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The Impact of Trade Openness on the Foreign Exchange Reserves in Algeria during the Period (1990-2022) using the ARDL Model

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Abstract:
This study aims to analyze the short- and long-run dynamic relationship between trade openness and foreign exchange reserves in Algeria during the period 1990-2022, using the ARDL model.
The study concluded that there is a positive impact of trade openness on the foreign exchange reserves in Algeria in the short and long-run, In addition to the absence of the problem of autocorrelation of the sequence of errors with the homogeneity of random estimates over time
Keywords: trade openness; foreign exchange reserve; Algeria, ARDL model.
JEL Classification Codes: F41, F32, O55, C51.

1. INTRODUCTION

Foreign trade is the only outlet for the national economy, which allows the economy of production expenditures and the expansion of the volume of consumption, including the increase in consumer benefits, which necessarily leads to an increase in economic growth rates and the expansion of the size of the national market to ensure the disposal of surplus production due to the narrowness and the emergence and growth of the protectionist trade policy and its escalation at the international level And the emergence of supporters and defenders in various countries, especially from the developing countries, most of which adopted this policy and used it to protect their emerging economies from the danger of foreign competition.

The international trade liberalization agreements have contribute to increasing the degree of interdependence between the countries of the world and to a significant increase in the volume of commodity and monetary flows between countries, which doubled the impact of trade on various economic aspects of most countries of the world, and perhaps one of the most important characteristics of international trade is winning all countries in

trade without exception. This is due to its positive effects on efficiency and economic well-being.

Given the importance of foreign trade, both exports and imports in Algeria, especially oil exports, which are the most important sources of hard currency accumulation in Algeria, Algeria hastened at the beginning of the new millennium to maximize the benefits of this commercial openness, by carrying out many trade reforms and enacting legislation and laws in line with the internal and external bets expected from Therefore, to analyze and clarify the impact of the policy of trade openness on foreign exchange reserves in Algeria, the following question can be asked:

- **What is the impact of trade openness on foreign exchange reserves in Algeria during the period 1990-2022?**

1.1 Study hypothesis: In order to answer the research problem, the following hypothesis was formulated:

"There is a response in foreign exchange reserves to changes in the rate of trade openness"

1.2 The Objectives and Importance of the Study:

Foreign trade is of great importance in the Algerian economic activity, whether in terms of exports or imports, that is, whenever Algeria opens up to the outside world, it benefits more from the proceeds of oil exports, which contributed greatly to the accumulation of foreign exchange reserves.

1.3 Study Methodology:

We will rely on the quantitative approach in order to measure the impact of trade openness on the foreign exchange reserves in Algeria in the long and short run according to the ARDL model and using the EViews 12.

1.4 Literature Review:

Over the years different scholars have researched different areas that relate this study, some domestic and some foreign. Among them:

(Khan, Bin Amin, & Ahmed, 2021)This study has explored the nexus among foreign exchange reserve, remittance, exchange rate, and trade balance in Bangladesh for the period of 1986 to 2019. By employing the ARDL model, the study has shown a statistically significant positive impact of remittance inflow and trade balance on foreign exchange reserves in the long run. If remittance inflow increases by 1%, then the foreign exchange reserve would increase by 0.43%, and if trade openness rises by 1%, then the foreign exchange reserve would rise by 1.22%. Granger causality test has revealed the presence of unidirectional causality from the remittance inflow to foreign exchange reserve and remittance inflow to exchange rate.(Kashif, Tonk, & Ruhi, 2019)The present study analyses empirically the effect of economic growth and trade openness on international reserves in India. The study employed time series data with annual frequency from 1996 to 2016. The study developed an econometric model relating RES to ECON and TRDOP variables and used logarithmic transformation of the variables for econometric estimation. The vector error correction model (VECM) of international reserves reveals that lagged independent

