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Exploring the source of container cargo and passenger flow : a case of Shanghai port

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EXPLORING THE SOURCE OF CONTAINER CARGO AND PASSENGER FLOW

A Case of Shanghai Port

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views and are not necessarily endorsed by the University.

(Signature):…………………………

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ABSTRACT

Title of research paper: **EXPLORING THE SOURCE OF CONTAINER CARGO AND PASSENGER FLOW——A CASE OF SHANGHAI PORT**

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Nowadays, the competition between ports is becoming more and more fierce. The status of the port has been put into a dynamic and changing process. What brings this uncertainty is often no longer the hardware level of the port, but the control of the hinterland for container ports, as well as the control of passenger source for cruise ship home port.

Therefore, it is necessary to propose systematic frameworks to explore the source of container cargo and passenger flow. In this paper, two procedures have been established to build up the relationship between small sampling and distribution, with the help of the method of minimum absolute deviations estimation method.

Shanghai has been leaped forward in the past few decades, both in the container throughput and cruise port. It is quite appropriate to take Shanghai as an example to verify the model put forward in the dissertation. After the verification by the annual static data of Shanghai Port, the model of this paper is preliminarily proven to be feasible. Because of its simplicity and directness, the frameworks have potential to be combined with big data technology and have wider applications in the future.

KEYWORDS: Port, Source of Container Cargo Flow, Source of Cruise Passenger Flow, Shanghai Port, Sampling, Minimum Absolute Method

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LIST OF ABBREVIATIONS

TEU	Twenty-feet Equivalent Unit
LSD	Least Squares Deviations Method
MAD	Minimum Absolute Deviations Method
MADE	Minimum Absolute Deviations Estimation
S.F	Stowage Factor

1 Introduction

1.1 Research Background

The increasingly multivariate global trade and sustainable Government concern impose substantial competitive pressure on modern ports, especially those serve as the hub port in the region. The experience of practitioners reveals that the volume of cargo passing through the port become an influencing factor in the sustainable development of a port. As a result, the competition for the cargo flow source is getting more and more attention from the port perspective and has been discussed by many scholars. For example, Notteboom et al. (2005) analyses the evolution of the port cities and point out that the port is stepping into a new phase called regionalization, which strengthens the emphasis of the source of cargo flow, hinterland. His study brings about new visual angle to port governance and put forward a functional focus that goes beyond the traditional port perimeter. Rodrigue et al. (2012) believes that linkage between ports and cargo flow source, an industry that was originally more differentiated from port production, turns into of more and more significance. Beresford et al. (2018) argues that the boom and bust cycle of the port is no longer a slow process as before, but a dynamic and fast-changing process, of which the main reason is cargo flow source.

Similarly, the rise of cruise tourism also absorbs the operational status of a port's cruise part into the whole evaluation system, besides the cargo part. It is based on this trend that the study on the source of container cargo and cruise passenger flows shares more and more significance. This dissertation will develop models to further exploration of the source of container cargo and cruise passenger flow.

In order to take an implement and verify the model, this paper takes Shanghai as an example. Since 2010, Shanghai Port has kept taking the leading position in the container throughput rank. Given the port-hinterland relationship is of great significance in container transportation; in this dissertation, further exploration of the source of container cargo flow via the port of Shanghai will be made.

At the end of 2017, soon after the Shanghai Yangshan Port Phase 4 automation terminal being put into operation, the throughput of the Shanghai Port exceeded 40 million TEUs. The container throughput of Shanghai has been ranked first in the world for many years, judging from container transportation. Therefore, Shanghai is a proper case for verification of the model, the port with the largest container throughput in the world.

In addition, as lots of famous cruise companies, such as Royal Caribbean start their business in “Bei Waitan” and “Wusongkou” cruise terminals, Shanghai Port makes continuous efforts to build up a cruise home port. Similarly, the source of passenger flow to a cruise terminal is just like cargo flow source for ports. Though the cruise industry absorbs increasing popularity, for the time being, adequate attention should also be paid to the source of tourists. Therefore, this research paper will take Shanghai port as a case to verify the frameworks for exploring the source of container cargo and passenger flow.

1.2 Research Objectives

a) To develop frameworks for exploring the sources of container cargo and passenger flow, with the assistance of Minimum Absolute Deviations Estimation (MADE) method, which can easily meet with the demand of dynamical exploration for the source of cargo flow by sampling technology.

b) To verify the feasibility of the model by applying the frameworks to the real case of Shanghai Port, and comparing the results with the data in value published by China General Administration of Customs.

1.3 Dissertation Structure

The rest chapters of this dissertation will be organized as follow, and the structure has been summed up by a framework shown in Figure 1.

Chapter 2 makes a literature review on the development characteristics of cargo hinterland as well as the cruise industry. At the same time, this part also summarizes the current methods of exploring the source of container cargo and passenger flow. Based on the literature review, the comment of the author has been made.

Chapter 3 constructs the framework for exploring of the source of container cargo and cruise passenger. After introducing the method of MADE, two specific models based on the dynamic sample survey has been developed for further exploration.

Chapter 4 based on the partial public annual data of Shanghai Port in 2017, have made case studies from the perspective of the source of container cargo and cruise passenger flow respectively. After analysis, the conclusions published in the relevant literature are used to verify the model.

Chapter 5 summarizes the whole paper and points out the shortcomings of the exploration framework in the future. At the same time, it also provides advice for further work.

