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Analysis of correlation and influence degree between BDI index and fluctuation of transport capacity index

Jinming Ren

College of Transport & Communications, Shanghai Maritime University, Shanghai 201306, China
1148522113@qq.com

ABSTRACT. *The Baltic Dry Index (BDI) is a barometer of the international dry bulk shipping market, the changes of BDI volatility related to many factors, which are greatly influenced by supply and demand side. In order to explore the correlation of BDI and the capacity index, the monthly data of Baltic dry index (BDI) and fleet capacity index from January 2014 to May 2020 were chosen as samples to establish VAR model, using Granger causality test, impulse response and variance decomposition methods to explore the causation and influence degree of them. It is concluded that used ship trading trading is the main reason that affects the fluctuation of BDI index, and the fluctuation of BDI index in turn will affect the capacity of demolitions and new shipbuilding orders, which provides a basis for shipping enterprises to adjust the capacity and effectively avoid operational risks.*

KEYWORDS: *BDI index, capacity supply, VAR model, Granger causality test, variance decomposition*

1. Introduction

Shipping industry is a capital-intensive, long-term investment return industry, is an important part of the national economy. Capacity scale represents the strength of shipping enterprises, and shipping enterprises need to adjust the scale of capacity dynamically according to market changes, through ship dismantling and used ship trading transactions, the Baltic Dry Bulk Freight Price Index (BDI) is the bellwether of the dry bulk shipping market, the fluctuation of of BDI and the change of capacity supply and demand are closely related, the change of capacity will have a certain impact on the supply and demand relationship of the shipping market, affecting the trend of the BDI index, the trend of the BDI index, the same. Shipping companies will also make certain capacity adjustments. Therefore, the study of the relationship between BDI and capacity indicators can be of great significance to the future trend,

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and provide a basis for shipping enterprises to adjust capacity and ship manufacturing industry to regulate risks in advance.

In view of the importance of BDI index, domestic and foreign researchers have carried on a series of studies on BDI index fluctuations. Based on the ARMA-GARCH model, Li Jing[1] and so on analyzed the influence factors of the fluctuation of dry bulk freight price index after the financial crisis, and concluded that the 2008 financial crisis had the greatest impact on the transport market of the Lingyi fleet and had the longest fluctuation duration,the model fit is better.Yang Hualong[2] and other models set up GARCH model to carry out the analysis of the fluctuation of the freight rate index by ship type, the results show that the dry bulk market of the Capesize type and the Handymax type is more sensitive to market shocks but has a short time. There are many researchers to compare BDI with other indicators, Chen Lifen[3] and other SVAR model based on the dry bulk freight price and fuel price analysis, the results show that the short-term fluctuations of the two have a two-way causal relationship, in which the change of fuel prices has a significant impact on the change of freight rates , the statement of the persistence of the short-term relationship between the two, and the strong correlation of persistence will be weaker. In addition, Li Ruihua[4] and others studied the relationship between financial markets and shipping markets, and the results showed that there is a negative co-integration relationship between BDI and gold prices and the Dow Jones indices, and Liu Bin[5] and others analyzed the Baltic Freight Index (BDI) and the Shanghai Composite Index by using statistical correlation coefficients and coefficients of variation.

Many literatures analyze the correlation between BDI and demand-side iron ore, fuel and other indicators or other field indicators, but there is still a lack of quantitative analysis between BDI index and supply-side capacity index, and this paper uses EVIEWS software and uses VAR model, stable test and other quantitative analysis, not only explores the causal relationship between BDI index and capacity index, but also analyzes the degree of influence between indicator variables from the data level, and provides reference advice to the shipping enterprises.

