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Influences Analysis of COVID-19 on Container Ship Capacity of China's Coastal Port based on AIS

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Abstract

As one of the important Bridges to communicate with the world, shipping is an important carrier of economic globalization. In recent years, China's shipping volume has ushered in an explosive growth. Under the impact of COVID-19 epidemic in 2020, container ship capacity of China's coastal ports will be significantly affected. In this paper, AIS big data technology is used to analyze the AIS data of ships in China's major coastal ports, aiming to study the changes of container ship capacity in China's coastal ports after the epidemic, and to provide reference for the future development of the global shipping market.

Keywords

Container Ship Capacity; China's Coastal Port; Epidemic Outbreak; COVID-19; Automatic Identification System (AIS).

1. Introduction

In early December 2019, 27 Wuhan residents were diagnosed with unidentified pneumonia. On Jan. 7, the culprit was a novel coronavirus. On January 20, Academician Zhong Nanshan clearly informed the existence of human-to-human transmission of the virus, and the State Council also presided over an executive meeting of the State Council to start the deployment of COVID-19 infection prevention and control work. At this point a virus to defend the war officially started.

In the context of economic globalization, shipping, as a link connecting the world, is of self-evident importance because of its simple means of transportation and high transportation efficiency. In particular, China's shipping industry is developing steadily. There are 10 large container ports in the world in 2019, which are Shanghai, Singapore, Ningbo Zhoushan, Guangzhou, Busan, Hong Kong, Qingdao... Among them, seven of the world's top ten container ports are from China, enough to show that China already has a place in the shipping industry.

According to real-time data from Worldometer, 8,2981,032 cases of COVID-19 have been confirmed worldwide, with 1809,633 deaths as of December 31, 2020, Beijing time at about 6:30. The number of new cases confirmed in a single day was 744,601, the largest increase in the world. There were 15,601 new deaths. More than 744,000 new cases have been confirmed outside China, bringing the total number of confirmed cases to over 82.89 million and the total number of deaths to over 1.704 million.

Containers are particularly vulnerable to COVID-19 because they mostly move between ports in different countries. Based on AIS, this paper analyzed the detailed data of ships, continuous spatio-temporal information, and actual navigation behavior of ships, providing a reference for exploring the changes of container ship capacity of China's coastal ports caused by COVID-19.

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2. Literature review

We can find some information on the impact of the outbreak on shipping markets. Epidemic outbreaks are one of many factors that produce shipping risks [1]. Many large shipping companies have reduced berths in China, which is called "blank sailings". The warehouses near Chinese ports are not fully operational, resulting in the need for ships to be transferred from Chinese ports to Korean ports [2]. By the end of February 2020, COVID-19 caused many container fleets to stop production activities, and China's manufacturing index fell to the lowest level since the Great Recession of the 2008 Economic Crisis, as China suspended production activities in order to contain the spread of the epidemic [3].

AIS data analysis is particularly useful in the space-time status of container ships. Based on AIS data, it can provide a good and reliable data source for us to study the voyage time of container ships [4]. The high spatial and temporal resolution of AIS data enables us to obtain ideal data of ship navigation [5]. AIS data can be used to study the differences in the distribution of ship behavior with different characteristics. The ship's transverse position, speed, heading and time interval can be used to describe the traffic condition of the ship, and why the geographical form of the channel, other navigation conditions and local laws and regulations all lead to the differences in ship behavior can be analyzed [6].

As the AIS data has good temporal and spatial characteristics, the situation of container liners operating in China's coastal areas can be clearly determined. Therefore, AIS data is suitable for analyzing the impact of COVID-19 pandemic on container ship capacity of China's coastal ports. At present, few studies have analyzed the changes of container ship capacity of China's coastal ports under the COVID-19 pandemic based on AIS data. This is the academic contribution of this paper to the research gap.

