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The Relationship Between Education and Economic Growth in Egypt Using Vector Auto Regression (VAR)

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Abstract: The study investigates the impact of education on economic growth during the period (1976-2022) where education represents a channel for human capital improvement that fosters economic growth. Vector Auto Regression (VAR) and testing causality in the long run through the Toda & Yamamoto (TY) causality test, dynamic analysis through impulse response functions analysis, and Variance Decomposition analysis were used in examining the relationship between economic growth and education. Education is measured by enrollment rate in higher education, and government expenditure on education while GDP growth rates are used as a proxy for the economic growth in Egypt during the period (1976-2022). Our main findings reveal that a shock to government investment in education led to a positive response of growth in the short and long run. The results asserted a positive relationship between education as measured by the enrollment rate of higher education and economic growth. For the causality test, there is a one-way causality running from the government expenditure on education to economic growth in the long run and a uni-directional relationship running from the government expenditure on education, economic growth, and foreign direct investment to the enrollment rate in higher education in the long run. The research recommends that the government should increase spending on education to promote economic growth both in the short and long run, encourage the expansion of higher education, and enhance the coordination between educational outcomes and labor market requirements.

Keywords : Education, Economic Growth, Vector Auto Regression EL: I21, I23, I25, H52

الملخص: تهدف هذه الدراسة إلى اختبار تأثير التعليم على النمو الاقتصادي خلال الفترة (1976-2022) بالتطبيق على الاقتصاد المصري. باستخدام نموذج متجه الانحدار الذاتي Vector Auto Regressive (VAR) واختبار السببية في المدى الطويل من خلال اختبار سببية Toda and Yamamoto (TY)، والتحليل الديناميكي من خلال تحليل مكونات التباين Variance Decomposition analysis ودوال رد الفعل impulse response functions analysis، لدراسة العلاقة بين التعليم والنمو الاقتصادي. وقد تم التعبير عن التعليم من خلال مؤشرين هما، الالتحاق بالتعليم العالي، والإنفاق الحكومي على التعليم، بينما استخدم معدل نمو الناتج المحلي الإجمالي كمؤشر للنمو الاقتصادي.وتوصلت الدراسة إلى أن صدمة في الاستثمار الحكومي في التعليم أدت إلى استجابة إيجابية للنمو في المدى القصير والطويل كما أكدت النتائج وجود علاقة إيجابية بين التعليم مقاساً بمعدل الالتحاق بالتعليم العالي والنمو الاقتصادي. بالنسبة لاختبار السببية، هناك علاقة سببية في اتجاه واحد من الإنفاق الحكومي على التعليم إلى النمو الاقتصادي على المدى الطويل، وهناك علاقة سببية في اتجاه واحد من الإنفاق الحكومي على التعليم والنمو الاقتصادي والاستثمار الأجنبي المباشر إلى معدل الالتحاق بالتعليم العالي في المدى الطويل. وتوصي الدراسة بضرورة الاهتمام وزيادة النسبة المخصصة من الانفاق الحكومي على التعليم فمن شأن زيادة الاستثمار الحكومي في التعليم تعزيز النمو الاقتصادي في الأجل الطويل. كذلك يجب على الحكومة تشجيع التوسع في التعليم العالي والذي من شأنه أن يعزز النمو الاقتصادي وكذلك تحقيق التوافق والتنسيق بين مخرجات التعليم ومتطلبات سوق العمل.

الكلمات الدالة: التعليم،النمو الاقتصادي،متجه الانحدار الذاتي

1. Introduction:

Economic research has been interested in studying the nexus between economic growth education and in the past decades for various reasons. Education is a leading factor in economic growth since it has socioeconomic impacts on any developed or developing nation. In addition to this, it can foster development by introducing a more efficient labor force, contribute to poverty alleviation, and have a crucial role in environmental issues awareness.

It is well known that education enhances learners' skills, enabling them to succeed. Moreover, education allows individuals to acquire new knowledge and abilities that improve their productivity. In Egypt, ensuring access to education for all citizens is a priority that has been heavily emphasized. The government, particularly the Ministry of Education and other related agencies, has been working seriously to ensure that every child in Egypt has the right to access education. Consequently, lowering the illiteracy rates in Egypt makes individuals more innovative and more professional in facing societal challenges. Since higher levels of literacy enable the labour force to secure better job opportunities, then education plays a vital role in reducing poverty and unemployment. In addition, well-educated citizens are more likely to access well-paying jobs, reducing their reliance on social assistance programs and consequently lowering the pressure on the governments especially in the less developed countries. Providing quality education to all individuals in Egypt contributes to a more equitable distribution of wealth and income that is essential for economic growth and later enhances economic development.

Furthermore, the importance of education has been highlighted many times in the literature and special attention has been given to it since the United Nations set the Millenium Development Goals in the year 2000 which was targeted to achieve universal primary education. In trying to achieve the universal primary education target large progress has been achieved since the year 2000 on different tracks, where the developing regions achieved an enrollment rate of 91%, in 2015, and on a worldwide basis number of children out of school has dropped by half, the literacy rates have increased, and girl's enrollment in schools has also surged. Despite these facts, some of the developing regions have faced many challenges in achieving this target such as the high levels of poverty, regional conflicts, and political instabilities. These challenges are of different degrees in Western Asia and North Africa, Sub-Saharan Africa. (UNDP, 2024)

When 2015 was achieved the United Nations coordinated global efforts to launch a new universal agenda under the name of Sustainable Development Goals. This universal agenda was characterized by five big transformative shifts that targeted all developed or developing countries. Among these universal goals for the SDGs, including an outright end by 2030 was a great emphasis on goal number four which calls for "Quality Education". This goal safeguards: "inclusive" and "equitable quality" education for all. If inclusive and quality education for all is achieved, then this ensures that education is one of the most powerful means for sustainable development. This goal guarantees that by 2030 all girls and boys should finish free primary and secondary schooling. Eliminating gender and wealth disparities equal access to affordable vocational training and achieving universal access to higher education are also ensured by achieving this target (UNDP, 2024).

Considering the correlation between education and economic growth, as mentioned earlier, and considering the great importance of the function of education in achieving economic growth and thus economic development and contributing to the attainment of sustainable development goals, it is important to identify quantitative and causal relationships between education and economic growth, as this helps the governments in formulating the right policies.

This research aims to investigate the relationship between education and economic growth in Egypt by using time-series data during the period (1976-2022).

The research tries to investigate the following hypotheses:

1. the relationship between economic growth andgovernment expenditure on education in Egypt is positive.
2. the relationship between economic growth andenrollment rate in higher education in Egypt is positive.
3. there is a causal relationship, in the long run, running from government expenditure on education to economic growth.

The research used both deductive and inductive approaches. Investigating the relationship between variables and estimating the response of each variable to shocks in other variables is done using the Vector Autoregression Model (VAR). In other words, each endogenous variable in VAR can be explained by its lagged values and the lagged values of all other endogenous variables in the model (Gujarati, 2002).

The VAR model avoids the endogeneity/ exogeneity problem by treating all variables as endogenous (Arodoye, 2012).

The study used time series data in Egypt through the period (1976-2022). The sample period has been chosen since it was the most recent available data. The data has been collected from World Development Indicators (WDI) in the World Bank database.

The research is divided after this introduction as follows; section two includes an overview of the education system in Egypt, while the third section reviews the literature, the fourth section explains the model used in the study, the fifth section displays the model results and, finally the last section illustrates the conclusion and suggest some recommendations for policymakers and further research.

2.Overview of education in Egypt

Free education for all citizens lies in the Egyptian government's responsibility. Education in Egypt is divided into basic education and secondary education. Primary education starts at the age of six and continues for six years, after that secondary education and access to specialized education are available. Even though primary education is mandatory, practically speaking access to education by every child is not granted because of various obstacles such as child labor and poverty. In addition to these obstacles, the lack of schools in rural areas compared to urban areas and a shortage of teaching materials contribute to this disparity.

This creates a wide gap between the poor and rich people where the rich families can pay for private schools while the poor families cannot support except underfunded schools which might have lower quality of education.

