Oil prices, Gold Prices and Exchange Rate in Algeria: A Non-Linear Analysis

Prix du pétrole, prix de l'or et taux de change en Algérie: une analyse non linéaire.

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Abstract: This analytical review explores the nonlinear links between crude oil prices, gold prices and Algeria Dinar real effective exchange rate for the period January 1990 to December 2016, we use in this paper a Markov Switching Auto-Regressive model (MSVAR) developed by Hamilton (1989), the empirical results show that there are two significant regimes, and the transitions between the two regimes followed the discounts of the Algerian Dinar value by the Central Bank (1991 and 1994), the results show also that oil prices affect the exchange rate by the limited manner especially in the first regime.

Keywords: Oil, Gold, Exchange rate, Markov Switching.

(JEL) Classification : C24 ،E31.

ملخص:

تهدف هذه الدراسة إلى دراسة العلاقة بين سعر البترول الخام، سعر الذهب وسعر صرف الدينار الجزائري خلال الفترة يناير 1990 إلى ديسمبر 2016، نستعمل من خلال هذه الدراسة نموذج الانحدار الذاتي ذو الانتقالات الماركوفية المطور من طرف Hamilton سنة 1989، وقد دلت النتائج على وجود نظامين معنوين، والانتقالات بين النظامين تتبع تخفيضات العملة الوطنية من طرف البنك المركزي (سنتي 1991 و1994)، كما أكدت النتائج على أن أسعار النفط تؤثر بصفة ضعيفة على سعر الصرف في الجزائر خاصة في ظل النظام الأول.

الكلمات المفتاحية: البترول، الذهب، سعر الصرف، النظم الماركوفية.

رموز jel: C24، E31.

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1. INTRODUCTION:

As said by (***Amano and Van Norden, 1998***) the oil prices has always been considered the leading indicator of the exchange rate movements in all the world, using data on real effective exchange rates for United States, Germany and Japan (***Amano and Van Norden, 1998 a,b***) find that the real oil prices is the major factor to determine the real exchange rates in the long-run term, also from Chaudhuri and Daniel (1998) study that investigate from 16 OECD countries that the nonstationary behaviour of the real exchange rates is due to the nonstationary behaviour of oil prices in the international markets, using different models many other studies conclude at the same results, for example, in the case of the Norwegian exchange rate, (***Akram, 2004***) find that the fluctuations in international oil prices affect directly the Norwegian exchange rate by a negative non-linear manner, (***Rogoff et al., 2012***) strongly confirm that in the short run term the oil prices can be treated as the major predictor of Canadian US dollar nominal exchange rates at daily frequency, the same results obtain from (***Beckman and Czudaj, 2013***) study for both oil exporting countries (Russia, Canada, Brazil, Norway and Mexico) and oil importing (Euro zone, South Africa, United Kingdom, Sweden and Japan), by returning to (***Lee and Ni, 1995***) and (***Hoocker, 1996***) it's clear that any collapse of oil prices (1986 collapse) affect directly the macroeconomics variables.

Gold is the chemical element with the symbol AU (Aurums) and the first known coins from gold were found around 600 BC, now gold is one of the most important metals, but after the World War II, the gold was replaced by the convertible currencies related by fixed exchange rates made by Breton Woods system, in 1971, led to the United States refusal to replace its dollars in gold, the Fiat currency system is made to fill the monetary roles, and in 1999 the Swiss Franc was the last currency to be divorced from gold, now, it's clear that the prices movements of oil and gold have a major role to explain the financial markets and all the economies, as declared by (***Jain and Biswal, 2016***) the oil and gold are the two most strategic commodities, (***Bildirici and Turkmen, 2015***) indicate that the volatility of both oil and gold prices has become invariably crucial for the economic development of all the countries, whereas, the increase in

the demand of the two commodities in all countries explain and affect all price trends for production processes.

