

Research on the Impact of Crude Oil Price Volatility on China's Economic Growth

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Abstract: Since the beginning of the 21st century, with the rapid development of the world economy, the demand for energy has become more and more vigorous. Oil has accounted for the highest proportion in the global energy structure. China has become the world's second-largest economy, whose domestic oil supply relies heavily on international imports, but international oil price has been in frequent fluctuations. In this context, it is of great practical significance to analyze and study the impact of oil price fluctuations on China's economy. This paper not only reviews the history of oil price fluctuations, but also makes an economic theoretical analysis of the various factors that can cause oil price fluctuations. In this paper, the stationarity test method, co-integration analysis method and VAR model are comprehensively used to study the impact of crude oil price volatility on China's economic growth. The results show that the crude oil price and the GDP data series of China's economic growth are both first-order stationary time series. Second, in the long run, there is no long-term co-integration relationship between crude oil prices and China's economic growth, which is mainly because there are various factors affecting China's economic growth, as well as technology innovation and human capital factors. Finally, based on VAR model, this paper analyzes the short-term interaction between crude oil price and China's economic growth. The results show that crude oil price volatility has a significant short-term impact on China's economic growth, and it will weaken with time. Finally, this paper summarizes the conclusion of this study, and proposes that the government should accelerate the construction of China's oil strategic reserve system, and also actively promote China's crude oil futures market, and improve the pricing mechanism of China's crude oil price.

1. Introduction

1.1 Research Background and Significance

Since the appearance of the first oil well in the world in 1859, oil has entered into human production and life, and has been widely used by virtue of its inherent unique advantages. In 1967, the proportion of oil in global energy utilization successfully surpassed coal and became the largest energy source in the world. With the extensive application of oil in all aspects of human production and life, the fluctuation of oil price has an increasing impact on the economy and society.

The two oil crises in the 1970s not only severely damaged the development of the world economy, but also began the prelude to frequent fluctuations in oil prices. Since 2002, the fluctuation of international oil price has been the most significant. Take WTI(West Texas Intermediate Crude Oil of the United States) as an example, the spot price of WTI was around \$20/barrel at the beginning of 2002. After that, the international oil price rose rapidly until it reached the record high level of \$147/barrel in July 2002. Since then, affected by the financial crisis in the United States, the world economy grew sluggishly, and the international oil price quickly entered a downward path. The spot price of WTI fell to \$30 / barrel. In 2009, with the government's massive bailout, the economy began to recover, and in 2011, the spot price of WTI rose above \$100/barrel. Since then, it has hovered around \$90. Since 2014, the price of oil has entered a downward trend again, hovering around \$50 as of December 2016. Frequent and drastic fluctuations in oil prices not only seriously affect people's normal production and life, but also have

a series of adverse effects on world economic growth and stability, due to its important role in energy structure in modern society.

At present, the world economy still depends on the mobility of energy and raw materials. Oil is still the most important fuel in the world. In 2015, global oil consumption accounted for 32.9% of the world's energy consumption. In 2015, China's energy consumption accounted for 23 percent of global consumption, the highest among the world's energy consumption, and the growth of energy consumption accounted for 34 percent of the net growth of global consumption. China's oil consumption is growing rapidly. In 2015, China's daily oil consumption reached 11,968 barrels, accounting for 12.9% of the global oil consumption, second only to the United States. However, China relies heavily on imports for its oil supply.

As a commodity, the supply and demand are the basic factors affecting the oil price, and the oil price has natural fluctuation due to its characteristics of being exhaustible, strategic and uneven spatial distribution. As an important factor affecting oil supply and demand, the strong growth of oil demand, sudden fluctuation of oil supply, the change of oil inventory and geopolitical instability will have a profound impact on the trend of oil price and aggravate the fluctuation of oil price. With the establishment and development of the international oil futures market, the participants and trading volume of the oil futures market have been increasing, and the financial derivatives such as oil futures and options have been developing rapidly, which makes the international oil market more and more financial. The frequency and amplitude of oil price fluctuations are aggravated by the excessive participation of financial speculative forces. On the other hand, in the face of such frequent fluctuations in international oil prices and China's increasing dependence on foreign oil, it is of significance to analyze in detail the impact of fluctuations in international oil prices on China's GDP growth, and take positive measures to deal with them to minimize the unreasonable impact.

1.2 Research Content and Framework

Accordingly, this paper is divided into the following parts: The first part is the introduction, which mainly includes the significance and background of the topic, as well as the research idea and writing structure of this paper.

