

The impact of international trade on economic growth in North Africa: Evidence from the PMG-ARDL approach, 2000-2018.

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Abstract:

This study investigates the effects of international trade on economic growth in developing countries, with a focus on North African countries. We employ the mean group estimation technique to evaluate the long-run and short-run relevance of international trade and economic growth over six countries during the period 2000-2018.

In general, the results are largely consistent with the positive impact of international trade on economic growth as found in the literature. However, empirical evidence indicates that the exchange rate has a positive impact in the long and short terms on economic growth. On the other hand, exports of goods and services have a positive impact in the short run while imports of goods and services have a negative effect in the long run on economic growth. The study concludes that foreign trade plays an important role in Africa's economic growth.

Finally, there should be concrete policy efforts to be a major provider of any product globally with the aim of achieving sustainable

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development economics.

Keywords: international trade; economic growth; North African countries; Pooled Mean Group.

1. INTRODUCTION

International trade is regarded as one of the main directions of any country's economy. It plays an essential role in emerging countries' economic growth. The relationship between international trade and economic growth extends back to the classic period of the 18th century, when Adam Smith and David Ricardo believed that trade had a general influence on the positive growth of the economy. Presently, this relationship has recently become a major concern for economists, especially in developing countries. The majority of previous and empirical studies show that international trade has a positive impact on economic growth.

In Africa, international trade is the key to long-term, sustainable economic growth and development. Africa has about two percent of all world trade, which is hard to believe considering all the tremendous resources that they have. But the power of trade, on the other hand, is that Africans have been able to grow their share of world trade from 2% to 3% or 4%, which has led to an improvement in the level of economic growth in African countries.

In the countries of North Africa (Algeria, Tunisia, Morocco, Libya, Mauritania, and Egypt), international trade is dominated by the oil and gas sectors in Algeria and Libya, while the other countries rely on tourism, agriculture, and light manufacturing. On the other hand, the economic development of these countries is growing slowly because it has been affected by political instability. This includes the civil war in Libya, political coups in Tunisia and Egypt, and the political conflict between Morocco and Algeria, among other political causes that have also had a negative impact on the economies of these countries.

The statement of the problem of this study is to understand the impact of international trade on economic growth in the North of

Africa region under the current political climate over the period 2000-2018. This study is limited to the context as per the consequences of our effort and struggle. Therefore, this paper aims to find out how international trade can impact on economic growth, but it is not able to analyse all the macroeconomic variables that are related according to the absence of some data.

This paper applies an econometric technique to analyse the long-run relevance of international trade and economic growth with their short-run adjustments or dynamics. Specifically, we employ a panel-pooled mean group-autoregressive distributed lag (PMG-ARDL) model over six countries during the period from 2000 to 2018.

The remainder of this paper is organized as follows. The next section is a literature review focusing on the evolution of the influence of international trade on economic growth. The second section includes the empirical estimation and results, and the final section provides conclusions and recommendations.

2. Literature review

2.1 Review of Theoretical Literature

The assessment of the international trade impact on economic growth is broadly discussed in the scientific literature. It has been under review since the classic by Adam Smith and David Ricardo. Adam Smith explained this relationship under two principals' ideas. One is that international trade made it possible to overcome the reduced dimension of the internal market, and in the other, by increasing the extension of the market, the labour division improved and productivity increased⁽¹⁾. Moreover, Adam Smith's theory of international trade is in favour of competition and free trade. In terms of the progressive states, David Ricardo presented a "dynamic model

(1) Smith, A. *An inquiry into the nature and causes of the wealth of nations* (Vol. 2). Lincoln, Royaume-Uni: Glasgow Edition of the Works and Correspondence of Adam Smith. (1776).

