based on SIC, maxlag = 4); augmented Dickey–Fuller test statistic

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−4.466705	0.0025
Test critical values	1% level	−3.808546	
	5% level	−3.020686	
	10% level	−2.650413	

Note(s): *MacKinnon (1996) one-sided *p*-values

Table A4. Null hypothesis: D(LNENROL_S) has a unit root; exogenous: constant; lag length: 0 (automatic – based on SIC, maxlag = 4)

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−4.267240	0.0038
Test critical values	1% level	−3.808546	
	5% level	−3.020686	
	10% level	−2.650413	

Note(s): *MacKinnon (1996) one-sided *p*-values

Table A5. Null hypothesis: D(LNINV) has a unit root; exogenous: constant; lag length: 0 (automatic – based on SIC, maxlag = 4)

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−3.579587	0.0162
Test critical values	1% level	−3.808546	
	5% level	−3.020686	
	10% level	−2.650413	

Note(s): *MacKinnon (1996) one-sided *p*-values

Table A6. Null hypothesis: D(LNINF) has a unit root; exogenous: constant; linear trend; lag length: 0 (automatic – based on SIC, maxlag = 4)

Statistics	Significance levels	*t*-statistic	Prob*
ADF test statistic		−3.736222	0.0433
Test critical values	1% level	−4.498307	
	5% level	−3.658446	
	10% level	−3.268973	

Note(s): *MacKinnon (1996) one-sided *p*-values

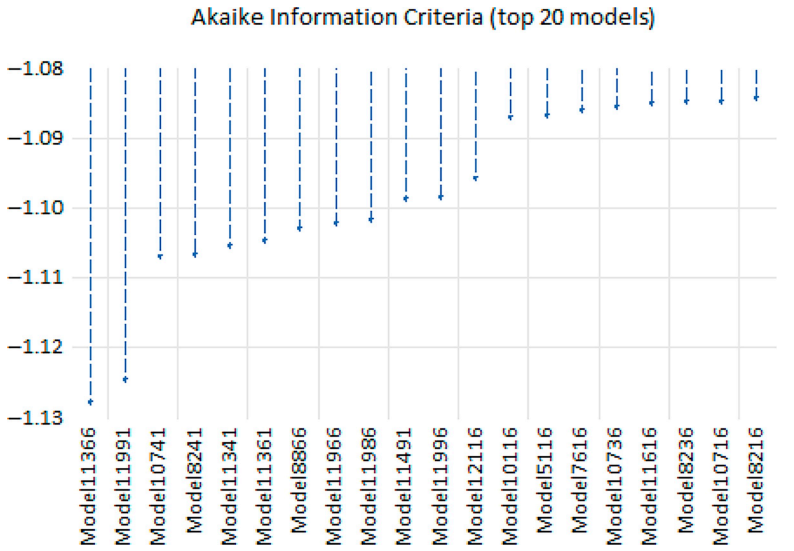

Figure A1. AIC test for model lag structure