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An Analysis on the Role of Consumption Space Effect in the World Petroleum Trade Pattern Formation

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Abstract

Based on the historical facts of classic spatial pattern, this paper analyzes the spatial effects of petroleum consumption on the trade pattern formation in different historical stages; analyses the development of transport and petrochemical industry, petroleum coal's comparative advantages, government's promotion and price's impacts on consumption; concludes that the consumption volume and production capacity of a trading country are both the important factors to decide the trading country's nature, and a country's consumption change also directly affects the oil trading spatial pattern.

Consumption is an important factor in determining the nature of a trading country. An increase in trade consumption will make the country use more oil production to meet its own needs, and reduce the volume of oil export. Conversely, consumption reduction can lead to an increase in export. Therefore, the consumption volume and production capacity of a trading country are both the important factors to decide the trading country's nature, and a country's consumption change also directly affects the oil trading spatial pattern.

Key words: Consumption; Trade pattern formation; Classic spatial pattern

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1. SPATIAL EFFECTS OF CONSUMPTION

1.1 Early Consumption and Trade Patterns

In the end of the 19th century, the invention of electric light did not make petroleum quit from people's consumption. More than 200 kinds of petroleum byproducts including lubricating oil, paraffin and drug, etc. entered people's daily life. Petroleum and its products had an increasingly expanding market. In particular, the invention of internal combustion engine made the automobiles enter the lives of ordinary people. In 1910, US gasoline sales exceeded the total sales of kerosene and other illuminating oil (Leonardo, 2006). From 1914 to 1917, US oil production rose from 3.35 barrels to 2.66 billion barrels, accounting for about 65% of the world production, of which about 80 million barrels were for export and the crude oil were basically exported to Europe. 80% of oil demands of the Allies for the wartime were provided by the US (Yergin, 1991, p.123). However, the United States is not the real exporting country during the time. With the stimulation of the rapid popularization of cars and other motor vehicles, the United States itself consumed a lot of oil and oil products. Thus in the first half of the 20th century, although the United States was the largest producer, during 1910 to 1945, the United States was a net exporter of oil for only nine years, but a net importer for the rest years. "If there is no arrival of the warm liquid from Venezuela and Arabia, the US east coast in the winter would be a frozen silence." (Roberts, 2008) Romania and Russia were another source of Europe's oil supply. The Allies' blockade made oil unavailable to Germany, which could only rely on Romania's oil. Looking from the world production, the yield in Romania is relatively low, but it is the largest oil producer in Europe except for Russia.

1.2 Consumption and Trade Patterns After the World War II

During the decades after the World War II, regardless of the changes in global politics, decline of imperial power

and rising national pride, there is a rapid upward straight line throughout the period – oil consumption (Yergin, 2008, p.104).

The United States announced the cancellation of oil rationing in less than 24 hours after the Japanese surrender. Automotive sounds which had been quiet for years reverberated throughout the country immediately. The consumption grew at an unprecedented rate. The oil prices also rose. The rising oil prices spurred oil production, but the consumption growth was surprising, oil shortage was getting worse. In 1948 the US's imported oil and oil products for the first exceeded export, which made US a net oil importer. The United States no longer played a historical role to provide oil to the rest of the world. During the 20 years, US oil consumption increased from 5,773 thousand barrels / day to 17,318 thousand barrels/ day, with an increase of three times. The consumption gap also continued to grow, so although the United States in that time period was the largest oil-producing country in the world, due to the rapid growth in consumption, it became the world's largest oil importer. This is why Paul Roberts holds that the US really dominates the world's energy consumption in consumption. After the war, France, Italy, Britain, Germany and Japan, etc. had a rapid economic growth, which promoted the growth of oil consumption in these countries. Although their amount of consumption was less than the United States, their growing speeds were very fast. From a regional perspective, in 1949, North America was the highest oil consumption region in the world, only the US consumed 5,773 thousand barrels/day. All other countries in the world consumed only 3,567 thousand barrels/day, even Europe with a relatively high consumption was far behind North America.

1.3 Consumption and Trade Patterns After the Second World War Until the Oil Crisis

After the World War II until the first world oil crisis, the world oil trade pattern has been completely different with the earlier world petroleum trade pattern. In 1965, the post-war economic recovery occurred in European countries, leading to a rapid growth of oil consumption in Europe. The consumption in Europe at this time reached 38% of the total world oil consumption, while the consumption in North America was 40.5% of the total, compared with the third Asia-Pacific region, whose consumption was 10.3% of the world's total oil consumption. From a regional perspective, due to the consumption growth in Europe became the world's largest importing region. In 1966, the consumption gap in Asia Pacific exceeded North America, and Asia Pacific became the second largest importing region next to Europe. However, because of almost no growth of yield but an increase of consumption, Central and South America had a declining oil export. In 1968, the total oil consumption in Europe for the first time exceeded North America, accounting for 39.2%, while the consumption in North America was 38.8% of total at the time. When there was a rapid growth of oil consumption in Europe, oil consumption also rapidly grew in Asia-Pacific region. In 1973, oil consumption in the Asia-Pacific region reached 15.9% of total world oil consumption. Although Africa, Latin America and the Middle East had an absolute growing consumption, the relative total volume was less than 9% of the world total oil consumption.

