

Analysis of Oil Prices' Impact on the economy and Industries

Ruoqi Li

Macao University of Science and Technology, Macao 999078, China

li18104117683@163.com

Keywords: oil; crude oil; US; economy; automobile; petrochemical

Abstract: This paper is aimed at discovering the pattern of how oil prices affect the market and relevant industries, from a macroeconomic perspective. The method used here is qualitative research method. First, the effect of oil on the entire market is analyzed, including its transmission from the leading indicator PPI to the lagging indicator CPI, then oil prices' influence on its value chain industries are expounded, lastly, oil prices' impact on several segmented industries such as the petrochemical and its sub-industries and automobile industry are shown. Finally, the conclusion can be made that oil is a significant constitute of upstream commodities and can surely affect living costs and quality of citizens if transcended successfully from PPI to CPI, and that oil prices also have tremendous effect on a variety of downstream industries such as petrochemical and its sub-industries, and various transportation industries including the shipping and automobile industries, etc. However, it is still weakened by new challenges in technology, such as the invention and rapid spreading of electro mobile.

1. Introduction

As proven, oil prices and oil price volatility both play important roles in affecting economic activity, [1] and the oil market has a significant impact on stock market that helps explain the dynamics of stock prices [2], it becomes necessary to understand the impact of oil prices on the market and industries and how exactly does a change in oil prices affect changes in markets and industries. Studies have been made concerning this topic, Baumeister and Kilian (2016) studied the effect of lower oil prices on investment during the recent oil price decline. They found that lower oil prices led to a sharp decrease in investment in the oil sector [3]; Ready (2017) finds that both oil supply shocks and demand shocks have a significant effect on U.S. and world stock prices [4]. Herrera et al. (2017) analyzed the effect of oil price shocks on job flows on various sectors of the U.S. economy (i.e., agriculture, construction, mining, utilities, manufacturing and services), and showed that an unexpected decline in oil prices reduces the pace of job creation for the oil and gas industry and decreases net employment in support activities for mining [5]. This paper in particular discusses oil prices' impact on both the economy and industries, and further expounded the logic behind these impacts, so as to connect the whole framework of oil price dynamics.

2. Oil prices' impact on the economy and industries

2.1 Logic of impacting the economy

2.1.1 Oil prices had a direct effect on PPI inflation

Commodity prices are the most important direct factor affecting PPI changes. In a sign of the importance of crude oil among commodities, (Fig.2) the crude oil futures contract accounts for 23% of the CRB commodity Index compiled by the U.S. Commodity Survey bureau, which is the highest proportion of any major commodity in the index. Therefore, the change of oil price can roughly determine the direction and extent of the change of PPI, and the price rises of oil and gas exploitation, oil processing, chemical industry, chemical fiber and textile industry together can explain more than half of the month-on-month increase in PPI. Becasue commodities are in the upstream sector, they have a high pricing power. In the first oil crisis, OPEC relied on its dominant stature in crude oil

production to artificially intervene the market and rise prices. And this leads to disruptions of supply and demand, decline in corporate profitability, and finally the rise of U.S. unemployment rate. Of course, with the rise of commodity price and the rise of raw material cost, the most direct result is the rise of manufacturing cost and decrease of profit, namely the rise of PPI.(Fig.1)

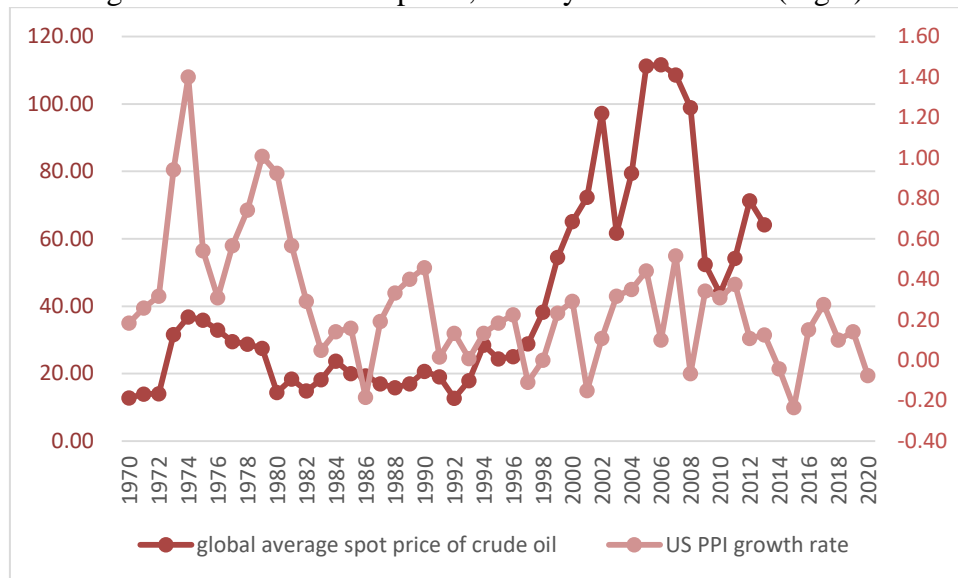


Fig.1 US PPI and Crude oil Price Chart (USD/BBL)