The second part focuses on the analysis of the internal mechanism of the impact of oil price fluctuations on China's economy. The third part is the impact of oil price fluctuations on China's economy. Firstly, the VAR model is used in this part to study transmission mechanism of oil fluctuation. Then, relevant policy suggestions are put forward according to the conclusions of the paper. The framework of the research is as follows:

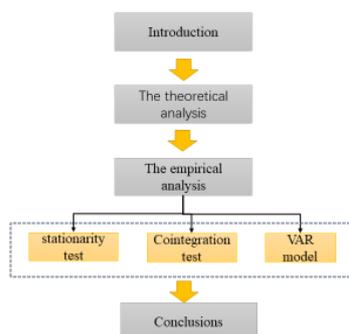


Fig.1 Research Logic and Framework

2. Mechanism of Oil Price Fluctuations on China's Economy

Oil price is affected by both supply and demand. Oil demand includes not only domestic demand but also foreign demand. Exogenous supply shock will also cause the fluctuation of oil price. The interaction between demand and supply can cause oil prices to fluctuate. On the other hand, oil demand is also affected by output, and when the economy grows rapidly, the price of oil will also rise sharply.

The financial speculation factor is also an important aspect that causes the fluctuation of oil price. The speculative capital mainly influences the trend of oil price through the futures market. With the continuous development of the crude oil futures market, the participants and trading volume of the crude oil futures market are increasing. The impact of the crude oil futures price on the spot price is also increasing. Besides, the role of financial speculation factors in the fluctuation of oil prices is becoming more prominent. Because of the crude oil futures market and spot market has the property of high-frequency trading, the futures price and spot price are also in frequent changes.

The relationship between oil price, price level and economic output has mutual influence. The rise of oil price can not only increase the price level (CPI and PPI), but also affects the output status (GDP). At the same time, the price level and output status can also affect the oil price. Previous studies have shown that higher oil prices will raise overall prices and depress output; On the other hand, when the overall price level of the society rises, the oil price will also rise. The continuous increase of output and the rapid economic development will also increase the demand for oil, driving up the oil price. Therefore, this paper will use the vector autoregression (VAR) model to study the interaction between the oil price and the output (GDP).

3. Empirical Results

3.1 Research Variables and Data Sources

This section for variable selection in full consideration of representative, so this paper selects the China's GDP data as an indicator on behalf of the condition of economic growth. In this section, WTI spot price is selected as the representative of crude oil price. In this section, the data source is WIND financial database, and the data processing software is Eviews8.0. The figure 1 shows the growth trend of China's GDP. The results show that since 1992, China's economy has presented a sustained and rapid growth trend, and there is a relatively significant quarterly trend. Therefore, this paper further detrending China's GDP data.

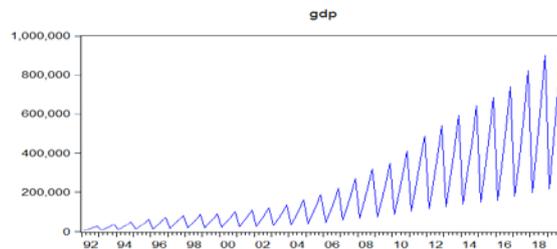


Fig.2 The Price Trend of Gdp

The figure 3 shows the trend of WTI crude oil price. The results show that the trend of crude oil price is significantly different from the trend of China's economic growth, with obvious periodicity and great volatility. Therefore, this paper also takes logarithmic form of crude oil price.

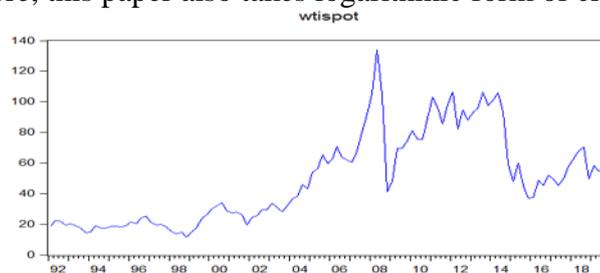


Fig.3 The Price Trend of Wtispot

3.2 Stationarity Test

The table 1 shows the results of the stationarity test of LOGGDP, and the statistical P value is 0.8253, so the null hypothesis cannot be rejected. The table 2 shows the results of the stationarity test of the first-order difference of LOGGDP, and the statistical P value is 0.0001, rejecting the null

hypothesis, indicating that LOGGDP is a first-order stationary series. Similarly, ADF test results show that LOGWTI is a first order stationary time series. The above empirical results show that LOGGDP and LOGWT are both first-order integral time series.

