



The impact of oil price fluctuations on the real exchange rate An econometric study over the period 1990-2024 using the ARDL model

التأثيرات الناتجة عن تقلبات أسعار النفط على سعر الصرف الحقيقي

دراسة قياسية خلال الفترة 1990-2024 باستخدام نموذج ARDL

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Abstract

This study aims to highlight the impact of oil price fluctuations on the exchange rate using annual data for the period 1990–2024 and applying the ARDL model.

The results show an inverse relationship between the two variables for most of the period, except between 2020 and 2024, when a direct relationship emerged. This shift is attributed to the foreign trade policies adopted by the government outside the hydrocarbon sector, efforts to encourage new oil discoveries, control imports, and reduce the depletion of foreign exchange reserves. External factors also played a role, particularly the increase in international hydrocarbon prices due to the Ukraine crisis and the resulting imbalance between global supply and demand.

Keywords

Oil price; exchange rate; hydrocarbons; time lag autoregressive model

JEL Classification Codes : E17; Q430; E4; F41.

الكلمات المفتاحية

صدمات أسعار النفط؛ سعر الصرف؛ المحروقات؛ نموذج الانحدار الذاتي للفجوات الزمنية.

تهدف هذه الدراسة إلى إبراز أثر تقلبات أسعار النفط على سعر الصرف، اعتمادًا على بيانات سنوية خلال الفترة 1990–2024 باستخدام نموذج ARDL ، وتشير النتائج إلى وجود علاقة عكسية بين المتغيرين خلال معظم الفترة، باستثناء السنوات بين 2020 و2024 حيث ظهرت علاقة طردية. ويُعزى هذا التحول إلى السياسات التجارية الخارجية التي انتهجتها الحكومة خارج قطاع المحروقات، وتشجيع الاكتشافات النفطية الجديدة، والتحكم في الواردات، والحد من تآكل احتياطي النقد الأجنبي. كما أسهمت العوامل الخارجية في ذلك، وخاصة ارتفاع أسعار المحروقات في الأسواق الدولية نتيجة أزمة أوكرانيا وما ترتب عنها من اختلال بين العرض والطلب عالمياً.

المخلص

تصنيف JEL : E17; Q430; E4; F41

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I.INTRODUCTION:

Oil is one of the most important sources of energy in the world and an indispensable basic material in the petrochemical industries, which has become the measure of progress and growth in modern industrial society, due to its specificity and importance in global markets.

Algeria is a producer and exporter of oil, which plays an important role in building and laying the foundations of the Algerian economy and is considered the backbone of the Algerian economy with more than 90 percent of its revenue.

The latter has known many stations from independence to the present day, and its performance varied from one period to another, and often many indicators were characterized by volatility and lack of monotony due to the impact of fluctuations in global oil prices and the instability of their exchange rates, as the exchange rate of the Algerian dinar against the dollar, euro and other international currencies witnessed many fluctuations and fluctuations, whether by rising or falling between one moment and another, with a slight decline evident in general, and this is the negative or hidden aspect of countries that rely heavily on natural resources in its economy, which was called the curse of natural resources.

In the light of the above, we have built the following problems:

How much can oil price fluctuations affect Algerian dinar exchange rate?

The importance of research:

The importance of the exchange rate stems from the fact that it is the instrument that connects the domestic and international economies, as the means to settle and make international payments for imports and responses, as well as the link between the cost of production, producers, consumption and consumers on the one hand. On the other hand, oil is one of the world's most important sources of energy today and is an international strategic commodity for both producers and consumers in times of peace and war.

The objective of the research is:

One of the objectives of this research is to:

-To know the nature of the relationship between oil prices and the Algerian dinar exchange rate and to determine the extent to which changes in oil prices affect the Algerian dinar's exchange rate;

-Highlight the stages of Algerian dinar pricing and the main factors affecting Algerian dinar exchange rate;

-Attempting to overthrow economic theory on the realities of Algeria's economy by relying on the standard study;

-Enrich the library by making a scientific addition.