In this section, we will demonstrate the education system in Egypt and the challenges that face this education system.

2.1.Education System

The Ministry of Education and Technical Education (MoETE) was established in the first half of the nineteenth century and was considered the principal government institution in Egypt which is responsible for basic education. The MoETE approves and guarantees for all equal opportunity for education, where more than 50,000 public schools deliver free education for more than 22 million students (UNEVOC, 2024)

The Ministry of Education listed the purposes of education which can be summarized in the following (Devanda et al, 2022):

1. Sustain democracy and equality of opportunity, in addition to the development of democratic persons.
2. Create an effective relationship between the labor market and the productivity of education.
3. Reinforce individual proprietorship of the nation and strengthen the Arab identity and culture.
4. Ensure ultimate education through self-education and self-improvement.
5. Incorporate knowledge development through the ability to read, write, languages other than Arabic.
6. Performs as a framework for collaboration in course assessment and development.

There are two categories of the education system in Egypt which is the formal and informal Spelling – education systems. The formal education system is divided into the secular system, the Al-Azhar school system, and the vocational and technical education.

The secular structure includes kindergartens and pre-play schools which are usually in cities, basic education from year one to year six followed by elementary education from year seven to year nine, and preparatory education. This preparatory education is followed by secondary education which is called high school education from year ten to year twelve. Afterward, higher education at universities is set.

AlAzhar school system is like the secular education system with more emphasis on the Islamic religious education system. When the students reach the last two years of education, a choice must be made between whether to join a public school for another two years or join a two-year religious school. After these two years of high school, at the university level, the study is the same as the secular system but again with more emphasis on the Islamic religious education system.

Finally, vocational and technical education has been widespread in Egypt since 1988. At the tertiary level, Egypt devours about 560 technical and vocational schools and about 30 technical institutes (Devanda et al, 2022).

On the other hand, the non-formal education sector presents a succession of planned educational activities that are far from formal education and is mainly concerned with literacy activities.

2.2. Education System Reform

The education system in Egypt passed through many reforms, in the early 1990s, elementary school study years were reduced from six years to five years. Technical secondary schools' entrance has increased and there has been expansion of staffing or employee training in non-formal education.

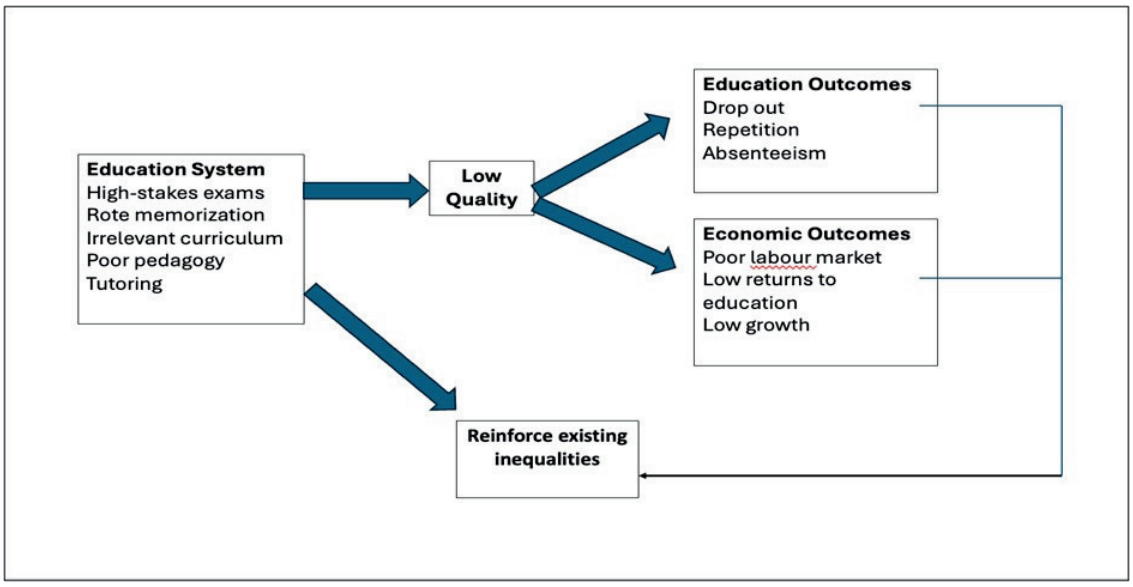
The Egyptian government has set education reform as one of its top national development priorities for the past ten years. A new vision for education in Egypt was proposed in the academic year 2018-2019. It can be summarized in the next paragraph.

1. A new system for pre-K and grade 1 named "Education 2.0" was proposed and followed a multi-dimensional approach and an integrated and interlinked package was set in which the language, math, social studies, and science will altogether be taught by the same instructor by applying certain themes that provide the structure for the class discussions and activities.
2. The MoETE initiated 'Education 1.1'; a repaired secondary school system, where students use new technologies such as a tablet to access one of the world's largest digital libraries "the Egyptian Knowledge Bank". It also aims to promote long-life learning through understanding and not memorizing. The examination for the new system is an 'open book' examination which measures students' understanding of the material.
3. The MoETE recognized the importance of technical education so, it called for adopting a new system called 'Technical Education 2.0'. this system provides students with training that enhances their role in qualifying many young people through the skills and capabilities that allow them to meet the needs market. This 'Technical Education 2.0' is considered an innovative program that will be the expression of the transformation of the Egyptian Technical and Vocational Education and training system, based on a new vision and sustainable approach for the development of the future Egyptian professional workforce. (UNEVOC, 2024).

2.3.Education System Challenges

There are great improvements in the education situation in Egypt such as education access, near-universal primary education enrollment, and narrowing the gender gaps in education enrollment. However, the education system in Egypt faces several challenges that might hinder the role of these improvements. These challenges and weaknesses can be summarized in accessibility, quality, and inequality shown in Figure (1).

Figure (1): Challenges in the education system in Egypt



Source: Krafft, 2012

2.4.Education Enrollment Trends

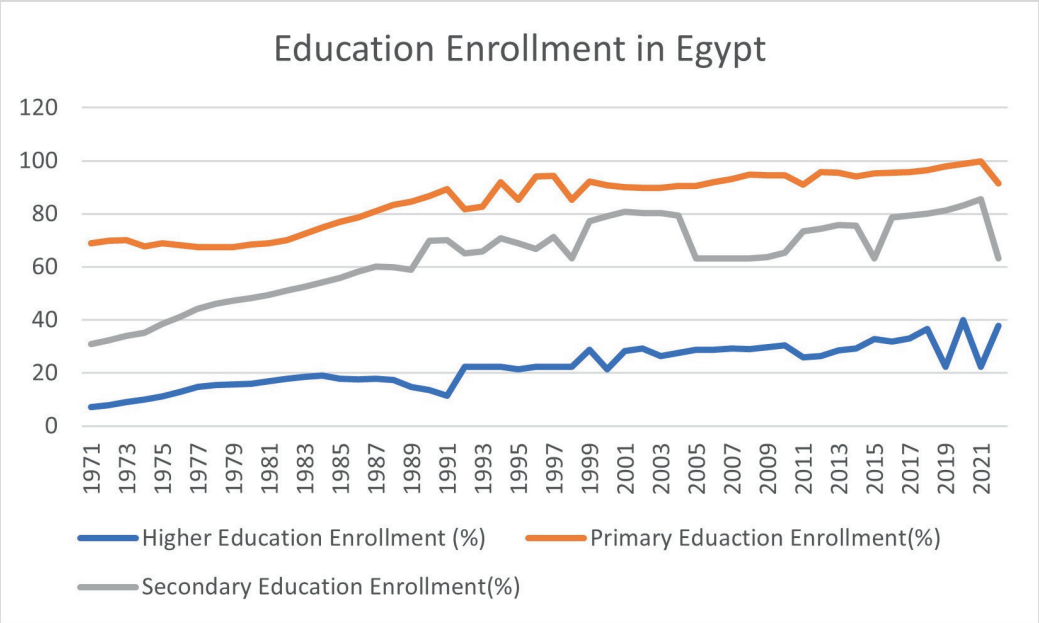
This section provides an overview of education enrollment trends in Egypt's primary schools, secondary schools, and higher education (1971-2022).