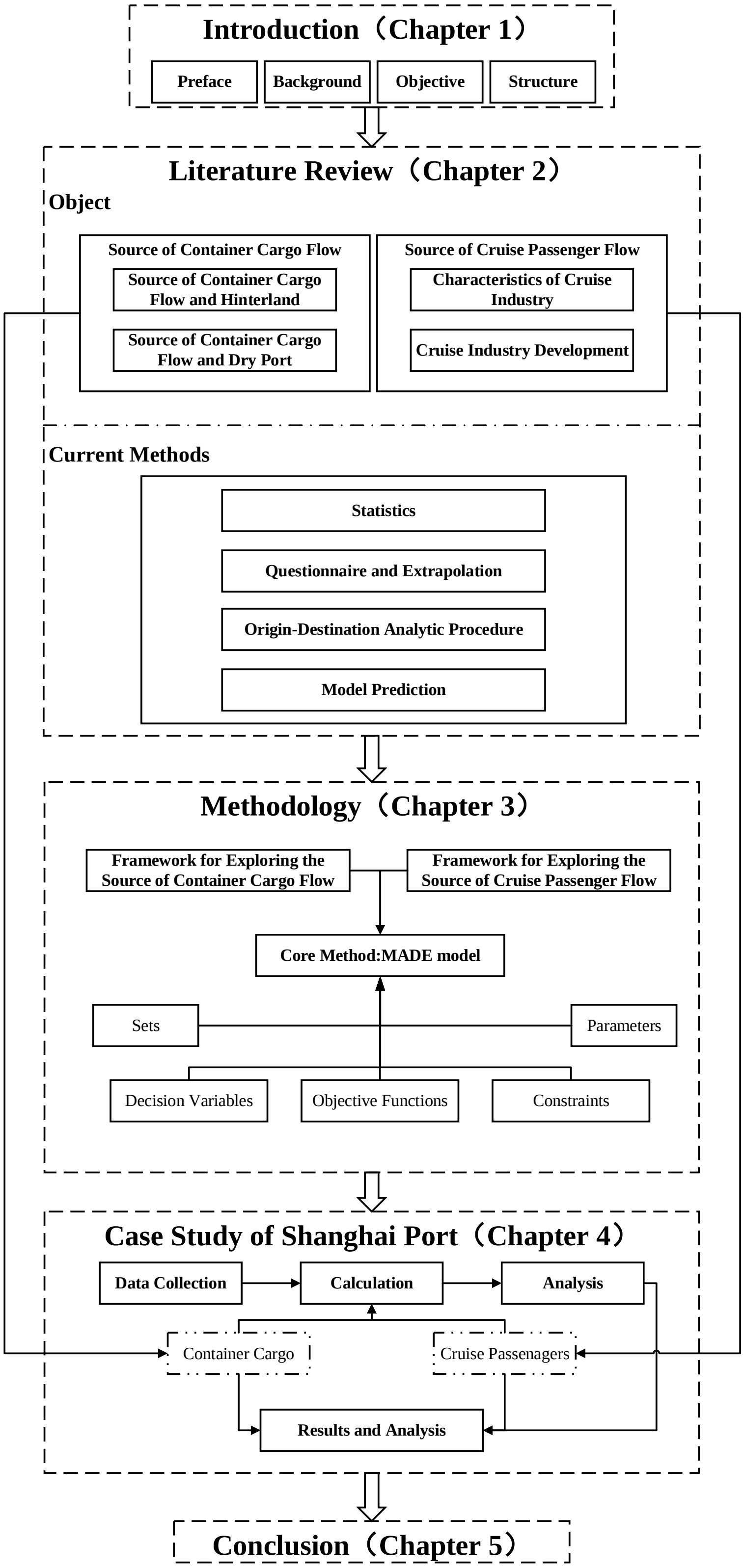

Figure 1 Dissertation Structure

2 Literature Review

Chapter 2 will be made up of three parts: Study on Source of Container Cargo and Cruise Passenger Flow, Methodology for Exploring these sources, and some comments.

2.1 Study on Source of Container Cargo and Cruise Passenger Flow

2.1.1 Source of Container Cargo Flow: Hinterland and Dry Ports

Source of container cargo flow is undoubted of great significance to a port, and its manifestations are varied. During the period of rapid development of container ports, the source of container cargo flow can be grouped into two sources——hinterland and dry port.

a) Hinterland

Shipping, land and rail transport have rarely been considered separately in recent years. Transport services have tended to become more efficient and customized transport network models such as Port-Hinterland have been increasingly studied by other scholars. The biggest advantage of marine transportation lies in its large scale and low cost. Therefore, as an important part of international transport, maritime transport is paying more and more attention to the efficiency and punctuality. In contrast, from the other side of the Port-Hinterland network system, how to better link inland cargo flows to the appropriate port to complete the overall quality of international transport is another important issue for inland transport (Halim, R. A. et al., 2016).

As for the transportation networks, many scholars insist that the great difference in cost among modal of transportations is the primary cause of the development of the hinterland. Rodrigue and Notteboom (2012) point out that the most significant cost in the Port-Hinterland network system is the cost of inland transport and transshipment, which accounts for about 80% of the total cost, due to the low cost of shipping. In other words, the hinterland side of the Port-hinterland network, plays a more important role in the modern transportation system because of its higher cost. In the study of international logistics supply chain, Halim et al. (2016) believe that it is necessary to study and optimize the transit and inland segments of goods in Port-hinterland network. Based on this important positioning, the new research point has emerged, the connectivity of the port to each inland node, as well as the selection of the sea ports for inland nodes.

The difference in transport organization between sea and land also determines the importance of the hinterland. Noteboom (2007) deems that for maritime transport, services are relatively homogeneous, and the main factors are port conditions and route choices. For inland transport, there may be a number of factors that may have an impact, such as the traffic situation and infrastructure along the transport. In this era of increasing inland transport demand, truck transport has the advantage of convenience, but road congestion also poses a great challenge to this model.

