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The Links between Gold, Oil Prices and Islamic Stock Markets in a Regime Switching Environment

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Abstract:

This paper investigates the interaction between gold, oil prices and Islamic stock market for the period 1996-2018. Using a VAR and a Markov switching VAR model, results can be summarized as follow (i) there are some significant relationships between the considered variables; (ii) the sign of the links varies significantly according to variables and regimes; (iii) there is a significant and positive link between oil and Islamic stock markets namely during the volatile periods suggesting the financialization of the crude oil market; (iv) the negative or the absence of relationship between gold market and both oil and Islamic stock markets confirm the role of gold as a hedge and safe haven for extreme market conditions.

JEL classification: C32, F30, G15

Keywords: oil prices, gold, Islamic markets, Markov switching, safe haven

1. Introduction

The relationship between stock and commodity markets has been commonly examined during the two last decades. However, a great importance is allowed by the researches to crude oil and gold markets. Most of these studies conclude on the one hand to the financialization of crude oil market (Creti et al., 2013; Kolodziej et al., 2014; Olson et al., 2014; Zhang et al., 2017). On the other hand, they point out the role of gold as a hedge and a safe haven for stock market movements (Baur and McDernott, 2010; Ciner et al, 2013; Chkili, 2016).

A great interest is addressed during the few recent years towards the Islamic finance industry. This interest is due to the risk-hedging alternatives and investment opportunities offered by the Islamic financial markets to financial analysts and investors. For instance, the Islamic capital markets have grown rapidly, achieving a growth rate between 19% and 23% at the end of 2017 (IFSI[1], 2018). The reasons for this fast growing are the strong investment in the *halal* sectors and the raise in demand for products complying with the principles of the Islamic law (or *Sharia*)[2]. In addition, the competitive nature of some of these products has attracted both Muslim and no Muslim investors. Given the importance granted to these markets, it is interesting to analyze the extent of information transmission between these markets and other asset classes such as gold and crude oil as well as the potential diversification benefits between them.

The literature that examines the relationship between Islamic stock market and commodity market is rare. Nagayev et al. (2016) investigate the dynamic relationship between commodities and Islamic market and the potential diversification between the two assets. The authors apply a MGARCH-DCC and Wavelet Coherence analyses for data ranging from January 1999 to April 2015. Their empirical evidence shows that the correlations between the two markets are time varying and high volatile during the period study suggesting that not all commodities offer equally good diversifiers at all time. According to the authors, gold, natural gas, agriculture, grains and livestock provide a good diversification opportunity for short-term investors for the pre-global financial crisis period. Therefore, Natural gas represents the best diversifier in the short run during and after the crisis. Shahzad et al. (2017) examine the extreme dependence between the major Islamic equity market and oil price using copula approach. Findings show evidence of asymmetric risk spillover from oil to Islamic equity

[1] Islamic Financial Service Industry: stability report 2018 :www.ifsb.org
[2] See Chkili (2017), Hammoudeh et al. (2014)

market and vice versa. More interestingly, this asymmetric risk spillover is greater after the 2008 global financial crisis.

Chebbi and Derbali (2016) use a DCC-GARCH approach to explore the evolution of the causality and dynamic correlation between commodity and Islamic stock returns over time. They conclude that the volatilities of the two markets are significantly correlated and the correlation is time-varying and highly volatile. Quite similar results are detected by Chebbi and Derbali (2015). They find significant correlation between commodity prices and the QE Al Rayan Islamic and this correlation follows a time-varying dynamic process.

Maghyereh et al. (2019) study the dynamic interdependence between gold, Sukuk and Islamic equities for the period September 2005-February 2018. The paper also highlights the diversification opportunity between the three assets. Empirical findings suggest that gold continues to play its traditional role as a hedge for Islamic equity market across all investment horizons. More precisely, gold is a good diversifier for Islamic equity portfolio in the short-run. In addition, investors should allocate 30% of their wealth in gold market in order to reduce the risk of an Islamic stock portfolio regardless of the time horizon. In the same context, Chkili (2017) examines the role of gold as hedge or safe haven for Islamic stock market volatility. Using a Markov switching model, results reveal that gold can serve as a hedge and a safe haven for extreme Islamic market conditions.

