


Article

Dynamic Characteristics of Oil Attributes and Their Market Effects

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Abstract: The commercial and financial attributes of oil have significantly changed the evolution characteristics of prices and returns of the international crude oil market. Using monthly data from April 2003 to October 2020, this paper identifies dynamic characteristics of oil's commercial and financial attributes based on the structural vector autoregressive model (SVAR) and further analyzes their market effects with different attributes. The result shows that there are situations of commercial and financial attributes dominating, and dual attributes co-dominating for oil. Furthermore, their durations account for 51%, 23%, and 26% respectively, of the full sample. Besides, the reactions of crude oil price or return to the different properties of oil are heterogeneous. Specifically, the dual attributes of oil play the most important role in the price evolution of the international crude oil market, which is 80.851. There are significant differences among the impact of different attributes of oil on the evolution of international crude oil market returns, which are 0.009, −0.008, and −0.004, respectively. Then, some relevant recommendations for policy-makers and investors based on the above research conclusions are also put forward.



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1. Introduction

The dynamic characteristics of oil attributes are of paramount importance to understand the behaviors of crude oil markets. The commercial attribute of oil determines its role as a general commodity. Since 2003, the demand for crude oil in developing countries, mainly from BRICs countries of China, India, Brazil, and Russia, has grown rapidly. Among them, China has gradually become the main area of the world for crude oil consumption, which rose from 7.21% in 2003 to 13.88% in 2018 of the total world consumption. With the acceleration of financial innovation, the international crude oil market has experienced the evolution of the spot market, forward market, and future market, which established its financial attribute. Given the financial attribute, oil can act as a commodity and an investment financial asset, and its price trends are affected by the US dollar index (USD) and speculative factors [1]. More importantly, there are dynamic characteristics in oil's different attributes. Oil's financial attribute is mainly related to the dynamic nature of speculative groups' investment intention, whereas its commercial attribute is mainly due to the evolution of supply and demand of the international crude oil market [2,3]. In addition, being affected by mutual investment intention and supply–demand relations, the international crude oil market has double attribute patterns. Thus, recognizing the dynamic characteristics of oil's attributes can help identify the risk sources of the international crude oil market and provide empirical evidence for formulating targeted policies for policy-makers.

The different attributes of oil have a significant impact on the evolution of the price and return in the international crude oil market. The influence of the financial attribute on international crude oil prices depends on the supply, demand, and the degree of capitalization in the market. Due to the crucial role of the US dollar on global payment, the USD_X, which reflects the exchange rate of the US dollar in the international foreign exchange market, has become a new basic element to affect the trend of international crude oil prices [4–6]. Since 2003, the USD_X has had a negative correlation with the international oil price fluctuation. From 2003 to 2011, the USD_X has showed a downward trend when the international crude oil prices increased. After 2011, the US economy has gradually recovered, with a rising trend for USD_X when the international crude oil prices showed a reverse trend [7,8]. As the world's main energy market, the international crude oil market has been involved in the financial market by attracting a large number of speculators and investors to invest in crude oil as a hedge asset, which made the speculative nature of commodity futures significantly increase [9]. Although the change of speculators' trading strategy is an important factor for oil price's fluctuation, it cannot well-describe the evolution characteristics of international crude oil prices from a certain attribute. In other words, there is a heterogeneous influence of oil's commercial and financial attributes on the evolution of international crude oil prices and incomes. Therefore, by comparing and analyzing this heterogeneity, investors gain more benefit to formulate investment strategies; at the same time, policy-makers can prevent the impact of the international crude oil market on macroeconomics.

The main purpose of this paper is to identify the dynamic characteristics of oil attributes and their impact on the evolution of the international crude oil market's prices and returns. With the development of oil's dual attributes and financialization in crude oil markets, we intend to study the evolution features of the international crude oil market's prices and returns comprehensively and systematically based on oil's dual attributes, which are better to prevent the impact of the international crude oil market on the stable economic operation. Along with the increasing dependence of China's economic development on oil and the establishment of the Shanghai International Energy Center, the price fluctuation of the international crude oil market has become a key factor in market security. With the gradual identification of oil's commercial and financial attributes, the concealment of the international crude oil market risk is improved, which makes risk warning and management more difficult [10,11]. By dynamically measuring the dominant position of oil's commercial and financial attributes, this paper further analyzes the differences in the evolution characteristics of the international crude oil market's prices and incomes. Risk warning of the international crude oil market's fluctuations is good for the following aspects, such as: preventing emergency work before crisis, formulating coping strategies timely, reducing the impact of the international crude oil price fluctuations on investors' returns, and financial system and economic development, thus, it can ensure stable and sustainable economic development.

The existing literature attempts to use different methods to predict prices and their determinants for the international crude oil market. The sequence decomposition and related econometric models are mainly used for this prediction. For example, Wu et al. [12] predicted international crude oil market prices by using Google trend and Web text data based on a traditional web model. In addition, Dai et al. [13] used network public opinion data on emergencies. Other studies mainly predicted international crude oil market prices from the perspective of sequence decomposition, which includes empirical mode decomposition (EMD), wavelet analysis, spectral decomposition, and variational mode decomposition (VMD) [14–19]. According to oil's different attributes, the influencing factors on international crude oil market prices can be divided into two categories: market supply–demand relation and factors of financial market. Based on the data of the international crude oil market from 1859 to 2010, Hamilton [20] divided the evolution of international crude oil market prices into five stages. From the perspective of the market supply–demand relationship, the oil stock, supply, and demand could be regarded as the

key factors in the evolution of international crude oil market prices [21–23]. Baumeister and Kilian [24] proved that oil's spare capacity in OPEC countries affects the evolution of international crude oil market prices. Manescu and Nuno [25] found that the development of shale oil in the United States has changed the intensity of crude oil imports, which also influenced the crude oil supply of OPEC countries. The financial factors that affect the evolution of international crude oil prices mainly include USDX, crude oil future market, and stock market [26–28]. From the above, a few studies have analyzed the evolution of the international crude oil market's price and return that are dominated by oil attributes.

The existing literature provides a theoretical basis for oil attributes' recognition and their effect analysis, but there is still room for further research. Firstly, the dynamic characteristics of oil's commercial and financial attributes need to be further identified. Oil's dual attributes are derived from the important role of oil in economic development and the financialization of the international crude oil market. In addition, according to the relevant literature on the international crude oil market, many researchers studied the international crude oil market based on the single attribute of oil. They analyzed the relationship between the crude oil price and supply/demand, and the correlation between the crude oil market and the financial market. However, the dominant position evolution of oil's dual attributes in the sample period has not been paid enough attention. Combining research purposes with the practical background, oil's commercial attribute has a great impact on the cost control and energy reserves in the process of economic development; at the same time, oil's financial attribute plays a key role in the stability of the financial market. Whether the commercial attribute or the financial attribute is dominant, it plays a crucial role in the macroeconomic stable operation, price stability, structural adjustment, and regional development.

Secondly, the heterogeneous evolution of crude oil prices and returns during several scenarios related to oil attributes should be analyzed further. On the one hand, oil resources can no longer be regarded as a commodity, but a compound commodity with the characteristics of financial products due to the close relation with the financial market. In addition, the shortening of fluctuation for the international crude oil market and the increase of the fluctuation range are considered as futures of oil with financial product characteristics. On the other hand, except for the scarcity, and the strategic and political nature of oil commodities, the evolution of the international crude oil market's price and returns can also be affected by market supply and demand. Due to the differences in the formation of oil attributes, the evolution of the international crude oil market's price and returns is significantly heterogeneous. Thus, this paper further analyzes the market reactions to oil's different attributes.

The remaining structure of this paper is arranged as follows: Section 2 presents the basic theories, including the theoretical hypotheses of recognizing different attributes of oil. Section 3 presents the research design, including the selection of a dynamic feature recognition model and variable selection of oil attributes. Section 4 conducts empirical analysis. The last section is the conclusion.

