



Investigating the causal relationship between imports and foreign exchange reserves in Algeria during the period 1990-2021

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Abstract:

The present study relies on Granger causality and co-integration based on Engel and Granger's method and the autoregressive ray model to analyse the causal and dynamic link between imports and foreign exchange reserves in Algeria during the period 1990–2021. The study concluded that there is a one-way causal relationship between foreign exchange reserves and imports, and based on estimation models, we found that foreign exchange reserves directly affect imports in the long term by 0.10% and directly in the short term by 0.12%, while there is no significant effect of imports on foreign exchange reserves in the short and long term.

Keywords: Foreign exchange reserve; Imports; VAR; Algeria.

Jel Classification Codes: F31 ·F13 ·C32 ·O55.

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1. Introduction

The management of foreign exchange reserves is a crucial issue because it poses a challenge to many nations, including Algeria, which has raised many concerns about managing these reserves, maximizing their benefits, and protecting their real value from eroding and depleting in light of the fluctuations in the exchange rates of major currencies, especially the U.S. dollar.

Most of these reserves are employed in the form of US bonds with poor returns, as the difference in the currency of payment and collection in foreign trade, the dependence on the hydrocarbon sector as a source of hard currency, and the sharp rise in the import bill lead to the erosion of the country's stock of foreign exchange.

Due to the limitations of the domestic production system, imports play a significant role in the national economy. Furthermore, they allow for the acquisition of goods and services that cannot be produced locally, as well as the improvement of individual living standards through consumer spending on imported goods and the expansion of domestic investment through the use of foreign capital goods. But the coverage of imports is linked to the rise in the country's treasury of foreign currencies, and from it, the following question can be raised:

- ➔ Is there a direct equilibrium impact between imports and foreign exchange reserves in Algeria during the period from 1990 to 2021?

Study hypothesis: To answer the study question, the following hypothesis is put forward:

There is a two-way causal relationship between imports and foreign exchange reserves in Algeria.

Study Objectives: The following goals of the study are the most crucial:

attempting to establish Algeria's ideal amount of foreign exchange reserves;

An investigation of the dynamic and causative relationship between Algeria's foreign exchange reserves and imports.

Study Methodology:

The descriptive-analytical methodology was employed to attempt to describe and analyze the theoretical aspect of the study. Additionally, the standard methodology was adopted to test the short-term and long-term relationship between imports and foreign exchange reserves using Eviews 12 software.

Previous studies:

The study of (benslimane, 2021) “**udying the impact of exchange rate fluctuations on the volume of imports in Algeria using the ARDL Bound testing approach (Analytical and Econometric study 1984-2019)**” This paper aims to study the relationship between the exchange rate and the volume of imports in Algeria, based on the data of the World Bank, during the period 1984-2019. The ARDL approach, and this method was presented by Pesaran and others (2001), where we found that there is a short-term as well as a long-term relationship between the exchange rate and the volume of imports, where the short-term elasticity was negative, meaning that the exchange rate has an opposite effect, the same thing we can say in the long run Which is consistent with economic theory.

The study of (Azar & Aboukhodor, 2017): is a study on foreign exchange reserves and macroeconomics in the countries of the Gulf Cooperation Council using cross-sectional data, where the results indicate negative and significant relationships between the accumulation of foreign exchange reserves, on one hand, the real effective exchange rate, and the debt ratio. However, the results show that the foreign exchange reserves in the Gulf Cooperation Council countries are not sensitive to the nominal actual exchange rates, to imports, nor to interest rates on the US dollar. The study shows a strong and positive relationship between foreign exchange reserves and oil prices on the one hand and economic growth in these countries on the other hand.

The study by (Nteegah & Okpoi, 2016) The study examined foreign trade and its impact on foreign exchange reserves in Nigeria from 1980 to 2015, using the cointegration model and error correction

model. The study analyzed various aspects of foreign trade, including oil and non-oil exports, oil and non-oil imports, and exchange rates. The results revealed substantial effects of foreign trade on foreign exchange reserves in Nigeria. Specifically, both oil and non-oil exports, oil and non-oil imports, and exchange rates exhibited notable impacts on the level of foreign exchange reserves in the country. Based on these findings, the researcher provided important recommendations. Emphasis was placed on the necessity of diversifying the export base beyond hydrocarbons to mitigate potential negative effects of oil price volatility on foreign exchange reserves. Additionally, the government was advised to minimize unnecessary imports as much as possible to achieve balance in the trade account and reduce pressure on foreign exchange reserves.

