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# The Impact of Primary Energy Consumption, Trade Openness and Foreign Direct Investment on Economic Growth: Evidence from MENA Countries

**Mousa Gowfal Selmey[1]*, Bassam A. Elbialy[2], Ibrahim Abdallah Abdelraouf Mohamed[3], Abdullah Abdulaziz Alhumud[2], Ibrahim Hamdy Sheta[1,4]**

[1]Department of Economics, Faculty of Commerce, Mansoura University, Mansoura, Egypt, [2]Department of Business Administration, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia, [3]Faculty of Law, Mansoura University, Mansoura, Egypt, [4]College of Business Administration in Yanbu, Taibah University, Medina, Saudi Arabia.
*Email: mousa_gowfal@mans.edu.eg

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**ABSTRACT**

This research examined how primary energy use, trade openness, and foreign direct investment influence economic growth in seven selected countries in the MENA region. Based on data availability (Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar) from 2000 to 2023, using three methods: the Panel Pooled Mean Group-Autoregressive Distributed Lag Model (PMG-ARDL), the Panel Fully Modified Least Squares (FMOLS), and the Panel Dynamics Least Squares (DOLS) models to explore the long-term relationships between these factors. The estimation results for PMG-ARDL, Panel-FMOLS, and Panel-DOLS indicate that capital, the labour force, primary energy consumption, and trade openness all have a statistically significant positive impact on economic growth in the MENA region. Foreign direct investment has a statistically significant negative impact on economic growth in the MENA region. In general, these results simply indicate that capital, labour forces, energy consumption, and trade openness are the main drivers of long-term economic growth in the MENA region. The study suggests enhancing investment in human and physical capital, increasing trade openness, and focusing on energy efficiency to stimulate long-term economic growth while reevaluating policies for attracting foreign direct investment and ensuring their alignment with developmental priorities.

**Keywords:** Primary Energy Consumption, Foreign Direct Investment, Trade Openness, MENA, PMG-ARDL
**JEL Classifications:** O24, Q4, Q5

## 1. INTRODUCTION

Sustainable economic growth is one of the sustainable development goals that various countries strive to achieve. Given that it is one of the main indicators reflecting the progress and stability of countries, governments strive to formulate effective economic policies that achieve high and sustainable economic growth rates. In this context, Energy consumption, foreign direct investment, and trade openness are essential factors in the economic growth process in various countries around the world. The relationship between energy consumption, foreign direct investment, trade openness, and economic growth has been discussed in numerous economic literatures, attracting the attention of many researchers to examine this fundamental relationship. These literatures can be divided into three main lines. The first line of research focuses on the relationship between energy consumption and economic growth (e.g., Omri, 2014; Tang et al., 2016; Baz et al., 2019; Usman et al., 2021; Khan et al., 2022). This relationship indicates that economic growth and energy consumption may be interdependently determined since increased economic growth necessitates elevated

energy consumption (Omri and Kahouli, 2014). In the past few decades, there has been much research on the determinants of energy consumption and economic growth, as well as the direction of the causal relationship between them. Examining the connection between energy consumption and economic growth is crucial for both developed and developing countries' energy policies. And although there is a correlation between them, the relationship is not always clear. Most researchers and policymakers are uncertain about when an increase in energy consumption in a country leads to improved economic growth or when economic growth can stimulate energy consumption, assuming other economic variables remain constant. Energy use is indispensable to achieving economic sustainability among the countries of the world. Energy consumption boosts job opportunities and enhances the export capacities of nations, which can positively impact both labor and capital productivity. Additionally, reliable energy supplies are essential for the manufacturing sector, which underpins nearly all economic activity (Lin and Benjamin, 2018).

The second line of empirical researches has investigated the association between foreign direct investment and economic growth. The inflow of foreign direct investment has attracted the attention of many researchers to explore the causal relationship between foreign direct investment and economic growth in host countries (Musibau et al, 2019; Taylor, 2020; Mwakabungu, and Kauangal, 2023). Foreign direct investment (FDI) has a significant impact on a country's economic growth. It can enhance the host nation's capacity to export; as a result, developing countries may see an increase in their trade revenues. Additionally, FDI can facilitate the creation of new job opportunities, the transfer of advanced technologies, the development of improved managerial skills, and overall economic growth in host nations (Kalai and Zghidi, 2019; Wang et al., 2022). Developing countries suffer from a capital shortage necessary to finance the development process, which is considered one of the main obstacles to economic growth. This situation makes attracting foreign direct investment an important goal for policymakers (Abdul Bahri et al., 2019). Therefore, foreign direct investment in developing economies is considered a major driver of economic growth through its positive impact on income generation from capital flows, advanced technology, management skills, job creation, and reducing unemployment issues in the country (Agrawal, 2015: Mwakabungu, and Kauangal, 2023). Since 1990, foreign direct investment has become the main source of investment flows to developing countries (Mahmoodi and Mahmoodi, 2016). Since the late 1980s and the 1990s, inflows of foreign direct investment (FDI) have rapidly increased almost worldwide, and it is very important for less developed countries to support development and economic growth relying on foreign direct investment (Wang et al., 2022). However, while foreign direct investment (FDI) boosts economic growth in developing countries, empirical evidence from existing studies still indicates mixed results regarding the relationship between FDI flows and economic growth. This issue highlights the importance of disclosing the relationship between foreign direct investment and economic growth in the countries of the Middle East and North Africa.