2. Analysis of the correlation between BDI and capacity indicators

BDI measures the relationship between the transportation demand of raw materials and the fleet capacity supply, the sensitivity of freight rates to the supply and demand relationship is high, the speciality of the supply and demand relationship will be reflected in the long-term fluctuations of BDI, the demand side is mainly iron ore, coal and grain and other bulk goods, the supply end is fleet capacity. Shipping enterprises need to constantly adjust capacity to achieve the right level to achieve optimal operation, the fleet capacity indicators are mainly dismantling capacity, delivery capacity, orderbook capacity, new shipbuilding orders and used ship trading. The data is taken from the monthly figures from January 2014 to April 2020 and are sourced from Clarkson. The trend of BDI and capacity indicators is shown in Figure 1, in which the capacity indicators take the

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two indicators of new shipbuilding orders and dismantling capacity as examples. As can be seen from Figure 1, there are three phases, the first of which is from January 2014 to February 2016 BDI tariffs continued to fluctuate and fall to a low of 307 points in February 2016, order capacity ratio reached an all-time low, dismantling capacity rapidly increased to maintain high levels, the second phase of BDI freight rates began to fluctuate to September 2255 points, new shipbuilding orders rebounded to a high of 3.27 million DWT, No dismantling capacity during the month, with the improvement in the shipping market and strong demand end, new shipbuilding orders continued to pick up, dismantling capacity continued to decline to maintain a low level.

3. Empirical analysis of the impact of BDI and capacity indicators

3.1 Stability test of time series

Because the time series has a non-stability nature, so it need to do the test to avoid pseudo-regression phenomenon, this paper uses ADF unit root test method for the stability of the data, EVIEWS software output results finishing as shown in the table, in 5% of the confidence interval, when the P-value is less than 0.05, there is no unit root.

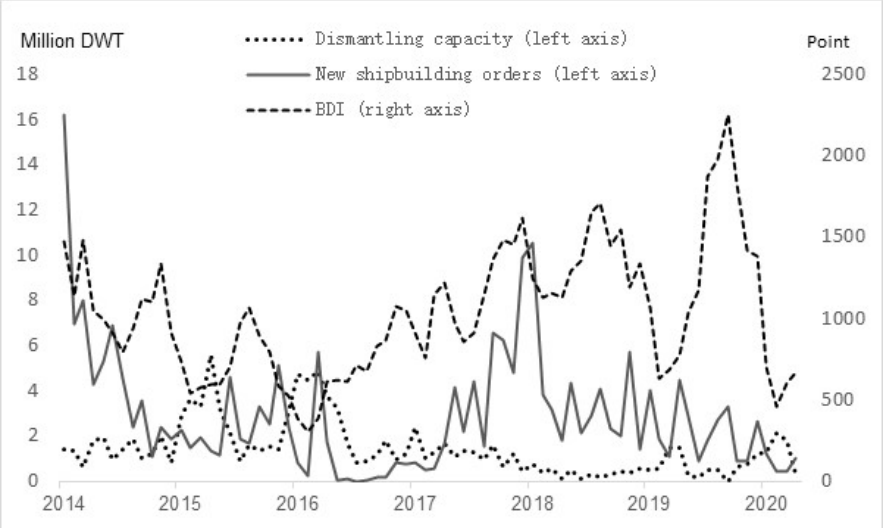

Figure. 1 Dismantling capacity, new shipbuilding orders and BDI trends

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Table 1 Sequence stability ADF test (under 5% confidence level)

The name of the variable	ADF inspection value	T statistics.	P-value.	Whether it's smooth
BDI	-3.4717	-4.1262	0.0085	Yes
BDI First-order difference	-3.4709	-7.6880	0.0000	Yes
Dismantling capacity	-3.4709	-3.6671	0.0309	Yes
Used ship trading	-3.5700	-5.2567	0.0002	Yes
Delivery capacity	-3.4816	0.2325	0.9978	No
Orderbook capacity	-1.9453	-2.2932	0.0220	Yes
New shipbuilding orders	-3.4700	-6.5199	0.0000	Yes

3.2 The lag period selection of the data

The causal relationship between the dependent variable and the explanatory variable generally has a time lag, so it is necessary to judge the lag order of the variable. Taking BDI and orderbook capacity as an example, the maximum lag period is selected according to the Red Pool Message Criterion (AIC) value principle, and the optimal lag period for orderbook capacity as shown in Table 2 is 3. The results of the same method estimate show that the lag period of BDI and new shipbuilding, used ship trading and dismantling capacity is 2, and the delay period of delivery capacity is 6.