2. Basic Hypotheses of Identification for Oil's Attributes

According to the previous review, the following three hypotheses will be investigated in this section:

Hypothesis 1. *The positive reaction of oil price to monetary policy depicts the financial attributes of oil.*

Hypothesis 2. *The commercial attribute of oil is related to the positive impact of oil demand on the international crude oil price.*

Hypothesis 3. *The dominant position of different attributes of oil has dynamic characteristics.*

Our first hypothesis considers the monetary policy as a vital element for crude oil price. In the view of the financialization of the crude oil market, we define the oil financial property as “crude oil price shows a new pattern which could be recognized as a financial asset”. In this sense, the oil financial attribute mainly reflects the strategy of investors and shows the positive relationship between monetary policy and crude oil price. Furthermore, crude oil could react in a hedging role with financial asset because of the negative correlation between oil and financial returns. On the one hand, monetary policy is the key factor to influence the US dollar exchange rate and even manipulate international oil prices [7,29,30]. As the only valuation currency for oil, the change of the US dollar varies the oil revenue of OPEC, and then increases the income surplus after deducting the development of the domestic economy and other domestic expenditures, namely petrodollars. Quantitative easing could be regarded as an unconventional monetary policy focused on long-term securities purchase. Under the quantitative easing monetary policy, the US dollar faces depreciation pressure, which makes the capital flow between the currency market and the commercial futures market. At this time, a large amount of speculative capital withdraws from the foreign exchange market and flows to the oil futures market, thus raising the price of the international crude oil market. In addition, the quantitative easing also brings currencies a relative rise, while it boosts economy activities with low interest rates [31]. Then, large numbers of dollars will hedge funds, as well as hit the capital markets of these countries. The change of the exchange rate of the US dollar leads to the conversion of capital between different currencies, and then triggers the change of the international oil price.

On the other hand, monetary policy creates opportunities for hedgers and speculators gaining profit in the international crude oil market. Based on the financial attribute of oil, oil reserves also have the nature of financial assets. The impact of monetary policy on the price of the international crude oil market is mainly due to the changes in speculative demand [32]. As a policy of demanding control, an expansionary monetary policy, such as quantitative easing, will increase the demand for oil, reduce the uncertainty of the international crude oil market, and release good news for investors. Investors’ optimistic expectations will be increased by grasping this news. Besides, their asset allocations of real and financial investments also change, as well as their speculative demand is increased accordingly [33]. Therefore, this good news leads to a price increase for oil financial derivatives, thus finally influencing the international crude oil market spot price in turn. On the contrary, tight monetary policy increases the uncertainty of investment in the international crude oil market, which leads to the change of investors’ expectations and the decrease of speculative demand, leading to the decline of oil financial derivatives’ prices [34]. Due to the important role of petroleum financial derivatives in price discovery, hedging, and risk aversion, the spot price of the international crude oil market has also changed.

The second hypothesis is based on an oil commercial attribute perspective, supporting that oil demand is an important determinant in the crude oil price. The commercial property of oil determines the positive impact of the international crude oil price mainly by oil demand. As a kind of bulk commodity, the price of the international crude oil market follows market principles to a certain extent and is mainly affected by the evolution of the relationship between supply and demand. Theoretically, the formation of oil commercial attributes has relations among the stock of oil resources, the change of oil supply and demand elasticity, and the evolution of supply structure in the international crude oil market [17,35]. As a kind of exhaustible resource, the stock of petroleum resources is related to the uncertainty of oil reserves, the development of alternative energy, and future demand. The oil price would rise if the cost of exploitation and resources remain unchanged; thus, it would accelerate the exploitation and supply of oil by oil-producing countries. At the same time, oil producers may delay production or scale back existing production if oil prices were expected to rise, or if future technological advances were to make extraction more efficient and cheaper. Besides, these aspects of oil inventory changes, technological progress, economic development, and economic structure would change

the elasticity of oil demand and supply, and then affect the international crude oil market price [36,37]. In addition, the supply structure of the international crude oil market has evolved from the original OPEC countries to the present OPEC rich countries group, OPEC poor countries group, and non-OPEC countries. Due to the difference of policy objectives among different players, the pricing of the international crude oil market is mainly based on the choice of long-term and short-term profits and the degree of mutual tolerance. Based on this supply structure, OPEC further put forward a pricing mechanism among oil price ranges by combining the market demand. However, due to the differences in oil production reserves, spare capacity, and exploitation costs within OPEC countries, OPEC countries cannot control the price of the international crude oil market, but become the recipient of international oil prices [38]. Therefore, the commercial property of oil satisfies the law of “adjusting with the supply and demand relationship of the international crude oil market” to a certain extent.

In reality, as a scarce strategic resource, oil always changes with the worldwide oil exploration activities, leading to the uncertainty of future oil reserves. Therefore, due to the inelastic supply in the short term, and the lag effect on the adjustment of oil supply by OPEC, the price of the international crude oil market is affected by the demand in the short term [34,39]. Besides, the demand for crude oil is usually correlated with the general order of the national economy. When the economy is booming, social demand increases, as well as the demand for oil. Further, the international crude oil market price will inevitably rise under the condition of unchanged oil supply in the short term. On the contrary, when the economy is in depression, the total social demand is weak, and the demand for oil also drops, which leads to a decline in the price of the international crude oil market [40,41]. In the long run, the supply of crude oil is elastic. However, as a non-renewable resource, oil’s storage capacity, resource endowment, production cost, production capacity, and OPEC’s decision will limit the supply of crude oil [39]. Therefore, the price change of the international crude oil market is mainly affected by the positive impact of oil demand in the long term.

The third hypothesis considers the differentiation of crude oil price determinants which seem to present a heterogeneous mode. The dynamic characteristics of the dominant position of oil’s financial and commercial attributes are mainly caused by the time-varying monetary policy and oil demand shock. The time-varying shocks are mainly related to the external environment [42,43]. The dominant position of financial and commercial properties of oil refers to the fact that the price of the international crude oil market is mainly affected by a certain characteristic of oil in a particular period. Taking the dominant position of the oil financial attribute as an example, under the influence of the financialization of the commodity market, the price of the international crude oil market in a certain period is mainly affected by the investment willingness of the speculators or the fluctuation of the US dollar. Besides, the influence of the international crude oil market factors on the price is small or contrary to the expectation. According to Hypotheses 1 and 2, the formation of the financial attribute of oil is related to the impact of monetary policy on the international crude oil price, whereas the formation of the commercial attribute of oil is related to the impact of oil demand on the international crude oil price. At the same time, the magnitude and direction of these influences will change as the external environment changes. To be specific, as oil and other commodity markets become more financialized, more and more investors are trading crude oil as a financial asset. When a large amount of capital flows into the international crude oil market, the financialization of oil and other commodities is further expanded, thus promoting the financialization development of the petroleum industry [44,45]. Influenced by capital flows, investor expectations, and speculative activities, international crude oil market prices mainly reflect the speculative intentions of oil investment groups. Since financial market profit is more than real investment, enterprises will change their capital allocation between entities in the pursuit of expected profit or excess profits. Further, oil’s commercial attribute will become weak, thus eventually making oil financial attributes dominant. Therefore,

when the financial attribute of oil is dominant, monetary policy has a positive effect on the international crude oil market price; however, oil demand has a negative or slightly positive effect on the international crude oil market price.