The third line of research has investigated the connection between trade openness and economic growth. There has been significant interest from researchers and policymakers in the importance of trade openness in supporting economic growth in various countries (e.g., Zahonogo, 2016; Irwin, 2025; Adenigbo et al., 2023). After the contributions of Grossman and Helpman (1990), Romer (1990), and Young (1991), the influence of trade on economic growth has engendered an expanding corpus of economic research. Since trade openness enhances the transfer of advanced technologies, it promotes technological advancements and boosts productivity; however, these advantages depend on the level of economic openness (Zahonogo, 2016; Keho, 2017). It has been found that trade openness can promote long-term economic growth by facilitating access to goods and services, optimising resource allocation efficiency, and enhancing overall productivity via technology and information transfers (Barro and Sala-i-Martin, 1997; Keho, 2017).

The theoretical literature has also indicated that trade openness may accelerate or hinder global economic growth. Especially if there are significant differences in the abundance of production factors between trading partners, if economic integration leads to an increase in global economic growth, it may have a negative impact on individual countries (Rivera-Batiz and Xie, 1993; Kind, 2002; Hye and Lau, 2015). There are relatively few studies that have shown a negative relationship between trade openness and economic growth, for example, Kim (2011), Hye (2012) and Zahonogo (2016). Accordingly, it is essential to explore the relationship between trade openness and economic growth in the countries of the Middle East and North Africa.

The Middle East and North Africa region possesses vast reserves of primary energy sources (coal, oil, and gas). Although recent years have seen diversification in the global energy mix (renewable and non-renewable), fossil fuels still dominated. Therefore, the Middle East and North Africa region represents a vital geoeconomics scope. Moreover, over the past two decades, there has been an increase in international trade size and the attraction of foreign direct investment in this region. Where has witnessed a fundamental shift in energy consumption patterns, foreign capital flows, and the degree of trade openness, influenced by internal factors such as economic reforms and government policies, or external factors like geopolitical factors and oil price fluctuations. However, the nature of the relationship between these variables remains complex and requires further examination and analysis. Thus, our research attempts to explain the intricacies of the Middle East and North Africa region spanning the period from 2000 to 2023. Thus, our study aims to understand how primary energy consumption, foreign direct investment flows, and trade openness affect economic growth in the context of the Middle East and North Africa countries. This study is significant because it illuminates a region characterized by its unique location, evolving government policies, foreign trade, investment policies, and energy resource endowments that have received little specific research attention.

This paper investigated the impact of energy consumption, foreign direct investment and trade openness on economic growth in the MENA countries (Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar) from 2000 to 2023. The estimation results for PMG-ARDL, Panel-FMOLS, and

Panel-DOLS indicate that capital, the labour force, primary energy consumption, and trade openness all have a statistically significant positive impact on economic growth in the MENA region. Foreign direct investment has a statistically significant negative impact on economic growth in the MENA region. In general, these results simply indicated that capital, labour forces, energy consumption, and trade openness are the main drivers of long-term economic growth in the MENA region.

This paper contributes to the current literature in several ways. First, this study closes a gap by precisely assessing the efficacy of different policy initiatives by examining key factors such as energy consumption, foreign direct investment, trade openness and economic growth from 2000 to 2023. We employed the cross-sectional dependence (CSD) approach, Fully Modified Ordinary Least Squares (FMOLS), and the Panel Pooled Mean Group-Autoregressive Distributed Lag Model (PMG-ARDL) to obtain estimates for the research variables in both the short and long term. Nevertheless, scant prior study has employed these approaches, particularly in investigating the long-term link between these elements within the setting of MENA nations. Third, economists and environmentalists could use this paper to model the economic determinants of sustainable growth. Policymakers from the MENA countries can utilize this paper to develop policies relating to energy mix and sustain economic growth.

We have divided this paper into the following parts: The "Review of Literature" section offers a summary of prior research and scholarly works. The "Methodology and Data" section delineates the methods and data employed in the investigation. The section entitled "Empirical Findings and Discussions" presents the study's results and offers a comprehensive analysis and explanation thereof. The "Conclusion" section is the final component of the study that encapsulates its findings.

## 2. REVIEW OF LITERATURE AND SYNTHESIS OF HYPOTHESES

This part reviews the literature exploring the relationship among energy consumption, foreign direct investment, trade openness, and economic growth.

### 2.1. Energy Consumption and Economic Growth

Many discussions and empirical research have shown that there is a relationship between energy consumption and economic growth. The empirical scholarship presented mixed and contradictory findings regarding the relationship between consumption of energy and economic growth (Lee and Chang, 2007; Wolde-Rufael, 2009; Belke et al., 2011; Mutumba et al., 2021; Dissanayake et al., 2023). There are four hypotheses regarding the causal relationship between energy consumption and economic growth (Yildirim et al., 2012; Gozgor et al., 2018). First is the growth hypothesis, which posits that energy consumption either directly or indirectly bolsters economic growth by complementing labour and capital factors in the production process. The credibility of the growth hypothesis suggests that energy conservation programs may diminish real GDP**.** Second is the conservation hypothesis, which posits that growth induces energy consumption. It suggests that conservation of energy initiatives would not diminish real GDP. The feedback hypothesis suggests an interdependent causal relationship between energy usage and real gross domestic product (GDP). Bidirectional Granger causality validity between energy use and real GDP supports the hypothesis. Ultimately, the neutrality hypothesis posits that energy consumption plays a minor role in influencing real GDP, and therefore conservation of energy initiatives would not diminish real GDP. The lack of Granger causality between energy usage and real GDP confirms the neutrality theory. indeed, Numerous studies empirically examine the association between energy use and economic growth across various countries and areas using diverse datasets. These studies also examine various econometric methodologies (Gozgor et al., 2018). This is confirmed, for example, by the study conducted by Adewuyi and Awodumi (2017), which surveyed empirical studies published over the last three decades by examining approximately 136 research studies. It concluded that 25% support the growth hypothesis, 41% support the feedback hypothesis, 21% support the conservation hypothesis, and 13% support the neutrality hypothesis within the relationship between energy and growth.