Table 2 The determination of the lag period between BDI and hand capacity

The lag period	La Grand i-Test	like-to-test	The final prediction deviation criteria	AIC value	SC value	HQ guidelines
1	-647.9347	N/A	421359.1	18.6270	18.7555	18.6780
2	-634.0992	29.1069	318120.7	18.3457	18.6027*	18.4478*
3	-628.7120	9.8508	305940.8*	18.3060*	18.6915	18.4592
4	-627.6251	1.9255	332880.7	18.3893	18.9032	18.5934

3.3 Co-integration of data

In order to test whether there is a long-term equilibrium relationship between variables, a co-integration test is required, assuming that the Jonhamson co-integration test adopts the default hypothesis, that is, the sequence has a linear deterministic trend and the co-integration equation has only intercepts, while the given VAR model has no exogenous variables, so there is no co-integration relationship between BDI and delivery capacity.

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Table 3 The results of the co-integration relationship test

Compare the data	Co-integration vector	The feature value	Likely than the test value	5% confidence	P-value	Co-integration relationship
BDI and disassembly capacity	None *	0.1779	21.7892	15.4947	0.0049	YES
	At most 1 *	0.0938	7.2894	3.8415	0.0069	
BDI deals with used ships	None *	0.2444	29.6666	15.4947	0.0002	YES
	At most 1 *	0.1089	8.6508	3.8415	0.0033	
BDI and delivery capacity	None *	0.1238	12.7671	15.4947	0.1236	NO
	At most 1 *	0.0489	3.5123	3.8415	0.0609	
BDI and orderbook capacity	None *	0.2163	21.8576	15.4947	0.0048	YES
	At most 1 *	0.0503	3.8228	3.8415	0.0506	
BDI and new shipbuilding orders	None *	0.1954	23.8452	15.4947	0.0022	YES
	At most 1 *	0.0956	7.5370	3.8415	0.0060	

3.4 Granger causality test

Because BDI and delivery capacity fail Co-integration test, the delivery capacity indicator of the supply side is excluded, and the Granger causality test under the VAR model between BDI and dismantling capacity, used ship trading transaction, hand-held capacity and new shipbuilding orders continues, and when the P value is less than 0.05, it is considered that the rejection of the original hypothesis indicates that the causality is established when the significant level is 5%, and the former is considered to be the reason for the latter's Granger.

Table 4 Granger causality test

The original hypothesis	The card check	P-value
BDI is not the Granger reason for dismantling capacity.	3.0206	0.0428
Dismantling capacity is not BDI's Granger reason.	6.3013	0.2208
BDI is not the Granger reason for used ship trading	1.6469	0.4389
Used ship trading is not BDI's Granger reason.	8.9606	0.0113
BDI is not the Granger reason for hand-held capacity.	4.2672	0.2340
Handheld capacity is not BDI's Granger reason.	3.4988	0.3209
BDI is not the Granger reason for new shipbuilding orders	10.9575	0.0042
New shipbuilding orders are not BDI's Granger reason	4.2721	0.1181

3.5 The correlation test of the data

The correlation test of variables is carried out to analyze the correlation between BDI and capacity indicators, and the results, as shown in Table 5, can be seen as a positive correlation between BDI and used ship tradings and new shipbuilding

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orders, negative correlation symmetric relationship with the dismantling capacity index, and the correlation between BDI and capacity dismantling is large.

Table 5 Self-relevance test

	BDI	Dismantling capacity	Used ship trading	New shipbuilding orders
BDI	1.0000	-0.6538	0.1968	0.3231
Dismantling capacity	-0.6538	1.0000	0.0353	-0.1613
Used ship trading	0.1968	0.0353	1.0000	-0.0117
New shipbuilding orders	0.3231	-0.1613	-0.0117	1.0000

3.6 VAR model stability test

Pulse response analysis should be based on model stability, by the AR root test pattern to test the stability of the VAR model, the results show, when the inverse of the feature root is less than 1, that is, the points are located in the unit circle, THE VAR(2) model has good stability, can be carried out the next pulse response analysis.