Figure (2) shows the education enrollment in Egypt during the period (1971-2022) at three levels primary education, secondary education, and higher education level. As shown in figure (2) the primary education enrollment in Egypt during that period averaged 85% and the minimum primary education enrollment was achieved in the year 1979 which counted about 67%, while the maximum primary education enrollment was achieved during the year 2021 which was 99%.

During the same period, secondary education enrollment in Egypt ranged from 31% to 85% of total education enrollment with an average of 63%.

Finally, higher education enrollment in Egypt during that period averaged 22% of total education enrollment with a maximum in the year 2020 of 40% and a minimum enrollment in the year 1971 which was only 7%.

Figure (2) Education Enrollment in Egypt (%)

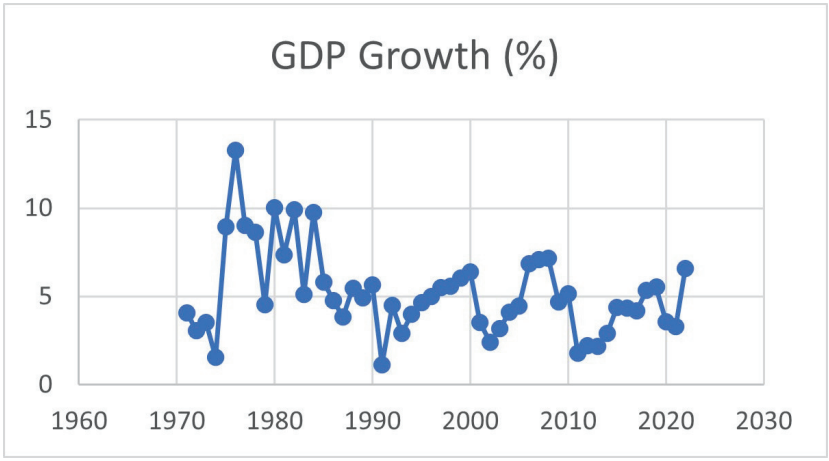


Source: Prepared by the researcher based on WDI.

2.5. Trends of GDP, Expenditure on Education, and FDI

Egypt has witnessed large fluctuations in the GDP growth rates. These fluctuations are clear in Figure (3) where it ranged from 1.12% in the year 1991 to 13.2% in the year 1976 with an average of 5.2%.

Figure (3): GDP growth rates (%)



Source: Prepared by the researcher based on WDI.

The GDP per capita growth rates during the period of the study are shown in Figure (46) where the year 1976 witnessed the highest GDP per capita growth rate, which was valued at about 11%, while the year 1991 witnessed the lowest growth rate counted at -1.3%. During the study period, negative rates were shown in the years 1974,1991, 2011-2013.
Egypt's GDP per capita faced significant changes from 1976 to 2022, reflecting the country's economic development over the study period. Here's an overview of the general trends:

During the period from 1976 till 1980 Egypt's economy was largely state-controlled, and the GDP per capita was relatively low. Then, the government began its economic reform program which called for a more open economy, and hence the GDP per capita growth was slow. In the early to mid-80s Egypt was hit by economic challenges, such as external debt and high inflation, which kept GDP per capita growth modest. Then, in the late 1980s, structural adjustments and economic reforms were implemented, leading to gradual improvements in economic performance.

Although Egypt faced economic stabilization challenges in the early 90s, the GDP per capita began to improve as the government continued with economic liberalization which was extended till the mid to Late 90s when there was a notable increase in GDP per capita due to accelerated reforms and increased foreign investment.

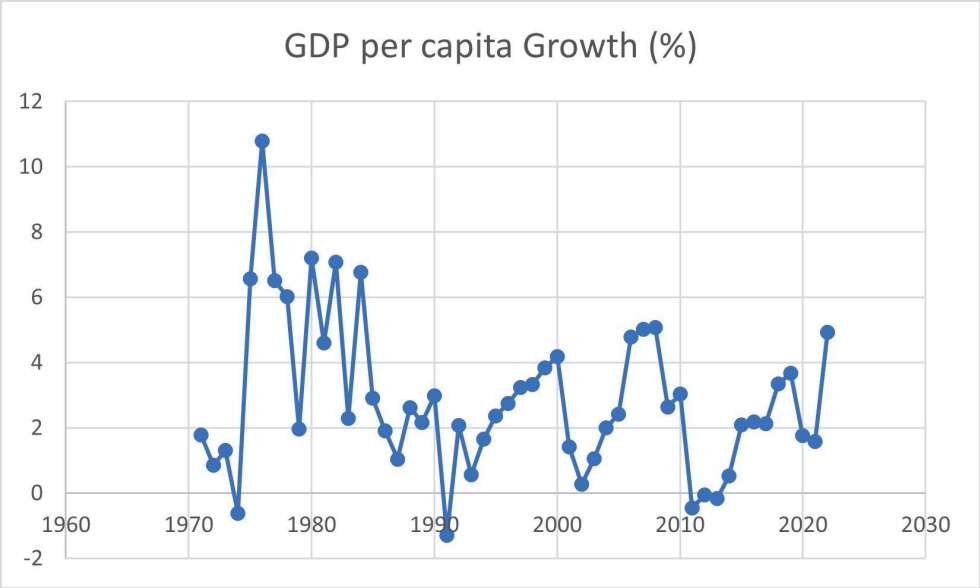
Then, Egypt's GDP per capita continued to rise as the economy diversified, and sectors like construction, telecommunications, and tourism drove growth till the financial crisis which led to the global economic downturn which impacted Egypt, but the GDP per capita managed to recover relatively quickly.

The Egyptian economy was hit by another slowdown in its GDP per capita growth because of the political instability following the revolution which led to a slowdown in economic growth, with a temporary dip in GDP per capita.
Then, in the mid to late 2010s, the economy gradually stabilized, and GDP per capita began to recover as the government implemented various economic reforms and infrastructure projects.

Unfortunately, the COVID-19 pandemic had a significant effect on Egypt's economy, that lead to a slowdown in growth. However, the government's efforts succeeded in mitigating some of these negative effects.

Finally, during the period 2021-2022, the GDP per capita showed signs of recovery as the economy started bouncing back from the pandemic, although global economic uncertainties continued to pose challenges.

Figure (4): GDP per capita growth rates (%)



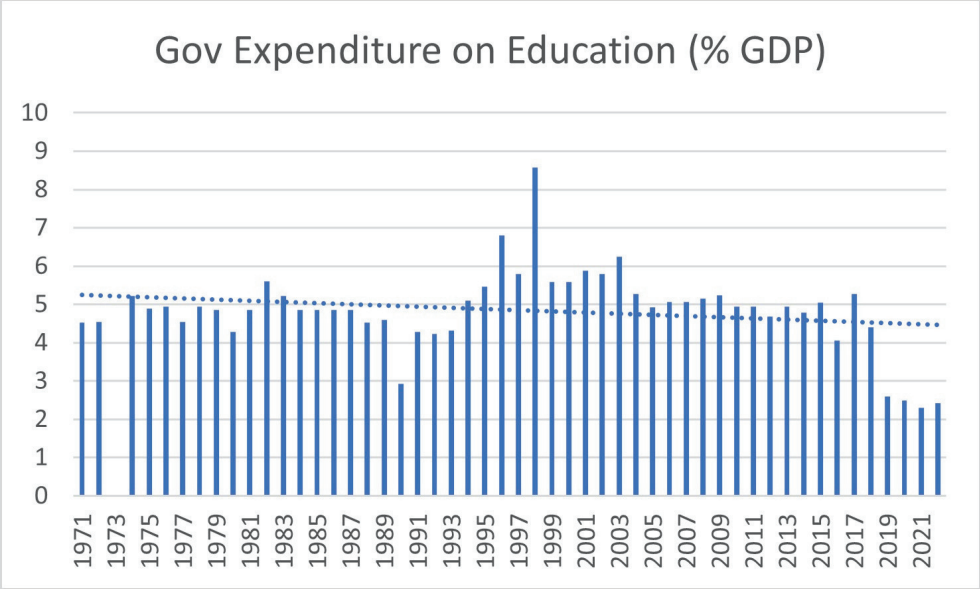
Source: Prepared by the researcher based on WDI

The expenditures by the Egyptian government on education as a percentage of GDP have shown almost a stable trend except for the year 1998 as shown in Figure (5). The government's expenditures on education as a percentage of GDP ranged from 8.5% in the year 1998 to 2.3% in the year 2021 with an average of 4.8%.

