

# The Influence of International Crude Oil Price on the Stock Price of Chinese Oil Companies

Yuzhou Huang and Qianru Zhuo

**Abstract**—With the rapid development of China's social economy, the development speed of various industries in China is also accelerating, but the development speed of China's oil industry has been relatively slow, and there is a large gap compared with the developed countries. From the perspective of the development of futures market and stock market, the trend of foreign oil companies' stock price and the change of oil price usually have significant synchronization, but the change of Chinese oil companies' stock price is very difficult to improve. This also shows that the ability of enterprises to deal with market risks is relatively poor. In this case, facing the fluctuation of international oil price, Chinese oil companies are very vulnerable to heavy losses, so they must make targeted adjustment and improvement in the follow-up time. This paper first expounds the theoretical transmission path of the impact of the original international price on the stock price of Chinese oil enterprises, analyzes the fluctuation of the international oil price and the specific impact of the international oil price on Chinese oil enterprises. This paper mainly adopts the methods of theoretical analysis and empirical analysis, taking the daily return index of 11 Chinese a-share companies and the daily return index of WTI as a variable through data processing and weighted average, and taking the daily value data from January 2015 to September 2019 as the interval sample. VAR model is used to analyze the influence of international crude oil price on the stock price of Chinese oil enterprises from the perspective of price spillover effect, and finally, four suggestions are put forward. For the development strategy of Chinese oil enterprises in the follow-up time has brought certain reference and reference to the development of Chinese oil enterprises in the domestic and foreign environment.

**Index Terms**—Crude oil price, petroleum enterprise, enterprise stock price, VAR model, industrial chain integration.

## I. INTRODUCTION

Oil enterprises are one of China's pillar industries, and the stable development of the petroleum industry has a very critical impact on China's national economic growth. Considering the development status of China's oil enterprises, they are already facing significant competitive pressure with a little ability to resist market risks. Crude oil price fluctuations are one of the main market risks faced by oil enterprises, and it will also directly affect the company's operating costs and overall performance, thereby affecting the stock market of oil enterprises. In this case, it is very important to analyze the relationship between international crude oil prices and the stock prices of oil enterprises. This study analyzes and discusses the impact of international

crude oil prices on the stock prices of Chinese oil enterprises.

## II. LITERATURE REVIEW

The impact of changes in international crude oil prices is more complicated [1]. The reasons for the changes mainly depend on market activities in the real economy, as well as the expected value and demand of various participants in the market environment for market changes [2]. Based on market economic activities, changes in international crude oil prices also have a greater relationship with market demand and supply [3]. In addition, crude oil prices and exchange rate changes have a significant positive impact on economic growth in the short and long term [4].

To a certain extent, the price of crude oil has become one of the important driving forces for the development of the stock market [5]. There is a long-term cointegration relationship between crude oil prices, exchange rate changes, and stock market returns [6].

As for the domestic situation, by analyzing the actual impact of international oil prices on China's A-share market, and believing that fluctuations in international oil prices would have a very significant negative impact on various economies [7]. Based on the data from 2013 to 2016, constructed a vector autoregressive model and a vector error correction model, and conducted a comprehensive analysis, believing that international oil prices will significantly affect the stock market [8].

When the international oil price drops sharply, China's stock market will be severely affected. Especially when major events are affected, it will bring a very significant risk impact to China's stock market [9].

China's petroleum industry is still relatively highly dependent on foreign sources, and the changes in international oil prices have also brought a significant impact on the stock prices of listed tight Gas companies in China [10]. The rise in international oil prices has had a significant positive impact on the changes in tight Gas's stock price, but there is still a certain lag in certain periods [11]. For China's A-share aviation listed companies, there is a significant negative relationship between changes in international oil prices and the impact of aviation indexes [12].

