Study on the Construction of Dynamic Monitoring System of Inland Shipping Market Operation in the Yangtze River

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Abstract. Under the full implementation of the Yangtze River Economic Zone development strategy during 2016-2020, inland shipping meets great opportunities to develop while the shipping market downturn makes the contradiction between supply and demand intensified and business condition declined. Without a dynamic monitoring and evaluation system for shipping market, a large quantity statistics data lacks in-depth analysis and guidance on market information becomes insufficient. Therefore, the study intends to construct a supply-demand index system and finds a basic evaluation method reflecting supply-demand conditions based on the existing inland shipping market operation index in the Yangtze River. The study is expected to enhance the information supervision management for inland shipping market in the Yangtze River, improve industrial information service and decision-making by the government, and then effectively control the fleet capacity, make supply-demand balance, improve the efficiency of infrastructure operation, increase profits for shipping enterprises and promote a healthy and stable shipping market.

Introduction

Crossing over the eastern, the middle and the western regions, covering Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Yunnan and Guizhou in total of 11 provinces, the Yangtze River Economic Belt has a population of 600 million and spreads over 2.05 million square kilometres, accounted for 45% of GDP in China, with its own advantages and great potential to develop.

The Yangtze River is the significant area of electric power, steel, petrochemical, building materials and manufacturing in China, with large shipping demand. This shipping line plays a leading role in local economic development along the river. As one of top three national strategies during 2016-2020, the Yangtze River Economic Belt Development has given the river a highly important position. It is no doubt that the Yangtze River shipping has a bright prospect in the future [1].

1. The Main Constitution of the Yangtze River Shipping Market

Shipping demand is described as the society has the request of cargo transport of raw materials and production in order to make normal production, distribution, exchange and consumption. Transportation is the bond of each link between production and consumption. Shipping demand is generally indicated by parameters such as freight volume and rotation volume of cargo transport. Different cargo with different characteristics makes different mode of transport. For example, coal, ore and grain belong to dry bulk cargo while oil, liquefied gas and chemicals belong to liquid bulk.

Fleet supply reflects the ability given by the shipping market to carry goods and passengers by vessels under a certain transport circumstances during a certain period. The industry generally uses the total deadweight tonnage of vessels to reflect the total fleet supply. Fleet structure includes the vessel type, tonnage, age and technical conditions etc.

Freight is an important index to reflect the supply-demand balance for the shipping market. It is also a key parameter indicating whether the market is booming or not. With the fleet
supply-demand changes, the freight rate will correspondingly go up and down. As a sensitive factor of fleet supply-demand balance, freight is able to completely show the role of market mechanism to fleet development.

2. The Target of Dynamic Monitoring System Construction

There are three targets of dynamic monitoring the shipping market in the Yangtze River. One is observing the impact of regional economic development on the demand for shipping. The second is monitoring the changes of fleet numbers and structure. The third is promptly tracking the freight trend of shipping market and then evaluating the supply-demand balance and finding the existing problems. The system structure is established as follow:

Dynamic monitoring shall be conducted from long-term, medium-term and short-term as much as possible. The cycle is to be divided into long-term (5 years), medium (1 year) and short-term (quarterly or monthly), not only reflecting the change rule of shipping market in a quite long period and the effect of economic policy implementation after a certain period, but also making us prompt track the industry operation in order to make reasonable market guidance and policy adjustment, as far as possible reduce or prevent a wide-range market fluctuation and risk and loss from national economy and enterprise management.

3. The Construction of Dynamic Monitoring Index System

3.1 Demand index system

Index system reflecting the total demand mainly includes freight volume; freight turnover; passenger volume; port cargo throughput; passenger throughput. By monitoring the total index, we will know the influence of economic development on inland cargo and passenger transportation.  

Index system reflecting the cargo structure includes freight volume, turnover and main port throughput of different cargo type. Ministry of Transport (MOT) classifies the cargo into 17 types i.e. coal and its products; oil, natural gas and its products; metal ore; steel; mineral building materials; cement; wood; non-metallic ore; chemical fertilizers and pesticides; salt; grain, chemical
materials and its products; non-ferrous metals; light industry medicine products; electrical products, agricultural, forestry, animal husbandry and fishery products; others. By monitoring cargo structure index, we will know the influence of Yangtze River Economic Belt economy structure changes on inland shipping structure.