The decreasing trend of government spending on education as a percentage of GDP in Egypt is alarming, especially when we consider the commitments made in the 2014 constitution. The constitution required that the government should allocate at least 4% of GDP to education, aimed at improving the quality of education and ensuring equitable access for all citizens. However, the observed trend suggests a discrepancy between policy commitments and actual practice. The current trend suggests that the government is not meeting the constitutional commitment to education funding, which could result in insufficient resources to improve the education system. This inadequacy could have long-term negative consequences for Egypt's human capital development. Reduced spending exacerbates the existing inequalities. This could lead to more inequality because access to quality education is increasingly dependent on wealth and geography.

In addition to this, the reduced spending makes efficiency issues more critical. However, if the trend is associated with inefficiencies in the system, such as corruption or poor management, the effectiveness of spending is further compromised. So, to reverse this trend, the government needs to prioritize education funding, ensure equitable access to quality education, and improve the efficiency of resource allocation. Failing to do so could hinder Egypt's socio-economic development and spread inequalities for future generations.

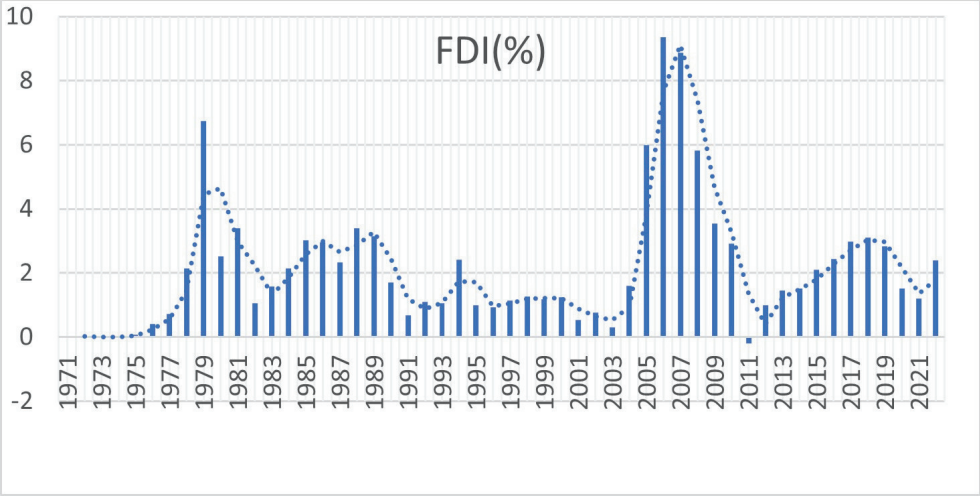
Figure (5): Government Expenditures on Education (%)



Source: Prepared by the researcher based on WDI

Finally, while observing the FDI trends in the Egyptian economy during the study period we noticed a wide range of fluctuations ranging from 9.3% in 2006 to -0.2% in 2011 as shown in Figure (6). The political instability in 2011 was clearly shown in this negative figure.

Figure (6): FDI (%)



Source: Prepared by the researcher based on WDI

3. Literature Review

Because of the great importance of education and its vital role in fostering economic growth several studies on this relationship are carried out. Some of this literature will be previewed in the next section.

Abdullah & Lulwa (1998), the study highlighted the relationship between education, women's participation in the labor force, and fertility in Qatar. The study investigated a sample of 1000 women in Qatar which represent 2.8% of total Qatari women capable of having children in the year 1997. The study used the SPSS program to estimate a simple linear regression model followed by a multiple regression model. The study concluded that on average the Qatarian family has 3.6 children and tends to double, when the average age of the husbands is 37.3 years old, and the average age of the wives is 21 years old. At that period, the rate of educated husbands and wives was high, and the employment rate was also high, moreover, the rate of high education ratio was high reaching about 55% for men and 69% for women. The labor force participation rate for men and women was also high reaching an average of 14 years of working for men and the percentage of working women was 69.5% which reflects about 8 years of working. The study concluded that the education level represented by the level of education of the father harmed families in Qatar. This indicates that educated families tend to reduce the size of their families.

Moqbel (2005), the relationship between education and the labor market in the Yemeni economy has been investigated in this study. The study has been divided into four sections, the first displayed the importance of education and its role in economic and social development, the second part lists the education system facts in Yemen during the study period 1996-2000, the third part displayed the relationship between education outcomes and labor market through studying and analyzing the growth of human force, labor force, and employment through the study period 1996-2000 in addition to this the employment and unemployment structure has been shown in this part. The last part of the study discussed the future policies for education and the labor market which had been set by a five-year plan from 2001-2005 for population and labor force. In addition to these future policies, a review of education policies and procedures to determine required priorities has been done.

The study concluded that there is a disparity between the education system and the policies during the last three decades which enlarged the gap between the education outcomes and labor market requirements which affected the Yemeni economy badly. The study concluded that population growth is a crucial factor for the continuation of the policy of horizontal expansion in education without taking into consideration the changes that occurred in the labor market during the 70s, 80s, and beginnings of the 90s. During the nineties, the gap between education outcomes and labor market requirements had widened and the government had stopped participating in job creation. The study also highlighted that despite the interest that has been expanding in technical education and vocational training, population growth prevented the implementation of this reform or even reviewing the policies of university admission. The study suggested the five-year plans as a solution for the major challenges that faced the Yemeni economy during the period of the study.

Johnes (2006), in his study, investigated some determinants of economic growth and highlighted the role of education. This was surveyed through multivariate OLS regression of economic growth against openness, wealth, schooling quality, growth rate of trading partners, political instability, distribution of education, investment, and GDP for the period (1980-2000) for 64 countries. The study results show that all variables are statistically significant and have the expected signs, except for the distribution of education and openness. Despite some problems associated with this investigation such as endogeneity bias, the research did not tackle this problem because of a lack of available instruments. Among the policy recommendations suggested by the research are how to achieve universal primary education, through policies that reduce child labor and develop the quality of education specifically in countries that are beyond the stride in economic terms through the universal transfer of proficiency. Finally, the paper introduced a key to the challenges it faced: accepting how groups of countries are formed into clusters and how policy can change the composition of these clusters.

Al-Maliki and Bin Obeid (2006), the study investigated the impact of investing in higher education in the Kingdom of Saudi Arabia. The study aimed to measure the economic return of investing in higher education since it is supposed to yield a significant economic return on the economy. The study used the internal rate of return method to test its hypothesis during the period of the study from 1994 to 1997 this period was chosen since it represents the period that a student spends in higher or university education.

Chandra et al. (2010) used a combination of approaches that uses linear and non-linear Granger Causality tests to determine the relationship between economic growth and education spending in India during the study period 1951-2009. It was discovered that there is a two-way relationship, where economic growth affects the level of government expenditures and at the same time investing in education influences economic growth. The results of this study concluded some important results; firstly, the time-series data are non-stationary at the level data, but after the first differences it is stationary, indicating that they are integrated of order one (Chandra,2012). Secondly, there is a two-way relationship between economic growth and education expenditures. However, the effect of education expenditures on economic growth takes a period of five to six years to be active. Thirdly, economic growth is one of the major factors affecting the government education expenditure. Finally, the causality running from economic growth to education expenditure is lasting despite lead or lag values. Lastly, this study recommends further studies to cover different sets of countries to help better understand the relationship under investigation, economic growth, and education. Another suggestion recommended by this study is to increase investments in education since it fosters economic growth, both directly and indirectly.