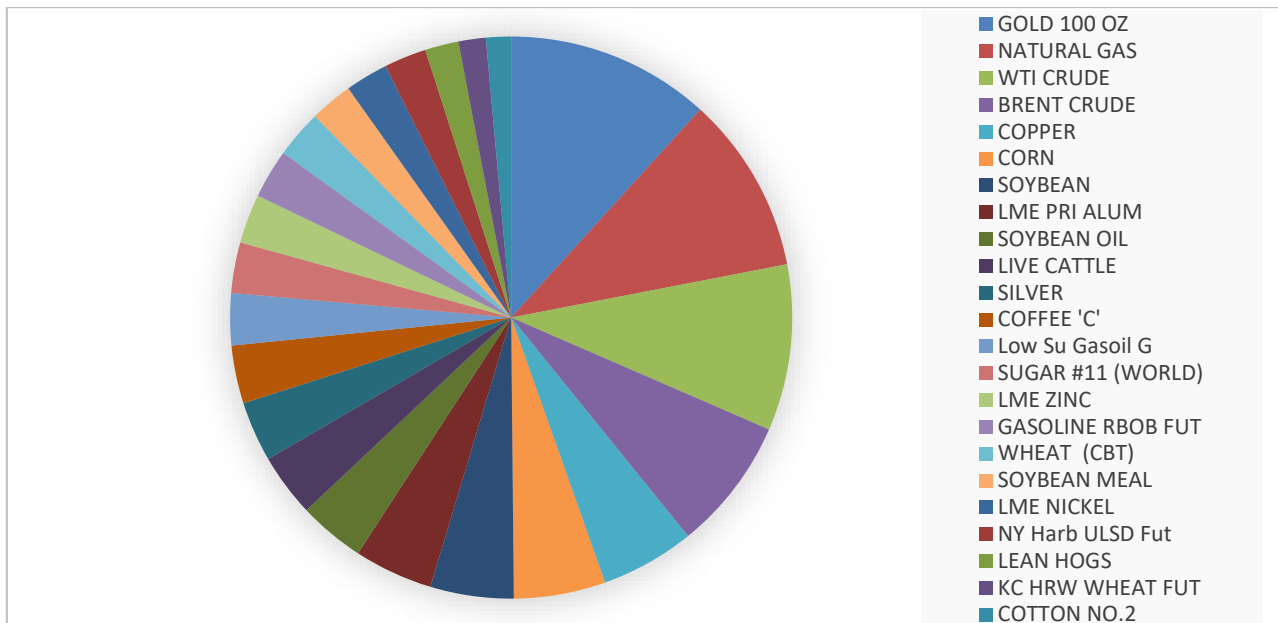


Fig.2 Commodity subdivision weight(See The Dow Jones Industrial Average.)

2.1.2 Oil prices drive up CPI and restrain investment and consumption

PPI and CPI in the United States are highly synchronized, and the link from commodity to PPI, and then to CPI can be effectively broken down. In this process, bulk commodities directly affect PPI, thus affecting the profitability of midstream manufacturing, and thus indirectly affecting CPI, that is, the cost and profit of raw materials affect the cost and profit of manufacturers, and then affecting the cost and profit of retailers, that is, CPI. As Kilian specified: positive oil-specific shocks decrease GDP and increase CPI.[6]

Mid-stream manufacturing industries' manufacturing cost is almost decided by the upstream raw material prices, this makes the small and medium-sized manufacturing enterprises, especially those with high correlation and oil face weak bargaining power and intense competition. Their cost transferring ability is relatively weak, so their reaction to fluctuations in oil prices will be quite demonstrable, net profit margin will fall sharply and the rate of expense will be high.

PPI can be transmitted to CPI in three ways. First, by pushing up costs. For example, rising prices of raw materials and processing industries will push up the costs of industrial consumer goods, which may spread to the household sector. Second, by affecting the price of substitutes, for example, the rise of crude oil price may lead to the rise of soybean meal and corn price, resulting in the rise of meat, eggs, milk and other food prices; Third, by boosting demand, a higher PPI will mean an increase in the profitability of industrial enterprises, and the expansion of investment by enterprises or the expansion of consumption by industrial employees may lead to an upward CPI.