The study by (kalid & usman, 2022) : This research examine the causal nexus between imports and economic growth in China, India and G7 economies. We use BC granger causality analysis in the frequency domain short (temporary) and long term (permanent) causality. Our results suggested that, there is a frequency domain (high and low) proof of the bi-directional causal nexus between imports and economic growth. The imports and economic growth in most economies seem to be long-term and short-term dependent. This empirical study shows that policymakers of these big economies need to analyze the transformation in the import-economic growth causality robustness throughout the year when planning policy actions.

By examining the causal relationship between the two variables using the Vecm model throughout the 1990–2021 time period, we discover that all prior studies have failed to disprove the existence of a relationship between foreign exchange reserves and imports, which we will attempt to demonstrate in Algeria.

2. Foreign exchange reserve

2.1 Definition of foreign exchange reserve

The term "foreign exchange reserve" has several definitions, among which we list the following:

✎ It is defined as: "all generally accepted, available, and unconditional international payment methods for the settlement of international payments."

✎ It is defined as: "the assets available immediately and subject to the control of the monetary authorities, for the purpose of direct financing of the imbalances in their external payments, or the indirect adjustment of these imbalances by influencing the exchange rate of their national currency through intervention in the exchange market, or to achieve other goals." (IMF, 2013, p. 3)

✎ It is defined as: "All payment instruments most acceptable to fulfil international obligations, and used by the state in settling the deficit in its balance of payments". (al-Nuaimi, 2012, p. 54)

✎ So, a foreign exchange reserve is: "a collection of liquid foreign assets that are used to settle international payments and are owned by monetary authorities."

2.2 Sources of foreign exchange reserve accumulation

The state of the balance of payments is a reflection of the value of the foreign exchange reserve. The value of the reserve increases, and in the event of a deficit, this reserve is depleted. Consequently, and accordingly, the higher the real income, the greater the increase in its ability to form reserves, and the balance of payments is divided according to the International Monetary Fund into three main accounts: (Sayd, 2013, p. 81)

a. The current account (current transactions account):

This account is considered one of the most important components of the balance of payments and includes the trade balance, services balance, income (compensation of workers, investment income) and the current transfers account (transfers from one party). (Krugman & Obstfeld, 2006, p. 306)

b. Capital Operations Account:

This account consists of all international economic transactions related to short and long-term investments and loans and includes two accounts: the long-term capital account and the short-term capital account. (John, 2001, p. 31)

c. Official Adjustments Account:

Foreign currencies, monetary gold, special drawing rights, and the IMF reserve position are all included in this account, which also contains the net liquid and illiquid official reserves account that expresses debtors' obligations and creditors' rights. (Dominick, 1982, p. 102)

2.3 Components of foreign exchange reserves in Algeria

The exchange reserve consists of five basic components: (Bouhnek, 2010, p. 115)

1. IMF reserves: the total reserves held by Algeria with the International Monetary Fund;
2. Gold: consists of gold reserves, gold that does not comply with international standards, and temporary gold investments;
3. international payment agreements;
4. SDR;
5. Hard currencies (especially dollars).

The progression of the items in the balance of payments made it possible to revise the exchange reserves. After the level of reserves was low and alarming, in the range of 1.3 billion dollars in the eighties, it moved to 4.3 billion dollars in the nineties and then to 12 billion dollars in 2000 due to the upward rise in oil prices, i.e., The main source of reserves development is the hydrocarbon revenues that are still linked to fluctuations in oil prices, which gives the possibility of fluctuation in the size of these reserves in the future, and it should be noted that all the increase in foreign exchange reserves during this short period has been achieved in official holdings of currencies. As for the remaining components of the reserve, there was no significant increase in it. (Abd El Aziz, 2014, p. 27)

2.4. The optimum level of exchange reserves in Algeria

The purpose of building reserves is to balance the flow of payments, meet external demands, and accumulate funds in foreign currencies to protect against external shocks and crises. Since holding reserves has a cost, the ideal level of reserves must be attained. In

Algeria, there are metrics that can be used to determine the number of official exchange reserves that are sufficient. Here are a few of them:

2.4.1. Import Reserve Coverage Index (R/M) :

It is appropriate to use the ratio of international reserves to imports (R/M) as an indicator of the sufficiency of international reserves in the Algerian economy because the Algerian economy is characterized by a high degree of commodity concentration in exports and a high degree of diversification of imports. This is because Algeria, like other Arab countries, depends on imports. This indicator is used to judge the solidity of the external financial position. It is calculated on the basis of dividing the total foreign exchange reserves at the end of the year by the value of merchandise imports for that year in the same country multiplied by 12 months. (Zairi, 2009, p. 58)

From Appendix 01, we note that Algeria has achieved high rates, and there is even a severe excess in the level of reserves, as the rate of coverage of reserves for imports moved from 0.9 months in 1990 to 15.5 months in 2000, an increase of 2300%. To continue This rate of increase ranged between 42.3 and 48.1 months during the period 2006 to 2013, then decreased in 2015 to 35.12 months and then to 23.06 in 2019 due to the drop in oil prices, which led to a shrinkage in the volume of reserves.