Tuna (2018) analyzes the presence of relationship between four precious metals namely gold, silver, platinum and palladium, and 32 Islamic stock markets belonging to emerging and developed countries. He reveals, on one hand that all the four precious metals are effective portfolio diversifications instruments for developed Islamic markets. On the other hand, only gold and palladium represent an effective opportunity of diversification for developing countries.

This paper contributes to the related literature in three ways. First, this paper investigates the relationship between Islamic stock market and two major commodities namely crude oil and gold. The main objective is to verify on the one hand the financialization process of the crude oil market through the analysis of the correlation between the oil and Islamic index prices. On the other hand, to test the role of gold as a hedge and safe haven for oil and Islamic stock market movements. Second, the period under investigation covers several economic and political events namely the Asian financial crisis, the dot-com bubble and the global financial crisis. Such events can affect the type of connectedness between the three variables. Third, we

apply the Markov switching VAR (MS-VAR) approach to test the relationship between the three assets for both normal and turbulent periods. Such analysis can help Islamic investors to opt for the optimal diversification strategies and to choose the better hedging tools namely for period characterized by the alternation between calm and turbulent phases.

The remainder of the paper is organized as follow. Section 2 describes the methodology. Section 3 presents the data and preliminary analysis. The empirical results are reported in Section 4. Section 5 concludes the paper.

2. Methodology

In this paper, we use in first step the VAR approach to test the relationship between the three markets for the whole period. In second step, the Markov switching VAR approach is employed to verify whether the link between the considered markets varies according the regimes. This approach is justified by the period under study that characterized by the emergence of several economic and political events such as the Asian financial crisis, the dot-com bubbles, the global financial crisis and the European debt crisis. Such crisis affects the dynamic of commodity and Islamic markets and so their interconnection.

2.1. VAR approach

To examine the linear relationship between the three variables namely the changes in Islamic stock index, crude oil price and gold price we use the vector autoregressive (VAR) model. Let $r_t = (r_{1t}, r_{2t}, \dots, r_{kt})^T$, a set of *k* variables, follows a VAR(*l*) process if it satisfies:

$$r_t = c + A_1 r_{t-1} + A_2 r_{t-2} + \cdots + A_p r_{t-l} + \varepsilon_t \quad (1)$$

Where *c* is a *k*-dimensional vector of intercepts, *A* is the *k*×*k* matrices of coefficients and ε_t is a sequence of serially uncorrelated random vectors with mean zero and covariance matrix Σ.

For $k = 3$[3], The three-equation VAR(*l*) model can be presented as follows:

$$r_{IM} = \alpha_0 + \sum_{i=1}^{l} \alpha_{k1} r_{IMt-i} + \sum_{i=1}^{l} \alpha_{k2} r_{COt-i} + \sum_{i=1}^{l} \alpha_{k3} r_{GDt-i} + \varepsilon_{1t}$$

$$r_{CO} = \beta_0 + \sum_{i=1}^{l} \beta_{k1} r_{IMt-i} + \sum_{i=1}^{l} \beta_{k2} r_{COt-i} + \sum_{i=1}^{l} \beta_{k3} r_{GDt-i} + \varepsilon_{2t} \quad (2)$$

[3] In our study k=3 refer to three markets: Islamic stock market, crude oil and gold.

$$r_{GD} = \gamma_0 + \sum_{i=1}^{l} \gamma_{k1} r_{IMt-i} + \sum_{i=1}^{l} \gamma_{k2} r_{COt-i} + \sum_{i=1}^{l} \gamma_{k3} r_{GDt-i} + \varepsilon_{3t}$$

where r_{IM}, $r_{CO}$and r_{GD} are the weekly returns of Islamic stock market, crude oil price and gold price, respectively. *l* denotes the optimal lag length. As shown in the model, each variable is a linear function of its own lagged values and the lagged values of the two other variables presented in the system.