Of course, the logistics transportation market is also constantly developing, and all logistics service providers are actively competing and cooperating with each other to better cope with the needs of the market and customers, so that enterprises can make a sustained profit. Halim, R. A. et al. (2016) takes stock in that choosing the right transportation route, the appropriate intermediate transportation mode, and the distance and proximity of the harbour will be the important factors for them to make the strategic decision. In order to cope with various and complex changes, the strategy should keep pace with the times. As the market continues to improve, eventually the market will naturally form a set of transport mode in line with the times. Nowadays, most of the transport service providers have the ability to provide multimodal transports. Unlike ten years ago, when the shipping companies are unable to take account of the inland transport segment, the efficiency of door-to-door transportation has been greatly improved (Paixao and Marlow, 2002). Gouvernal et al. (2010) pinpoint that in such a situation, ocean transportation has developed more mature, but the near ocean multimodal transport is still less concerned about the number of people. Similarly, Merk and Notteboom (2015) conclude that the situation is mainly due to the fact that short sea shipping has long been considered an isolated sector that is difficult to integrate into the supply chain, because of the friction costs, ex. Incurred in double handling and in the storage of goods due to the inefficiency of flows.

In the process of the development of port-hinterland network, more and more sea port operators begin to pay attention to the distribution of the source of cargos, in order to achieve a better purpose of collecting goods. Notteboom and Rodrigue (2005) also mention that the advantage of doing so is that it is closer to the source of the goods and can further develop its competitiveness, thus solidifying its dominant position and standing out among the many ports in the region. Therefore, the theory of hinterland corridor has been put forward. With the continuous improvement of big data and artificial intelligence, a better understanding of the cargo flow source is one of the most important ways to develop.. The complexity of inland transportation and whether the port-hinterland network is feasible should also be taken into account, when we inspect the source of goods, because there is a possible situation, the lack of infrastructure and other problems that cannot be efficiently realized. Therefore, judging cargo flow source is also a very effective way for sea port to discover problems in distribution network (Merk and Notteboom, 2015).

b) Dry Port

The need for more multimodal transport is reflected in the further modern transport system; as a result, many researchers, such as Hanaoka and Regmi (2011) and Roso (2013) come into an idea that dry ports working as important “bridges” or “links” between sea nodes and land nodes has been developing. From the view of environmental protection, Roso and Lumsden (2010) point out that dry ports can also accomplish the task better, under the premise of ensuring higher efficiency of transportation and transhipment. At the same time, dry ports can greatly reduce the number of transport sections because it is closer to the source. For example, a mature container railway can transport the containers from all stations along the railway through the voyage, which is much more efficient than truck transportation. From a transportation cost point of view, the effect of establishing dry ports is very good under certain circumstances. Henttu and Hilmola (2011) believe that if dry port, as a new model been spread for less than a decade, wants to succeed, it needs to grab more freight from the traditional mode of transportation.

Roso et al. (2009) roughly categorizes dry ports into three types according to the function and relative distance with regard to seaports: distant, midrange and close dry ports. In some reviews of dry ports, Roso and Lumsden (2010) deem the least recognized advantages of dry ports are very distant from the seaport is an increased seaport capacity and reduced congestion at the seaport, in the Inside-Out model. The dry ports are at strong position. On the other hand, Roso (2013) is convinced of the fact that close dry ports are often started by the seaports, through the Outside-In model, such as Sydney’s Port Botany terminals. This type shows high benefits for the seaports, who are at strong position. This indicates a tightly intentional relationship of the strategy of the party who seeks for benefits from the cooperation. Unfortunately, the development of dry ports ultimately depends on one of the most important reasons, to facilitate the sea port or inland node, either to enhance the port's cargo collection capacity or to enhance the efficiency of the inland node, regardless of which model (Bask, A. et al., 2014). Three different types of dry ports, according to their characteristics, can also reflect their benefits from Table 1 (Roso, 2013).

Table 1 Potential benefits of the transport system resulting from different types of dry ports

	Distant	Midrange	Close
Seaports	+Less congestion +Expanded hinterland +Interface with hinterland	+Less congestion +Dedicated trains +Depot +Interface with hinterland	+Less congestion +Increased capacity +Depot +Direct loading ship-train
Seaport cities	+Less road congestion +Land use opportunities	+Less road congestion +Land use opportunities	+Less road congestion +Land use opportunities
Shipping lines and forwarders	+Improved service	+Improved service	+Improved service
Rail and intermodal operators	+Economies of scale +Gain market share	+Day trains +Gain market share	+Day trains +Gain market share
Road operators	+Less time in congested roads and terminals	+Less time in congested roads and terminals	+Less time in congested roads and terminals +Avoiding environmental zones
Shippers	+Improved seaport access +"Environment marketing"	+Improved seaport access	+Improved seaport access
Society	+Modal shift +Less infrastructure +Lower environmental impact +Job opportunities	+Modal shift +Less infrastructure +Lower environmental impact +Job opportunities	+Lower environmental impact +Job opportunities

Source：Roso and Rosa, 2013

2.1.2 Source of Passenger Flow and Cruise Industry

The constant attention to the source of passenger flow is inseparable from the vigorous development of cruise industry. To some extent, characteristics of cruise industry determine the dependence of cruise ports on the source of passenger flow. The rapid development of the cruise industry and its huge profitability make cruise ports place more and more attention to the source of passenger flow.

a) Characteristics of Cruise Industry

Unlike Cargo transportation, cruise ships provide hotel, transportation, catering, and a range of entertainment services at sea based on passenger ships (Teye and Leclerc, 1998). The combination of onshore travel and on-board vacation has become a new popular form of tourism. Due to the continuous improvement of marine cruise services, cruise ships have made certain development in the dimension of time and space. The modern cruise service industry has been refined into a comprehensive service system from short distance to long distance, from short to long-term, in order to absorb more customers. As a result of different local laws, some unlanded cruise projects also gradually emerged because of the permit of gambling (Ahmed et al., 2002). From another point of view, cruise tourism is a new combination of hotel and tourism (Hoseason, 2000).

