OIL PRICE, FINANCIAL MARKETS INDEX AND INFLATION IN IRAN'S ECONOMY

[1]SHAHRAM FATTAHI, [2]KIOMARS SOHAILI, [3]SHAHRAM DEHGHAN JABARABADY

Razi University, Kermanshah Province, Kermanshah, Zakariya Razi Blvd, Iran
E-mail: sh_fatahi@yahoo.com

Abstract - This study aims to examine the dependence of oil price, financial markets index and inflation in Iran's economy during the period December 2008 to April 2016. To do so, a hybrid model including a stochastic model and continuous wavelet transform has been used. The results show that the cause of inflation and other fluctuations in Iranian economy is the fluctuation of the oil market. On the other hand, there is an interrelationship between the pair markets of oil and stock, oil and gold, and ultimately oil and currency in the short term, but in the long run there is only a relationship between the stock market and the oil market. Furthermore, oil sanctions have resulted in increasing the interconnection between the pair markets.

Keywords - Inflation, Financial Market, Stochastic Modeling, Wavelet Transform
JEL classification - C01, E31, G10

I. INTRODUCTION

The interrelationship between financial markets is one of the major issues that researchers have broadly focused on; and these studies are more important when financial crises occur. Over past few years, one recent phenomenon of financial crises is that the tendency toward increasing the interrelationship among financial markets is high during the crisis. This property is referred to as financial contagion. Inmost cases, it is assumed that contagion occurs in financial markets where price dependency is more differentiated in financial markets. It is also as such in times of crisis. Various empirical studies using different econometric methods have shown that, asthe market moves towards turmoil, the interrelationship problem in the markets breaks out.

The relationship between inflation rate and financial markets in Iran is of special importance. The research objectives are divided into two sections. In the first part, we will focus on the issue where the contagion will begin. And the second part examines the relationship between the pair markets in the short, medium and long terms. After that, the effects of sanctions markets dependence in Iran's Economy will be examined.

It is obvious that one of the manifestations of the crisis in the Iranian economy is the various international sanctions imposed, especially oil sanctions. On March 31, 2012, the oil sanctions against Iran were enforced. The sanctions are imposed by direct measures such as banning purchases or purchasers, as well as immediate measures, such as insurance sanctions on oil tankers or banking sanctions.

The outbreak of oil sanctions against Iran has further revealed the level of dependence of Iranian economy on oil and gas exports. Oil exports, including crude oil, petroleum products, natural gas, condensate and gas account for 80% of Iranian exports. On the other hand, Iranian exports account for about 35% of Iran's GDP. In this way, it is possible to say that about 28 percent of the Iranian economy is in the hands of oil exports. Now, if this oil export is reduced by 50%, there is a 14% decline in GDP.

In this study, we try to investigate the relationship among inflation, financial markets and oil price in Iranian economy. In this respect, the following questions are raised:

Where is the starting point of contagion among the variables?

What is the relationship between the variables in the short and long terms?

A combination of the Ornstein-Ellen beck process and wavelet transform has been used; where, the OU process helps the researcher to answer the first question and find more evidence on the relationship between the variables. Besides, the second method will provide a general overview of the relationship between variables in the time-frequency vector.

The paper is divided into four sections. Following introduction in section 1, section 2review the literature. Section 3 reports the empirical results. Finally, section 4 concludes the paper.

II. LITERATURE REVIEW

The issue of contagion has attracted the attention of many researchers in recent years. Techniques that examine the issue of contagion are more focused on finding changes in a multi-lateral description of return rates during times of crisis and Meta crisis.

Masson (1990) examines the types of models producing multiple equilibria in financial markets. Such models are consistent with observed phenomena, such as the greater volatility of financial asset prices than of macroeconomic fundamentals. During the 1997 Asian crisis, Kaminsky and Schmuckler (1999) studied 9 Asian countries. They stated that large unwanted changes could be

