

# Impact of COVID-19 on the International Container Shipping Market: A Data-Driven Analysis of North America-Asia and West-East Coast America Routes

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**Abstract.** This study examines the impact of the COVID-19 pandemic on the international container shipping market, focusing on the changes observed in the North America-Asia routes and the East and West Coast routes of the United States. The study analyzes market changes before and after the pandemic outbreak by collecting Shanghai Containerized Freight Index (SCFI) data from 2017 to 2022. Utilizing a Difference-in-Differences analysis, the research explores the pandemic's effect on the SCFI index. The findings reveal that the SCFI index for the North American route increased significantly by approximately 6,807 points compared to the Asian route due to the pandemic. In contrast, the East Coast of the United States had a freight index 1,246 points higher than the West Coast, mainly due to decreased port efficiency and insufficient capacity during the pandemic. Additionally, the study identifies that severe port congestion and reduced efficiency in the United States further contributed to the rise in freight rates.

## 1 Introduction

Due to the global COVID-19 pandemic, China's export container shipping market continued to experience high prices. Shipping prices on several ocean routes increased by varying degrees, and the composite index rose [1]. In 2021, the global shipping industry was in "ice and fire" owing to overseas countries' severe epidemic, artificial shortage, and port container mountain. The demand for trans-Pacific routes starting in the summer season has been on the rise, and the duration of the peak season has exceeded everyone's expectations. During the pandemic, the zero-sale inventory in the United States was emptied, exacerbating the need for zero-sale merchants to replenish their inventory. In September, the trans-Pacific route's container shipping volume was 2.16 million standard containers, an 8% increase year-on-year and a 31% increase year-on-year [2]. Asian ports were busy, but were often plagued by "shortage" and "small container". Container prices soared, which was still hard to find, and some shipping routes rose nearly 10 times. The international container shipping market has seen an unprecedented high freight rate, with container prices as high as several times or even

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dozens of times before. Many shippers cannot support such high freight rates and have to give up some orders [3].

Before the outbreak, the container industry had plunged into a 10-year recession cycle, a massive reduction in capital spending. Global container transport capacity had fallen sharply, and the outbreak of the production chain worsened this situation. More importantly, the pace of economic recovery in countries worldwide after the pandemic was out of balance. China was the first country to recover and the most aggressive to meet the huge demand of the global market. Despite large transfers of foreign trade orders to China and the huge demand for containers, Chinese containers shipped to Europe and America were not able to dock on time due to the epidemic, owing to the unloading capacity's not enough and not being empty in time, even with the partially emptied containers. Also, the local production chain could not form a cargo supply, and the container could not carry cargo back, resulting in a large number of solid boxes and empty boxes, congestion, and accumulation in the European and American country's ports. Meanwhile, there was a severe shortage of containers at the eager Chinese ports. The extreme imbalance between supply and demand inevitably pushed up shipping prices.

At the beginning of 2023, the Shanghai export container freight Index released by the Shanghai Shipping Exchange was 1028.7 points, a significant decrease of 80% from 5109.6 points in early January 2022. It had fallen to the average freight level before the epidemic. The international container shipping market has seen an unprecedented high freight rate, with container prices as high as several times or even dozens of times before. Many shippers need help to support such high freight rates and have to give up some orders [4]. A number of industry insiders told *The Times* that the overall cargo demand would continue to decline; on the contrary, the new transport capacity was still increasing, and the business performance of the major transportation companies in the first half of 2023 was not optimistic. In these cases, this study will analyze the specific situations and the main reasons behind this phenomenon.

## **2 Data Collection**

For the current industry, while lamenting the soaring freight prices and the difficulty of exporting a single box at domestic ports, perhaps it is more concerned about whether the rising trend of export freight prices can be sustained and how market conditions will operate [5]. Shanghai Containerized Freight Index(SCFI) is an essential indicator of export container freight rates in Shanghai. It reflects the supply and demand dynamics and price fluctuations in the shipping market. The relationship between the supply and demand and the shipping cost impacts it. It is a sign for traders and supply chain managers.

