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Foreign Direct Investment Inflows, Trade Openness and Economic Growth in Algeria: an ARDL Bounds Testing Approach (1980-2020)

تدفقات الاستثمار الأجنبي المباشر، والانفتاح التجاري، والنمو الاقتصادي في الجزائر: منهج اختبار حدود الانحدار الذاتي للإبطاء الموزع ARDL (1980–2020)

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Abstract:

This study examined the relationship between foreign direct investment inflows (FDI % of GDP), trade openness (TO % of GDP), and economic growth (GDP growth rate %) in Algeria using time series data from 1980 to 2020. Data was taken from the World Bank. The study applied ARDL Co-integration analysis together with the error correction model (ECM) technique to examine the long-run as well as the short-run relationships between the variables under study. The empirical results revealed a positive and significant relationship between trade openness and economic growth both in the long run and short run in Algeria. The results also showed that FDI inflows had a negative and statistically insignificant long run and short-run relationships with GDP in Algeria during the period. In line with the results, the study recommended that the government should put in place the required policy that would promote technology-based, export-promoting foreign direct investment. Government should also implement economic reforms to attract more investments.

Keywords: Foreign Direct Investment Inflows; Trade Openness; Economic Growth; ARDL; Algeria.
JEL Classification Codes : C32, E22, F14, F21, O40.

ملخص:

تناولت هذه الدراسة العلاقة بين تدفقات الاستثمار الأجنبي المباشر الوافدة (نسبة الاستثمار الأجنبي المباشر من الناتج المحلي الإجمالي)، والانفتاح التجاري (% من الناتج المحلي الإجمالي)، والنمو الاقتصادي (معدل نمو الناتج المحلي الإجمالي%) في الجزائر باستخدام بيانات السلاسل الزمنية من 1980 إلى 2020. البيانات مأخوذة من البنك العالمي. استخدمت الدراسة تحليل التكامل المشترك $ARDL$ مع الاستعانة بنموذج تصحيح الخطأ ECM لفحص العلاقات طويلة المدى والقصيرة المدى بين المتغيرات قيد الدراسة. كشفت نتائج الدراسة الميدانية عن علاقة طردية ومعنوية بين الانفتاح التجاري والنمو الاقتصادي على المدى الطويل والقصير في الجزائر. وأظهرت النتائج أيضًا أن تدفقات الاستثمار الأجنبي المباشر الوافدة لها علاقات طويلة المدى وقصيرة المدى عكسية وغير معنوية إحصائيًا مع الناتج المحلي الإجمالي في الجزائر خلال فترة الدراسة. وبالتوافق مع النتائج، أوصت الدراسة بضرورة قيام الحكومة بوضع السياسة المطلوبة التي من شأنها تعزيز الاستثمار الأجنبي المباشر القائم على التكنولوجيا والمعزز للتصدير علاوة على إجراء الإصلاحات الاقتصادية لجذب المزيد من الاستثمارات.

كلمات مفتاحية: تدفقات الاستثمار الأجنبي المباشر، الانفتاح التجاري، النمو الاقتصادي، ARDL، الجزائر.

تصنيفات JEL: C32، E22، F14، F21، O40.

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INTRODUCTION:

In the era of globalization and liberalization, countries' economies are closely linked to the international economy through external activities such as foreign direct investment and international trade. Therefore, the global economic situation is one of the most important determinants of growth in countries with open economies. This relationship has grown gradually in recent years because international trade and capital movements are more integrated. As a result, global economic activities generate higher growth in world income. A recent trend suggests that capital movements in various countries, especially foreign direct investment, can improve domestic economic growth. Foreign direct investment affects domestic growth by increasing product competitiveness, facilitating technology transfer, and enabling access to the world market.

Increasing employment, improving performance, higher productivity, capital and technology transfer, and improving managerial skills are some of the economic and social benefits of FDI to host countries. Innovation and technology can be used by exporters while acting as subcontractors to foreign companies or through competition on global marketplaces. Furthermore, trade openness is an important catalyst for growth, employment, and poverty reduction. Trade provides new opportunities for local firms, greater productivity, and innovation through competition. Foreign direct investment is likely to have a direct or indirect effect on trade-related growth. Thus, foreign direct investment and trade are interrelated. Foreign direct investment results in the transfer of knowledge and technology that will boost production efficiency. As a result, it will have an impact on the extension of trade, which is a key driver of economic growth and will further support foreign investors. Moreover, foreign direct investment is estimated to have an impact on trade because it is essentially driven by two incentives, namely the provision of resources to national markets and the utilization of low-cost inputs of production in the host countries. It will have a positive effect if the countries are export-oriented, and vice versa. Given the reciprocal relationships between foreign direct investment, exports, imports, and economic growth, the positive association between those variables make sense.

Helpman and Krugman hypothesise that economies of scale, specialisation in production, and the transfer of technical knowledge through FDI all contribute to the growth-promoting effects of exports. In addition, Bhagwati stated that the growth-led hypothesis supported the neoclassical trade theory, according to which economic growth boosts both the supply and demand sides of an economy. (Awokuse, 2007, p. 392) This means that the causal link between trade, economic growth, and FDI is mutual. Trade openness is a crucial factor in economic performance. The study of Belhadi, Ayad, and Zenasni found that greater trade openness led to increased economic activity, which in turn boosted the competitiveness of Algeria's non-hydrocarbon export sector (Belhadi, Ayad, & Zenasni , 2021, p. 721) .The country's market or trade potential is typically indicated by the level of GDP in the country, which attracts foreign investment, hence, creating new opportunities for more trade. Trade Openness supports the transfer of technology and knowledge into the economy, which contributes to the exploitation of comparative advantage by increasing the confrontation of competition. Besides, liberalization increased specialization and division of labor, which in turn increased the country's productivity and export capacity, thus enhancing overall

economic performance. Trade openness and FDI have become key drivers of growth in developing countries.

The relationship between economic growth and foreign direct investment has been extensively investigated by numerous researchers but doesn't give a conclusive answer on whether FDI and trade openness have a significant impact on economic growth. The outcomes of some researchers revealed that openness to trade has a positive impact on economic growth (EG) because a country that is more open to the world economy can absorb new technological advancement from developed countries.