2.2. MS-VAR approach

As suggested by some previous studies (Creti et al. 2013; Chkili, 2017), the relationship between stock market and commodity market is not stable and varies significantly following the state of each market. In order to take into account the regime shift of volatility in our analysis, we apply the MS-VAR model developed by Krolzig (1997). Such model allows us to examine the relationship between the considered markets for normal and volatile periods. The MS-VAR model can be written as follows:

$$r_{IM} = \alpha_0(S_t) + \sum_{i=1}^{l} \alpha_{k1}(S_t) r_{IMt-i} + \sum_{i=1}^{l} \alpha_{k2}(S_t) r_{COt-i} + \sum_{i=1}^{l} \alpha_{k3}(S_t) r_{GDt-i} + \nu(S_t)\varepsilon_{1t}$$

$$r_{CO} = \beta_0(S_t) + \sum_{k=1}^{l} \beta_{k1}(S_t) r_{IMt-i} + \sum_{k=1}^{l} \beta_{k2}(S_t) r_{COt-i} + \sum_{k=1}^{l} \beta_{k3}(S_t) r_{GDt-i} + \nu(S_t)\varepsilon_{2t} \quad (3)$$

$$r_{GD} = \gamma_0(S_t) + \sum_{k=1}^{l} \gamma_{k1}(S_t) r_{IMt-i} + \sum_{k=1}^{l} \gamma_{k2}(S_t) r_{COt-i} + \sum_{k=1}^{l} \gamma_{k3}(S_t) r_{GDt-i} + \nu(S_t)\varepsilon_{3t}$$

S_t is the unobservable discrete variable which is supposed to follow a two-state Markov switching process defined by the transition probability matrix:

$$P = \begin{bmatrix} P_{11} & P_{21} \\ P_{12} & P_{22} \end{bmatrix}$$

Where:

$$\begin{cases} P_{11} = P(S_t = 1/S_{t-1} = 1) \\ P_{12} = P(S_t = 1/S_{t-1} = 2) \\ P_{21} = P(S_t = 2/S_{t-1} = 1) \\ P_{22} = P(S_t = 2/S_{t-1} = 2) \end{cases} \quad (4)$$

For all $i, j \in \{1,2\}$, $\sum_{j=1}^{2} P_{ij} = 1$.

The average duration of regime *j* can be calculated as follows: $D = \frac{1}{1-P_{jj}}$

3. Data and descriptive statistics

We use weekly closing prices for the Dow Jones Islamic market index, the gold and the WTI crude oil. The sample study covers the period from January 1996 to August 2018. The data are collected from International Datastream, Federal Reserve Bank Database and EIA Database[4], respectively. This period covered several political and economic crises such as the Asian financial crisis, the dotcom bubbles, the global financial crisis and the European debt crisis. Such choice enables us to examine the relationship between the variables for normal and instability periods. We use weekly data for two reasons. First, weekly data frequency allows avoiding any potential biases related to daily data such as the problem of non-synchronous trading and short-term correlations due to noise with higher frequencies. Second, several previous studies (Hamilton and Susmel, 1994; Aloui and Jammazi, 2008; Chkili et al., 2011) suggest that Markov switching can be better detect regime shifts across time using lower frequency data such weekly data. The returns are computed by taking the natural logarithm of the ratio of two consecutive prices as follows:

$$r_{it} = \frac{P_{it}}{P_{it-1}}$$

Where P_{it} is the price for the asset *i* at time *t* and r_{it} is the return of the considered asset.

Table 1 presents summary descriptive statistics and the matrix correlation between variables. Panel A shows that the weekly average returns are positive for all the considered series. The Islamic stock market provides the higher average returns (12.66%) followed by the oil market (10.79%) while the gold market is the least profitable with an average returns of 9.62%. With regards to volatility, as measured by the standard deviation, the oil market appears as the more volatile while the gold market seems the stable one. The skeweness and kurtosis normality tests show that return distributions are negatively skewed and highly leptokurtic relative to the normal distribution, respectively. The Jarque-Berra test also rejects the null hypothesis of normality as the empirical values are statistically significant at 1% level. The last column of

[4] US Energy Information Administration https://www.eia.gov

table 1 reports the Augmented Dickey-Fuller unit root test results for the three markets. The results show that the ADF test rejects the null hypothesis suggesting that all the return series are stationary at conventional levels.

Panel B presents the unconditional pairwise correlations between the three variables. We can observe that the average correlation is positive and significant for all cases. More interestingly, this correlation varies between 0.1108 for the gold/Islamic stock return pair and 0.1992 for the crude oil/Islamic stock return pair. However, while the table presents only the average values of correlation over the whole period, the relationship between the considered assets can differ significantly according to the state of markets and the regime of volatility.