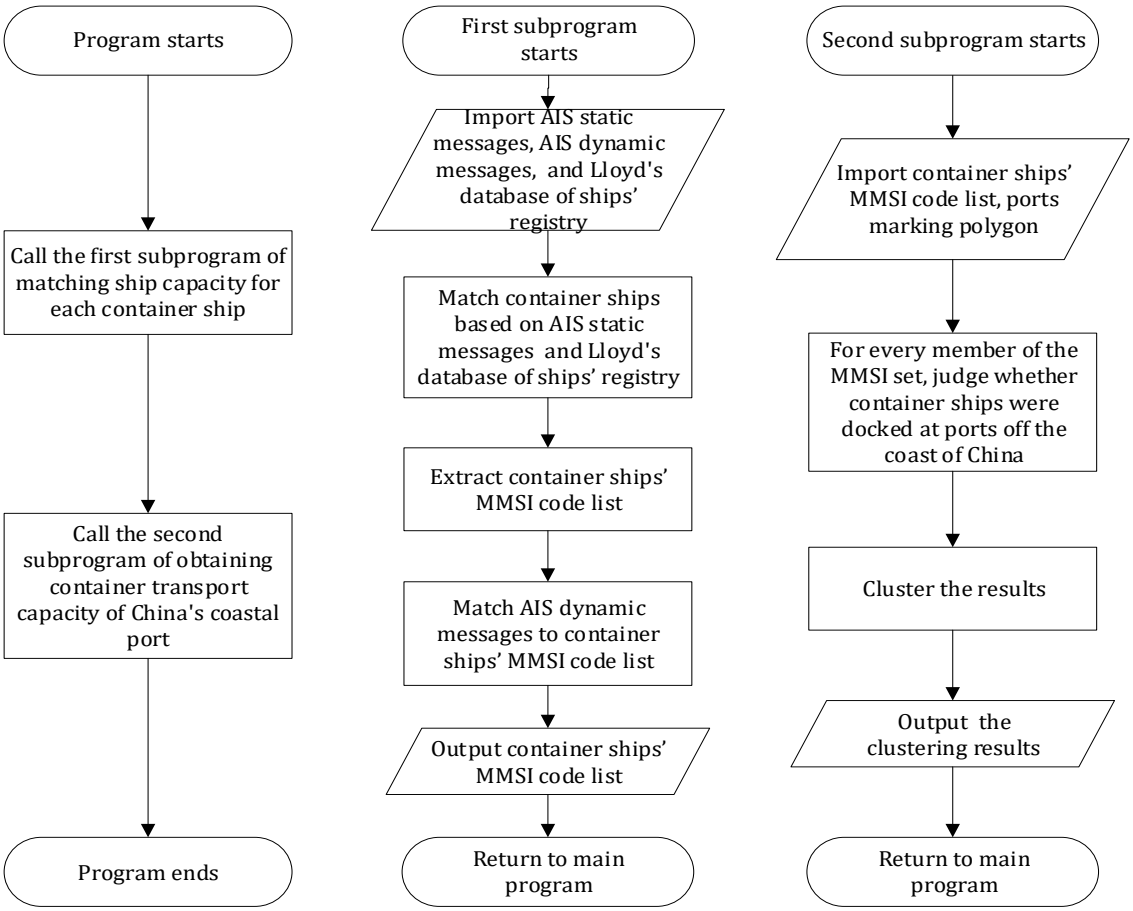

Figure 1. The flow chart of methodology

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3. Methodology

In this section, we introduce a method to analyze container ship capacity of China's coastal ports through AIS big data. First, AIS big data was matched with Lloyd's ship archives to obtain the navigation conditions of container ships around the world. Secondly, through the matching analysis of the obtained matching data and the geo-marked data of global wharf berths, the entry, anchoring, berthing, departure, cruise and other events of container ships in Chinese ports can be analyzed from the trajectory data. The method flow chart is shown in Figure 1.