Overall, from the start of the Marshall Plan to the first oil crisis, namely during the 25 years from 1949 to 1973, global oil consumption increased from 9300 thousand barrels / day to 56,000 thousand barrels / day, with an increase of six times, so this period is also known as "the golden age of oil". Due to the high initial consumption, oil consumption in North America only tripled, while in other countries it grew 11 times, with an average annual growth rate of over 11%, or oil consumption doubled every 6.5 years (Leonardo, 2006, p.73). The expansion of total consumption and uneven regional consumption led to a change in the world oil trade spatial pattern. Contrast to the fast-growing consumption in European countries, despite of a relative declining oil production in Venezuelan, because of Venezuelan's small consumption, it's still a significant exporter. Similar to Venezuela, although the growth rate in the former Soviet Union was less than Iran and Saudi Arabia in the Middle East, it's still an important exporter because of its slow consumption growth.

1.4 Consumption Pattern After the World Oil Crisis

Despite the growth in oil consumption after the oil shock in the 1970s slowed down, the consumption has steadily increased in the 20th century, increasing from 500 thousand barrels/day in 1900 to 10,000 thousand barrels/ day in 1950, and to 75,000 thousand barrels/day in 2000. In the twenty-first century oil consumption has grown rapidly, and in 2008 it has reached 84,450 thousand barrels / day. When oil consumption growth expanded the spatial scale and effect of world oil trade, the spatial pattern of world oil consumption also undergone a significant change. With respect to the first oil crisis, North America once again became the world's first oil consumption region in the late 20th century, Asia ranked second, Europe dropped to the third in the world due to a relatively lower oil consumption, followed by the Latin America, Middle East and Africa successively. Owing to the rapid development of the Asian economy, until 2008, the Asia-Pacific region has become the world's largest oil consumption region, followed by North America, and the third rank of Europe.

2. MAIN FACTORS AFFECTING CONSUMPTION

2.1 Development of Transport and Petrochemical Industry

When oil was known as the "blood" of modern industry to firstly enter people's lives, it was just a cheap and easy-using lighting material. In 1846, Canadian geologist Dr. Abraham Gesner extracted kerosene from coal, and applied patent for this product which could be used for "lighting or other purposes" in 1954. Because it was cheaper than any other lighting materials, safe and easy to use, it has been promoted in western Pennsylvania and New York City (Giddens, 2010, p.1). In 1857 American Michael Dietz invented the kerosene lamp. This seemingly humble invention eventually made whale oil completely gets out of the lighting market, hence human entered the era of petroleum lighting. The invention of kerosene seems to have little relation to the petroleum industry, but the time proves that petroleum is the best raw material to extract kerosene. People's demands for lighting have become the driving force of the modern oil industry growth in a very long period. Therefore, some people hold that 1846 marks the beginning of the modern history of oil industry.

Led by the two big auto companies of GM and Ford, in 1927 US automobile production accounted for 80% of world automobile production, and in 1929 78% of the world's automobiles concentrated in the US. The United States therefore entered the age of automobile, with an ownership of 20 cars / per 100 people. At the time car ownership in Europe was 2.5 cars / per 100 people, and only 0.14 cars / per 100 people in Japan. In the late 1920s, registered vehicles in the US increased to 23.1 million, and every vehicle ran further year after year. In 1919, the average mileage of the vehicles was 4,500 miles, and 1929 it reached 7,500 miles. Additionally, every vehicle was gasoline-powered. In the US, the impact of this automobile revolution is larger than any other places in the world. Needless to say, the United States is the largest consumer of gasoline. The basic direction of the changes in the oil industry is equally dramatic. In 1919, the daily US demand for oil was 1,030 thousand barrels, in 1929 it reached 2,580 thousand barrels, which were 2.5 times that of 1919. Oil proportion in the entire energy consumption in this period increased from 10% to 25%, with the fastest growth in gasoline which was 4 times of before. In 1929 gasoline and fuel oil together accounted for 85% of total oil consumption. In contrast, the production and consumption of kerosene were not worth a mention. "New light" has given way to the "new fuel."

As the automobile industry developed, internal combustion engine began to be used for ships and naval vessels. As a fuel for the navy, oil has incomparable advantages compared to coal. The same quality oil has 50% further sailing distance than that of coal, is more easily stored and transported, and can reduce spatial occupancy and labor consumption. Because of this, Churchill began to lobby the Royal Navy in 1911 to use oil instead of coal to maintain the marine superiority and suppress the rise of German Navy. Churchill succeeded in 1913. The World War I deepened people's understanding of oil. During the war, petroleum, gasoline and diesel oils were the main fuels of aircrafts, cars and warships. Before the World War I, the French oil import was 0.4 million tons, but in 1918 France had to import one million tons of oils per year (Stern, 2010). The American Petroleum undoubtedly became an indispensable part of the war in Europe.

