# How does oil financialisation affect oil prices?

***Qiang Ji,*** Center for Energy & Environmental Policy research, Institute of Policy and Management, Chinese Academy of Sciences, E-mail: jqwxnjq@163.com

***Wanli Zhao,*** School of Economics & Management, Beihang University**,** E-mail: zhaowanli007@foxmail.com

***Ying Fan,*** School of Economics & Management, Beihang University**,** E-mail: ying_fan@263.net

## Overview

In recent years, the oil market has attracted increasing capital inflow and investors' attention, which has presented the process of accelerating financialization. During this process, financial factor has become the new driving force in determining the price changes in oil market. Therefore, it is of great significance to analyze how financial factors affect oil price over time.

In this paper, eight different indicators are selected to reflect the different dimentions of oil financialization charateristics. First, trading volume is used to measure the development of futures market, while non-commercial long position is employed to investigate the speculative activities. The CBOE implied volatility index (VIX) which is calculated based on S&P 500 index options is selected as a measure of market sentiment. The US dollar index (USDX) is used to reflect the market currency factor, while Economic Policy Uncertainty Index (EPU), MSCI World Index (MSWR), and St. Louis Fed Financial Stress Index (STLFSI) are included as the indicator of policy uncertainty, external market information spillover and financial stress, respectively. And finally, Google trend (GTd) of the keyword "crude oil price" is used as the internet concern measuring information shocks.

By using a connectedness framework proposed by Diebold and Yilmaz (2014), we can analyze the magnitude, direction, and dynamic characteristics of mutual influence of oil prices and financial factors. So we contribute to the literature by showing the complex interaction effect among oil price and market factors.

## Methods

Following Diebold and Yilmaz (Diebold & Yilmaz, 2009, 2012, 2014, 2015), we use the method of connectedness network. This method has multiple advantages in analyzing the time-varying relationship between multiple data, as well as data visualization.

First we use the VAR model to incorporate all the data. $\boldsymbol{x}_t$ are vectors including oil price and market factors. VAR can be written as

$$\boldsymbol{x}_t = \sum_{i=1}^{p} \boldsymbol{\phi}_i \boldsymbol{x}_{t-i} + \boldsymbol{\varepsilon}_t$$

Where $\boldsymbol{\phi}_i$ is parameter matrix. And assume that the error terms $\boldsymbol{\varepsilon}_t$ is independently and identically distributed with zero mean, $\Sigma$ covariance matrix. If this VAR model is stationary, then there exists a moving average representation as

$$\boldsymbol{x}_t = \boldsymbol{\varepsilon}_t + \boldsymbol{A}_1\boldsymbol{\varepsilon}_{t-1} + \boldsymbol{A}_2\boldsymbol{\varepsilon}_{t-2} + \boldsymbol{A}_3\boldsymbol{\varepsilon}_{t-3} + \cdots$$

Where $\boldsymbol{A}_i$ is MA parameter matrix that can be estimated recursively.

Variance decomposition calculation is usually done using orthogonal VAR impulse response function. The Cholesky recognition scheme achieves orthogonality, but the calculated variance decomposition will be unstable and depends on the ordering of the data. Therefore, a generalized variance decomposition is proposed by Koop et al. (1996) and Pesaran and Shin (1998), called GFVD. In GFVD framework, $\boldsymbol{\varepsilon}_t$ are assumed to be multinormal distribution. If we set the shock $\varepsilon_{jt} = \delta_j$, then the expect of the rest shock could be calculated as

$$E\left(\boldsymbol{\varepsilon}_t \middle| \varepsilon_{jt} = \delta_j\right) = \boldsymbol{\Sigma}\boldsymbol{e}_j\sigma_{jj}^{-1}\delta_j$$

By standardized the shock to standard deviation, the n-step-ahead forecast error variance decompositions $\psi_j^g(n)$ is computed as

$$\sigma_{jj}^{-1}\sum_{l=0}^{n}(\boldsymbol{e}_i^{\mathrm{T}}\boldsymbol{A}_l\boldsymbol{\Sigma}\boldsymbol{e}_j)^2$$

To get a unit sum of each row of the variance decomposition, we following Diebold and Yilmaz to normalize each entry of the matrix by the row sum as:

$$\theta_{ij}^{g}(n) = \frac{\sigma_{jj}^{-1}\sum_{l=0}^{n}\left(\boldsymbol{e}_i^{\mathrm{T}}\boldsymbol{A}_l\boldsymbol{\Sigma}\boldsymbol{e}_j\right)^2}{\sum_{l=0}^{n}(\boldsymbol{e}_i^{\mathrm{T}}A_l\boldsymbol{\Sigma}A_l^{T}\boldsymbol{e}_i)}, \quad i,j = 1,2,\dots,m$$

In this way we can calculate the connectedness matrix and analyze the results by various complex network methods.

## Results

The static results shows that the total connectedness is 34.09%, which is relatively high compared with existing research. This indicates that crude oil price indeed interact with financial factors. The return of oil price is mostly affected by long positions of non-commercial traders, which is 12.22%. This suggests that speculative factor are the main driving factor affecting crude oil price returns. In addition, MSWR, STLFSI and VIX are the larger contributions to the oil price returns' information inflow , which indicate that financial markets, especially the stock market and the crude oil market, are interlinked. Moreover, VIX and MSWR have the net contribution to the whole oil-financial factors system.

From a dynamic perspective, the total connectedness presents significant time-varying features. Since the global economic recovery in late 2008, the total connectedness has risen in conjunction with economic recovery until the beginning of 2015. This shows that on the one hand, the crude oil market is gradually becoming financialization, on the other hand, it also shows that the crude oil market also profoundly affects the traditional financial market. However, the total connectedness fell sharply during the 2015-2016 period, probably because of the sharp decrease of crude oil prices. Dynamic connectedness from WTI to other factors has the same trend as total connectedness. The impact of oil prices on other factors has reached a peak during the period from 2014 to 2015, reaching about 45%, which is consistent with the period of high oil prices. As oil prices go down, the total explanatory power of crude oil price to other financial factors is also declining, eventually floating around 40%.

## Conclusions

This paper examines the interaction between crude oil prices and financial factors from the perspective of oil financialisation. The study found that there is indeed a high degree of connectedness between the crude oil market and financial factors, which verified the financiliastion process of oil market. The total connectedness between crude oil price and financial factors presents a time-varying feature, which is highly correlated with oil price changes. Moreover, financial factors selected in this paper present specific contribution to oil price returns and to the whole system, reflecting the different information transmission mechanism. Our findings can provide useful implications for oil investors to risk management and hedging portfolio of spread trading among oil and financial markets.