The relationship between energy consumption and economic growth has been extensively studied; Tang et al. (2016) examined the association between energy consumption and economic growth in the Republic of Vietnam using the neoclassical Solow growth model over the period from 1971 to 2011. The results confirmed that energy consumption positively influenced economic growth in the Republic of Vietnam. Eggoh et al. (2012) conducted research on the relationship between energy use and economic growth in 21 African countries from 1970 to 2006. They used new methods for analysing data. The research outcomes indicated that there is a positive and long-term equilibrium relationship between energy consumption and real GDP. In contrast, Baz et al. (2021) studied the asymmetric effects of fossil fuel on economic growth in Pakistan from 1980 to 2017 using a nonlinear approach and asymmetric causality methodologies. The asymmetric causality test revealed that both increases and decreases in fossil fuel use and economic growth did not have a significant effect on each other, while a two-way relationship was found between fossil fuel consumption and economic growth. Also, Wolde-Rufael (2009) investigated the causal relationship between energy use and economic growth in seventeen African nations. The findings indicated that the use of energy has a minimal effect on the economic growth of African economies.

Prior investigations on this subject have produced ambiguous or inconclusive findings. According to the available literature, we propose that there is a relationship between energy consumption and economic growth. Therefore, we present the following hypothesis:

$H_1$: There is an association between energy consumption and economic growth.

### 2.2. Foreign Direct Investment and Economic Growth

Foreign direct investment is an essential tool for attracting external capital and fostering economic growth in developing nations. International organizations, researchers, and policymakers

underscore the crucial role of foreign direct investment in the economies of developing countries (Mathebula et al., 2024). Foreign direct investment (FDI) enables firms to access advanced technology, establish cost-effective production facilities, create markets and new distribution channels, and acquire specialized skills (Akonnor, 2018). Empirical studies from various nations at different phases of development have produced inconclusive findings about the influence of foreign direct investment on economic growth.

Lin and Benjamin (2018) investigated the interaction between foreign direct investment and economic growth in MINT countries (Mexico, Indonesia, Nigeria and Turkey) over the period from 1990 to 2014, employing a panel dynamic ordinary least squares approach. The results showed a bidirectional causal relationship between economic growth and foreign direct investment inflows in Mexico, Indonesia, Nigeria, and Turkey. Alaa et al. (2021) explored the relationship between foreign direct investment and economic growth in Egypt from 1980 to 2018 using the Johansen cointegration method and Granger causality. The results concluded that there is a long-term positive relationship between investment and economic growth. The Granger causality test also indicated that there is a bidirectional causal relationship between foreign direct investment and economic growth in Egypt. Bölük et al. (2022) demonstrated the unequal relationship between foreign direct investment and economic growth in Turkey between 1987 and 2015, employing the NARDL methodology. The results concluded that there is a positive relationship between foreign direct investment and economic growth in Turkey. Long-term economic growth in Turkey increases by 0.053% when the positive shock of foreign direct investment increases by 1%. On the other hand, it discovered that a 1% increase in the negative shock results in a 0.057% decrease in economic growth. Raihan et al. (2025) investigated the influence of foreign direct investment on economic growth in Egypt from 1990 to 2021 using the autoregressive distributed lag model, dynamic ordinary least squares, and fully modified ordinary least squares. the results found that an increase in foreign direct investment by 1% would lead to an increase in Egyptian economic growth by 1.87% in the long term and 1.11% in the short term.

Numerous papers have indicated results that contradict the positive relationship between foreign direct investment and economic growth, such as, for example, Ahmad (2024) examined the relationships between foreign direct investment and economic growth in Kuwait from 1971 to 2014 using the autoregressive distributed lag model. The results found that the foreign direct investment harms economic growth in Kuwait in the long term. Asafo-Agyei and Kodongo (2022) studied how foreign direct investment affects economic growth in Sub-Saharan Africa, focusing on how well countries can take in the benefits of FDI using a specific analysis method. The outcomes indicated that the threshold level of FDI inflows per capita is around US$44.67 annually. For foreign direct investment (FDI) to significantly influence economic growth, nations must possess a minimum capacity to assimilate the growth-enhancing advantages of FDI. The technology gap between overseas-hosted firms and domestic enterprises must be at least 0.6904. Alvarado et al (2017) investigated the impact of foreign direct investment on economic growth in 19 Latin American economies, employing panel data econometrics. The outcomes indicated that the impact of foreign direct investment on economic growth is not statistically significant when considered in aggregate. This outcome varies when they consider the developmental levels attained by the countries in the region. Foreign direct investment exerts a positive and significant influence on production in high-income nations, whereas its impact in upper-middle-income countries is inconsistent and non-significant. The impact on lower-middle-income countries is negative and statistically significant. The results indicated that foreign direct investment is not an effective tool for stimulating economic growth in Latin America, except in high-income nations. Ang (2009) explored the roles of foreign direct investment in economic growth in Thailand from 1970 to 2004.The findings show that foreign direct investment negatively affects output growth in the long term in Thailand.

In theoretical terms, increasing foreign direct investment might enhance various economic activities in a region, which could lead to an increase in GDP. This paper aims to investigate the beneficial impacts of foreign direct investment in MENA economies, validate donated hypotheses, and consider how they interact between dependent and independent variables. Therefore, we present the following hypothesis:

$H_2$: There is a positive and significant relationship between foreign direct investment and economic growth.