This level of reserves far exceeds the optimal and reasonable level, which ranges between 3-6 months as a coverage rate, and the reason for exaggerating the size of the reserves is to intervene in the inter-exchange market to maintain the stability of the real effective exchange rate at its equilibrium level, although it does not require this volume. It was possible to benefit from the surplus reserves in the operations of financing the economy or invest in high-return foreign assets wasted on alternative opportunities. (Burnan, 2015, p. 209)

2.4.2 Index of Reserves to Money Supply (R/M2) :

It is an important measure used as an early warning of falling into a financial crisis, and it measures the amount of money that residents can transfer abroad (the flight of hard currency). The

following table shows the ratio of exchange reserves (net foreign assets) to the money supply (M2) in Algeria.

From Appendix 01, we noted from the analysis of the (net foreign assets/monetary mass) indicator, the continuous increase in the value of the indicator except for the year 1999, when it decreased from what it was in 1998 (17.62%) to 9.47%, i.e., a decrease of 46.25%. The reason is the decline in oil prices due to the Asian tiger crisis, which led to a decrease in the demand for oil. Since 2005, for the first time, net foreign assets have exceeded the money supply (M2) by 102.68 percent, after it did not exceed 9.47% in 1999.

It peaked at 151.75% in 2009 but has since fallen due to increased resources in the Revenue Control Fund as well as monetary policy tools that the Bank of Algeria has begun to use as a liquidity recovery tool. which is a voluntary and voluntary deposit of surplus deposits with the Bank of Algeria (7 days in 2002, 3 months in 2005, and 6 months in 2013), as well as deposit facilities (for a period of 24 hours). That is, since the year 2000, and due to financial surpluses, the Bank of Algeria resorted to introducing new tools to reduce dependence on foreign assets as a major source of the monetary mass.

We note that the relationship between the change in reserves and the change in the money supply (M2) is not fixed in terms of direction. For example, we find that in 2008 the change in net external assets was estimated at 38.1%, while the change in the money supply was in the range of 16. In 2019, there was an increase in reserves estimated at 3.54%, while the monetary expansion (M2) increased by 0.97%.

2.4.3. Index of reserves to total external debt:

This indicator is useful in evaluating the state's financial health since it evaluates the nation's capacity to fulfill its obligations. If the state is unable to fulfill its obligations, it will experience a lack of liquidity, which will cause capital to flee the country. The following table displays Algeria's reserves as a percentage of its overall external debt, and we've divided the research period into two portions using data from Appendix 01:

In the period (1990–2001), we found an improvement in the rate of coverage of foreign indebtedness reserves, as this ratio represented only 2.78% in 1990 and rose to 40.58% in 1998, i.e., it changed by 1357,86%. This is due to Algeria's exchange reserves increasing from 0.73 billion dollars in 1990 to 6.84 billion dollars in 1998, then falling to 15.5 percent in 1999 due to a drop in oil prices, then increasing to 47.1 percent the following year and 79.5% in 2007.

This development in the index's value is mainly due to the beginning of the formation of foreign exchange reserves in Algeria starting in the year 2000 as a result of the improvement in oil prices on the one hand, and a slight decrease in the debt balance, as it moved from 28,315 billion dollars at the end of 1999 to 25,261 billion dollars, then 22,571 billion dollars in 2000 and 2001, respectively.

Starting in the year 2002, we found that the reserves exceeded the indebtedness for the first time in the history of Algeria, reaching a coverage rate of 102%. This indicator continued to rise to reach its highest value in 2013 when the volume of the exchange reserve exceeded the volume of the existing external debt by more than 57 times, and this is what indicates the strength of Algeria's external financial position.

This improvement in Algeria's external financial position was for two reasons. The first is the increase in the volume of foreign reserves, and the second is the decrease in the value of external indebtedness as a result of the prepayment of Algeria's external debt starting in 2004. As for the decline of this indicator in recent years, starting from 2014, it goes back to the oil crisis and the drop in oil prices to less than 60 dollars in the last three years of 2014, to below 50 dollars a barrel in 2015, which led to a decrease in foreign exchange reserves to 144 billion dollars in 2015, and then to 88.61 billion dollars in 2018, after it was more than 190 billion dollars in 2012 and 2013, to less than 50 billion dollars in 2020.

