

## The relationship between oil price, exchange rate and money supply: Case of Algeria

العلاقة بين سعر النفط وسعر الصرف والعرض النقدي: حالة الجزائر

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### المخلص:

هدفت هذه الدراسة إلى اختبار العلاقة بين سعر البترول، معدل الصرف وكذا العرض النقدي في الجزائر لتحديد ما إذا كانت الكتلة النقدية في الجزائر متأثرة بشكل كبير بتغيرات معدل الصرف. وقد ارتكزت الدراسة على نموذج ARDL الإحصائي الذي تم استخدامه كأداة قياسية. وخلصت الدراسة إلى التأكيد على أهمية مراقبة هذه المتغيرات الثلاثة لاتخاذ القرارات السليمة الهادفة إلى تغطية الإنفاق العام؛ من جهة وتقليل معدل التضخم من جهة أخرى.

الكلمات المفتاحية: سعر البترول، سعر الصرف، الكتلة النقدية، التضخم.

### Abstract:

This study aimed to investigate the relationship between oil price, exchange rate and money supply in order to determine whether the last one may be affected, mainly, by reducing exchange rate to cover the decrease of oil income. The principal statistical method used in the study is Auto-Regressive Distribution Lags model. The study concluded that it is very important to control the three variables in order to take the best decisions aiming, as much as possible, to cover the public expenditure and cut down the inflation rate that can be recorded.

**Key words:** oil price, exchange rate, money supply, inflation.

### I-Introduction:

Since many decades, oil price has captured the attention of several researchers in economy, because it is one of the most important sources of income for a lot of countries, and one of the main elements of production for many companies. In fact, it is critical to investigate its relationship with the principal economic indicators, affected by its level recorded in the international market

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such as: global domestic product, employment rate, exchange rate, money supply..., etc.

For the economy of Algeria, oil prices level is the major topic since the Algerian oil is almost the unique source of foreign money owned by the country so far. This importance makes the Algerian government thinks about how to deal with the current crisis of hydrocarbon, especially because the decrease of oil prices recorded recently has a great impact on the ability of the government to finance its public expenditure.

Moreover, the decrease of foreign income limits the capability of the government to keep the value of its currency, or even it may be obliged to reduce the exchange rate in order to cut down the deficit recorded in its public budget, knowing that this reduction may enlarge the money supply and the inflation rate. For this reason, it is crucial to investigate the relationship between oil price, money supply and exchange rate in hope of setting up the best strategy covering the three variables and aiming, at the same time, to reduce as much as possible the negatives effects of the current crisis of hydrocarbon.

### **I-1-Problematic of the study:**

The current study aimed to investigate the impact of oil price and exchange rate volatility on money supply in Algeria, by trying to answer the following problematic:

What's the importance of oil price and exchange rate volatility in affecting money supply in Algeria during 2002 -2015?

### **I-2-Importance of the study:**

The importance of the study goes back to the nature of the Algerian economy which is based mainly on oil income, and its character which is highlighted by high inflation rates recorded in the country due to the money supply, and the exchange rate adopted by the monetary authorities. For this reason, it is extremely important for the Algerian economy to investigate the relationship between, oil price, money supply and exchange rate in order to take right decisions.

### **I-3-Previous studies:**

There are many researches allocated to study the impact of oil price, money supply, exchange rate and the related topics in Algeria and over the world. Among theme are:

-(**SEGAL, 2007**): this research aimed to control the impact of oil prices in order to determine the reasons for which high oil prices do not appear to have led to a slow-down the world economy. The research concluded that oil prices have a

relationship with monetary policy because when oil prices pass through to core inflation, monetary authorities raise interest rates, slowing growth.<sup>1</sup>

- **(ASARI & others, 2011)**: this study tried to investigate the relationship between interest rate, inflation rate and exchange rate volatility in Malaysia during the period 1999-2009. The study used Vector Error Correction Model (VECM) as principal statistical tool. The study concluded that in the long term interest rate moves positively while inflation rate goes negatively towards exchange rate volatility in Malaysia.<sup>2</sup>

- **(OMOLADE & NGALAWA, 2016)**: this study aimed to investigate the relationship between monetary policy and growth of the manufacturing sector in Algeria over the period 1980-2010. The researchers used a Structural Vector Auto-Regressive Model. The study showed that there is no evidence that monetary supply responds to instability of the manufacturing sector growth or gross domestic product growth in Algeria.<sup>3</sup>