### 2.3. Trade Openness and Economic Growth

The association between trade openness and economic growth has garnered significant attention in both theoretical and emirical research over the past thirty years. Nonetheless, there is barely any consensus on whether increased trade openness fosters economic growth (Keho, 2017; Silajdzic and Mehic, 2018). Krueger (1978) and Bhagwati (1978) contend that trade openness promotes specialization in industries characterized by economies of scale, thereby enhancing long-term efficiency and productivity. Newer endogenous growth models elucidate the positive association between trade openness and economic growth, attributing it to the global dissemination of innovative technology (Keho, 2017). This explanation shows that trade openness enhances the dissemination of technological knowledge between countries, thereby positively influencing long-term economic growth. Rivera-Batiz (1995) elucidated that if the local human capital structure fails to effectively assimilate the innovative knowledge produced by trade openness, then it has an inverse relationship with economic growth.

Accordingly, several research papers have indicated a positive relationship between trade openness and economic growth. The key outcome of Tahir and Azid (2015) is that the connection between trade openness and economic growth is both positive and statistically significant for developing economies. Idris et al. (2016) revealed a bidirectional causal relationship between trade openness and growth for both developing and OECD countries, supporting endogenous growth theory. Also, Sampath (2018) indicated that trade openness significantly enhances economic growth in India. Raghutla (2020) studied the impact of trade openness on

economic growth in five emerging countries from 1993 to 2016. The outcomes found that trade openness significantly enhances economic growth in the long term.

On the other hand, several pieces of literature have indicated a negative relationship between trade openness and economic growth. For instance, Hye and Lau (2015) examined the linkage between trade openness and economic growth in India. They employed a rolling window regression model and an autoregressive distributed lag technique. The results indicated that the trade openness index negatively affects economic growth in the long term. The analysis shows that the rolling regression results regarding the impact of the trade openness index on economic growth are unstable across the entire sample. Using endogenous growth models, Huchet□Bourdon et al. (2018) studied the association between trade openness and economic growth in 169 countries over the period from 1988 to 2014 and found that openness to trade may harm the growth of countries that focus on low-quality products. Malefane and Odhiambo (2021) explored the linkage between trade openness and economic growth in Lesotho using ARDL methodology. The empirical findings indicated that trade openness does not significantly affect economic growth in either the short term or the long term.

Based on previous studies, it is evident that trade openness plays a fundamental role in enhancing economic growth in developing countries. Therefore, we present the following hypothesis:

$H_3$: There is a positive and significant relationship between trade openness and economic growth.

## 3. DATA AND ECONOMETRIC METHODOLOGY

### 3.1. Data

This paper relied on annual data for seven selected countries in the MENA region based on data availability (Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar) over the period from 2000 to 2023. Table 1 displays the data sources used in this study. The data sources represent economic growth expressed by GDP (constant 2015 US$), capital expressed by gross capital formation (constant 2015 US$), labour (expressed by labour force, total), foreign direct investment (expressed by foreign direct investment, net inflows (BoP, current US$)), and trade openness expressed as a percentage of GDP. Data for the above variables are derived from the World Bank's World Development Indicators. Lastly, the Statistical Review of World Energy provides the measurement of primary energy consumption in exajoules.

**Table 1: Data and sources**

| Indicator | Abbreviation | Measurement | Source |
|---|---|---|---|
| Economic Growth | GDP | GDP (constant 2015 US$) | World Development Indicators |
| Primary Energy Consumption | EC | Exajoules | Statistical Review of World Energy |
| Capital | K | Gross capital formation (constant 2015 US$) | World Development Indicators |
| Labor | L | Labor force, total | World Development Indicators |
| Foreign direct investment | FDI | Foreign direct investment, net inflows (BoP, current US$) | World Development Indicators |
| Trade openness | TR | Trade (% of GDP) | World Development Indicators |

Source: The authors

### 3.2. Model Specification

The foundational works by Solow (1956, 1957) established a foundation for several empirical research studies utilizing the neoclassical model. These studies employed the aggregate production function, which linked economic outputs to capital and labour inputs based on macroeconomic data. The model regarded the labour force and capital stock as variable controls (Ben Abdallah, 2024). The model included the investment as a constant production ratio. Variables such as foreign direct investment, energy consumption, and trade openness are used alongside labour and capital in the model to control for other factors that determine economic growth and reduce the problem of omitted variable bias (Ben Abdallah, 2024). Consequently, our proposed model, along with the extensive literature on the determinants of economic growth, articulates the relationship as follows:

$$Y_{it} = A \cdot K_{it}^{\beta_1} \cdot L_{it}^{\beta_2} \cdot EC_{it}^{\beta_3} \cdot FDI_{it}^{\beta_4} \cdot TR_{it}^{\beta 4} \cdot e^{\varepsilon_{it}} \quad (1)$$

In this context, Y represents the GDP of country i at a specific date t, while $\varepsilon_{it}$ signifies an error term that follows the Gauss–Markov assumptions (Ben Abdallah, 2024).

Inserting the logarithm to transform the equation into a linear form result in the following expression:

$$LnY_{it} = \beta_0 + \beta_1 LnK_{it} + \beta_2 LnL_{it} + \beta_3 LnEC_{it} + \beta_4 LnFDI_{it} + \beta_5 LnTR_{it} + \varepsilon_{it} \quad (2)$$

with the constant. $\beta_0$ = logA.