II. THEORETICAL FRAMEWORK AND PREVIOUS STUDIES:

A number of studies have dealt with the topic under study, as follows:

1.Belharash Aisha, "Equilibrium Real Exchange Rate: A Case Study of the Real Exchange Rate": This thesis aims to shed light on the level of the equilibrium real exchange rate in Algeria by identifying its basic determinants, based on some recent applied studies in this field This study used the method of simultaneous integration of the economic variables represented in the following. The real exchange rate of the Algerian dinar as a proxy for the real exchange rate of the Algerian dinar: The real exchange rate of the Algerian dinar as a dependent variable, oil prices, gross domestic product, government spending, openness This study found that there is a long-run equilibrium relationship between the variables in the long run

2. Ben elzawy Abdelrazak "effects of deviation of the real exchange rate from its equilibrium level "the case of Algeria": published in the Journal of Humanities issue, November 23, 2011, this study aims to shed light on the level of the equilibrium real exchange rate in Algeria, in an attempt to provide a picture of the appropriateness of the level of the equilibrium real exchange rate to the exchange policy followed in Algeria

3. **Ali Mustafa Al-Qudah) The Impact of Oil Price Shocks on Amman Stock Exchange Real Return** Published in the International Journal in commerce and Social Sciences, vol., issue 05, November 12, 2014, this study aims at the impact of oil price shocks and short-term interest rates at the ASE, as this study found that the impact of oil price shocks and short-term interest rates have a negative impact on the real yield at the ASE.

4. **First topic:** oil prices

Several price terms are used in the petroleum market. They are used as an appraisal tool for the price of the petroleum commodity in different cases. The following will be mentioned the most important of these:

1-Definition of oil price

Oil price can be defined as "the value of the substance or petroleum commodity in cash within a specified period of time and under the influence of a combination of economic, social, political, climatic... etc., in addition to the prevailing nature of the market then (Aldouri, 1983, p. 194)

It is known that the oil markets are considered one of the most volatile commodity markets in general, this is mainly due to the low price elasticity of demand for oil, as it is a necessary commodity that is not available for replacement in the short term in most of its uses, and in the long term in key sectors such as transport, transportation, and also on the supply side, increasing production capacities requires long periods of time and high investment flows that are available under stable markets, low risks and guaranteed returns in case of ensuring future demand, where the increase in excess production capacity entails raising the cost and reducing the feasibility of investment. these reasons lead to a decrease in the elasticity of the price supply of oil, causing in The increasing degree of extreme sensitivity of oil prices to any news indicating the risk of supply disruptions, and directly contributes to the increased volatility in oil prices (Al-Zaytouni, 2010, p. 23)

2-Types of oil price:

Several price terms are used in the petroleum market in different cases, most notably:

2-1 **Advertised Price Posted Price:**

This type of price began to be used in the United States, where petroleum companies were advertising it at production wells and then the advertising process moved to export ports, and as the discovery and exploitation of petroleum increased global production, petroleum companies became announcing prices at their export ports. (chitour, 1998, p. 114)

2-2 **Actuel Price:**

This price was introduced in the late 1950s when declared prices dropped due to the emergence of national petroleum companies, which offered various discounts to buyers.

The real price expresses the real purchase, and is also called the transfer price of the purchase agreed upon between the two parties, or expresses the accounting price, which is when a company cedes to

another company a quantity of crude oil and the price paid for it is called the ceding price, and indicates that the real price is never published to the public opinion but remains with the petroleum companies.

2-3 Reference Price or Référence Price:

It appeared in the 1960s, where it was used to calculate the value of petroleum between some oil producing countries and foreign oil companies in order to distribute petroleum financial returns between the two parties, and it is calculated on the basis of determining the ratio between the declared and realized price for several years.

2-4 Tax cost price:

This price is applied with petroleum companies operating on the territory of petroleum producing countries, where they extract oil and then buy it from them at a price equivalent to the production cost plus the government's return represented in the tax, and other prices move according to this price in the petroleum market.

2-5 spot price:

Is the price of the oil unit exchanged immediately in the oil markets, and this price appeared with the advent of the free market

It can be considered an unstable market due to its correlation with the level of imbalance between supply and demand (Aldouri, 1983, p. 119), The reason for the emergence of this type of prices is due to the imbalance between supply and demand at the end of the seventies, so this type of price is greatly affected if there are differences in the petroleum market as it is subject to increase and decrease at the same time.

2-6 specific price:

It is the price for each type of oil such as: West Texas crude oil, Brent oil (North Sea in England), OPEC basket oil, which consists of a theoretical but not actual average of 11 types of world oil, and prices vary in terms of quality, density and oil components.

Second topic: definition of the exchange rate and its forms

Algeria, like other Arab countries, considers that its currency exchange system was not a choice of domestic economic policy, but a legacy of colonial political systems, which was an expression of the economic and financial interests of the colonial powers and their representatives.