Table 1 the Stationarity Tests of Loggdp

Null Hypothesis: LOGGDP has a unit root			
Exogenous: Constant			
Lag Length: 4 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.762022	0.8253
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	
*MacKinnon (1996) one-sided p-values.			

Table 2 the Stationarity Tests of d(Loggdp)

Null Hypothesis: D(LOGGDP) has a unit root			
Exogenous: Constant			
Lag Length: 2 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.295325	0.0001
Test critical values:	1% level	-3.492523	
	5% level	-2.888669	
	10% level	-2.581313	
*MacKinnon (1996) one-sided p-values.			

Table 3 the Stationarity Tests of Logwti

Null Hypothesis: LOGWTI has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.612486	0.4729
Test critical values:	1% level	-3.490210	
	5% level	-2.887665	
	10% level	-2.580778	
*MacKinnon (1996) one-sided p-values.			

Table 4 the Stationarity Tests of d(Logwti)

Null Hypothesis: D(LOGWTI) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-10.01186	0.0000
Test critical values:	1% level		-3.490772	
	5% level		-2.887909	
	10% level		-2.580908	
*MacKinnon (1996) one-sided p-values.				

3.3 Co-Integration Test

This paper further use Johansen Cointegration test to investigate empirically whether there is a long-term Cointegration relationship between the crude oil price and economic growth, according to the results based on the Unrestricted Cointegration Rank test (Trace) inspection of the P value is 0.8056, showing that the price of crude oil and does not exist long-term Cointegration relationship between economic growth. This is because there are much factors that affect China's economic growth, and the price of crude oil is only one among the factors. In addition, institutional factors, scientific and technological innovation, human capital and other factors are also the core and key factors affecting China's sustainable economic growth.

Table 5 Co-Integration Test

Included observations: 107 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LOGWTI LOGGDP				
Lags interval (in first differences): 1 to 4				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.041490	5.030491	15.49471	0.8056
At most 1	0.004628	0.496356	3.841466	0.4811
Trace test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.041490	4.534135	14.26460	0.7991
At most 1	0.004628	0.496356	3.841466	0.4811

Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

3.4 Results of Var Model Estimation

This paper further applies VAR model to analyze the impact of crude oil price fluctuations on the short-term fluctuations of China's economic growth. Firstly, this paper applies the following model to determine the optimal lag order of the VAR model. The table shows the test results of lag order of the VAR model. According to LR, AIC and SC criteria, the optimal lag order of the VAR model can be determined as order 5.

Table 6 Var Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: DLOGGDP DLOGWTI						
Exogenous variables: C						
Included observations: 103						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-94.62167	NA	0.022380	1.876149	1.927309	1.896870
1	-80.22934	27.94627	0.018291	1.674356	1.827836	1.736521
2	-65.43024	28.16140	0.014832	1.464665	1.720464	1.568272
3	195.3263	486.0704	0.000101	-3.520899	-3.162780	-3.375849
4	320.4002	228.2903	9.67e-06	-5.871849	-5.411411	-5.685355
5	331.7158	20.21421*	8.39e-06*	-6.013898*	-5.451141*	-5.785962*
6	333.5768	3.252227	8.76e-06	-5.972364	-5.307287	-5.702985
7	336.4535	4.915568	8.97e-06	-5.950553	-5.183156	-5.639731
8	338.6553	3.676849	9.30e-06	-5.915637	-5.045921	-5.563372
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

The Table 7 shows the estimated VAR model results of the crude oil price and the of China's economic growth. The results show that the coefficient in front of DLOGWTI(-1) is significantly positive at the significance level of 1%, indicating that the volatility of WTI crude oil price has a significant positive impact on the volatility of China's economic growth.

Table 7 Var Model Estimation Results

Vector Autoregression Estimates		
Included observations: 106 after adjustments		
Standard errors in () & t-statistics in []		
	DLOGGDP	DLOGWTI
DLOGGDP(-1)	0.111515 (0.09340) [1.19400]	0.067829 (0.91763) [0.07392]
DLOGGDP(-2)	-0.058652	0.068813

