Iranian Journal of Economic Studies
Vol. 4, No. 1, Spring 2015, 101-126

Non-Linear Relationships Among Oil Price, Gold Price and Stock Market Returns in Iran: A Multivariate Regime-Switching Approach

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Abstract

In this paper, the effects of oil and gold prices on stock market index are investigated. We use a cointegrated vector autoregressive Markov-switching model to examine the nonlinear properties of these three variables during the period of January 2003 - December 2014. The Markov-switching vector-equilibrium-correction model with three regimes representing "deep recession", "mild recession" and "expansion" provides a good characterization of the sample data. The results of the model show that the impact of oil price on stock returns is positive and significant in the short run. However, it has negative effects on stock market in the long run. Moreover, we find out that the relationship between gold price and stock market returns varies during the period under investigation depending on the market conditions. More specifically, the positive gold price shock decreases the stock market returns in the short run (10 months), while it increases the stock market returns in the medium and long run.

Keywords: Stock Market Price, Oil Price, Gold Price, Markov Switching-Vector Error Correction Model (MS-VECM), Iran.
JEL Classification: E32, E37, C32, G17.

Received: 14/10/2015 Accepted: 13/4/2016
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1. Introduction

The stock market in economy is known as an organized and official market of capital and its most important task is mobilization and allocation of financial resources and turning them into capital. Achieving the desired economic growth and development without long-run financial resource mobilization is impossible. Yet, one of the main characteristics of developing countries is that they suffer from fragmentation and scarcity of savings and capital and the capital is not being conducted to optimum routs of production. Thus, it is necessary to form a strong and efficient capital markets in order to optimize the circulation of financial resources and conduct them to optimum routs of economy (Dimson, 1988).

One of the important components of capital market is the stock exchange. The existence philosophy of capital market and also stock market is that they transfer funds from sector with surplus to funds from sectors in need of cash. If the sectors invest the funds in producing the capital, it is expected to be added to the wealth of society. Accordingly, increase the returns of capital markets is the primary objective of market policy makers and legislators (Barvch, 1988). It has been argued that the most common method for making investment decisions in the stock market is the study and the awareness of the stock price trend. Stock price index shows the general trend of the stock market moves. In fact, the degree of capital market success or failure is detected according to the trend. Thus, portfolio managers and other natural and legal people who deal with stock trading and other financial assets in the market need various factors affecting the stock price under different economic conditions, in order to maintain and increase the value of their portfolio.

Several factors affect the returns of the stock exchange. One of the affecting factors is the oil price. Oil and its products are used as the main sources of energy in manufacturing processes in the world; thus, volatilities in the oil price can affect the cost of production and profitability of production companies. Oil is the most important source of income for some exporting countries and through this, its price and volatilities can affect natural sector and also the capital market, so that in many countries with poor management of oil revenues, oil price is coupled with an increase in government revenue and monetary base and has the inflation effects. Rising inflation will have a positive effect on the stock price.

Iran has 11 percent of world oil reserves and is the second largest producer in the Organization of Petroleum Exporting Countries (OPEC). Based on the time series data of the central bank of the Islamic republic of Iran, 80 to 90 percent of total export revenue and 40 to 50 percent of the annual government budget come from oil exports. In addition, the sale of oil is over 20 percent of GDP of Iran; so Iran's economy is largely dependent on exports of crude oil. Shocks in world oil markets can have a great impact on the economic structure of Iran. Another factor affecting the capital market is the price of gold. Gold is considered as the most important world monetary standard which is mostly used in coins and gold bullion as an international monetary reserve. Gold is also part of the central bank's intemational reserves. From the economic point of view, gold can be considered an strategic commodity.

Depression and expansion of stock exchange affects the national economy. It is clear that depression and expansion of stock exchange may be caused by many factors in the economy. As a powerful exogenous variable, the world oil price would affect many macroeconomic variables such as stock price index. On the other hand the changes in the world gold price captures many international monetary and financial development. Therefore, the main objective of this study is to investigate the effect of the oil and the gold prices on the stock market in Iran.

2. Literature Review

Several studies have been done on the relationships between different markets (gold, oil and capital) which can be presented in different categories. It has been tried to classify and present the studies based on result analysis method, namely linear and nonlinear time-series methods.

All the studies done by Papapetrou (2001), Maghyereh (2004), Park and Ratti (2008), Fayyad and Daly (2011) and Mohd Hussin and et al. (2012) have used vector auto regression method (VAR) on the markets of stock, oil and in some cases gold in different countries. The results have been interpreted in the following.

Papapetrou (2001) showed that oil price affect real activities of Greece’s economy and employment, while no evidence of relationship between oil prices and stock returns can be found. Maghyereh (2004) tested the dynamic relationship between crude oil price and stock returns in twenty-two emerging market economies. She showed that oil price shocks do not have significant impact on the stock index returns.

Park and Ratti (2008) studied the oil market price volatilities on key financial variables such as stock prices in the United States and thirteen developed countries. The results of their studies indicate that there is statistically a significant relationship between oil price volatility and stock index in the mentioned markets. However, type of the relationship depends on countries whether they are exporter or importer and this is evident with regard to the short time period of one month. Fayyad and Daly (2011) compared the effect of oil price shocks on the stock returns in GCC countries, America and the UK. They have concluded that the predictive power of oil price in the stock market has been increased after a rise in oil price during the global crisis. Qatar and the UAE among GCC countries and the UK compared to other countries have been more responsive to shocks.

Mohd Hussin and et al. (2012) studied the relationship between of strategic goods (i.e oil and gold prices) and Malaysia's stock market. The aim of their study was to investigate the dynamic effects of oil prices and changes in gold prices on the stock market of Malaysia by using vector auto regression (VAR). They, applying correlation analysis, Granger causality test, Impulse Response Function (IRF) and Variance decomposition (VDC), showed that the stock returns do not have integrated correlation with strategic goods in the long run. According to Granger causality, it was observed that the two-way causality relationship is only between stock returns and oil price. So only oil price variables among the strategic goods will affect stock returns in the short-run in Malaysia. This implied that the gold price is not a valid variable to predict the stock price changes.

The non-linear methods have been used in all the studies done by Maghyereh and Al-Kandari (2007), Arouri and Fouquau (2009), Arouri and Nguyen (2010), Nguyen and Bhatti (2012) and Mansoor Baig and et al. (2013), on the markets of stock, oil and in some cases gold in different countries. The results have been interpreted in the following.