variables shows the expected signs i. e. economic growth and trade openness have significant effect on international reserves. Findings of the study suggest that economic growth and trade openness is positively related to international reserves.(Tayseer, 2017)The research was based on a model consisting of one linear multi-variables equation. The deficit in the trade balance and the gap between the official exchange rate and its counterpart in the parallel market were used as explanatory variables for the variations in foreign exchange reserve. Using the OLS, the search attained the following results: That the widening gap between the official exchange rate and the exchange rate in the parallel market leads to a deterioration of foreign exchange reserves and it is the main reason for its deterioration during the study period. While the results indicate that the volatility of the current account deficit has less impact and that it has not been a major cause.(Nteegah & Okpoi, 2017)Utilizing data on foreign reserves, oil imports, non-oil imports, oil export, non-oil exports and exchange rate in Nigeria during the period 1980 – 2015 and analyzing it using the cointegration and Vector Error Correction Model, the findings revealed that foreign trade has serious implications for Nigeria's foreign reserves. This is evidenced from the causality test results which revealed that oil import, non-oil imports, oil exports, non-oil exports and exchange rate propelled foreign reserves. Also, the Vector Error Correction result indicates that oil and non-oil export are positively and correctly signed hence has positive implication on foreign reserves while oil and non-oil imports were negatively signed implying that they retarded foreign reserves in Nigeria. Specifically, oil export, non-oil imports and exchange rate were significant at 5%. (Azar & Aboukhodor, 2017)This research looks into the accumulation of foreign exchange reserves and the development of the macro-economy in the Gulf and Cooperation Council countries (GCC countries), namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. Using yearly data covering the period from 1996 through 2015, the empirical results show positive and significant relationships between foreign exchange reserves accumulation on one hand, and oil prices, GDP, the ratio of current account to GDP, and the ratio of broad money to GDP on the other hand. Moreover, the results point to negative and significant relationships between foreign exchange reserves accumulation on one hand, and real effective exchange rate, the ratio of debt to GDP, and call money rates on the other hand. However, the results show that the stockpile of foreign exchange reserves in the GCC countries is not sensitive to nominal effective exchange rates, neither to the ratio of imports to GDP, and nor to interest rates on the US Dollar. Furthermore, the study shows a robust and positive link between foreign exchange reserves and oil prices on the one hand and economic growth in these countries on the other hand.

2. The theoretical concepts of the study

2.1 Theoretical framework of foreign trade

The expansion of foreign trade as a result of technological progress contributed to the internationalization of international economic relations and the trend towards liberalizing the world economy in order to dispose of the increasing surpluses in production

Regarding domestic consumption and the consolidation of international economic relations between countries.

2.1.1 Definition of trade openness

Trade openness is defined as that policy that leads to the abandonment of biased policies against exports and the adoption of neutral policies between export and import and the reduction of the value of the high customs tariff in addition to the transformation of quantitative restrictions into customs tariffs and thus the content of the trade liberalization program includes many procedures regarding import policies and export promotion, macroeconomic management policy (Jaballah & cherit, 2018, p. 181)

It also defines trade openness according to international institutions as that policy that leads to the abandonment of biased policies against export, the adoption of neutral policies between export and import, the reduction and control of the high tariff value, in addition to the transformation of quantitative restrictions into customs tariffs, and the trend towards a unified system for the latter (Zadoun & Jeddou, 2019, p. 195)

2.1.2 Definition of Foreign trade

Foreign trade is defined as: "the process of trade exchange in goods, services and other various elements of production between several countries with aim of achieving mutual benefits for the parties to the exchange"(Hamdi, 2010, p. 10).

Foreign trade also means the international movements of goods and services, which is an economic term that deals with movement of goods and services between different countries. Which natural, production or technical conditions may interfere with its non-production (Shehata, 2007, p. 46)

2.1.3 Foreign Trade Liberalization Requirements

The commercial liberalization policy depends on several requirements, the most important of which are (keddi, 2005, p. 2)

- Existence of sound macroeconomic policies and realistic exchange rates that reflect the economic reality;
- the abolition of quotas and similar restrictions, which can be replaced by tariffs;
- Increasing the volume of exports before carrying out the process of reducing customs tariffs;
- Providing an appropriate environment to encourage further commercial liberalization.

2.2 Theoretical framework of foreign exchange reserves

Studies differed about the development of an accurate concept of the foreign exchange reserve, and the reason for this difference is due to the incompatibility in defining its components. The foreign exchange reserve is considered a tool to settle international payments and safety valve for countries to face financial and economic shocks and crises.