The cruise tourism industry has flourished in recent decades, thanks largely to the continuous improvement of ship technology, although it can be traced back to 1840. In the future, with the gradual weakening of the geographical concept, the modern cruise industry will surely become more and more developed (Hoseason, 2000).

b) Development of Cruise Industry

In the course of the continuous development of modern tourism, the cruise industry has been thriving for many years (Lee and Ramdeen, 2013). It is at an important stage of development rather than a promising one, which has not yet reached the highest point (Sun et al., 2011; Juan and Chen, 2012). Studies have shown that the average annual passenger volume growth can reach 7% from the 1990 cruise industry up to now. At the beginning of the 21st century, this trend was stimulated mainly by the South American market, the Mediterranean market, which grew by 10% or more (CLIA, 2011, 2012; Hur and Adler, 2011).

Based on the characteristics of the service industry, cruise tourism also presents excellent profitability and shares more and more popularity (Dwyer and Forsyth, 1998; Wanhill, 1982; Dwyer et al., 2004). It is precisely because of this characteristic, many ports originally devoted to container transport have also gradually promoted the construction of the port for a cruise ship (Lekakou et al., 2009). From the government's point of view, in order to improve the status of the port city and promote regional development, they deposit more investment in cruise terminals (Brida et al., 2012a). There is no doubt that most of the ports' cruise ship home port infrastructure has tended to a relatively high level. In this case, the main object of competition moves from service level to passenger flow. To some extent, whether they are 'home' or 'secondary' ports also determine their global status. The reason is very simple, where the port of call in the middle is often only passive in accepting passenger flows. Once the cruise companies choose not to choose them, there will be a loss of passenger volume. In contrast, the mode of o home port serves as the port of origin and the port of destination which is at irreplaceable status. Similar to hub port in container transportation, cruise home port is also highly regional competitive for the source of passenger flow.

For the cruise terminal, the number of passengers directly determines the revenue of the cruise terminal. A simple piece of data will be used to illustrate it, on average, a cruise terminal generates \$100 for every passenger it receives (FCCA, 2012). This is only an average result, and data of some port of call will far outweigh that number.

The literature on passenger flow has only been published in recent years. However, most of the research is on the expenditure of passengers who have boarded the ship, few about the source. Seidl et al. (2006, 2007) take Costa Rica as a starting point to study the relationship among age, education and, consumption behaviour of passengers. Morrison et al. (2003) study the consumer behaviour of cruise passengers and point out that passengers prefer to choose a more discounted all-inclusive package than other choices. Douglas et al. (2004) propose passengers from different countries will have a similar interest in Tourism package choice.

Besides the studies of passenger behaviour, there are many researches based on economic models. Brida et al. (2012b) analyses the port of Cartagena, Colombia, and take advantage of cross-section regression models to estimate the revenue of the cruise. In his paper, he believes that Age, Culture, level of income are highly related to high spending on board. On the other hand, Brida and Risso (2010) come to a conclusion that Those who have a higher tendency for shopping on cruise ships tend to spend more time on shore when calling a middle port.

For example, Costa and Royal Caribbean have launched various tourism projects and gained a large number of loyal customers. The function of transportation means for the cruise has gradually weakened in these company's strategy. Through perfect facilities, the concept of "mobile five-star hotel" has been promoted, which lead to an update of the concept of a cruise ship. Through cruise travel, a large number of carry-on luggage can be placed in the room on the cruise, providing more pleasant conditions for tourists to travel ashore, which is one of the important reasons for the attraction of the cruise project. Pallis (2015) come to an idea that from the cruise companies' point of view, different ports of source also need to be considered based on the actual culture in different regions when arranging cruise lines; for example, Chinese tourists prefer Southeast Asia routes, while European travellers are more inclined to pure sea cruise vacation.

Because of the weakening of its function as a means of transport, another development for cruise ships is that more and more ports of origin and destination of cruise lines are tending to be the same. In other words, Cruise has become an integrated package service. Most of the premium hotel services can be found in the cruise service, so the cruise operation mode is completely different from the traditional shipping industry, but with a lot of hotel elements (Sun et al., 2011). Another important reason why the cruise industry has attracted much attention is that it has the dual characteristics of passenger transport and hotels.

2.2 Methodology for Exploring the Source of Container Cargo and Cruise Passenger Flow

Generally speaking, at present, the following methods are used to explore the distribution of cargo (passenger) flow sources.

2.2.1 Statistics Method

Li et al. (2016) put forward method that to analyse the proportion of the source structure of the local port and the economic hinterland, according to the local logistics economic development research countermeasures as well as the data of port throughput, which is published by the Chinese Statistical Yearbook and other official source issued by the Government.

2.2.2 Questionnaire and Extrapolation Method

Based on the literature of hinterland, Wan (2006) develops the direct economic hinterland region. Then, take advantage of the import and export data of the goods source, the questionnaire is sent to the related trade enterprises and 3PL companies in the hinterland, while the proportion of the questionnaire amounts to different hinterland are decided according to the import and export volume of the cargo flow source. The attraction of the port to the direct economic hinterland can be obtained by questionnaire survey. According to the indirect hinterland data of port statistics, the statistical data of container production in this region over the years are collected, and then the forecast value of container production in the near future can be obtained by using polynomial prediction model.

2.2.3 Origin-Destination Analysis Method

Based on the theory of hinterland accessibility to determine the cargo flow from these domestic hinterlands, he third industrial output value, GDP, and other factors of the hinterland, Wu (2012) bring about a method to estimate the volume of the domestic containers obtained from them. Using the various generation coefficient of foreign trade goods accordingly, which means the number of containers that can be generated per 100 million US dollars, the O-D Table of foreign trade volume and foreign trade container volume of each city is calculated according to certain conversion ratio, also with the help of the import and export trade volume and the type of goods of different countries and regions in hinterland provided by customs. In view of the port transportation network, the container origin hinterland and cargo type were investigated by means of origin-Destination point method.