In this area we can distinguish three channels to explain the relationship between oil and gold prices:

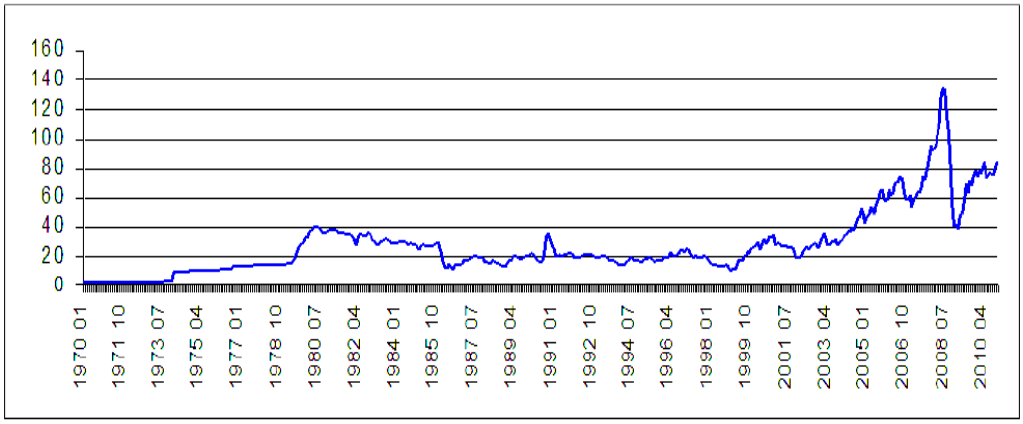
Inflation channel: as declared by (***Narayan et al., 2010***), the rising of oil prices affect the cost of goods and services production especially in oil importing countries, this what cause an increasing inflation, and as the gold is the effective and unique tool against inflation, any increase in oil prices lead to increase in gold demand and its prices (***Bampinas and panagiotidis 2015; Van Hoang et al 2016 and Kumar 2017***).

Economic growth channel: (***Reboredo, 2013***) show that any rise in oil prices negatively impact the economic growth and lead to force the investors to bay gold as an alternative investment to store some asset value; this what cause the rising of gold prices response to demand rising.

Export revenue channel: in 1990 Melvin and Sultan suggest that there is a strong relationship between oil and gold prices through the export revenue channel, when the oil prices rise, the revenue rise this what drive the oil exporting countries the increase the proportion of gold in their portfolio.

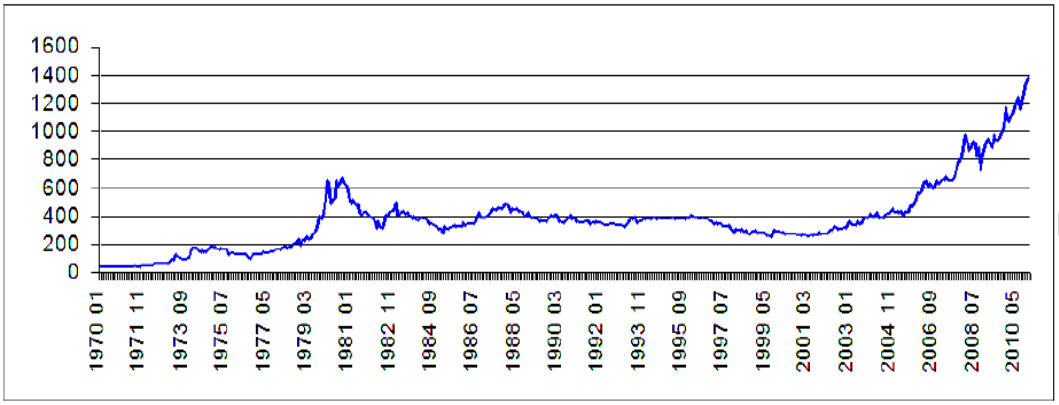
From figure 1(a,b), we perceive that both of the commodities tend to trade in the same direction for the period 1985-2015, especially in the new millennium:

Fig (01.a) the oil prices variation for the period 1970-2010



Source: Federal Reserve Economic Data.

Fig (01.b) the gold prices variation for the period 1970-2010



Source: Kitco.