**Index system reflecting regional distribution of cargo** includes inland passenger and freight volume and turnover along the Yangtze provinces; the main line of Yangtze River cargo carrying capacity; each segment in the main line of Yangtze River cargo throughput; the ship lockage freight volume of the Three Gorges Lock; inland port cargo throughput along the Yangtze provinces; cargo throughput according to different types in the upper, middle and lower reaches of the Yangtze River. By monitoring the above index, we will know the influence of regional development in the Yangtze River Economic Belt on inland shipping distribution structure.

### 3.2 Fleet supply index system

**Index reflecting the total fleet supply** includes total number, net deadweight tonnage, passenger space, standard container space and gross power of inland vessels. By monitoring the fleet supply index, we will know the inland fleet supply changes with the development of shipping demand.

**Index reflecting fleet structure** mainly includes:
- Indicators in terms of ship type which includes power-driven vessels (dry bulk carriers, oil tankers, chemical tankers, containerships, ro-ro ships, passenger ships, push tugs), barges a total are monitored. By monitoring ship type index, we will know the influence of structure changes of inland shipping demand on inland fleet supply structure.
- Indicators classified by vessel tonnage. According to the characteristics of inland fleet, the structure of inland vessel tonnage in the Yangtze River is divided into 7 parts: under 100t, 100-300t, 300-500t, 500-1000t, 1000-3000t, 3000-5000t and more than 5000t. By monitoring the structure of vessel tonnage, we will know the large-scale trend and tonnage structure improvement for inland vessels in the Yangtze River.
- Indicators classified by vessel age. Vessel age structure is divided into 4 parts: 0-7 years, 8-14 years, 15-21 years and more than 21 years. By monitoring vessel age structure, we will know the overall technical condition and update of vessels.

### 4. The Evaluation Method of Dynamic Monitoring the Supply-Demand Balance

#### 4.1 Role of supply-demand balance in shipping market

Shipping demand is driven by passenger and cargo flow required by national economy. The economic development level, allocation of productive forces and resource distribution are important factors affecting shipping demand changes. Fleet supply means under a certain level of freight, the market is willing and capable to provide a total deadweight of ships. Factors affecting the shipping demand will have an influence on shipping supply as well. Apart from that, shipping and fleet supply is directly affected by shipowners’ decisions. Generally speaking, shipowners would like to launch more vessels on shipping market if there are potential interests to themselves which is called “shipowners interests” and the freight rate is the main factor directly affecting the owners’ decisions.

Shipping demand and fleet supply are two aspects indicating the conflict between supply and demand in shipping market. Fleet supply ability is generally changing along with the shipping demand changes to keep a balance. To pursue the balance between the two aspects is the best situation of resource allocation of efficiency in shipping market. However in the open market, fleet supply and shipping demand are normally in a non-equilibrium situation where balance is relatively expected and pursued. Tracking and evaluation method studies on supply-demand balance in shipping market will strengthen the role of market information and policy guidance, optimizing resource allocation, preventing from large-wide market fluctuation made by imbalance between supply and demand and other operational risk, promoting the healthy development of inland shipping market.
4.2 The evaluation method of supply-demand balance in shipping market

4.2.1 Freight rate and its index

Acting as the most sensitive factor in market-oriented economy, freight rate is also an important parameter indicating whether the shipping market is booming since the rate will increase or drop with supply and demand changes. Freight rate is treated as one of factors to measure the balance between supply and demand fully reflecting the market mechanism on shipping supply. In general, when it comes to excess fleet supply, the owners have to reduce the freight rate to look for cargo, triggering a price war; or even put the excess supply out of the shipping market. Therefore, freight or freight index could reflect the supply-demand balance situation in shipping market to some extent.

Freight/Rate (Rpf) is the ratio of freight to required freight rate (required freight rate is the necessary freight revenue for shipping companies to reach a predetermined internal rate of return on unit volume transportation). Rpf directly reflects the profit level for shipping companies. If Rpf > 1, shipping companies will make profits, whereas Rpf < 1, losses incurred. On the other hand, Rpf also reflects the supply situation from different angles. When fleet supply is insufficient, the freight will be higher than normal profit level for enterprises, and freight/rate index rises. When it comes to excess supply, companies earn less or even deficit, and freight/rate index decreases at that time.