of economic growth" in which he characterized progressive states as having high savings, capital accumulation, production, productivity, benefit, and labor demand, thereby forcing wage increases and population growth⁽¹⁾. He believes that foreign markets could not only delay the eventual falls in the profit rates brought by higher wages and land limitations, but also that countries would specialize in goods that had the lowest opportunity costs and a stronger comparative advantage that would lead to larger welfare gains. Finally, John Stuart Mill is just like Ricardo. He recognized that underlying 'the progressive state', and that ultimately the force capable of delaying this state was technical progress⁽²⁾. They believed that international trade had positively affected economic growth because the increased accumulation of technical progress and capital would boost higher welfare gains as well as increased growth. From the 1870s forward, classical thought lost way to "marginalism." As a result of this fact, a new theory was born (neoclassical). When the followers of Ricardo ignored the foundations of comparative advantages, Ricardien theory demonstrated the increase of welfare caused by international trade but ignored eventual gains in the rate of economic growth. The context of neoclassical general equilibrium was presented by the models of Eli Heckscher, Bertil Gotthard Ohlin⁽³⁾ and Paul Samuelson⁽⁴⁾, whose contribution to a rigid analysis of the model is to show that the analysis of static gains in welfare is distinct and distinct from the analysis of country opening.

Finally, they propose that the differences in countries' resources are the driving force of international trade. They conclude that if any

(1) Ricardo, D. *The Principles of Political Economy and Taxation*. london: John Murray. (1817).

(2) Mill, J. S. *the Principles of Political Economy, with some of their Applications to Social Philosophy*. london: W. J. Ashley. (1848).

(3) Ohlin, B. *Interregional and International trade*. Cambridge: Havard university press. (1957).

(4) Samuelson, P. A. International factor price equalization once again. *Economic Journal* , 59, (1949).181-197

country with an appropriate factor endowment creates a larger-scale product and shares it with other countries, its growth will be boosted. Nowadays, there are many empirical studies on the relationship between international trade and economic growth in individual countries or cross-country differences.

2.2 Review of Empirical Literature

In fact, many empirical studies show that international trade exerts a major effect on economic growth in individual countries or cross-country differences, especially in Europe and American countries.

Although in North Africa region we found a few number of empirical research that have been done on whether there is an existence significant impact of international trade on economic growth. Despite this, it needs policy recommendations for action to overcome the development challenges that the continent faces. Table (01) classifies the literature that has explained and discussed the principal of economic development responsibility in international trade from a single and bilateral or multiple country perspective.

Table (01): summary of literature review.

Authors	Period	Study area	Method	Interpration
Elbeydi,K. Hamuda,A. and Gazda,V	1980- 2007	Lybia	VECM	the export promotion policy contributes to the economic growth in Libya. unidirectional causality between exports and imports and between exports and economic growth ⁽¹⁾

(1) Elbeydi,K.Hamuda,A. and Gazda,V. The Relationship between Export and Economic Growth in Libya Arab Jamahiriya. *Theoretical and Applied Economics* , 542 (1), (2010),69-76.

Soltani,H. and Ochi,A.	1975-2009	Tunisia	Cointe g.	FDI could help boost the process of long-term economic growth ⁽¹⁾ .
Guenouni,H. Tsabet,A. and Adouka,Z.	1990-2010	Algeria	ECM.	positive impact of both imports of food, raw materials and industrial equipment on economic growth ⁽²⁾
Bouzahzah, M. and Elmenyani,Y	1980-2010	Morocco-tunisia	Cointe g. And causal.	Positive impact of international tourism on economic growth ⁽³⁾ .
Sghaier,I and Abida.Z	1980-2011	North Africa countries	GMM	the development of the domestic financial system is an important prerequisite for FDI to have a positive effect on economic growth ⁽⁴⁾ .
Omri,A. and Sassi-Tmar,A	1985-2011	North Africa countries	GMM	the two-way linkage between FDI inflows and economic growth has been verified in all three economies ⁽⁵⁾ .
Afaf A. Saaed, and M. Hussain	1977-2012	Tunisia	Cointe g. And causal.	unidirectional causality between exports and imports and between

(1) Soltani,H. and Ochi,A. (2012). Foreign Direct Investment (FDI) and Economic Growth: an approach in terms of cointegration for the case of Tunisia. *Journal of Applied Finance & Banking* , 2 (4), 193-207.

(2) Guenouni,H. Tsabet,A. and Adouka,Z. Imports and Economic Growth: Algeria as a Case Study 1990-2010. *Mediterranean Journal of Social Sciences*,5(10),(June2014),p127,127-135. Doi:10.5901/mjss.2014.v5n10p127.