Table (01) Comparison of 10 years average Gold, Oil prices in 1900-2016 period

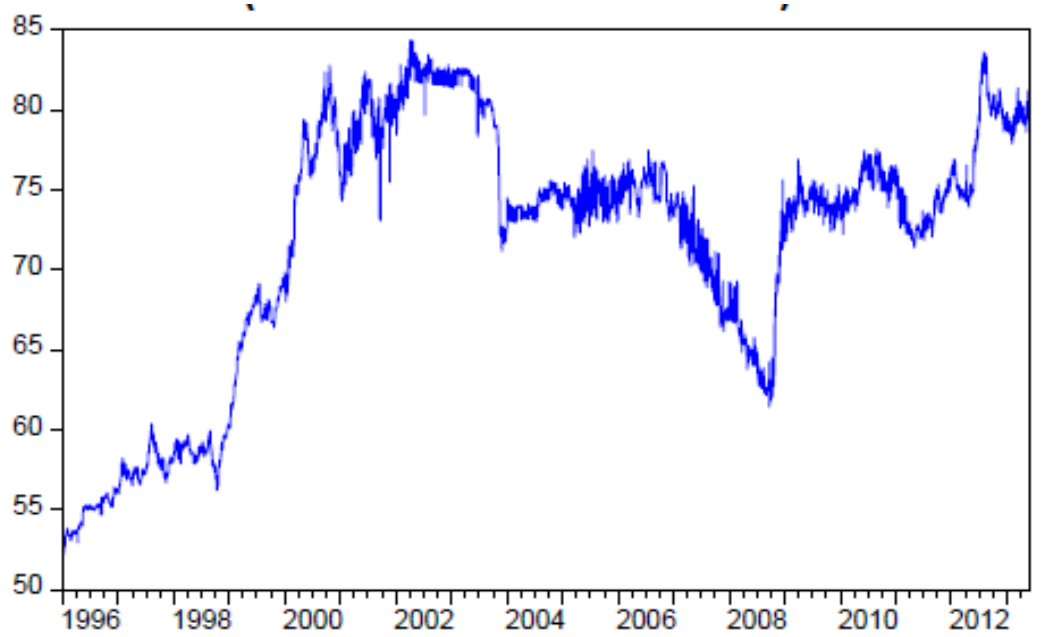
Year	Crude Oil Prices	Gold Prices
1900-1910	20.19	519.74
1910-1920	19.64	398.32
1920-1930	19.90	254.83
1930-1940	14.78	451.80
1940-1950	15.43	405.33
1950-1960	14.98	277.55
1960-1970	12.15	240.19
1970-1980	38.36	490.84
1980-1990	55.40	868.10
1990-2000	26.57	505.25
2000-2010	54.97	624.03
2010-2016	78.78	1366.90

Source : Sujit and Kumar (2011). Study on dynamic relationship among gold price, oil price, exchange rate and stock market returns. International Journal of Applied Business and Economic Research, 9(2), 145-165.

In Algeria oil and gas revenues are the major components of the Algerian income by 97% of exports for the period 2002-2015 and between 32 to 50% of GDP for

the same period and between 45 to 72% of government revenue, Based on a basket of 14 currencies the former regime was adopted for the period 1974-1995, but since 1996 a floating exchange rate was built upon a strong concentration of the US dollar because of its 98% in the hydrocarbon export receipts, from figure 2 its clear that there is different periods of depreciation and appreciation of the Algerian Dinar because of the prevailing economic situation.

Fig 02. evolution of Algerian Dinar-US Dollar exchange rate for the period 1996-2013.



Source: Sami Diaf, Toumache (2013). ***Multifractal Analysis of the Algerian Dinar-US Dollar exchange rate***.