The tight Oil Revolution mainly affects the net profit of enterprises by reducing crude oil prices. Therefore, crude oil price fluctuations are the main reason that affects the stock prices of oil-producing companies and their own performance [13]. In China, when the price of refined oil is impacted by international crude oil prices, the price of refined oil fluctuates significantly [14]. Changes in international oil prices show a negative correlation with

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China's oil stock prices, but the overall price transmission relationship is not clear [15].

### III. THEORETICAL ANALYSIS OF THE IMPACT ABOUT INTERNATIONAL CRUDE OIL PRICES ON THE STOCK PRICES OF CHINESE OIL COMPANIES

#### A. Analysis of the Impact Transmission Path at the Macro Level

First, balance of payments. When international crude oil prices rise, the balance of payments between oil importing and exporting countries will be directly destroyed. The income of importing countries will increase significantly and international expenditures will expand. Rising costs and a decline in the international competitiveness of related products will eventually have an impact on the stock prices of various companies in the entire industry. For oil exporting countries, the rise in international crude oil prices can also directly increase international income, leading to an increase in the stock prices of oil companies.

Second, inflation. Inflation triggered by the rise in international crude oil prices affects the stock prices of oil companies.

Third, interest rates. When international crude oil prices are rising, in order to avoid inflation, oil-importing countries have comprehensively implemented contractionary monetary policies and appropriately raised interest rates. Raising the financing cost of the company, leading to the company's operating conditions is likely to deteriorate, resulting in a decrease in the company's stock price.

#### B. Analysis of Influence Transmission Path at the Micro Level

From a micro perspective, the operating costs of each listed oil company are closely related to international oil prices. Therefore, international crude oil prices will have an impact on factors such as the expected earnings of listed companies and the investment expectations of investors. From a comprehensive microscopic point of view, the specific theoretical path for Chinese oil companies' stock prices to be affected by international crude oil prices is reflected in the income level of oil companies and consumer demand levels.

### IV. RESEARCH METHODS AND DATA

The specific content of the VAR model is as follows.

$$Y_t = c + \sum_{i=1}^p A_i Y_{t-i} + \varepsilon_t \quad (1)$$

Among them,  $c$  is a constant vector of  $n \times 1$ ,  $A_i$  is an  $n \times n$  coefficient matrix,  $p$  is the lag order,  $t$  is the number of samples, and  $\varepsilon_t$  is an error vector of  $n \times 1$ .

First, clarify the optimal subsequent order of the VAR model. Second, when establishing the VAR model system, all relevant variables should be counted into the system as much as possible.

#### A. Source of Information

This article collects daily data on changes in international crude oil prices from January 2015 to September 2019. The

stock price change data of Chinese oil companies collected daily data of 11 oil companies from January 2015 to September 2019.

#### B. Data Processing

The daily data of 11 oil companies are weighted average, and the logarithmic difference is taken to express the daily return rate. In the process of subsequent analysis, the international crude oil price index is mainly represented by WTI, and after the logarithm is taken, the rate of return is used to represent the fluctuation.

### V. AN EMPIRICAL ANALYSIS OF THE IMPACT ABOUT INTERNATIONAL CRUDE OIL PRICES ON CHINESE OIL COMPANIES' STOCK PRICES

#### A. Descriptive Statistics of the Return Rates of the Two Markets

Mainly need to extract the two indicators of Chinese oil company stock return CO and international crude oil price WTI. Table I shows the descriptive statistics of the yields of Chinese oil companies' stocks and the US West Texas Intermediate base crude oil yields.

TABLE I: DESCRIPTIVE STATISTICS OF THE RETURN RATE OF THE TWO MARKETS

	Mean	Max	Minimum	Standard deviation	Skewness	Kurtosis
Oil company stock price (CO)	-0.001	0.170	-0.2425	0.0467	-0.3675	5.0642
International crude oil price (WTI)	0.0001	0.2252	-0.1224	0.0259	0.8657	11.8673