Similarly, the uncertainty of profits in financial markets makes oil's commercial attribute dominant. As the most important input factor of industrial production and life, the commercial attribute of oil is the key attribute of the price formation of the international crude oil market. The international crude oil market has a regulating effect on the speculative manipulation factors of oil investment groups. Besides, the uncertainty of obtaining expected profits by enterprises would increase because the investment in the financial market faces high risks and other factors. The variation in the external environment such as economic development, technological progress, and industry structure adjustment make enterprises change their investment strategies [2]. As the macro-economy improves, the profit space for enterprises to invest in the real economy is expanded, and the consumption demand for oil is bound to rise. On the contrary, the demand for oil would decrease. The development and utilization of alternative energy also reduce the consumption demand for oil [41]. Consumption demand expectations, which transfer from optimistic expectations to scarcity expectations, inevitably promote the competition for access to oil resources, thus eventually leading to the rise of international crude oil prices. Under this circumstance, the financial property of oil mainly plays the function of price discovery in the international crude oil market; on the contrary, the influence of monetary policy on the price of the international crude oil market is also mainly reflected in the change of oil consumption demand because the functions of hedging, speculation, and arbitrage are obviously insufficient. Therefore, when the commercial attribute of oil dominates, the oil demand has a positive impact on the international crude oil market price; however, the monetary policy has a negative or slightly positive impact.

The joint dominance of the dual nature of oil is highly correlated with special events. Except for the single dominance of oil's dual attributes, there is also a common dominance of the financial and commercial attributes. This situation depends on two aspects. One is that it may affect the correlation between monetary policy and international market prices of crude oil due to special events, while the other is that it will change the role of oil demand in the international crude oil price evolution [17,42]. With the development of economic and financial integration, special events not only cause changes in the main market of the source of the event, but also influence other markets, thus affecting the price evolution of other markets. On the one hand, exceptional events can change policy expectations. Monetary policy has a regulatory effect on investors' expectations. Investors' expectations change when influenced by special events, which eventually lead to changes in the regulatory effect of monetary policy [32]. On the other hand, special events can impact oil demand. Special events may increase the difficulty of economic development and industrial structure adjustment, and then change the profit margin of enterprises' real economic investment, and finally make changes to the oil consumption demand [36]. Therefore, the joint dominance of oil financial and commercial attributes is correlated with the occurrence of special events.

3. Research Design

3.1. Model Selection for Identification of Oil Attributes

There is an endogenous relationship among the price of the international crude oil market and monetary policy and oil demand. First of all, both monetary policy and oil demand have a positive impact on the international crude oil price from the second part. Then, the international oil price varies with the changes in production cost of enterprises, and also affects oil demand, as well as influencing a country's inflation level. Besides, in order to maintain price stability, a country formulates corresponding monetary policies to adjust the inflation level, which means the price of the international crude oil market also affects monetary policy [36]. Based on the endogenous relationship among international crude oil market price, monetary policy, and oil demand, this paper considers building VAR-

type models for the limitations of the traditional linear model. In addition, by considering the immediate impact of international crude oil price, oil demand, and monetary policy, as well as the description of structural shocks to their correlations, the SVAR model is constructed to identify the dual attributes of oil based on Kilian [46].

The basic form of the SVAR (p) model is shown in Formula (1):

$$B_0 X_t = \sum_{i=1}^p B_i X_{t-i} + \varepsilon_t. \quad (1)$$

where $X_t = (\text{opi}_t, \text{dem}_t, \text{mpo}_t)'$ is the dimensional vector of 3×3 , opi_t represents the crude oil market price at the time t , dem_t means oil demand at the time t , mpo_t depicts monetary policy at time t , and p is the lag order, which is determined by SC criterion. B_0 describes an immediate impact of international crude oil market price, oil demand, and monetary policy, and similarly, B_i describes the marginal impact of lag order i .

Since it is reversible, Formula (1) can be simplified as Formula (2):

$$X_t = \sum_{i=1}^p B_0^{-1} B_i X_{t-i} + B_0^{-1} \varepsilon_t. \quad (2)$$

where, $\varepsilon_t = (\varepsilon_t^{\text{price-shock}}, \varepsilon_t^{\text{demand-shock}}, \varepsilon_t^{\text{policy-shock}})$ is the structural vector of international oil price shocks, which includes shocks of specific oil price, international oil price demand, and its monetary policy.

Combined with the research purpose and the existing literature, this paper imposes a short-term zero constraint on the immediate influence matrix B_0 , and constructs a SVAR model. The specific constraint matrix is shown in Formula (3):

$$B_0 X_t = \begin{bmatrix} 1 & b_{12} & b_{13} \\ 0 & 1 & b_{23} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \text{opi}_t \\ \text{dem}_t \\ \text{mpo}_t \end{bmatrix}. \quad (3)$$

where the corresponding position in the matrix represents the immediate influence among variables. Specifically, the international crude oil prices respond to the impact of oil demand and monetary policy, so the first element of the first row of the constraint matrix is 1, and the other elements are not 0. Although oil is taken as the main raw material and fuel in global economic activities, due to the formulation of enterprise investment plan and oil reserve, its demand has a lag effect on the international crude oil price when its price changes; that is, the impact of oil price does not affect the current oil demand, $b_{21} = 0$. In addition, variables in international oil prices and oil demand will not cause changes in monetary policy; that is, $b_{31} = b_{32} = 0$. The changes in monetary policy cause changes in oil demand in the current period. From the above, the short-term constraint matrix of Formula (3) is constructed. The authors also estimated another SVAR model by adding the oil production. The results show there are no differences between models in impulse and structural shocks of oil price, oil demand, and money supply.

3.2. Variable Selection

According to the model selection, international crude oil market price, oil demand, and monetary policy are the three variables. The spot price of Brent oil is used as a proxy variable for the international crude oil market price. The changes in spot prices of Brent and WTI crude oil reflect the price evolution characteristics of the international crude oil market. Due to the change in Brent crude oil demand of emerging countries and the controlling crude oil export of the US government in recent years, Brent has become the international oil benchmark. Although Brent has been activated in Europe, it can also be used to assess the basic price for other grades. In this way, the Brent crude oil spot price is selected to measure the international crude oil price.

Oil demand is measured by the growth rate of the Baltic Dry Index (BDI). The change of oil demand is highly related to economic demand. The oil demand increases during the economic boom, which leads to the price of the international crude oil market showing

a rising trend, whereas oil demand falls when the economy is depressed. Therefore, two problems should be considered simultaneously in the selection of the oil demand measurement index. First, the differences in industrial structures of different countries, making the dependence of economic development on oil vary from country to country. Second, the contribution of emerging countries such as BRICS in global economic development, making oil demand become a key factor that affects the price changes in the international crude oil market. Based on the practice of Kilian [46], this paper selects dry bulk freight index as the proxy variable of oil demand by considering the close relationship between shipping index and oil demand.

The global money supply is selected to measure monetary policy. The money supply, a main indicator for the central bank to adjust monetary policy, reflects the stock of money available for transaction in a given period. Based on data availability, this paper quantifies the global money supply with the sum of the M2 from the United States, Japan, and the European Union. M2 includes all possible forms of money to show purchasing power, usually reflecting changes in aggregate social demand and the pressure state of future inflation. All the above data are from the Wind database. After obtaining the money supply of various countries, the historical bilateral exchange rate data are used to convert the money supply into dollars, and then the sum is used to obtain the value of the monetary policy proxy variable.

Then, we used the monthly data from April 2003 to October 2020 for empirical analysis. The Bank of Japan first announced M2 as money supply in April 2003. Although the time for selection is short, the results can better reflect the dynamic characteristics of the dominant position of oil's dual attributes. In addition, by taking seasonal effects of the variables into account, we made seasonal adjustments to international crude oil prices, BDI, and money supply (GM2) by X12. On this basis, in order to eliminate heteroscedasticity, this paper further implements logarithmic processing for data. After treatment, the statistical characteristics of variables in Table 1 are analyzed.

Table 1. Descriptive statistics.