explained by clear news from organizations such as international organizations, credit rating agencies, etc. Examinations based on the impact of the East Asian contagion cycle on the GDP of emerging countries showed that fixed investment in affected areas dropped by 7.9%, while their GDP fell by 7.8% more than the effects of contagion. However, it was strongly felt that the long-term effects of the crisis were affected by the decline in capital accumulation (Adelman and Yeldan, 2000). Bradley and Taqqu(2004) argued that the contagion of the market x into the market y occurs when the interrelationship between the studied markets is greater than the time when the x market (the period when the decline of market x is more than the average) is in the normal state. Hsin (2004) stated in a case study of the United States, England and Canada that the impact of contagion on other countries was caused by the studying countries, and that the Asia-Pacific markets were more exposed to contagion effects. Candelon et al. (2008) found a significant interrelationship between Asian stock markets during the crisis period. The countries studied included South Korea, Malaysia, Singapore, Taiwan and Thailand. Reliability tests showed that the rise of interconnections between the markets by their nature occur more abruptly than gradually. Baur (2013) studied the relationship between stock markets and real markets using data from financial markets that were divided into different parts.

III. EMPIRICAL RESULTS

3.1 Data

In order to investigate the relationship between inflation rate and financial markets, theCPI data, Tehran Stock Exchange Index and OPEC prices have been used. Stock market data from Tehran Stock Exchange and CPI data from the Iranian Statistics Center havebeen obtained. Crude oil price data are collected from the OPEC site. The study periodincludes time series data from December 2008 to April 2016. Monthly sampling rateshave been used to avoid problems such as working hours and official holidays. The graph of the data is as follows:

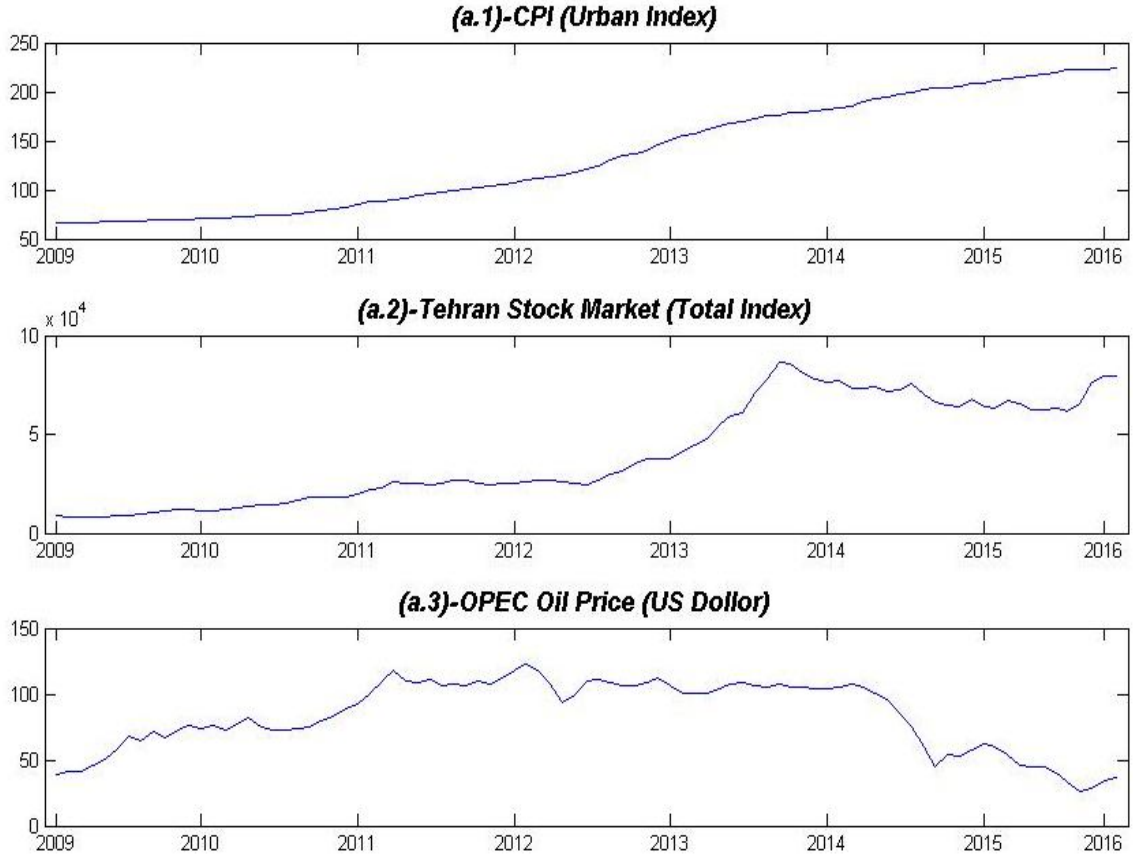

Figure 1: Trends of variables during the time

Due to the fact that the data used, especially the non-nominal stock index, are first-order, and their distribution is usually asymmetric, in order to avoid the problems ofusingnon-nominal data, to make estimations, the first-order difference of the data are used inthe research. For avoiding unreasonable observations in the data, their first-orderdifference modulus is used, the descriptive statistics of which are given in Table (1). The Philips-Peron test shows that first-order difference modulus of the data is nominal.

Table 1: Descriptivetable

	Mean	STD	Kurtosis	P-P test (P-Values[b])
CPI	0.013996	0.010185	4.427364	0.0303[a]
Total return index	0.046650	0.038106	3.446787	0.0003[a]
Oil price	0.062125	0.059362	5.862968	0.0032[a]

* The reported Phillips-Perron is statistically significant at 5% level of significance.
** The estimated P-P test values, which indicated with ([a]), reject null hypothesis of unit root test.
*** Phillips-Perron test are prob. Values and tests are in level and nothing included (no trend and no intercept).
(b) MacKinnon (1996) one-sided p-values.

3.2 The OU process estimation

For modeling and displaying the starting point of the occurrence of the contagionamong variables the Ornstein Uhlenbeck stochastic process is used. In the present study, a second method presented by Sitmo 2014 (2014) has been used. In the case of having aset of observations, for example $\rho_1, \rho_2, \dots, \rho_N$ using ordinary least squares methods ormaximum likelihood, we can obtain the values μ, θ and σ. Estimated values based onMaximizing logarithm of likelihood are presented in Table (2). The values of Table (2)are derived from the estimation of the following equations and by using a sampling of the correlation of the values of the variables on the whole sample by the jackknife method.

$$S_p = \sum_1^N \rho_i \,, S_{p-1} = \sum_1^N \rho_{i-1} \,, S_{pp} = \sum_1^N \rho_i^2$$
$$S_{(p-1)(p-1)} = \sum_1^N \rho_{i-1}^2 \,, S_{p(p-1)} = \sum_1^N \rho_i \rho_{i-1} \,, \qquad \omega = e^{-\theta\,\Delta t} \qquad \textit{Eq. 1}$$

According to the above estimations, Ornstein-Uhlenbeck process parameter can be estimated as below:

$$\mu = \frac{S_p . S_{(p-1)(p-1)} - S_{p-1} . S_{p(p-1)}}{N\left(S_{(p-1)(p-1)} - S_{p(p-1)}\right) - \left(\left(S_{p-1}\right)^2 - S_{p-1} . S_p\right)}$$
$$\theta = \frac{l}{\Delta t} \ln \frac{S_{p(p-1)} - \mu S_{p-1} - \mu S_p + N\mu^2}{S_{(p-1)(p-1)} - 2\mu S_{p-1} + N\mu^2} \qquad \textit{Eq. 2}$$
$$\sigma^2 = \frac{2\theta}{N(1-\omega^2)}\left[S_{pp} - 2\omega S_{p(p-1)} + \omega^2 S_{(p-1)(p-1)} - 2\mu(1-\omega)\left(S_p - \omega S_{p-1}\right) + N\mu^2(1-\omega)^2\right]$$

Markets with a higher value of θ return faster to their own mean value, and to a marketwhose index is used in the coherence calculation (long-term mean is calculated using μ). As a result, it is expected to see higher values among more interconnected markets. Theestimated values of the Ornstein- Uhlenbeck method are presented in Table (2), the column with the highest number of higher values of θ represents the starting point of the contagion.

Table 2: Estimates calculated by the Ornstein- Uhlenbeck method

	CPI	Total return index	Oil price
CPI	…	1.7650	3.9508
Total return Index	1.7650	…	2.1367
Oil price	3.9508	2.1367	….