Table1

Descriptive statistics and matrix of correlations

Panel A. Descriptive statistics

	Mean	SD	Skewness	Kurtosis	JB	LB^2	ADF
RDJI	0.1266	2.3685	-1.0257	10.922	3300.91**	288.63**	-35.312**
Roil	0.1079	4.2794	-0.2002	5.6302	348.91**	373.71**	-18.105**
Rgold	0.0962	2.3455	-0.2666	6.9067	766.33**	511.98**	-26.017**

Panel B. Matrix of correlations

	RDJI	Roil	Rgold
RDJI	1.000		
Roil	0.1992 [0.00]	1.000	
Rgold	0.1108 [0.00]	0.1720 [0.00]	1.000

Note: RDJI, Roil and Rgold are the returns of the Islamic stock market, the crude oil prices and the gold prices, respectively. SD is the standard deviation. JB. JB is the Jarque-Berra test for normality, LB^2 refers to the empirical statistics of Ljung-Box test for autocorrelation of squared returns series, ARCH (5) is the Engle (1982) test for conditional heteroscedasticity, ADF is the empirical statistics of the Augmented Dickey and Fuller (1979) unit root test. The p-values are in brackets.

** indicates the rejection of null hypotheses at the 1% level.

Fig. 1 displays the evolution of the prices and returns of the three studied markets. As shown in the left panel, the Islamic stock market and crude oil market present similar trends. The two markets exhibit an increasing trend with some important swings during the period under investigation. Therefore, some drops can be detected namely during the global financial crisis and the European debt crisis. The gold price also experienced an increasing evolution up to 2014. Afterwards, a downward trend is observed until 2018. The right panel plots the return series for each market. From the plots, we can see the presence of volatility clustering: large (small) variations in the prices tend to be followed by large (small) variations by either signs.