Hussin et al (2012) surveyed Malaysia on the long-run relationship and causality between government expenditure in education and economic growth. The paper used time series data to apply the Vector Auto Regression (VAR) method from 1970 to 2010. The study displayed the real GDP as a function of gross fixed capital formation, government expenditure on education, and labor. The empirical results show that there is positive cointegration between economic growth and fixed capital formation, labor force participation, and government expenditure on education, and all the variables are significant. Since better education levels can improve labor force efficiency and productivity and affect economic development in the long run, also economic growth can foster better education, then the Granger causality test reveals the two-way association between education and economic growth. Finally, the paper asserts that the quality of education is one of the main driving forces for economic growth and enhancing human capabilities. Consequently, the researchers recommend a significant surge in education expenditures to improve the economic performance to achieve significant economic growth.

Bolkol (2016) for the period 1985-2012, in Turkey the research analyzed the association between education and economic growth by examining and relating the time-series literature and using empirical analysis.

This research empirical analysis used ADF (Augmented Dickey-Fuller) unit root tests and PP (Phillips-Perron) to investigate the relationship. This paper used time-series quantitative variables expressing education as average years of schooling, enrollment rate, adult literacy index, and number of graduates from one side and economic growth from the other side. The empirical results reveal no agreement about the causality direction between economic growth and education even for the same country. So, Bolkol suggested instead of using time-series data use panel data and use control variables or/and dummy variables to support the results.

Hanif and Arshed (2016) studied the relationship between school education and economic growth in South Asian Association for Regional Cooperation (SAARC) countries including Pakistan, Bangladesh, India, Sri Lanka, and Bhutan during the period 1960-2013 using panel data depending on the World Development Indicators official website. For their study, they used GDP as a proxy for the dependent variable, economic growth. They introduced four independent variables education, inflation rate, physical capital, and labor force. Their empirical analysis depended on static models represented by two models, one which assumes that all the countries mentioned in the study are like each other and the second assumes that all the countries are the same in terms of the effect of the independent variables only after that the countries are heterogeneous. This study advocated the significant role of human capital on economic growth represented in three proxies which yield different degrees of significance. Estimating this model using the pooled OLS and Fixed Effect model cannot be interpreted because of the presence of spuriousness. Accordingly, a unit root test was used to test the non-stationary presence in the variables. The test results show that all variables are non-stationary, and hence all the variables must be cointegrated. After this cointegration test, FMOLS was used to estimate long-run estimates. The FMOLS results concluded that education has a strong positive effect on economic growth, and consequently, the study recommends highlighting the government's role in achieving higher rates of economic growth through investing more in the education sector by providing teachers with enhanced and new technologies, encouraging people to educate their children in addition to better studying conditions.

Bouhajeb et al (2018) investigated multilateral relations between economic growth higher education, and innovation, by using the Dynamic Ordinary Least Square (DOLS) method. The GDP is a function of human capital and innovation. The study used panel data for 42 countries, developed and developing, through the period (1996-2014). GDP per capita was

used to measure economic growth, research and development expenditure used RD as a proxy, the number of patent applications used PAT as a proxy, and EDU was used as the proxy of expenditure on tertiary education. The study concluded that higher education is an instrument for development and growth in the knowledge society, because of its crucial role in boosting knowledge, research, and technical innovation. The empirical results of the study determined a cointegration association between the series. A direct effect of innovation in tertiary education on economic growth was concluded. The study provides a long-run relationship between the selected variables where economic growth is affected positively by expenditure on tertiary education and innovations. In brief, the elasticity of GDP for RD, PAT, and EDU is 0.854%, 2.862%, and 0.075% respectively in the long run. The policy implications of these results are straightforward. Fostering long-run economic growth can be achieved through focusing on training and labor productivity, increasing the expenditures on education from the primary to the higher levels or strengthening the students' participation in R&D activities. Consequently, the research recommends the use of innovation as an important part of educational reform in most of the countries all over the world.

Ramos et al (2019) viewed education as a tool for human capital enhancement that will increase economic growth. In the research, it was assumed a level for education, after which economic growth characteristics will change. To tackle this issue, they used a nonlinear framework by applying Smooth Transition Regression models for the education-economic growth of Spain during the period 1971-2013. The estimated models show how the change in education generates nonlinear effects on current economic growth. The research investigated the issue in question in two steps. Firstly, highlights the responsibility of secondary and tertiary education in economic growth in Spain. Secondly, nonlinear analysis for several Spanish regions, and then a test for the existence of regional heterogeneity was used. Using these two stages for Spain, at the country level empirical results ensure for both secondary and tertiary education a nonlinearity in the relationship between economic growth and education, and hence both are significant for economic growth and special attention must be taken into consideration. The linear analysis has revealed a positive correlation between economic growth and education in Spain. The nonlinear analysis showed some different results about the role of secondary education as an exogenous variable, and the importance of other variables that are of great importance such as the labor force, while others are less significant such as public spending on education.

Jackson (2023) examined the impact of expenditure on education on economic growth in Sierra Leone during the period 2000-2021. During the time series study period, Vector Autoregression methodology was used to highlight the effect of a shift in government investment in education. The findings showed a direct but not immediate response to growth that confirms that the efficiency of increasing investment in education is more beneficial in the long-run growth in Sierra Leone. The Granger Causality test asserts a one-way association between investment and economic growth. In addition to this, the economic growth elasticity concerning government investment in education is more elastic at first, then in later years, it becomes less elastic and the elasticity of economic growth to government investment in education is found to be weak firstly. Nevertheless, it became strong in the third and fifth years. Moreover, huge resources should be directed to training institutions to enhance the tertiary education sector because of its importance for economic growth. Finally, the study highlights the important role of investing in education to serve as a way of reducing poverty and hence achieve one of the most crucial goals of sustainable development goals. The study suggests greater efforts by policymakers to foster economic growth to secure and ensure sustainability which can be achieved by dual efforts between the public and private sectors of the economy. Finally, the study suggests the existence of further studies to cover a longer period to make sure of the results and be able to apply them to different countries.

Gupta et al (2023) in their review research used a multidimensional theoretical framework and concluded that there was a strong positive correlation between higher levels of education and economic growth. However, some factors moderate this relation, this strong relationship implies that there will be a further investigation. They used educational attainment, human capital, education quality, and expenditure to measure the impact of education on economic growth. They used a multidimensional theoretical framework, where they used a two-stage analysis process. They implemented a systematic screening and selection process. Then a thematic analysis approach was employed to extract key findings and themes from the selected studies. The study was applied across different countries and regions. This cross-country analysis revealed that education plays a very important role in human capital accumulation and hence can enhance productivity and technological innovation, which leads to a better level of economic growth. And finally, they concluded that there is a continued need for continuous monitoring and evaluation of the education systems. And there must be a regular assessment of the educational outcomes, such as enrollment ratios,

skills acquisition, and literacy rates because this might help in identifying the areas of improvement for policy making.

Reviewing the literature in the previous section shows that there is a small degree of agreement about the relationship between education expenditures and economic growth, where some studies find a direct relationship between education expenditures and economic growth while others conclude that the relationship is not always positive between education and economic growth (Kakar, Khilji & Khan). Empirical evidence is not conclusive regarding the relationship between education and growth. Despite the importance of this topic, few studies discussed it in Egypt during this period. This study will fill the gap in the literature by adding a longer period to examine the relationship between education and growth in Egypt and examine the presence of a nonlinear relationship between education and growth using VAR.

4. The Empirical Analysis

4.1. Data Sources

Time-series data on GDP, government expenditure on education, higher education enrollment rate, and FDI were gathered from the World Development Indicators database.

4.2. Methodology

To examine the relationship between economic growth and education VAR model is used in this paper. The VAR model is "a multi-equation system where all variables are treated as endogenous. There is thus one equation for each variable as the dependent variable. Each equation has lagged values of all the included variables as dependent variables, including the dependent variable itself. Since no contemporaneous variables are included as explanatory, right-hand side variables, the model is a reduced form. Thus, all the equations have the same form since they share the same right-hand side variables". (Olanrew et al, 2015). Each endogenous variable in VAR is interpreted by its lagged values and the lagged values of all other endogenous variables in the model (Gujarati, 2002). The VAR model avoids the endogeneity/exogeneity problem by treating all variables as endogenous (Arodoye, 2012).

