ANALYSIS OF OPEC CRUDE OIL PRICES VOLATILITY INTERDEPENDENCY: GREY CORRELATION AND BAYESIAN NETWORK PERSPECTIVE

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Overview

Crude oil as a non-renewable strategic resource has an important influence to the international trade. Due to the smaller demand elasticity of the crude oil, the demand change at a lower level will bring the oil prices' fluctuation at a higher level. The history of the crude oil market can be regarded as the history of the oil prices' fluctuation. Particularly, OPEC (Organization of Petroleum Exporting Countries) as an oil cartel plays an important role in the global crude oil market. Since the first oil shock of the 1970s, scholars have begun to study the OPEC behavior strategy. The exist research are mainly focused on the influence of the OPEC oil pricing system and the OPEC production quotas regime. And scholars tend to agree that the OPEC production quotas regime is a more reasonable way to explain how the OPEC behavior strategy affects the oil price volatility. Some valid models are constructed and tested from the perspective of the OPEC member states' oil output, such as the cartel model, the target income model and the competition model. However, due to the limitations of the empirical data and the complexity of the oil price volatility, the exist study still can't completely explain the OPEC behavior strategy at different times. Scholars generally believe that it is difficult to model the OPEC behavior strategy in more and more complicated global oil market. If our study is focused on the oil export prices volatility of the OPEC member states, it is useful to find out the oil prices feature of the OPEC member states from the perspective of the trade relationship between the OPEC and the global market, which is account for the influence of the OPEC oil pricing system.

This paper is focused on the the oil prices volatility interdependency of the OPEC member states for revealing the structure feature of the OPEC oil pricing system. The oil export FOB (Free On Board) prices as the empirical data are employed for revealing the impacts of OPEC oil pricing system on the global oil market, which is accounted for the situation of the oil trade and demand-supply.

The paper is organised as follows: After the introduction the second section gives a brief overview about the investigation of the OPEC. The third section addresses the grey correlation theory and the bayesian network that have to be introduced for the deeper investigation of the oil prices volatility interdependency. In section four we describe the results. In the final section the conclusion is derived.

Methods

The grey correlation theory, complex network algorthm and bayesian network model.

Results

The paper used the weekly data of 12 member states' oil export FOB prices (dollars per barrel) covered the period from 18 June 1999 to 18 March 2011, which is the global oil prices' special fluctuating period from the great increase period to the high shock period obtained from the EIA (Energy Information Administration) (http://www.eia.gov/). The total number of observations amounts to 612. The logarithmic reprocessing is employed to make the original data stationary for better revealing the volatility. The results is as follows:

First, we employed the grey correlation theory to calculating the average grey correlation degree matrix of the one-to-one relationship between each pair of the oil prices, which is accounted for the volatility correlation of the oil prices. We found that all the volatility correlations of the oil prices of different member states are very high, the minimum is 0.87 and the maximum is 0.97.