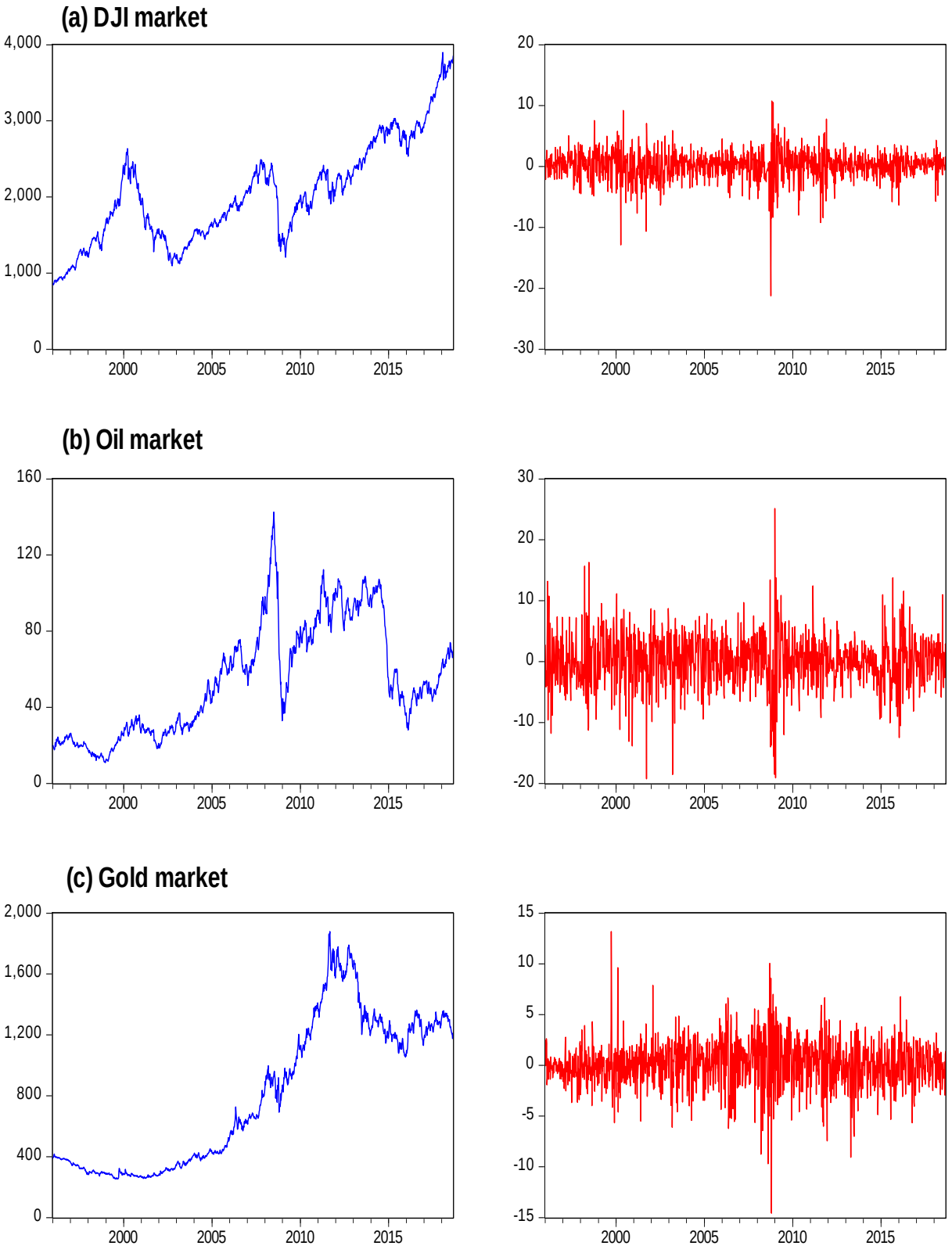

Fig. 1. Prices (left panel) and returns (right panel) for Islamic stock, oil and gold markets

4. Results

4.1. VAR model results

Table 2 presents the estimation results and diagnostic tests for the VAR model. We start our analysis by determining the optimal lag length of the model. According to Log-likelihood, Akaike information criterion and Schwarz information criterion the optimal lag is equal to one[5].

From table 2, we see that the estimated coefficient relating the Islamic market return and gold return is negative and statistically significant at conventional levels. This suggested that gold can serve as a strong hedge for Islamic stock market fluctuations. This result is in line with the definition of Baur and McDermott (2010). According to the authors, an asset is regarded as a strong (weak) hedge if it is negatively correlated (uncorrelated) with another asset on average. Chkili (2017) provide similar results for some Islamic markets. Besides, the insignificant coefficient detected between gold and crude oil markets indicates that gold can be considered as a weak hedge for oil price movements.

The reported results also show that oil price returns is positively affected by the lagged value of Islamic stock returns. This result underlines the financialization process of the commodity market. In fact, the price of the crude oil is not only determined by their lagged values but also by the lagged values of stock market. The phenomenon of the financialization of the crude oil market is well documented in the literature (see eg. Creti et al., 2013; Silvennoinen and Thorp, 2013). In this vein, Shahzad et al. (2017) examine the risk spillover between oil price volatility and the Dow Jones Islamic Market (DJIM) as a benchmark index for Islamic stock markets. Using the copula approach, their results find evidence of positive and extreme lower tail dependence between the crude oil prices and the Islamic stock markets. According to the authors, the two markets co-move in the same direction and so the drop of oil price leads to a low Islamic stock market performance.

[5] The optimal lag has the highest Log likelihood and the lowest Akaike and Schwarz information criteria.

Table 2
Estimation results of VAR approach

	RDJI	Roil	Rgold
Panel A: Estimation results			
constant	0.135** (1.956)	0.071 (0.577)	0.090* (1.820)
$RDJI_{t-1}$	-0.021 (-0.698)	0.185*** (3.483)	0.023 (0.793)
$Roil_{t-1}$	-0.001 (-0.075)	0.129*** (4.375)	-0.022* (-1.812)
$Rgold_{t-1}$	-0.058** (-1.960)	-0.023 (-0.441)	0.034 (1.163)
std. dev.	1.775	3.352	1.858
Panel B: Residual diagnostics			
Log *L*	-6309.93		
AIC	14.748		
SIC	14.801		

Note: RDJI, Roil and Rgold are the returns of the Islamic stock market, the crude oil prices and the gold prices, respectively. AIC is the Akaike Information criterion. SIC is the Schwartz Information criterion. Student-*t* statistics of parameters are reported in parentheses.
***,** and * refer to significance levels at 1%, 5% and 10%, respectively.

4.2. Regime shifts in the relationship between commodity and Islamic stock markets

Table 3 reports the estimation results of the MS-VAR approach. We begin with testing whether a regime shifts exist in the relationship between the three markets. Practically we apply the likelihood ratio (LR) test calculated as follow:

$$LR = 2 \times |Log\ L_{MS-VAR} - Log\ L_{VAR}|$$

Where $Log\ L_{MS-VAR}$ and $Log\ L_{VAR}$ are the log likelihood for the MS-VAR and VAR model, respectively. The LR test statistic reported in panel A is significant at the 1% level. We can thus reject the null hypothesis of no regime switching in the link between commodity and Islamic stock markets. This result implies that the MS-VAR process is suitable for testing the dynamic linkage between the considered markets under condition of regime changes.