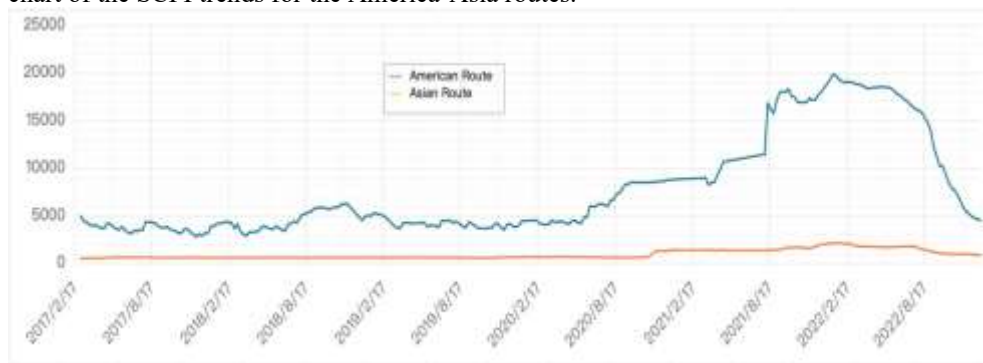
This study takes SCFI as a standard to reflect the international container ship market. This study utilized the International Container Shipping Market Biweekly Report published by the Shanghai International Shipping Institute to collect and summarize the SCFI indices for the Far East-North America routes (West Coast and East Coast routes) and intra-Asian routes (Japan and Southeast Asia routes). This study gathered weekly data spanning from 2017 to 2022. Some of this data contained errors, such as date discrepancies or missing information, and this study excluded the weeks with erroneous data. Subsequently, this study divided the collected data into two parts, using the date the WHO named COVID as a boundary- 11th February 2020- thereby categorizing the data into "normal" and "pandemic" appearances.

### 3 Data-Driven Analysis of America-Asia Shipping Routes

#### 3.1 Data Driven of America-Asia Route

##### 3.1.1 Trend analysis

As shown in Figure 1, this study used the collected data to create a comparative analysis line chart of the SCFI trends for the America-Asia routes.



**Fig. 1.** SCFI Trends Analysis Chart for Asia and America.

The SCFI for the American routes gradually increased after the pandemic; it peaked and then rapidly declined, whereas the Asia routes remained relatively stable. The impact of COVID-19 on the American routes was more significant than that on the Asia routes.

##### 3.1.2 Logarithmic growth rate analysis of SCFI

To verify the observation, this study calculated the logarithmic growth rates of the SCFI for both routes every week and conducted a Difference-in-Differences (DID) analysis, with the results as shown in Table 1 in Appendice.

**Table 1.** DID analysis of the logarithmic growth rates of SCFI(America-Asia).

Regression statistics						
Multiple R	0.056769051					
R Square	0.003222725					
Adjusted R Square	-0.002356252					
Standard error	10.764267					
Observations	540					
ANOVA						
	df	SS	MS	F	Significance F	
Regression analysis	3	200.7977554	66.93258514	0.577655185	0.629891112	
Residuals	536	62106.02198	115.869444			
Total	539	62306.81974				
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.070715953	0.890857075	-0.079379683	0.936760255	-1.820715328	1.679283423
After	0.069639008	1.314555944	0.05297531	0.957771318	-2.512674299	2.651952316

Treated	-1.24775853	1.259862158	-0.990392895	0.32242899	-3.722631382	1.227114321
Interaction Group(After* Treatment)	1.449453746	1.859062844	0.779669042	0.435929828	-2.202488756	5.101396247

The R-squared value is small, indicating that the model is underfitting, probably due to an incorrect analytical approach selection or unincluded variables that interfere with the results. The  $P > 0.05$ , so there is not enough evidence to suggest that the pandemic significantly impacts the logarithmic growth rates of the SCFI for both America and Asia. There is no significant difference in the logarithmic growth rates of the SCFI for America and Asia before and after COVID-19.

### 3.1.3 SCFI analysis

This study calculated the growth rate using different methods and found that the P-value was always greater than 0.05. Then, this study performed a difference-in-differences (DID) analysis on the SCFI of the two routes, with the results shown in Table 2.

**Table 2.** DID analysis of SCFI (America-Asia).

Regression statistics						
Multiple R	0.841530964					
R Square	0.708174363					
Adjusted R Square	0.70654101					
Standard error	2743.553829					
Observations	540					
ANOVA						
	df	SS	MS	F	Significance F	
Regression analysis	3	9790582223	3263527408	433.5710669	7.0083E-143	
Residuals	536	4034518961	7527087.615			
Total	539	13825101184				
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	4159.472603	227.0581305	18.3189767	1.43315E-58	3713.439678	4605.505527
After	7448.099978	335.0488234	22.22989444	4.49347E-78	6789.930168	8106.269788
Treated	-3564.40411	321.1086876	-11.10030419	6.5236E-26	-4195.189921	-2933.618299
Interaction Group(After* Treatment)	-6807.337907	473.8305902	-14.36660707	7.91283E-40	-7738.130578	-5876.545235

COVID-19 has led to an increase in the outcome variable for the American route. Compared to the Asian route, the SCFI for the American route increased by approximately 6807 after COVID-19. Since  $P < 0.01$ , the result is statistically significant, indicating that this effect is not due to random error.

### 3.2 Data Analysis of America-Asia Route

The market for North American routes is growing relatively quickly, and while the market capacity supply has gradually recovered, capacity constraints have remained the same [6]. It can be seen that after the epidemic outbreak, the working efficiency of various ports was

reduced, resulting in reduced shipping efficiency and a lack of transport capacity, which made the SCFI index rise.