The sign *Ln* denotes the natural logarithm. We employed logarithms to circumvent problems associated with the distributional properties of the data series such as avoiding heteroscedasticity (Fraz, 2022; Selmey et al., 2024). The coefficients like $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$ denote the explanatory variables' parameters that must be estimated. These parameters denote the elasticities of the coefficients of economic growth (*GDP*), capital (*K*), labor (*K*), primary energy consumption (*EC*), foreign direct investment (*FDI*), and trade openness (*TR*), respectively. $\varepsilon_{it}$ denotes the error term, which $\beta_0$ denotes the fixed intercept (the fixed effect of the countries involved). We assume that K increases economic growth if ($\beta_1 > 0$) and otherwise when ($\beta_1 < 0$). We assume that L increases economic growth if ($\beta_2 > 0$) and otherwise when ($\beta_2 < 0$). We assume that EC increases economic growth if ($\beta_3 > 0$) and otherwise when ($\beta_3 < 0$). We assume that FDI increases economic growth if ($\beta_4 > 0$) and otherwise when ($\beta_4 < 0$) and assume that TR increases economic growth if ($\beta_5 > 0$) and otherwise when ($\beta_5 < 0$). This paper examines how primary energy consumption (EC),

capital (K), labour (L), trade openness (TR), and foreign direct investment (FDI) influence economic growth (GDP) in seven selected countries in the MENA region. The study utilized data from a range of countries, including Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar, spanning 2000-2023. This study applied the main methodology, the Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) model, a robustness method called the Fully Modified Ordinary Least Squares (FMOLS) model, and the Dynamic Ordinary Least Squares (DOLS) model to examine the long-term relationships among primary energy consumption, capital, labour, trade openness, foreign direct investment, and economic growth.

The study used the Pooled Mean Groups-Autoregressive Distributed Lag (PMG-ARDL) method, which is known for explaining both short-term and long-term effects. We took the following steps to put this methodology into practice:

### *3.2.1. Cross-sectional dependence tests*

Analyzing cross-sectional dependence among nations is one of the most vital diagnostic tests in the panel data. To improve long-term estimates, researchers need to first check for cross-sectional dependence between countries and look at the stability of the data series (Tugcu, 2018; Selmey et al., 2024). Furthermore, it enables us to implement more appropriate unit root tests and cointegration tests.

The present study utilizes two tests for cross-sectional dependence: the Breusch and Pagan (1980) LM, and the Pesaran (2004) scaled LM. The test statistics for these tests, denoted as *LM* and $CD_{LM}$, can be calculated using the following formula (Sarafidis et al., 2009).

We can calculate the test statistics for these tests, represented by *LM*, $CD_{LM}$ and *CD*, respectively, using the following formula (Sarafidis et al., 2009).

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \tag{3}$$

$$CD_{LM2} = \sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T\hat{\rho}_{ij}^{2}-1\right)} \tag{4}$$

The symbol ( $\hat{\rho}_{ij}$ ) denotes the correlation coefficients obtained from the residuals of the model. If we reject the null hypothesis, the residuals exhibit cross-sectional dependence (Selmey et al., 2024).

### *3.2.2. Panel unit root tests*

This study used the augmented unit root test (CADF) and the CIPS test because they can work with cross-sectional data, as shown by the earlier mentioned tests for cross-sectional dependence. Pesaran (2008) proposed two varieties of unit root tests for panel data. The first test was the cross-sectional C.I.P.S. test conducted by Im, K.S., Pesaran, M.H., and Shin, Y. The next test was the cross-sectionally augmented Dickey-Fuller (C.A.D.F.) test (Westerlund et al., 2016; Azam et al., 2021). Given the stationary null hypothesis, we can express the C.A.D.F. test statistic as follows (Alataş, 2022):

$$\Delta y_{it} = \omega_0 + \omega_1 y_{i,t-1} + \omega_2 \bar{y}_{t-1} + \sum_{j-1}^{m}\beta_{1ij}\Delta\bar{y}_{i,t-j} + \sum_{k=0}^{n}\beta_{2ij}\Delta y_{t-j} + \mu_{it} \tag{5}$$

Pesaran (2007) showed that the C.A.D.F. test for unit roots in panel data gives strong and reliable results, even when the number of segments N and the time period T are both small (Alataş, 2022). The C.I.P.S. statistic is derived by assessing the specified equation subsequent to calculating the C.A.D.F. statistic for each cross-section (Azam et al, 2021).

$$CIPS = N^{-1}\sum_{i=1}^{N} CADF_i \tag{6}$$

### *3.2.3. Cointegration test*

We employ the bootstrap cointegration test for panel data to check the potential of a long-run cointegration relationship among non-stationary data. Westerlund and Edgerton's (2007) test posits that the null hypothesis indicates the presence of cointegration in panel data. "Their null hypothesis posits the nonexistence of cointegration." The Lagrange multiplier, developed by McKoskey and Kao in 1998 and foundational for this test, yields favorable outcomes for small samples and allows for the demonstration of cross-sectional dependence among cross-sectional units (Alataş, 2022).

### *3.2.4. PMG-ARDL methodology*

Dumitrescu and Hurlin (2012) developed the Pooled Mean Groups-Autoregressive Distributed Lag method, which this paper uses to analyses the short-term and long-term relationships between a group of variables. This approach is different from traditional co-integration methods because it can work with data that is stable at the first level I (0), the first difference I (1), or both without depending on the second difference I (2). Consequently, with this availability, we may employ the ARDL methodology to estimate both short-term and long-term effects, taking into account an adequate number of lags. This methodology is appropriate for small sample sizes and yields solid cointegration results for such samples (Azam et al., 2021). Dumitrescu and Hurlin (2012) emphasize the ultimate and most substantial advantage of this technology, namely its use within the Panel A.R.D.L. methodology. The model's formula is (p, q), with p denoting the lag of the dependent variable and q indicating the lag of the explanatory variables. We can articulate this model in the following way:

$$\begin{aligned} LnGDP_{it} = {} & a_0 + \varphi_i\sum_{j=1}^{p}\Delta LnGDP_{it-j} + \theta_i\sum_{j=1}^{q}LnK_{it-j} + \\ & \omega_i\sum_{j=1}^{q}\Delta LnL_{it-j} + \beta_i\sum_{j=1}^{q}\Delta LnEC_{it-j} + \delta_i\sum_{j=1}^{q}\Delta LnFDI_{it-j} \\ & +\eta_i\sum_{j=1}^{q}\Delta LnTR_{it-j} + \pi_i + \lambda_1 LnGDP_{it-1} + \lambda_2 LnK_{it-1} + \\ & \lambda_3 LnL_{it-1} + \lambda_4 LnEC_{it-1} + \lambda_5 Ln\,FDI_{it-1} + \\ & \lambda_6 Ln\,TR_{it-1} + \varepsilon_{it} \end{aligned} \tag{7}$$