Variables	Descriptive Statistics Analysis					Correlation Analysis		
	Mean	Max	Min	Std. Dev.	Coefficient of Variation	Brent	BDI	GM2
Brent	4.179	4.826	3.145	0.405	0.097	1		
BDI	7.498	9.197	6.059	0.753	0.101	0.0256	1	
GM2	18.55	18.95	17.94	0.235	0.013	0.4582	−0.521	1

Some interesting results, referring to the evolution of Brent, BDI, and GM2 and their correlations, are showed in Table 1. From the results of the correlation analysis in Table 1, we can see that the correlation coefficient between BDI and Brent is 0.0256, while it is 0.4582 between Brent and GM2. This indicates that the relationships among the international crude oil market, oil demand, and money supply are positive. In addition, the fluctuation characteristics of different variables are different. Both standard deviation and variable coefficient of variation can better reflect the fluctuation characteristics of variables, but the fluctuation characteristics described by coefficient of variation can eliminate the dimensional differences among different variables, which makes the fluctuation characteristics comparable among international crude oil market prices, oil demand, and monetary policy. From Table 1, the variable BDI fluctuates the most during the sample period, which is 0.101. GM2 has the smallest fluctuation, which is 0.013. Combined with correlation analysis, it was found that BDI with the largest fluctuation has the smallest correlation with Brent, whereas GM2 has the largest correlation with Brent. In order to further explore the internal relationship among the international crude oil price, oil demand, and money supply, we used the Granger causality test to verify the internal relationship of these variables.

We can see the Granger causality test results of Brent, BDI, and GM2 in Table 2. On the one hand, the Granger causality test is an effective tool to test the causality between

variables, and on the other hand, it can be used to test the short-term constraint matrix. From the test (a), we can see that the p -values of the causality test between Brent and BDI are all less than 0.05, which means that there is a two-way causality between the Brent oil price and the BDI. Similar to test (b), GM2 is the Granger cause of Brent, while Brent oil prices do not cause changes in GM2, whose p -values are 0.0053 and 0.6942, respectively. Paying attention to test (c), we found that the p -value is 0.0000 when the null hypothesis was “GM2 is not the Granger cause of BDI”. On the contrary, when the null hypothesis was “BDI is not the Granger cause of GM2”, the p -value was 0.8165. Based on the above, the GM2 is the Granger cause of the BDI, whereas the opposite case is rejected. Therefore, there is a correlation among Brent oil price, BDI, and GM2, and the short-term constraint matrix conforms to the expected setting.

Table 2. Granger causality test.

Test	Null Hypothesis	F Statistical Quantity	Prob.
a. Brent and BDI	BDI is not the Granger cause of Brent	3.0646	0.0488
	Brent is not the Granger cause of BDI	6.1687	0.0025
b. Brent and GM2	GM2 is not the Granger cause of Brent	5.3865	0.0053
	Brent is not the Granger cause of GM2	0.3657	0.6942
c. BDI and GM2	GM2 is not the Granger cause of BDI	15.729	0.0000
	BDI is not the Granger cause of GM2	0.2028	0.8165

4. Dynamic Characteristics and Effect Analysis of Oil Attributes

Based on the hypothesis and research design, the SVAR model was used to identify the dynamic dominant characteristics of different attributes of oil. At the same time, the heterogeneity characteristics of international crude oil market prices and returns in different periods were further analyzed by using descriptive statistics. Then, this paper checked the stability of variables in the SVAR model and next determined the lag order in the SVAR model. Further, the dynamic characteristics of commercial attribute, financial attribute, and dual attributes of oil were identified by structural shocks based on the validation results of the model. Finally, in view of the dynamic characteristics of these attributes, the evolution characteristics of the international crude oil market price and return were analyzed under different attributes' domination.

4.1. Model Settings

The model test mainly includes stationary tests and lag order determination. The variables in the VAR-type models should be stationary variables. In this paper, the stabilities of international crude oil prices, BDI, and GM2 were used to test by the ADF method. The ADF test process needs to determine whether the intercept term and trend term exist in different variables or not. According to the time sequence diagram of these three variables, we found that the international crude oil price, BDI, and GM2 all have an intercept term and trend term, but there is no intercept term and trend term with variable difference. Based on these, with the limitation of paper length, we only show the test results after variable difference in Table 3. According to the test results, the ADF test statistics are -10.62 , -12.04 , and -14.05 respectively, after Brent, BDI, and GM2 difference, and the test p -value is $0.0000 < 0.05$. It can be seen that all variables are stationary variables after first-order difference.

Table 3. Results of variable stability test.

Variable	ADF Critical Value			ADF Value	Prob.
	1% Critical Value	5% Critical Value	10% Critical Value		
Brent	−2.5760	−1.9423	−1.6157	−10.619	0.0000
BDI	−2.5760	−1.9423	−1.6157	−12.039	0.0000
GM2	−2.5760	−1.9423	−1.6157	−14.049	0.0000

Notes: Table only shows the test results after variable difference.

The SC criterion was used to select lag order. AIC and SC are commonly used criteria to determine the lag order. AIC has the criterion to measure the good fit of a model, while SC criterion has more strict inspection procedures. The basic principle of the SC criterion test is to determine the appropriate lag length by comparing the goodness of fit of VAR models with different lag orders. The testing process is adding the lagged items of Brent, BDI, and GM2 variables to the VAR model until the SC value no longer decreases; that is, the SC value is selected to reach the minimum lag order, p . From Table 4, we can see that the value of SC is the minimum when $p = 1$ from the SC minimum criterion. Based on this, the SVAR (1) model was constructed.

Table 4. Selection of lag order.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	716.210	NA	2.04×10^{-7}	−6.891	−6.843	−6.871
1	743.774	54.063	1.71×10^{-7}	−7.071	−6.877 *	−6.992 *
2	755.463	22.587	1.66×10^{-7}	−7.096	−6.758	−6.959
3	765.688	19.461 *	1.64×10^{-7} *	−7.108 *	−6.625	−6.912

Note: * is the recommended lag order under different criteria.

4.2. Identification of Dynamic Features for Oil's Dual Attributes

Based on the model test results, this paper identifies the dynamic features of oil's different attributes by using the first-order difference variables of Brent, BDI, and GM2 to fit the SVAR (1) model (the estimation results of the SVAR model are available upon request). Combined with the basic hypotheses, the dynamic identification of oil's commercial and financial attributes mainly includes their existence and dynamic characteristics. In view of these, we first analyzed the existence of oil's commercial and financial attributes by impulse analysis, and then analyzed their dynamic characteristics according to the correlations among structural shocks.

Crude oil demand and money supply have a significant positive impact on the international crude oil market price. Figure 1a,b both show the impulse response of international crude oil market prices to crude oil demand (BDI) and monetary policy (M2), respectively. From Figure 1, the positive impact of crude oil demand and monetary policy on the international crude oil price indicates the existence of commercial and financial properties of oil. Specifically, the impact of crude oil demand and monetary policy on the international crude oil price is positive, and this positive impact reaches the maximum when the lag period is two, and the impact is basically zero when the lag period is five. According to Hypothesis 1, the financial attribute of oil is related to the positive impact of monetary policy. This is mainly because the change of monetary policy would affect the role of financial factors, such as the exchange rate of the US dollar and crude oil assets' speculation in promoting the change of the international crude oil price, thus forming the financial attribute of petroleum [7,44]. The loose monetary policy leads to the depreciation pressure of the US dollar, which in turn makes the capital flow from the money market to the international crude oil futures market. At this time, a large amount of speculative capital flows from the foreign exchange market to the oil futures market, thus stimulating the international crude oil market price. In addition, the declining dollar stimulated the US

economy while allowing other countries to raise their currency, relatively. This in turn leads to the transfer of capital between different currencies, and eventually to the change of international oil prices. In addition, the policy of monetary expansion reduces the uncertainty of the international crude oil market, and releases good news for investors. Then, by grasping this news, investors' optimistic expectations are increased, which in turn changes the allocation of their money in real and financial investments, and speculative demand increases accordingly as well. Therefore, making use of good news leads to the oil financial derivatives' price increase, and eventually has an impact on the international crude oil market spot price.