Presented values in Table2 have been calculated according to step in time, which is here a month. The step in time can take other values based on the length of the time period. Estimated figures indicate that financial markets in Iran are significantly reliant on the oil market and that inflation substantially relied on the oil market. Clearly, CPI and stock market changes are related to the oil market, respectively. Since the main source of income in Iran is the sale of oil, the obtained results are reliable. For example, oil sanctions against Iran in January2012 clearly explain high inflation rates, especially from 2011 to 2014 (Fig. 1 - (a-1)). The weaker link

between the oil market and the stock market is due to the fact that the stock market depends not only on foreign exchange markets with varying degrees of relationship but also on domestic markets limited to the borders of a country. It also depends not only on economic conditions, but also on political issues and decisions, but with regard to the relationship between markets, global activities will also affect different sectors of the economy.
Based on the values presented in Table (2), the oil market is known as the starting point of the contagion; therefore, in order to provide further details between the pair of markets, the mean long-tern mean values and fluctuation velocity are shown in Table (3)

Table 3: Estimates of the Ornstein- Uhlenbeck method assuming the oil market as thestarting point of the contagion

	μ	θ	σ
Oil&CPI	-0.2540	3.9508	0.0229
Oil & Stock market	-0.0516	2.1367	0.0174

In the classification of markets in different groups, the values of μ play a significant role. Larger μs along with larger θ values represent a stronger interconnection between market pairs.

3.3 The wavelet coherence estimation

The next step in assessing of the estimation model is the estimation of the interrelationship between the oil market and other variables in the frequency-time graph using the wavelet coherence coefficient. To do this, the toolbox of MATLAB has been used, which is based on the theoretical background (Aguiar-Conrara and Soares, 2014). The estimated values shown in Figure 1 represents a wavelet coherence of the logarithmic rate of the time series pair. Each of the values of $R_{xy}(0 \leq R_{xy} \leq 1)$ at a specific point in the frequency-time graph isdisplayed in the form of a pixel and with a specific color. X axis of the maps is the time scale and the vertical axis is the frequency scale,which here, is the time units (one month to 10 years). Significant statistical coherences have been identified based on the Monte Carlo test, which are presented as contoured lines in the graph. Edge Effects are partsofthe charts that are marked with bold black lines and are called Impact Cones.

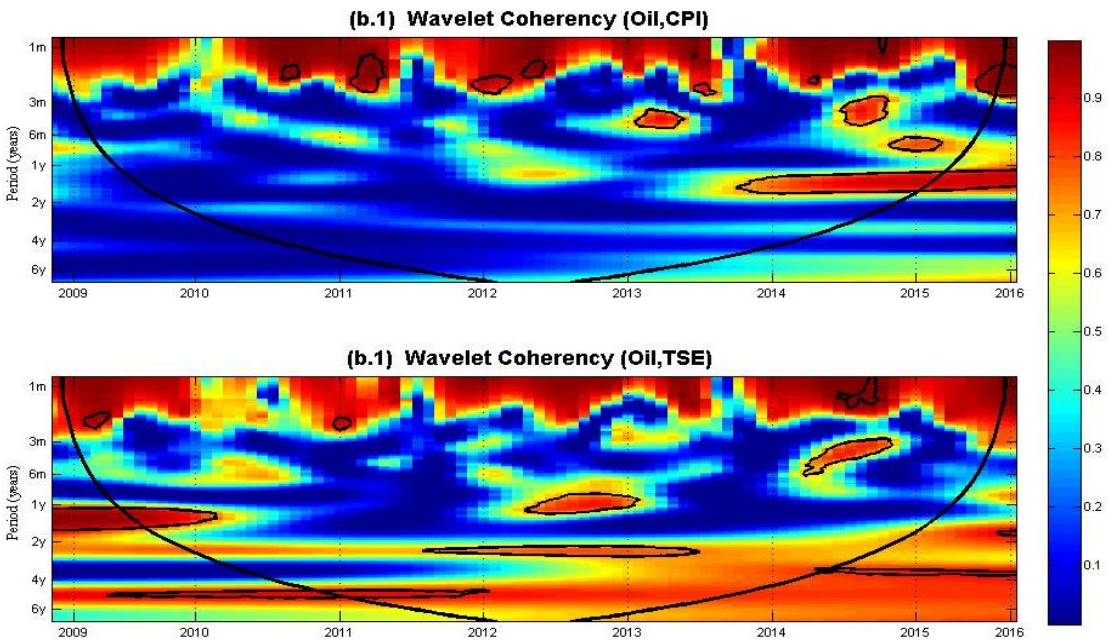

Figure 1: Wavelet coherency among pairs of oil market, CPI and TSE: assumed contagion starts from Oil market.