3. Commodity concentration of Algeria's imports

3.1. Definition:

In the legal context, imports are the value of the products that are bought from other countries in order to gain advantages and meet local consumption needs. They show demand from people living in an economy for products and services made outside of that economy and make up the debit side of the state's trade balance accounting. (Abd al-Rahman, 2019, p. 397)

In its broad sense, it is the value of all imported goods, services, and capital from the rest of the world, and it is included in the debit side of the country's balance of payments accounts, as the country faces the problem of declining national income when paying the value of its imports.

3.2. Development of imports in Algeria:

Imports in Algeria fluctuated from 1990 to 1994, reaching 10.1 billion dollars in 1995 before starting to decline until 2002, when they recorded 11.97 billion dollars. Investment and demand for imported capital goods started rising every year in light of the complete absence of import control, reaching 58.33 million dollars in 2014 before starting to decline due to the oil crisis that hit the global market in mid-2014, which greatly increased the national economy. The government, within its 2015 plan of action, adopted a policy of austerity at all levels and imposed more restrictions on imports, which contributed to reducing the bill to 36.4 billion dollars in 2020.

3.3. Commodity concentration of imports:

According to Appendix 02, industrial equipment acquired the largest percentage, reaching 15,573 million dollars in 2010, at a rate of 38.73%, to start declining gradually, reaching 8696 million dollars in 2020, and the reason for this decline is for many reasons, the most important of which is the decline in the country's income from hard currency from.

On the one hand, and imposing more restrictions on imports on the other hand, semi-manufactured materials came in second place, as they were 9944 million dollars in 2010 and began to decline to reach

7575 million dollars in 2020, for the same reasons mentioned above, and it is noted that foodstuffs came third In terms of the concentration of imports, especially since the bill for importing wheat and basic materials is increasing year after year in light of the decline in the exchange rate of the Algerian dinar on the one hand, and the increase in domestic demand for these commodities on the other hand, and in light of the weakness of the real production system, despite the agricultural reforms and huge support for this sector

However, the failure to track the channels of disbursement of these funds made agricultural reforms below the desired level, and the lowest share of imports was the share of agricultural equipment, which indicates the state's lack of interest in the agricultural sector.

4. Methodology and Tools of the study

4.1. Pre-tests:

4.1.1. Time Series Stability Test:

To test the stability of the time series we use the Phillips-Peron PP test. It allows us to cancel the biases resulting from the special features of random oscillations, and through Table No. (1) it is shown that the series is unstable at the level, while all of them stabilize after doing the first difference, as indicated by the results of the Phillips-Peron test PP, and therefore are integral of the first degree (1). This confirms the possibility of co-integration of the variables in the long run:

Table 1. Time-Series Stability Test (Phillips-Perron Test)

UNIT ROOT TEST RESULTS TABLE (PP)			
Null Hypothesis: the variable has a unit root			
	<u>At Level</u>		
		LIMP	LRES
With Constant	t-Statistic	-0.8615	-2.4917
	Prob.	0.7868	0.1271
		n0	n0
With Constant & Trend	t-Statistic	-1.1458	0.1016
	Prob.	0.9042	0.9959
		n0	n0
Without Constant & Trend	t-Statistic	1.2421	0.2733
	Prob.	0.9419	0.7588
		n0	n0
	<u>At First Difference</u>		
		d(LIMP)	d(LRES)
With Constant	t-Statistic	-3.8818	-4.8718
	Prob.	0.0060	0.0005
		***	***
With Constant & Trend	t-Statistic	-3.8711	-5.8685
	Prob.	0.0262	0.0002
		**	***
Without Constant & Trend	t-Statistic	-3.6284	-4.7012
	Prob.	0.0007	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 output.*

4.1.2. Determining the model's degrees of delay:

Using the criteria for determining the degree of delay of the var model, the lowest value of (AIC) and (SC) is chosen, which corresponds to the optimal time lag, and after applying these two criteria, the results came as shown in Table No. 02, Thus, it turns out that the lowest value of (AIC) is when the time lags are equal to (1), that is, the need to take one time gap, as well as (SC) when the time lags are equal to (1), that is, the degree of time lag is (1), and thus it is found The results of the table show that all criteria: HQ, SC, LR, FPE, and A/C agree that the delay period (P) is equal to 1, and therefore this period will be relied on in the model.