(3) Bouzahzah, M. and Elmenyani,Y. International tourism and economic growth: the case of Morocco and Tunisia. *The Journal of North African Studies* ,18, (2013). 592-607.<https://doi.org/10.1080/13629387.2013.836321>.

(4) Sghaier,I and Abida.Z, Foreign Direct Investment, Financial Development and Economic Growth: Empirical Evidence from North African Countries. *Journal of International and Global Economic Studies* , 6(1), . (June 2013).1-13.

(5) Omri,A. and Sassi-Tmar,A. Linking FDI inflows to economic growth in North African countries. *Journal of The Knowledge Economy* , 6, (2015),90-104.<https://mp.ra.ub.uni-muenchen.de/id/eprint/82611>.

				exports and economic growth ⁽¹⁾ .
Zghidi,N.Sghaier,I and Abida, Z.	1980-2013	North Africa countries	GMM	a positive link between FDI and economic growth ⁽²⁾ .
Omri,A. and Sassi-Tmar,A.	1995-2015	North and Southern Africa	GMM	the development of financial markets has a positive and significant effect on economic growth only in the Southern African region ⁽³⁾
Touitou,M. Djellit,T. and Boudeghdegh,A.	2005-2015	Algeria	VECM	The high dependence of the economy on the external sector and export-led growth hypothesis ⁽⁴⁾ .
Simon,A. and Pingfang,D.	2000-2018	53 African countries	POLSR, FE GMM	the positive effects of trade on economic growth ⁽⁵⁾ .
Mubasher,Z. And Chen.P	2013-2018	BRI countries	GMM	The positive impact of FDI on economic

(1) Afaf A. Saaed, and M. Hussain. Impact of exports and imports on economic growth : evidence from Tunisia. *Journal of Emerging Trends in Educational Research and Policy Studies* , 6 (1), (2015).13-21.

(2) Zghidi,N.Sghaier,I and Abida, Z. Does Economic Freedom Enhance the Impact of Foreign Direct Investment on Economic Growth in North African Countries? A Panel Data Analysis. *African Development Review* , 28, (2016)., 64-74.<https://doi.org/10.1111/1467-8268.12167>.

(3) Omri,A. and Sassi-Tmar,A. Linking FDI inflows to economic growth in North African countries. *Journal of The Knowledge Economy* , 6, (2015), 90-104.<https://mpr.ub.uni-muenchen.de/id/eprint/82611>.

(4) Touitou,M. Djellit,T. and Boudeghdegh,A. The Role of Export and Terms of Trade for an Economy with Resource Dependence, Case of Algeria. *European Journal of Sustainable Development* , 7 (1), (2018), 218-228. Doi: 10.14207/ejsd.2018.v7n1p218.

(5) Simon,A. and Pingfang,D. International trade and economic growth in Africa:The role of the digital economy. *Cogent Economics & Finance* , 9, (2021), 1-25.<https://doi.org/10.1080/23322039.2021.1911767>.

				growth ⁽¹⁾ .
Mohammed,M. And Khosrul,A.	1980- 2018	20 biggest economies	PMG	Trade and FDI have positive impacts on economic growth. ⁽²⁾
Mohammed,M.	1970- 2017	BRICS and ASEAN countries	Panel- causali ty test	International trade has a positive impact on economic growth ⁽³⁾ .
Adel,S.	1980- 2018	China	VAR model	Exports, imports and FDI have positive impact on economic growth ⁽⁴⁾ .

Source: created by the authors.

Summarizing all the empirical studies analyzed, we can conclude that open trade has a positive, significant impact on economic growth by increasing exports, decreasing imports, and energizing the exchange rate. The results of previous research may depend on the analysis period, the country's economy, political instability, level of development, the source of data, and the method used.

Thus, the question remains in what direction the changes in international trade will affect North African countries' economic growth.