- **(HSIEH, 2008)**: the researcher tried to investigate the effects of oil price shock and macroeconomic conditions on output fluctuations for Korea. The study used simultaneous-equation model. The results showed that the output elasticity concerning the real oil price indicates that if the real oil price rises 10%, real GDP may decrease by 0.42%. Also, real output in Korea has a positive relationship with monetary supply, real deficit spending and the real stock price and it is negatively affected by real depreciation of the won.<sup>4</sup>

- **(RAHMAN & MUSTAFA, 2008)**: the study focused on the long-run and short-run dynamic effects of broad money supply (M2) and oil price on U.S. market. The study concluded that the VECM didn't show a converging long-run causal flows, while short-run interactive feedback relationships have been proven. The study concluded as well that negative monetary and oil shocks initially depress the U.S. stock market.<sup>5</sup>

- **(SI MOHAMMED & BENHABIB, 2016)**: this study focused several factors determining inflation in Algeria during the period 1980-2012 such as: imports price, oil price, money stock, government expenditure and effective nominal exchange rates. The study adopted ARDL model and it concluded that a stable long-run relationship exists between inflation and its determinant. But, in the short run the relationship exists just only with the external factors which are: imports price, oil price and effective nominal exchange rates.<sup>6</sup>

- **(KHIN & others)**: the main purpose of this study was to investigate the impact of exchange rate volatility on macroeconomic determinants in Malaysia from January to august 2016. The study used Vector Error Correction Model (VECM). The study finished by noting that "efforts on structural and institutional reforms are needed for financial sectors in order to deal with the changes caused by exchange rate volatility."<sup>7</sup>

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- **(ENNEMRI, 2016):** using multiple regression analysis, the researcher tried to investigate the effectiveness of the bank of Algeria in managing money supply over 2001-2015, issued from the accumulation of foreign monetary reserves. The researcher concluded that the local and the foreign reserves available at the bank of Algeria were among the main elements influencing the excess of liquidity and the inflation recorded in Algeria during the period of the study.<sup>8</sup>

## II -Method:

### II-1- Variables of the study:

The study based on three variables which are:

- **P:** This variable, representing oil prises, has been included in order to determine whether the oil income increased the money supply recorded in Algeria during the period of the study by affecting firstly the public expenditure of the same period.
- **EXC (dollar-dinar):** the exchange rate (EXC) is crucial to be included in the study to determine whether the most important part of money supply has been generated, by the oil income or by the decrease of the exchange rate adopted by Algeria.
- **M2:** This one is the main important variable of the study because it is the dependent variable, knowing that if it increases, inflation rate may increase in turn and affect negatively the economy, therefore monetary authorities should control it continuously in order to keep the macroeconomic equilibrium.

### II-2- Data of the study:

The study used a data (2002-2015) issued mainly from some reports published by the bank of Algeria and, especially for the exchange rate, the researcher used an Arab economic report published by the Arab Monetary Found through its website. Also, in order to get quarterly data from annual data, the study used Gandolfo's desegregation technical basing on the following equations:

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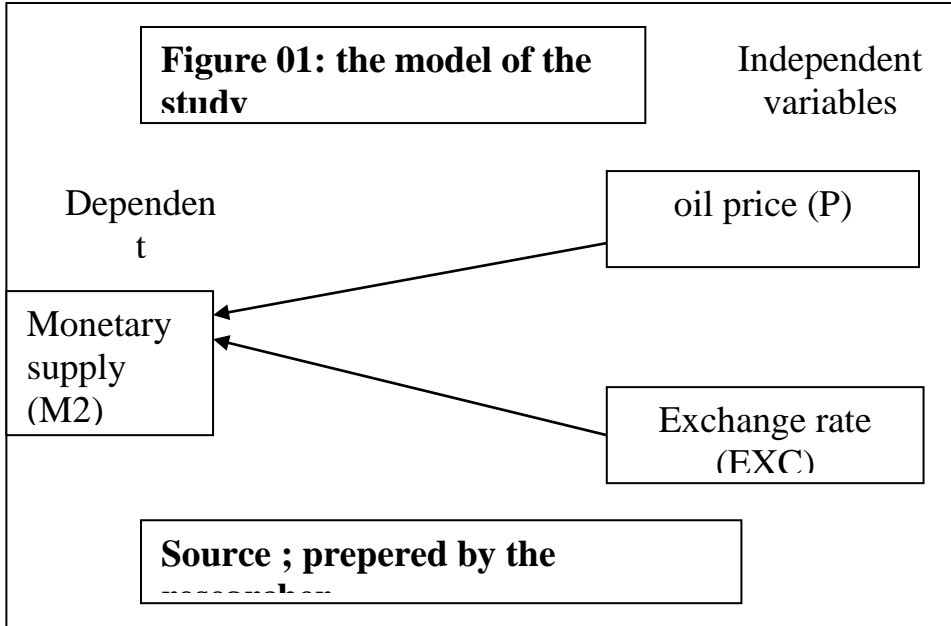
$$\begin{aligned}y_t^1 &= \frac{7}{128} y_{t-1} + \frac{15}{64} y_t - \frac{5}{128} y_{t+1} \\y_t^2 &= \frac{1}{128} y_{t-1} + \frac{17}{64} y_t - \frac{3}{128} y_{t+1} \\y_t^3 &= \frac{3}{128} y_{t-1} + \frac{17}{64} y_t - \frac{1}{128} y_{t+1}\end{aligned}$$