An important number of researches, strategic agreements and international discussions, have been written on the controversial effects of trade openness, foreign direct investment, and domestic investment on economic growth. Several studies examined the impact of different economic factors, such as foreign direct investment and international trade, on the economic growth of one or a group of countries. The findings of empirical studies may not be completely consistent, but the common denominator is that foreign investment and international trade are associated with economic growth.

This study aimed to examine the relationship among FDI, trade openness and economic growth in Algeria through a systematic approach that explores the following question:

Is there a short-term and long-term relationship between FDI inflows, trade openness and economic growth in Algeria over the period 1980-2020?

It is possible to state that there is a significant positive short-term and long-term relationship between FDI inflows, trade openness, and economic growth in Algeria. By focusing on the case of Algeria, this study aims to enhance our understanding of the dynamic interaction among FDI, trade openness, and economic growth through an econometric analysis based on ARDL and ECM.

The current study is organized as follows: the second section deals with a brief part of the literature review. At the same time, the study attempts to highlight methodological differences that help us to explain the different results of previous studies. The third section is about the research methodology, which refers to the processing for the data collection. The fourth section presents and discusses the empirical results. The final section offers a conclusion and policy recommendations for the study.

1- Literature review:

Numerous studies have been conducted in the literature to investigate the relationship between trade, FDI and economic growth. Due to some features and differences, the results of these studies were inconsistent. For example, some studies have found positive or negative relationships between trade, FDI and economic growth. On the other hand, some studies revealed a mixture of relationships between trade openness, foreign direct investment, and economic growth. The empirical literature is listed in this section, indicating the author, period, methodology, and findings.

Foreign direct investment and international trade belong to the field of external economic relations. These activities have different effects on the economy, which can be positive or negative. Determining the effect of these activities on the economy and implementing suitable

policies are key priorities for governments seeking to achieve high and sustainable economic growth.

The relationship between foreign direct investment, trade, and growth has frequently been studied empirically in the context of the export-led growth hypothesis and the FDI-led growth hypothesis. From this perspective, international trade channels derive their benefits for economic growth by improving knowledge sharing, technology transfer, and competitiveness (Trejos & Barboza, 2015, p. 121)

Balasubramanyam et al. highlighted the importance of foreign direct investment in the growth process, which is defined by various trade regimes in developing countries. Countries with outward-oriented trade policies have a stronger positive growth effect of FDI than those with inward-oriented trade policies. (Balasubramanyan, Salisu, & Sapsford, 1996, p. 99)

Melitz has demonstrated that international trade influences the intra-industry allocation and overall productivity of the industry. According to the FDI-led growth hypothesis, inward FDI supports the economic growth of host countries by increasing capital stock, generating jobs, and facilitating technology transfer. (Melitz, 2003, p. 1711)

Positive effects associated with foreign direct investment and trade, include poverty reduction, employment opportunities, technology transfer, competitiveness and economic growth. (Su, Nguyen, & Christophe, 2019, p. 245)

Researchers Karbasi, Mohamadi, and Ghofrani have studied how trade and foreign direct investment contribute to economic growth in some developing countries as well as how these three factors interact. Over the previous three decades, the researchers have examined data from 42 developing countries. According to the study's findings, foreign direct investment boosts domestic investment, while trade, human capital, domestic investment, and foreign direct investment are important enablers of economic growth in emerging countries. (Karbasi, Mohamadi, & Ghofrani, 2005)

Liu, Burridge and Sinclair examined the causal relationships between trade, economic growth and foreign direct investment in China. The study identified two-way causality (bidirectional) between economic growth, FDI and exports. The researchers state that because of the open-door policy, economic growth, exports, and foreign direct investment appear to support each other. (Liu, Burridge, & Sinclair, 2002, p. 1439)

Dritsaki, Dritsaki and Adamopoulos, examined the relationship between trade, FDI and economic growth (EG) in Greece from 1960 to 2002. According to the cointegration analysis, there is a long–run relationship equilibrium among the variables under study. (Dritsaki, Dritsaki, & Adamopoulos, 2004, p. 230)

Metwally investigates the interaction between foreign direct investment, exports, and economic growth in three Middle Eastern countries: Egypt, Jordan, and Oman, from 1981 to 2000. The simultaneous equations model findings indicate that higher rates of economic growth result in a greater inflow of foreign capital. Moreover, the export of goods and services in these three countries is strongly influenced by foreign direct investment. (Metwally, 2004, p. 127)

Baliamoune-Lutz used the Granger causality test to examine the causal relationship among foreign direct investment (ratio of nominal FDI to nominal GDP), exports (ratio of nominal exports to nominal GDP), and economic growth (annual percentage change in real GDP) in Morocco from 1973 to 1999. The results of the study revealed that there is a

feedback causality relationship between exports and FDI as well as a two-way causal relationship where each variable, foreign direct investment and exports, causes GDP growth. (Baliamoune-Lutz, 2004, p. 49)

Makki and Somwaru investigated the role of foreign direct investment and trade in the economic growth of developing countries. Using cross-section data from a sample of 66 developing countries collected over three decades, the results of the study revealed that foreign direct investment and trade contribute toward advancing economic growth in developing countries. There is a strong, positive relationship between foreign direct investment and trade. Foreign direct investment is frequently the main channel through which advanced technology is transferred to developing countries. The findings suggest that the benefits from such investments would be greatly improved if the host country had a better stock of human capital. (Makki & Somwaru, 2004, p. 798)

Using data from ten European transition economies, Nath examined the relationship between trade, FDI, and growth. These results support the hypothesis that export-oriented trade policies improve the growth effects of FDI in these countries. (Nath, 2009) Likewise, Kakar and Khilji studied the role of trade openness and foreign direct investment in the economic growth of Pakistan and Malaysia from 1980-2010. The study revealed that trade openness had a long-term positive impact on economic growth in both Pakistan and Malaysia. Long-term effects of the degree of trade openness also turned out to be significant and important. (Kakar & Khilji, 2011, p. 56)