Maghyereh and Al-Kandari (2007) studied the relationship between oil price and stock markets in Arabic countries located around the Persian Gulf and used the non-linear correlation analysis and error correction mechanism in their studies. They showed that in the mentioned countries, oil price would affect the index of stock prices in the long-run but the relationship is non-linear. Arouri and Fouquau (2009) examined short-run relationships between oil price and stock markets of Arabic countries located around the Persian Gulf, by using nonparametric Kernel regression method with the Gaussian Kernel. The result was that the relationship between stock returns and oil price in Qatar, Oman and United Arabic Emirates was nonlinear and there is asymmetry between changes of oil price and stock returns in these countries. They did not find a significant relationship in other Arabic countries in the Persian Gulf region. Afterward in 2010, Arouri and et al. studied the stock market responses of Arabic countries in the Persian Gulf region to volatilities of the oil price. They showed that the stock market returns significantly respond to oil price volatilities in Qatar, Oman, Saudi Arabia and the United Arab Emirates. Moreover, the relationship between the oil price and stock market in the countries is non-linear and depend on the oil price. However, the significant relationships were not seen between mentioned variables in Bahrain and Kuwait. Also Nguyena and Bhatti (2012) studied the relationship between the oil price and stock market in China and Vietnam by using copula functions and parametric and nonparametric methods. They found that there was tail dependence between oil world price and stock market index of Vietnam; however this relationship had the opposite result for stock market of China. Finally, Mansoor Baig and et al. (2013) studied the relationship between the oil price, gold price and stock market returns of Karachi in Pakistan and concluded that there was not a significant relationship between gold price growth, oil price growth and stock market returns of Karachi in the long-run.

3. Data

The monthly data index of this study is taken from Iran's stock market and then transformed into the natural logarithms to examine the economic relationship between the oil price (LnOil) and the gold price (LnGold) effect on Stock market returns (LnStock). The sample size of the study was 144 observations that were started from January 2003 until December 2014. The study structure was a quantitative approach and several steps were undergone before applied MS-VECM on examine the economic relationship model.

Figure (1) shows the diagrams of logarithm values of the oil price (OPEC basket oil (dollars)), gold price (World Gold ounces (dollars)) and the stock price (total index of stock exchange) in Iran. As it can be seen, the diagram related to the total index of stock has volatility and reached its peak in December 2013 and its minimum in March 2003.The diagram related to the oil price has a lot of volatilities and these volatilities are more tangible during July 2008 (peak) to December 2008. The diagram related to the gold price approximately kept its upward trend until September 2011 and has started to decline afterwards.

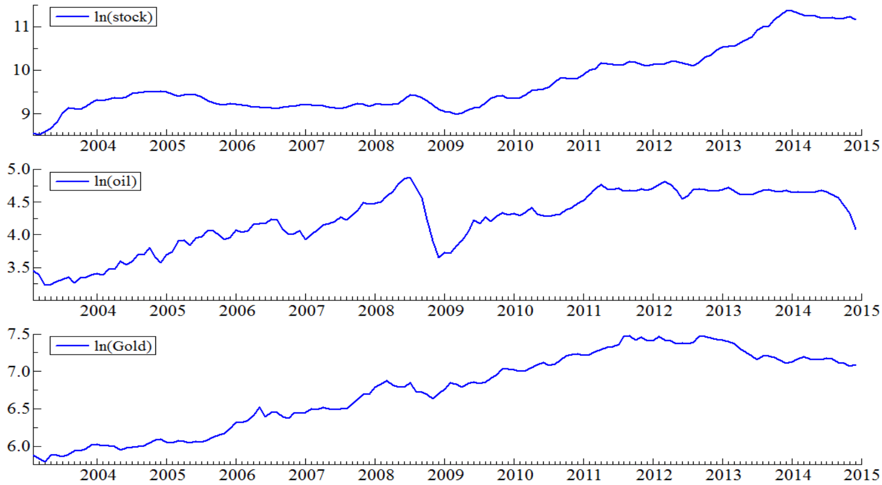


Figure 1: The Variables in Level

Figure (2) shows the diagrams of logarithm values of the stock price, oil price and gold price after taking the first differencing process. The diagram of the stock market returns shows a lot of volatilities, as the maximum returns were in July 2003 and the minimum was in December 2008. Also the diagram related to the oil price shows the maximum amount of changing in June 2009 and minimum in October 2008 and finally the diagram related to the gold price shows the maximum positive change in August 2011 and the minimum negative change in June 2006.

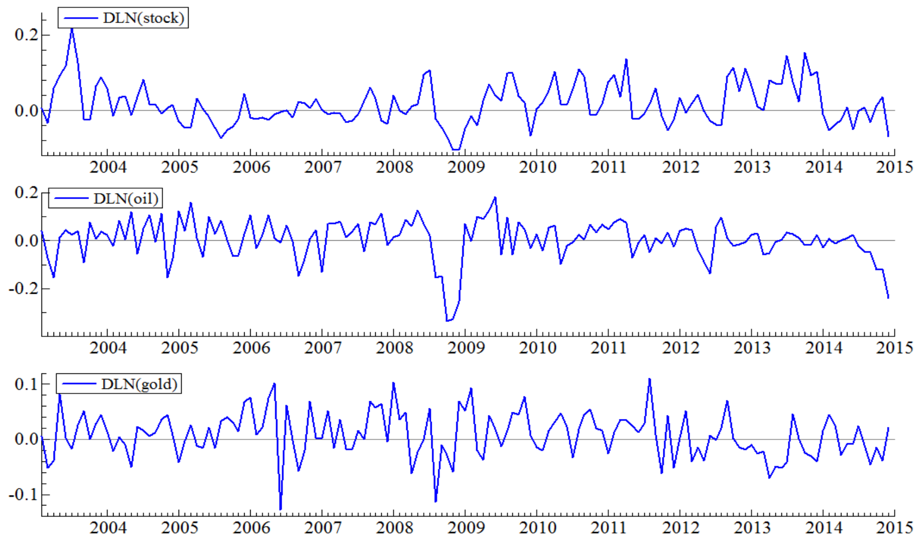


Figure 2: The Variables in First Differencing

4. Econometrics Method: MS-VECM

Various time-series models have been used to analyze the behavior of economic and financial variables. Linear models such as Auto Regression model (AR), Moving Averages (MA) and their combination (ARMA) model as the common models were used. Although these linear models in many cases are good fitting, they are not able to illustrate non-linear dynamic patterns of variables due to their ability to detect asymmetry (including structural break in time-series). Thus, non-linear models are presented.