Where, $LnGDP_{it}$ represents the dependent variable for cross-section (i) and time (t). Δ denotes the difference. φ, θ, ω, β, δ, η denotes to the short-term coefficients. $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6$ denotes to the long-term coefficients. *p, q, q, q, q* denotes the maximum number of lags. $\varepsilon_{it}$ represents the error term. Hence, The Panel's Pooled Mean Group-Autoregressive distributed lag technique (PMG-ARDL) is employed in this paper and is explained as follows: (Adams et al., 2020):

$$\Delta Ly_{it} = \varnothing_i ECT_{it} + \sum_{j=0}^{q-1} \Delta Lx_{it-j}\beta_{ij} + \sum_{j=1}^{p-1} \psi_{ij} \Delta Lx_{it-j} + \varepsilon_{it} \quad (8)$$

$$ECT_{it} = y_{it-1} - X_{it}\theta \quad (9)$$

In equations (8) and (9), the variable y denotes the dependent variable, specifically GDP. The vector X denotes the collection of independent variables, specifically K, L, EC, FDI, and TR. All these variables exhibit the same lag q, which different across several nations (i) at different time(t). Δ denotes the difference operator, whereas θ signifies the long-run coefficient, yielding estimates of ψ and β at convergence.

## 4. EMPIRICAL RESULTS AND DISCUSSION

This section delineates the preliminary statistical analyses and the major empirical findings. The researcher initially examines cross-country dependence among countries. The data presented in Table 2 rejected the null hypothesis, demonstrating independence across countries for all variables. The findings indicate the presence of cross-sectional dependence across countries. The Pesaran scaled LM and the Breusch-Pagan LM tests were significant at the 1% significance level. This signifies that a shock facing one member of the MENA group substantially impacts the rest of the others. This result, based on the earlier mentioned method, also helps in identifying and using better unit root and cointegration tests for the model (Alataş, 2022; Selmey et al., 2024).

The next step is to conduct unit root tests that allow cross-sectional dependency to ascertain the stationarity of all variables in the estimated model. To achieve this, we employ Pesaran's (2008) unit root tests for panel data, specifically the C.I.P.S. and C.A.D.F. methods.

Tables 3 and 4 present the results of the C.I.P.S. and C.A.D.F. tests. The analysis indicates that all variables included in the model (LnGDP, LnK, LnL, and LnTR) are stationary when examined at their first differences, with the exception of primary energy consumption (LnEC) and foreign direct investment (LnFDI), which are stationary at their levels. In the next step, to examine the probable long-term cointegration connection between the time series of variables, we use the panel bootstrap cointegration test. Westerlund and Edgerton (2007) assert that the null hypothesis of this test posits no existence of cointegration, as it is founded on the Lagrange multiplier developed by McKoskey and Kao (1998).

The ADF test statistic for cointegration, as presented in Table 5, is −1.435736, with a P = 0.0755, indicating that the ADF test statistic is significant at the 10% level. Consequently, we reject the null hypothesis of no cointegration and confirm that cointegration exists between the variables in the long term.

The next step involves estimating the model parameters for both the long and short terms using the PMG-ARDL methodology. We must ascertain the best lag periods for the model employing the Akaike Information Criterion (AIC) test prior to estimating the model with the PMG-ARDL approach. The outcomes were as follows.

The findings in Table 6 denote that the optimal lag length employing the AIC test is ARDL (1, 0, 0, 0, 0). Consequently, we can execute the estimate process utilizing the PMG-ARDL model

**Table 2: The results of cross-section dependence**

| Test | Statistic | Prob. |
|---|---|---|
| Breusch-Pagan LM | 133.9368 | 0.0000* |
| Pesaran scaled LM | 17.42653 | 0.0000* |

*Denotes statistical significance at the 1% levels
Source: The authors prepared the result using the outputs from EViews 13

**Table 3: C.I.P.S. test results**

| Variable | C.I.P.S. | |
|---|---|---|
| | Level (Prob.) | Δ (Prob.) |
| LnGDP | 0.3289 | 0.0000* |
| LnK | 0.1008 | 0.0000* |
| LnL | 0.1403 | 0.0004* |
| LnEC | 0.0046* | - |
| LnFDI | 0.0035* | - |
| LnTR | 0.1848 | 0.0000* |

*Denotes statistical significance at the 1% level
Source: The authors prepared the result using the outputs from EViews 13

**Table 4: C.A.D.F. test results**

| Variable | C.A.D.F. | |
|---|---|---|
| | Level (Prob.) | Δ (Prob.) |
| LnGDP | 0.2825 | 0.0000* |
| LnK | 0.1646 | 0.0001* |
| LnL | 0.2286 | 0.0013* |
| LnEC | 0.0117** | - |
| LnFDI | 0.0065* | - |
| LnTR | 0.1778 | 0.0000* |

*, and **indicate statistical significance at the 1% and 5% levels, respectively
Source: The authors prepared the result using the outputs from EViews 13

**Table 5: Kao Cointegration test results**

| Augmented Dickey–Fuller (ADF) | Kao Cointegration Test | |
|---|---|---|
| | t-Statistic | Prob. |
| | −1.435736 | 0.0755*** |

***indicate statistical significance at the 10% level
Source: The authors prepared the result using the outputs from EViews 13