From the estimation results, we can identify two types of regime: a low volatility regime (regime 1) and a high volatility regime (regime 2). As shown in the table, the volatility estimates for regime 1 is 1.301 for Islamic market, 2.895 for oil and 1.763 for gold. While in regime 2, the extent of volatility is more important for all considered markets and varies between 2.134 for gold and 4.262 for crude oil. Furthermore, the probability of staying in regime of low volatility in other words the probability that a week of low volatility will be pursued of a week of low volatility is equal to 0.985. The probability of staying in regime of high volatility is less important and is around 0.973. The average duration of the low volatility regime is 66.66 weeks (16.6 months) while the high volatility regime is less persistent and lasts on average 37.04 weeks (9.25 months).

Fig. 2 plots the evolution of the smoothed probabilities of regime 1 (upper panel) and regime 2 (lower panel). We can see that the high volatility regime coincides mostly with the periods of the major political and economic events that occurred during the period under examination such as the Asian financial crisis, the dot-com bubble, the Global financial crisis and the European debt crisis.

The estimation results displayed in table 3 show that the estimation coefficients connecting gold to the oil and Islamic stock market returns are negative and not significant for the normal period that corresponds to low volatility regime. This confirms the role of gold as a hedge for both oil and Islamic markets. Seetharam and Bodington (2015) point out that hedges are useful instruments for portfolio risk management and gold has been classified as hedges against many economic and financial variables in addition to its value as a financial asset.

Turning to regime 2, empirical findings show positive and significant link of oil to Islamic stock. More precisely, changes in oil prices are predicted based on previous oil price changes and Islamic stock index innovations during turbulent period. This interdependence confirms the financialization mechanism of crude oil market. This result is in line with those of Creti et al. (2013). According to the authors, a high correlation is observed between both markets during financial turbulence which reflecting the phenomenon of financialization of oil market. Shahzad et al. (2018) find similar results for Islamic market. They find an extreme positive lower dependence between the oil and the Islamic indexes. This interdependence reduces the diversification opportunities for international investors during turmoil periods.

The findings also show a negative and significant links between Islamic index and gold price changes during the high volatile regime. This suggests that gold cans serve as a strong safe haven during turbulent Islamic stock market conditions. Chkili (2017) finds quite similar results for some Islamic markets. He concludes that gold is a strong safe haven against extreme Islamic stock market movements. According to the author, this can be explained by the fact that the price of gold maintained an increasing trend during period of major crises. More precisely, the demand for gold increase given that investors sell assets associated with high risk and purchase safe haven assets during extreme political and financial turmoil. This movement is known as the *flight to quality* phenomenon (Hammoudeh et al., 2010; Klein, 2018). Nagayev et al. (2016) reveal that the correlation between gold and Islamic market is around 0% during turbulent periods. They explain the weakening of correlation by the divergence of equity and precious metal prices since the gold price increases during financial

markets turmoil as opposed to equity prices. The authors conclude that gold continues to play its role as a safe haven during turbulent periods.

Table 3
Estimation results of MS-VAR approach

		RDJI	Roil	Rgold
Panel A: Regime switching tests				
LR test	172.56 [0.00]			
Log *L*	-6223.65			
Panel B: Estimation results				
constant		0.306*** (5.323)	0.205** (2.192)	0.076 (1.193)
$RDJI_{t-1}$	regime 1	-0.048 (-0.986)	0.101 (0.792)	-0.175* (-1.848)
	regime 2	-0.006 (-0.123)	0.164* (1.838)	-0.034 (-0.659)
$Roil_{t-1}$	regime 1	0.006 (0.308)	0.167*** (2.987)	-0.014 (-0.611)
	regime 2	0. 161* (1.932)	0.145*** (2.620)	-0.006 (-0.297)
$Rgold_{t-1}$	regime 1	-0.014 (-0.475)	-0.033 (-0.489)	0.024 (0.409)
	regime 2	-0.112* (-1.734)	-0.005 (-0.052)	-0.015 (-0.206)
std. dev.	regime 1	1.301	2.895	1.763
	regime 2	2.543	4.262	2.134
Panel C: Regime characteristics				
Duration	regime 1	66.66		
	regime 2	37.04		
probability	P_{11}	0.985	0.027	
	P_{22}	0.014	0.973	
Correlation coefficient				
RDJI	regime 1			0.304
	regime 2			0.080
Roil	regime 1	0.139		
	regime 2	0.317		
Rgold	regime 1		0.260	
	regime 2		0.169	
Panel D: Residual diagnostics				
Log *L*	-6223.65			
AIC	14.3862			
SIC	14.3942			