Table 2. Determination of delay degrees in the var. model

VAR Lag Order Selection Criteria Endogenous variables: LIMP LRES Exogenous variables: C Date: 12/13/22 Time: 11:49 Sample: 1990 2021 Included observations: 28						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-57.09432	NA	0.233477	4.221023	4.316180	4.250113
1	18.73923	135.4170	0.001382*	-0.909945	-0.624472*	-0.822673*
2	19.37935	1.051631	0.001768	-0.669954	-0.194166	-0.524501
3	26.76295	11.07540*	0.001408	-0.911639*	-0.245537	-0.708005
4	29.95619	4.333687	0.001530	-0.854014	0.002403	-0.592199
* indicates lag order selected by the criterion LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Source: *Eviews 12 output.*

4.1.3. Granger's causality test:

Granger's test is used to ascertain the extent to which there is a feedback or feedback relationship or a reciprocal relationship between two variables, in the case of time series data, and depends mainly on the F test, while Table No. 03 shows the results of the causality test.

Table 3. Results of the (Granger) Causality Test

VAR Granger Causality/Block Exogeneity Wald Tests Date: 12/13/22 Time: 11:52 Sample: 1990 2021 Included observations: 30			
Dependent variable: LIMP			
Excluded	Chi-sq	df	Prob.
LRES	14.23771	2	0.0008
All	14.23771	2	0.0008
Dependent variable: LRES			
Excluded	Chi-sq	df	Prob.
LIMP	5.058497	2	0.0797
All	5.058497	2	0.0797

Source: *Eviews 12 output.*

Through the results of the Granger test of causality, it is clear that imports do not affect the foreign exchange reserve, where the level of morale for the variable of imports was not significant at the degree of freedom of 5%, while the foreign exchange reserve affects the imports, where the level of morale for the variable of the exchange reserve was significant at the degree of freedom of 5 %, meaning that the causal relationship is one-way between imports and foreign exchange reserves, which has been proven by many studies, including the study (Syukri, 2020).

4.1.4. Johansen's test to determine complementarity relations:

It is a more modern method based on estimating the autoregressive ray using the greatest reasonableness, as it assumes the presence of P of economic variables in one ray of the autoregressive degree of K. The application of this method proceeds from two hypotheses:

H0: assumes no co-integration at a given significance level (eg 5% or 1%);

H1: the integration is assumed, and the results are given in Table 4.

Table 4. Results of the Johansen test for determining complementarity relationships

integration	null hypothesis	eigenvalue	trace	Prob	Critical value of impact test 5%	Great eigenvalue	Critical value of the eigenvalue test 5%	Prob
(nix)*	(r=0)*	0.507316	30.21851	0.0002	15.49471	20.47009	14.26460	0.0046
(maximum 1)*	(r ≤1)	0.285486	9.748414	0.0018	3.841465	9.748414	3.841465	0.0018
The null hypothesis was rejected at the 5% level of significance.								

Source: Eviews 12 output.

Through Table No. 4 it becomes clear to us that the first test is significant; it means that we reject the null hypothesis (there is no long-term equilibrium relationship), and we accept the alternative

hypothesis that there is at least one long-term equilibrium relationship, and therefore the VAR model is the best model for estimating the long-term equilibrium relationship.

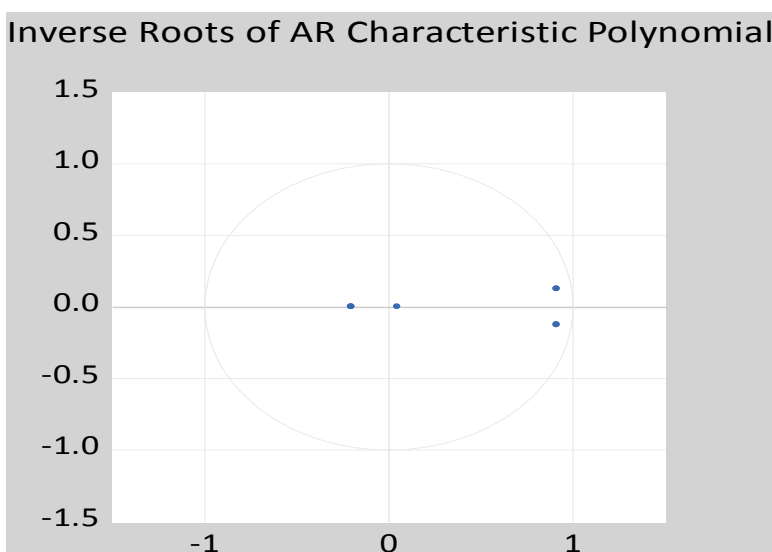
4.2. Model Validity Test:

To assess the strength of the VAR model, several statistical tests will be used, including

4.2.1. Model stability test:

The stability of the model can be confirmed by the test shown in the following figure:

Fig. 1. Model stability test



Source: *Eviews 12 output.*

Through the figure, we notice that the model fulfills the condition of stability, as all the parameters are less than one and all the roots are located within one circle.