2.2.4 Mathematical Prediction Method

Zhang et al. (2006) based on the economic and social development planning and development trend in the hinterland, as well as the development trend of the export-oriented economy, predict the containerization rate of foreign trade goods, the packing rate and the volume of containers produced per billion US dollars of foreign trade. On this basis, the volume of regional container production will be predicted. With the assistance of the diversion of various modes of transportation, the forecast number of container volume of various modes of transport is formed, and the quantity of container source of the port is obtained.

The main contents are as follows:

a) Determine the development level of import and export of foreign trade in the past years and the future, and to estimate the parameters by analyzing the industrial structure of hinterland and the development of container transportation. Referring to the relevant data and combining with the actual situation in the hinterland, we can get the rate of containable cargo and the rate of packaged goods in this area.

b) The formula for calculating the volume

container production = the import and export volume of foreign trade * the ratio of containerized goods * the packing rate * the ratio of packing goods * the volume of foreign trade per unit of US $100 million is equal to that of foreign trade of US $100 million. Average container production * (1-empty cargo ratio), get hinterland container production.

c) Determine the proportion of containers in and out of the port in the hinterland, based on container flow analysis combined with historical data.

2.3 Comments

It can be observed that current research has created conceptual models for exploring the source of container cargo and passenger flow. The concept of the fourth-generation port raised the mode of port development to a new height. The development of the port no longer simply depends on the port hardware, but also on the competition for the goods. Also because of the current high-intensity competition, port business is also facing changeable, dynamic challenges. Port-hinterland connection and the establishment of dry ports are all related to the compete for the source of container cargo flow.

As for exploration method, after comprehensive comparison, the current methods mentioned can be roughly classified into two major types. One is to take key accounts visits and questionnaires, and investigate first-hand data in the field, in order to obtain the distribution of the source of the cargos by a summary category. This method is very intuitive, and the theoretical data is more reliable, while the field investigation is very costly. It is also difficult to coordinate the organization at the same time. In addition, in the actual operation, the data accuracy problem caused by various reasons is also worth paying attention to. The second one is to collect relevant statistical data and deduce the distribution of the cargo flow source indirectly with the help of the relevant mathematical models. Although the system is becoming highly integrated and much more powerful than before, the data accuracy is still open to question, especially for the distribution of passenger flow source at the micro level.

Based on the current situation, there is a lack of method that can catch up with the fast-changing market, and explore the source of container cargo and passenger flow. Simple and isolated approach is no longer appropriate, and two frameworks will be proposed in the following Chapters. One is for the source of container cargo flow, and the other is for the cruise passenger flow. Both frameworks will be slightly differed from the existing methods by introducing the idea of small sampling and Minimum Absolute Deviations Method to simplify the whole process, which combines the thought of Statistics, Questionnaire, and Optimization methods.

3 Modeling for Exploring the Source of Container Cargo and Cruise Passenger Flow

With the continuous development of information technology, in many ports Customs, Inspection, etc. have been integrated into efficient information systems, such as YITONG company (See Appendix C) for Shanghai Port. The development of this kind of information technology also conforms to the trend of the popular big data at present and requires for further research on the current flow of goods based on a large number of collected data. Therefore, it is no longer a problem for the government to know the detail information of the import and export of container cargo and the types of goods. Unfortunately, new circumstances occur, that many exporters, for the purpose of protecting trade secrets, use inland transshipment techniques to conceal the real origin of the goods. Data from the “single window” system can only reflect them exported or imported to or from Shanghai without knowing the exact source of further shipments. Based on this situation, Chapter 3 divides into three parts: General Framework, Core Method, and Specific Application in order to illustrate the whole procedure of exploration.

3.1 General Framework

3.1.1 Framework for Exploring the Source of Container Cargo Flow

Basing on the analysis of the individual features of various methods for exploring the Source of Container Cargo, this paper generate the following framework to optimize the exploration process (See Figure 2).

The framework takes full account of the development of port information systems, which can be done quickly by a summary of separate processing of precise data (water-water transhipment container) and Fuzzy data (water-truck transhipment Container).