Recently, Markov Switching model (MS) has increasingly been used in international studies and is one of the popular models of nonlinear time-series. This model consists of multiple structures which can check the behavior of the time-series of different regimes. A new form of Markov Switching model is the conversion and transmission mechanisms between different structures and regimes which are controlled by invisible status variable which is following the Markov first order chain. The main form of regime shift model is changing all or some of the parameters based on Markov processes in different conditions or regimes. Different situations are shown by invisible variable. The logic of this kind of modeling is the combination of different distribution with different characteristics. The current values of variables are extracted from this model, according to the more probable state (invisible) which is determined by observation.

The Markov switching model was introduced by Quandt (1972), Goldfeld and Quandt (1973) for the first time and then, was developed for the extraction of business cycles by Hamilton (1989). Unlike other nonlinear methods such as Artificial Neural Network (ANN) and Smooth Transition Autoregressive (STAR) in which the transition from one regime to another is a gradual switching, sudden switching is done in the Markov model.

Also vector auto regression method is one of the methods used in studying the relationships among economic variables. One of the disadvantages of the method is that it assumes all the variables considered in the model are stationary, but in fact they are not. When all variables or one of them are not stationary, vector error correction model could be a good alternative for vector auto regression model. Vector error correction model (VECM) relates the short-run volatilities of variables to the long-run equilibrium values and considers short-run dynamic response of variables. Vector error correction model is a model for linking the short-run to long-run relationships based on VAR model with the convergence characteristics.

When the series are non-stationary in levels and cointegrated, a bivariate vector error correction model (VECM) of order p can be used to jointly modeling rates behavior. Formally:

$$\Delta y_t = \nu + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \varepsilon_t \tag{1}$$

Where y_t =[LnStock LnOil LnGold]´ is a three-dimensional vector of Stock, Oil and Gold Market; LnStock is the natural logarithm of total price index differential as stock market return; LnOil represents the oil price differential and LnGold is the gold price differential. Γ_i is 3×3 autoregressive short-run parameters matrices and Π is the long-run impact matrix, whose rank r determines the number of cointegrating vectors. In the bivariate case, Π can be partitioned into a 3×1 vector β of long-coefficients, representing the long-run relationships among the variables, and a 3×1 vector α containing the equilibrium correction (speed of adjustment) coefficients ($\Pi = \alpha\beta'$).

Model (1) assumes that the relationships among stock market, gold and oil price rates are symmetric and linear. Stock market return series are characterized by occasional jumps or structural changes in their levels or volatility. The presence of important discrete economic events induces substantial non-linearity in the stochastic process and distorts inference if it is not appropriately modeled. However, most of the studies adopt a deterministic approach, which consists identifying structural breaks in the series and modeling these shifts by augmenting the empirical specification with an appropriate set of dummy variables or by conducting split sample analyses (Blot and Labondance, 2011; Panagopoulos and Spiliotis, 2012). When regime shifts are stochastic rather than deterministic, these approaches may lead to biased or at least inefficient results (Dahlquist and Gray, 2000; Clarida et al., 2006). In such cases, a multivariate generalization of the univariate Markov-switching (MS) model proposed by Hamilton(1989) represents a viable alternative to allow for stochastic behavioural changes.

Multivariate generalized Markov switching model is introduced by Krolzig (1996) as Markov Switching-Vector Error Correction Model (MS-VECM) and is related to the concept of multiple equilibriums in dynamic economic theory.

According to Krolzig study (1996), a Markov Switching-Vector Error Correction Model (MS-VECM) in the form of equation (2) is a model with regime dependent parameters:

$$\Delta y_t = v(s_t) + \alpha(s_t)\left[\beta' x_{t-1} - \gamma t\right] + \sum_{k=1}^{p-1} \Gamma_i (s_t) \Delta y_{t-k} + u_t \qquad (2)$$

The model is related to the concept of multiple equilibriums in dynamic economic theory. From now on, every regime which is defined by a system with the phrase $\delta(s_t)$ and long-run equilibrium $\eta(s_t)$, would be determined in the form of equation (3):

$$\Delta y_t - \delta(s_t) = \alpha\left[\beta' y_{t-1} - \eta(s_t) - \gamma t\right] + \sum_{k=1}^{p-1} \Gamma_i \left[\Delta y_{t-k} - \delta(s_t)\right] + u_t \qquad (3)$$

In the model, it is assumed that a regime which is occurs in t time, is invisible and depends on (s_t) an invisible process.

To complete the model, characteristics of s_t process should be identified. s_t in the Markov switching model is considered as a first degree Markov process. This assumption reflects the fact that s_t only depends on last period regime, means s_{t-1}. In the following, we would complete the model by introducing the equation (4) the transition probabilities from one state to another one:

$$\Pr = \left[s_t = j \middle| s_{t-1} = i, s_{t-2} = k, ...; y_{t-1}, y_{t-2}, ... \right] = \Pr\left[s_t = j \middle| s_{t-1} = i \right] = p_{ij} \quad (4)$$

Transition between regimes can be shown by transition probability matrix. For example, the matrix is in the form of equation (5) for a two-regime model:

$$P = \begin{pmatrix} \Pr(s_t = 1 | s_{t-1} = 1) & \Pr(s_t = 2 | s_{t-1} = 1) \\ \Pr(s_t = 1 | s_{t-1} = 2) & \Pr(s_t = 2 | s_{t-1} = 2) \end{pmatrix} = \begin{pmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{pmatrix} \quad (5)$$

In equation (5), $p_{ij}\,(i, j = 1, 2)$ shows the probability of transition from $s_t = j$, assuming $s_{t-1} = i$ and $p_{i1} + p_{i2} = 1$.

The MS-VECM model allows all the variables in it to be shocked, in the context of the model. When the system is affected by the regime transition, impulse response is checked by considering the transition of variables of dependent on VAR feature regime and hidden Markov chain. Impulse responses are often used in examining the relationship between the dynamic model variables. So that the ultimate impact of impulse on the system is being followed over time.