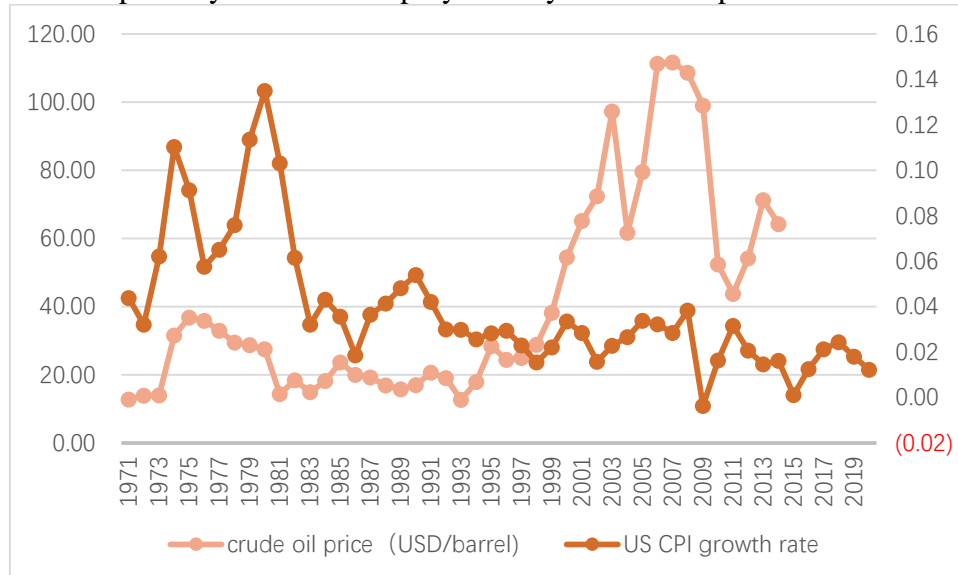


Fig.3 US CPI and crude oil price chart

But whether or not PPI eventually feeds through to CPI and pushes up the year-on-year CPI index depends on a number of factors. It includes the length of the oil rising cycle and the persistence of the resulting rise in PPI, the extend to how much the oil prices rise, the driving factor behind the rise of oil prices and the market's expectation beforehand. In general, the longer the cycle and the higher the rise in oil prices, the higher the expectation of further market gains, so that the PPI to CPI transmission will tend to be more timely and faster.(Fig.3)

2.2 Logic of impacting the industrial value chain

Crude oil price is the main driving force of industrial chain price, executing its upstream pricing power. Oil belongs to the energy sector. The price trend of energy and other commodities is differentiated, and the transmission mechanism is unique. Its uniqueness mainly lies in the pricing power of the upstream sector, and the upstream supply side determines the price and profitability of the industrial chain. The oil industry chain is divided into three parts: the upstream sector is consisted of oil exploration and exploitation, the mid-stream sector is consisted of oil processing and distribution and retail of refined oil products, and the downstream sector is consisted of various fuel vehicles, infrastructure, power generation and other sub-sectors. Changes in raw material prices have a direct impact on mid-stream production costs, hurting profitability in downstream industries.

Take the price rise as an example, after the production cost in midstream increases, the price of chemical products can only increase under the pressure of shrunken profitability, which is transmitted to the downstream of the industrial chain. The excessively high price center caused by the compulsory price adjustment is bound to affect consumers' purchasing willingness, further contributing to the weakening of demand, the reduction of order quantity and the compression of profitability. In this process, the middle and lower reaches of the enterprise gross margin space is very limited. Leading enterprises or enterprises with strong competitiveness can gradually build entry barriers, lock the price of upstream products in advance, strengthen cost management, and enhance coping mechanism to resist the impact of raw material price fluctuations on costs. Due to the lack of bargaining power, medium, small and micro enterprises will be accelerated to clear out, and the overall competition landscape will be reshaped.

Although the cost transfer through price transmission of bulk commodity industry chain can relieve pressure to a certain extent, compared with the fluctuation speed of raw material prices in the upstream, the price adjustment of downstream finished products generally has a lag time, and the lag time is usually 1-3 months.

In general, the upstream price rise has both advantages and disadvantages. The advantages are that it can accelerate the rectification and remodeling of the industry landscape and integrate the existing resources of the industry; improve the earning and revenue performance of companies in the upstream oil exploration, production, oilfield service and petrochemical industries; strengthen coal and other energy's "substitution effect". But at the same time, the disadvantages are obvious. In terms of the sequence along the industrial chain(Fig.4), for the mid-stream chemical industry, the continuous rise of crude oil price will increase the intermediate input cost of enterprises in the oil refining and processing industry, which is not conducive to the improvement of sales and profits of these enterprises. For the downstream transportation industry, the continuous rise of crude oil price. Companies in aviation, maritime transport, automotive and logistics industries are highly dependent on crude oil and derivatives.

To sum up the advantages and disadvantages, it can be found that in the case of price raising, the advantages are basically concentrated in the upstream industries, while the disadvantages are basically concentrated in the middle and downstream industries.