2.2.1 Definition of foreign exchange reserves

There are many definitions provided in order to define foreign exchange reserves, among which we mention:

- Foreign exchange reserves are defined as: "All generally accepted, available and unconditional international payment methods for settlement of international payments."
- It is also defined as: “the assets available immediately and subject to the control of the monetary authorities, for the purpose of direct financing of the imbalances of their external payments, or the indirect adjustment of these imbalances by influencing the exchange rate of its national currency through intervention in the exchange market, or to achieve other goals”(IMF, 2013, p. 45).
- It is also defined as: "all payment instruments most acceptable to fulfill international obligations, and used by the state in settling the deficit in its balance of payments."
- As defined by the International Monetary Fund as: “those external assets. "Which are readily available and controlled by monetary authorities to achieve balance and meet the financing needs of payments and to intervene in currency exchange markets in order to influence the exchange rate of the currency or for other purposes”.
- As a comprehensive definition, foreign exchange reserves can be defined as: "a collection of liquid foreign assets that are used to settle international payments, and are owned by monetary authorities."(mouakeni & zidane, 2020, p. 135).

2.2.2 The sources of foreign exchange reserve accumulation

The state of the balance of payments is a reflection of the value of the foreign exchange reserve with the monetary authorities. In the event of a surplus, the value of the reserve increases, and in the event of a deficit, this reserve is depleted, and accordingly, the higher the real income of the country, this leads to an increase in its ability to form reserves, And divides balance of payments According to the International Monetary Fund into three main accounts, she:

- Current Account (Current Transaction Account): This account is considered one of the most important components of the balance of payments and includes both the trade balance and the services balance Income (compensation of employees, investment income) and calculating remittances Ongoing (one-sided transfers).
- Capital Operations Account: This account includes all Transactions Economic international which for short and long-run investments and loans It includes two accounts: the long-run capital account and the short-run capital account(Krugman & Obstfeld,, 2006, p. 306).
- Formal Settlements Account: This account includes the net official reserves account Liquid and illiquid, which express the obligations of debtors and the rights of creditors, which includes foreign currencies, cash gold, special drawing rights, and reserve position with IMF(Jean-Pierre, 2001, p. 31).

3. Methods and Materials

3.1 Model Specification and Description of the Data

The estimable model could be expressed as follows in equation 1; for examining the impact of trade openness on the foreign exchange reserves in Algeria.

LFERt = f(LTOPt)……(1)

Where:

LFERt is Logarithm of Foreign Exchange Reserves;

LTOPt is Logarithm of trade openness;

3.2 ARDL Model Estimation

The ARDL modeling approach was originally introduced by Pesaran and Shin (1999) and later extended Pesaran et al. (2001). The ARDL co-integration approach has numerous advantages in comparison with other co-integration methods. Unlike other co-integration techniques, the ARDL does not impose a restrictive assumption that all the variables under study must be integrated of the same order. In other words, the ARDL approach can be applied regardless of whether the underlying regressors are integrated of order one [I(1)], order zero[I(0)] or fractionally integrated. Secondly, while other co-integration techniques are sensitive to the size of the sample, the ARDL test is suitable even if the sample size is small. Thirdly, the ARDL technique generally provides unbiased estimates of the long-run model and valid t-statistics even when some of the regressors are endogenous (Odhiambo, 2019, p. 219). The ARDL model used in this study can be expressed as follows in equation 2:

$$\Delta LFER_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta LFER_{t-i} + \sum_{t=0}^{q} \beta_2 \Delta LTOP_{t-i} + \alpha_1 LFER_{t-1} + \alpha_2 LTOP_{t-1} + \varepsilon_t \ldots . (2)$$

Where:

Δ : is the first difference operator;

p, q,r..,z: are the lagged values of the dependent and independent variables to control for higher-order correlation;

$\beta_0, \beta_1, \beta_2$ ....: are coefficients corresponding to the long-run dynamic relationship.re coefficients of short-run dynamics;

$\alpha_1, \alpha_2, \alpha_3$ ....: are coefficients corresponding to the long-run dynamic relationship;

4.1 Unit Root Test

To test the stationarity on differenced variables, we use the Phillips-Perron test, which is presented in table 1. The result shows that after differencing in variables once, all variables were integrated on the first difference. That means all variables were confirmed to be stationary in this study.

Table 1. Phillips-Perron Unit Root Test

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

		At Level	
		LFER	LTOP
With Constant	t-Statistic	-2.4508	-2.3790
	Prob.	*0.1372*	*0.1558*
		n0	n0
With Constant & Trend	t-Statistic	0.6474	-1.5774
	Prob.	*0.9993*	*0.7780*
		n0	n0
Without Constant & Trend	t-Statistic	0.2732	-0.7313
	Prob.	*0.7585*	*0.3913*
		n0	n0
		At First Difference	
		d(LFER)	d(LTOP)
With Constant	t-Statistic	-4.7567	-6.5610
	Prob.	*0.0007*	*0.0000*
		***	***
With Constant & Trend	t-Statistic	-5.8334	-8.0605
	Prob.	*0.0003*	*0.0000*
		***	***
Without Constant & Trend	t-Statistic	-4.5086	-6.7161
	Prob.	*0.0001*	*0.0000*
		***	***

Notes:
a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant
b: Lag Length based on SIC
c: Probability based on MacKinnon (1996) one-sided p-values.