1-Definition of the exchange rate:

Due to the importance of the topic of exchange and the multiplicity of researchers ' study, every researcher knows his concept, and we will present some definitions:

- The relationship between countries and the outside world raises a problem of a monetary nature for us, because if the economic intermediaries of one country want to buy products from other countries (Mustafa, 2000, p. 278), they must receive the currency of this country. It is clear that exchanging one currency for another requires a ratio to exchange this currency for that or a price for this currency denominated in that, and this price is called the exchange rate(Adel Ahmed Hashish, 2000, p. 113)

- The exchange rate is also defined as a linking tool between the open economy and the rest of the world's economies, through international costs and prices to facilitate various international transactions and ways to market them.
- The exchange rate expresses the number of monetary units in which a unit of local currency is exchanged for a unit of foreign currency (between two different transactions), and thus embodies the link between the local economy and other economies, and it links the prices of goods in the local economy with their prices in the global market, as the global price and the local price of the commodity are linked through the exchange rate.
- The exchange rate is the main instrument with a direct impact on the relationship between domestic and external prices and is often the most effective tool when it comes to encouraging exports and supplying imports.
- The exchange rate is an important means of influencing the allocation of resources between economic sectors, the profitability of export industries and the cost of imported resources.
- The exchange rate is the means by which one country settles another country's payments.

2- Forms of the exchange rate:

There are four forms of the exchange rate:

2-1 Nominal exchange rate: A measure of the value of one country's currency that can be exchanged for the value of another country's currency of another country, where currencies are exchanged or bought and sold according to the prices of these currencies to each other.

We can distinguish between two types of nominal exchange rate, one is the official exchange rate, which is the basis for official current exchanges, and the second is the parallel exchange rate, which is traded in parallel markets.

The nominal exchange rate of a currency is determined by its demand and supply in the exchange market at a given moment in time, and this rate can change either as a result of changing demand and supply or due to the exchange system adopted in the country, and the nominal exchange rate is the current price of the currency, which does not take into account the purchasing power of the currency (Abdelmadjid Qadi, 2006)

2-2 Real exchange rate: the person or company wishing to buy another currency concentrates

What you can buy with it, and here we get to what is known as the real exchange rate, it shows us how we can rate a commodity in a particular country compared to the value of another commodity in a second country, In other words, it shows us how many units of foreign commodity are needed to buy in order to buy one unit of domestic commodity and thus reflects the competitiveness of national products. and the following equations show us how to determine the real exchange rate:

$$er = e \cdot p / p^*$$

er: Real exchange rate

e: Nominal exchange rate

p: Commodity price in local currency

p^* : Commodity price in foreign currency

Thus, the real exchange rate reflects the difference between the purchasing power of the domestic country and the purchasing power of the foreign country. (Omar, 2010/2011, p. 4)

2-3 Actual exchange rate: the indicator measuring the average change in a currency's exchange rate

For several other currencies in a given period of time.

The actual exchange rate is the number of units of currency actually paid or received for an international transaction valued at one unit. In order to assess the evolution of the value of the currency internationally, we calculate the actual exchange rate as the latter is the estimated average of the rates of exchange for the direction of the major trading partnership, as the actual exchange rate is conducting an international currency progression study. (Ali, 2012, p. 50)

Real actual exchange rate: is the real value of the national currency for foreign currency i.e.

National currency purchasing power for a foreign State, determined on the basis of the relative purchasing power parity of the two States' currencies (AHSAN, 2004, p. 02)

It is known that the oil markets are considered one of the most volatile commodity markets in general, this is mainly due to the low price elasticity of demand for oil, as it is a necessary commodity that is not available for replacement in the short term in most of its uses, and in the long term in key sectors such as transport, transportation, and also on the supply side, increasing production capacities requires long periods of time and high investment flows that are available under stable markets, low risks and guaranteed returns in case of ensuring future demand, where the increase in excess production capacity entails raising the cost and reducing the feasibility of investment. these reasons lead to a decrease in the elasticity of the price supply of oil, causing in The increasing degree of extreme sensitivity of oil prices to any news indicating the risk of supply disruptions, and directly contributes to the increased volatility in oil prices (Al-Zaytouni, p. 23.)