$$y_t^4 = \frac{5}{128} y_{t-1} + \frac{15}{64} y_t + \frac{7}{128} y_{t+1}$$

Knowing that  $y_t^1, \dots, y_t^4$  are the values of the variable  $y$  in the quarter 1,...,4 of the year  $t$ .

### II-3-Model of the study:

The model adopted three variables, money supply as dependent variable, oil price and exchange rate as independent variables:



From the figure, the researcher performed the following equation to investigate the relationship between the variables of the study:

$$\log(m2)_t = a1 + a2 * \log(P)_t + a3 * \log(p)_{t-1} + a4 * \log(p)_{t-2} + a5 * \log(p)_{t-3} + a6 * \log(EXC)_t + a7 * \log(EXC)_{t-1} + a8 * \log(EXC)_{t-2} + a9 * \log(EXC)_{t-3} + a10 * \log(m2)_{t-1} + a11 * \log(m2)_{t-2}$$

Knowing that:

t: Period;

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$u_t$  : Residuals.

$a_1, a_2, \dots, a_{11}$  : Constants

## II-4-Statistical tools:

Several statistical tools were very important to be used by the researcher in order to investigate the relationship between the variables of the study. These tools are as follows:

- **Stationarity test of time series:** ADF test allows verifying the fluctuation degree of the time series adopted in the study. If the time series are stationary at the same level, it is worth noting that there is a good coordination between the variable of the study.

- **ARDL method:** ARDL allows getting an equation aiming to estimate future results.

## III- Results and discussion:

### III-1-Stationarity test:

The next table contains the results of ADF test:

**Table (01): stationarity test results**

Designation	T statistique	Level 05 %			First difference 05 %		
		Log(m2)	Log(p)	Log(exc)	Log(m2)	Log(p)	Log(exc)
Intercept	-2.91	-1.31	-1.10	-3.10	-3.30	-2.62	-2.99
Trend and intercept	-3.49	-0.01	0.81	-1.12	-3.57	-3.32	-6.29
None	-1.94	0.66	-0.67	0.38	-3.52	-2.76	-3.00

**Source: from Eviews 08 using the study**

The table provides evidence that the null hypothesis at level is not accepted for all the time series at 05 % (except for log(p) with intercept) because the calculated value T is less than the critical value. Therefore, generally, it is worth noting that all the time series are not stationary at level. The first difference illustrates that the null hypothesis is accepted since the calculated value is above the critical value for logm2 and log exc. But, for logp, the null hypothesis is accepted only with no intercept and no intercept and no trend (none). However the researcher concluded that this time series is stationary at least at 10% (the researcher found out that at 10% all the time series are without unit root).

### **III-2- ARDL method:**

The upcoming results are issued from using ARDL method with the study data:

**Table (02): ARDL model results**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.125916	0.131583	-0.956929	0.3441
LOGP	0.340603	0.034586	9.847959	0.0000
LOGP(-1)	-0.443293	0.077977	-5.684955	0.0000
LOGP(-2)	0.131313	0.074611	1.759975	0.0857
LOGP(-3)	0.035470	0.038936	0.910969	0.3675
LOGEXC	0.640904	0.059196	10.82676	0.0000
LOGEXC(-1)	-0.792676	0.123822	-6.401744	0.0000
LOGEXC(-2)	0.225704	0.123619	1.825800	0.0750
LOGEXC(-3)	0.060740	0.081364	0.746526	0.4595
LOGM2(-1)	1.275473	0.117098	10.89238	0.0000
LOGM2(-2)	-0.333931	0.114845	-2.907669	0.0058
<b>R-squared</b>	<b>0.998914</b>	<b>Mean dependent var</b>		<b>7.488407</b>
<b>F-statistic</b>	<b>3864.843</b>	<b>Durbin-Watson stat</b>		<b>2.339346</b>
<b>Prob(F-statistic)</b>	<b>0.000000</b>			