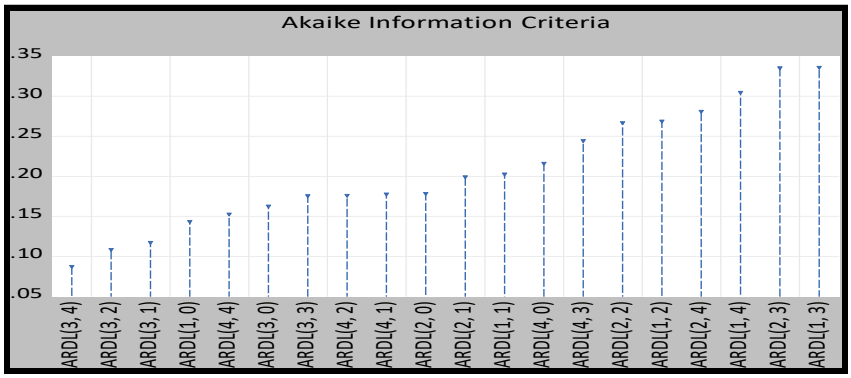
This Result is The Out-Put of Program Has Developed By:
Dr. Imadeddin AlMosabbeh
College of Business and Economics
Qassim University-KSA

Source: EViews 12

4.2 Optimum Lag Selection

To select the number of lags required in the co-integration test, we use the Akaike Information Criterion as shown in the following Figure 1. The results of AIC showed that the model (3,4) was the optimal lag lengths.

Fig.1. Results of Akaike Information Criteria



Source: EViews 12

4.3 F-Bound Tests

The results reported in Table 2 show that the F-statistic is greater than the upper critical bound at all level of significance and K =2, which means that the null hypothesis is rejected and confirms the existence of a long-run relationship between variables.

Table 2. The F-bound tests

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.523410	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual Sample Size	29		Finite Sample: n=35	
		10%	3.223	3.757
		5%	3.957	4.53
		1%	5.763	6.48
			Finite Sample: n=30	
		10%	3.303	3.797
		5%	4.09	4.663
		1%	6.027	6.76

Source: EViews 12

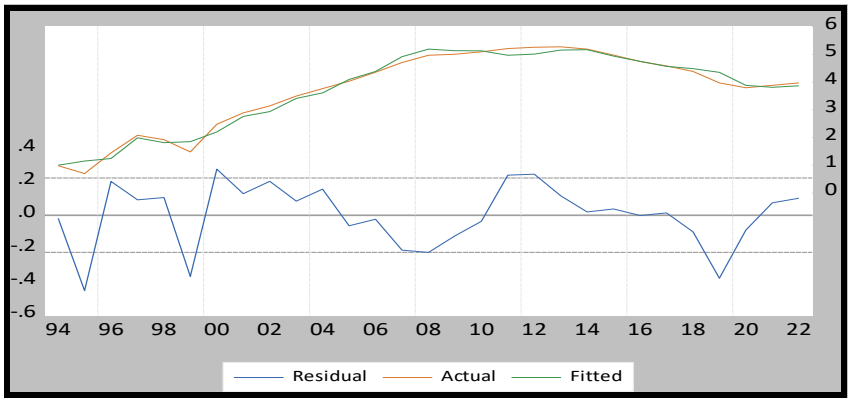
4.4 Residual Diagnostics:

We should check the robustness of the optimal model by using the Residual Diagnostics and Stability Diagnostics Before estimating the ARDL (3,4) in Long-run Coefficients and Error Correction Regression test.

4.4.1 The actual, fitted and residuals Graph

Through The results of Figure 2, we observing the approximation of the fitted values of the actual values for variables, this result indicates the quality of the estimated model, for that it is reliable to interpret and analyze the results.