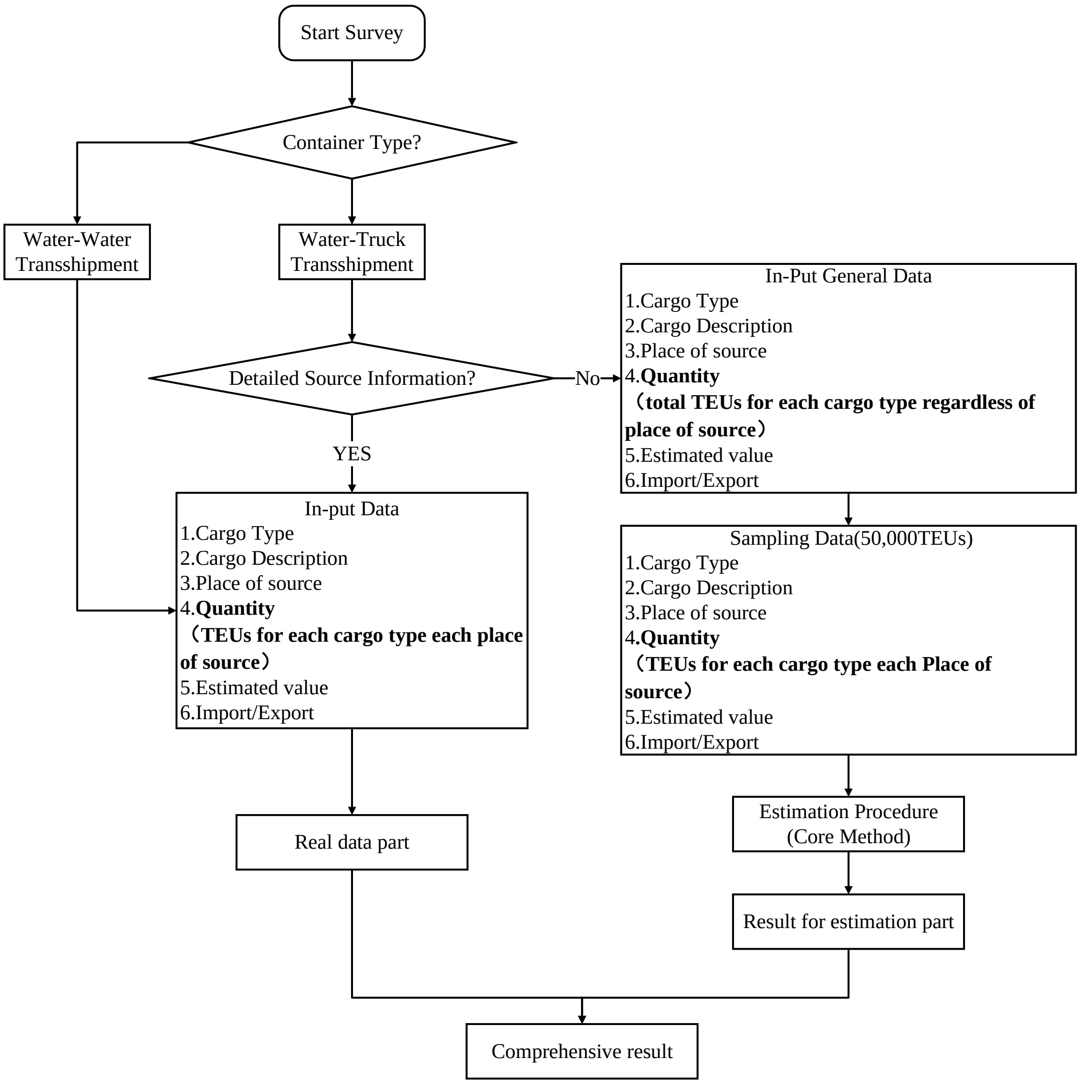

Figure 2 Framework for Exploring the Source of Container Cargo Flow

3.1.2 Framework for Exploring the Source of Cruise Passenger Flow

Basing on the analysis of the individual features of various methods for exploring the source of cruise passenger, this paper generates the following framework to optimize the exploration process.

The framework takes full account of the development of port information systems, which can be done quickly by a summary of separate processing of domestic passengers and Foreign passengers (See Figure 3).

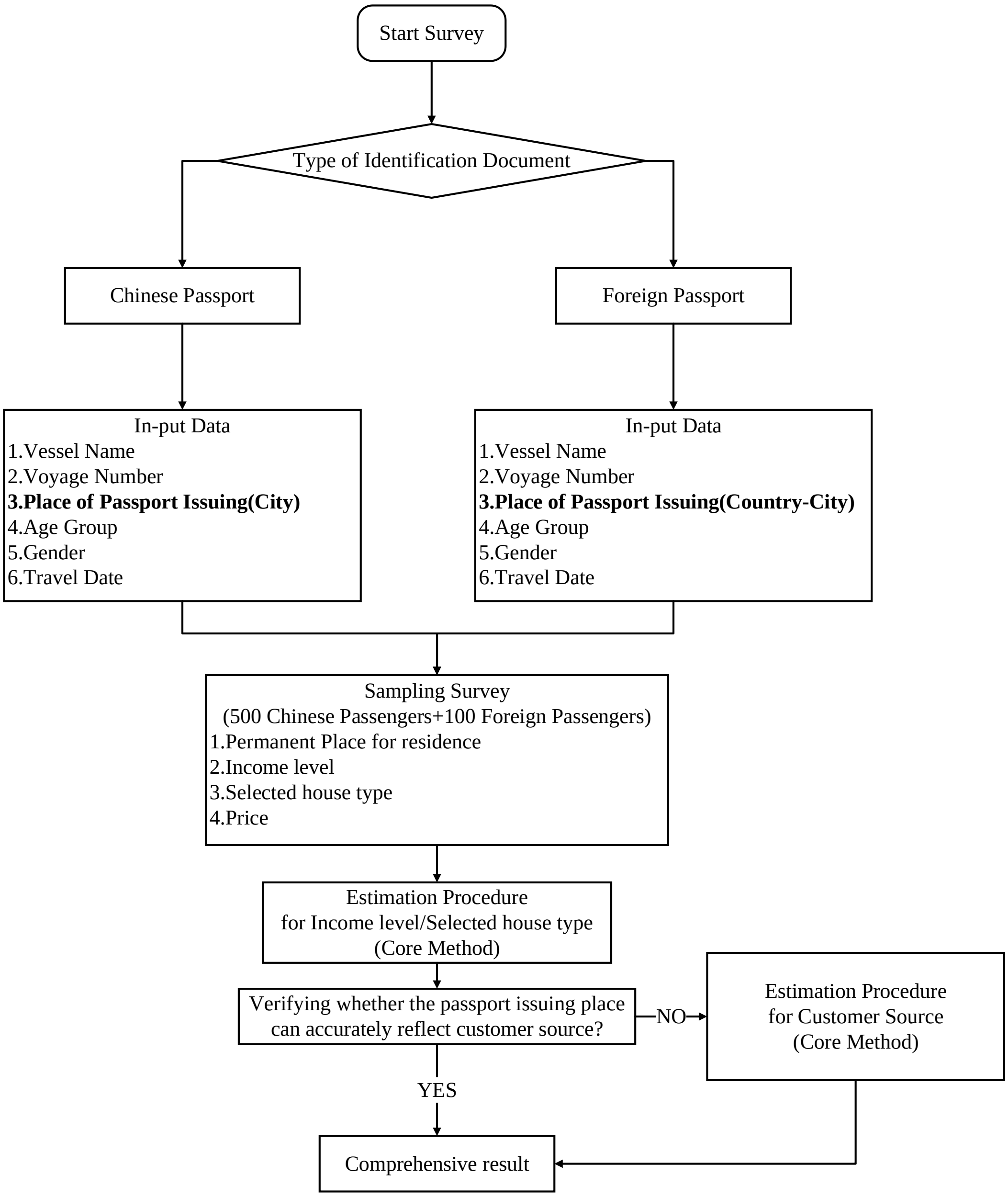

Figure 3 Framework for Exploring the Source of Cruise Passenger Flow

3.2 Core Method

In order to complete the process of the two frameworks above, a reasonable core method, a mathematical sampling method for exploring the source of container cargo and cruise passenger flow is urgently needed to be proposed. As described in Chapter 2, each of the existing independent methods has its own advantages and disadvantages, but none of them is well suited to be used as the core method in the frameworks. In the application of big data technology, two most commonly used methods of sampling estimation are Least squares deviations (LSD) method and Minimum absolute deviations (MAD) Method.