In terms of mean value, the average stock return of Chinese petroleum enterprises is -0.001, indicating that the development of Chinese petroleum enterprises is general. The average international crude oil price is 0.0001, indicating that the international crude oil market has developed normally in recent years. In terms of standard deviation, the standard deviation of stock return of Chinese petroleum enterprises is 0.0467, which is slightly higher than the standard deviation of West Texas Intermediate crude oil return of 0.0259, showing that there is little difference in the volatility of the two returns. In terms of distribution characteristics, the skewness of stock return of Chinese petroleum enterprises is -0.3675, less than 0, to the left, and the skewness of West Texas Intermediate crude oil return is 0.8657, greater than 0, to the right; Their kurtosis are 5.0642 and 11.8673 respectively, which are greater than 3, so they show the characteristics of peak distribution.

#### B. The Stability Test of the Return Rates of the Two Markets

The ADF statistic of CO is -27.9782, which is less than the critical values of 1%, 5% and 10% significance levels -3.4368, -2.8643 and -2.5683, and the adjoint probability is 0.0000 and less than 0.01. The original hypothesis of "variable has unit root" is rejected at the 1% significance level, indicating that the co series has no unit root and is a stationary series. The ADF statistic of WTI is -35.7587, which is less than the critical values of 1%, 5% and 10% significance levels -3.4368, -2.8643 and -2.5683, and the adjoint probability is 0.0000 and less than 0.01. The original

hypothesis of "variable has unit root" is rejected at the 1% significance level, indicating that WTI series has no unit root and is a stationary series. In conclusion, CO and WTI sequences are stable.

TABLE II: SERIAL UNIT ROOT TEST RESULTS OF CHINA PETROLEUM CORPORATION'S STOCK RETURN AND INTERNATIONAL CRUDE OIL PRICE RETURN

Variable	t-Statistic	1% level	5% level
China's oil company stock return (CO)	-27.97816	-3.436844	-2.864296
International crude oil price (WTI)	-35.75874	-3.436837	-2.864293

C. Construction of VAR Model

The criterion for the minimum value of AIC and SC selects the lag period. If the value of AIC and SC is not the smallest at the same time, the lag order is determined according to the principle of minority obeying the majority.

TABLE III: LAG TERM CRITERION TEST RESULT

Lag	LogL	LR	FPE	AIC
0	3743.185	NA	1.46e-06	-7.761794
1	3779.588	72.57896	1.36e-06	-7.829020
2	3793.256	27.19588	1.34e-06*	-7.849080*
3	3794.262	1.995657	1.35e-06	-7.842866
4	3797.848	7.105158	1.35e-06	-7.842007
5	3800.692	5.624039	1.35e-06	-7.839610
6	3804.138	6.798552	1.35e-06	-7.838460
7	3807.048	5.730659	1.35e-06	-7.836200
8	3810.908	7.582825	1.36e-06	-7.835909
9	3815.317	8.645290	1.35e-06	-7.836758
10	3821.589	12.27076*	1.35e-06	-7.841472
11	3822.722	2.211507	1.36e-06	-7.835523
12	3823.702	1.908451	1.36e-06	-7.829257

Since the AIC and SC principles do not take the smallest value at the same time, according to the principle that the minority obeys the majority, the optimal lag order of the VAR model chooses the lag 2 order. Next, build the VAR(2) model. The results are as follows:

TABLE IV: ESTIMATED RESULT OF VAR MODEL

	CO	WTI
CO(-1)	-0.262279	0.003377
	(0.03178)	(0.01817)
	[-8.25172]	[ 0.18588]
CO(-2)	-0.142158	-0.006057
	(0.03172)	(0.01813)
	[-4.48149]	[-0.33407]
WTI(-1)	0.119531	-0.129833
	(0.05629)	(0.03218)
	[ 2.12340]	[-4.03504]
WTI(-2)	0.134895	0.048052
	(0.05633)	(0.03220)
	[ 2.39453]	[ 1.49226]
C	-0.001555	9.19E-05
	(0.00144)	(0.00082)
	[-1.07868]	[ 0.11153]
R-squared	0.076432	0.020928
Adj. R-squared	0.072620	0.016886
F-statistic	20.04799	5.178102
Akaike AIC	-3.361401	-4.480046
Schwarz SC	-3.336343	-4.454988