Price reduction's condition is the opposite, but the extend to which the upstream companies will reduce price will be minor. The price is determined by the upstream sector. The decline of upstream oil prices is usually due to the substitution effect or the downward trend of the overall energy sector, or the pessimistic economic trend and subsequently, negative macro sentiment. This situation shows that the profit ceiling of the overall petrochemical industry is compressed. In order to ensure profits, the range of price decrease will not be too exaggerated. Similarly, due to the existence of transmission lag and a certain amplification effect of profit and loss along the industrial chain, general risks are mostly borne by the middle stream. However, a pullback in oil prices could increase speculative opportunities and be favourable for fuel procurement in oil-strapped countries.

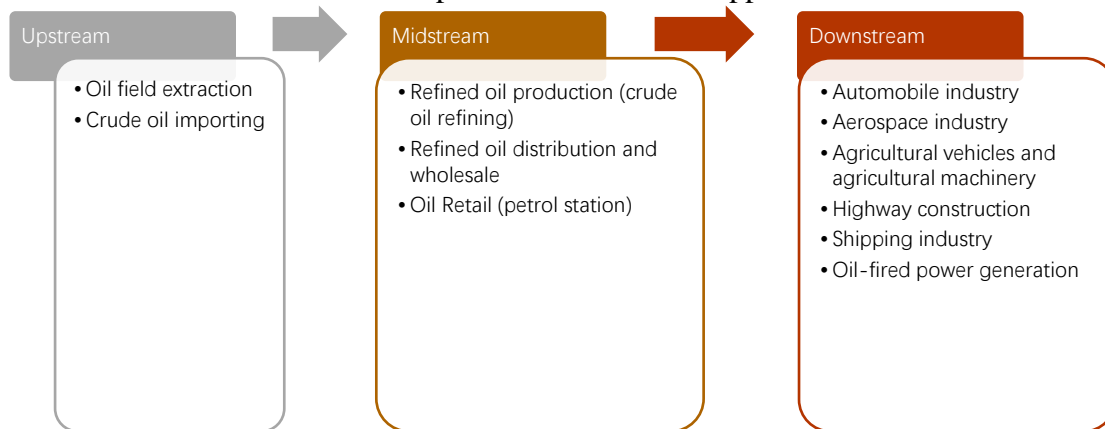


Fig.4 Industrial value chain of oil

2.3 Logic of impacting segmented industries

2.3.1 Petrochemical and its sub-industries

Crude oil products can be divided into petroleum fuels, petroleum solvents and chemical raw materials, lubricants, paraffins, petroleum bitumen and so on. Among them, fuel production is the largest, accounting for nearly 90% of total output.

First, crude oil products are a major supplier of energy. Oil refining produces gasoline, kerosene, diesel, (Fig.5)heavy oil and natural gas to fuel cars, tractors, airplanes, ships and boilers. Secondly, crude oil products are the backbone of the materials industry. The output of polymer synthetic materials provided by crude oil chemical industry in the world is about 145 million tons. In addition to synthetic materials, crude oil products also provide most of the organic chemical raw materials. The construction materials industry, light industry and textile industry are also typical users of crude

oil products. The development and promotion of new materials, new technology and new products are inseparable from that of original products. Agriculture is also dependent on crude oil products. The crude oil industry provides 80% of the total nitrogen fertilizer.

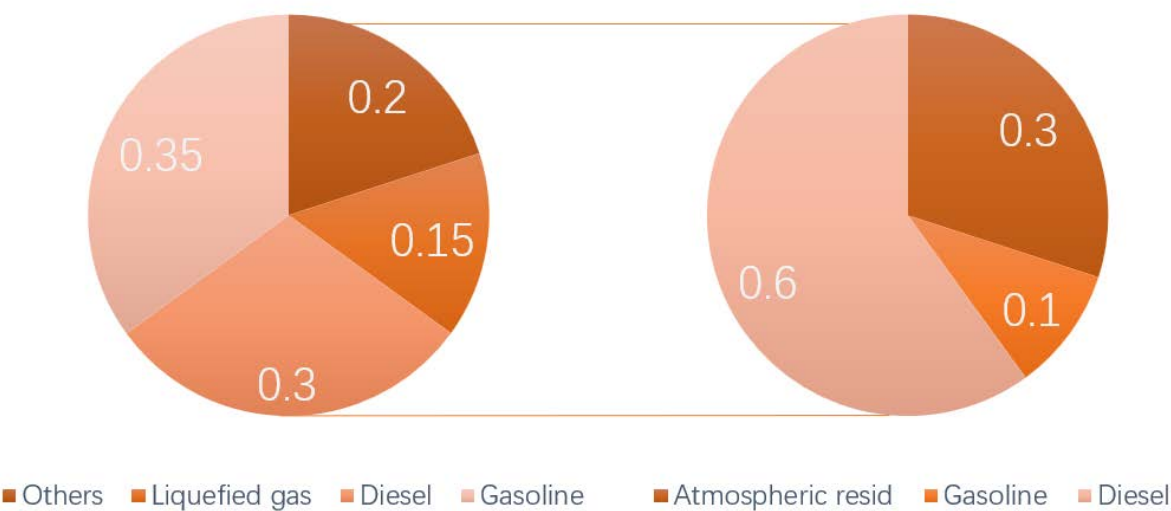


Fig.5 Proportion of finished products of atmospheric residue(Left) Ratio of finished products of crude oil(Right)