**Table 6: Results of akaike information criteria test**

| Model | AIC | Specification |
|---|---|---|
| 1 | 0.168026 | ARDL (1, 0, 0, 0, 0) |
| 2 | 0.25953 | ARDL (1, 1, 0, 0, 0) |
| 3 | 0.351033 | ARDL (1, 0, 1, 1, 0) |
| 4 | 0.442536 | ARDL (1, 1, 0, 1, 0) |

Source: The authors based on EViews 13 results

subsequent to ascertaining the optimal lag length for the model variables. Upon completion of the estimation process, the findings were shown in Table 7:

Table 7 clearly indicates that primary energy consumption has a significant and positive impact on economic growth in the MENA countries at a significance level of 1%. The empirical findings indicate that a 1% increase in primary energy consumption results in a 0.377% increase in economic growth in the MENA countries over the long term. This means that increasing the EC improves economic growth in the MENA countries over time. This outcome aligns with the findings of numerous previous studies (e.g., Kyophilavong et al., 2015; Tang et al., 2016; Gozgor et al, 2018; Azam et al., 2023). This can be explained by the fact that an increase in primary energy consumption can lead to an increase in the productive capacity of industries, which enhances industrial production. Additionally, energy availability stimulates new investments in various sectors such as manufacturing, mining, and infrastructure and increases employment opportunities, thereby supporting economic growth. Energy consumption and economic growth are therefore positively and significantly correlated, particularly in the early phases of economic development.

The results in Table 7 also showed that the effect of trade openness on economic growth in MENA countries is insignificant in the short term but positive and significant in the long term, at a 1% level of significance. 1% increases in trade openness led to a 0.33012% rise in economic growth in the MENA countries. This outcome aligns with numerous previous works of literature, including Tahir and Azid (2015), Idris et al. (2016), Keho (2017), Sampath (2018), Raghutla (2020), and Wiredu et al. (2020). Trade openness is essential for enhancing the flow of commodities, services, and intermediate goods and then augmenting economic production (Selmey et al., 2024). Most MENA countries depend on diversifying their exports, including oil and gas, agricultural products, and industrial goods, while also enhancing import efficiency by increasing access to production inputs.

The outcomes of Table 7 indicated a significant negative relationship between foreign direct investment and economic growth in the MENA region over the long term, with a 10% significance level; specifically, a 1% increase in foreign direct investment results in a 0.0162% decline in economic growth over the long run. This finding can be explained by the fact that foreign direct investment (FDI) can undermine economic growth because it often focuses on unproductive sectors (such as real estate), crowds out local investment, and so on. Additionally, direct foreign investment requires a favourable environment, including strong infrastructure and effective legislation; it can also increase external dependence and lead to financial volatility, which undermines economic stability. Also, this negative relationship between foreign direct investment and economic growth may be due to ill-considered investment attraction policies, such as offering exaggerated tax incentives. This result is consistent with the outcomes of several studies, including Dinh et al. (2019) and Ahmad (2024).

**Table 7: Results of both long-and short-term parameter estimations**

| Dependent variable (LnGDP) | Long-run results | | |
|---|---|---|---|
| **Independent variables** | **Coefficient** | **t-statistics** | **P-value** |
| LnEC | 0.37718 | 5.709321 | 0.0000* |
| LnTR | 0.33012 | 10.4427 | 0.0000* |
| LnFDI | −0.016234 | −1.974236 | 0.0749*** |
| LnK | 0.180735 | 5.709321 | 0.0000* |
| LnL | 0.223255 | 4.912982 | 0.0000* |
| Short - run results | | | |
| ECT (−1) | −0.52357 | −3.52704 | 0.0006* |
| D (LnGDP [−1]) | 0.25806 | 1.964255 | 0.0516*** |
| D (LnEC) | 0.165184 | 1.166329 | 0.2455 |
| D (LnTR) | −0.057884 | −0.68464 | 0.4947 |
| D (LnK) | 0.052922 | 1.753529 | 0.0818*** |
| D (LnL) | 0.52357 | 3.502704 | 0.0006* |

*, **and ***indicate statistical significance at the 1%, 5% and 10% levels, respectively
Source: The authors based on EViews 13 results

The other variables—labour and capital—are important determinants of the production process. The results showed that the estimated coefficients for the labour and capital elements are statistically significant and have a positive impact on economic growth at a significance level of 1% in both the short and long terms. Table 7 illustrates that a 1% increase in these factors results in a long-term increase in economic growth of 0.180735% and 0.223255%, respectively, and a short-term increase of 0.052% and 0.5235% at a 5% and 1% significance level in the short term, respectively. These outcomes, along with recent studies like Kahia et al. (2017) and Ghazouani (2024), highlight the vital role of physical capital and the labour force in the economic growth of MENA regions. Also, this finding is consistent with the results of other studies conducted in different countries and regions, such as Wolde-Rufael (2009), Hye and Lau (2015), and Wahyudi (2024).

In general, these results simply indicated that capital, labor force, energy consumption, and trade openness are the main drivers of long-term economic growth in MENA regions.

The error correction term (ECT) determines the pace of adjustment, which refers to how quickly a variable return to its long-run equilibrium. At the 1% significance level, the ECM value indicates that the ECT is both extremely significant and negative. This result indicates a stable and consistent connection among the natural logarithms of GDP, K, L, EC, TR, and FDI. The ECT number signifies that the adjustment rate requires roughly 52% of a year to attain equilibrium over the long term. In other words, the entire adjustment occurs over an approximate two-year period to reach the state of long-term equilibrium (Selmey et al. 2024).