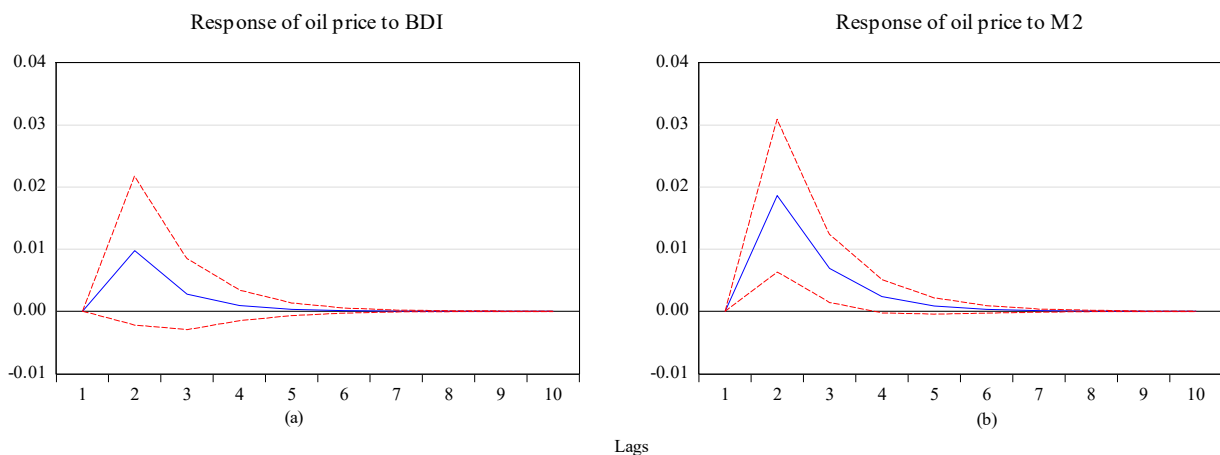


Figure 1. Identification of oil's commercial and financial attributes. Notes: (a) refers to the identification of oil's commercial attribute, and (b) is the identification of oil's financial attribute.

According to Hypothesis 2, the commercial attribute of oil is related to the positive impact of crude oil demand. The evolution of the supply structure of the oil market, namely, first from OPEC countries as the main body to the three main bodies of OPEC rich countries, then to OPEC poor countries and non-OPEC countries, which has affected the crude oil supply and weakened OPEC's pricing power on the international crude oil market [38]. Due to influencing factors, such as alternative energy sources, if oil prices are expected to rise, oil-producing countries may delay production or scale back existing production by improving their mining efficiency and decreasing mining costs when future technology is developed. Besides, the differences in oil production reserves, sparse capacity, and production costs among different oil suppliers make a single supplier unable to control the price of international crude oil market, but become the recipient of international oil price instead. The difference between the long-term and short-term effects of supply and demand elasticity on the international oil price also makes the demand for crude oil a key factor in the fluctuation of the international oil price. Oil reserves always change with the worldwide oil exploration activities, which leads to the uncertainty of future oil reserves. Therefore, the supply quantity is inelastic in the short term; at the same time, OPEC has a lag effect on the adjustment of oil supply, making the price of the international crude oil market become affected by the demand in the short term. In the long term, the supply of crude oil is elastic. However, being a non-renewable resource, the supply of crude oil would be limited by its reserves, resource endowments, production costs, production capacity, and OPEC decisions [17,36]. Therefore, the price change of the international crude oil market is mainly affected by the positive impact of oil demand in the long term, which provides support to Hypotheses 1 and 2.

Besides, international crude oil markets react similarly to changes in oil demand and monetary policy. The similarity between the impact of crude oil demand and monetary policy on the price of the international crude oil market is related to the source of the impact. The impact of crude oil demand on crude oil price is mainly affected by the external environment changes, such as technological progress, economic development, and alternative

energy. The impact of monetary policy on the international crude oil market price is highly related to the external environment, such as exchange rate fluctuations, capital flows, investor expectations, and speculative behaviors [9,34]. Based on the above, the similarity not only illustrates the dynamic characteristics of the dual properties of oil, but also indicates the importance of using the correlation between structural shocks to judge the dynamic characteristics. Affected by uncertain factors such as technological progress of enterprises and investment in financial markets, entity enterprises and oil investment groups adjust their investment strategies according to the changes of the external environment to ensure expected profits, which lead to the alternating characteristics of the dominant position of oil's commercial and financial attributes in the formation of international crude oil prices. However, due to the positive shocks with different impact sizes, structural shocks can better describe the main roles of different variables in the market price. Besides, the correlation direction between structural shocks indicates the contribution of crude oil demand or monetary policy to the price changes in the international crude oil market. Therefore, we further analyzed the dynamic alternate characteristics of oil's commercial and financial attributes.

There exists a dynamic feature in terms of the dominant position between oil's commercial and financial attributes. Figures 2 and 3 separately demonstrate the identification of the dynamic feature. The identification of the dynamic feature comes from two aspects, as stated below. On one hand, except for the time periods, such as from July 2006 to March 2007, December 2011 to April 2013, May to December 2015, February to September 2019, and January to June 2020, we can see that structural shocks of oil demand and crude oil price basically change in the same direction. At the same time, except for the time periods from January 2004 to September 2006, September 2018 to February 2019, and January to July 2020, structure shocks of monetary policy and crude oil price also basically change in the same direction. On the other hand, this paper compares the signs (negative or positive) of oil demand or monetary policy structural shocks in order to further contrast oil's dynamic feature of dual attributes within the sample time. For example, in the second half of 2003, the structure shocks of oil demand and monetary policy are both positive, while monetary policy has a certain lag effect on the international crude oil prices. That is, oil demand had an instant effect on the change of the international crude oil price while monetary policy was affected by hysteresis, which actively demonstrated that the change of international crude oil price was mainly regulated by demand of the crude oil market. Therefore, within this period, oil's commercial attribute took predominance. Moreover, from the second half of 2007 to the beginning of 2008, even if the structure shocks of oil demand and international crude oil price still moved in positive correlation, the sign of the impacts was still negative. The structure shocks of monetary policy and international crude oil prices are positive, and their relationships also show a positive nature. This further shows that the financialization of the commodity market is coming into being. A large amount of oil entered into the reservation sphere instead of the production field as an investment or even speculative commodities. Therefore, within this period, oil's financial attribute took predominance. A similar situation prevailed in July 2020. From the above, the dual attributes of oil dominated by stage characteristics can be found in Table 5.

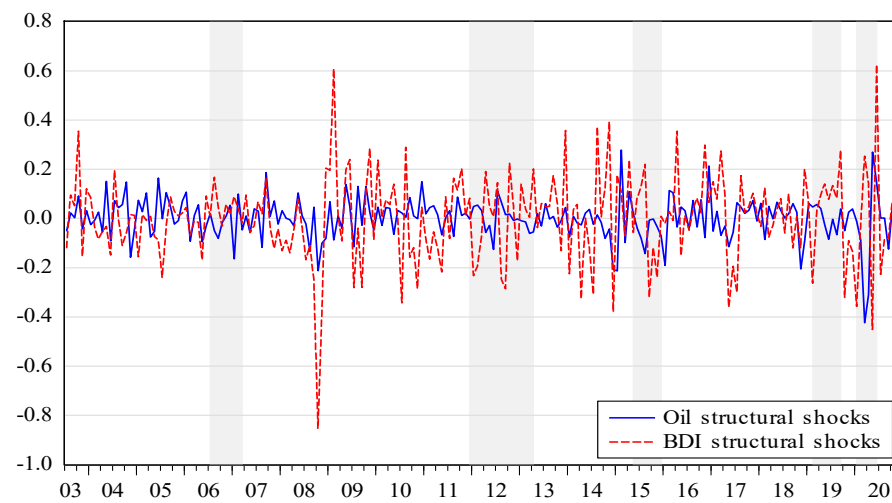


Figure 2. Identification of dynamic features of oil's commercial attribute. Note: The demand in the shadow part has a negative relation with structural shocks of oil prices.