Javed et al. assessed the relationship between FDI, Trade, and Economic Growth in four South Asian nations, namely Bangladesh, Sri Lanka, India, and Pakistan, using annual data from 1973 to 2010. The study applied the Generalized Method of Moments (GMM). The findings revealed that FDI has a positive effect on growth in all countries except Sri Lanka, whereas exports have a positive effect on output in all countries. Imports have a positive and significant impact on output only in Pakistan and Sri Lanka. Trade openness is statistically significant, suggesting that the more open an economy is, the more FDI it attracts in the short run. (Javed, Falak, Awan, & Ashfaq, 2012, p. 216)

Using Granger causality tests, Yussof and Nuh investigated the relationship between foreign direct investment, international trade, and economic growth in Thailand. According to the findings, foreign direct investment and trade have positively contributed to the economic growth of Thailand. (Yusoff & Nuh, 2015, p. 79) Furthermore, Sakyi and Egyir demonstrated in 45 African countries that the interaction between foreign direct investment and trade improves their two growth effects. (Sakyi & Egyir, 2017, p. 83)

Boakye and Gyamfi assessed the effects of foreign trade, foreign direct investment, external debt per capita, gross capital formation, inflation, and remittances per capita on Ghana's economic growth using the ordinary least-squares approach. The findings demonstrated that GDP was correlated with every variable. Ghana's economic growth was positively and significantly influenced by export. A unit increase in exports could on average boost GDP by 2.085751. FDI also had a positive impact on GDP but was insignificant. A 1% increase in foreign direct investment would lead to a 2.676054% increase in Ghana's economic growth. (Boakye & Gyamfi, 2017, p. 24)

Meanwhile, Nantharat and Kang analysed the influences of foreign direct investment, human capital, trade openness and institutional quality on the economic growth of the Lao PRD (Lao People's Democratic Republic) from 1993 to 2015. The research findings indicated that foreign direct investment and trade openness had a positive influence on economic growth in Lao PRD, while human capital and institutional quality had a negative influence. Based on the results of the study, the researchers recommended the Lao PRD government promote foreign direct investment for a long time and attract better quality and more sustainable foreign direct investment to achieve sustainable growth rates over the long term. Additionally, the Lao PRD government should promote economic competitiveness on a regional and international scale. (Nantharath & Kang, 2019, p. 157)

While many researchers argue that foreign direct investment and trade openness have positive effects on economic growth in some countries, other researchers have concluded that there is no significant effect of these variables on economic growth. Previous studies have highlighted the weaknesses and methodological limitations of these studies. Thus, the results are inconclusive.

Khan and Leng used the Granger causality test to examine the interaction between foreign direct investment, exports, and economic growth in Singapore, Taiwan, and South Korea from 1965 to 1995. They concluded that no evidence exists to support the causal relationship between foreign direct investment and exports in Taiwan and South Korea. Singapore also has a one-way causal relationship that runs from exports to foreign direct investment. (Khan & Leng, 1997, p. 53)

Yanikkaya examined the relationship between trade openness and economic growth in developing countries. The findings show that trade openness is negatively correlated with economic growth. (Yanikkaya, 2003, p. 57)

Alici and Ucal studied the causal relationships between inward foreign direct investment, exports, and Turkish economic growth from 1987 to 2002 quarterly. The relationship between foreign direct investment and export growth does not exist in Turkey. (Alıcı & Ucal, 2003, p. 13) Similarly, Belloumi examined the causal relationship between economic growth, foreign direct investment, trade, labour and capital investment in Tunisia for the period of 1970 to 2008. Applying the ARDL model to investigate the existence of a long-run relationship among the above variables, and the Granger causality within VECM to test the direction of causality. The results showed that there is cointegration between the variables included in the model. Trade openness and economic growth promote foreign direct investment in Tunisia in the long term. The results also indicated that there is no significant Granger causality from FDI to economic growth or from economic growth to FDI in the short term. According to the results of the Granger causality test for economic growth and trade openness, there is also no significant Granger causality from trade to economic growth or from economic growth to trade in the short term. (Belloumi, 2014, p. 281)

In the case of the Asian economies, Goh et al. used a bootstrap test for cointegration to demonstrate that there is no long-term co-integration between foreign direct investment, exports and economic growth. (Goh, Sam, & McNown, 2017, p. 12)

In contrast to previous studies, some researchers have come to different results that can be reviewed in the following. For example, Hsiao and Hsiao have studied the Granger causality links between Gross Domestic Product, Exports, and Foreign Direct Investment in

eight countries of East and Southeast Asia. In this study, the researchers estimated the VAR and VECM of the three variables to find various Granger Causal relations for each of the eight countries. They used a fixed effects and random effects approach to estimate the panel data. The study revealed that each country has different causality relations and does not yield general rules. Furthermore, the panel data causality results revealed that Foreign Direct Investment has unidirectional influences on GDP directly and also indirectly over exports, and there also exists bidirectional causality between exports and GDP for the group of Countries. (Hsiao & Hsiao, 2006, p. 1082)

The bounds testing cointegration approach and the VAR Granger causality/Block Exogeneity, Wald tests were used to investigate data for Côte d'Ivoire from 1980 to 2007 and, revealed that there is a unidirectional long-run association between FDI, trade openness, and output; and the causality runs from FDI, trade openness to output and from output, FDI to trade openness. Trade openness and FDI are both important growth drivers in Côte d'Ivoire. (Yaoxing, 2010, p. 103)

According to Adhikary, capital formation, trade openness, and foreign direct investment, all had a positive relationship with GDP. He assessed the link between these economic factors in Bangladesh from 1986 to 2008. A significant long-run equilibrium link between foreign direct investment, trade openness, capital formation, and GDP was found by the study. The amount of foreign direct investment and the level of capital formation had a positive effect on Bangladesh's economic growth. Although, trade openness had a significant negative, decreasing impact on the economy. The main causes which led to the negative effect of trade openness were the exchange rate depreciation, the enormous volume of imported materials, and the state of the trade balance. Adhikary recommended the government of Bangladesh implement policies to promote foreign direct investment and ensure a higher degree of capital formation to stimulate economic growth. (Adhikary, 2011, p. 21)