**Source: from Eviews 08 using the study**

The table shows that 99 % of money supply changes are related to the volatility of both oil price and exchange rate. This huge relationship proves the high correlation between the variables and, also, explains that the great part of the money supply available at the Algerian economy has been generated thanks the oil income owned by the country. In fact, the results are very logical because the Algerian economy is based on oil income and the most part of public expenditure is covered by this income. Moreover, exchange rate is among the main factors affecting money supply in Algeria since it is the key element determining the equivalent value, by Dinar, of the oil income amount owned by Dollar.

The following correlogram proves the reliability of the previous analysis since a problem of autocorrelation doesn't exist:

**Table(03): auto-correlation test results:**

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob *
. *   .	. *   .	1	-0.205	-0.205	2.3467	0.126
.   * .	.   * .	2	0.114	0.075	3.0901	0.213



.   .	.  *	3	0.056	0.097	3.2712	0.352
**   .	**   .	4	-0.218	-0.209	6.0871	0.193
.   .	.   .	5	0.041	-0.059	6.1873	0.288
.   .	.   .	6	-0.060	-0.019	6.4081	0.379
. *   .	. *   .	7	-0.169	-0.173	8.2155	0.314
.   .	.   .	8	0.046	-0.061	8.3537	0.400
. *   .	. *   .	9	-0.184	-0.167	10.590	0.305
.   .	. *   .	10	-0.008	-0.096	10.595	0.390
.   .	.   .	11	0.012	-0.060	10.604	0.477
.   .	.   .	12	0.047	0.047	10.761	0.550
.   .	.   .	13	0.025	-0.050	10.805	0.627
.   .	.   .	14	0.033	-0.050	10.885	0.695
.  *	.  *	15	0.134	0.121	12.265	0.659

**Source: from Eviews 08 using the study**

From the last tow tables, the adequate equation containing the variables of the study is as fallows:

$$\log(m2)_t = 0.1259 + 0.3406 * \log(P)_t - 0.4432 * \log(p)_{t-1} + 0.1313 * \log(p)_{t-2} + 0.0354 * \log(p)_{t-3} + 0.6409 * \log(EXC)_t - 0.7926 * \log(EXC)_{t-1} + 0.2257 * \log(EXC)_{t-2} + 0.0607 * \log(EXC)_{t-3} + 1.2754 * \log(m2)_{t-1} - 0.3339 * \log(m2)_{t-2}$$

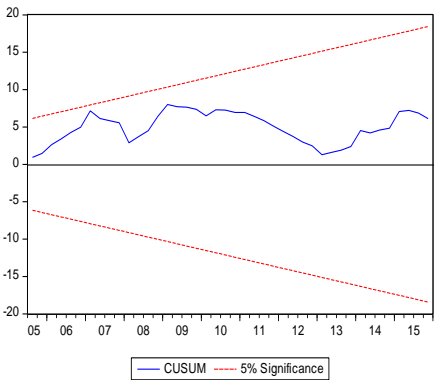
The next figures of CUSUM test and CUSUMQ for squares test demonstrate as well the reliability of the last equation:

**Figure(02) : CUSUM and CUSUMQ tests**

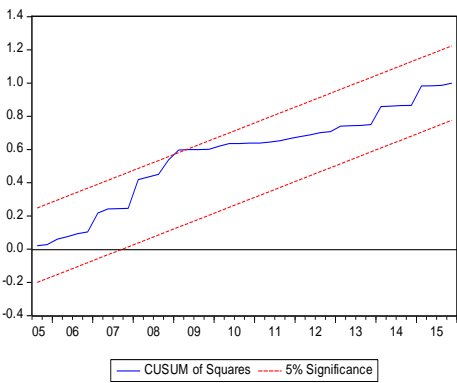
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Source: from Eviews 08 using the study



IV-Conclusion:

The huge relationship between money supply, oil prices and exchange rate, concluded by this study, proves that the Algerian government can move into reducing the exchange rate in order to face the current crisis of hydrocarbon. Such reducing allows getting a higher amount by dinar of the same income owned

usually, by any foreign currency, before the crisis. But this method may affect negatively the Algerian economy since it is a source of increasing inflation. For this reason, this policy should be followed, closely, by an economic policy aiming to diversify the economy and improving the global domestic product at least in the middle run.

## V-References:

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