4. Empirical results

This study analyzed the navigation activities of container ships in China's coastal ports from January to April 2020. Figure 2. shows that with the outbreak of COVID-19, the number of active container ships at China's coastal ports began to decline from January 25, 2020. At the same time, container ship capacity began to decline. COVID-19 has become increasingly prominent in China's coastal ports.

On February 1, 2020, the number of container ships in China's coastal ports reached a short-term low point, with 707 active ships, 15.53% less than on January 24 and 18.08% less than on January 4. The total capacity of 3,431,399 TEU is 14.88% less than that of January 24 and 18.06% less than that of January 4. The reason for the low number and capacity of container ships at China's coastal ports is that the COVID-19 epidemic period in China mainly occurs from late January to late February, when most of the new cases occur in Asian countries such as China, Iran, Japan, Singapore and South Korea.

Since then, the number of container ships along China's coast has rebounded. On March 13, 2020, there were 944 active ships, an increase of 33.52% compared with February 1; The total capacity is 5,030,781 TEU, an increase of 46.61% compared with January 24. Then it showed an oscillating downward trend and dropped sharply on April 1. On April 1, there were 773 active ships, down 11.76% from March 30 and 18.11% from March 13. Total capacity reached 4,083,416 TEU, down 18.11% from March 30 and 18.83% from March 13. Then there was a wobbling trend.

This is mainly because the European and American countries from April began serious epidemic, governments issued strict policy regulation and powerful measures, countries are basically take the injunction has the most powerful measures, such as the whole of Europe and the United States port in April production operating efficiency is reduced, indirectly led to China ocean voyage to the port number and capacity of a container ship.

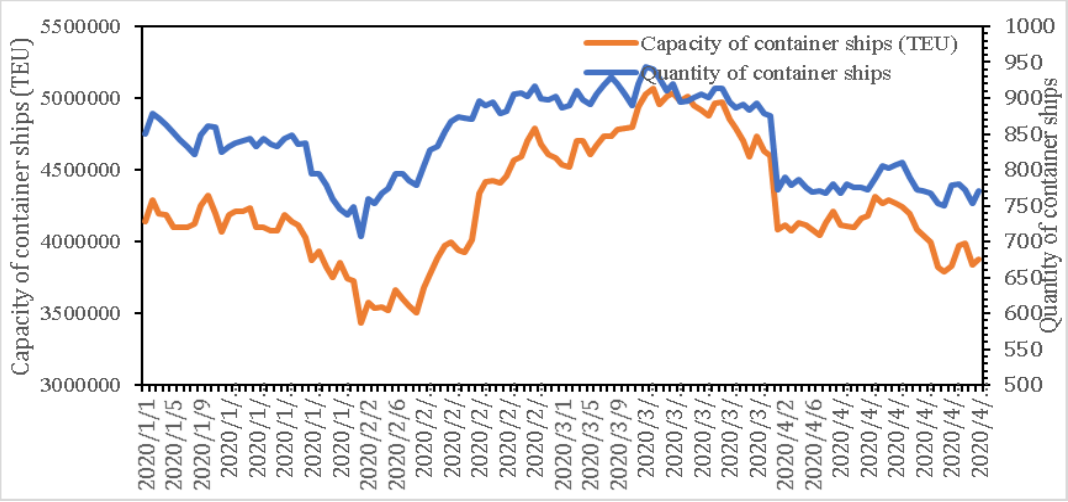

Figure 2. Statistics of container ships in coastal ports of China

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We conducted an analysis on container ships under 4000TEU in China's coastal ports (Figure 3.). It can be seen that when ships below 4000TEU are selected, the trend is more gentle compared with Figure1.However, we can still observe that at the end of January 2020, the number and capacity of container ships fell to a trough.

On January 29, 2020, the number of container ships in China's coastal ports reached a short-term low point, with 373 active ships, 15.23% less than on January 24 and 13.00% less than on January 4. The total capacity of 618,371 TEU is 18.38%% less than that of January 24 and 14.58%% less than that of January 4.