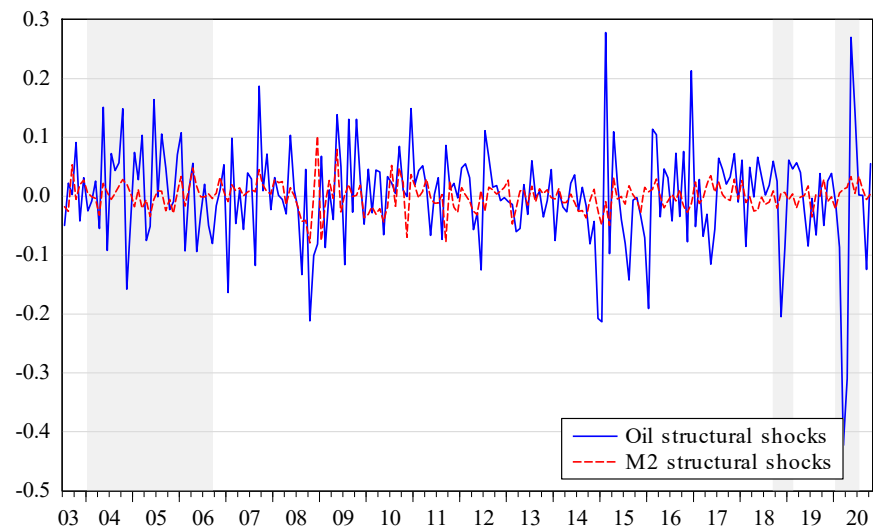


Figure 3. Identification of dynamic features of oil's financial attribute. Note: The monetary policy in the shadow part has a negative relation with structural shocks to crude oil prices.

Table 5. Stage characteristics dominated by dual attributes of oil.

Attribute Names	Specific Time	Maximum Duration	Minimum Duration	Period Percentage
Commercial attribute	Jun. 2003–Aug. 2006; Mar. 2007–Jun. 2007; Apr. 2013–May 2015; Jan. 2016–Feb. 2019	38 months	4 months	51%
Financial attribute	Sep. 2006–Feb. 2007; Jul. 2007–Dec. 2007; Jan.2012–Mar. 2013; Jun. 2015–Dec. 2015; Mar.2019–Sep. 2019; Jul. 2020-	15 months	5 months	23%
Joint effect	Jan. 2008–Dec. 2011; Oct. 2019–Jul. 2020	48 months	10 months	26%

The heterogeneity exists periodically in the predominance of either oil's commodity or financial attributes, and fluctuation has taken place in international crude oil prices under collective control of both attributes. From Table 5, it can be seen that the financial attribute poses its predominance for the most part before and after special events, which are specifically from September 2006 to March 2007, July to December 2007, December 2011

to April 2013, May to December 2015, February to September 2019, and July 2020 until now. At the same time, the commercial attribute poses its predominance in the periods of steady development, which are specifically from July 2003 to September 2006, March to June 2007, April 2013 to May 2015, and January 2016 to February 2019. Besides, the periods when the dual nature of oil jointly dominated the international crude oil market price were related to special events, which are December 2012 and January to July 2020.

Ever since the half second of 2006, many countries have progressively established commodity markets, as well as the market system has gradually integrated. More and more investors consider crude oil as a hedge asset to guarantee expected or excessive profit return on account of the negative correlation between bulk commodities such as oil and financial assets such as stock [47,48]. However, investors can further obtain information in regard to the international crude oil market by policy changes under the circumstance where the variation of international crude oil price is driven by oil's financial attribute. Conversely, because the indetermination of profit obtained in the financial market is surpassing expected return from the investment of the real economy, as well as price variation caused by financialization of the commodity market regulated by the international crude oil market, the international oil price is gradually stabilized and required to be regulated by supply and demand. Therefore, the commercial nature of oil dominated from March to June 2007. In addition, since July 2020, due to the residual heat effect of the global epidemic and the implementation of sanctions against Iran by developed countries such as the United States, the price of the international crude oil market has been under pressure of recovery. From the perspective of market stability and investor sentiment, policy-makers use relevant policy tools to adjust the price of the international crude oil market, then gradually improve the confidence of market participants in order to achieve the effect of market stabilization.

Periodic heterogeneity of oil's dual attributes shows that the alternating traits are closely connected to the external environment. With the degree of financialization of the bulk commodity market including oil, more and more investors are trading crude oil as a financial asset. A large amount of capital flows into the international crude oil market, which subsequently enlarges the financialization of bulk commodities, thus promoting the financialization development of the petroleum industry [44]. Influenced by capital flows, investor expectations, and profiteering activities, the international crude oil market price reflects investment aspirations from oil investment groups. Under this circumstance, enterprises convert their capital allocation between finance and entity for the pursuit of expected or excessive profits, which results in the weakness of oil's commercial attribute and ultimately predominance of the financial attribute. In addition, indetermination of profit obtainment in financial markets can cause the reign of oil's commercial attribute. The international crude oil market has a regulating effect on the speculative manipulation of oil investment groups, as well as investment of enterprises in the financial market assume higher risks, which increases the uncertainty of enterprises to obtain expected profits. Besides, changes in external environments along the lines of economic progress, technological advance, and adjustments of industrial structure impel enterprises to change their investment strategies. As the macro-economy tends to be a good prospect, profits are expanded in terms of investments in the real economy, and the consumption demand for oil is bound to rise. On the contrary, oil demand decreases instead. The financial property of oil mainly plays the function of price discovery in the international crude oil market, and there exists an insufficiency of functions such as hedge and profiteering in the financial attribute. Monetary policy's impact towards the international crude oil market is basically displayed in the perspective of converting oil demand [41]. At this point, oil's commercial attribute takes predominance. Overall, the existence of periodic heterogeneity of oil's commercial and financial attributes is assured.

The joint action of the dual attributes of oil is highly related to emergencies. From 2008 to 2011, the American subprime crisis has caused the global financial crisis, and the European debt crisis influenced the stability of the financial market. Due to the integrated development of economy and finance, this impact gradually spilled over to the commodity market and has affected the smooth operation of the economy. In response to such shocks, various countries use monetary policy and other policy tools by maintaining investor confidence in the market and smooth economic operation, stimulating consumer demand, and mitigating the impact of the crisis on the market to the greatest extent [49]. At the beginning of 2020, the outbreak of the pandemic posed new challenges to the effectiveness of the global health system. Affected by the epidemic, countries have adopted different attitudes and measures to reduce the impact [50]. Due to the development of global integration, the epidemic has begun to spread around the world. Further, it affected shipping and air transportation and other international links, and ultimately influenced global economic development, which undoubtedly created pressure on the global economic recovery. Besides, the pandemic also has affected the information exchange and expectation of market participants, so the price of the international crude oil market is also impacted by monetary policy. Therefore, the change of the international crude oil price at this time is dominated by the oil financial and commercial attributes. From the above, hypothesis 3 is proven.

The characteristic of duration for oil's dual attributes are different. Table 5 shows statistical characteristics of the durations of the dual attributes of oil. Besides, the longest and shortest durations of international oil prices jointly dominated by its dual properties are both the largest, which are 48 and 7 months, respectively. However, the longest duration of oil's commercial attribute dominating the international crude oil price is longer than that of the oil financial attribute, which are 38 and 16 months, while the shortest duration of oil's financial attribute's domination is larger than that of oil's commercial attribute, which are 5 and 4 months. By comparing the proportion of dominant time of different attributes in the sample period, the international crude oil market price is mainly influenced by oil commercial attributes, at 51%. The next is the dominant role of the dual attributes on the international oil price, at 26%. The lowest is the dominance of financial attributes, accounting for 23%. From the above analysis, the impact of emergencies on the international crude oil market lasts the longest, and the ability of the market to respond to unexpected events is still a key indicator to test its stability [17]. As the most important input factor, the price variation of the international crude oil market is still affected by the market supply and demand, especially the influence of demand change to a large extent; however, the impact of oil's financial attribute on the international oil price has gradually developed into a factor that cannot be ignored in the market.

