



Nexus Between Foreign Direct Investment and Exports in Algeria: Empirical Evidence from ARDL Technique

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Received: 11/03/2021

Accepted: 08/10/2021

Published: 16/12/2021

Abstract:

The aim of this study is to examine the nexus between foreign direct investment and exports in Algeria by using Autoregressive Distributed Lag (ARDL) bound testing and causality analysis for the period of 1980-2019. According to the result, foreign direct investment is an important factor that positively affects the exports in Algeria in both the short and long term. The Toda-Yamamoto causality analysis reveals a two-way causality relation between foreign direct investment and exports.

Key Words: Foreign direct investment; Exports; Autoregressive Distributed Lag (ARDL) ; Cointegration ; Algeria.

JEL Classification: F21, F14, C51.

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Introduction :

Today's new international economic context is characterized by a generalization of the process of opening up and liberalization of economies. Over the last three decades, foreign direct investment (FDI) has also become one of the most important aspects of the manifestation of globalization.

In this context, foreign direct investment seems to be an essential vector of development and modernization. Thus, both developed and developing countries have continued to compete fiercely to improve the attractiveness of their location for FDI.

Such as other developing countries, Algeria has undertaken numerous reforms to attract more FDI that will be devoted to achieving its economic growth objectives, particularly by increasing its trade flows.

FDI can play a curial role in the promotion of exports. Theoretical and empirical analyses of the relationship between FDI and exports highlight two main effects: a substitution effect (FDI would crowd out exports) and a complementarity effect (FDI would have a positive impact on exports).

This paper aims to examine the long-run relationships between exports and FDI in the case of Algeria during the (1980-2019) period. More precisely, it investigates whether FDI inflows displace or complement exports. In order to



estimate the long-run relationship, ARDL/Bounds testing approach to cointegration has been applied.

The remainder of the paper is structured as follows. Section 2 presents the theoretical and empirical literature review on the relation between FDI and exports. Section 3 provides a brief overview of Algeria's inward foreign direct investment and export trends from 1980-2019. Section 4 presents the data and method. Section 5 discusses the empirical findings. Finally section 6 is a conclusion containing overall remarks.

I. Theoretical and empirical literature

1.Theoretical literature:

The first theoretical approach to explain the nexus between foreign direct investment and exports was proposed by Mundell. The author starts from the assumptions of the Neoclassical Heckscher-Ohlin-Samuelson theory and shows that the relationship of substitutability between exports and FDI stems from the differences between factor prices and factor endowments (Mundell, 1957). As the inter-country mobility of international factors increases, these differences become even less insignificant. According to Mundell, capital mobility driven by foreign direct investments is an excellent alternative to exportation (Berkman, 2019). Additionally, other theories, as for instance the Internalization theory (Markusen & Venables, 2000) suggest that that high-cost exports lead to the emergence of foreign direct investments.

Helpman et al.(2003) show that the relationship between foreign direct investment and exports depends on the nature of FDI. Horizontal FDI (refers to the foreign production of products and services roughly similar to those the firm produces for its home market) is negatively related to exports, whereas vertical FDI (refer to those that geographically fragment the production process by stages of production) is positively related to exports. (Helpman, 2003)

2. Empirical literature:

Various studies have been carried out on the relationship between foreign direct investment and exports for different countries by different methods and most of them arrive at results implying a complementary relationship between FDI and exports.

Elsevar et al. (2019) examined the long-run and short-run relationship between foreign direct investment (FDI) inflows and exports in Jordan over the period of 1980–2018; the study implies Autoregressive Distributed Lag (ARDL) boundary test approach to reveal the relationship between the variables. The study indicates that FDI inflows have a positive and significant relationship with exports in the long-run. If FDI inflows increase, Exports will increase. (Elsevar, 2019).

Abraham Babu (2018) examined the relationship between FDI and Exports during the period from 1990 -1991 to 2014-2015 in India using the Granger causality test, and as a result, he found a bi-directional causality relationship from FDI to exports and from Export to FDI. (Babu, 2018)



Roger Hosein et al (2019) examined the relationship between FDI; exports and GDP during the (1980-2015) period in Santa Lucia using the Toda-Yamamoto Causality test, and as a result of the analysis, they found a bi-directional causality between GDP and FDI, unidirectional causality from exports to GDP and unidirectional causality from FDI to exports (Roger, 2019)