2. Literature review:

The relationship between oil prices, gold prices and exchange rates have researched extensively in literature, Sari et al (2010) examine the co-movements and information transmission among the spot prices of gold, silver, platinum, palladium and oil prices with the US dollar/Euro exchange rate, and they found a weak long-run equilibrium relationship but strong feedbacks in the short-run, (***Zhang and Wei, 2010***), to test whether there exists a lead-and-lag price mechanism between the crude oil price and gold price, the authors investigated the co-

integration test for the long-run relationship and they applied both linear and nonlinear Granger causality under the PT model (Permanent Transitory) and IS model (Information Share) to find out the respective contribution of the two markets for their common price, the results indicate that there are consistent trends between the two commodities prices with significant positive correlation coefficient (92%) during the period of study (January 2000-March 2008), and there are a long-term equilibrium between the two markets, from the linear Granger causality the results indicate that the oil prices causes the volatility of gold prices but not vice versa, moreover, the two prices do not have a significant nonlinear Granger causality.

(***Narayan et al, 2010***) found that a rise in the oil price lead to a rise in the inflation rate which translates into higher gold prices, and using a co-integration test the results show that gold and oil spot and futures markets up to the maturity of 10 months were co-integrated, which means that the oil market can be used to predict the gold market and vice versa, (***Lee and Lin, 2012***), this study constructed a model for examine the nonlinear dynamic relationship between USD/YEN and gold prices according to crude oil prices using a panel smooth transition regression (PSTR) model for the period January 1990 to December 2009, the results indicate that the role of gold is determined according to oil prices, and gold is hedge and safe haven for developing countries but not for emerging countries, (***Hsiao et al., 2013***) examine the correlation between oil prices, gold prices and the NT dollar versus US dollar exchange rate for the period 03/09/2007 to 28/12/2012 in the case of Taiwan, by applying a Johansen co-integration test, VAR model and Granger causality, the results shows that the three variables are considerably independent from one another.

(***Jain and Biswal, 2016***), this study try to investigate the relationship between gold prices, oil prices, the USD/INR exchange rate and stock market in India using DCC-GARCH (standard, exponential and threshold) model and symmetric and asymmetric nonlinear causality tests, the results indicate that a fall in gold prices and oil prices cause fall in the value of Indian Rupee (INR) and the benchmark stock index for the period 2008-2013, and the results of Krystow-Labys nonlinear causality provide in the symmetric case that gold prices cause the exchange rate and the exchange rate cause the stock market, moreover, asymmetric causality

reveal causal relationship between crude oil prices and INR and a fall in oil prices causes both depreciation of the INR and stock market, (***Kumar, 2017***) using the (***Hiemstra and Jones, 1994***) nonlinear Granger causality tests and nonlinear ARDL (NARDL) approach try to examine the causal relationship between oil and gold prices in the Indian context, the results show a strong evidence of bidirectional nonlinear relationship between oil and gold prices, and the results obtained from NARDL test reveal that positive shock in oil price has more pronounced effect than negative shocks on gold prices, and as a conclusion the study suggest that the interactive mechanism between oil and gold prices is nonlinear and asymmetric.

3. Data and methodology:

The linear regression is one of the most important and primary tools in the statistical and econometric studies, especially since the Box and Jenkins ARIMA (Auto-Regressive Integrated Moving Average) models presented in 1971, and also the VAR model developed by Christopher Sims in 1980, but in the other, it's clear that the nonlinear modelling is sometimes appropriate, especially with the macroeconomics relationships that are follow the regime change, in this area we found many switching models as Goldfeld and Quandt 1973 and 1976, (***Maddala 1983***), (***Hamilton 1994***), (***Krolzig, 1997***) and (***Fruhwirth-Schnatter, 2006***).

The TAR (Threshold Auto-Regressive model) proposed by (***Tong, 1978***) and SETAR (Self-Exciting Threshold Auto-Regressive model) proposed by (***Tsay, 1989***) and (***Hansen, 1997***), this models have regimes that determined by the magnitude of an observable weakly exogenous variable, but in the Markov Switching model the regimes are determined by and unobserved state or regime variable following a discrete state Markov process (Markov chains), the MSVAR model is assumed that the regime St is generated by a hidden discrete state homogenous and ergodic Markov chain as follows:

$$Pr (St / St\text{-}1, Yt\text{-}1, Xt) = Pr (St / St\text{-}1; P) \quad (1)$$

Defined by the transition probabilities:

$$Pij = Pr (St+1 = j/ St = i) \quad (2)$$

We use in this paper monthly data for crude oil prices, gold prices and real effective exchange rate of Algerian Dinar for the period January 1990 to December 2016.