4.3. Market Effects of Different Oil Attributes

The dynamic characteristics of different properties of oil have a heterogeneous impact on the evolution of the international crude oil market price and income. Based on this, we analyzed the evolution characteristics of international crude oil market prices and returns, and then examined their heterogeneity from the perspective of the dominant period of different properties of oil. Figure 4 shows the evolution of international crude oil market prices and returns in different attribute periods. Table 6 further reports the value of descriptive statistics of mean, median, and standard deviation based on Figure 4.

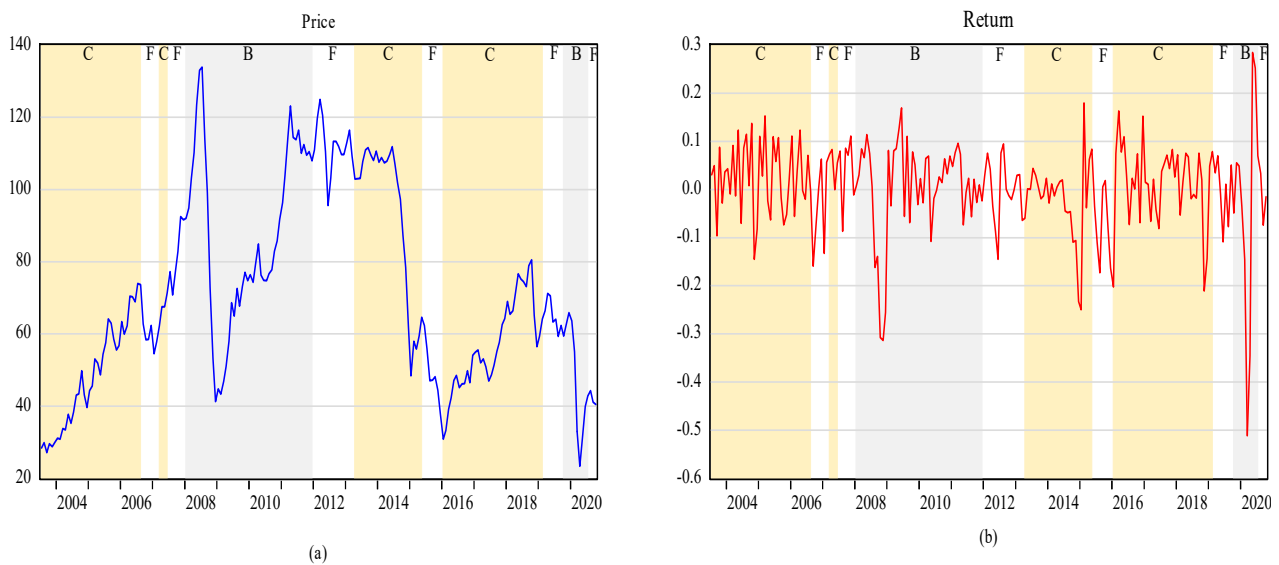


Figure 4. Evolutionary characteristics of prices and returns for the international crude oil market with different attributes' periods. Notes: (a) refers to the evolution of spot prices in the international crude oil market, and (b) is the evolution of returns for the international oil market. B is dominated by both financial attribute and commercial attribute, C is dominated by commercial attribute, and F is a financial attribute of oil.

The dual attributes of oil have heterogeneous effects on the price of the international crude oil market. From the price evolution of the international crude oil market in Figure 4a, during the dominant period of oil commercial attributes, the international crude oil market price shows an upward trend, except for April 2013 to May 2015, while it shows a downward trend during the period when the oil financial attribute is dominant; simultaneously, it experiences a cyclical change of first rising and then falling when the dual attributes of oil jointly dominate. These changes are mainly due to the difference of different properties of oil on the period impact of the international crude oil market price. When the commercial nature of oil dominates, the price of the international crude oil market is mainly affected by the change of supply and demand balance, especially the demand for crude oil. The commercial nature of oil stimulates the demand for crude oil, which in turn increases dependence on crude oil by the economic development of world countries and regions, and eventually leads to the rise of the international crude oil market price [36]. From 2013 to 2015, because of the influence of the global financial crisis and the European debt crisis, the international crude oil market had a lag response to the changes in market information caused by the alternation of oil properties, whereas the economic demand for crude oil increased slowly. Although the price evolution of the international crude oil market at this time is mainly affected by the supply and demand relation, the increase in the demand for crude oil does not exceed the decrease in the speculative demand, so the price of the international crude oil market shows a downward trend. The financial attribute of oil has a short-term effect on the international crude oil market. If investors take crude oil as a hedge of financial assets to invest, oil's financial attribute performs effectively, so the speculative demand of crude oil in the market and investors' expected earnings change as financial investors' trading strategy varies, which results in the overall decline in international crude oil market price [47,48]. The dynamic characteristics of the development of major events have become the key factor to influence the dual properties of oil on the price of the international crude oil market [17,42]. Before the financial crisis in 2008, the high profits of financial investment would lure investors to take crude oil as a hedge investment asset, which led to an increase in speculative demand for crude oil, as well as the leading role of financial markets to real investment would increase economic development demand for crude oil. Based on this, the international crude oil market price shows a rising trend before major events occur. The outbreak of the financial crisis has caused a significant impact on the financial market and economic development. Under this circumstance, the speculative

demand for crude oil and the total social demand will be decreased; at the same time, the price of the international crude oil market also shows a downward trend. In the post-crisis era, with the efficient recovery of the financial market and the world economy, the price of the international crude oil market would gradually recover.

The effect of the commercial attribute and dual attributes of oil on the return of the international crude oil market is gradually increasing, whereas the effect of the financial attribute of oil is basically the same. From Figure 4b, when the dual attributes of oil jointly dominate, the maximum fluctuation range of returns shows an expanding trend. The smallest fluctuation range of earnings is dominated by oil financial attributes. Its fluctuation range will not change basically when compared with different dominant periods of financial attributes. When the oil commercial attribute is dominant, the fluctuation range of the international crude oil market returns is larger than that of the financial attribute, but less than that of the dual attribute. As expected, when oil was dominated by dual attributes, the speculative demand for crude oil and total social demand fluctuated greatly due to changes in investors' expectations and the impact of major events [17]. In addition, due to the joint impact of the event on financial investment and economic development, the fluctuation range of the international crude oil market income under the dual nature of oil has increased. Surprisingly, the volatility of the international crude oil market is the smallest under the financial property of oil. On the one hand, taking crude oil as a hedge asset for investment, financial investment groups make the dominant financial attribute of oil have little effect on the income of the international crude oil market in order to avoid risk. On the other hand, the short-term effect of the financial properties of oil does not significantly alter the changes in the basic information of the market. As the main input factor, the commercial attribute of oil has complicated influence factors on the international crude oil market. Although the price is mainly affected by the change of market supply and demand, the supply and demand factors are being affected by the international crude oil market itself, domestic economic development, economic development, and policy changes in other countries and regions. More importantly, the impact of these factors on supply and demand varies significantly over time in the market, which requires the comprehensiveness of market participants in acquiring information and the ability to analyze information shocks [3,36,51]. Under the dominance of oil commercial properties, the international crude oil market income fluctuates greatly.

Table 6. Descriptive analysis of international oil prices and returns under different oil attributes.