3.2.1 Least squares deviations (LSD) method

The least square method is not a very new mathematical method. But it was a method that had a tremendous impact on the mathematical and physical world, and he gave an optimal fitting method based on historical data that could be calculated for the assumption of unknown curves. It has been widely used in many fields since 18th century:

a) The initial least-squares method was proposed by Roger Cotes for the purpose of deducing the physical formula of the observed data better in 1722.

b) The biggest advantage of the least squares method is that it accepts the partial inaccuracy of the historical observations given, and instead targets the minimum overall error; as a result, the applicability of this method is greatly enhanced. Tobias Mayer and Pierre-Simon have used this method to study the evolution of the moon and the difference between Jupiter and Saturn.

c) The least squares method was further optimized by Laplace. Laplace put forward a mathematical method of using probability density to describe the things and redefined the objective function of the least square method and made further research with the sum of absolute value deviation as a testing tool (Stigler, S. M.[1], 1986).

a) Method statement

“The objective consists of adjusting the parameters of a model function to fit a data set best. A simple data set consists of n points (data pairs) $(x_i, y_i), i = 1,2,\cdots,n$, where x_i is a dependent variable whose value is found by observation. The model function has the form $f(x,\beta)$, where m adjustable parameters are held in the vector β . The goal is to find the parameter values for the model that "best" fits the data. The fit of a model to a data point is measured by its residual, defined as the difference between the actual value of the dependent variable and the value predicted by the model:

$r_i = y_i - f(x_i,\beta)$ (Equation 3-1)

The minimum absolute deviations method finds the optimal parameter values by minimizing the sum, S, of squared residuals:

$S = \sum_{i=1}^{n} r_i^2$ (Equation 3-2)

An example of a model in two dimensions is that of the straight line. Denoting the y-intercept as β_0 and the slope as β_1 the model function is given by $f(x,\beta) = \beta_0 + \beta_1 x$. A data point may consist of more than one independent variable. For example, when fitting a plane to a set of height measurements, the plane is a

[1]The book, The history of statistics: The measurement of uncertainty before 1900, written by Stigler, S. M. was not found, and the concept was mentioned in the article of Wikipedia:https://en.wikipedia.org/wiki/Least_squares

function of two independent variables, x and z, say. In the most general case, there may be one or more independent variables and one or more dependent variables at each data point." (Stigler, S. M.[1], 1981)

3.2.2 Minimum absolute deviations (MAD) Method

In subsequent studies, it was found that simply using the least square method to test hypothetical curves might not be the best approach. So Minimum absolute deviations (MAD) method was put forward based on the least square method as an alternative to the comparison, and some scholars pointed out at the time that in some particular cases the effect of Minimum absolute deviations method might be better than the least square method. The error can be further circumvented by using the MAD method (Schlossmacher E J., 1973).

Minimum absolute deviations remained silent for many years, but no one was interested until Linear Programming put forward this method. First, Linear Programming solved the problem of solving objective function. At the same time, the computational efficiency and scope of application have been greatly improved so that this method has been officially adopted today. Although the efficiency is greatly improved, the Minimum absolute deviations approach still faces several big problems: firstly, when the reference data is too much, the dimension of the data becomes very large and not easy to calculate; secondly, it is not conventional linear programming existing software programming can be programmed to calculate (Schlossmacher E J., 1973).

a) Method statement

"The objective consists of adjusting the parameters of a model function to fit a data set best. A simple data set consists of n points (data pairs) $(x_i, y_i), i = 1,2,\cdots,n$, where x_i

is a dependent variable whose value is found by observation. The model function has the form $f(x,\beta)$, where m adjusTable parameters are held in the vector β. The goal is to find the parameter values for the model that "best" fits the data. The fit of a model to a data point is measured by its residual, defined as the difference between the actual value of the dependent variable and the value predicted by the model:

$r_i = y_i - f(x_i,\beta)$ (Equation 3-3)

The least-squares method finds the optimal parameter values by minimizing the sum, S, of squared residuals:

$S = \sum_{i=1}^{n} |r_i|$ (Equation 3-4)

An example of a model in two dimensions is that of the straight line. Denoting the y-intercept as β_0 and the slope as β_1 the model function is given by $f(x,\beta) = \beta_0 + \beta_1 x$. A data point may consist of more than one independent variable. For example, when fitting a plane to a set of height measurements, the plane is a function of two independent variables, x and z, say. In the most general case, there may be one or more independent variables and one or more dependent variables at each data point." (Soliman, S. A. et al., 1987)

3.2.3 Least squares deviations (LSD) VS Minimum absolute deviations (MAD)

With the continuous development of computer technology, many scholars have found that when the least square method and Minimum absolute deviations method can be solved at the same time, the latter has a significant advantage in the effect of near zero variables. The main reason for this is that the least square method artificially reduces the absolute error of below 1, which is not a problem for the MAD.