Because of the higher shipping cost of the eastern US route, the SCFI freight index is more significant than that of the western route. In the second half of 2021, if the epidemic in the United States gradually stabilizes, China's exports to the United States are expected to remain stable. Still, it will be challenging to continue to grow significantly. The supply and demand relationship of the North American route will return to balance, and the market freight rate is expected to return to an average level from the historical high [7]. There are two significant stages: surge and decline.

### *3.2.1 Surge*

The main reason for the sharp increase is the century-long congestion of ports in the United States. According to the data from CITIC Construction, in July, the average port capacity of ports in the West and East of the United States reached 8.7 million standard containers (TEUs) within 7 days, an increase of 200% compared to pre-pandemic levels.

The Asian to North American shipping routes have far exceeded the average growth rate of container traffic and the capacity of ports, which is the first important reason for port congestion in the United States.

The main reason for the significant growth in the East Coast compared to the West Coast is that the main congested ports are located on the West Coast of the United States. Hence, shipping companies divert to the East Coast and use trailers to transport goods to their destinations, which sharply increases the East Coast SCFI index.

### *3.2.2 Decline*

The status of the eastern US route began to decline at its peak, while the status of the western US route continued to rise. The reason is that after the easing of port congestion, the demand for the eastern US route delined, and the transport capacity of the east US route was surplus compared with the west, so the SCFI of the eastern US decreased.

The main ports in the United States are concentrated in the West, and after the port congestion eased, the SCFI of the Western American route gradually increased.

## **4 Data-Driven Analysis of West-East Coast America Route**

### **4.1 Data Driven of West-East Coast America Route**

#### *4.1.1 Trend analysis*

This study conducted a more detailed study on the American routes, creating a comparative analysis line graph of the SCFI trends between the West Coast and East Coast routes in the United States, as shown in Figure 2.



**Fig. 2.** SCFI Trends Analysis Chart for West-East Coast of America.

The SCFI for both routes gradually increased, peaked, and then rapidly declined, with the trends remaining broadly consistent after COVID-19. The impact of COVID-19 on the West Coast and East Coast routes in the United States was quite similar.

#### 4.1.2 Logarithmic growth rate analysis of SCFI

To verify the observation, this study calculated the logarithmic growth rates of the SCFI for both routes every week and conducted a Difference-in-Differences (DID) analysis, with the results as shown in Table 3.

**Table 3.** DID analysis of the logarithmic growth rates of SCFI (West-East coast of America).

Regression statistics						
Multiple R	0.029479319					
R Square	0.00086903					
Adjusted R Square	-0.004723121					
Standard error	8.387183507					
Observations	540					
ANOVA						
	df	SS	MS	F	Significance F	
Regression analysis	3	32.79514534	10.93171511	0.155401789	0.926200687	
Residuals	536	37704.83809	70.34484718			
Total	539	37737.63323				
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.093507156	0.694128246	-0.134711643	0.892890437	-1.457052478	1.270038165
After	0.027171196	1.024261283	0.026527602	0.978846391	-1.984887367	2.039229758
Treated	0.593080291	0.981645579	0.604169472	0.545986605	-1.335263995	2.521424578
Interaction Group(After* Treatment)	-0.495650952	1.448524198	-0.342176508	0.73235219	-3.341131459	2.349829555

The R-squared value is small, indicating that the model is underfitting, probably due to an incorrect analytical approach selection or unincluded variables that interfere with the results.

The  $P > 0.05$ . So, there is not enough evidence to suggest that COVID-19 significantly impacts the logarithmic growth rates of the SCFI for both West Coast and East Coast routes. There is no significant difference in the logarithmic growth rates of the SCFI for West Coast and East Coast routes before and after COVID-19.

### 4.1.3 SCFI analysis

This study calculated the growth rate using different methods and found that the P-value was always greater than 0.05. This study performed a Difference-in-Differences (DID) analysis on the SCFI of the two routes, with the results as shown in Table 4.

COVID-19 has led to an increase in the outcome variable for the East Coast route. Compared to the West Coast route, the SCFI for the East Coast route increased by 1246. Since  $p < 0.01$ , the result is statistically significant, indicating that this effect is not due to random error.