Applying the VAR model requires many steps.Firstly, the stationarity of the series based on augmented Dicky- Fuller (ADF) and Philips Perron (PP) must be determined, the hypothesis of this test:

$$H_0: \sigma = 0 \ (unit\ root\ /not\ stationery)$$

$$H_1: \sigma \neq 0 \ (no\ unit\ root\ /\ stationery)$$

Accepting the null hypothesis means that there is no stationarity in the series while rejecting the null hypothesis implies stationarity. If the series is not stationary at level I (0), we will take the first differences to convert the series to a stationary series (Shaari, 2014). The VAR model is used if the variables were stationary at level I (0) or integrated of the same degree, or if the variables were not integrated of the same degree (Jackson,2021).

Secondly, the optimal lag periods depending on the AIC and SC criteria are determined, to determine the length of the optimal lag period in the VAR model, where the smallest values of the two criteria are chosen (Shrestha & Bhatta, 2018).

After that, the stability of the VAR model must be ensured through diagnostic tests that prove the validity of the model, such as the test of the structural stability of the VAR model through the inverse roots test and LM test which check the autocorrelation between the residuals and the Jarque- Bera test to ensuring that residuals follow a normal distribution in addition to ensuring the homoskedasticity of the variance of residuals using the VAR Heteroskedasticity test (Ahmad et al, 2012).

After ensuring the stability of the VAR model an analysis of the dynamic relationships between variables by using "impulse response functions" must be applied to show the effect of a shock of one unit to one of the variables in the model. The response impulse function is beneficial in studying the relationship between variables in the autoregressive model. These functions are the response of variables to shocks to which the system is showing.

Then, Variance decompose analysis is applied to explain the relationship between the variables based on variance components analysis. Through variance decompose analysis, we know the contribution of each of the variables to the amount of variation that occurs in the desired variable at a certain period, and at any period, the sum of the variance components is equal to one (Akkaya, 2021). Finally, testing causality in the long run will be done using Toda & Yamamoto test.

4.3. Model Specification

The specified model used time series data for the study period (1976-2022). The model highlighted three explanatory variables to explain some of the reasons behind economic growth according to Wang & Zhang (2024), Hussin et al (2012), Mallick et. Al (2016), Kocevska (2023). Abraham (2023) and Chandra et al. (2010). GDP per capita was used as a proxy of economic growth; the enrollment rate of higher education was used as a proxy of education and government expenditure on education.

Equation (1) expresses the estimating equation used in this study:

$$GDP = \beta_0 + \beta_1 GEXP + \beta_2 UE + \beta_3 FDI + u \dots\dots\dots\dots\dots\dots\dots (1)$$

Where:

GDP: gross domestic product per capita, is a proxy of economic growth (dependent variable).

The independent variables

GEXP: government expenditure on education, is a proxy for education

UE: Is a proxy for education enrollment rate in higher education

FDI: is foreign direct investment (a control variable).

Equation (2) is the Logarithmic form of equation (1), where the coefficient (represents the elasticity which means the percentage change in the dependent variables if the independent variable changes by one percent.

$$LGDP = \beta_0 + \beta_1 LGEXP + \beta_2 LUE + \beta_3 LFDI + u \dots\dots\dots\dots\dots\dots\dots (2)$$

5. Results and Discussion

5.1. Unit root test

The results of the stationary test are shown in Table (1). The results show that all the variables under investigation are Nonstationary at level I(0) whereas the Unit root test result indicates that all variables integrated from order 1 I (1) which implies that all variables are stationary after taking the first differences. The results of ADF and PP tests are elaborated in Table (1)

Table (1)

Variables	ADF		PP	
Intercept	P value (0)	P value (I)	P value (0)	P value (I)
lgdpp	0.5814	0.0007	0.2013	0.0011
lgexp	0.5274	0.0000	0.5664	0.0000
lfdi	0.0122	-----	0.0221	-------
LUE	0.4707	0.0000	0.2165	0.0001
Intercept and Trend				
lgdpp	0.1136	0.0040	0.0609	0.0040
lgexp	0.6475	0.0000	0.7628	0.0000
lfdi	0.0566	0.0000	0.0917	0.0000
LUE	0.2268	0.0000	0.0001	-----
None				
lgdpp	0.9998	0.0167	1.0000	0.0274
lgexp	0.3472	0.0000	0.3472	0.0000
lfdi	0.0587	0.0000	0.0629	0.0000
LUE	0.9202	0.0000	0.9981	0.0000

Source: prepared by the researcher using E-Views 12

If the variables are integrated in the same order, Johansen co-integration tests will be applied to determine whether there are long-run association between the variables. The Trace test and maximum test as shown in Table 1 in the appendix indicate that there is no cointegration between variables. Then we determine the lag period in the VAR model, and as shown in Table (2), the smallest values of the AIC, FPE, SC, HQ, and LR criteria were 1 lag period.

Table (2)

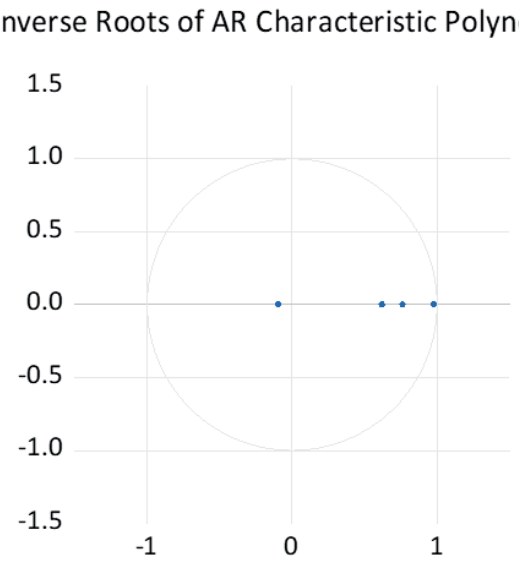
Lag	LR	FPE	AIC	SC	HQ
0	NA	5.06e-05	1.459965	1.650280	1.518146
1	180.1003*	6.40e-08*	-5.227628*	-4.276053*	-4.936722*
2	17.53667	8.64e-08	-5.007753	-3.294919	-4.484123
3	11.62568	1.54e-07	-4.639942	-2.165848	-3.883586

Source: prepared by the researcher using E-Views 12

5.2. Diagnostic Tests

The structural stability of the VAR model was examined and revealed that all roots have coefficients less than one and that all points lie within the circle of inverted roots, which confirms the stability of the model as shown in Figure (7)

Figure (7): Structural stability of the model



Source: prepared by the researcher using E-Views 12

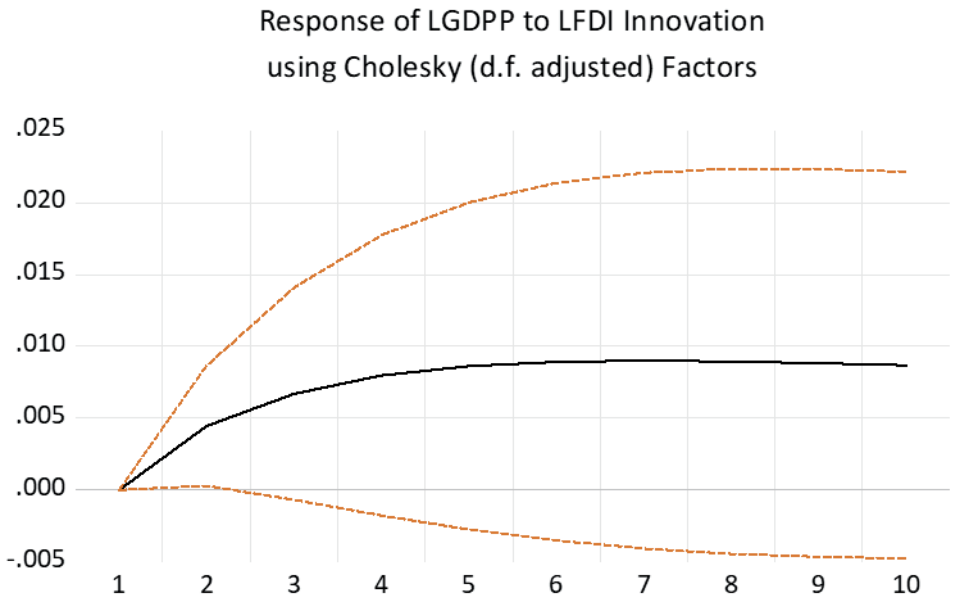
The Lagrange multiplier test (LM test) also showed that there is no serial correlation between the residuals, as shown in Table 2 in the appendix, where all the values of the statistics were greater than 5%, which means we are accepting the null hypothesis, which states that there is no serial correlation between the residuals.