4. Empirical results:

A two regimes (M=2) Markov-Switching VAR model was selected and estimated by a maximum likelihood method using the expectation maximization algorithm developed by (***Hamilton, 1989***), table (2) present the estimation results of the two regimes:

Table (03) : MSVAR estimation results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
LNO	-0.13124	0.015774	-8.320048	0.0000
LNG	-0.00216	0.014041	-0.154470	0.8772
C	5.19293	0.058323	89.03680	0.0000
Regime 2				
LNO	0.00557	0.059654	0.093526	0.9255
LNG	1.30369	0.107103	12.17235	0.0000
C	-2.53301	0.585149	-4.328829	0.0000
Common				
LOG(SIGMA)	-2.55298	0.041378	-61.69882	0.0000
Transition Matrix Parameters				
P11-C	4.68685	0.737798	6.352497	0.0000
P21-C	-2.97648	0.775371	-3.838785	0.0001
Mean dependent var	4.74394	S.D. dependent var		0.18872
S.E. of regression	0.08996	Sum squared reside		2.56539
Durbin-Watson stat	0.33903	Log likelihood		351.084
Akaike info criterion	-2.11163	Schwarz criterion		-2.0066
Hannan-Quinn criter.	-2.06971			

Source: author calculations according Eviews10.

From table (2) above, we conclude that there is no significant effect from gold prices on Algerian exchange rate in the first regime, but in the second regime there is a strong significant effect on exchange rate from the world gold prices, and we conclude the opposite results for the oil prices, when we observe that there is a weak significant and negative affect from oil prices to Algerian exchange rate

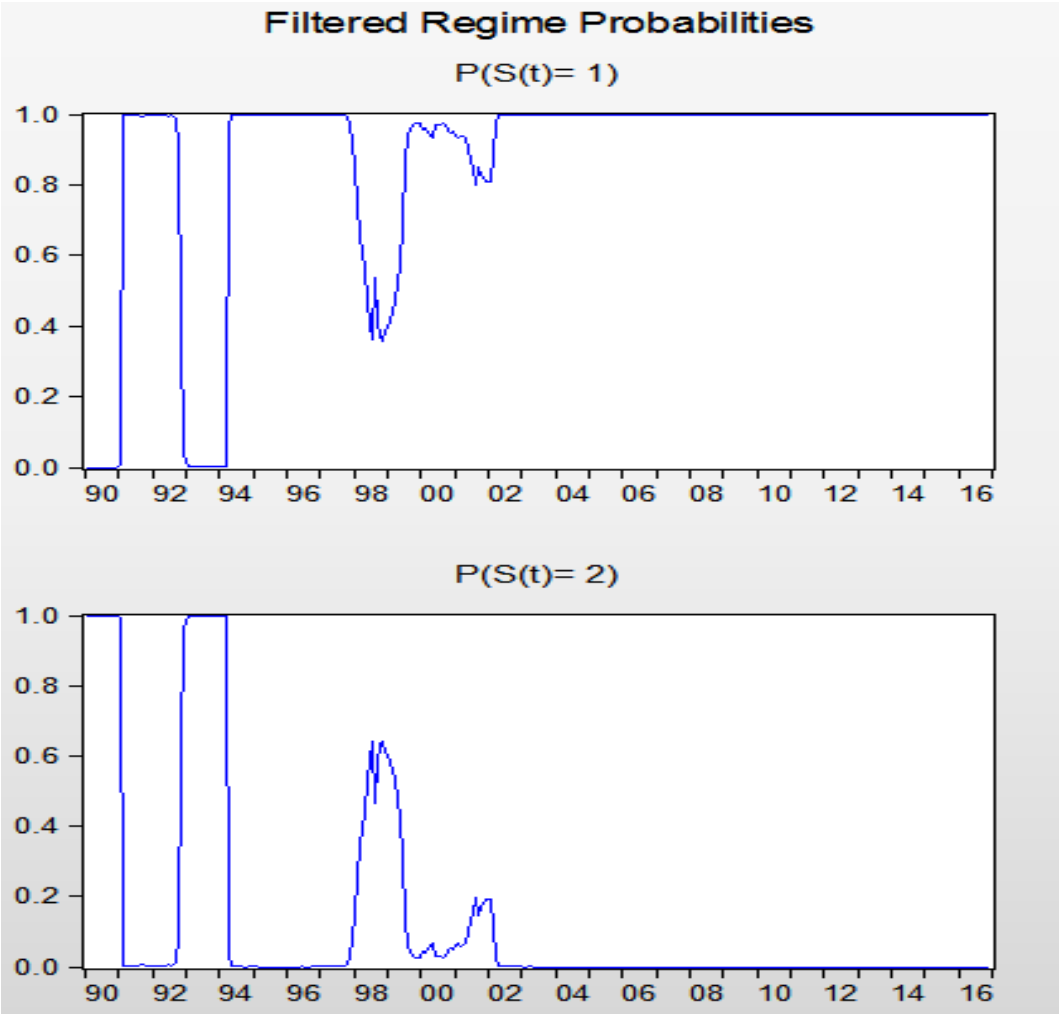
in the first regime, this result is considered as one of the symptoms (features) of the Dutch disease, but this symptom vanish in the second regime.