	(0.02710)	(0.26626)
	[-2.16431]	[0.25845]
DLOGGDP(-3)	-0.058405	0.132051
	(0.02709)	(0.26615)
	[-2.15606]	[0.49615]
DLOGGDP(-4)	0.941474	0.071190
	(0.02710)	(0.26625)
	[34.7422]	[0.26738]
DLOGGDP(-5)	-0.169447	0.001150
	(0.09080)	(0.89213)
	[-1.86613]	[0.00129]
DLOGWTI(-1)	0.038585****	0.090045
	(0.01025)	(0.10066)
	[3.76611]	[0.89453]
DLOGWTI(-2)	0.003278	-0.173359
	(0.01098)	(0.10791)
	[0.29844]	[-1.60651]
DLOGWTI(-3)	0.001985	0.020210
	(0.01058)	(0.10391)
	[0.18767]	[0.19450]
DLOGWTI(-4)	0.001984	-0.053760
	(0.01045)	(0.10265)
	[0.18988]	[-0.52371]
DLOGWTI(-5)	-0.041682	-0.201850
	(0.01054)	(0.10358)
	[-3.95359]	[-1.94865]
C	0.006680	0.003490
	(0.00397)	(0.03898)
	[1.68369]	[0.08954]
R-squared	0.999642	0.172109
Adj. R-squared	0.999604	0.084962
Sum sq. resids	0.027264	2.631852
S.E. equation	0.016941	0.166444
F-statistic	26528.72	1.974936
Log likelihood	287.6707	45.46734
Akaike AIC	-5.220202	-0.650327
Schwarz SC	-4.943808	-0.373933
Mean dependent	0.039396	0.010785
S.D. dependent	0.851676	0.174000
Determinant resid covariance (dof adj.)		7.95E-06
Determinant resid covariance		6.38E-06
Log likelihood		333.1677
Akaike information criterion		-5.871088
Schwarz criterion		-5.318299
Number of coefficients		22

Figure 4 shows the characteristic root test results of the above VAR model. The results show that all AR characteristic roots are in the unit circle with unit 1, indicating that the VAR model constructed above is robust and reliable.

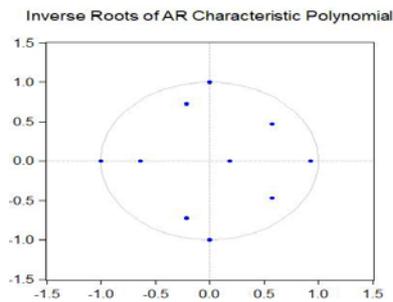


Fig.4 The Ar Root Figure of the Var Model

The figure shows the impulse response of China's economic growth and crude oil price shocks to China's economic growth. Results show that the fluctuations in China's economic growth itself factors on the impact of China's economic growth has continued periodic effect. And the crude oil price shock to China's economic growth has significant short-term effect. In detail, the results show that in general in the second quarter has significant positive effect, then the impact gradually weakened and eventually disappear.

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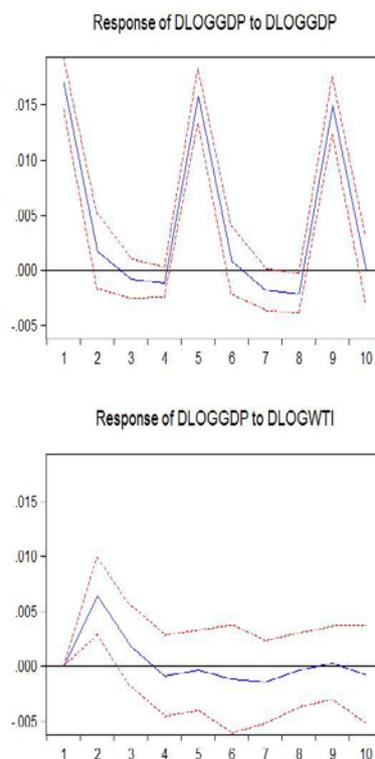


Fig.5 Impulse Response Result

4. Conclusions and Suggestions

By reviewing the historical fluctuations of international oil prices, and based on various econometric model methods such as stationarity test, co-integration test and VAR model, this paper studies the impact of crude oil price fluctuations on China's economic growth, and draws the following conclusions:

Firstly, as the most important energy product in the world, oil itself has its own particularity. The price of oil is bound to fluctuate. Although the current global oil supply and demand are still in a

relative equilibrium state, the impact of supply and demand on oil price cannot be ignored. Many emergencies that can affect oil supply and demand can still directly affect the trend of oil price.

Secondly, there is no long-term co-integration relationship between WTI crude oil price and China's economic growth, mainly because there are many factors affecting China's economic growth, among which crude oil is only one. In addition, institutional factors and human capital factors are also important factors affecting China's long-term economic growth. There is a correlation between WTI spot price and China's GDP, and the fluctuation of WTI spot price has a certain impact on China's GDP. And the impact is mainly relatively delayed for two quarters, and eventually the impact gradually disappeared. Thus, in the future, the government should improve the energy consumption structure and actively develop alternative energy so as to better deal with the impact of crude oil price fluctuations on the economy.

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