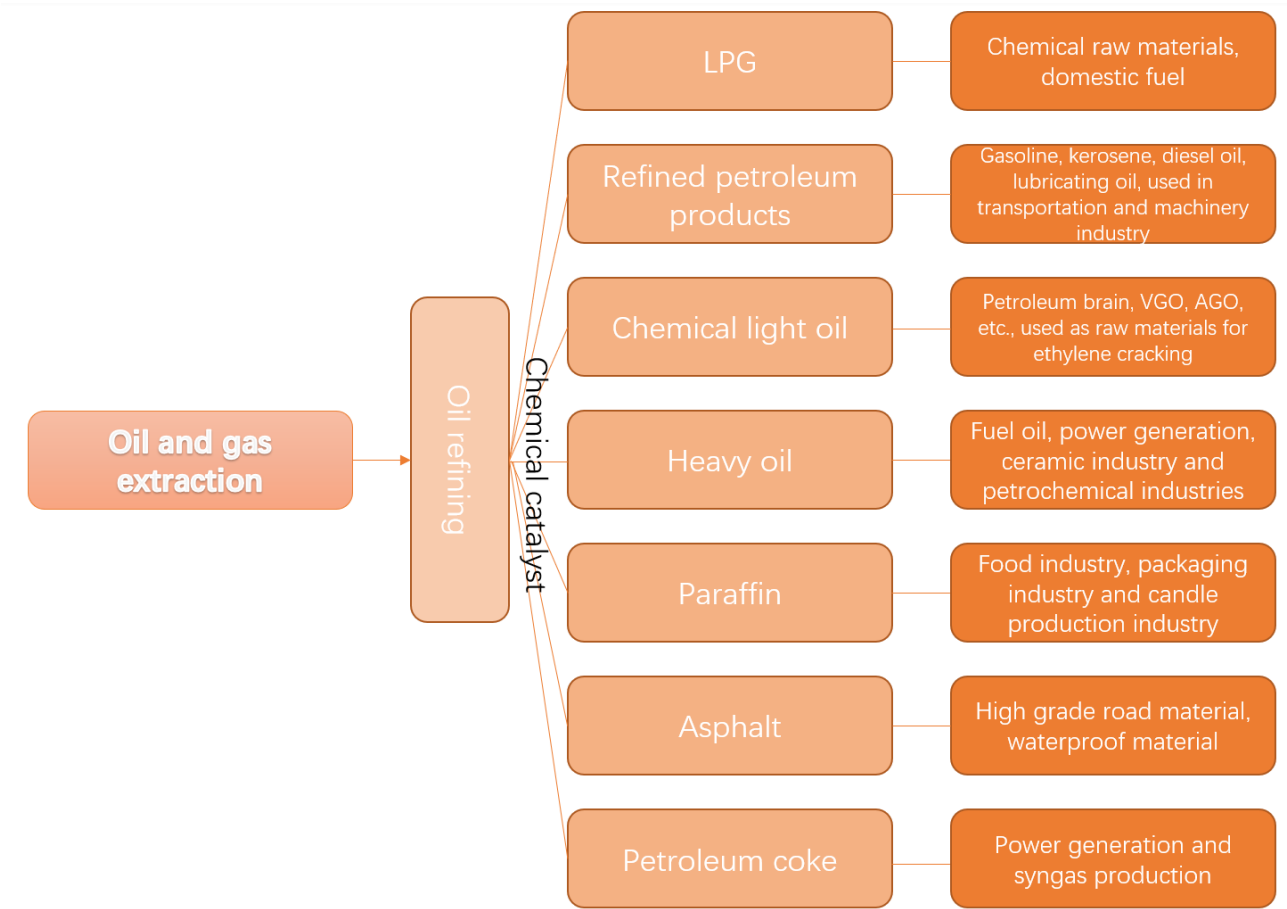


Fig.6 Petroleum refining industry chain

*LPG stands for liquefied petroleum gas

There are many chemical sub-industries with different industrial chain positions,(Fig.6) so the speed and accessibility of price transmission to various sub-industries after oil price’s decline are quite different. Some energy-intensive sub-industries that are closer to the oil industry supply chain,

more involved in the crude oil derivatives market, or are more able to adjust inventory in advance or pass on costs would be less affected by an increase in oil prices caused by an oil-specific demand shock [7]. Generally speaking, chemicals close to the consumer end have a long distance from crude oil, and the corresponding response in its price is rather inert, with its change both small and lagging behind. In addition, as the coal chemical industry will lose its competitive advantage when crude oil prices fall, the price of related products may be negatively affected.