4.2.2. Normal distribution of residuals:

The nature of the residual distribution is revealed by testing the hypothesis that "the residuals are normally distributed." This is done by extrapolating the statement that allows the observation of the residuals gathering around the centre and decreasing as they move away from the center towards the edges, or not gathering them around

the centre, or by comparing the statistic (jarque-bera) with the tabular value (chi-square) at the degree of freedom 02 and the level of significance 0.05.

According to Table No. 06, we discovered that the test result was not significant (> 0.05), indicating that the residuals are subject to a normal distribution and that the value of $J-B = 2.57$ is less than $2 = 5.99$, indicating that the model's residuals are subject to a normal distribution

Table 06. Normal distribution of residuals

VAR Residual Normality Tests Orthogonalization: Cholesky (Lutkepohl) Null Hypothesis: Residuals are multivariate normal Date: 12/13/22 Time: 12:03 Sample: 1990 2021 Included observations: 30				
Component	Skewness	Chi-sq	df	Prob.*
1	0.297807	0.443445	1	0.5055
2	-0.557524	1.554164	1	0.2125
Joint		1.997609	2	0.3683
Component	Kurtosis	Chi-sq	df	Prob.
1	2.022780	1.193699	1	0.2746
2	4.411177	2.489275	1	0.1146
Joint		3.682974	2	0.1586
Component	Jarque-Bera	df	Prob.	
1	1.637144	2	0.4411	
2	4.043439	2	0.1324	
Joint	5.680583	4	0.2243	
*Approximate p-values do not account for coefficient estimation				

Source: *EvIEWS 12 output.*

4.2.3. Error Autocorrelation Test:

To ensure that there is no autocorrelation, we use the LM test, as shown in the following table:

Table 7. Autocorrelation test results for errors

VAR Residual Serial Correlation LM Tests Date: 12/13/22 Time: 12:04 Sample: 1990 2021 Included observations: 30						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	7.487907	4	0.1122	1.991473	(4, 44.0)	0.1124
2	12.87653	4	0.0119	3.644141	(4, 44.0)	0.0119
3	1.013133	4	0.9078	0.250464	(4, 44.0)	0.9078
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	7.487907	4	0.1122	1.991473	(4, 44.0)	0.1124
2	12.98763	8	0.1123	1.763062	(8, 40.0)	0.1137
3	17.01192	12	0.1491	1.542771	(12, 36.0)	0.1541
*Edgeworth expansion corrected likelihood ratio statistic.						

Source: *Eviews 12 output.*

Through Table 7, we note that the model does not suffer from the problem of autocorrelation of errors, and this is until the third gap, where the value of Prob is greater than 0.05. Therefore, we accept the null hypothesis that there is no autocorrelation.

4.2.4. Variance stability test:

To detect the stability of variance over time, we use the test shown in the following table:

Table 8. Results of the variance stability test

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Date: 12/13/22 Time: 12:05					
Sample: 1990 2021					
Included observations: 30					
Joint test:					
Chi-sq	df	Prob.			
30.46941	24	0.1697			
Individual components:					
Dependent	R-squared	F(8,21)	Prob.	Chi-sq(8)	Prob.
res1*res1	0.225233	0.763116	0.6381	6.756996	0.5631
res2*res2	0.490243	2.524508	0.0425	14.70728	0.0651
res2*res1	0.295630	1.101735	0.4007	8.868903	0.3535

Source: *Eviews 12 output.*

According to this test, Prob Chi-sq is greater than 0.05, and therefore we accept the null hypothesis, which indicates the stability of the variance.

5. Results and their discussion

Referring to the results of the unit root test, which states that all study variables are stable at the first difference, as well as the Johansen co-integration test, which shows the existence of at least one relationship of co-integration between the variables, the VAR model can be applied in estimating the relationship between imports and exchange reserves of an alien country.