Note: RDJI, Roil and Rgold are the returns of the Islamic stock market, the crude oil prices and the gold prices, respectively. AIC is the Akaike Information criterion. SIC is the Schwartz Information criterion. Student-*t* statistics of parameters are reported in parentheses.
LR statistics is test calculated as $2 \times |log\ L_{MS-VAR} - \log L_{\ VAR}|$. *p*-values are in brackets.
***,** and * refer to significance levels at 1%, 5% and 10%, respectively.

Finally, the insignificant parameter relating oil price and previous gold changes highlights that gold can be regarded as a weak safe haven for oil market movements. This result is in line with Reboredo (2013). Using a copula approach, his results point out that gold exhibits the propriety of a safe haven asset in falling crude oil prices.

Panel C reports the correlation coefficients between the three assets for the low and high volatility regimes. As we can see, the coefficient values for the couples gold/oil and gold/Islamic stock returns is lower during the high volatility regime confirming the role of gold as safe haven for extreme stock and oil markets movements. Moreover, correlation between oil and Islamic stock returns is higher during the high volatility regime suggesting the connection between the two markets namely during crisis periods.

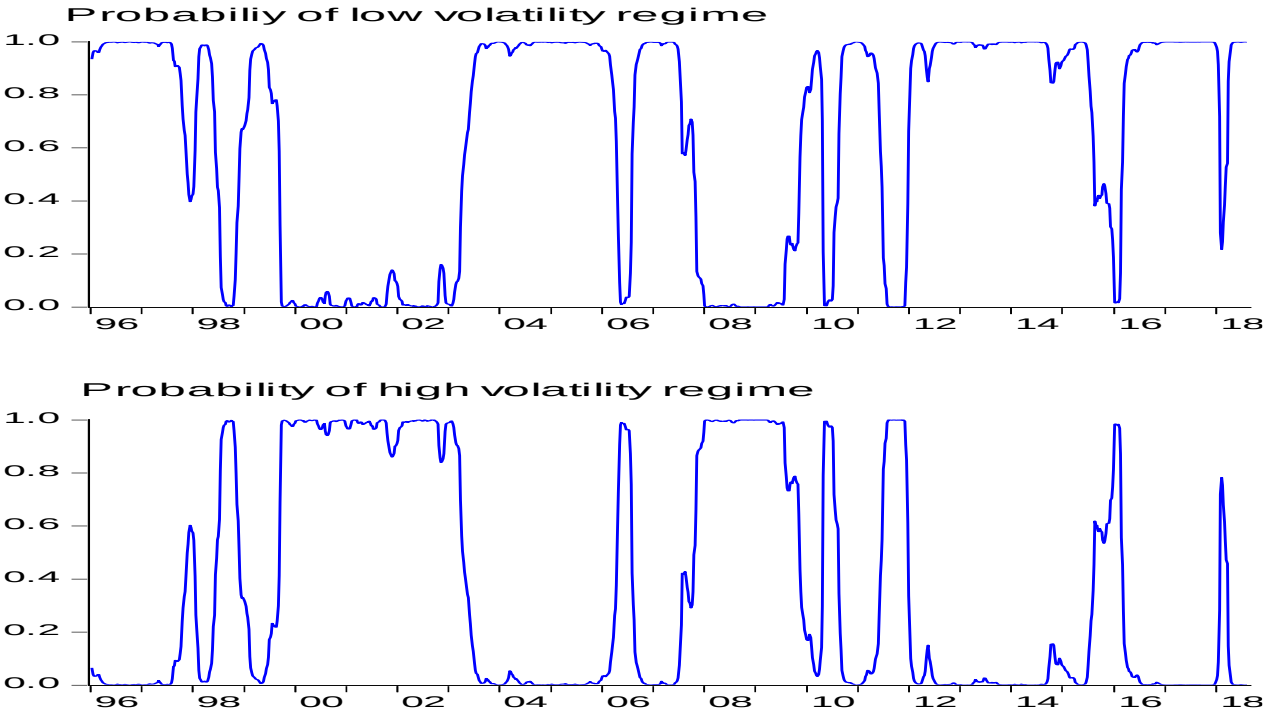

Fig. 2. Smoothed probability for low and high volatility regimes

On the whole, our findings show some resemblance between Islamic and conventional stock markets concerning their relationship with commodity prices. As shown in Fig. 3, the links between commodity and Islamic stock market varies through the regimes. The major conclusion provided is the processes of the financialization of crude oil markets with the reference of the links between oil and Islamic stock markets. This result has several implications for Islamic investors who want to share their wealth among several assets in order to reduce the risk of their portfolio. In addition, the negative links between gold prices and Islamic markets offer a better diversification opportunity given that gold can act as a strong hedge and safe haven against Islamic stock market volatility.