Consumer-oriented chemicals are expected to benefit from the drop in oil prices. Synthetic leather, modified plastics, paint inks, adhesives and tire products have strong consumption attributes, and their price changes are relatively less affected by crude oil prices. The decline of crude oil prices is conducive to the improvement of profitability of these industries. Looking back on the historical data(Fig.7), it can be found that the ROE and gross margin of the above consumer-oriented chemical products are basically in a reverse relationship with the oil price.

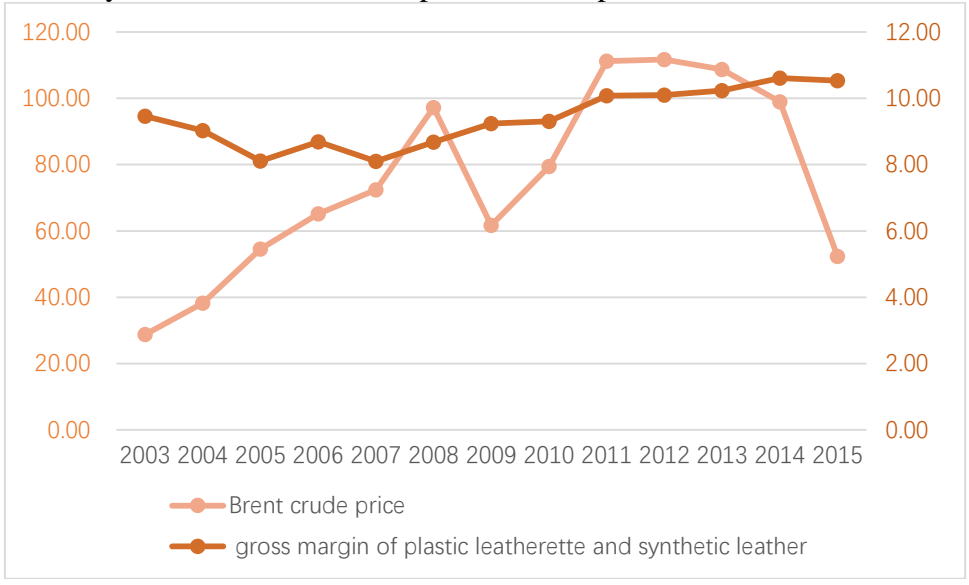


Fig.7 Gross margin of plastic leatherette and synthetic leather, and Brent Crude price (dollar/barrel)

Resource end and coal chemical product will bear pressure in prices. Polyester filament yarn enterprises will suffer a large loss of raw material inventory in the short-term collapse of oil price, and should pay more attention to their supply and demand relationship in the medium and long term price difference. In addition, the decline of oil prices on the polyurethane plate has a certain negative impact. Coal chemicals, which use coal as a raw material, have a significant cost advantage when oil prices are high, but when oil prices plummet, profits from coal chemical industry will shrink. Looking back on the historical data,(Fig.8, Fig.9) the price of crude oil has an obvious positive relationship with the price of urea, methanol, PVC, ethylene glycol and many other coal chemical products.

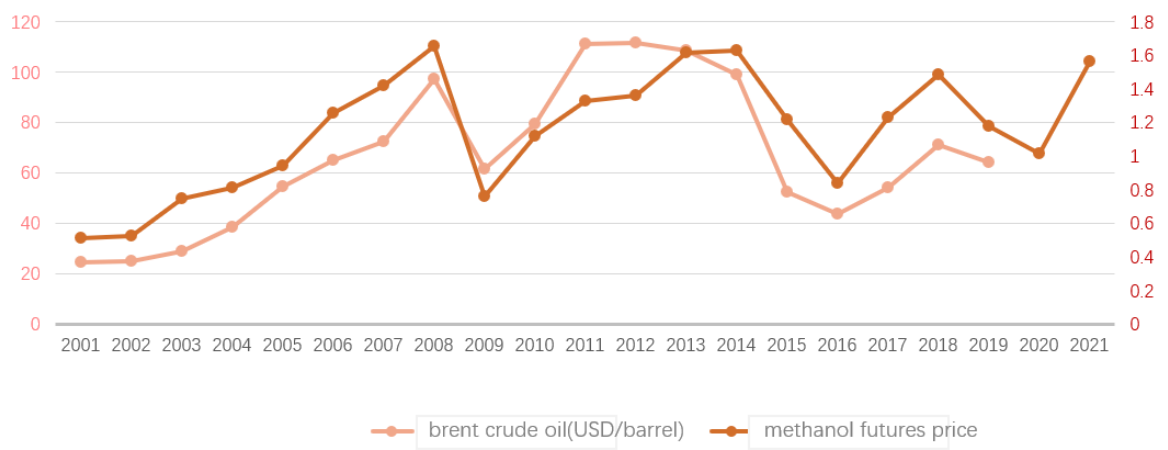


Fig.8 Methanol futures price and Brent crude oil price (USD/BBL)