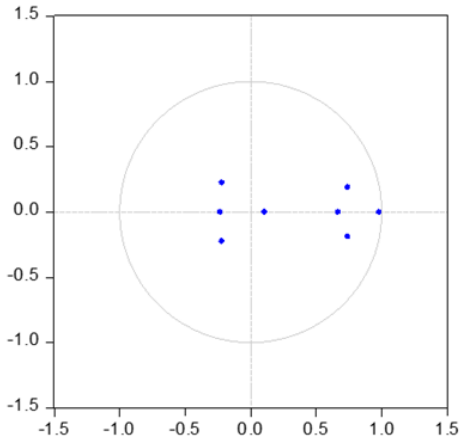

Figure. 2 VAR model stability test

3.7 Pulse response analysis of the data

This section further quantifies variables with causality and uses pulse response functions to analyze the dynamic effects of BDI and capacity indicator shocks. In the figure, the vertical axis units are natural, the horizontal representation period sits, the solid line represents the trend of the pulse response function, and the dashed line is the 95% confidence interval around the pulse response function trend. BDI's impact response to its own impact and used ship trading transactions to BDI is

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shown in Figures 3 and 4. And is always positive and gradually weakened. BDI's impact response to dismantling capacity and new shipbuilding orders can be seen in Figure 5 and Figure 6 respectively, which can be seen that the impact response is changed from negative to positive trend, indicating that BDI and the capacity supply side are divided and have a lag effect. BDI's pulse response to new shipbuilding orders is more obvious, reaching the largest positive at around the 5th period, after which the impact gradually falls back.

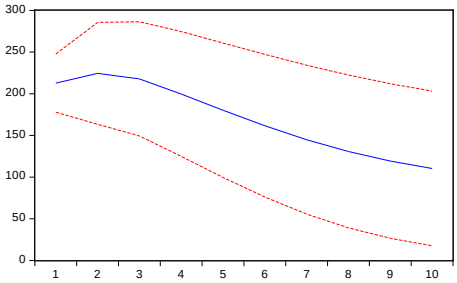

Figure. 3 BDI's own pulse response

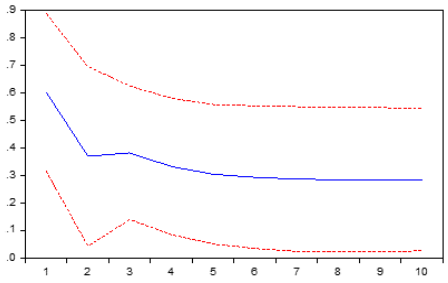

Figure. 3 Used ship trading responds to BDI pulses

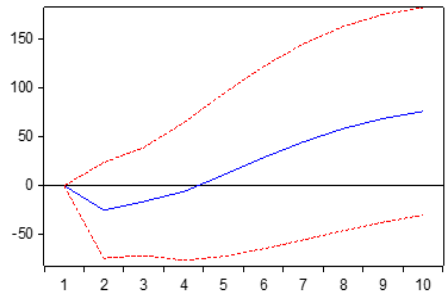

Figure. 5 BDI's response to dismantling capacity pulses

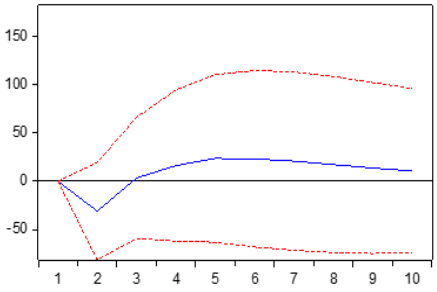

Figure. 6 BDI pulse response to new shipbuilding orders

3.8 Data variance decomposition

Variance decomposition can give the contribution of one variable to another variable, as shown in Table 6, it is concluded that the used ship trading's contribution to BDI is greater, the 10th phase can reach 16.8%, and the new shipbuilding orders and dismantling capacity are weak in the interpretation of BDI.