To examine the long-run relationship between FDI, export, and economic growth for some EU countries, Acaravci and Ozturk applied the ADRL and Granger causality tests to the quarterly statistics from 1994 to 2008. The findings suggest that only the Czech Republic, Slovakia, Poland, and Latvia have long-run co-integration. Additionally, they have concluded that the effect of FDI on growth exceeds that of exports in these countries. (Acaravci & Ozturk, 2012, p. 61)

Mahmoodi and Mahmoodi examined the relationship between FDI, exports and economic growth in two panels of developing countries comprising eight European developing countries and eight Asian developing countries. They investigated the tri-variate model of FDI, exports, and GDP using a panel-VECM causality approach. Causality results in European developing countries show bidirectional causality between GDP and FDI, and unidirectional causality from GDP and FDI to exports in the short run. (Mahmoodi & Mahmoodi, 2014, p. 193) However, Dritsaki and Stiakakis' study revealed that the relationship between exports and economic growth is significant, while incoming foreign direct investments have an insignificant impact on the growth of the Croatian economy. (Dritsaki & Stiakakis, 2014, p. 187)

Makhetha and Rantaoleng examined the long-term relationship between foreign direct investment, trade openness and economic growth in Lesotho from the period 1980-2011. VAR-Granger causality shows unidirectional causality from trade openness, FDI to output and, from the output, FDI to trade openness. (Makhetha & Rantaoleng, 2017, p. 147)

Nguyen investigated the short and long-term effects of exports and FDI on economic growth in Vietnam from 1986 to 2015. The researcher estimated an ARDL model utilizing data on GDP growth rate, FDI and exports to GDP shares, and revealed cointegration between the variables studied. The finding revealed a negative and significant effect of exports on economic growth and a positive and significant effect of FDI on economic growth over the long run. In the short term, an ARDL-ECM estimation found that neither FDI nor exports had a significant effect on Vietnam's economic development. (Nguyen, 2017, p. 521)

Sultanuzzaman et al. examined the role of foreign direct investment and exports on economic growth in Sri Lanka from 1980 to 2016. The researchers used annual time series data on GDP growth, net FDI inflows, and exports of goods and services. They revealed a long-term equilibrium relationship between FDI, exports, and economic growth by using the Pesaran-Shin-Smith cointegration bound test to an ARDL model. The findings demonstrate that foreign direct investment has a significant and positive impact on economic growth in both the short and long term and that exports have a significant and negative impact on economic growth in both the long and short term. (Sultanuzzaman, Fan , Akash, & Wang, 2018)

Hobbs et al. investigated the link between exports, FDI inflows, and economic growth in Albania from 1992 to 2016. The Johansen cointegration tests revealed that the variables had a long-term relationship. Then, the VECM and Granger causality tests revealed that economic growth is significantly more effective at boosting FDI inflows and exports than FDI and exports are at boosting economic growth. According to the VECM, exports were shown to be more effective at promoting economic growth than FDI, because there was a stronger dependency between exports and GDP growth. (Hobbs, Paparas, & AboElsoud, 2021, p. 15)

The previous literature review highlighted a lot of empirical research investigating the relationships between foreign direct investment, trade openness, and economic growth. Such relationships were examined by using different tools and methods. Given the lack of agreement from past evidence, it will be interesting to examine again the relationship between trade openness, FDI inflows, and economic growth in Algeria, where there is a long enough data series to apply the autoregressive distributed lag approach (ARDL) proposed by Pesaran et al. The main objective of this study is to estimate the short and long-term relationships between FDI, trade openness, and economic growth in Algeria, during the period 1980-2020.

2- Methodology and Data Collection:

This section briefly describes the methodology, data collection and the way in which this study was conducted. In other words, it is about how to answer the research question.

2-1 Data Sources and Econometric Model:

This study uses annual time series data for the period 1980-2020 for Algeria, which is taken from World Bank Open Data. In order to examine the relationship between foreign

direct investment inflows, world trade openness, and economic growth in Algeria.

The variables under study are described in Table 1. Hence, equation Eq (1) represents the functional relationship as follows:

$$\mathbf{GDP} = f(\mathbf{FDI}_t, \mathbf{TO}_t)$$

Table (1): Data Sources and Variables Measurement

Variables	Description	Measurement	Data Source	Expected Sign
FDI	Foreign Direct Investment inflows	Foreign direct investment, net inflows (% of GDP)	World Bank Open Data	POSITIVE(+)
TO	Trade Openness	Trade Openness is the sum of exports and imports of goods and services measured as a share of gross domestic product (% of GDP)		POSITIVE(+)
GDP	Economic Growth	The annual percentage growth rate of GDP at market prices based on constant local currency		----------

Source: Author Compilation

Dependent Variable: $\mathbf{GDP_t}$, Gross Domestic Product, serves as a proxy for Economic Growth.

Explanatory Variables: $\mathbf{FDI_t}$, Foreign Direct Investment, refers to direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capital. **$\mathbf{TO_t}$**, Trade Openness is the sum of exports and imports of goods and services measured as a share of gross domestic product.

The current study applied the ARDL bounds test approach developed by Pesaran et al. The ECM representation of ARDL was formulated with reference to GDP in equation (2) in order to examine the co-integration of the variables defined in equation Eq (1):

$$\Delta GPD = \alpha_0 + \beta_1 GPD_{t-1} + \beta_2 FDI_{t-1} + \beta_3 TO_{t-1} + \sum_{i=1}^{n} \emptyset_1 \Delta GDP_{t-i} + \sum_{i=1}^{n} \emptyset_2 \Delta FDI_{t-i} + \sum_{i=1}^{n} \emptyset_3 \Delta TO_{t-i} + \varepsilon_t \qquad (2)$$

Whereas, the constant or the intercept. β and ∅ represent the long-run and short-run coefficients of the variables, respectively. Δ represents the change. Represents the error term. It is assumed to be independently and normally distributed. The subscript (t) indexes time.

The null hypothesis of no cointegration among the variables is rejected if the F-statistics is above the upper bound values, and the null hypothesis is accepted if the F-statistics is below the lower bound critical values. The presence of a long-run relationship is considered inconclusive if the F-statistics is between the upper and lower bound values.