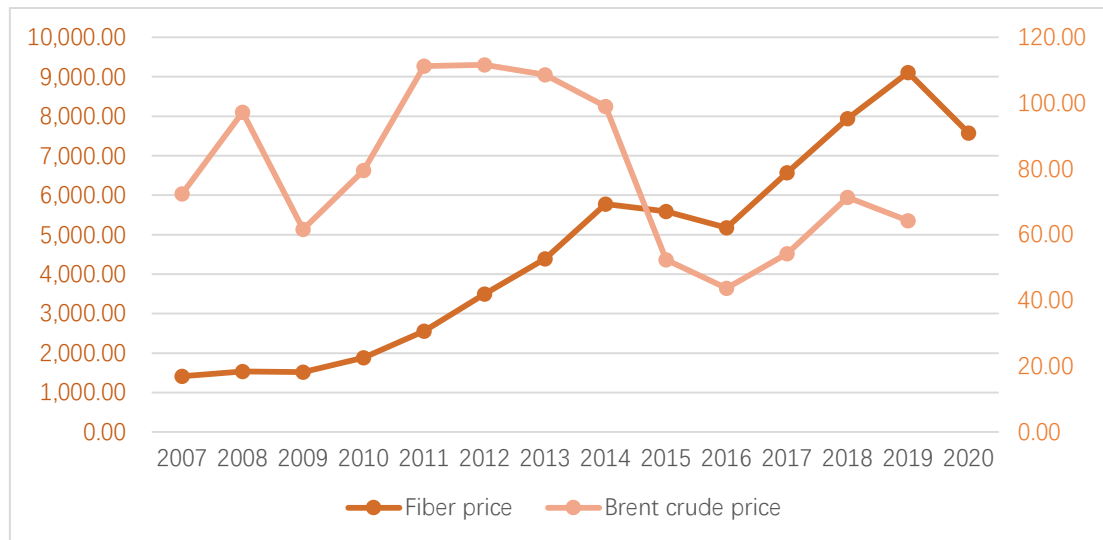


Fig.9 Motor Chemical Fiber Price (Yuan/ton) and Brent Crude price trend Chart (dollar/barrel)

2.3.2 Automobile industry

While both demand and supply of industries are affected by oil price shocks, oil price shocks mostly reduce the supply of oil-intensive industries while they mostly reduce the demand of many other industries, especially the automobile industry,[8], as it is one of the major consumer of oil.(Fig.11)

The automobile industry is mainly divided into two subsectors, new energy/energy saving (hybrid PHV and pure electric EV) vehicles and fuel (gasoline and diesel) vehicles. A ton of crude oil can be refined into about 0.31 tons of gasoline and 0.48 tons of diesel. Among them, fuel car is the complementary product of oil and other fuel, and new energy car is the substitute of fuel car. New energy vehicles refer to the use of unconventional vehicle fuel as the power source (or the use of conventional vehicle fuel combined with the use of new vehicle power device). New energy vehicles include pure electric vehicles, hybrid power-based vehicles, fuel electric vehicles, hydrogen engine vehicles, etc. In contrast, the traditional fuel vehicles are convenient for refueling, mature technology, strong fuel tank endurance, low cost, but relatively poor performance in energy conservation, energy efficiency, only less than 25% of the utilization rate, compared with about 50% of new energy vehicles, relatively unsatisfactory. But the traditional fuel cars still occupy most of the main market, The market penetration rate of new energy vehicles in 2020 was only 1.75 percent.(Fig.10) The oil price of finished products such as diesel and kerosene can still have a decisive impact on the automotive industry in the short to medium term.