(a) International crude oil market prices					
	Mean	Median	Max	Min	Std. Dev.
Full sample	71.2887	65.0418	133.8991	23.3400	26.9772
Commercial property dominance	63.1442	57.7741	111.8686	27.0981	24.1550
Financial attribute dominance	77.7788	68.4687	124.9286	37.7217	27.2117
Dual attributes dominance	80.8514	76.5527	133.8991	23.3400	27.5378
(b) International crude oil market gains					
	0.0018	0.0153	0.2844	−0.5114	0.0991
Full sample	0.0018	0.0153	0.2844	−0.5114	0.0991
Commercial attribute dominance	0.0099	0.0161	0.1793	−0.2499	0.0817
Financial attribute dominance	−0.0082	0.0011	0.1107	−0.1729	0.0769
Dual attributes dominance	−0.0045	0.0231	0.2844	−0.5114	0.1382

There are differences between the price level and volatility of the international crude oil market under the dominance of different attributes of oil. Table 6 shows the descriptive statistics of the international crude oil market prices in the dominant period of different attributes. When oil's commercial attribute dominates, the average international crude oil market price is less than the average of the full sample, being 63.13 and 71.28. When dominated by oil's financial attribute and dual attributes, the average value is greater than the average of the entire sample period. Additionally, when dominated by the dual attributes of oil, the average value of the international crude oil market price is the largest.

Besides, the standard deviation of the price has the same result. Specifically, when the dual attributes of oil are co-dominant, the price fluctuation is the largest at 27.54, the next is the period when the financial attribute of oil is dominant, and the lowest price fluctuation is in the period when oil commodity attributes are dominant, which are 27.21 and 24.15, respectively. These show that the financial attribute of oil would improve the average level of international crude oil market prices and increase the volatility of international crude oil market prices. On the one hand, the establishment of oil's financial attribute has increased the speculative demand for crude oil, which in turn enlarged the total demand for the international crude oil market. On the other hand, variations in trading strategies for investors have increased the liquidity of the international crude oil market, which increased investors' expectations as a result. In summary, the financial attribute of oil has improved the average level of international crude oil market prices. At the same time, the market participants' expectations have also changed significantly. Therefore, the double impact of major events on the speculative demand for crude oil and the total social demand has made the average level and volatility of the international crude oil market price much stronger.

Different attributes of oil have differences in the statistical characteristics and price levels of the international crude oil market revenue. Table 6 reflects the descriptive statistics of the international crude oil market revenue during the period when different attributes are dominant. From the amount of average revenue value, the largest is the international crude oil market when the oil's commercial attribute dominates, the next is the oil financial attribute dominating, and the smallest one is the period when the oil's dual attributes are co-dominant. The revenue in these three periods is larger than the full sample period. From the trend of the average return value, when the oil financial attribute and dual attributes are co-dominant, the international crude oil market's revenue trend is negative, whereas the period dominated by the full-sample and oil commodity attribute is positive. In addition, there are differences in the volatility of the international crude oil market's revenue. Specifically, when oil's commercial or financial attributes dominate, the volatility of the international crude oil market's revenue is less than that of the full sample. However, when the dual attributes of oil are jointly dominated, the volatility of the international crude oil market's revenue is greater than in other situations. Different from the characteristics of price evolution, the average level of revenue in the international crude oil market under oil's financial attribute is less than that of the commercial attribute. These show that the change of trading strategies is relatively large if taking crude oil as a hedge asset by financial speculation groups in order to avoid the risks of investing in other financial assets. Variation in trading frequency causes changes in the liquidity of the international crude oil market, whereas in turn, it affects international oil prices, while it has a small impact on the fluctuation of revenue because the effects on the international crude oil market revenue mainly change the trend of revenue. The uncertainty in the international crude oil market has changed the speculative demand and the total social demand; besides, it also lowered investors' expectations, and in turn changed the trend and volatility of the international crude oil market revenue. To sum up, when oil is dominated by different attributes, there are differences in the basic information of the international crude oil market. In other words, investigating the risk evolution characteristics of the international crude oil market, the commercial and financial attributes of oil cannot be ignored.

5. Conclusions

The dynamic characteristics of oil's commercial and financial attributes play a significant role in the evolution of prices and returns of the international crude oil market. Based on the monthly data from April 2003 to October 2020, using impulse and structural shock, this paper first identified the dynamic characteristics of different properties of oil by constructing the SVAR model. Then, the evolution characteristics of prices and returns for the international crude oil market for different properties of oil dominating were analyzed. The conclusions are as follows.

Firstly, the different attributes of oil show the characteristics of dynamic alternation. On the one hand, oil has a commercial attribute and a financial attribute. Through the analysis of the positive impact of crude oil demand and monetary policy on the international crude oil market price by the SVAR model, it can be proven that oil has dual attributes of commodity and finance. On the other hand, the dominance of different attributes of oil is dynamic and dominated by dual attributes. The dominant period of oil's financial attribute mostly occurs before and after the special events, mainly including six periods, which are from September 2006 to March 2007, June to December 2007, December 2011 to April 2013, May to December 2015, February to September 2019, and July 2020. The dominant period of oil's commercial attribute is the stable period of the international crude oil market, including four periods, which are from July 2003 to September 2006, March to June 2007, April 2013 to May 2015, and January 2016 to February 2019. In addition, the period in which the dual attributes of oil jointly dominate the price of the international crude oil market is related to special events. It has two time periods, which are from January 2008 to December 2011 and October 2019 to July 2020.

Secondly, the dominance of the dual attributes of oil has the greatest effect on the evolution of the international crude oil market price. During the period of oil's commercial attribute's dominance, the international crude oil market prices basically showed an upward trend, and the average value and fluctuation of prices were minimal, which was 24.155. When oil's financial attribute dominates, the international crude oil market prices basically showed a downward trend, and when the dual attributes jointly dominate, international crude oil prices experienced cyclical changes that first rose and then fell. In this circumstance, both the average and volatility of the international crude oil market prices have increased significantly compared to other periods, which are 80.851 and 37.537.

Thirdly, there are significant differences in the impact of different attributes of oil on the evolution of international crude oil market returns. When oil's commercial attribute was dominant, the average value of the international crude oil market was the largest and the impact was positive, at 0.009. When the financial attribute was dominant, the impact of the average return of the international crude oil market was negative, and the fluctuation was the smallest, at 0.076. When the dual attributes of oil were dominant, the average return of the international crude oil market was the smallest and the impact was negative, at -0.004 ; besides, the volatility was the largest, at 0.138. In addition, oil's commercial attribute and dual attributes have gradually increased their impact on the income of the international crude oil market, whereas the effect of the financial attribute of oil is basically the same.

From the above conclusions, the following suggestions for policy-makers and investors are offered. For policy-makers, it is necessary for them to strengthen the identification mechanism of oil's commercial attribute, financial attribute, and dual attributes within their dominant periods. The dominance of different oil attributes plays an important role in the evolution of prices and revenues in the international crude oil market. Through identification of different attributes, it is helpful to monitor the fluctuation sources of the international crude oil market and prevent risk shocks. For investors, they can improve their own information acquisition and information judgment capabilities. In fact, different sources of market information have heterogeneous impacts on the international crude oil market's prices and revenues. By enhancing information capabilities, judging market trends accurately, changing investor expectations, and adjusting investment strategies on time, the expected revenue can be obtained.

There is still some room for further research. First, to find out whether identifying different attributes of oil cause structural changes or not in the international crude oil market prices. The instantaneous effect of the alternation of oil's different attributes on the international crude oil market's prices and income can help us to better control the effect of attributes on the international crude oil market. Therefore, the analysis on the combination of the breakpoint or classification of international crude oil market prices and the alternation of different attributes of oil is a worthy area for further study. In addition,

the analysis of risk evolution, spillover effect, and spillover mechanism of the international crude oil market with different attributes of oil is also a significant area that can be further studied [52–54]. Furthermore, there are significant differences in market reactions to events and market efficiency. In this vein, it is a particularly interesting and valuable area to explore the heterogeneous evolution of oil attributes and its crucial role in different crude oil markets [55,56].

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