The autoregressive distributed lag model (ARDL) was developed by Pesaran et al. It has many advantages compared to traditional cointegration models; for example, Johansen's approach, and the Engle and Granger cointegration approach. The main advantage of ARDL

is that it can be used for a small sample size. Indeed, the ARDL model is also distinguished by its ability to estimate short-run and long-run parameters at the same time. ARDL can be used if the series is stationary at level or at first difference I (0) and I (1) or a combination of the two. (Khan, Teng, & Khan, 2019, p. 438)

Indeed, the advantage of this approach lies in its identification of cointegrating vectors where there are multiple cointegrating vectors. The Error Correction Model (ECM) can be derived from the ARDL model through a simple linear transformation, which integrates short-run adjustments with long-run equilibrium without losing long-run information. The associated ECM model takes enough lags to capture the overall data generation process for specific modelling frameworks. (Nkoro & Uko, 2016, p. 75) Thus, ARDL is a robust and dynamic approach.

2-2 Procedures:

Firstly, unit root tests are used to check the data's stationarity and make sure that none of the variables is of order I(2). Later, the ARDL model is then performed on variables using the AIC as the lag length criterion. The bounds test is conducted to check that the variables have a long-run relationship. After confirmation of the cointegration relationship among the variables, the long-run and short-run elasticities of the variables are estimated. Lastly, the model's stability is tested through a variety of diagnostic and stability tests.

3- Results and Discussion:

3-1 Descriptive Analysis and Correlation Matrix:

A preliminary analysis is made of the statistical properties of the series. Table 2 shows both Descriptive Statistics and Pairwise Correlations Matrix of the variables over the 1980-2020 period. The Descriptive Statistics include the mean, median, maximum, minimum, and Std. Dev, Skewness, Kurtosis, Jarque-Bera, Probability and Sum Sq. Dev of each time series.

Table (2): Descriptive Statistics and Pairwise Correlations Matrix

	GDP	**FDI**	**TO**
Mean	2.543673	0.646929	56.83388
Maximum	7.200000	2,033265	76.68452
Minimum	-5.100000	-0.324012	32.68458
Std. Dev.	2.507658	0.644917	10.27763
Skewness	-0.692710	0.474530	-0.252456
Kurtosis	3.684146	2.244124	2.598214
Jarque-Bera	4.078555	2.514774	0.711297
Probability	0.130123	0.284396	0.700719
Correlation Matrix			
	GDP	**FDI**	**TO**
GDP	1		
FDI	0.173173	1	
TO	0.44075	0.608168	1

**. The correlation is significant at the 0.01 level (bilateral).

Source: Author Calculation Using E-Views 10

Before beginning the analysis, the scatter plot between GDP, FDI and TO in Fig. 1 can give an idea about this relationship partially. It might be concluded from Fig. 1 that there is no relationship between economic growth and trade openness in Algeria.

The summary statistics of the variables are reported in Table 2. The average value of GDP was 2.543673 %, ranging from [-5.1% ─ 7.2%] with a standard deviation of 2.507658%. Accordingly, FDI has a mean value of 0.646929%, ranging from [-0.324012% ─ 2.033266%] having a standard deviation of 0.644917%. Also, the average value of TO was 56.83388%, ranging from [32.68458% ─ 76.68452%] with a standard deviation of 10.27763%. Thus, TO is the most volatile variable with the highest standard deviation of 10.27763%.

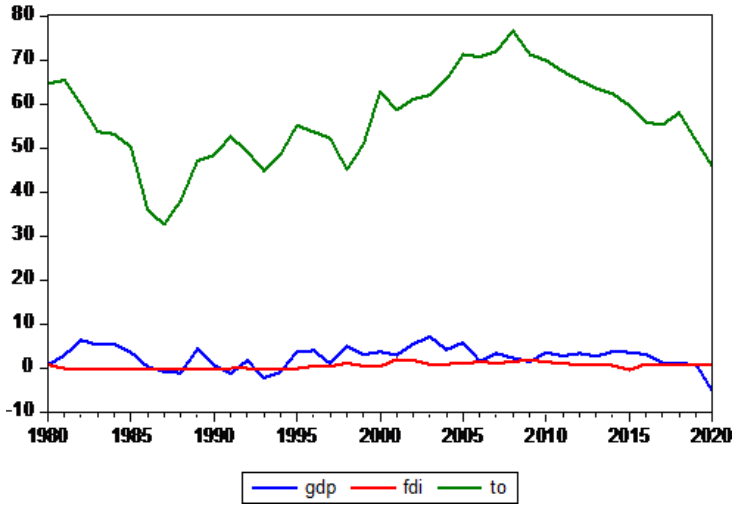
Skewness and Kurtosis indicators reflect whether the focused variables are following the normal distribution or not. The skewness coefficients had a value of (-0.692710, 0.474530, -0.252456) and this indicated that the distribution was negatively or positively skewed. The kurtosis coefficients of (3.684146, 2.244124, 2.598214), which measured the thickness (the peakedness or flatness) of the tails of the distribution, were considered to be low. Values lower than four were considered very close to the normal distribution. Overall skewness and kurtosis coefficients attest the variables are following the normal distribution.

The probability values of the Jarque-Bera test are: (0.130123; 0.284396; 0.700719), which is larger than the 5% level, indicating a normal distribution of GDP, FDI, TO. In other words, the GDP, FDI, and TO data are not normally distributed.

Correlation coefficients can be considered as the first sign of interdependence among variables. In general, all the correlation coefficients are positive. Whereas, the correlation coefficient was moderate between FDI and TO (0.608168). All other correlation coefficients reveal values less than 0.5 (0.173173, 0.44075), which indicates that those variables are not linearly correlated (weak correlation among FDI, TO and GDP). The previous results indicate that there isn't a multicollinearity problem across independent variables, as all correlation coefficients are less than 0.8.

The next Figure 1 shows the evolution trend of GDP, FDI, and TO as a percentage of GDP from Algeria for the period of 1980-2020.