In Krolzig and Toro (1999) study, at first MS (M) -VECM(P-1) model is considered in the form of equation (6) to analysis the impulse response in Markov switching model:

$$\Delta y_t = M\xi_t + \alpha\beta' y_{t-1} + \Gamma_1 y_{t-1} + ... + \Gamma_{p-1} y_{t-p+1} + u_t \quad (6)$$

In equation (6): $M = \left[1 : ... : M\right]$. MS (M)-VAR(P) model corresponded to equation (6) is in the form of equation (7).

$$y_t = M\xi_t + A_1 y_{t-1} + A_p y_{t-p} + u_t \quad (7)$$

In equation (7), $A_j = \Gamma_j - \Gamma_{j-1}$ and $A_1 = I_k + \alpha\beta' + \Gamma_1$ for $A_j = \Gamma_j - \Gamma_{j-1}$ and 1< j < p are equal to $\Gamma_p = 0_k$. A show of MS(M)-VAR(1) accumulated with a process of MS(M)-VAR(P) is used to calculate the impulse response function. By considering $y_t = (y'_t, ..., y'_{t-p+1})'$ equation (7) is rewritten as equation (8):

$$y_t = H\xi_t + JAy_{t-1} + u_t \tag{8}$$

The state-space representation is completed in the form of equation (9) by the VAR(1) representation of the Markov chain (Hamilton, 1994):

$$\xi_{t+1} = F\xi_t + v_t \tag{9}$$

In equation (9), ξ_t is the unobservable $(M \times 1)$ state vector consisting of the indicator variables $I(S_t = m)$ for $m = 1,...,M$; Hence the expectation of y_{t+h} conditional upon $\{u_t, \xi_t, y_{t-1}\}$ is given by equation (10):

$$y_{t+h|t} = H\xi_{t+h|t} + JAy_{t+h-1|t} \tag{10}$$

In equation (10), conditional expectation of ξ_{t+h} is as equation (11):

$$\xi_{t+h|t} = F^h \xi_t \tag{11}$$

According to equation (11), impulse response analyses (response of system to normal shifts in variables) of linear VAR models are as equation (12):

$$\frac{\partial y_{t+h}}{\partial u_{jt}} = JA^h \iota_j \tag{12}$$

In equation (12), ι_j is the jth column of the identity matrix. If variance-covariance matrix $\sum_u$ is regime-dependent the standardized and orthogonalized impulse-responses also become regime-dependent:

$$\frac{\partial y_{t+h}}{\partial u_{jt}} = JA^h D(\xi_t)\iota_j \tag{13}$$

In equation (13), $u_t = D(\xi_t)\varepsilon_t$ and $D(\xi_t)$ is a lower triangular matrix resulting from Choleski decomposition of $\Sigma u(\xi_t) = D(\xi_t)D(\xi_t)'$

5. Empirical Results and Discussion

5.1. Unit Root Test

At first, stationary of variables should be ensured to avoid spurious regression. In this section, stationary of variables are checked by the Augmented Dickey Fuller (ADF), Dickey Fuller GLS (ERS) and Kwiatkowski-Philips-Schmidt-Shin (KPSS) tests. ADF and ERS tests showed that under the null hypothesis of a unit root; their outputs reported MacKinnon lower-tail critical and p-values for these tests, but the KPSS test differed from the other unit root tests described here in that the series are assumed to be stationary under the null hypothesis and the KPSS output only provided the asymptotic critical values tabulated by KPSS.

Test results, presented in Table 1, clearly indicate the presence of a unit root for all the series in levels and a rejection for the series in first-differences, providing evidence of an I(1) behavior.

Table 1: Unit Root Test

	Ln(stock)		**Ln(oil)**		**Ln(gold)**	
	Level	First diff.	Level	First diff.	Level	First diff.
a)Unit root test						
ADF	-0.6374 (0.8574)*	-6.2123 (0.000)	-2.0693 (0.2574)	-7.5060 (0.000)	-1.6817 (0.4384)	-10.6824 (0.000)
DF-GLS	0.8738 (0.3837)	-6.0998 (0.000)	-1.0174 (0.3107)	-7.2494 (0.000)	0.7368 (0.4624)	-10.7053 (0.000)
b) Stationary test						
KPSS**	1.1160	0.1674	1.2106	0.1684	1.3077	0.380

*The value in parentheses is represented to the p-value.

** Asymptotic critical values for the KPSS test are 0.739, 0.463 and 0.347 at the 1, 5 and 10% levels, respectively.

5.2. Cointegration Test

To estimate the cointegration model of Johansen, The optimal interval of variables must be provided at first. Thus LR test and information criterion are used to identify the optimal interval and also the optimal number of regime and optimal model in Markov switching model. The model is optimal when the amount of its information criterion is minimum. Three of the most common information criterion includes:

The Akaike Information Criterion (AIC) Test:

$$AIC = 2k - 2\log(L) \tag{14}$$

The Schwarz Information Criterion (SC) Test:

$$SC = k\ln(n) - 2\log(L) \tag{15}$$

The Hannan-Quinn Information Criterion (HQ) Test:

$$HQ = 2k\ln(\ln(n)) - 2\ln(l) \tag{16}$$

Where k represents the number of parameters, n is the number of observations and L is the maximized likelihood value.

To indicate the optimal lag of VAR model and according to the table (2), the number 8 is considered as the maximum of optimal interval in the model. The optimal interval is 2, according to the existed criteria.

Table 2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-181.3006	NA	0.003017	2.710303	2.774552	2.736412
1	616.0590	1547.816	2.78e-08	-8.883220	-8.626221	-8.778782
2	650.5638	65.45768*	1.91e-08*	-9.258291*	-8.808543*	-9.075525*
3	659.4575	16.47950	1.92e-08	-9.256728	-8.614231	-8.995633
4	667.0748	13.77844	1.96e-08	-9.236395	-8.401148	-8.896972
5	669.6355	4.518813	2.16e-08	-9.141699	-8.113703	-8.723947
6	678.255	14.83151	2.17e-08	-9.136111	-7.915366	-8.640031
7	685.1897	11.62494	2.25e-08	-9.105731	-7.692237	-8.531323
8	692.8311	12.47349	2.30e-08	-9.085752	-7.479508	-8.433015

* indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error

At this point, we determine the number of cointegration vectors. This is a means of testing for cointegration in a multivariate context, where there is the possibility of more than one cointegrating vector being present. It follows the same principles as the Engle-Granger approach to cointegration, in so far as the order of integration of the variables are first assessed, if the variables are I(1) the Johansen Maximum Likelihood (ML) procedure can then be used to determine whether a stable long-run relationship exists between the variables.

Johansen cointegration method based on $\hat{\lambda}_{trace}$, trace test and $\hat{\lambda}_{\max}$, maximum eigenvalue test is used to determine the number of cointegration vectors. Summary of the results of maximum eigenvalue test and trace test is in table (3). According to results of Table (3), all two statistics of $\hat{\lambda}_{trace}$ and $\hat{\lambda}_{\max}$ confirm the existence of a cointegration vector; because null hypothesis of no convergence vector is ruled out by both statistics but the hypothesis of presence of more than one integration vector is not ruled out.