The change of freight rate index is considered as the market barometer. The existing rate index reflecting inland shipping supply-demand balance in the Yangtze River is as follows: the Yangtze River shipping dry bulk freight index; the Yangtze River containership comprehensive freight index (divided into the upper area index, the middle area index and the lower reaches area index). In addition, other related index reflecting the Yangtze River inland shipping market and enterprise operation is as follows: the Yangtze River shipping prosperity index (divided into the upper shipping, the middle shipping prosperity index and the lower shipping prosperity index); the Yangtze River shipping confidence index and the shipping and port enterprise prosperity index.

4.2.2 The ratio of shipping supply and demand

The ratio of shipping supply and demand is the ratio of shipping demand and capability in a certain period of time, the mathematic express is as follows:

\[ R_i = \frac{D \times i_i}{k_i \times s_i} \]  

(1)

Ri is the ratio of shipping demand and capability for i tonnage vessel in a certain time;  
D is the annual shipping demand;  
K is the seasonal unbalance coefficient;  
S is the volume of freight for vessel operating a whole year (s=D deadweight Quotas \times\epsilon \times\text{Operating Rate} \times\epsilon \times\text{Navigation Rate} \times\epsilon \times\text{Average Speed} \times 365).

The Ratio of shipping supply and demand is regarded as a basic index reflecting demand-supply balance situation in shipping market. When Ri = 1, the annual turnover made by ships (fleet) and shipping demand remain the same, the supply and demand are basically consistent; when Ri > 1, ships are abnormally operated causing fleet supply shortage. The shipowners could buy or charter vessels and speed up the construction of newbuildings. When Ri < 1, the fleet supply exceeds demand. If no macro-control carried out, the shipping enterprises may reduce the freight rate in order to get more cargo thus causing a shipping market downturn. The government at that time should strictly restrict new fleet supply entering to the market.

The ratio of shipping supply and demand treated as a method to evaluate the supply-demand situation is more suitable for a particular route and in a specific region. The data of shipping company operations and efficiency is required for this method [2].

4.2.3 The ratio of supply and demand rate

The ratio of supply and demand rate is a method on the basis of confirming the balance year to evaluate the supply-demand balance situation according to the ratio of fleet supply and shipping demand increase rate. Confirming the base year i.e. supply-demand balance year is of great importance.
For example, the supply and demand is basically consistent in China inland shipping around 2000. Therefore assuming the ratio of inland fleet supply and volume of goods for 11 provinces in the Yangtze River in 2000 as the benchmark to measure, the relationship of supply and demand of Yangtze shipping market from 2000 to 2015 is as follows: during the 10th Five-Year Plan, the average annual growth of inland volume of cargo for 11 provinces in the Yangtze River is 7.8%, whereas the average annual growth of fleet supply during the same period is 17% more than ten percentage points than shipping demand growth rate, the supply-demand relationship turned into 33% excess capacity from the early stages of the 10th Five-Year Plan Period. During the 11th Five-Year Plan Period, the average annual growth of inland volume of cargo for 11 provinces in the Yangtze River is 11.8%, whereas the average annual growth of fleet supply during the same period is 9.7% lower than the demand growth rate, the excess capacity situation is improved from 33% to 26% to some extent. During the 12th Five-Year Plan Period, the average annual growth of inland volume of cargo is actually 7.5%, whereas the average annual growth of fleet supply during the same period is 11% contributing to a further expanding of excess capacity from 26% to 38%. If in the 12th Five-Year Plan Period point of view, regarding 2010 as the base year, the excess capacity situation is still intensified expanding 15% on the basis of 2010 [3].

5. Summary

The Yangtze River Economic Belt Development Strategy will be fully employed in China in the 13th five-year period and inland shipping in the Yangtze River will meet a new round development opportunity. Shipping market becomes more open and active. Strengthening the information monitoring and evaluation of the shipping elements and market guidance will benefit the healthy development of shipping market. According to the existing statistics, the article builds a dynamic monitoring index system of shipping demand including demand, cargo structure and distribution structure etc. and a dynamic monitoring index system of fleet supply including total fleet supply, ship type tonnage and age structure etc. In addition, three methods of evaluation of supply-demand balance for shipping market are put forward including freight rate and index evaluation method, the ratio of shipping supply and demand evaluation method and the ratio of supply and demand rate evaluation method.

References