Figure (1): Trend of GDP, FDI Inflows and Trade openness from 1980-2020 in Algeria



Source: Author Compilation Using E-Views 10

Figure 1 shows that FDI inflows to Algeria have generally been very low and volatile. It witnessed its highest levels in 2001 and 2009. Also, it continued to decrease, reaching its lowest levels in 2015.

3-2 Unit Root Test:

To control for potential spurious regression, time series properties of the data were examined using three unit-root tests (Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Dickey-Fuller GLS (DF- GLS)). In other words, before running the ARDL model, it is very important to perform the stationarity tests in order to ensure that all the variables are not integrated of order 2 I(2). Because the F-test would be spurious in the presence of I(2).

Table (3): ADF and PP unit root tests

Series	In level (Trend and intercept)			In first difference (Trend and intercept)			Decision
	ADF	PP	DF- GLS	ADF	PP	DF- GLS	Order of Integration
GDP	-2.981039	-3.094467	-3.076613	-5.816963	-7.700378	-7.145263	Stationary I(0)
	(0.0453)	(0.1214)	(0.0038)	(0.0001)	(0.0000)	(0.0000)	
FDI	-3.302639	-3.355528	-3.070976	-6.776569	-10.10284	-7.357090	Stationary I(0)
	(0.0804)	(0.0721)	(0.0039)	(0.0000)	(0.0000)	(0.0000)	
TO	-1.535842	-1.535842	-1.468003	-4.746164	-4.635909	-4.845750	Stationary I(1)
	(0.8000)	(0.8000)	(0.1501)	(0.0000)	(0.0033)	(0.0000)	

Source: Author Calculation Using E-Views 10

The results of the unit root tests are not consistent, as our variables are found to be a combination of I(0) and I(1). This confirms that none of the variables is integrated at I(2). The results show different values in each test, as presented in Table 3. All the variables correspond to I(0) or I(1) as the requirement for the ARDL cointegration method, so the ARDL method can be run to test the long-run relationship among the variables under study.

3-3 Optimal lag order selection:

It is important to select the optimal lag length before applying the ARDL bounds test, as an inappropriate lag length can reduce the reliability of the model and lead to incorrect estimates.

Table (4): VAR Lag Order Selection (Max Lag=7)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-224.4633	NA	129.8801	13.38019	13.51487	13.42612
1	-185.5298	68.70620*	22.39975*	11.61940*	12.15811*	11.80311*
2	-177.3827	12.93940	23.89937	11.66957	12.61232	11.99108
3	-173.9324	4.871113	34.33245	11.99602	13.34281	12.45531
4	-169.0053	6.086326	46.74625	12.23561	13.98643	12.83269
5	-161.1299	8.338643	56.23584	12.30176	14.45662	13.03663
6	-146.2566	13.12358	48.25120	11.95627	14.51517	12.82893
7	-133.8072	8.787751	53.44847	11.75337	14.71630	12.76381
* Indicates lag order selected by the criterion						

Source: Author Calculation Using E-Views 10

The optimal lag length is selected by the minimum value of the sequentially modified LR test statistic (each test at 5% level) (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn information criterion (HQ). The results of these criteria are presented in table 4.

From Table 4, the selected lag order is indicated by an asterisk sign (*) which corresponds to lag 1. The rule of thumb is to choose the criterion with the lowest value which again is the AIC at 11.61940 this is because the lower the value, the better the model. Therefore, the optimal lag length for the model is 1 and also the best criterion to adopt for the model is AIC (11.61940).

3-4 ARDL Bounds Testing for Cointegration:

The series is of a different order of cointegration, the appropriate test to use is the ARDL Bounds cointegration test. It is applied to identify whether there exists a cointegration relationship among GDP, FDI and TO, when GDP is the dependent variable.

Given a relatively small sample size (40 Observations) and the use of annual data from 1980 to 2020, a lag length of 2 is used in the bounds test. The results of the bounds test for the ARDL model are given in Table 3. The upper bound assumes that all the regressors are I(1), and the lower bound assumes that the regressors are I(0). Here, the null hypothesis of the F-Bounds test is that there is no cointegration among variables. If the calculated F-statistic (or t-statistic) is below the lower bound, the null hypothesis will be accepted. If the F-statistic (or t-statistic) is higher than the upper bound, the null hypothesis will be rejected and the cointegration among variables will be verified. If the F-statistic (or t-statistic) lies between the upper and lower bounds, the result can't be conclusive.

Table (5): ARDL Bounds Test Results - ARDL (1, 0, 0)

F-Bounds Test		**Null Hypothesis: No levels of relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.602409	10%	3.17	4.14
k	2	5%	3.79	4.85
		2.5%	4.41	5.52
t-Bounds Test		**Null Hypothesis: No levels of relationship**		
			Critical values	
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.746420	10%	-2.57	-3.21
		5%	-2.86	-3.53

Source: Author Calculation Using E-Views 10

Table 5 reports the results of the bounds test approach to cointegration. The outputs indicate the existence of a unique cointegrating equation when GDP is the dependent variable. The estimated F-statistic of 5.602409 (or absolute value of t-statistic=3.746420) exceeds the upper critical bound at 2.5%, 5%, and 10% significance level, thus, rejecting the null hypothesis of no cointegration. Therefore, FDI inflows, and TO are considered to be the long-run forcing variables of GDP in Algeria from 1980 to 2020. Evidence shows that all the variables in this study are cointegrated in the long run; i.e., they move together in the long

run. After approving the cointegration relationship, it is now possible to estimate the long-run coefficients of the model.

3-5 Estimation of Long and short-run relationship:

The ARDL cointegration technique is used in determining the long-run relationship between series with different orders of integration. The Akaike Information Criterion (AIC)-based lags selected for the study were ARDL (1, 0, 0).

Table 6 presents the results of the Long-run coefficient estimates.

Table (6): Long-run coefficient estimates

Levels Equation				
Case 3: Unrestricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
FDI	-1.097522	1.124446	-0.976055	0.3356
TO	0.178554	0.074007	2.412685	0.0211
EC = GDP - (-1.0975*FDI + 0.1786*TO)				

Source: Author Calculation Using E-Views 10

Table 6 presents the long-run elasticity of GDP regarding the independent variables. FDI has an insignificant negative (Coefficient/ Prob = -1.097522/0.3356) impact on GDP, while trade openness has a significant and positive impact on GDP in the long run.