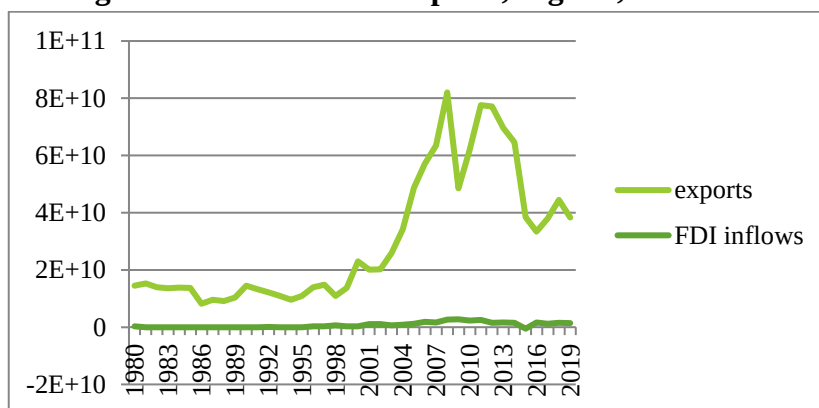
In the analysis they conducted with the data of seven EU countries belonging to the years between 1973 and 2004, Martin and Mariya (2008) found that exports cause FDI but not vice versa (Martin, 2008).

Mousawi et al (2015) investigated Algeria in their study to examine the relationship between foreign direct investment (FDI), exports and economic growth. The causality direction was tested by Granger causality test. The results point to a tow-way causality between direct foreign investments and exports (Mousawi, 2015).

II. Overview of Algeria's inward foreign direct investment and export trends:

The annual foreign direct investment and exports level of Algeria are seen in fig 1. According to fig1, Algeria's exports grew faster than FDI beginning in the 2001s, and significantly faster than FDI after 2016. This sharp rise in export has led to questions over the relationship between exports and FDI within the Algerian economy.

Fig. 1: Inward FDI and Exports, Algeria, 1980-2019



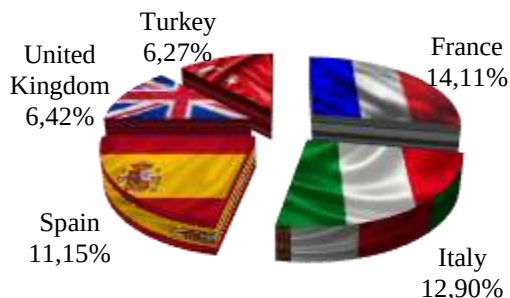
Source: Author's own elaboration based on UNCTAD database

According to Fig.2, China and Singapore has been the most important source of Algeria's FDI inflows with account for about 46% in total. Spain, Turkey and Germany are ranked the second, third and fourth largest investors in Algeria respectively. In term of sector distribution of FDI, the investments are concentrated in industry and tourism.

**Fig.2: Algeria's main investing countries**

Source: Author's own elaboration based on ANDI

In 2019, Algeria's main exports were France (14.11%), Italy (12.11%), Spain (11.15%), United Kingdom (6.42%) and Turkey (6.27%).Fig.3

Fig.3: Algeria's main exports

Source: Author's own elaboration based on CNIS

III. Data and method:

In this study, the long-term relationship between foreign direct investment and exports in Algeria is tested with a cointegration test. The sample of the study covers the years between 1980 and 2019 and employs foreign direct investment, exports, GDP growth, reel exchange rate and degree of openness as variables. Table.1 below displays definitions and sources for five variables used in the study.

Table 1: Definition of data

Variable	Definition of variable	Source
Exports (X)	Exports of goods and services	CNUCED
Foreign direct investment (FDI)	Inward flow	CNUCED
Growth (GDP)	Real gross domestic product	CNUCED
Real effective exchange rate (RER)	Real exchange rate (based on consumer price index)	International Financial Statistics (IFS)
Degree of openness (DO)	the ratio of the sum of total imports and exports to GDP	CNUCED

Source: Author's



In empirical estimations, all variables were used in a logarithmic form.

The model can be written as follows:

$$\ln X_t = \alpha_0 + \alpha_1 \ln FDI_t + \alpha_2 \ln GDP_t + \alpha_3 \ln RER_t + \alpha_4 \ln DO_t + \varepsilon_t$$

Where:

$\alpha_0; \alpha_1; \alpha_2; \alpha_3; \alpha_4$: parameters of the model.