2.3. Statistics on North African countries' international trade in goods

According to statistics of The Observatory of Economic

(1) Mubasher,A. and Chen,P (2021). Fostering the role of FDI, trade openness, IT exports, and capital formation in BRI countries. *Journal Heliyon. Volume(07).pp.1-10.* <https://doi.org/10.1016/j.heliyon.2021.e08559>
(2) Mohammed,M. And Khosrul,A (may2021). Exploring the driving factors of economic growth in the world's largest economies.*journal Heliyon.volume(07).pp.1-9.* <https://doi.org/10.1016/j.heliyon.2021.e07109>
(3) Mohammed,M. (229). The dynamics nexus of energy consumption, international trade and economic growth in BRICS and ASEAN countries:a panel causality test. *Journal energy.volume(2021).pp.1-10.* <https://doi.org/10.1016/j.energy.2021.120679>
(4) Adel,S. (2020).Exploring the relationship between international trade and economic growth in china. *Asian Journal of Economics and Finance. Volume(2).pp.75-86.*

Complexity⁽¹⁾ and the world integration trade solution⁽²⁾, the union Europe and China are North African countries' largest trade-in goods partners. Further, the exports receipts from natural resources reached almost 14% of GDP When the share of imports from Europe is to 44% in 2018.

Algeria's and Libya's "principal exports" are petroleum products, exported mostly to the European Union at around 31% and 45%, respectively. On the other hand, their major imports include refined petroleum, cars, and packaged medicines from China, at 19% and 11%, respectively, and from the European Union, at 9% and 11%, respectively. In Egypt, it exported petroleum products to the United States, which accounted for 7% of its total. When the imports are refined petroleum, wheat, crude petroleum, cars, and packaged medicines, they are imported mostly from China and the United States at around 5% and 8%, respectively, for the year 2018. Mauritania produces non-fillet frozen fish, gold, mollusks, and processed crustaceans, mostly exported to China and the European Union at 32% and 20%, respectively. However, the major imports are army equipment, nutrition products, and refined petroleum from China, the EU, and Morocco, at 8%, 11%, and 0.01 percent, respectively. For this last country, the primary exports are insulated wire, mixed mineral or chemical fertilizers, phosphoric acid, and non-knit women's suits, exported mostly to the European Union at 50%. Alternatively, we find that Morocco imports refined petroleum, cars, petroleum gas, and coal briquettes from the EU and China, at around 23% and 10%,

(1) The Observatory of Economic Complexity, consulted the 02/28/2022, on OEC: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjvuv8eGwaj2AhWQgf0HHez9Ca8QFnoECAGQAQ&url=https%3A%2F%2Foc.world%2F&usg=AOvVaw3V8bg7XJUnzJ46C5yitWUc>

(2) the world integration trade solution, consulted the 02/28/2022, on WITS: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjspsvywqj2AhWfg_0HHSbcB9cQFnoECAMQAQ&url=https%3A%2F%2Fwits.worldbank.org%2F&usg=AOvVaw0BPfnX7gOHULRhDEsOteon

respectively. Tunisia's principal exports are insulated wire, crude petroleum, non-knit suits, and pure olive oil, with 70% going to the European Union and Libya. On the other hand, petroleum products, low-voltage protection equipment, cars, and insulated wire are major imports, coming from the EU, China, and Algeria at 38%, 9.5%, and 4%, respectively. After all, we can conclude that there is no change in trade between them, and the economic dependence of the North African countries on the EU remains.

3. Empirical analysis

In this part, we first describe our Pooled Mean Group model with the identification of the variables, and sources of our data. We present the results of descriptive statistics, correlation, and panel unit root, which entail the panel cointegration tests. Finally, we will discuss the results obtained from using the panel ARDL technique.

3.1 Model specification

Our sample is made up of six North African countries, namely: Algeria, Tunisia, Morocco, Libya, Egypt, and Mauritania. The choice of these countries comes from the fact that North African countries share similar climatic and geographical characteristics, but they differ in terms of their economic progress, social and political development, which makes it an advantage of free trade between them.

The study was carried out based on 2000-2018 period panel data because, according to Hsiao Cheng owing to the larger number of data points, the greater degrees of freedom, and lower collinearity⁽¹⁾. Hence, improving the efficiency of econometric estimates and analyzing a number of questions that can be addressed using cross-sectional and time-series data sets.