The estimated coefficient of (0.178554) for trade indicates that a 100% increase in trade results in an increase of 17.78% in GDP. It is viewed that trade allows to improve economic performance through increasing competition and giving domestic companies access to the best foreign technology, which is very useful for increasing productivity and improving financing.

Once the long-run relationship is confirmed, it is now necessary to check the adjustments (error correction model) towards the long-run equilibrium relationship. The results of the short-run dynamics associated with the ARDL (1, 0, 0) are reported in table 7.

Table (7): Short-run coefficient estimates

Conditional Error Correction Regression				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-4.295684	2.186857	-1.964319	0.0572
GDP (-1)*	-0.621673	0.165938	-3.746420	0.0006
FDI**	-0.682300	0.667249	-1.022556	0.3133
TO**	0.111003	0.043543	2.549239	0.0152
ECM(-1)*	-0.621673	0.147596	-4.212002	0.0002
Specification	**Test**		**Stat**	***P*-value**
R^2	Goodness of Fit		0.318275	-
Adjusted R^2	Predictive Power		0.300335	-
F-statistics	Overall Significance		17.74096	0.000150
* p-value incompatible with the t-Bounds distribution.				
** Variable interpreted as Z = Z(-1) + D(Z).				

Source: Author Calculation Using E-Views 10

The estimated coefficient of the ECM or the error correction term (-0.621673) is negative as required and statistically significant (0.0002<1%). The value of ECM indicates that 62 per cent of the disequilibrium caused by the previous year's shocks converges back to the long-run equilibrium in the current year. It suggests that the short-term disequilibrium can be corrected at the speed of 62 %. Once shocked, the larger the ECM coefficient, the faster will be the return to equilibrium. As expected, the error correction term ECM (-1) is negative and significant, which indicates how fast the dependent variable adjusts to the long-run equilibrium point. Otherwise, a 100% increase in TO has approximately an 11.1% corresponding increase in GDP. On the other hand, a 100% increase in FDI results in a 62.16% decrease in GDP. This could be due to the existence of low levels of FDI in Algeria. Thus, foreign direct investment inflows (FDI) are related in an unobvious and undesirable way to Algeria's GDP.

The results of short-run dynamic coefficients indicate that the variables (FDI, TO) have different signs in the long run. However, like in the long run, FDI was not found to be statistically significant because the effect of FDI could not be felt in the short run.

It is evident from table 10 that R-squared (R^2), is 0.318 or 31.8% of the calculated value, which means that the exogenous variables determine around 31.8% of the adjustments in the endogenous variable. The equation illustrates how the different variables have such strong predictive power and are constantly backed by a strongly adjusted R^2. The F-statistic illustrates the overall significance level of the formula; i.e., it demonstrates what the exogenous variables in the endogenous variable can describe variations. With an F-statistical value of 17.74096 and a significant value of 0.000150, it is evident that the independent variables can jointly describe the changes in the dependent variable and thus, render us conform to conclusive results from such a model.

The negative relationship between foreign direct investment and economic growth in Algeria can be explained by the fact that most of the benefits of foreign direct investment accrue to the countries of foreign investors, while Algeria gets limited benefits from FDI inflows. This can also be attributed to the relatively small share of foreign direct investment received by Algeria.

3-6 Diagnostic tests results:

The results confirm that the model has the required econometric properties (see Table 8 below). The Lagrange Multiplier test of serial correlation between the error terms suggests that the residuals are not serially correlated, since the study failed to reject the null hypothesis of no serial correlation in the residual, as the probability value is greater than the 5% level of significance. The Jarque-Bera test has indicated that the null hypothesis of normally distributed residuals cannot be rejected, as the probability value is higher than the 5% level of significance, which means that errors are normally distributed. Breusch- Pagan-Godfrey test of heteroskedasticity detected that the disturbance term in the equation is homoscedastic, as the study failed to reject the null hypothesis since the probability value exceeded the 5% significance level.

Finally, the Ramsey RESET test result confirms that there is no specification error in the

estimated model. The results of diagnostic tests: serial correlation, functional form, normality, and heteroscedasticity are presented in Table 8. As can be observed, the model has the desired econometric features, in that the residuals are serially uncorrelated, normally distributed, and homoscedastic, as well as having the correct functional form. Thus, the results are valid for meaningful interpretation.

Table (8): Diagnostic tests results

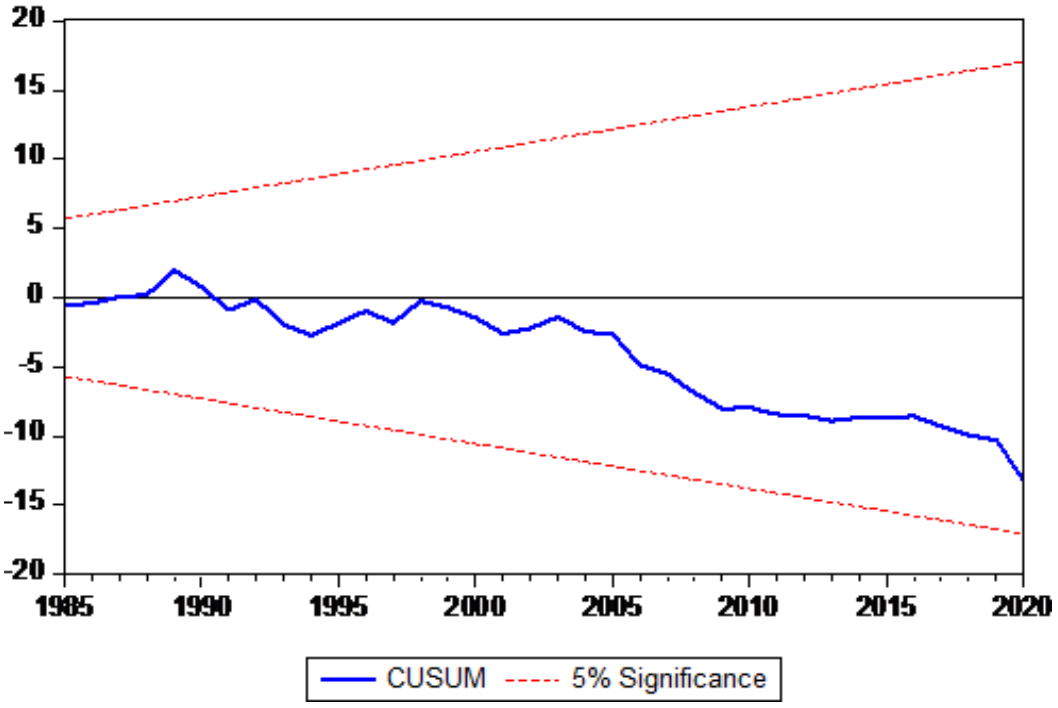
Specification	**Test**	**Stat/*P*-value**	**Interpretation**
Jarque-Bera	Normality	0.706399/ *0.702437*	Residuals are normally distributed
Breusch-Godfrey Serial Correlation LM	Serial Correlation	0.279848/*0.7576*	No serial correlation
Breusch-Pagan-Godfrey	Heteroscedasticity	1.945981 / *0.1396*	Residuals are homoscedastic
Ramsey Reset test	Linearity test/Omitted Variables	0.007004/*0.9338*	The functional form of the model is correct