Third topic: studying the impact of oil price fluctuations on the exchange rate

Before touching on the standard study between the two main variables, we are trying to show some preliminary results of developments over the years that have occurred on the oil price and the exchange rate through the graph See Figure No.1

Figure 1: oil price and exchange rate developments during 1990-2024. Unit: (dollar)



Source: Prepared by researchers using .Eviews13

Through the figure and what has been concluded, We note that there is an inverse relationship between the oil price and the exchange rate during the periods {1990-1991}, {1993-2007}, {2007-2009}, {2010-2014} and {2014-2021}, but during the period {2020-2024} we note a direct relationship between the two variables, which explains the existence of a special situation witnessed by the Algerian economy during this period can be reached in the latest study .

III. METHOD AND PROCEDURES:

- Definition of study variables
- In this axis, the impact of oil price fluctuations on the exchange rate in Algeria during the period between 1990-2024 will be presented, and through several theoretical and experimental considerations mentioned, our general model of the equation of economic growth will take the following form:
- $TCH = \alpha + \beta_1 OIL + \beta_2 INF + \beta_3 GDP + \varepsilon$
- Dependent variable: oil prices, denoted by TCH.
- Independent variables:
 - OIL exchange rate
 - Economic growth GDP
 - Inflation INF
- The average number of 34 years of study is taken from the base of the World Bank

IV. STUDY RESULTS (ANALYSIS AND DISCUSSION) :

- 2 Study the stability of variables:

We say about a stable time series if it has a fixed arithmetic medium and their common discrepancies are not related to time, nor does they contain the general direction vehicle, the quarterly vehicle or any factor affected by time change. And to see if the time series is stable or not, there are several tests. Most important is the test of the unit by Dickey-Fuller, which aims to examine the characteristics of the time series This test is based on the following hypothesis:

H0: There is a unit root in the series , i.e. the series is unstable.

H1: There is no unit root in the series, i.e. the series is stable.

So that this test is done on the original time series (at level I) If you don't settle at the level we go to the first difference and so to settle down and the hypothesis of nowhere is rejected that there is a unit root if the absolute value calculated for a test is greater than the absolute critical value at the 5% morale level or if the probability value is 5%, and based on the estimate the three models showed the results in the following table See Table No1.

Table 1: Dickie Fuller ADF Results

variables	I(0)	I(1)	integration
TCH	-0.403816 0.8969	-3.949269 0.0049	I(1)
OIL	-1.174516 0.6731	-4.608420 0.0009	I(1)
GDP	0.257101 0.9719	-4.450026 0.0014	I(1)
INF	-1.675424 0.4337	-5.610559 0.001	I(1)

Source: Prepared by researchers using .Eviews13

According to the results of the Dickey - Vollar test, by conducting a stability test without a slope and a function constant, it can be seen from the table that the time series of the oil price, the exchange rate, economic growth and inflation are not constant at the level where we find that the calculated t values are not significant at all levels of significance, which indicates the presence

At the first difference we find that the calculated value of t is significant at all levels of significance for all time series, which means that there is no root of unity, time series are stable, and the data is constant, so co-integration can be performed and the study of the long-term relationship between variables makes the use of the ARDL model possible.

-3Joint integration test using non-linear boundary approach :

From the table See Table No2

Table 2: Unit Root Test Results for Time Series

Levels of morale	10 %	5%	1%	decision
I(0)	2.6 76	3.2 76	4.61 4	Acceptance of the alternative hypothesis that provides for the co- integrative atmosphere at 10% morale level
I(1)	3.5 86	4.0 36	5.96 6	
Fisher's calculated statistic	Facal=9.331322			

Source: Prepared by researchers using .Eviews13

we find that the calculated statistical value F of (9.331322) is greater than Fisher's top tabular values at morale levels, and this assures us to reject the zero hypothesis and accept the alternative hypothesis. This means a long-term balance between oil prices and the exchange rate, including a common integration relationship.