Table 3: Johansen Test Outputs

Hypothesized No. of CE(s)	Trace statistics		Maximum Eigenvalue statistics	
	$\hat{\lambda}_{trace}$	5% critical value	$\hat{\lambda}_{\max}$	5% critical value
None*	41.2697* (0.0098)	35.1927	25.6711* (0.0163)	22.2996
At most 1	15.5985 (0.1940)	20.2618	12.1865 (0.1754)	15.8921
At most 1	3.4119 (0.5067)	9.1645	3.4119 (0.5067)	9.1645

The value in parentheses is represent the p-value
* denotes rejection of the hypothesis at the 0.05 level

Table 4 shows the convergent and normalized vector of the model. As it is clear, the cointegration vector under consideration is normalized with regard to variable of Lnstock.

Based on the results of linear error correction, stock price index has a reverse relationship with the oil price and a direct relationship with the gold price in long-run. Since, the variables used in this model are logarithmic; we can interpret coefficients as elasticity. The long-run elasticity of stock price index with regard to the oil price is -5.2399, this means that one percent increase in the oil price decreases the stock price index up to 5.2399 percent. Also, the long-run elasticity of the stock price index with regard to the gold price is 4.5395 which means that one percent increase in the gold price increases the stock price index up to 4.5395 percent in the long-run.

On the one hand, the oil price increases along with the increase in the oil incomes which disrupts the allocation of financial sources in government sector and will develop marginal investments and unfinished projects; on the other hand, increase in importing consumer would decrease the competition power of internal products and output of private sector investments. As a result, those who work in private sectors are not motivated to invest in exchangeable products sector and this issue affects the capital market. The direct relation between the stock price and the gold price has somewhat encountered difficulty in the long-run. Considering such results, we should take necessary caution. Such unexpected result may be due to stock market inefficiency and lack of currency basket among people. Other reason of such results may be the fact that the gold price in Iran is affected by two sides. On one hand, it is affected by world gold price and on the other hand, it is affected by the assessed economic policies.

Table 4: Cointegration Vector of Linear

Cointegrating Eq:	CoinEq1
Lnstock(-1)	1.0000
Lnoil(-1)	5.2399 (1.4500) [3.6135]
Lngold(-1)	-4.5395 (1.2388) [-3.6643]
C	-2.2744 (3.8802) [-0.5861]

The value in () is represent to the standard errors
The value in [ ] is represent to the t-statistics

5.3. MS-VECM Result

5.3.1. Testing for Non-Linear Relations and Regime Characteristics

Markov Switching models are created through change in mean, intercept, heteroskedasticity and autoregression coefficients. Two conditions are required for selecting an optimum model. Firstly, the null hypothesis which is based on stable regime in the model must be rejected. Secondly, the mentioned model must be more appropriate in terms of information criteria than the probable models in which the first condition is proved.

Through investigating various techniques, taking into consideration the nature of data and the optimum interval, we could identify three regimes. Then, the models were compared based on AIC, SC, and HQ criteria and LR test. At the end, MSIH(3)-VECM(1) model was selected as the superior one. In this model, intercept and heteroskedasticity variance depend on the regime.

Table 5 shows the results of estimating parameters of the above model by using maximum likelihood method. The statistical amount of LR test based on the linearity behavior of variables is 78.7059 and based on the p-value number related to Davises Statistics, this hypothesis is rejected and the non-linearity relation between these variables is confirmed.

Table 5: Criterion Test Results on the Markov Switching Models

	MSIH(3) – VECM(1)	Linear VECM
Log-likelihood	706.626	667.2740
AIC criterion	-9.3187	-9.1025
HQ criterion	-8.9380	-8.9248
SC criterion	-8.3820	-8.6653
LR linearity test:	78.7059 Chi(18) =[0.0000]	DAVIES=[0.0000] Chi(24)=[0.0000]

The results of estimating MSIH(3)-VECM(1) model for investigating the impact of the stock market return on the oil and the gold prices are presented in Table 6. As it shows, during this study the impact of these parameters can be divided into three regimes and also the variable coefficients are statistically significant. Since, the intercept of regime 1 is less than regimes 2 and 3, we can say that stock output in regime 1 is less than the two other regimes. So, regime 1 is considered as deep recession, regime 2 as less recession and regime 3 as expansion situation.

Coefficients of variables are significant. As it can be seen in Table 6, the sign related to independent variable, oil price, is positive which shows that there was a direct relation between the oil price and the stock output in the short run. Moreover, gold price has negative effect on the stock market returns.

CYN coefficient which shows the adjustment rate demonstrates that for the total index of stock exchange in each period 0.6 percent is adjusted which indicates the low rate of adjustment in the model.

The results in Figure (3) show that the three-regime MS-VECM model is suitable for estimating the variables in the financial relationship model because the fitted and 1-step predicted probabilities for all variables in the system fit to the mean.

Table 6: MSIH(3)-VECM(1) Outputs

	$DLN(stock)_t$	$DLN(oil)_t$	$DLN(gold)_t$
Intercepts			
Const (Regime 1)	-0.0523	-0.1248	-0.0179
	(-6.4493)	(-4.0419)	(-1.0383)
Const (Regime 2)	-0.0077	0.0015	0.0042
	(-1.5396)	(0.1549)	(0.7935)
Const (Regime 3)	0.0546	0.0021	0.0193
	(5.9902)	(0.0902)	(1.5447)
Autoregressive coefficients			
$DLN(stock)_{t-1}$	0.3017	0.0807	-0.0557
	(4.5659)	(0.5100)	(-0.6108)
$DLN(oil)_{t-1}$	0.0513	0.1970	0.0263
	(1.2705)	(2.0761)	(0.5794)
$DLN(gold)_{t-1}$	-0.2335	-0.0004	0.1265
	(-3.5185)	(-0.0035)	(1.4918)
Adjustment coefficient			
CYN	-0.006	-0.0124	-0.0013
	(-2.7001)	(-2.6621)	(-0.5220)
Standard Error			
SE (Regime 1)	0.0266	0.0922	0.0603
SE (Regime 2)	0.0241	0.0731	0.0336
SE (Regime 3)	0.0389	0.0400	0.0406