The main purpose of the study is to assess the impact of international trade on economic growth. This study discusses the long

(1) Hsiao, C. *Analysis of Panel Data* (éd. Second Edition). Cambridge: University Press. (2003).

and short runs relationship between, with the inclusion of the variables: the official Exchange rate, Exports of goods and services, Imports of goods and services and Net foreign direct investment inflows are independent variables, and Economic growth rate is the variable of interest. Some of these data sources include the publications of the World Bank and others are being collected from the website World Data Atlas (Knoema.com).

The purpose of this study, we employ a special model that is broadly similar to other papers' research that we mentioned earlier. The research model is specified as follows:

$$GDP = F(ER, X, M, FDI) \dots \dots \dots (1)$$

$$GDP_{i,t} = \beta_0 + \beta_1 ER_{i,t} + \beta_2 FDI_{i,t} + \beta_3 X_{i,t} + \beta_4 M_{i,t} + \mu_{i,t} \dots (2)$$

Hence the equation takes the form of dynamic panel ARDL:

$$\begin{aligned} & \Delta(GDP_i)_t \\ = & \sum_{j=1}^{p-1} \lambda_j^i \Delta(GDP_i)_{t-j} + \sum_{j=0}^{q-1} \delta_j^i \Delta(ER_i)_{t-j} + \sum_{j=0}^{q-1} \delta_j^i \Delta(FDI_i)_{t-j} \\ & + \sum_{j=0}^{q-1} \delta_j^i \Delta(X_i)_{t-j} + \sum_{j=0}^{q-1} \delta_j^i \Delta(M_i)_{t-j} + \phi_i [(GDP_i)_{t-1} - \beta_0^i \\ & - \beta_1^i (ER_i)_{t-1} - \beta_2^i (FDI_i)_{t-1} - \beta_3^i (X_i)_{t-1} \\ & - \beta_4^i (M_i)_{t-1} \dots \dots \dots (3) \end{aligned}$$

Where the λ and δ represent the short-run coefficients the short-run coefficients of both dependent and independent variables, respectively. β is the long-run coefficients, ϕ is the coefficient speed of adjustment to the long-run equilibrium. i and t represent country and time respectively.

3.2 Descriptive statistics and correlation

The descriptive analysis, as presented in table (02), shows the distribution and variability of data for the economic growth rate, Net foreign direct investment inflows, official exchange rate, exports of

goods and services, and imports of goods and services. All the variables are transformed into standard form. The table displays the maximum and minimum observations, the mean and the standard deviation. A reading of this table reveals that the economic growth rate averaged 0.02 against a maximum value of -2.51 and a minimum value of 3.47. However, the Net foreign direct investment inflows has an overage equal to 0.04, maximum value of -2.47 and minimum value of 3.56. For official exchange rate, which recorded an average value equal to -0.06, has a maximum value of -1.4 and a minimum value of 2.28. On the other hand, the exports and imports of goods and services have an average of -0.02 and -0.02 respectively, a maximum of -1.91 and -1.80 respectively, and a minimum of 2.34 and 2.75 respectively.

Table(02) : Descriptive statistics.

Variables	Obs	Mean	Std.Dev	Min	Max
GDP	114	0.02	0.98	-2.51	3.47
FDI	114	0.04	0.97	-2.47	3.56
ER	114	-0.06	0.93	-1.40	2.28
X	114	-0.02	0.96	-1.91	2.34
M	114	-0.02	0.99	-1.80	2.75

Source: author’s computation using R software.

The table (03) displays the Skewness and Kurtosis results for testing the normality distribution. It indicates that the exports and imports goods and services are accepted as having a normal distribution. Other variables, exchange rate, Net foreign direct investment inflows and economic growth rate, are rejected as having a normal distribution at the 1% significant level, suggesting strong volatility.

Table (03): Normality distribution test.

Variables	Pro(Skewness)	Pro(Kurtosis)	chi2(2)	Prob>chi2
GDP	0.006	0.0075	20.306	0.0035
FDI	$2.2e^{-16}$	$5e^{-04}$	49.527	$2.2e^{-16}$

ER	$2.2e^{-16}$	0.4635	28.374	$5e^{-04}$
X	0.8385	0.0415	3.3893	0.1145
M	0.2955	0.1265	2.8345	0.1555

Source: author's computation using R software.