Then there was an upward trend. On February 15, 2020, the number of container ships in China's coastal ports reached 485, up 30.03% compared with January 9. The total capacity reached 762,978 TEU, up 23.39% compared with January 9.

Again, a big drop on April 1, 2020.The number of container ships in China's coastal ports reached 377 on April 1, down 12.33 percent from March 31 and 22.27 percent from February 15.The total capacity reached 628605TEU, down -22.27% compared with March 31 and down 17.61% compared with February 15. Then there was a wobbling trend.

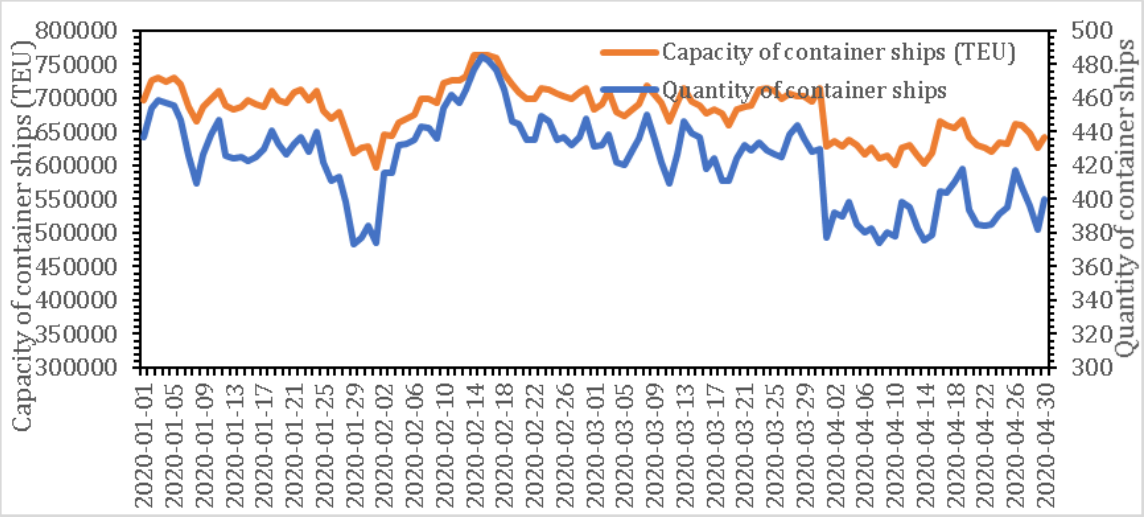

Figure 3. Statistics of container ships less than 4000TEU in coastal ports of China