The value in () is represent to the t-statistics

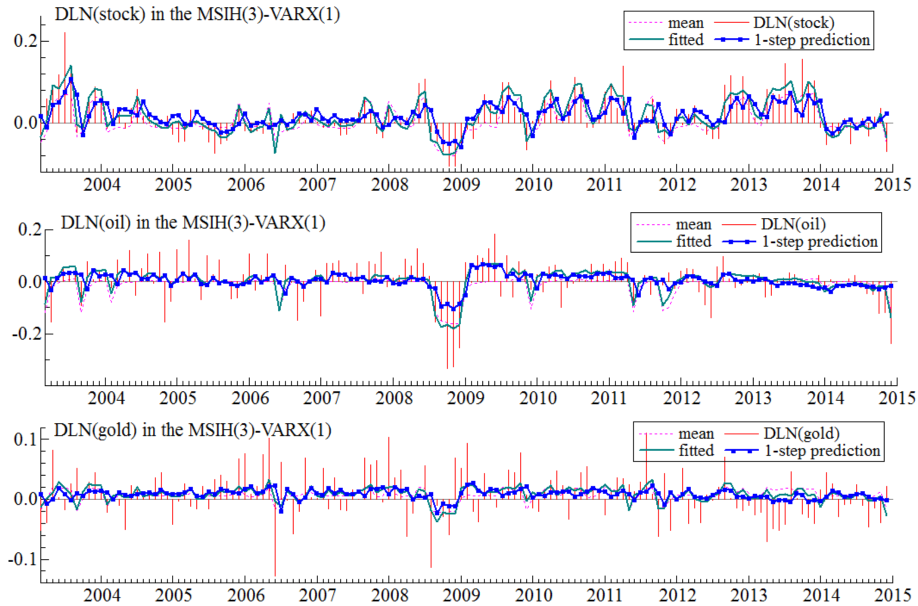


Figure 3: MSIH(3)-VECM(1) Fit

Based on the results in Table 7, the dominant economical regime is the second regime so that markets under investigation are in normal conditions or recession (regime 2) with the probability of 0.5756 and the average survival duration of 4.04, in prosperity duration (regime 3) with the probability of 0.326 and the average survival duration of 2.38, and in slump situation (regime 1) with the probability of 0.098 and the average survival duration of 1.63.

Table 7: Regime Properties

	No. of observations	Probability	Duration
Regime 1	14.3	0.0984	1.63
Regime 2	81.4	0.5756	4.04
Regime 3	46.4	0.3260	2.38

The situations of the three regimes are presented in Figure 4.

Figure 4: MSIH(3)-VECM(1) Probabilities Sketched

In order to investigate the degree of regimes instability and probabilities of transfer of each regime to another, we have extracted Matrix of transition probability. As Table 8 indicates, the probability of transfer from regime one (deep recession) to regime 2 (less recession) is 0.61 and from regime 2 to regime 1 is 0.009. Probability values show that regime 2 is more stable than regime 1. Also, the probability of transfer from regime 1 to regime 3 (expansion) is very low and from regime 3 to regime 1 is 0.168. As a result, regime 1 is more stable than regime 3. At most, the probability of move from regime 2 to regime 3 is 0.237 and from regime 3 to regime 2 is 0.251. So, the stability of regimes 2 and 3 is almost the same.

In addition, the probability of transfer from regime 2 to regime 3 is 0.75 which is more stable than the other ones. The results obtained from regimes transfer is in line with economic cycle's theories and are expected so that change of stagnation condition into prosperity condition happens with less probability and in the long run, while change of prosperity condition into stagnation condition happens with more probability and in a short run.

Table 8: Matrix of Transition Probabilities

	Regime 1	Regime 2	Regime 3
Regime 1	0.3860	0.6140	1.846e-006
Regime 2	0.0096	0.7526	0.2377
Regime 3	0.1683	0.2515	0.5803

5.3.2. Impulse Response Analysis

In next stage, the impact of shock on the particular variable on other variables is investigated through Impulse Response Function (IR). The analysis of active reciprocal impacts of created impulses in the system is done through variance decomposition and Impulse Response Functions.

Impulse Response Functions (IRF) shows the active behavior of pattern variables at the time of creating impulses on each of the pattern variables in the duration. These impulses are usually selected as one standard deviation. The origin or the beginning point of response variable movement is the values related to the stable situation of system (without impulse).

Figure 5 shows the response of the stock price index, the oil price and the gold price toward one shock standard deviation to each variable in different three regimes.

The response of stock market to the shock on the gold price in each of the three regimes is similar and it is negative in short time, also it decreases the stock price. But, gradually the effects disappear and after about 10 months, the gold price shock would have a positive effect on the stock market and it would have a positive and stable long term effect.

Moreover, the results show that the response of stock market to the positive shock on the oil price in each of the situations decreases the stock price. This effect is stable in all the short term and long term durations.

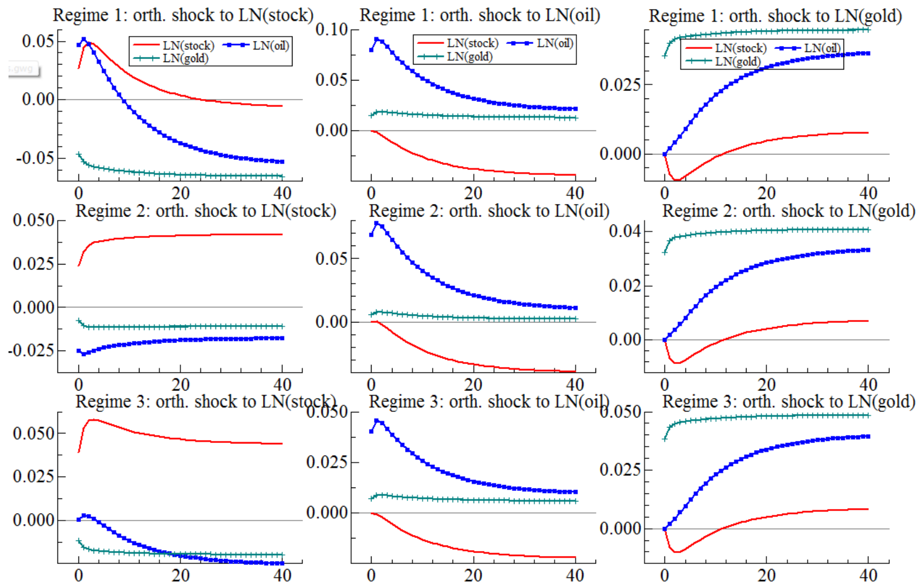


Figure 5 : Impulse Response Analysis

6. Conclusion

In this study, the impact of oil and gold prices on Iran's stock market were investigated through monthly data covering the period January 2003 to December 2014. A cointegrated vector autoregressive Markov switching model was used to examine the nonlinear properties of the variables. Impact of shocks on each variable was investigated and was anticipated.

Three different regimes including “deep recession”, “mild recession” and “expansion” are used to characterize the sample data respectively. The results obtained from the model show that the impact of the oil price on stock return in each regime is statistically significant and positive in the short run. However, it has negative effect on stock market in the long run.

The relation between the gold price and the stock market return varies during the period under investigation depending on the market conditions. More specifically, the positive gold price shock decreases the stock market returns in the short time (10 month), while it increases the stock market return in the medium and long run. Our finding might have implications for policymakers and investors in the stock market of Iran.