ε_t : random error

t : time period

In order to apply the cointegration tests developed by Engel and Granger (1987), Johansen (1988), and Johansen and Juselius (1990), which are used extensively to investigate the long-term relationships between variables, it is important that the series should be non-stationary and become stationary when applying the first. In other words, the degree of integration of variables must be the same. (Pesaran, 2001) established the Bounds Test Approach to remove these constraints. This test can investigate long-term relationships between variables, regardless of their degree of integration (Akinci, 2019).

IV. Empirical findings:

1. Descriptive statistics:

Descriptive statistics and correlation matrix for all variables used in the study are given in Tables 2 and 3 in detail.

Table 2: Descriptive statistics findings

	X	FDI	GDP	RER	DO
Mean	30 351	765	95 833	177.3834	28.55929
Median	17712	320	605670	119.5290	28.47255
Maximum	82 038	2746	213 808	449.4970	38.34292
Minimum	8 188	-5.37	41764	93.27353	16.34229
Observations	40	40	40	40	40

Source: Author's computation from E-View 9.0

Table 3: correlations findings

	X	FDI	GDP	RER	DO
X	1.000000				
FDI	0.856261	1.000000			
GDP	0.898034	0.750001	1.000000		
RER	-0.538039	-0.557866	-0.496403	1.000000	
DO	0.739406	0.681502	0.489756	-0.477988	1.000000

Source: Author's computation from E-View 9.0

As seen in Table 2, the exports value is 30,351 million US\$ and the foreign direct investment value is 765 million US\$ on average. The difference between the maximum value and the minimum value for the foreign direct investment is lower than the exports. Therefore, it shows that the effect of FDI level on exports may differ. When we look at the correlation matrix in Table 3, there is a statistically significant and positive correlation between exports and FDI. According to this result, the exports increase as the FDI increases.



2. Unit Root Test:

Stationary analysis of the series was investigated using the Augmented Dickey-Fuller (ADF) test and Phillips-Peron (PP) test.

Table 4: Unit Root Test Results

Level			1 st Differences			I (d)
Variable	ADF stat	P.Perron stat	Variable	ADF stat	P Perron stat	
LnX	0.6317* (0.8486)	0.6317* (0.8486)	$\Delta \ln X$	-5.7635* (0.0000)	-5.7635* (0.0000)	I (1)
LnFDI	-6.2543** (0.0000)	-6.2547** (0.0000)				I (0)
LnGDP	1.7987* (0.9809)	1.4710* (0.9627)	$\Delta \ln GDP$	-5.1553* (0.0000)	-5.3299* (0.0000)	I (1)
LnRER	-1.7793* (0.0716)	-1.5409* (0.1143)	$\Delta \ln RER$	-2.2200** (0.0273)	-4.4060** (0.0001)	I (1)
lnDO	-0.4401* (0.5173)	-0.4401* (0.5173)	$\Delta \ln DO$	-4.7166* (0.0000)	-4.5491* (0.0000)	I (1)

* Model without trend and intercept. ** Model with intercept and no trend. *** Model with intercept and trend

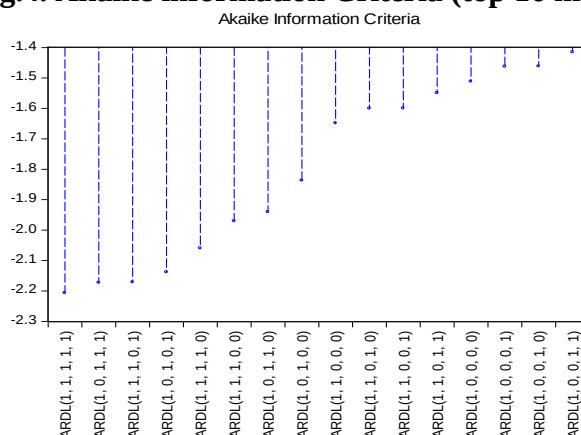
Source: Author's computation from E-View 9.0

According to the results of the ADF and PP unit root tests in Table.4, It is seen from the test results that lnX, lnGDP, lnRER and lnDO series are stationary in I (1) and lnFDI series are stationary in I(0).

3. ARDL Model:

The study will be continued with ARDL since the variables have different degrees of stationarity. By permitting a maximum of 7 delays for all series, the most optimal delay number was determined according to Akaike (AIC) criteria. According to the AIC criterion, the most suitable model is ARDL (1, 1, 1, 1, 1). This ARDL (1, 1, 1, 1, 1) model has been selected from 16 different models according to AIC criteria. Fig.4 below shows the number of lags for the first 16 models providing the lowest AIC value.