Construct the following VAR model based on the VAR results:

$$\begin{pmatrix} CO \\ WTI \end{pmatrix} = \begin{pmatrix} -0.001555 \\ 9.19E-05 \end{pmatrix} + \begin{pmatrix} -0.262279 & 0.119531 \\ 0.003377 & -0.129833 \end{pmatrix} \begin{pmatrix} CO_{t-1} \\ WTI_{t-1} \end{pmatrix} + \begin{pmatrix} -0.142158 & 0.134895 \\ -0.006057 & 0.048052 \end{pmatrix} \begin{pmatrix} CO_{t-2} \\ WTI_{t-2} \end{pmatrix} \quad (2)$$

It can be seen that the stock returns of Chinese oil companies that lag 1 and 2 periods have a negative effect on the current stock returns of Chinese oil companies. The international crude oil prices lagging one and two periods have a positive effect on the current stock returns of Chinese oil companies.

The stock return of Chinese oil companies lagging one period has a certain positive effect on the current international crude oil prices, and the stock return of Chinese oil companies lagging two periods has a certain negative effect on the current international crude oil prices. The international crude oil price lagging 1 period has a certain negative effect on the current international crude oil price, and the international crude oil price lagging 2 period has a certain positive effect on the current international crude oil price.

In order to determine the stability of the VAR model established above, the relationship between the corresponding unit circle and each dot is shown below.

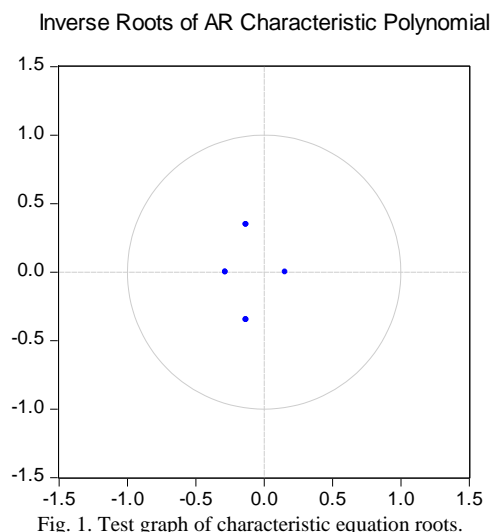


Fig. 1. Test graph of characteristic equation roots.

It can be seen that the reciprocal modules of all characteristic roots are in the unit circle, and there are no roots outside the unit circle. It can be determined that the VAR model established in this paper has passed the stability test and the model is stable.

D. Granger Causality Test

The statistic of the original hypothesis that "WTI is not the Granger cause of CO" is 8.99, and the adjoint probability is 0.0111, less than 0.1. The original hypothesis is rejected at the significance level of 10%, indicating that WTI is the Granger cause of Co; The statistic of the original hypothesis that "CO is not the Granger cause of WTI" is 0.18, and the adjoint probability is 0.9122, greater than 0.1. The original hypothesis is accepted at the significance level of 10%, indicating that CO is not the Granger cause of WTI. In

conclusion, WTI and CO have a one-way Granger relationship.

TABLE V: THE GRANGER CAUSALITY TEST RESULTS OF CHINESE OIL COMPANIES' STOCK RETURNS AND INTERNATIONAL CRUDE OIL PRICE RETURNS

Null hypothesis $H_0$	The Amount of Statistics	P value
WTI does not Granger Cause CO	8.993623	0.0111
CO does not Granger Cause WTI	0.183864	0.9122

### E. Analysis of Variance

After the pulse response function analysis, it is also necessary to carry out a complete and comprehensive analysis of variance, and make a sub item analysis on the two indicators of stock return Co of Chinese petroleum enterprises and international crude oil price WTI. Variance decomposition is to decompose the variance of a variable in the VAR model system into each disturbance term, and then calculate the relative importance of the impact of each disturbance term, that is, the contribution rate of the disturbance term.