The results confirmed that residuals follow the normal distribution according to the Jarq Bera test, in which the null hypothesis states that the residuals follow the normal distribution, and the probability value was greater than 5%, which means that the null hypothesis cannot be rejected, meaning that the residuals follow the normal distribution, as shown in Table 3 in the appendix. Also, we examine the Heteroskedasticity of the variance as shown in Table 4 in the appendix, which shows that the probability value is greater than 5%, which means accepting the null hypothesis, where the variance of the random error is homogeneous.

5.3. Impulse response function

As shown in Figure (8) the impulse responses of GDP to one standard deviation shocks of FDI. FDI has a permanent impact on GDP where there is a positive impact in the short and long run between two variables.

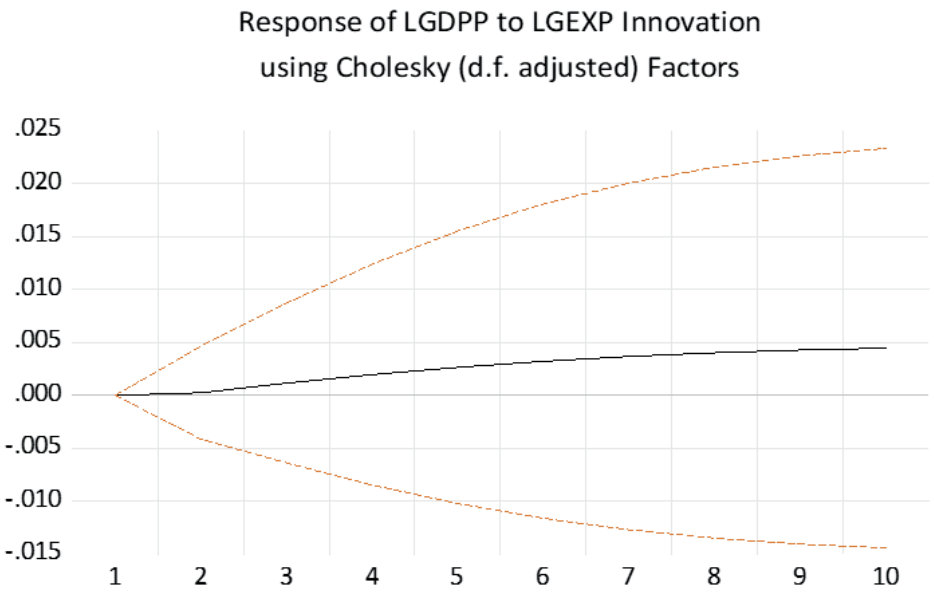
Figure (8): Impulse Response Functions



Source: prepared by the researcher using E-Views 12

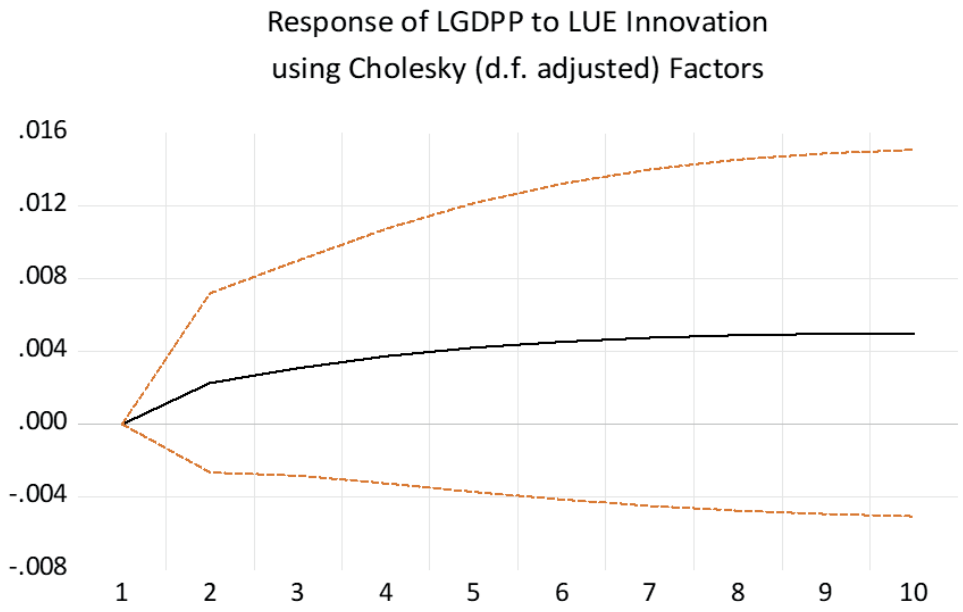
The response of GDP to lgexp as shown in Figure (9) indicates that the impact of government expenditures on education is positive in short and long run, this effect was very weak in the short run and the positive relationship appears during the medium and long run. Then the relationship between the two variables is symmetric. and so, we accept the first hypothesis of the study. This result agrees with Hussin et al (2012), Chandra et al. (2010), and Abraham (2023).

Figure (9): Impulse Response Functions



Source: prepared by the researcher using E-Views 12

Figure (10): Impulse Response Functions



Source: prepared by the researcher using E-Views 12

5.4. Variance Decomposition

Table (3) shows the result of the decomposition of the variance for every variable that is attributable to its changes and the change in other variables. In the first period, the economic growth rate (LGDPP) explains 100% of the changes and declines gradually to 0.79% in the long run (the tenth period).

The percentage change in variance in economic growth rate (LGDPP) due to foreign direct investment (FDI) is very low in the short run but this share explains LGDPP increase over time until it reaches about 14% in the long run. The Percentage change in variance in LGDPP due to the enrollment rate in higher education (LUE) increases gradually from 0.84 % in the short run to about 4% in the long run. Finally, the percentage change in variance in LGDPP due to government spending on education (LGEXP) increases in the long period, demonstrates the importance of spending on education and the rate of enrollment in higher education to stimulate economic growth in the long term.

Table (3) Variance Decomposition of GDP

Period	S.E.	LGDPP	LFDI	LUE	LGEXP
1	0.016023	100.0000	0.000000	0.000000	0.000000
2	0.024825	95.91348	3.233943	0.841950	0.010625
3	0.032074	92.12106	6.306694	1.433699	0.138546
4	0.038378	88.95297	8.727623	1.959977	0.359426
5	0.043926	86.40905	10.52798	2.420628	0.642346
6	0.048849	84.36372	11.85336	2.824182	0.958741
7	0.053251	82.70082	12.83416	3.177752	1.287267
8	0.057215	81.33101	13.56833	3.487654	1.613002
9	0.060808	80.18855	14.12577	3.759456	1.926233
10	0.064083	79.22514	14.55560	3.998081	2.221177

Source: prepared by the researcher using E-Views 12

5.5. Toda Yamamoto Test of Granger causality

The empirical results of the unit root test asserted the stationarity of all the variables at the first difference I (1) which means that dmax =1 and the lag length of VAR is K=1 based on the Akaike Information Criterion (AIC). So, the VAR system will estimate at the level with the total of K+ dmax = 2 lags (Abu, Haseeb & Azam. 2014). The results of causality are reported in table (4). The results show that there is a one-way causality running from the government expenditure on education to economic growth at a 10% significant level. Therefore, we accept the third hypothesis of the study. We also found one-way causality running from the government expenditure on education at a 5% significant level. And one-way causality running from economic growth, and foreign direct investment to the enrollment rate in higher education at a 10% significant level.