Table 9. Short-term estimation results

Vector Error Correction Estimates Date: 12/13/22 Time: 12:07 Sample (adjusted): 1993 2021 Included observations: 29 after adjustments Standard errors in () & t-statistics in []		
Cointegrating Eq:	CointEq1	
LIMP(-1)	1.000000	
LRES(-1)	-0.079213 (0.06922) [-1.14428]	
C	-2.787443	
Error Correction:	D(LIMP)	D(LRES)
CointEq1	0.001411 (0.05072) [0.02781]	-0.469874 (0.10017) [-4.69088]
D(LIMP(-1))	0.164364 (0.20513) [0.80125]	0.449250 (0.40515) [1.10885]
D(LIMP(-2))	-0.071614 (0.20837) [-0.34369]	1.239449 (0.41154) [3.01175]
D(LRES(-1))	0.123523 (0.08534) [1.44748]	-0.277691 (0.16854) [-1.64758]
D(LRES(-2))	0.084384 (0.08259) [1.02168]	-0.418912 (0.16313) [-2.56800]
C	0.020926 (0.02945) [0.71069]	0.120897 (0.05816) [2.07884]

Source: *Eviews 12 output.*

- short-term relationship:

Table 09 indicates the following:

There is no effect of imports on the foreign exchange reserve in the short term due to the insignificance of the parameter of the foreign exchange reserve variable, which is consistent with the economic theory where, according to the Triffin index (adequacy of reserves for imports), reserves affect more imports than the effect of imports on foreign exchange reserves. Also, until 2008, Algeria relied mainly on debt to cover its imports, so the exchange reserve was not affected by changes in imports.

The positive and statistically significant effect of foreign exchange reserves on imports in Algeria, where the higher the exchange reserve by 1%, the imports increased by 0.12%, which is consistent with the economic theory that, according to the Triffin index on the adequacy of the foreign exchange reserves for imports,

Algeria depends, like other Arab countries, on taking This indicator measures the solidity of the external financial position and is calculated on the basis of dividing the total foreign exchange reserves at the end of the year by the value of merchandise imports for that year in the same country multiplied by 12 months (Zaire, 2009, p. 58).

The results also showed that there is a short-term dynamic relationship between imports and foreign exchange reserves, and this is due to the negative and statistically significant estimated error, and its value was (CointEq(-1)=-0.46), which measures the proportion of imbalance in the dependent variable that can be corrected from one time period to another. Furthermore, the negative sign supports the existence of a long-term equilibrium relationship between the variables at a rate of 46%.

- long term relationship:

Table10The relationship between imports and foreign exchange reserves in the long run can be written through the following relationship:

$$\text{LIMP} = 0.795558577089 * \text{LIMP}(-1) - 0.0571936487564 * \text{LIMP}(-2) + 0.102226400662 * \text{LRES}(-1) + 0.0119124796924 * \text{LRES}(-2) + 0.456758929067$$

$$\text{LRES} = -0.0884410956462 * \text{LIMP}(-1) - 0.332783940043 * \text{LIMP}(-2) + 0.872375647039 * \text{LRES}(-1) + 0.208631517492 * \text{LRES}(-2) + 1.13063156943$$

The positive and statistically significant effect of foreign exchange reserves on imports in Algeria, where the higher the exchange reserve by 1%, the imports increased by 0.10%, which is consistent with the economic theory, as Algeria is a non-producing oil country that depends on oil for the accumulation of its reserves, which directly affects imports. Especially in light of the fragility of the local productive sector, which depends on imports to cover its needs, and imports are increasing every year despite the erosion of foreign

exchange reserves in recent years (especially with the onset of the oil crisis in mid-2014).

There is no statistically significant effect of imports on foreign exchange reserves.

Table 10. Long-term estimation results

Vector Autoregression Estimates Date: 12/13/22 Time: 12:12 Sample (adjusted): 1992 2021 Included observations: 30 after adjustments Standard errors in () & t-statistics in []		
	LIMP	LRES
LIMP(-1)	0.795559 (0.19797) [4.01862]	-0.088441 (0.57516) [-0.15377]
LIMP(-2)	-0.057194 (0.16280) [-0.35132]	-0.332784 (0.47298) [-0.70359]
LRES(-1)	0.102226 (0.06476) [1.57858]	0.872376 (0.18815) [4.63672]
LRES(-2)	0.011912 (0.07080) [0.16827]	0.208632 (0.20568) [1.01433]
C	0.456759 (0.14910) [3.06345]	1.130632 (0.43319) [2.61004]

Source: *EvIEWS 12 output.*

6 Results and Recommendations:

Foreign trade, especially imports, plays a significant role in Algeria's trade balance because demand for imports is growing year after year and because a significant portion of these imports is consumer goods and industrial equipment. However, the extent to which these imports are covered by exports is unclear.