The analysis of the correlation matrix is one of the important steps to interpret the kind of relationship between the variables used in our study. A problem of multi-collinearity exists between the dependent variables only when the correlation coefficient exceeds the order of $0.9^{(1)}$. When the correlation coefficient between the dependent variables surpasses the order of 0.9, we can say there exists a problem of multi-collinearity. The correlation matrix in table (04) shows that all the coefficient correlation between all the variables is less than 0.9, which confirms the absence of a correlation problem.

Table(04) : Correlation matrix.

Variables	GDP	FDI	ER	X	M
GDP	1.00	0.37	-0.17	0.19	0.01
FDI	0.37	1.00	-0.20	0.37	0.13
ER	-0.17	-0.20	1.00	-0.24	0.17
X	0.19	0.37	-0.24	1.00	0.43
M	0.01	0.13	0.17	0.43	1.00

Source: author's computation using R software.

3.3. Panel unit root tests:

It is necessary to determine the order of integration before using the cointegration approach technique. For this purpose, we need to evaluate the stationary of the variables in our panel data by using (IPS) and (LLC) tests.

IPS test is from the first generation of tests, it was proposed by Im, Pesaran and Shin and it assumes the cross-sectional independency

(1) Dohoo, I.R. and Ducrot, C. an overview of techniques for dealing with large numbers of independent variables in epidemiologic studies. *Preventive Veterinary Medicine*, 29, (1997), 221–239. [https://doi.org/10.1016/S0167-5877\(96\)01074-4](https://doi.org/10.1016/S0167-5877(96)01074-4).

between panel unit roots. It is obtained as an average of ADF statistics and it allows for heterogeneity both in intercept and slope terms for the cross section⁽¹⁾. The LLC test proposed by Levin, Lin and Chu (2002) assumes the process of a common unit root across cross sections⁽²⁾. All the tests use the null hypothesis of the existence of a unit root.

Table (05) shows the results of the panel unit root tests for each variable: economic growth rate, official exchange rate (ER), Net foreign direct investment inflows (FDI), exports (X), and imports (M) of goods and services. As can be seen from the results, we can say that the variables GDP and FDI are stationary at the level, while the other variables, (ER), (X) and (M) are stationary at the first difference. Both of these variables are integrated of order between 0 and 1, so this indicates the appropriateness of the panel cointegration test and panel ARDL analysis.

Table (05): the results of panel unit root tests.

Var	LLC		IPS	
	Trend	Const and trend	Trend	Const and trend
GDP $\Delta(GDP)$	(4.1104) *** (-9.4501) ***	(-8.5371) *** (-7.9357) ***	(4.3218) *** (-12.161) ***	(-8,5371) *** (-7.9357) ***
FDI $\Delta(FDI)$	(-5.7495) *** (-16.735) ** *	(-5.7643) *** (-15.438) ***	(-6.082) *** (-14.595) ***	(-5.9189) *** (-15.438) ***
ER $\Delta(ER)$	(4.5629) (-5.1194) ***	(1.4850) (-6.0249) ***	(4.4505) (-4.4137) ***	(4.3015) (-6.7246) ***
X $\Delta(X)$	(-1.4073) * (-6.8623) ***	(-1.5482) * (-5.8488) ***	(-0.55506) (-6.557) ***	(-5.9189) *** (-5.3041) ***

• (1) So Im,K. Pesaran,H. & Shin,Y. Testingfor unit roots in heterogeneous panels. *Journal of Econometrics* , 115, (2003)., 53-74. doi:10.1016/S0304-4076(03)00092-7.

• (2) Levin,A. Chien-Fu,L. & Chien-Shang,J. Unit root tests in panel data:asymptotic and finite-sample properties. *Journal of Econometrics* , 108, (2002)., 1-24.

M $\Delta(M)$	(-2.6308) *** (-7.7468) ***	(-3.9581) *** (-6.3938) ***	(-1.0378) (-7.3499) ***	(-2.8521) *** (-6.1152) ***
Note: significance levels ***, ** and * correspond to 1%, 5% and 10% respectively.				