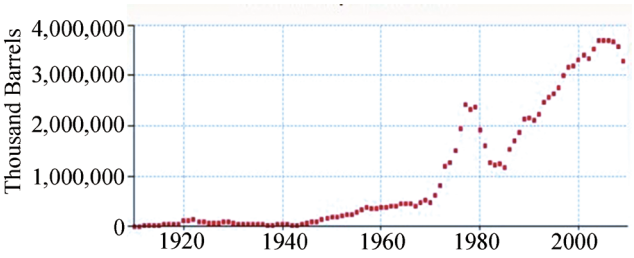

Figure 1
Annual Oil Importing Evolution of the US
Note. Source: US Energy Information Administration (EIA)

After the 1950s, Europe began the scale production of small and medium sized people's cars. German Volkswagen's "Beetle", French Renault's "4CV", Italian's "Fiat 500", "Fiat 500", British Motor Corporation's "mini" have appeared. Vehicle production in Europe soared from merely over 1 million in 1950 to 11 million in 1972. Similarly, the Japanese auto industry which was in its infancy at the end of World War II also developed rapidly. It exceeded Germany to become the world's second largest automobile manufacturer in 1972, and had a staggering output of 4.5 million automobiles in 1973, while in 1960, its yield was only 165,000 (Jean-Pierre & Chanaron et al., 1982). The development of automobile industry in Europe and Japan promoted the growth of world oil consumption, and also made the world's oil consumption regional structure undergo fundamental changes. France, Italy, Britain, Germany and Japan have become the important importing countries in the world. Meanwhile, in order to increase car production, equipment and packaging materials, directly or indirectly to meet consumer demands, factories had to increase their supplies and increasingly used oil as the fuel. Meanwhile, the petrochemical industry turned oil and gas into plastic. Large quantities of chemical plastic in various forms began to replace traditional materials. Consumptions were further increased. Adequate oil supply further promoted the development of automobile industry, and the development of automobiles increased oil consumption, so the development of automobile and related petrochemical industries formed a positive feedback to oil supply and promote each other.

2.2 Petroleum's Comparative Advantages to Coal and Governments' Promotion

Compared with coal, oil is more economical and more environmentally friendly. Therefore, oil has changed the energy consumption structures in the US and European countries. In the first half of the 20th century, the United States' energy consumption was coal-based. With the drop in oil prices, as opposed to coal, using oil as fuel is more economical, so oil has replaced coal to be the main source of energy in the United States.

After World War II, coal shortage led to a serious energy crisis in Europe. The cheap oil from the Middle East became an inevitable choice to solve Europe's energy crisis, but coal burning-caused environmental pollution also made the British residents and government beleaguered. For this reason, the government set up the "smoking areas" where coal burning for heating was prohibited, and in 1957 passed the *Clean Air Act* to support the use of oil. The decline in oil prices made the Act be successfully implemented. In 1960, the French government also began to use oil in a large scale, adjusted and reduced the domestic coal industry. The French government stressed that the use of oil was a way to promote industrial equipment modernization. John Maynard Keynes once said, "The German Empire is not so much built on the basis of blood and iron, as it is built on the basis of coal and iron." When oil was cheaper than coal, the Germans also turned to oil. This change has a comprehensive nature. In 1955, coal accounted for 75% of all energy consumption in Western Europe, and oil accounted for only 23%. By 1972, the proportion of coal has been reduced to 22%, and oil demand has increased to 60% (Yergin, 2008, p.106). It can be said that the supports of governments led to the growing oil consumption, and the world oil trade spatial pattern thus changed accordingly.

2.3 Prices

Price is the main factor affecting oil consumption. Production $[A_i]$, consumption $[B_i]$, $[X_{ij}]$ ($i = 1 \ldots n, j = 1 \ldots n$), the difference between A_i and B_i is nature of a country, difference between A_i and X_{ij} is export, different between B_i and X_{ij} is import. From a perspective of economic, when A and B are equal, the world oil market prices remain unchanged. When A is greater than B, the oil market prices drop, consumption B increases, and this increase is reflected in the changes of B_1, B_2 ... B_n. In other words, when different regions or countries face the oil price changes, their consumptions also change, leading to an overall evolution of the spatial pattern. This evolution is mainly reflected in two aspects, namely the changes in trade capacity of spatial pattern, including the overall capacity as well as the change in trade capacity in a single country; the evolution of trade structure, including the establishment of new trade links, interruption of existing trade links and trade capacity ratio changes in different trade links.

CONCLUSION

In the spatial pattern evolution of the world oil trade, the functions of trade depend the difference between production and consumption. When production exceeds consumption, oil producers will look for external markets to transfer the value of use and realize the value; when production is less than consumption, a trading country's resource supply will depend more on foreign trade, namely, the changes in consumption promote the changes of the world oil trade pattern.

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