Source: Author Calculation Using E-Views 10

3-7 Stability Tests:

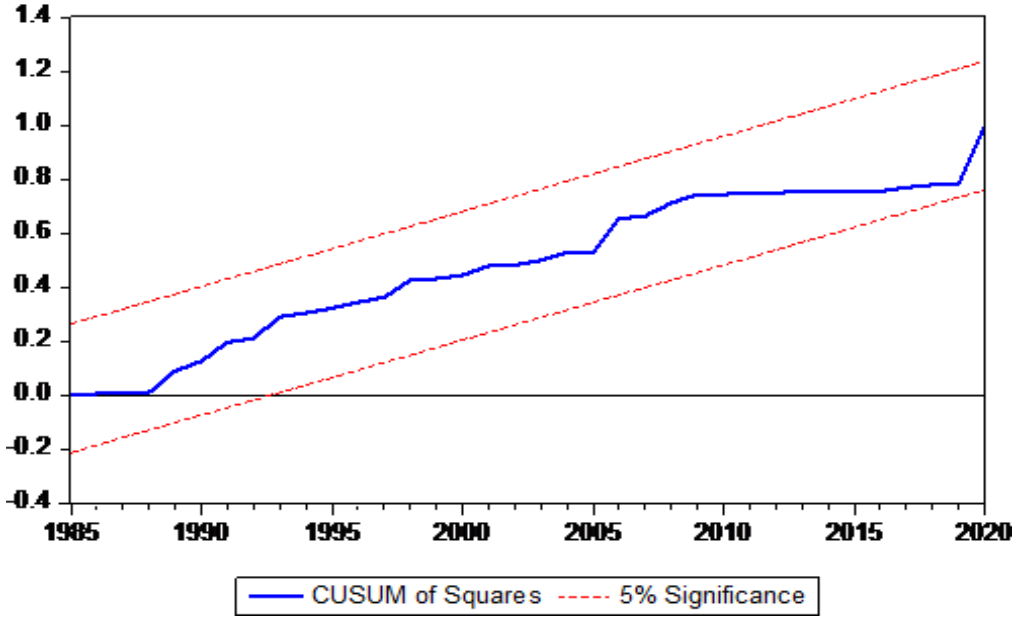
Finally, after examining the stability of the long-run parameters as well as the short-run movements for the equations. The study relied on the cumulative sum (CUSUM) and cumulative sum squares (CUSUMSQ) tests proposed by Pesaran and Pesaran, to test the stability of the long-run coefficients.

Fig (2): Test CUSUM



Source: E-Views 10 outputs

Fig (3): Test CUSUM of Squares



Source: E-Views 10 outputs

The CUSUM test detects systematic changes in the regression coefficients, while the CUSUMSQ test identifies sudden changes in the reliability of the regression coefficients. The tests applied to the residuals of the ECM model. The CUSUM and CUSUMSQ tests are demonstrated in Figures 2 and 3.

Figures 2 and 3 plot the results of the CUSUM and CUSUMSQ tests. The findings indicate the nonexistence of any instability of the coefficients because the plots of the CUSUM and CUSUMSQ statistics fall inside the critical bounds of the 5% confidence intervals of parameter stability. Therefore, the coefficients are stable throughout 1980-2020 for Algeria.

Conclusion:

This study concluded that trade openness had a positive and significant effect on economic growth in Algeria for the period under investigation. But, foreign direct investments had a negative effect on economic growth, it however was insignificant in comparison with trade openness which was highly statistically significant in increasing economic growth. This finding aligned with other studies like Khan and Leng, (1997), Belloumi, (2014), Goh, Sam, & McNown, (2017).

Overall, the findings of this study suggest that trade openness is a more effective accelerator for economic growth in Algeria than foreign direct investment. Therefore, economists seek to support Algerian companies to penetrate export markets. Whereas supporting exports will enable companies to grow and take advantage of economies of scale. Additionally, this will create more jobs, raising income levels. Trade openness facilitates economic growth by the utilization of economies of scale, reducing the obligatory constraint to allow increases in the import of capital and intermediate goods, and enhancing efficiency through improved competition. The findings of this study support the argument that trade

openness will continue to be viewed as a key determinant of economic growth.

Policymakers also need to design new policies to attract export-enhancing, technology-based FDI that can stimulate economic growth, as opposed to FDI that is focused on creating multinational companies that just crowd out local companies. This will enable Algeria to narrow the technological gap with developed economies and boost the productivity of key sectors, thereby improving its competitive position in international trade. Therefore, it is crucial to carry out economic reforms that attract more foreign direct investment. As a policy measure, it is stated that FDI is one of the most important variables that should be targeted to improve growth. To gain the benefits of FDI and growth spillover effects, the former should be attracted through changes in a country's economic, political, and social environments as part of policy measures.

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