Fig.2. The actual, fitted and residuals Graph

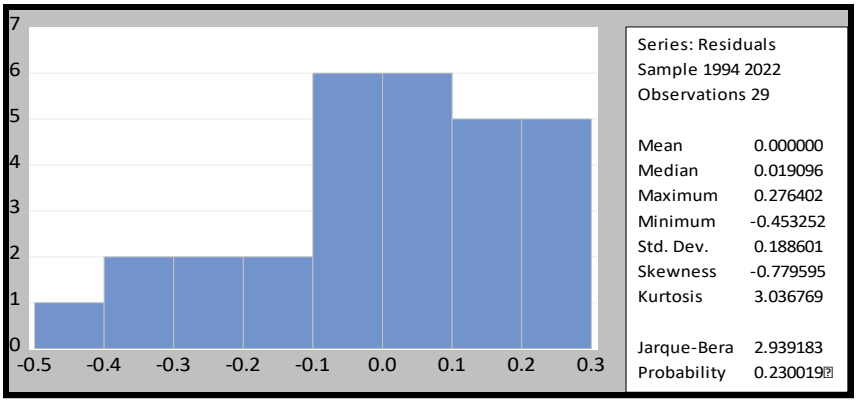


Source: EViews 12

4.4.2 Histogram and Normality Test

The result of the test was insignificant ($\alpha > 0.05$) and the value of J-B = 2.93 was less than $x^2 = 5.99$. This means accepting the null hypothesis and residuals are subject to normally distributed residuals. As shown in the following Figure 3.

Fig.3. Normality Test Result



Source: **EViews 12**

4.4.3 Serial Correlation LM Test

For testing serial correlation, we use Autocorrelation, Breusch-Godfrey correlation LM test as shown in the following Table 3. According to the LM test, the Prob chi-square is greater than 0.05 and therefore we accept the null hypothesis there is no autocorrelation.

Table 3. Serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.487233	Prob. F(2,18)	0.6222
Obs*R-squared	1.489345	Prob. Chi-Square(2)	0.4749

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 04/15/23 Time: 16:23
Sample: 1994 2022
Included observations: 29
Presample missing value lagged residuals set to zero.

Source: EViews 12

4.4.4 Heteroskedasticity Test

Through The results of Table 4, the f-statistic is insignificant, prob F is greater than 0.05, therefore accepting the null hypothesis (Constant error variance over time).

Table 4. Heteroskedasticity test

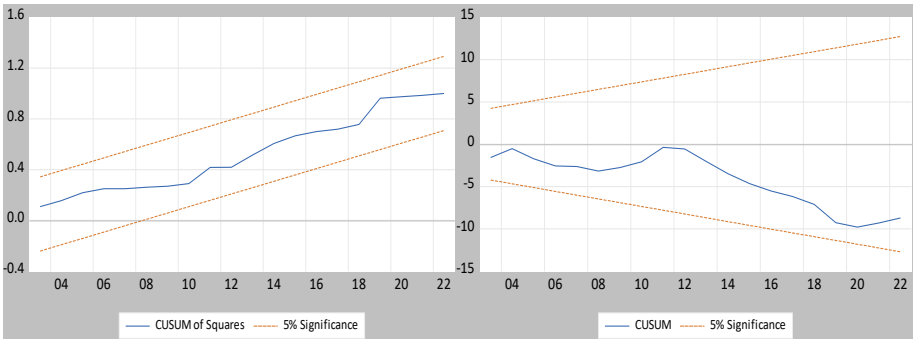
Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	1.710177	Prob. F(8,20)	0.1574
Obs*R-squared	11.77982	Prob. Chi-Square(8)	0.1613
Scaled explained SS	5.705774	Prob. Chi-Square(8)	0.6802
Test Equation: Dependent Variable: RESID^2 Method: Least Squares Date: 04/15/23 Time: 16:24 Sample: 1994 2022 Included observations: 29			

Source: EViews 12

4.4.5 Stability Diagnostics

Through The results of Figure 4, we note all the plots of statistics CUSUM and CUSUMSQ are inside the critical bounds at 5% level of significance, which means that all the coefficients in the error correction model are constant, indicate that our ARDL model is stable.

Fig.4. Cusum Test and Cusum of Square Test



Source: EViews 12

4.5 ARDL Error Correction Regression Test

Appendix 01 explains the presence of a positive and statistically significant effect of Trade Openness on the Foreign Exchange Reserves in the long run at a level of significance of 5%. As Trade Openness increases by 1%, the Foreign Exchange Reserves will increase by 1.14%. This agrees with the economic theory that stresses the importance of trade openness for countries, especially on the export side, which Algeria benefited from due to the rise in oil exports in light of the rise in oil prices until mid-2014. It was able to attract more than 900 projects in the period 2002-2017, especially in the oil sector, which contributed even a little to the country's income, despite the fact that the national economy is still dependent on oil prices.