Source: author’s computation using R software

3.4. Panel cointegration tests

The next step is to verify the existence of cointegration between the variables. We focused on two panel cointegration tests, which are Pedroni (1999, 2004) and Kao (1999). The null hypothesis of Pedroni and Kao is the absence of cointegration, while the alternative is the existence of cointegration. The null hypothesis is rejected when the value of the test statistic is greater than the critical value.

Pedroni tests statistics are proposed by Pedroni Peter. They allow for heterogeneous fixed effects and deterministic trends, as well as for heterogeneous short-run dynamics⁽¹⁾. Chihwa Kao proposes the cointegration test for panel data by taking a similar approach as the Pedroni cointegration tests but imposing cross-sectional specific intercepts and homogeneous coefficients on the independent variables⁽²⁾. In our study, we employed the Kao panel cointegration test to confirm the validity of the results from the Pedroni tests.

As exemplified in table (05) and table (06), the results of the Kao cointegration test panel cointegration tests coincide with the results of the Pedroni panel cointegration tests, which indicates that the null hypothesis of no-cointegration is rejected at the 5% significance level for each panel data set, suggesting that the variables of our study,

(1) Pedroni, P. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics* , 61(S1), (1999),653–670.<https://doi.org/10.1111/1468-0084.0610s1653>.
(2) Kao, C.Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics* , 90(1), (1999), 1-44.[https://doi.org/10.1016/S0304-4076\(98\)00023-2](https://doi.org/10.1016/S0304-4076(98)00023-2).

(GDP), (ER), (FDI), (X) and (M) are cointegrated between each other and a long-run relationship exists between them.

Table (05): The results of the Pedroni panel cointegration tests

Within dimension (panel statistics)			Within dimension (panel statistics)		
Test	Statistics	Probability	Test	Statistics	Probability
Panel v-stat	- 0.510726	0.6952	Panel v-statistic	- 0.932081	0.8244
Panel ρ-stat	- 0.636625	0.2622	Panel ρ-statistic	- 0.739452	0.2298
Panel PP-stat	- 8.621933	0.0000	Panel PP-statistic	- 9.469767	0.0000
Panel ADF statistic	- 6.949439	0.0000	Panel ADF statistic	- 7.243971	0.0000
Between dimension (individual statistics)					
Test		Statistics		Probability	
Group rho-Statistic		0.142341		0.5566	
Group PP-Statistic		-12.03428		0.0000	
Group ADF-Statistic		-8.730140		0.0000	

Source: author’s computation using eviews 9 software.

Table (06): the result of Kao cointegration tests.

	Statistics	Probability
ADF	-2.401237	0.0082
Residual variance	1.519396	
HAC variance	0.672791	

Source: author’s computation using eviews 9 software.

Thus, it can be concluded that we can use the pooled mean group panel ARDL estimation method suggested by Hashem Pesaran and Ron smith⁽¹⁾ (Pesaran,MH. Smith,R, July 1995) ,and modified to

(1) Pesaran,MH. Smith,R. Estimating long-run relationships from dynamic heterogeneous panels. *journal of econometric* , 68, (July 1995), 79-113.[https://doi.org/10.1016/0304-4076\(94\)01644-F](https://doi.org/10.1016/0304-4076(94)01644-F).

account for cross-sectional dependency using a cross-sectional ARDL model proposed by Alexander Chudik⁽¹⁾.

3.5. Estimation results

We based on the Pooled Mean Group (PMG) technique, which was introduced by Pesaran, Shin and Smith. It is the most recent technique, and it is considered the most technically consistent. Table (07) displays the empirical results of the short and long run relationships between economic growth and international trade.

Table (07): the results of pooled mean group dynamic autoregressive distributed.