Table (4): Toda Yamamoto causality test

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 02/10/24 Time: 16:05			
Sample: 1976 2022			
Included observations: 31			
Dependent variable: LGDPP			
Excluded	Chi-sq	df	Prob.
LFDI	1.493451	2	0.4739
LUE	4.047441	2	0.1322
LGEXP	5.601711	2	0.0608
Dependent variable: LUE			
Excluded	Chi-sq	df	Prob.
LGDPP	5.974407	2	0.0504
LFDI	4.993724	2	0.0823
LGEXP	7.949877	2	0.0188

Source: prepared by the researcher using E-Views 12

6. Discussion

The research aimed to investigate the effect of education expressed by government spending and enrollment rate in higher education on economic growth in Egypt through the period 1976- 2022 using the VAR model. Regarding the results, researchers found that:

- The impact of government expenditure on education is positive in the short and long run, the positive relationship appears clearly during the medium and long run. The results also prove that the relationship between the two variables is symmetric. Hence, we accept the first hypothesis of the study. This result agrees with Hussin et al (2012), Chandra et al. (2010), Abraham (2023), (Zaman et al., 2021), and (Adeniyi et al., 2021)
- ·The enrollment rate in higher education directly affected economic growth in the short and long run, and this effect was stronger in the long run compared to the short run where the expansion of university education contributes to the qualification and training of the workforce and provides the economy's needs for different workforce requirements and specializations.Thus, we accept the second hypothesis of the study. This result coincides with Hanushek (2016) and (Mariana, 2015).

- FDI fosters economic growth in Egypt as our findings verify a positive significant impact in the short and long run between FDI and Growth.
- Regarding the Toda Yamamoto causality test our findings confirm that there is a one-way causality running from the government expenditure on education to economic growth. This emphasizes the importance of spending on education in stimulating growth in Egypt. Therefore, we accept the third hypothesis of the study. We also found one-way causality running from the government expenditure on education, economic growth, and foreign direct investment to the enrollment rate in higher education.

7.Conclusion, Recommendations and Future Research

Education can be defined as the stock of skills, competencies, and other productivity-promoting characteristics. Education is one of the principal elements of economic growth since it has socioeconomic impacts on any developed or developing nation. In addition to this, it can foster development by introducing a more efficient and productive labor force, contribute to poverty alleviation, and have a crucial role in environmental issues awareness. So, there is considerable nexus between the two variables. Better education leads not only to higher per capita income but is a necessary condition for long-run economic growth.

This paper aimed to investigate the impact of education on economic growth where education represents a channel for human capital improvement that fosters economic growth. Vector Auto Regression (VAR) and testing causality in the long run through the Toda & Yamamoto (TY) causality test in Egypt during the period (1976-2022) was used. Our main findings confirm a positive association between economic growth and government spending on education in both the short and long run. A positive relationship between economic growth and enrollment rate in higher education in both the short and long run was shown. In addition to this, there is a causal relationship in the long run running from government spending on education to economic growth. A causal relationship in the long run runs from economic growth to enrollment rate in higher education.

The research recommends that the government should increase its spending on education to promote economic growth because the productivity of countries is highly affected by the rate of the qualified labor force and raising the quality of labor can be achieved through investment in human capital. Consequently, in this regard, the Egyptian government should increase its spending on education, and this implies:

- Improving the quality of education via developed and updated curricula and investment in training to improve the education quality.
- Investing in training programs to effectively improve teaching skills in different fields.
- Allocating more financial resources to schools, especially in rural and marginalized areas, to ensure that all students have access to education.
- Providing scholarships and financial programs to support students from low-income families, to ensure their access to secondary and higher education.
- Improving access to early education where investing in early education programs provides a strong foundation for children at an early age and enhances their chances for education.
- Encouraging the expansion of higher education where higher education is important for skilled jobs. When employees have a higher level of education, they can work more efficiently and productively. This results in an overall increase in economic growth. More of Government spending on education, especially in higher education, encourages research and development (R&D), which leads to technological innovations. These innovations can drive economic growth by improving production efficiency and opening new markets.
- Enhance the coordination between educational outcomes and the labor market requirements.
- Provide the necessary infrastructure for education to improve the efficiency of university education in Egypt.
- Motivate new specializations, especially in the field of modern technology.
- Stimulate innovations and research and development activities.
- The balance between improving quality and increasing quantity in education.

In some cases, focusing on improving the quality of education can lead to better economic outcomes than simply increasing the number of years of education. In other cases, increasing access to basic education may be the first and most important step.

Future research is suggested since education has an essential role in the progress of societies, achieving economic development, and eliminating the problems that any society suffers from. The future research should focus on the role of education in achieving inclusive growth, the role of education in reducing the unemployment rate, and the role of education in reducing poverty. Despite not adding labor and capital to the research, it might be suggested to add these variables and estimate their impacts by applying another estimation model, other than the VAR, such as the ARDL for example which might lead to similar results.

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Table (1)

Date: 02/15/24 Time: 12:41
Sample (adjusted): 1978 2022
Included observations: 31 after adjustments
Trend assumption: Linear deterministic trend
Series: LGDPP LFDI LUE LGEXP
Lags interval (in first differences): 1 to 1

	0.05	Trace		Hypothesized
Prob.**	Critical Value	Statistic	Eigenvalue	No. of CE(s)
None	0.506619	38.64501	47.85613	0.2746
At most 1	0.312568	16.74434	29.79707	0.6589
At most 2	0.117851	5.125785	15.49471	0.7953
At most 3	0.039166	1.238562	3.841465	0.2657

Trace test indicates no cointegration at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

	0.05	Max-Eigen		Hypothesized
Prob.**	Critical Value	Statistic	Eigenvalue	No. of CE(s)
None	0.506619	21.90066	27.58434	0.2255
At most 1	0.312568	11.61856	21.13162	0.5856
At most 2	0.117851	3.887223	14.26460	0.8710
At most 3	0.039166	1.238562	3.841465	0.2657

Max-eigenvalue test indicates no cointegration at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

Table (2)

VAR Residual Serial Correlation LM Tests
Date: 02/06/24 Time: 18:40
Sample: 1976 2022
Included observations: 35

Null					
Lag	LRE* stat	Prob	Rao F-stat	df	Prob.
1	14.67326	0.5487	0.918458	(16, 70.9)	0.5521
2	13.56265	0.6313	0.842729	(16, 70.9)	0.6343
Lag	LRE* stat	Prob	Rao F-stat	df	Prob.
1	14.67326	0.5487	0.918458	(16, 70.9)	0.5521
2	34.26812	0.3594	1.086153	(32, 71.7)	0.3770

Table (3)

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 02/06/24 Time: 18:42
Sample: 1976 2022
Included observations: 35

Component	Skewness	Chi-sq	df	Prob.
1	0.227542	0.302024	1	0.5826
2	0.076409	0.034057	1	0.8536
3	-0.568820	1.887412	1	0.1695
4	0.488231	1.390491	1	0.2383
Joint		3.613984	4	0.4608
Component	Kurtosis	Chi-sq	df	Prob.
1	3.883515	1.138373	1	0.2860
2	3.513915	0.385158	1	0.5349
3	3.512155	0.382524	1	0.5363
4	4.078529	1.696370	1	0.1928
Joint		3.602426	4	0.4625

Component	Jarque-Bera	df	Prob
1	1.440397	2	0.4867
2	0.419215	2	0.8109
3	2.269937	2	0.3214
4	3.086861	2	0.2136
Joint	7.216410	8	0.5135

*Approximate p-values do not account for coefficient estimation

Table (4)

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Date: 02/06/24 Time: 18:44
Sample: 1976 2022
Included observations: 35

Joint test:		
Chi-sq	df	Prob.
93.39573	80	0.1452