The results also showed a dynamic relationship between Trade Openness and Foreign Exchange Reserves in Algeria, and this is due to the estimated negative statistically significant and moral error and its value was (CointEq (-1)=-0.2306), which measures the proportion of imbalance in the dependent variable that can be corrected From one time period to another at a rate of 23.06%, and the negative sign supports the existence of a long-term equilibrium relationship between the variables.

4.6 Estimated Long Run Coefficients

Appendix 02 explains the presence of a positive and statistically significant effect of Trade Openness on the Foreign Exchange Reserves in the long run at a level of significance of 5%. As Trade Openness increases by 1%, the Foreign Exchange Reserves will increase by 7.68%. This agrees with the economic theory that stresses the importance of trade openness for countries, especially on the export side. For this reason, Algeria worked to create the investment climate by issuing a number of laws and providing attractive tax incentives, and worked to modernize and modernize the infrastructure, which contributes to attracting investors, but its share of foreign direct investment is still small. In light of the 51/49 investment rule, this did not allow Algeria to get out of the dominance of the oil sector over the national economy, and the only source of hard currency.

5. CONCLUSION

Hydrocarbon revenues represent the most important source of accumulation of foreign exchange reserves, and imports are considered the largest drain on them. The reserves in Algeria have become the main source of monetary issuance since its reformation. And the continuation of its accumulation starting in the year 2000 because it became the main counterpart to the sums of the monetary mass in the national economy, For this reason, Algeria worked and to get rid of the dependence of the oil sector on the liberalization of trade and the modernization and modernization of the infrastructure, which contributed to attracting foreign investors with more than 900 projects during the period 2002-2017 with a value exceeding 3000 billion dinars, This confirms the importance of trade openness as a source of accumulation of international reserves.

This was confirmed by the econometric study, where we found that foreign exchange reserves respond significantly to changes in the rate of trade openness in the long and short run, by more than 100%.

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7. Appendices:

Appendix 1. Error Correction Regression test

ARDL Error Correction Regression
Dependent Variable: D(LFER)
Selected Model: ARDL(3, 4)
Case 2: Restricted Constant and No Trend
Date: 04/15/23 Time: 16:28
Sample: 1990 2022
Included observations: 29

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFER(-1))	-0.273136	0.144701	-1.887591	0.0737
D(LFER(-2))	-0.377335	0.145921	-2.585886	0.0177
D(LTOP)	1.146116	0.372343	3.078120	0.0059
D(LTOP(-1))	0.048601	0.525025	0.092568	0.9272
D(LTOP(-2))	0.475215	0.412800	1.151199	0.2632
D(LTOP(-3))	0.754824	0.364469	2.071021	0.0515
CointEq(-1)*	-0.230610	0.049703	-4.639747	0.0002

R-squared	0.705651	Mean dependent var	0.123701
Adjusted R-squared	0.625374	S.D. dependent var	0.347626
S.E. of regression	0.212770	Akaike info criterion	-0.050704
Sum squared resid	0.995964	Schwarz criterion	0.279333
Log likelihood	7.735207	Hannan-Quinn criter.	0.052660
Durbin-Watson stat	1.734306		

Source: EViews 12

Appendix 2. Long Run Coefficients Test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LFER)
Selected Model: ARDL(3, 4)
Case 2: Restricted Constant and No Trend
Date: 04/15/23 Time: 16:20
Sample: 1990 2022
Included observations: 29

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.153519	0.584623	3.683605	0.0015
LFER(-1)*	-0.230610	0.064036	-3.601235	0.0018
LTOP(-1)	1.771920	0.551209	3.214606	0.0043
D(LFER(-1))	-0.273136	0.152285	-1.793588	0.0880
D(LFER(-2))	-0.377335	0.153952	-2.450998	0.0236
D(LTOP)	1.146116	0.418170	2.740791	0.0126
D(LTOP(-1))	0.048601	0.628896	0.077279	0.9392
D(LTOP(-2))	0.475215	0.486517	0.976770	0.3404
D(LTOP(-3))	0.754824	0.408962	1.845706	0.0798

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTOP	7.683634	1.193341	6.438759	0.0000
C	9.338374	0.822014	11.36036	0.0000

EC = LFER - (7.6836*LTOP + 9.3384)

Source: EViews 12