References

Arouri, M. E. H., & Fouquau, J. (2009). On the short-term influence of oil price changes on stock markets in GCC countries: linear and nonlinear analyses, *Cornell University Library*.

Arouri, M. E. H., & Nguyen, D. K. (2010). Oil prices, stock markets and portfolio investment: Evidence from sector analysis in Europe over the last decade. *Energy Policy, 38*(8), 4528–4539.

Barvch, L. (1988). Toward a Theory of Equitable and Efficient Accounting policy. *The Accounting Review*, *63*, 15-37.

Blot, C., & Labondance, F. (2011). Bank interest rate pass-through in the euro zone: monetary policy transmission during the boom and since the financial crash. Paper presented at the 15th Annual Conference on Macroeconomic Analysis and International Finance.

Clarida, R. H., Sarno, L., Taylor, M. P., & Valente, G. (2006). The role of asymmetries and regime shifts in the term structure of interest rates. *Journal of Business*, *79*(3), 1193-1224.

Dahlquist, M., & Gray, S. F. (2000). Regimes switching and interest rates in the European monetary system. *Journal of International Economics*, *50*, 399-419.

Dimson, E., & Mussavian, M. (1998). A brief history of market efficiency. *European Financial Management*, *4*, 91-193.

Engle, R F., & Granger, C.W. J. (1987). Cointegration and error correction: representation, estimation and testing. *Econometrica*, *55*, 251-276.

Fayyad, A., & Daly, K. (2011). The impact of oil price shocks on stock market returns: comparing GCC countries with the UK and USA. *Emerging Markets Review, 12*(1), 61-78.

Goldfeld, S. M., & Quandt, R. E. (1973). A Markov model for switching regressions. *Journal of Econometrics*, *1*(1), 3-15.

Hamilton J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica*, *57*, 357-384.

Hamilton, J. D. (1994). Time series analysis (Vol. 2). Princeton: Princeton university press.

Krolzig, H. M. (1996). Statistical analysis of cointegrated VAR processes with Markovian regime shifts. Berlin: Humboldt University Press.

Krolzig, H. M., & Toro, J. (1999). A new approach to the analysis of shocks and the cycle in a model of output and employment. European University Institute. *Working paper ECO*, no. 99-30.

Maghyereh, A. (2004). Oil price shocks and emerging stock market: a generalized VAR approach. *International Journal of Applied Econometrics and Quantitative Studies*, 1(2), 27-40.

Maghyereh, A., & Al-Kandari, A. (2007). Oil prices and stock markets in GCC countries: new evidence from nonlinear cointegration analysis. *Managerial Finance*, 33(7), 449-460.

Mansoor Baig, M., Shahbaz, M., Imran, M., Jabbar, M., & Ain, Q.U. (2013). Long run relationship between gold prices, oil prices and Karachi stock market. *Acta Universitatis Danubius*, *9*(5), 28-39.

Mohd Hussin, M. Y., Muhammad, F., Abu, M. F., & Awang, S. A. (2012). Macroeconomic Variables and Malaysia Islamic Stock Market: A Time Series Analysis. *Journal of Business Studies Quarterly*, *3*(4), 1-13.

Mohd Hussin, M. Y., Muhammad, F., Abu-Hussin, M. F., & Abdul Razak, A. (2012). The Relationship between Oil Price, Exchange Rate and Islamic Stock Market in Malaysia. *Research Journal of Finance and Accounting*, *3(*5), 83-92.

Nguyen, C.C., & Bhatti, M.I. (2012). Copula model dependency between oil prices and stock markets: Evidence from China and Vietnam. *Journal of International Financial Markets, Institutions & Money*, *22*, 758–773.

Panagopoulos, Y., & Spiliotis, A. (2012). Is the Eurozone homogeneous and symmetric? An interest rate pass-through approach before and during the recent financial crisis. Paper presented at the 15th Annual Conference on Macroeconomic Analysis and International Finance.

Park, J., & Ratti, R. A. (2008). Oil price shocks and stock markets in the U.S. and 13 European countries, *Energy Economics*, *30*(5), 2587-2608.

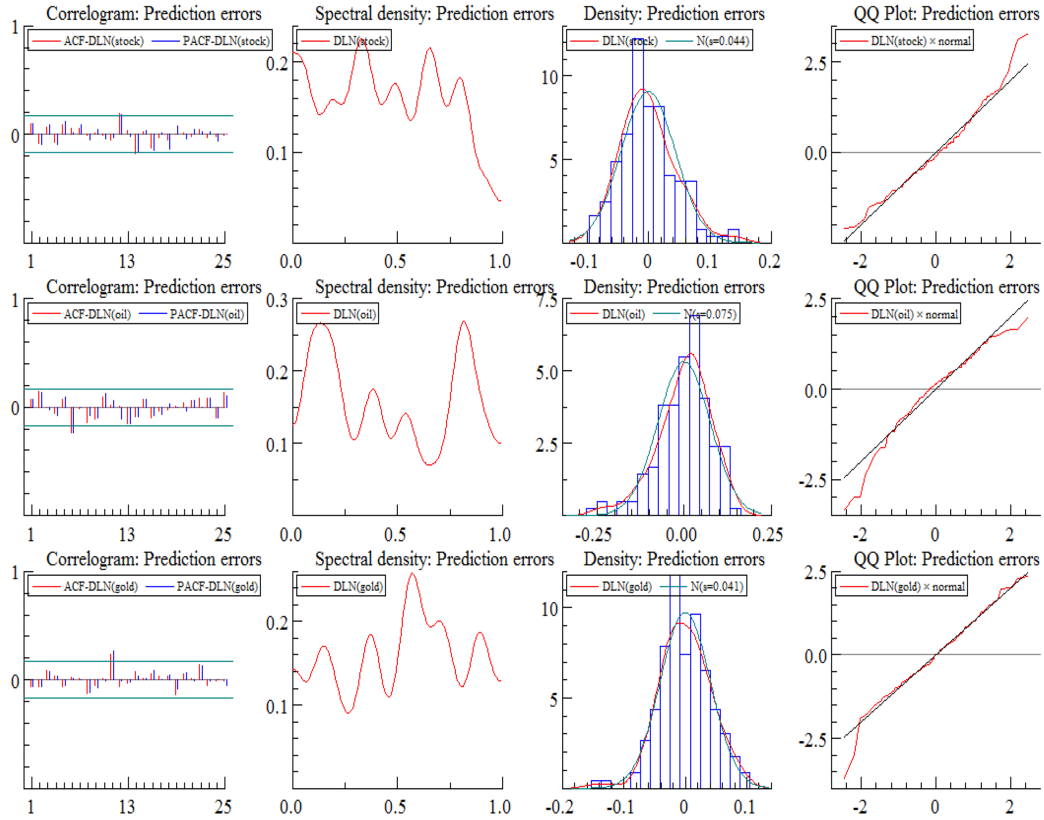
Papapetrou, E. (2001). Oil price shocks, stock market, economic activity and employment in Greece. *Energy Economics*, *23*(5), 511-532.