Panel PMG-ARDL estimation				
Variables			GDP	
Long-run Relationship				
Variables	Estimate	Std.error	Z-value	Pr(> z
Intercept	-0.198344	0.089170	-2.224352	0.0295
ER	0.261239	0.081256	3.215013	0.0020
FDI	0.115593	0.098263	1.176361	0.2436
X	0.064866	0.108754	0.596452	0.5529
M	-0.198344	0.089170	-2.224352	0.0295
short-run Relationship				
ECT	-1.581758	0.269041	-5.879241	0.0000
D(GDP(-1))	0.079451	0.107491	0.739141	0.4624
D(ER)	0.586774	0.272420	2.153932	0.0348
D(FDI)	-0.348218	0.164097	-2.122021	0.0375
D(X)	0.616379	0.171287	3.598519	0.0006
D(M)	-0.190747	0.328756	-0.580208	0.5637
C	-0.041225	0.046740	-0.881999	0.3809

Source: author's computation using eviews 9 software.

The first thing that attracts attention is that the official exchange rate has a positive impact on the economic growth rate, both in short and long terms, at the 1% level, with respective coefficients of 0.26

(1) Chudik, A., K. Mohaddes, M. H. Pesaran, and M. Raissi. *Debt, Inflation and Growth Robust Estimation of Long-Run Effects in Dynamic Panel Data Models*. (2013).

and 0.58. On the other hand, the result indicates the negative impact of imports of goods and services on economic growth rate in the long term at 5% with a coefficient equal to -0.19.

In the short term, the result holds the positive impact of exports of goods and services at 1% with a coefficient of 0.61 and the negative impact of Net foreign direct investment inflows on economic growth rate at 5% with a coefficient of -0.34. In addition, the error correction term (ECT) is negative and statistically significant at 1% level. The significance and correct sign of the ECT imply that the adjustment of the variables towards long-run dynamics is insured.

Two main conclusions can be summarized from these results. First, concerning the no-significant impact of Net foreign direct investment inflows and exports of goods and services on long term, and the no significant impact of imports of goods and services on short term, this relatively intriguing finding may suggest that the use of a linear specification to study the relationship between international trade and economic growth rate may not be appropriate.

Second, regarding the official exchange rate's effect on economic growth rate in long and short terms, we can say that, overall, these findings prove that the improvement of this rate positively influences economic growth rate evolution, and the decreasing value of imports of goods and services reduces the inefficient of economic growth rate.

4. Conclusion and recommendation

The aim of this article is to study the relationship between international trade and economic growth in North Africa countries for the period 2000-2018. This study has analyzed how international trade effects on economic growth in long and short terms adjustment by applying panel time series technique namely panel ARDL-PMG approach. We have attempted to explore, for the first time in literature, the international trade effect on economic development in North African countries. Generally, our empirical were explored. Firstly, the description and correlation matrix of our data indicate the absence of

multicollinearity. Secondly, the results of panel unit root of (LLC) and (IPS) show that the variables direct investment inflows and economic growth rate are stationary at the level but variable official exchange rate, imports and exports of goods and services are stationary at the first differences. Thirdly, the result of panel cointegration test proves that there is a long-run relationship between variables. Finally, we applied the panel ARDL-PMG model when the result indicates that international trade has a positive impact on economic growth in long and short terms by exchange rate effect, it has a negative impact in short run by exports of goods and services and direct investment inflows effects when imports of goods and services has a negative impact in long run.

Finally, recommendations for necessary measures to stimulate foreign trade and economic growth in Africa, in particular in North African countries.

Political and security stability should have a major impact on the economy's development, most notably in Libya. But also in other countries that have a large tourism sector, like Egypt, Morocco, and Tunisia. Therefore, Ensuring food security has become an issue of key importance to countries with different degrees of economic development. Algeria, Mauritania, Libya, and Egypt should develop their agricultural sectors because it plays a strategic role in improving food availability.

Algeria has enormous renewable energy potential. It is also the third-largest CO₂ in Africa. Therefore, it should invest in renewable resources instead of petroleum products by creating different projects with Libya and Mauritania to realize them and export them to Morocco and Tunisia first, and then to other parts of the world.

In conclusion, North African countries should collaborate to achieve political stability in their respective countries and region. They should create self-sufficiency and specialize in producing and exporting commodities.

Their governments should put in place trade policies that seek to promote exports and reduce imports to ensure a trade surplus is achieved. Furthermore, North African countries must begin to trade with each other more than ever before by opening their borders, because it is important to create regional competitiveness before global competitiveness, which will allow them to improve and increase their economic growth.