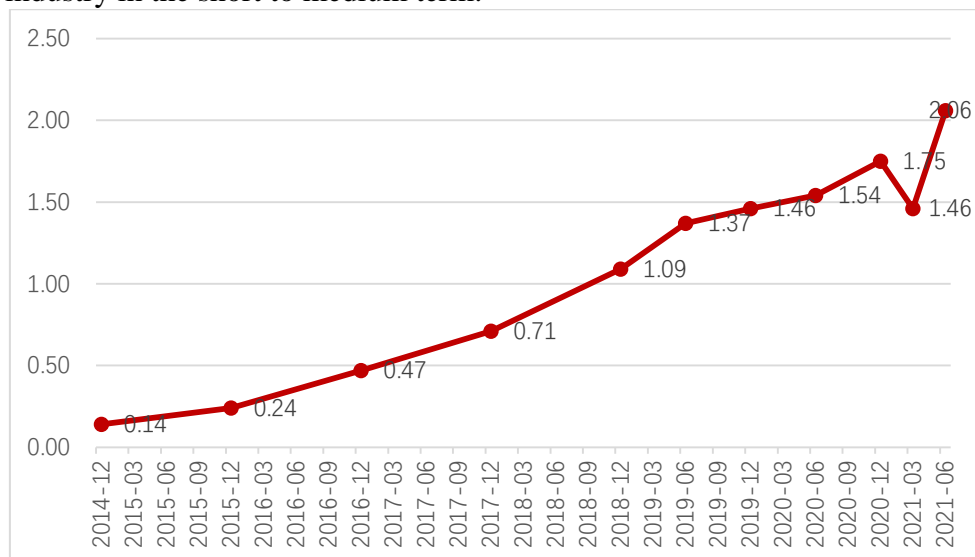


Fig.10 New energy vehicles: proportion of total vehicle ownership: quarter %

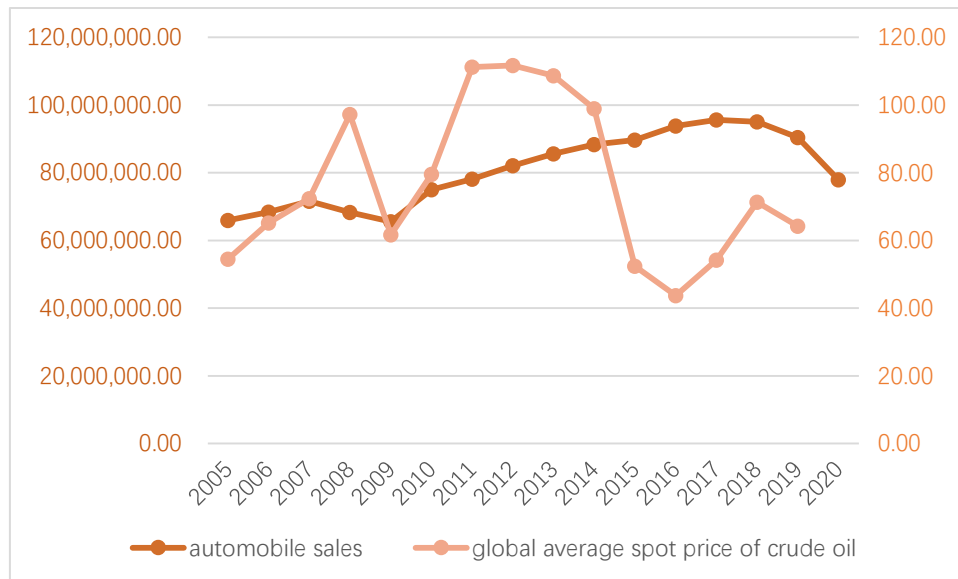


Fig.11 Auto sales (vehicles) and crude oil price (dollar/barrel)

3. Summary

Finally, the conclusion can be made that oil is a significant constitute of upstream commodities and can surely affect living costs and quality of citizens if transcended successfully from PPI to CPI, and that oil prices also have tremendous effect on a variety of downstream industries such as petrochemical and its sub-industries, and various transportation industries including the shipping and automobile industries. However, it is still weakened by substitution effects and new challenges in technology, etc.

References

- [1] Perry Sadorsky, Oil price shocks and stock market activity, *Energy Economics*, Volume 21, Issue 5, 1999, Pages 449-469
- [2] Yudong Wang, Chongfeng Wu, Li Yang, Oil price shocks and stock market activities: Evidence from oil-importing and oil-exporting countries, *Journal of Comparative Economics*, Volume 41, Issue 4, 2013, Pages 1220-1239
- [3] Baumeister, C., Kilian, L., 2016. Lower oil prices and the U.S. economy: is this time different? *Brook. Pap. Econ. Act.* 2016 (2), 287–357 (Brookings Institution Press).
- [4] Ready, R.C., 2017. Oil prices and the stock market. *Rev. Financ.* 22 (1), 155–176.
- [5] Herrera, A.M., Karaki, M.B., Rangaraju, S.K., 2017. Where do jobs go when oil prices drop? *Energy Econ.* 64, 469–482.
- [6] Kilian, L. (2009) Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market, *American Economic Review*, 99, 1053–69.
- [7] Tan, X. F., J. Han, and W. X. Yin. 2015. The effect of international oil price fluctuation based on disentangling shocks on Chinese industries:1998-2015. *China Industrial Economics* 12:51–66. (in Chinese).
- [8] Kiseok Lee, Shawn Ni, On the dynamic effects of oil price shocks: a study using industry level data, *Journal of Monetary Economics*, Volume 49, Issue 4, 2002, Pages 823-852