The hydrocarbon sector is the main source of the accumulation of foreign exchange reserves in Algeria, as the rise in oil prices accumulated international reserves at the Bank of Algeria, and Algeria

was able to exploit these financial surpluses in the prepayment of debts, the launch of development programs, as well as the establishment of a revenue control fund, including a large increase in imports. However, the mid-2014 crisis demonstrated the limitations of the announced plans in the absence of an effective government policy.

In the legal context, imports are the value of the products that are bought from other countries in order to gain advantages and meet local consumption needs. They show demand from people living in an economy for products and services made outside of that economy and make up the debit side of the state's trade balance. Therefore, the government must review its development policy, especially the structure of exports, in order to provide other alternatives to the accumulation of foreign exchange reserves.

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8. Appendices:

Appendix 1. Optimal level of foreign exchange reserves

1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	السنة
5,8	9,54	11,92	5,54	2,5	3,39	2,25	2,17	2,3	0,9	معدل التغطية (res/imp)
9,47	17,62	32,39	14,63	3,29	8,35	3,12	4,39	5,85	1,9	المؤشر (res/M2)
15,5	40,58	25,69	12,61	6,37	9,05	5,68	5,43	5,34	2,78	المؤشر (res/dette)
2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	السنة
45,4	43,5	47,8	43,5	33,1	28,2	29,2	23,1	21,6	15,5	معدل التغطية
151,8	147,3	123,7	114,2	102,68	85,6	69,83	60,51	53	38,36	المؤشر (res/M2)
2618,4	2561,7	1965,4	1386	326,7	197,5	141	102	79,5	47,1	المؤشر (res/dette)
	2018	2017	2016	2015	2014	2013	2012	2011	2010	السنة
	23,02	25,33	29,37	35,18	36,1	42,3	45,4	46,2	48,1	معدل التغطية
	93,34	94,72	97,65	118,07	114,95	127,5	135,63	140,21	144,87	المؤشر (res/M2)
	2237,62	2445,48	2978,64	4566,6	4790,6	5712,9	5161,3	4132	2930,2	المؤشر (res/dette)

Source: Prepared by researchers based on the statistical bulletins of the Bank of Algeria, citing www.banque-of-algeria.dz

Appendix 02. Commodity Concentration of Algeria's Imports 2010-2021

years	unit	Imports	energy	food	Raw materials	Semi-manufactured	agricultural equipment	Industrial equipment	FMCG
2010	million \$	40212	945	6027	1406	9944	330	15573	5987
	%	100	2,35	14,99	3,50	24,73	0,82	38,73	14,89
2011	million \$	47300	1164	9805	1776	10431	229	15951	7944
	%	100	2,46	20,73	3,75	22,05	0,48	33,72	16,79
2012	million \$	50376	4955	9023	1839	10629	329	13604	9997
	%	100	9,84	17,91	3,65	21,10	0,65	27,00	19,84
2013	million \$	54903	4356	9572	1766	10810	449	15745	12205
	%	100	7,93	17,43	3,22	19,69	0,82	28,68	22,23
2014	million \$	58330	2851	11005	1884	12740	657	18906	10287
	%	100	4,89	18,87	3,23	21,84	1,13	32,41	17,64

Investigating the causal relationship... Journal of Economic & Financial Research

2015	million \$	51646	2352	9329	1508	11512	579	16593	9773
	%	100	4,55	18,06	2,92	22,29	1,12	32,13	18,92
2016	million \$	46727	1292	8224	1559	11482	501	15394	8275
	%	100	276	17,60	3,34	24,57	1,07	32,94	17,71
2017	million \$	46059	1992	8438	1528	10985	611	13992	8513
	%	100	4,32	18,32	3,32	23,85	1,33	30,38	18,48
2018	million \$	46197	1015	8573	1896	10959	563	13433	9756
	%	100	2,20	18,56	4,11	23,72	1,22	29,08	21,12
2019	million \$	44632	1369	7694	1921	9840	437	10845	7934
	%	100	3.07	17.24	4.30	22.05	0.98	24.30	17.78
2020	million \$	36484	890	7722	2198	7575	198	8696	5557
	%	100	2.51	21.76	6.19	21.35	0.56	24.51	15.66
2021	million \$	37464	513	8877	3401	7313	247	9158	6498
	%	100	1.37	23.69	9.08	19.52	0.66	24.44	17.34

Source: Prepared by researchers based on the statistical bulletins of the Bank of Algeria, citing www.banque-of-algeria.dz

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