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Table 6 Variance decomposition test

Forecast period	BDI	Dismantling capacity	Used ship trading	New shipbuilding orders.
1	100.0000	0.0000	0.0000	0.0000
2	98.3627	0.6478	0.0001	0.9893
3	96.8149	0.6029	1.9231	0.6591
4	93.6085	0.4743	5.2825	0.6347
5	90.1489	0.4383	8.6594	0.7533
6	86.9550	0.6754	11.5271	0.8425
7	84.1544	1.2494	13.7066	0.8896
8	81.7380	2.1400	15.2234	0.8986
9	79.6492	3.2708	16.1955	0.8845
10	77.8374	4.5461	16.7570	0.8595

4. Analysis of the extent of the impact

1) Through co-integration test, it is shown that there is no co-integration relationship between BDI and delivery capacity, that is, there is no long-term equilibrium relationship, and BDI has a long-term equilibrium relationship with dismantling capacity, used ship trading transactions, hand-held capacity and new shipbuilding orders.

2) Through the causality test, the used ship trading under the long-term relationship is the reason for BDI fluctuations, and BDI has a one-way causal relationship between dismantling capacity and new shipbuilding orders. The rationality of this conclusion is explained as: from the perspective of capacity supply, the end-end capacity contraction will be accompanied by the rise of freight rate index, which will stimulate shipowners to expand the demand for fleet capacity, and with a large number of new shipbuilding orders and used ship trading transactions. When the volume of used ship trading continues to increase, shipping market capacity is constantly put into place, capacity to reach a certain peak, will be accompanied by a sharp decline in the freight rate index, and finally, the freight rate index to maintain a low absorption of excess capacity stage, when the dismantling capacity will pick up, and then enter the next cycle.

3) The correlation test shows that There is a positive relationship between BDI and used ship trading and new shipbuilding order indicators, a negative correlation with dismantling capacity, and the highest correlation index between BDI and dismantling capacity index, and stronger correlation between the two.

4) Pulse response analysis obtains BDI itself and used ship trading transactions on BDI impact response are positive, BDI for dismantling capacity and new shipbuilding are negative to positive trend, indicating that BDI and capacity indicators have a certain degree of segmentation, BDI on the dismantling capacity has a more significant impact, BDI in the short-term impact of new shipbuilding orders is more obvious, and in the 5th phase of the greatest impact.

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5) Variance decomposition shows that the variance change of BDI is mainly caused by its own impact, the contribution rate is about 85%, that is, it has a better ability to explain, the capacity index of used ship trading transactions on BDI impact degree from the 1st period of 0 to 10, the contribution rate of 16.8%, indicating that the used ship trading transactions on BDI fluctuations have a certain explanatory ability, dismantling and new shipbuilding interpretation capacity is weak, indicating that other factors in the shipping market can not be ignored, the degree of impact.

5. Conclusion

This paper selects the monthly data from January 2014 to May 2020 as the sample collection interval, studies the correlation between the BDI of dry bulk freight price and the supply end of the shipping market capacity, confirms the relationship ale between BDI and the capacity index, and further quantitatively analyzes the one-way causal relationship between BDI new shipbuilding orders and dismantling capacity, the used ship trading transaction has the strongest ability to explain the fluctuations of BDI, that is, the second-hand market is more active than the current shipping market. As the used ship trading market warms, the BDI freight index picks up, potentially triggering new shipbuilding orders and slowing ship dismantling. Shipping enterprises can closely pay close attention to the changes in the used ship trading market to predict the future trend of BDI, or they can make use of the peak and trough of freight rates to carry out ship trading and trading carefully, dynamically adjust the scale of capacity, to achieve the best cost and maximum operating profit.

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