Estimated values of Figure 1.(b-1) show that Oil market and CPI changes are interconnected in the short term studied , but there is almost no such relationship in the long run. As notable is, there are signs of a long-term relationship between these two markets after 2012, which is growing more dramatically from 2013 onwards. Following the imposition of oil sanctions on Iran in January 2012, this relationship has come about. It is noteworthy that CPI relies significantly on the oil market in the short run and crisis times, and the events in the oil market are significantly influencing the inflation rate. Recent evidences after the imposition of global sanctions on Iran and the consequent rise in inflation even after

imposition of JCPA indicate this relationship. Therefore, it can be concluded that fluctuations in the oil market in the short term will lead to changes in the inflation rate in Iran, but if these fluctuations are not controlled in the short-term markets, the pair markets will face more severe fluctuations in the long run which will be hard to control and manage.

Figure1.(b-2) is a demonstration of the relationship between oil and stock markets. Estimated values for this point suggest that the oil and stock market in Iran are significantly interrelated in both short and long term periods. It is noteworthy that, after imposing 2012 oil sanctions on Iran, the interrelationship between these two markets is expanding and becoming a medium term problem in the long run. This relationship arises from the fact that, after imposing sanctions on the grounds that it is not possible to export or exchange oil with a world outside the Iranian economy, oil products are driven to domestic markets and most of the oil products in the domestic markets are mostly used as raw materials in the production of domestic goods. These products, which have been used as part of raw materials or energy for their production, will be traded in stock markets; as a result, fluctuations in the oil market will move on to the stock market.

CONCLUSION

In this study, the relationship between inflation rate and financial markets in Iran has been investigated. To do so, the combination of Ornstein- Uhlenbeck method and continuous wavelet transform and time series data in Iran have been used. The results of the study showed that the starting point of contagion in the Iranian markets is the oil market. On the other hand, the relationship between oil markets and CPI changes is only available in the short term; but, for the stock market, this relationship is not only visible in the short term but also in the long run. It is important to note that the relationship between the oil market and other variables has been increasing in the long run after 2012 (the time when global oil sanctions against Iran started).

Therefore, policymakers need to focus on controlling economic shocks in the short run, in order to apply appropriate policies to control inflation and create sustainability in financial markets. It should be noted that unless short-term events are controlled, these fluctuations will either be transmitted in the long run. On the other hand, events such as global sanctions separating the domestic market from the outside world will mark the relationship between the variables in the long term.

REFERENCES

[1] Adelman, I., & Yeldan, E. (2000). Is this the end of economic development? Structural Change and Economic Dynamic, 95-109.

[2] Aguiar-Conrara, L., & Soares, M. J. (2014). The continuous Wavelet transform: Moving beyond uni and bivariate analysis. J.Econ. Surv, 28, 133-175.

[3] Bradley, B., & Taqqu, M. S. (2004). Empirical evidence on Spatial contagion between financial markets. Finance Letters, 77-86.

[4] Cnadelon, B., Piplack, J., & Straetmans, S. (2008). On measuring synchroniuzation of Bulls and Bears: the case of EastAsia. Banking and Finance, 1022-1035.

[5] Hsin, C. W. (2004). A multilateral approach to examing the comovements among major world equity markets. International Review of Financial Analysis, 433-462.

[6] Kaminsky, G. L., & Schmukler, S. L. (1999). What triggers market jitters? a chronicle of the Asian crisis. International Money and Finance, 537-560.

[7] Masson, P. (1999). Multiple equilibria, contagion, and the emerging market crises. International monetary found.

[8] Sitmo. (2014). Calibrating the Ornstein-Uhlenbeck (Vasicek) Model, Avaiable at:. Retrieved from http://www.sitmo.com/article/calibrating-the-ornstein-uhlenbeck-model

★★★