Quandt, R. E. (1972). A New Approach to Estimating Switching Regressions. *Journal of the American Statistical Association*, *67*(338), 306-310.

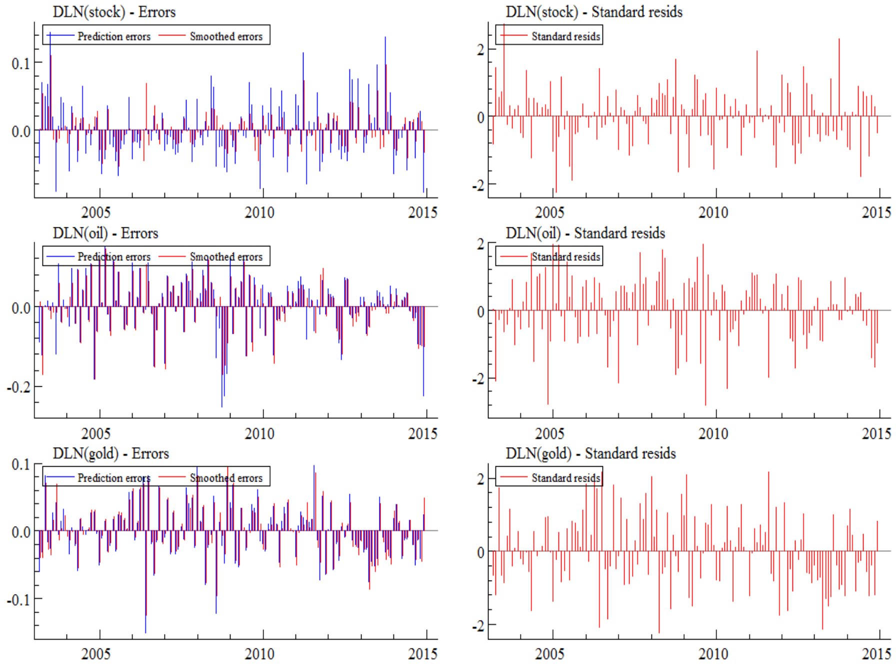
Appendix:

A1: Regime Classification

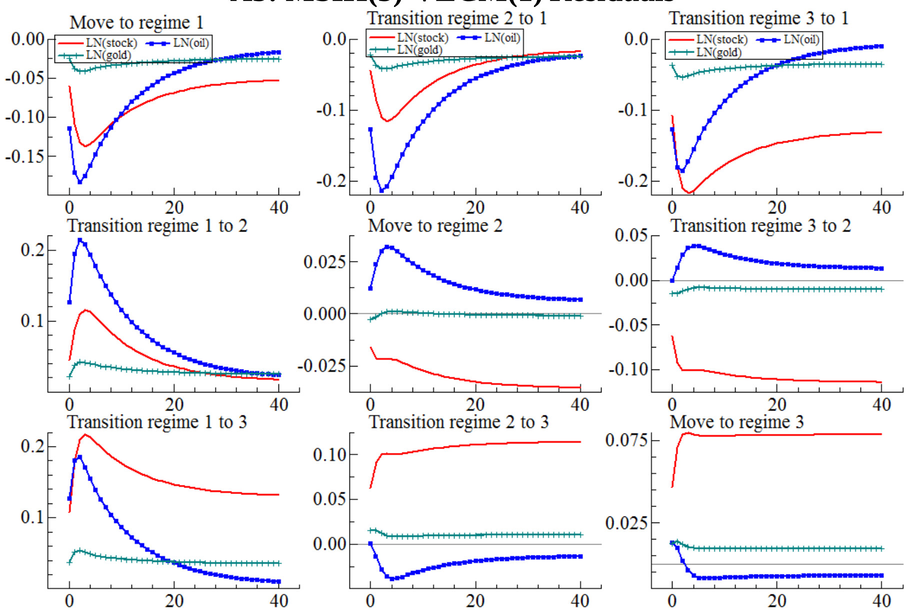
Regime 1	Regime 2	Regime 3
2003:3 - 2003:3 [0.9756] 2003:9 - 2003:9 [0.9990] 2004:2 - 2004:2 [0.6931] 2006:6 - 2006:6 [0.9874] 2008:8 - 2008:12 [0.9996] 2009:12 - 2009:12 [0.9029] 2011:5 - 2011:5 [0.9693] 2011:10 - 2011:11 [0.7666] 2014:12 - 2014:12 [1.0000]	2003:4 - 2003:4 [0.9999] 2003:10 - 2003:10 [0.9979] 2004:3 - 2004:6 [0.9544] 2004:8 - 2005:11 [0.9528] 2006:1 - 2006:4 [0.9546] 2006:7 - 2007:8 [0.9118] 2007:11 - 2007:12 [0.9547] 2008:2 - 2008:5 [0.8729] 2009:1 - 2009:7 [0.9363] 2010:1 - 2010:2 [0.9769] 2010:5 - 2010:6 [0.8638] 2010:10 - 2010:12 [0.8245] 2011:6 - 2011:7 [0.8996] 2011:12 - 2012:8 [0.8976] 2013:1 - 2013:3 [0.8131] 2014:1 - 2014:11 [0.8463]	2003:5 - 2003:8 [0.9993] 2003:11 - 2004:1 [0.9321] 2004:7 - 2004:7 [0.9884] 2005:12 - 2005:12 [0.9806] 2006:5 - 2006:5 [0.9700] 2007:9 - 2007:10 [0.8875] 2008:1 - 2008:1 [0.9957] 2008:6 - 2008:7 [0.9999] 2009:8 - 2009:11 [0.8971] 2010:3 - 2010:4 [0.8850] 2010:7 - 2010:9 [0.9069] 2011:1 - 2011:4 [0.9037] 2011:8 - 2011:9 [0.9565] 2012:9 - 2012:12 [0.8980] 2013:4 - 2013:12 [0.9153]



A2: MSIH(3)-VECM(1) Diagrams



A3: MSIH(3)-VECM(1) Residuals



A4: MSIH(3)-VECM(1) Regime Shifts