Fig.4. Akaike information Criteria (top 16 model)



Source: Author's computation from E-View 9.0



After determining the most suitable model, the long term cointegration relation was examined. F statistic is calculated by bound testing to be able to determine the long term cointegration relation. It is decided on the presence of the long-term relationship by comparing the F statistic found with critical values.

Table 5: Results of ARDL Bounds Test

Test Statistic	Value	K
F-statistic	4.7371	4
Significance	I(0) Bound	I(1) Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87

Source: Author's computation from E-View 9.0

According to the results in Tab. 5, the F value of 4.7371 is higher than the upper threshold at 2.5%, 5% and 10% significance levels; this shows the presence of a long term cointegration relationship between variables.

Long term coefficients were calculated by taking into account the ARDL (1, 1, 1, 1, 1) model. Long term coefficients are presented in Table 6

Table 6: Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LnFDI	0.039671	0.018584	2.134687	0.0414
LnGDP	0.796149	0.050609	15.731406	0.0000
LnRER	-0.120824	0.058253	-2.074141	0.0470
lnDO	1.457638	0.171545	8.497112	0.0000
C	-1.242217	1.442151	-0.861364	0.3961

Source: Author's computation from E-View 9.0

When the ARDL long-term results are examined, there is a statistically significant relationship at significance level of 5% between "FDI" and "X" in the long term. The results indicate that a 1% increase in FDI results in 0.03% increases in exports. This result is consistent with the logic of the economic theory.

In our case, this positive effect can be explained by the concentration of FDI in Algeria in the hydrocarbons sector, which is the most active sector in terms of exports. The results of this study are consistent with many previous studies, such as Roger Hosein et al (2019), Abraham Babu (2018) and Mousawi (2015).

The GDP growth is significant at 5% level of significance and it affects positively the exports in Algeria. According to the literature, GDP growth is one of the determinants of exports so the expected sign is positive.

The real exchange rate has a negative impact on exports with an elasticity of - 0.12%. In other words, a 1% increase in the real exchange rate reduces exports by 0.12%. This result is consistent with economic theory. According to this theory, the appreciation of the national currency (the Algerian dinar) has led to a decrease in exports because national products are more expensive than foreign products.



The degree of openness has a positive impact on exports. A 1% increase will increase exports by 1.45%

After the long-term relationship was revealed, short-term relationships have been examined by establishing the error correction model ECT(-1) based on the ARDL(1, 1, 1, 1, 1) model. Error correction model results are presented in Table.6

Table 7: Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(lnFDI)	0.010425	0.004138	2.519350	0.0175
D(lnGDP)	1.356218	0.093888	14.445045	0.0000
D(lnRER)	-0.287449	0.107023	-2.685862	0.0118
D(lnDO)	1.383712	0.116447	11.882808	0.0000
CointEq(-1)	-0.545812	0.094552	-5.772640	0.0000
$Cointeq = \ln X - (0.0397 * \ln FDI + 0.7961 * \ln GDP - 0.1208 * \ln RER + 1.4576 * \ln DO - 1.2422)$				

Source: Author's computation from E-View 9.0

According to the error correction model results, the fact that the short-term error coefficient (-0.545812) is between -1 and 0 and is statistically significant (Prob: 0.0000) which shows that the error correction model works. This parameter forces variables to converge to long term equilibrium value.

Short-term results remain almost identical to long-term results, but with relatively smaller impacts. It can be observed that the foreign direct investment (FDI) variable significantly explains Algeria's exports at the level of 5%. A 1% increase in FDI inflows to Algeria leads to a 0.01% increase in exports. This validates the complementary effect of FDI and Algerian exports. For the other variables, there are no major differences worth noting.

The table below shows that the values of the diagnostic tests take the expected values and that there are no problems in terms of establishing the model. In the study, the significance level of these tests is accepted as 5%. In this context, the coefficient of LM Test (Breusch-Godfrey) is 1.9951 while its probability value is 0.1688. The coefficient of the Jarque-Bera Test is 1.4759 while the probability value of this coefficient is 0.4780. The coefficient of the Ramsey RESET Test is 0.0142 with a probability value of 0.9058. Heteroskedasticity Test based on ARCH technique has a coefficient of 1.4768 with 0.2322 as the probability value. Based on these results, it can be concluded that there is no statistical problem in terms of establishing the model.

