How does investor attention affect international crude oil prices?

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HIGHLIGHTS

- We detect the impacting mechanisms of investor attention on crude oil prices.
- We construct a proxy for investor attention in crude oil market based on the GSVI.
- Investor attention has significant negative impact on oil prices during 2004–2016.
- Investor attention contributes 15% to the long-run fluctuation of WTI oil prices.

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ABSTRACT

In order to investigate the impacting mechanism of investors' attention and crude oil prices, we construct a direct, timely and unambiguous proxy for investor attention in crude oil market by aggregating the Google search volume index (GSVI). Based on the GSVI, we employ the Structural Vector Autoregression (SVAR) model to empirically explore the impact of investor attention on WTI crude oil price from January 2004 to November 2016. The results indicate that: (1) investor attention does have significant negative impact on WTI crude oil price during the sample period; (2) investor attention shocks contributes 15% to the long-run fluctuation of WTI crude oil price during the sample period, which is second only to that of supply shocks (69%) among the contributors concerned; and (3) when the business cycle stays in expansion, it has positive influence on both investor attention and WTI crude oil price. Meanwhile, our robustness check, using Brent crude oil price and a different construction form of the GSVI, confirms that the central results are reliable.

1. Introduction

Crude oil is a crucial strategic resource, whose price fluctuation has significant impact on economic growth [1], financial market [2,3] and national security [4]. Consequently, as an important energy commodity, crude oil has the ordinary commodity property, whose prices are initially determined by the supply-demand fundamentals [5–8]; meanwhile, as a basic strategic resource and a financial product, crude oil also has evident political and financial properties, whose prices tend to be sharply influenced by the non-fundamentals (such as geopolitical events, US dollar exchange rate and market speculation). In particular, non-fundamentals often lead to the psychological changes of investors in crude oil market, and further cause crude oil price deviating from fundamentals [9–11], which makes crude oil market become a typical complex system.

In fact, investor attention proves an important index to reflect the psychological changes of investors, and may significantly influence the price fluctuations in stock and commodity markets. Investors often make the buying or selling decisions based on their belief about the fundamentals. However, the fundamentals of assets are hard to observe; in the end, investors tend to infer the fundamentals by processing related information. When they process the information related to a certain asset, they may inevitably pay attention to it. However, attention is a scarce resource [12], and the information process will be influenced by attention constraint and attention allocation. Investors may allocate more attention to reduce the uncertainty to the fundamentals while the asset price fluctuates as the investors update the belief based on the information process. In this way, investors' attention allocation has an effect on asset price dynamics [13].

In fact, several existing literature on investor attention has confirmed the significant effect of investor attention on asset prices. For instance, Barber and Odean [14] argue that individual investors are net attention-driven investors and their attention-grabbed buying behavior results in a positive pressure to stock prices. Hou et al. [15] examine the effect of investor attention in stock prices, and they find that, on the one hand, limited investor attention is likely to cause potential earnings

momentum for underreacting to earnings news; on the other hand, the interaction of limited attention and learning biases results in price momentum. Besides, Andrei and Hasler [16] find that both investor attention and uncertainty significantly affect asset price changes.

It should be noted that investor attention is hard to observe and measure; consequently, in prior relevant literature, investor attention is often measured by indirect proxies. The frequently used proxies include extreme returns [14], trading volume [14,15], news and headlines [10,17,18], and price limits [19]. These proxies are based on a common hypothesis that if the asset or stock is of extreme return or trading volume, or mentioned in news headline, investors have paid attention to it. However, the abnormal return or trading volume cannot guarantee investors' attention to it, and investors even never read the news in *The Wall Street* related to the asset or stock [20]. Therefore, the proxies are usually biased and lagged. Specifically, on the one hand, for the selection of indicators used for investor attention, the proxies are of strong subjectivity. On the other hand, most indicators are calculated through the statistical data, and they can hardly measure the investor attention in time.

Under these circumstances, in this paper, we develop a direct and unbiased proxy for investor attention in crude oil market by constructing the Google search volume index (GSVI) and then explore the relationship between investor attention and crude oil prices. Google search volume data are available in Google Trends (https://www.google.com/trends), a service provided by Google.

There are two reasons for us to choose the Google search volume as the measure of investor attention. First, Internet users are inclined to use search engines to collect information, and Google continues to be the most popular, especially in developed countries. Thus, the Internet search behaviors of general population are most likely to be reflected by the search volume provided by Google. Second, the Google index proves a direct measure of the market attention. When we search oil in Google, we are undoubtedly concerning about it. Consequently, the aggregated Google search volume is a direct and unbiased measure of the market attention. In fact, some studies have confirmed this viewpoint. For instance, Da et al. [20] argue that the search frequency in Google is a timely proxy for measuring the investor attention. Drake et al. [21] claim that investors accept information through the Internet and the Google searches can reflect investors' demand for public information. Da et al. [22] construct the Financial and Economic Attitudes Revealed by Search (FEARS) index by counting the search volume related to household concerns.