**Table 4.** DID analysis of SCFI (West-East Coast of America).

Regression statistics						
Multiple R	0.717238896					
R Square	0.514431634					
Adjusted R Square	0.511713901					
standard error	1994.687793					
Observations	540					
ANOVA						
	df	SS	MS	F	Significance F	
Regression analysis	3	2259393794	753131264.5	189.2870126	1.09309E-83	
Residuals	536	2132625753	3978779.391			
Total	539	4392019547				
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1563.664384	165.0815363	9.472073124	8.7194E-20	1239.378262	1887.950505
After	3101.004971	243.5956572	12.73013241	1.27399E-32	2622.485734	3579.524208
Treated	1032.143836	233.4605476	4.4210632	1.18953E-05	573.5340049	1490.753666
Interaction Group(After* Treatment)	1246.090035	344.4962821	3.617136381	0.000326044	569.3616404	1922.81843

## 4.2 Data Analysis of West-East Coast of America Route

Because of the different epidemic situations and policies in Asia and the Americas, the SCFI of the two routes is differently sensitive to the epidemic.

### 4.2.1 The delay in growth of the Asian SCFI index

Due to stricter epidemic control policies in Asia compared to the Americas, trade between Shanghai and Asian countries is hindered, resulting in lower demand. Asia routes need to catch up to the epidemic's impact on SCFI compared to the Americas.

By the end of 2020, the epidemic control measures in Asian countries were gradually lifted, leading to increased demand, insufficient transportation capacity, and increased ASIAN ROUTE'S SCFI index.

#### *4.2.2 The decline of both routes' SCFI in the end*

From the end of 2021 to the beginning of 2022, the epidemic policies of countries(except China) were lifted, and the world's economy was recovering. During the epidemic, strikes and other problems led to the port's congestion and lower shipping efficiency, which caused shipping companies to increase their capacity continuously. After the epidemic, the efficiency of the port has become higher, which leads to higher shipping efficiency and excess capacity. To collect more goods, shipping companies decrease the freight rates. Therefore, the SCFI index of both the America and Asia lines decreased.

## **5 Suggestions**

### **5.1 Own more ways of transportation.**

Due to the severe congestion of ports in the United States caused by the epidemic, freight rates have SURGED. ZIM Shipping Company has ports and port fleets in the United States and neighboring cities. It has effectively addressed this issue through sea and land transportation. Therefore, other shipping companies can alleviate similar problems by learning from this approach. The competitive landscape is more important than the supply and demand landscape, and the capacity management strategy is crucial. Currently, freight rates are no longer mainly driven by the balance of supply and demand. The approach adopted by the shipping industry to cope with demand shocks is more important than the relative increase or decrease of demand itself [8].

### **5.2 Reasonably and appropriately increase transportation capacity.**

As the epidemic's impact on global industrial and supply chains evolves from temporary and local to long-term and systemic, and the decrease in port efficiency and customs clearance efficiency during the epidemic, transportation capacity needs to be improved [9]. Then, major shipping companies purchase many ships to build ships to meet transportation capacity. However, since the degree of transportation capacity shortage varies for each route, this study believes that similar results can be achieved by allocating transportation capacity, cooperation between companies, and the logistics methods mentioned earlier instead of wildly building ships. In response to the changes in the market after the outbreak of the Covid-19 pandemic, the shipping company ZIM solved the problems substantially during the surge of the market after the outbreak of the Covid-19 pandemic by rent ships instead of buying or building more ships, which means if the market becomes worse later, they can stop signing the renting contract so that they can save their cost flexibly. And though there are a lot of shipping alliances in the world, such as 2M, Ocean Alliance, and so on, ZIM remains independent to ensure they can face the changes more flexibly. These behaviors or plans of the ZIM shipping company show sustainable and flexible solutions and give me many ideas for suggestions for the market. For China, China is the largest country in goods trade and the leading supplier of ships. However, China's maritime capacity, such as the number of ocean-going vessels and the international influence of shipping companies, is not matched by its trade volume and status. The development of ship and maritime upstream and downstream industries and derivative service markets is relatively lagging, and there is a realistic need to improve further and enhance [10].



## 6 Conclusion

Due to the outbreak of the epidemic, international trade has been dramatically affected, especially the container shipping business, which is mainly seaborne. The SCFI index, as an indicator to measure the freight rate of maritime containers, plays a vital role in analyzing the epidemic's impact on the maritime container transport business. This paper selects the North America-Asia route and the East America-West route as the research objects calculate the logarithmic growth rate of the SCFI index and analyzes the logarithmic growth rate of the DID, resulting in the conclusion that COVID-19 has led to an increase in the outcome variable for the American route. Compared to the Asian route, the SCFI for the American route increased by approximately 6807 after COVID-19. Meanwhile, after the epidemic outbreak, the working efficiency of various ports was reduced, resulting in reduced shipping efficiency and a lack of transport capacity, which made the SCFI index rise.

Because of the higher shipping cost of the eastern US route, the SCFI freight index is more significant than that of the western route. In contrast, COVID-19 has led to an increase in the outcome variable for the East Coast route. Compared to the West Coast route, the SCFI for the East Coast route increased by 1246.

This study is limited in length, but the above research has some reference value for future changes in the maritime container market and has implications for the sustainable development of marine shipping container enterprises.

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