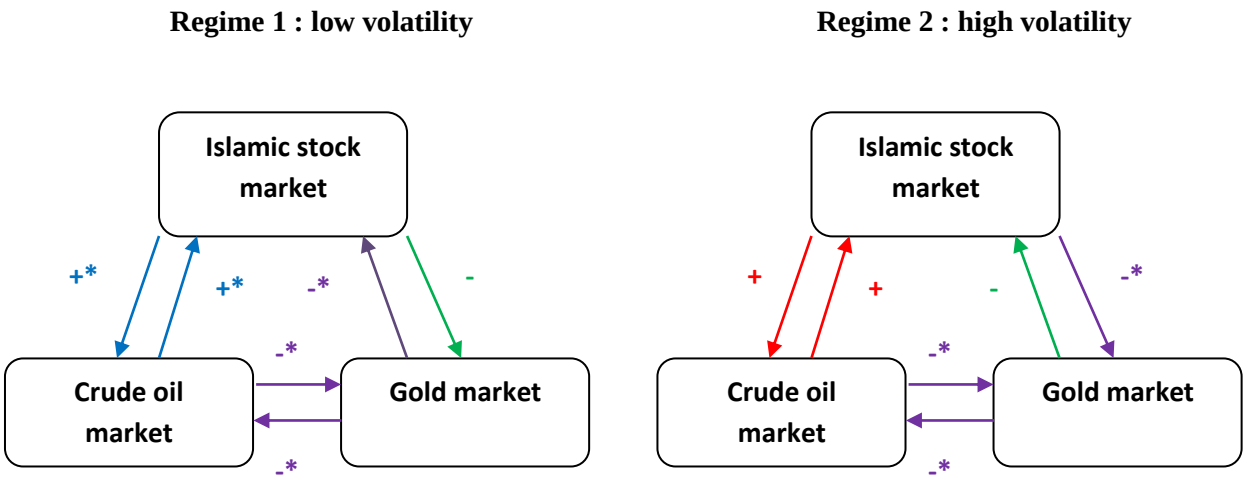

Fig. 3. Summary of the relationship between Islamic stock, oil and gold for low and high volatility regimes. Four types of link:

- positive and no significant (+*)
- negative and no significant (-*)
- positive et significant (+)
- negative and significant (-).

5. Conclusion

In this paper we investigate the relationship between Islamic stock market and two major commodities namely gold and crude oil for the period ranging from January 1996 to August 2018. We first use the VAR approach to detect the type of links between the three variables for the whole period. The empirical findings show a positive relationship between oil and Islamic stock markets confirming the process of the financialization of the crude oil market. While the negative relationship uncovered between Islamic equity market and gold highlights the role of gold as a strong hedge for Islamic market volatility. Second, by considering the Markov switching approach, we find that the relationship between the variables varies across volatility regimes. For the low volatility regime, results confirm the role of gold as a hedge for Islamic market movements. Turning to the high volatility regime, the empirical evidence reveals a negative and significant connection between Islamic index and gold price changes. This finding provides evidence that gold can be regarded as safe haven against extreme Islamic stock market conditions. These results have several implications for Islamic investors when they decide to share their wealth between different assets. Such decision requires a better understanding of the relationship between markets in order to opt to the most beneficial portfolio diversification design and to choose the optimal hedging strategy.

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