-4 Model Estimation ARDL

The results of the estimate in the table See Table No.3

Table 3: Estimated ARDL Model

Dependent Variable: TCH Method: ARDL Date: 03/27/24 Time: 16:58 Sample: 5 32 Included observations: 28 Dependent lags: 4 (Automatic) Automatic-lag linear regressors (4 max. lags): OIL INF GDP Deterministics: Restricted constant and no trend (Case 2) Model selection method: Akaike info criterion (AIC) Number of models evaluated: 500 Selected model: ARDL(3,4,2,3)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
TCH(-1)	0.905703	0.189864	4.770269	0.0005
TCH(-2)	-0.442506	0.254501	-1.738722	0.1076
TCH(-3)	0.535291	0.247522	2.162603	0.0515
OIL	-0.226799	0.046553	-4.871858	0.0004
OIL(-1)	0.163092	0.070796	2.303688	0.0399
OIL(-2)	-0.126031	0.080197	-1.571515	0.1420
OIL(-3)	0.090729	0.082397	1.101124	0.2924
OIL(-4)	0.219968	0.068100	3.230057	0.0072
INF	-0.413744	0.230883	-1.792005	0.0984
INF(-1)	0.485183	0.247385	1.961245	0.0735
INF(-2)	-0.201277	0.168518	-1.194391	0.2554
GDP	-4.13E-12	3.51E-12	-1.174883	0.2629
GDP(-1)	-7.21E-12	3.38E-12	-2.133884	0.0542
GDP(-2)	4.55E-12	5.50E-12	0.827828	0.4239
GDP(-3)	5.74E-12	4.37E-12	1.313388	0.2136
C	24.23330	7.436788	3.258570	0.0068
R-squared	0.993076	Mean dependent var	80.65183	
Adjusted R-squared	0.984422	S.D. dependent var	24.24926	
S.E. of regression	3.026624	Akaike info criterion	5.348322	
Sum squared resid	109.9254	Schwarz criterion	6.109592	
Log likelihood	-58.87665	Hannan-Quinn criter.	5.581057	
F-statistic	114.7454	Durbin-Watson stat	1.701699	
Prob(F-statistic)	0.000000			

Source: Prepared by researchers using .Eviews13

show that the model's interpretive capacity through the corrected determination coefficient was 0.993076, which means that the independent variables could explain the exchange rate at 99.30% is a good percentage for analysis and study. The overall morale of the model through the Fisher test was 114.7545 with a potential facility (0.00 less than 5) (%) which means rejection of the bad hypothesis that the model as a whole is statistically acceptable As for statistical 1.70 = DW.it is an unreliable result because the model contains an affiliate variable that is late in time as one of the independent variables that is incompatible with the terms of use of the DW test, Which means that alternative tests should be used to make sure there is no self-association and to make sure the model is valide.

-5Diagnostic tests of the model:

See Table No.4

Table 4.Self-correlation testing 5-1 for errors:

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	2.122526	Prob. F(2,10)	0.1705
Obs*R-squared	8.344053	Prob. Chi-Square(2)	0.0154

Source: Prepared by researchers using .Eviews13

The self-correlation test indicates that the F-test value is estimated at 0.1705 and finds that the probability value is greater than 5% or 0.05, from which it accepts the nowhere hypothesis that there is no self-correlation between errors.

5.2ARCH variance invariance test :

The autocorrelation test for the residuals indicates that the F-test value is 0.8313 and the probability value is greater than 5% or 0.05, thus accepting the null hypothesis that there is no variance invariance.see the table NO 5.

Table 5. ARCH variance invariance test

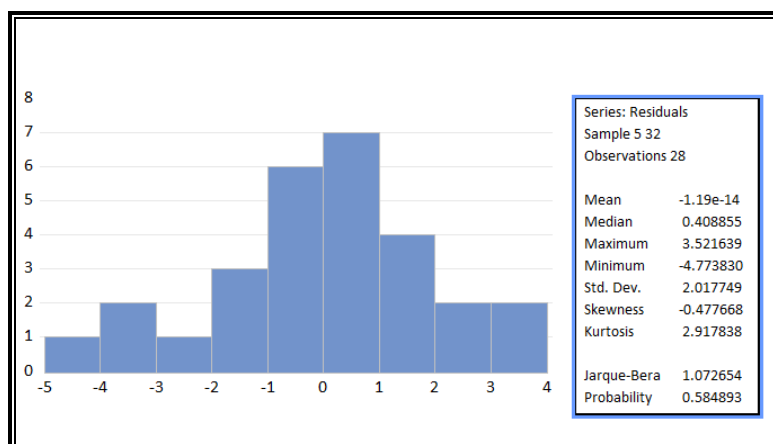
Heteroskedasticity Test: ARCH			
F-statistic	0.046350	Prob. F(1,25)	0.8313
Obs*R-squared	0.049965	Prob. Chi-Square(1)	0.8231

Source: Prepared by researchers using .Eviews13

3-5normal distribution test: the results of this test were as shown:

From the figure, SEE figure NO 2

Figure no2: represents the normal distribution test



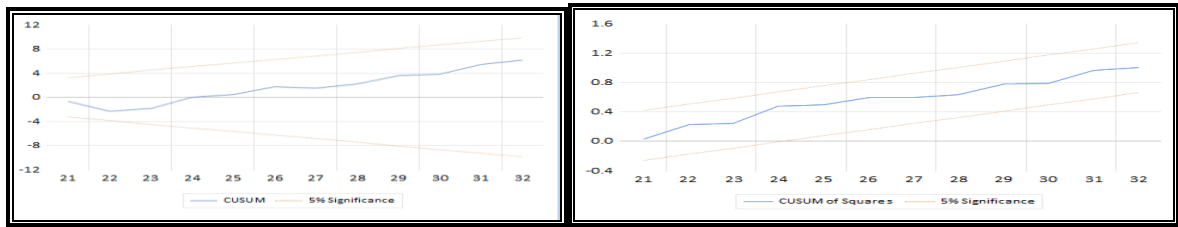
Source: Prepared by researchers using .Eviews13

we observe that Jaque Bera is equal to 1.072645 greater than 0.05 and we observe that the probability value 0.5844983 is greater than 0.05 at 5% significance level, thus we accept the null hypothesis and say that the residual series follows a normal distribution.

4-5Structural stability test for the ARDL model:

From the figure, SEE FIGURE NO 3

Figure (03): Structural Stabilization Results



Source: Prepared by researchers using .Eviews13

we can see that both the cumulative sum of the residuals and the cumulative sum of the squares of the residuals are a median line that lies within the critical zone, indicating structural stability between the long- and short-term results .

V.CONCLUSION:

As the exchange rate is one of the important economic indicators in the economy, it is subject to fluctuations in the prices of this substance, and the study we are about to undertake aims to determine the relationship between oil prices and the exchange rate of the Algerian dinar. From the above, we find that oil prices are the first source of fluctuations in the real exchange rate of the Algerian dinar.

This is known as the Dutch disease hypothesis, which has not been realized in Algeria during the past years, as the negative response to a structural shock in oil prices indicates an inverse relationship between the two indicators.

However, during the recent period 2020-2022, we see the realization of the previous hypothesis, i.e., an increase in oil prices followed by an increase in exchange rates, which can be explained by two internal and external reasons:

- The internal reason is due to the appreciation of the value of the national currency, through the foreign trade policy adopted by the Government, which consisted in increasing the value of exports outside hydrocarbons and encouraging Sonatrach to make new discoveries, and on the other hand to control imports and limit the erosion of the exchange reserves, resulting in a significant surplus in the trade balance.
- The external reason is the rise in fuel prices on the international market as a result of the crisis in Ukraine and the resulting imbalance between supply and demand, especially after the imposition of Western sanctions on Russia, which were interpreted by global economic analysts as confirming that this geopolitical crisis is not short-lived.

Suggestions and recommendations:

Based on the findings of this study, it is possible to develop some suggestions and recommendations that can help decision makers in Algeria to develop the appropriate strategy, which we believe is necessary to correct the shortcomings and enhance the positives recorded, which are listed below:

- Diversification of exports outside hydrocarbons, following the restructuring of the productive sector, rationalization of expenditure and encouragement of investment.

The rise in oil prices led Algeria to positive results in the short term, which was known as the “period of economic prosperity,” but as soon as the crisis of low oil prices appeared, the economy

collapsed and went through a difficult financial period “austerity,” due to the failure to invest the period of prosperity, which showed symptoms of Dutch disease in the long term, in order to draw a sound exchange policy for the real exchange rate, it is necessary to separate the real economy from oil revenues, develop the agricultural sector and pay attention to tourism, as this sector Algeria can bring foreign currency from and improve the exchange rate of the Algerian dinar

- Creating a favorable investment climate and promoting partnership between local and foreign investors by financing various non-hydrocarbon sectors and encouraging exports from these sectors.
- Attention to human capital in all economic sectors, especially productive sectors
- Disclosure of the exchange system adopted by the Algerian state with transparency and clarity, and the application of governance in all economic fields
- Carrying out reforms by revising the way the Algerian dinar is valued in a way that is in line with the current internal and external economic developments and conditions
- Privatizing sectors, especially productive sectors, and providing financial support to small investors

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