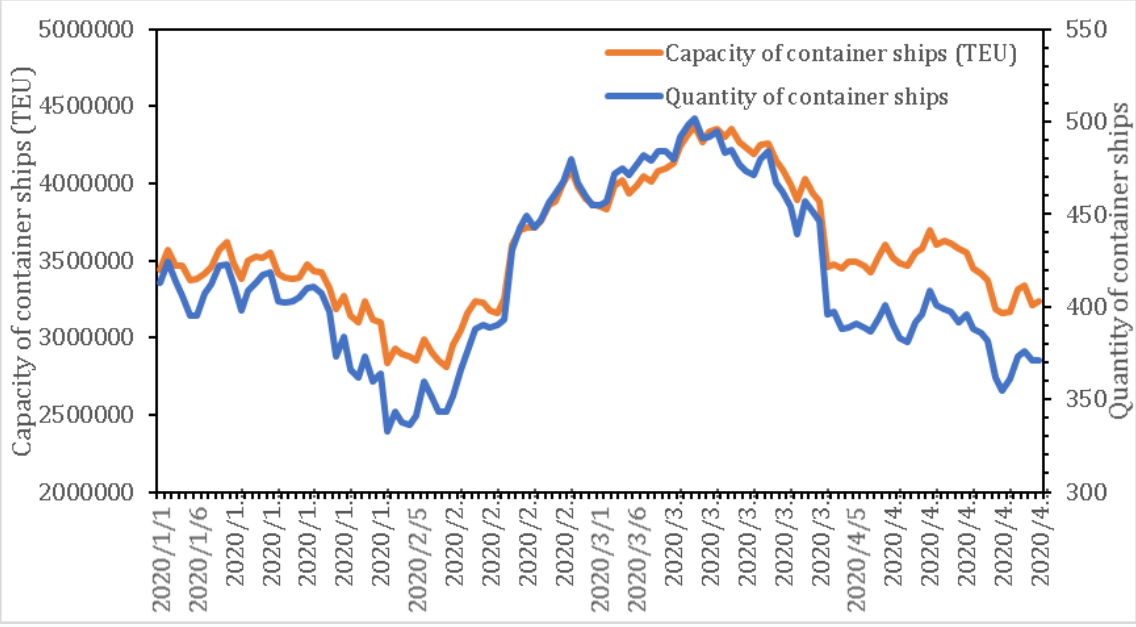

Figure 4. China's coastal ports are more than 4000TEU container ship statistics

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We conducted an analysis on container ships over 4000TEU in China's coastal ports (Figure 4.). We found that when ships below 4000TEU were removed and only ships above 4000TEU were retained, the trend was close to Figure 1. We can still observe that as of February 1, 2020, the number and capacity of container ships at China's coastal ports have reached a trough.

On February 1, 2020, the number of container ships in China's coastal ports reached 333, down 18.98% from January 22, and down 21.46% from January 2. The total capacity reached 2834966TEU, down -21.46% from January 22 and down 20.50% from January 2.

Subsequently, the number and capacity of container ships at China's coastal ports increased dramatically, reaching a peak on March 14, 2020.On March 14, the number of container ships in China's coastal ports reached 502, up 50.75% from February 1. The total capacity reached 4370214TEU, rising 54.15% compared with February 1.

Consistent with Figure 1. and Figure 2., there is a precipitous drop on April 1, 2020.On April 1, the number of container ships in China's coastal ports reached 396, down 11.21% from March 31 and 21.12% from March 14. The total capacity reached 3454811TEU, down -11.04% compared with March 31 and down 20.95% compared with March 14.

It can be seen that compared with large container ships, small container ships are less vulnerable to the impact of emergencies such as COVID-19, and the fluctuation amplitude is more moderate than that of large container ships.

In 2020, when the COVID-19 was serious in China in January, the number and capacity of container ships in China's coastal ports decreased significantly. In April, when the COVID-19 was serious in Europe and the United States, the number and capacity of container ships in China's coastal ports also decreased significantly. Container ships in China's coastal ports are affected by both domestic and foreign factors. But as the epidemic has been brought under control, the number and capacity of container ships at China's coastal ports have been rising, gradually returning to the level of previous years.

5. Conclusion

By using big data technology, we analyzed the AIS data of ships and analyzed the impact of COVID-19 on the shipping market. It is found that after the occurrence of an emergency, it will be reflected in the value of port container ship capacity, and the value will show a fluctuation trend of decreasing first and then increasing. According to the above analysis, the COVID-19 pandemic has had a serious impact on the container ship capacity of China's coastal ports. COVID-19 has led to a reduction in the number of berthing vessels at China's major coastal ports, which has seriously affected the global international container liner shipping market demand and further affected a number of industries.

However, as order returns to the market, it will gradually return to normal levels. This has a considerable impact on the policy formulation of the maritime market. If such an emergency occurs in the future, it can provide a basis for government policy making and enterprise booking decisions.

With the increasing impact of COVID-19 on the global scale, there are still directions for future research. Analyze the impact of the COVID-19 pandemic in Europe, the Americas, Southeast Asia and other regions. Since COVID-19 outbreaks are not consistent in time and extent across countries, it is necessary to analyze how ports in these regions are affected by COVID-19.

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