TABLE VI: ANALYSIS OF VARIANCE OF STOCK RETURNS OF CHINESE OIL COMPANIES

Period	S.E.	CO	WTI
1	0.044950	100.0000	0.000000
2	0.046528	99.56570	0.434305
3	0.046689	99.33478	0.665217
4	0.046771	99.26253	0.737469
5	0.046772	99.26085	0.739153
6	0.046773	99.26049	0.739510
7	0.046773	99.26042	0.739577
8	0.046773	99.26042	0.739578
9	0.046773	99.26042	0.739581
10	0.046773	99.26042	0.739581
11	0.046773	99.26042	0.739581
12	0.046773	99.26042	0.739581

From the variance decomposition results of CO, it can be seen that in the first phase, the change of CO completely comes from its own influence. In phase 2, the variance of CO decreased from the part explained by itself to 99.57%, and the part explained by WTI was 0.43%. With the increase of the number of periods, the part of CO change explained by itself decreased and the part explained by WTI increased phase by phase. However, after phase 9, the part of CO explained by itself no longer decreased. From phase 9 to 12, the part of CO variance change explained by itself was 99.26% and the part explained by WTI was 0.74%.

TABLE VII: TABLE OF VARIANCE ANALYSIS OF INTERNATIONAL CRUDE OIL PRICE RETURN RATE

Period	S.E.	CO	WTI
1	0.025693	0.316785	99.68322
2	0.025908	0.311742	99.68826
3	0.025964	0.318775	99.68123
4	0.025967	0.319869	99.68013
5	0.025967	0.319866	99.68013
6	0.025967	0.319886	99.68011
7	0.025967	0.319887	99.68011
8	0.025967	0.319887	99.68011
9	0.025967	0.319887	99.68011
10	0.025967	0.319887	99.68011
11	0.025967	0.319887	99.68011
12	0.025967	0.319887	99.68011

According to the variance decomposition results of WTI,

in the first phase, 99.68% of the changes of WTI come from its own influence and 0.32% from the influence of Co. In phase 2, the variance change of WTI decreased from the part explained by itself to 99.69%, and the part explained by CO was 0.31%. With the increase of the number of periods, the part of WTI explained by itself decreased and the part explained by CO increased phase by phase. However, after phase 6, the part explained by WTI did not decrease. From phase 6 to 12, the part explained by itself and the part explained by CO were 99.68% and 0.32 respectively.

## VI. CONCLUSIONS AND RECOMMENDATIONS

### A. Conclusions

After a comprehensive study of this thesis, three conclusions are drawn.

First, the fluctuations of international crude oil prices are mainly affected by market supply and demand, the exchange rate of the U.S. dollar, and speculative behavior. They are also affected by factors such as military politics, sudden natural disasters, and unexpected accidents. Because of these factors, the international crude oil prices have significant volatility.

Second, changes in international crude oil prices will also have a more significant impact on the stock prices of Chinese oil companies.

Third, through exploring the theoretical transmission model and specific empirical analysis of the impact of international crude oil prices on the stock prices of Chinese oil companies, it is found that fluctuations in international crude oil prices will indeed have a significant impact on the stock prices of Chinese oil companies.

### B. Recommends

- 1) Pay full attention to the cost management of enterprises.
- 2) Realize the integration of the upstream and downstream industrial chains of the industry.
- 3) Actively promote the transformation of scientific and technological innovation achievements.
- 4) Establish a comprehensive risk prevention system.

### CONFLICT OF INTEREST

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

### AUTHOR CONTRIBUTIONS

Yuzhou Huang, Qianru Zhuo contributed to the conception of the study; Yuzhou Huang, Qianru Zhuo concuted the research; Yuzhou-Huang analyzed the data; Yuzhou Huang, Qianru Zhuo wrote the paper; all authors had approved the final version.

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