In order to measure the investor attention in crude oil market by aggregating the search volume, we need to understand how crude oil price can be searched by investors. To do this, we aggregate the search volumes of a series of key words related to "crude oil price", which are likely to be used by users for different search habits, and we proceed as follows. We input the primitive words "crude oil price" into Google Correlate (https://www.google.com/trends/correlate), and retrieve the top related words whose correlation coefficients with "crude oil price" are larger than 0.9. After filtering out the related words, we can acquire the search volumes of these words and construct the composite attention index by weighting the search volumes. There are many widely used weighting methods, such as the subjective weighting method, the information entropy theory and the linear combination weighting method [23]. However, among these search volumes, some should be correlated with other search volumes, and among the widely used weighting methods, the Principle Component Analysis (PCA) is powerful in reducing the dependence of individual proxies. Meanwhile, the index constructed by individual proxies would behave almost the same as the index organized by PCA [24,25]. Therefore, we apply the PCA approach to build a linear combination of the selected proxies, so as to construct the GSVI.

After obtaining the unbiased and direct proxy of the investor attention, we need to further investigate the effect of investor attention on international crude oil price applying some quantitative methods.

Relevant literature mainly employs the traditional regression approaches to investigate the effect of investor attention on asset prices [22]. Unfortunately, the traditional regression approaches in current literature tend to hardly consider the dynamic relationship among various factors and it is hard for us to identify the endogenous and exogenous variables in the regression models [26]. In contrast, the SVAR model can avoid these problems and has been widely applied in energy economics and policy modeling literature; in particular, it can analyze the dynamic relationship between crude oil price and its various influencing factors and can provide rich quantitative results upon the impact of these factors on crude oil prices [27–30].

Therefore, in this paper, we first construct a direct, timely and unambiguous proxy for investor attention in crude oil market by aggregating the search volume reported by Google. Then, based on the GSVI, we employ the SVAR model to explore the dynamic quantitative impact of investor attention on crude oil price. Specifically, we attempt to answer the following questions: (1) How does the investor attention relate to crude oil price fluctuations? (2) Compared with other influencing factors, how much does investor attention explain crude oil price fluctuations? (3) Does the business cycle affect the fluctuation mechanisms of investor attention and crude oil prices? Besides, we also detect the robustness of results in this paper from two aspects. On the one hand, we use different global benchmark crude oil prices for the research, including WTI crude oil and Brent crude oil prices. On the other hand, we consider the effect of different construction forms of GSVI by using the ten "top searches" related to the primitive words provided by Google Correlate. We find that the empirical results in this paper are reliable on the basis of solid robustness tests.

The contribution of this paper consists of two aspects. First, we construct a new proxy for investor attention in crude oil market by aggregating the search volume reported by Google using the PCA approach. Second, based on the proxy, we introduce the SVAR model to investigate how the investor attention may affect crude oil price, as well as how long the effect can last, so as to quantitatively confirm the contribution of investor attention to crude oil price fluctuations. Overall, by constructing the investor attention index, we not only investigate the qualitative effect of investor attention on crude oil price, but also quantitatively study the contribution of the influencing factors in crude oil price. This study will be beneficial for us to reveal the influencing mechanisms of investor attention on crude oil price, so as to better understand the complex pricing process of crude oil and forecast its changing trends, and provide important reference for policy makers to monitor and control extreme risks in crude oil market.

The remainder of this paper is organized as follows. Section 2 presents the data definitions and methods used in this paper, Section 3 describes the empirical results and discussions, and Section 4 concludes this paper.

2. Data and methods

2.1. Data definitions

In this paper, we mainly consider four variables, including global crude oil production, global oil demand, investor attention in crude oil market and WTI crude oil prices. Specifically, global crude oil production and WTI crude oil prices are available from EIA (https://www.eia.gov/totalenergy/data/monthly/#international); global oil demand is represented by the global real economic activity index developed by Kilian [31]; and investor attention is denoted by the Google search volume index (GSVI), which is constructed based on the search volume data provided by Google Trends. Google Trends provides both the weekly and monthly search volume data starting from January 2004. However, the global real economic activity index developed by Kilian [31] is formed as monthly frequency data. As a result, for data availability, we select the monthly data ranging from January 2004 to November 2016 as the sample in this paper. It should be noted that, except