Table (3) shows transition probabilities, the probability that regime 1 is followed by regime 1 is 0.9908, and the probability that regime 2 is followed by regime 2 is 0.9515, but the probability that regime 1 is followed by regime 2 is 0.0091 and the probability that regime 2 is followed by regime 1 is 0.0484, that what means that the transitions between the two regimes are very rare as we can see in figure 3, a regime shift at the first quarter of 1990,19 92 and at the first month of 1994, this dates are very close to the discounts of the Algerian Central Bank on the currency value (1991 by 25% and 1994 by 40%).

Table (04) : estimated transition probabilities for the MSVAR model with 2 regimes

Constant transition probabilities P(i, k) = P(s(t) = k | s(t-1) = i) (row = i / column = j)			
		1	2
All periods	1	0.990869	0.009131
	2	0.048500	0.951500

Fig (03) : filtered regime probabilities



4. CONCLUSION *:*

In this paper, we study the effects of oil prices and gold prices on the real effective exchange rates in the case of Algerian Dinar, using monthly data for the period January 1990-December 2016 by applying a nonlinear approach based on Markov Switching Auto-Regressive Vector model (MSVAR model) developed by Hamilton (1989) and Krolzig (1997), the evidence suggests that there is a null or minimal impact from oil prices in Algerian Dinar exchange rate in one of the

regimes (regime 1), while there is a strong impact in the case of gold prices is the other regime (regime 2), this nonlinear evidence may help us to understand the conflicting results of the Dutch disease studies in Algeria. Our results have significant practical implications for policymakers, the relationship between gold prices and the Algerian Dinar real effective exchange rate would help the policymakers to alleviate the unfavourable impacts of oil prices shocks on the Algerian economy and to get rid of the Dutch disease symptoms.