To validate the quality of the estimated model's results, we employed an econometric technique to address the problems of heterogeneity in estimating (Kao et al., 1999; Pedroni, 2004). Since this method is important, we use panel fully modified least squares with weighted estimation (Panel-FMOLS) and panel dynamic least squares with weighted estimation (Panel-DOLS) to assess the estimated model parameters (Zakari et al., 2021; Selmey et al., 2024). As shown in Tables 8 and 9, the estimation results of Panel-FMOLS and Panel-DOLS indicate that capital,

**Table 8: Panel-FMOLS estimation findings**

| Variables | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| LnEC | 0.641512 | 7.219909 | 0.0000* |
| LnTR | 0.110489 | −2.03992 | 0.0431* |
| LnFDI | −0.009370 | 1.329773 | 0.1556** |
| LnK | 0.146913 | 2.29763 | 0.0034* |
| LnL | 0.019159 | 2.55016 | 0.0047* |

**Table 9: Panel-DOLS estimation findings**

| Variables | Coefficient | t-Statistic | Prob. |
|---|---|---|---|
| LnEC | 0.159458 | 2.554783 | 0.0061* |
| LnTR | 0.012061 | 1.450712 | 0.0528** |
| LnFDI | −0.001166 | 1.445719 | 0.1617** |
| LnK | 0.086137 | 4.297409 | 0.0000* |
| LnL | 0.248093 | 3.716764 | 0.0003 |

*, and **indicate statistical significance at the 1% and 5% levels, respectively
Source: The authors based on EViews 13 outputs

the labour force, primary energy consumption, and trade openness have a statistically significant and positive impact on economic growth in the MENA region. On the other hand, the results show that foreign direct investment has a statistically negative impact on economic growth but is insignificant in the MENA region. This aligns with the findings of the PMG-ARDL estimating approach. The estimation results reveal that capital, the labour force, primary energy consumption and trade openness significantly affect economic growth in the MENA region. Also, the robustness and reliability of the estimated model are consistent with the findings of the PMG-ARDL estimation approach.

In general, these results simply indicated that capital, labor force, energy consumption, and trade openness are the main drivers of long-term economic growth in MENA regions.

This research examined how energy use, trade openness, and foreign direct investment influence economic growth in seven selected countries in the MENA region Based on data availability (Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar) over 2000-2023, using three methods: the Panel Pooled Mean Group-Autoregressive Distributed Lag Model (PMG-ARDL), the Panel Fully Modified Least Squares (FMOLS) and Panel Dynamics Least Squares (DOLS) models to explore the long-term relationships between these factors. The estimation results for PMG-ARDL, Panel-FMOLS, and Panel-DOLS indicate that capital, the labour force, primary energy consumption, and trade openness all have a statistically significant positive impact on economic growth in the MENA region. Foreign direct investment has a statistically significant negative impact on economic growth in the MENA region. In general, these results simply indicated that capital, labour forces, energy consumption, and trade openness are the main drivers of long-term economic growth in the MENA region.

The study suggests enhancing investment in human and physical capital, increasing trade openness, and focusing on energy efficiency to stimulate long-term economic growth while reevaluating policies for attracting foreign direct investment and ensuring their alignment with developmental priorities.

## 5. CONCLUSION

The study sought to examine the influence of capital, the labour force, primary energy consumption, trade openness, and foreign direct investment on economic growth in seven selected countries in the MENA region (Algeria, Egypt, Morocco, the United Arab Emirates, Saudi Arabia, Oman, and Qatar) from 2000 to 2023, based on data availability throughout that timeframe. The study used the PMG-ARDL, Panel FMOLS, and Panel DOLS procedures, which represent contemporary econometric techniques. The study outcomes indicated that (1) primary energy consumption exerts a statistically significant and positive effect on long-term economic growth. This outcome aligns with previous research (e.g., Kyophilavong et al., 2015; Tang et al., 2016; Gozgor et al., 2018; Azam et al., 2023). This correlation can be explained by the fact that an increase in primary energy consumption can lead to an increase in the productive capacity of industries, which enhances industrial production. Additionally, energy availability stimulates new investments in various sectors such as manufacturing, mining, and infrastructure and increases employment opportunities, thereby supporting economic growth. Energy consumption and economic growth are therefore positively and significantly correlated, particularly in the early phases of economic development. (2) Trade openness has a positive influence on economic growth in the short and long term. at a 1% level of significance. 1% increases in trade openness led to a 0.33012% rise in economic growth in the MENA countries. This outcome aligns with numerous previous works of literature, including Tahir and Azid (2015), Idris et al. (2016), Keho (2017), Sampath (2018), Raghutla (2020), and Wiredu et al. (2020). Trade openness is essential for enhancing the flow of commodities, services, and intermediate goods and then augmenting economic production., (3) Foreign direct investment has a significant and negative effect on economic growth in the MENA region in the long term at a significant level of 10%, where a 1% increase in foreign direct investment leads to a 0.0162% decline in economic growth in the long run. This result is consistent with the outcomes of several studies, including Dinh et al. (2019) and Ahmad (2024)., (4) The other variables—labour and capital—are important determinants of the production process. The results showed that the estimated coefficients for the labour and capital elements are statistically significant and have a positive impact on economic growth at a significance level of 1% in both the short and long terms. These outcomes, along with recent studies like Kahia et al. (2017) and Ghazouani (2024), highlight the vital role of physical capital and the labour force in the economic growth of MENA regions. In general, these results simply indicated that capital, labour force, energy consumption, and trade openness are the main drivers of long-term economic growth in MENA regions. In conclusion, emerging economies in the Middle East and North Africa continue to suffer from economic recession caused by political upheavals in countries like Egypt, Libya, and Syria, as well as the repercussions of these events for other nations in the region. Moreover, the security situation deteriorates, labour unrest persists, infrastructure faces difficulties, and some countries in this region are subject to international economic sanctions.

The study suggests enhancing investment in human and physical capital, increasing trade openness, and focusing on energy efficiency to stimulate long-term economic growth while reevaluating policies for attracting foreign direct investment and ensuring their alignment with developmental priorities.

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