Table 8: Diagnostic tests results

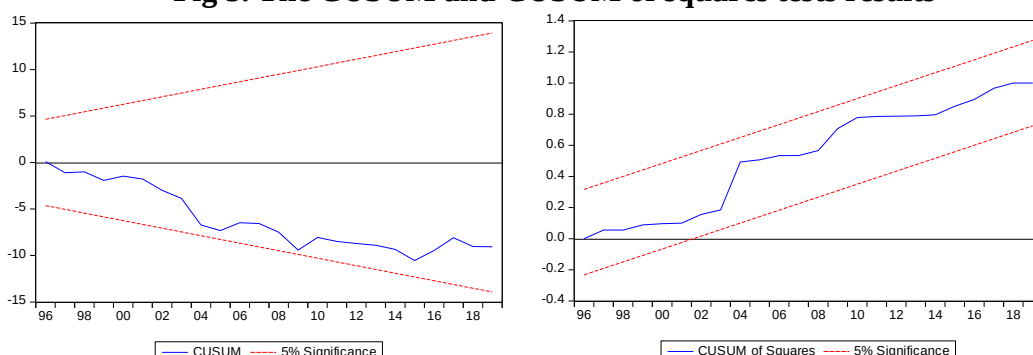
Diagnostic Tests	Test Value	(Prob.)
Breusch-Godfrey Serial Correlation LM Test	1.995133	(0.1688)
Heteroskedasticity Test: ARCH	1.476886	(0.2322)
Ramsey RESET Test	0.014252	(0.9058)
Jarque-Bera Test	1.47595	(0.4780)

Source: Author's computation from E-View 9.0



The results of the CUSUM and CUSUM of Squares Tests are shown in Fig 5. The results display that the model is stable.

Fig 5. The CUSUM and CUSUM of squares tests results



Source: Author's computation from E-View 9.0

4. Toda Yamamoto Causality Analysis:

In order to determine the relationship between the variables, the causality relationship between the “X”, “FDI”, “GDP”, “RER” and “DO” variables was examined by the Toda-Yamamoto causality test proposed by Toda-Yamamoto (1995) which does not consider the degrees of stationarity of variables, and they are shown in Table 9.

Table 9: Toda-Yamamoto Causality Test Results

Df	Dependent variables	Independent variables				
		lnX	lnFDI	lnGDP	lnRER	lnDO
2	lnX		5.6977 (0.0579)	3.1143 (0.2107)	0.4511 (0.7981)	3.6093 (0.1645)
	lnFDI	4.7065 (0.0951)		4.2655 (0.1185)	0.3352 (0.8457)	1.3948 (0.4979)
	lnGDP	0.6280 (0.7305)	5.6715 (0.0587)		0.6485 (0.7230)	1.6453 (0.4393)
	lnRER	0.503988 (0.7772)	0.4502 (0.7984)	0.6474 (0.7235)		1.2360 (0.5390)
	lnDO	1.2180 (0.5439)	1.5445 (0.4620)	1.6453 (0.4393)	3.3516 (0.1872)	

Source: Author's computation from E-View 9.0

According to the results in table 9:

There is a two-way causality relation between FDI and exports, and there is One-way causality from GDP to FDI.



Conclusion:

In this study, the long-run relationship between foreign direct investment and exports in Algeria in the period of 1980–2019 is investigated using ARDL bounds test.

In our analysis, we first found the results of unit root test. Foreign direct investment is stable at the level, although exports, growth domestic product, reel effective exchange and the degree of openness are stable at the first. The ARDL model was established because the studied variables are stable at different grades. As a result of the ARDL estimator made, 1 unit increase in foreign direct investment was found to increase exports by 0.03% and 0.01% in the long run and in the short run, respectively. Therefore, there is a complementarity relationship of inward flows of FDI with exports. According to the Toda-Yamamoto causality analysis, there is a two-way causality relation between foreign direct investment and exports.

These results show that foreign direct investment can play a curial role in the promotion of exports in Algeria and needs to be encouraged. Note, however, that whatever the effect of FDI on Algerian foreign trade, none can ignore the importance of FDI in boosting national economies. FDI plays, in fact, a very important role in improving the productivity of national firms, which become more motivated to adopt more efficient production or management methods and to carry out research and development efforts in order to maintain their competitive advantage. FDI also plays an important role in employment growth, which is one of the most difficult macroeconomic problems in developed and developing countries. FDI is also a very important vector in technology transfer and in the learning of new technologies, especially for the least developed countries.

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