5. Bibliography List and Citations:

1. Akram, Q. F. (2004). ***Oil prices and exchange rates: Norwegian evidence***. the econometrics Journal, 7(2), 476-504.
2. Amano, R. A., & Van Norden, S. (1998). ***Oil prices and the rise and fall of the US real exchange rate***. Journal of international Money and finance, 17(2), 299-316.
3. Bampinas, G., & Panagiotidis, T. (2015). ***Are gold and silver a hedge against inflation? A two century perspective***. International Review of Financial Analysis, 41, 267-276.
4. Barsky, R. B., & Kilian, L. (2004). ***Oil and the Macroeconomy since the 1970s***. Journal of Economic Perspectives, 18(4), 115-134.
5. Basher, S. A., Haug, A. A., & Sadorsky, P. (2016). ***The impact of oil shocks on exchange rates: a Markov-switching approach***. Energy Economics, 54, 11-23.
6. Beckmann, J., & Czudaj, R. (2013). ***Oil prices and effective dollar exchange rates***. International Review of Economics & Finance, 27, 621-636.
7. Bildirici, M. E., & Turkmen, C. (2015). ***Nonlinear causality between oil and precious metals***. Resources Policy, 46, 202-211.
8. Dauvin, M. (2014). ***Energy prices and the real exchange rate of commodity-exporting countries***. International Economics, 137, 52-72.
9. Diaf, S., & Toumache, R. (2013). ***Multifractal Analysis of the Algerian Dinar-US Dollar exchange rate***.
10.Ferraro, D., Rogoff, K. S., & Rossi, B. (2012). ***Can oil prices forecast exchange rates?*** (No. w17998). National Bureau of Economic Research.
11.Ghalayini, L. (2011). ***The interaction between oil price and economic growth***. Middle Eastern Finance and Economics, 13, 127-141.
12.Hooker, M. A. (1996). ***What happened to the oil price-macro economy relationship?***. Journal of monetary Economics, 38(2), 195-213.
13.Jain, A., & Biswal, P. C. (2016). ***Dynamic linkages among oil price, gold price, exchange rate, and stock market in India***. Resources Policy, 49, 179-185.
14.Jain, A., & Biswal, P. C. (2016). ***Dynamic linkages among oil price, gold price, exchange rate, and stock market in India***. Resources Policy, 49, 179-185.

15.Kumar, S. (2017). On the nonlinear relation between crude oil and gold. Resources Policy, 51, 219-224.
16.Lee, K., Ni, S., & Ratti, R. A. (1995). ***Oil shocks and the macro economy: the role of price variability***. The Energy Journal, 39-56.
17.Lee, W. C., & Lin, H. N. (2012). ***Threshold effects in the relationships between USD and gold futures by panel smooth transition approach***. Applied Economics Letters, 19(11), 1065-1070.
18.Melvin, M., & Sultan, J. (1990). ***South African political unrest, oil prices, and the time varying risk premium in the gold futures market***. Journal of Futures Markets, 10(2), 103-111.
19.Narayan, P. K., Narayan, S., & Zheng, X. (2010). ***Gold and oil futures markets: Are markets efficient?***. Applied energy, 87(10), 3299-3303.
20.Raymond, J. E., & Rich, R. W. (1997). ***Oil and the macro economy: A Markov state-switching approach***. Journal of Money, Credit, and Banking, 193-213.
21.Reboredo, J. C. (2010). ***Nonlinear effects of oil shocks on stock returns: a Markov-switching approach***. Applied Economics, 42(29), 3735-3744.
22.Reboredo, J. C., & Rivera-Castro, M. A. (2013). ***A wavelet decomposition approach to crude oil price and exchange rate dependence***. Economic Modelling, 32, 42-57.
23.Ricci-Risquete, A., Ramajo, J., & De Castro, F. (2016). ***Time-varying effects of fiscal policy in Spain: a Markov-switching approach***. Applied Economics Letters, 23(8), 597-600.
24.Sari, R., Hammoudeh, S., & Soytas, U. (2010). ***Dynamics of oil price, precious metal prices, and exchange rate***. Energy Economics, 32(2), 351-362.
25.Sujit, K. S., & Kumar, B. R. (2011). ***Study on dynamic relationship among gold price, oil price, exchange rate and stock market returns***. International Journal of Applied Business and Economic Research, 9(2), 145-165.
26.Van Hoang, T. H., Lahiani, A., & Heller, D. (2016). ***Is gold a hedge against inflation? New evidence from a nonlinear ARDL approach***. Economic Modelling, 54, 54-66.
27.Zhang, Y. J., & Wei, Y. M. (2010). ***The crude oil market and the gold market: Evidence for co-integration, causality and price discovery***. Resources Policy, 35(3), 168-177.