Second, based on the average grey correlation degree matrix, constucting the network structure of the oil price volatility. The nodes of the network represent the OPEC member states. The edges of the network represent the grey correlation between the oil price volatility of different OPEC member states. By seeking for the best ratio of the graph density and modularity, we determined the threshold to filter the grey correlation matrix as the weight of the edges. Then we employed the Biclique algorithm and Triangle algorithm to discover two kinds of network group clusters, which is accounted for the detailed oil prices volatility structure of the OPEC member states (Fig. 1).
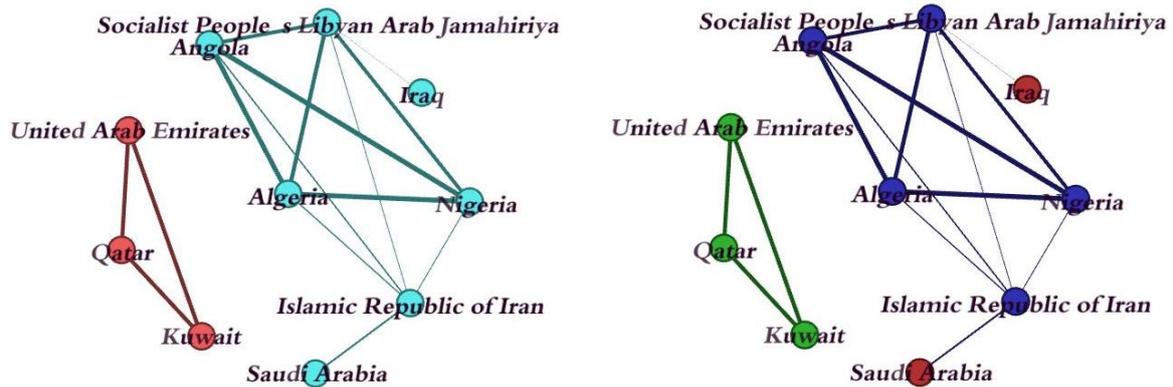
Fig.1 Two kinds of network group clusters based on the Biclique algorithm and Triangle algorithm

Third, by considering the impacts of the OPEC oil exports weekly weighted price (WWP) on the oil prices of the member states, we employed the bayesian network modeling based on the network group clusters to reveal the oil price volatility transmission feature, which is accounted for the potential interdependent causality of the OPEC member states' oil prices volatility (Fig. 2).
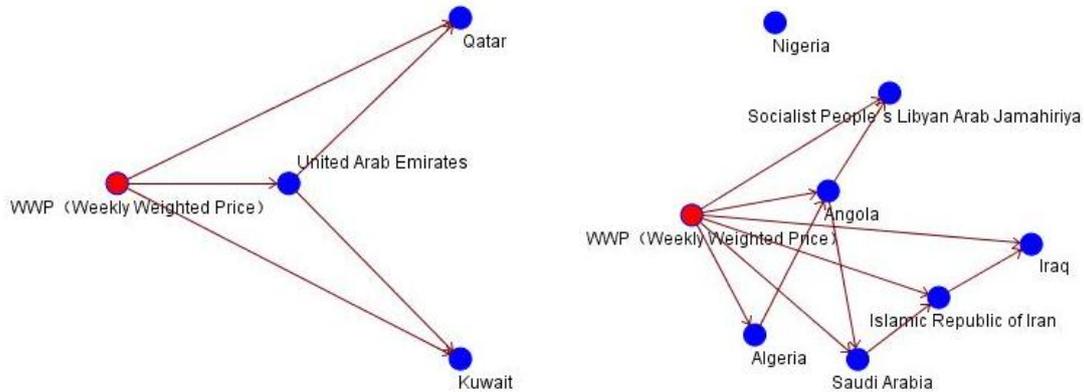
Fig.2 The bayesian network modeling based on the network group clusters

Conclusions

In OPEC, the correlation of the oil prices volatility of different member states is very high, which is not only accounted for the status that the oil pricing system of the OPEC is based on an uniform reference price, and also indicates that the oil prices of the global market tend to be integration. And there are different kinds of network group clusters of the oil prices volatility of different member states, which are not completely based on the regional similarity. Particularly, the six member states of the Middle East belong to three network group clusters respectively, which is accounted for the competitive characteristic among different member states' oil prices. In contrast, the 4 member states of the Africa belong to one network group cluster, which indicates the stronger consistency of the oil prices volatility. And the two member states of the South America do not belong to any network group cluster, the reason of which is that the regional difference of the oil exports FOB prices. In general, the distribution difference of the network group clusters is due to the difference of the oil export's target countries. The network group clusters of the oil exports FOB prices indicate the oil price volatility similarity and difference of the oil trade between the OPEC member states and other oil markets. The oil prices volatility interdependency presented by the bayesian networks based on different network group clusters provides a scientific reference for the better investigation of the OPEC oil prices volatility structure.

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