Although the least square method has the advantages of simple and easy to calculate and widely used, what cannot be denied is that Minimum absolute deviations also has some advantages. The following are some of the scholars' conclusions about the comparison of the two approaches:

a) The larger the amount of data, the more accurate the results obtained by the Minimum absolute deviations method, if it is calculable.

b) The smaller the amount of data observed, the shorter the computing time of Minimum absolute deviations. It cannot be ignored that the variation of this time is exponential and variable.

c) The stability of minimum absolute deviations is higher when there are a few abnormal data in the sample, compared to the least square method.

d) When abnormal data are rare, and the sample size is very close to the total, the advantages of Minimum absolute deviations are not obvious and may even be less efficient than Least squares deviations (Wilson, H. G., 1978).

To sum up, since the estimated values in the objective functions of the two frames in this paper are between 0 and 1, Minimum absolute deviations is chosen as the core method to do the estimation part of the frameworks in this paper. For convenience, Minimum absolute deviations Estimation will be abbreviated to MADE.

3.3 Specific Application of MADE Method

3.3.1 MADE Method for Exploring the Source of Container Cargo Flow

a) Sets, Parameters, and Decision variable

Sets and Parameters

i refers to the cargo type number $i \in N$, $N = \{1, 2, \cdots, n\}$

j refers to the cargo hinterland number $j \in M$, $M = \{1, 2, \cdots, m\}$

Decision variable

x_{ij} refers to estimated cargo flow I from/to hinterland j (TEU)

Parameters

a_{ij} refers to sample result of cargo flow i from hinterland j (TEU)

b_i refers to the total type I cargo flow in/out of Shanghai

c_j refers to the total cargo flow from hinterland *j*

d_i refers the weight of 1 TEU cargo type *i*

b) Objective Functions and Constraints

Objective Functions

$$MinZ = \sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{a_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{m}a_{ij}} - \frac{x_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{m}x_{ij}}\right| \quad \text{(Equation 3-5)}$$

For Convenience:

Let $A = \sum_{i=1}^{n}\sum_{j=1}^{m}a_{ij}$ (Equation 3-6)

Let $B = \sum_{i=1}^{n} b_i = \sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij}$ (Equation 3-7)

Turn the objective function into this way:

$$MinZ = \sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{a_{ij}}{A} - \frac{x_{ij}}{B}\right| = \frac{1}{B}\sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{B}{A}a_{ij} - x_{ij}\right| \quad \text{(Equation 3-8)}$$

The objective function is to minimize the sum of the absolute deviations between the ratio of the estimated volume and the sampled volume.

Constraints

$$\begin{cases} 1.\sum_{j=1}^{m} x_{ij} = b_i, \forall i \in N \\ 2.\sum_{i=1}^{n} d_i x_{ij} \le c_j, \forall j \in M \quad \text{(Equation 3-9)} \\ 3.x_{ij} \ge 0 \end{cases}$$

Constraint 1 3-9: the sum of the total quantity of goods of type I in each place of the source is equal to that of all goods exported through Shanghai.

Constraint 2 3-9: the sum of the total volume of the goods from the j source cannot exceed the total volume of the export of the source j (as there is no guarantee that all the goods from this source are going from Shanghai, so this condition is chosen as < = "instead of strictly" = ")

Constraint 3 3-9: Non-negative decision variables

3.3.2 MADE Method for Exploring the Source of Cruise Passenger Flow

a) Sets, Parameters, and Decision variable

Sets and Parameters

i refers cruise type number $i \in$， $N = \{1, 2, \cdots, n\}$

j refers to the place for residence number $j \in M$， $M = \{1, 2, \cdots, m\}$

Decision variable

x_{ij} refers to the estimated passengers (person) take brand *i* from the city (region) *j*

Parameters

a_{ij} refers to the sample result of domestic passenger flow *i* from city *j* (person)

b_i refers to the total passenger take the service of brand *i* in Shanghai

c_j refers to the total passenger flow from city(region) *j*

b) Objective Functions and Constraints

Objective Functions

$$MinZ = \sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{a_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{m}a_{ij}} - \frac{x_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{m}x_{ij}}\right| \quad \text{(Equation 3-10)}$$

For Convenience:

Let $A = \sum_{i=1}^{n}\sum_{j=1}^{m}a_{ij}$ (Equation 3-11)

Let $B = \sum_{i=1}^{n}b_i = \sum_{i=1}^{n}\sum_{j=1}^{m}x_{ij}$ (Equation 3-12)

Turn the objective function into this way:

$$MinZ = \sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{a_{ij}}{A} - \frac{x_{ij}}{B}\right| = \frac{1}{B}\sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{B}{A}a_{ij} - x_{ij}\right| \quad \text{(Equation 3-13)}$$

The objective function is to minimize the sum of the absolute deviations between the ratio of the estimated volume and of the sampled volume.

Constraints

$$\begin{cases} 1.\sum_{j=1}^{m} x_{ij} = b_i, \forall i \in N \\ 2.\sum_{i=1}^{n} x_{ij} \le c_j, \forall j \in M \\ 3.x_{ij} \ge 0 \end{cases} \quad \text{(Equation 3-14)}$$

Constraint 1 in 3-14: the sum of the total number of a passenger taking brand i in each place of the source is equal to a whole number of brand *i*.

Constraint 2 in 3-14: the sum of the total volume of the passengers from place j cannot exceed the total volume of the place *j* (as there is no guarantee that all the goods from this source are going from Shanghai, so this condition is chosen as < = "instead of strictly" = ").

Constraint 3 in 3-14: Non-negative decision variables.

4 Case Study: Exploring the Source of Container Cargo and Passenger Flow in Shanghai Port

Chapter 4 will be organized from two aspects: exploring the source of container cargo and passenger flow in shanghai port.

4.1 Exploring the Source of Container Cargo Flow in Shanghai Port

4.1.1 Data Collection

This chapter obtains the import and export of Shanghai Customs in 2017 from the Shanghai Customs website. Due to the wide variety of customs cargo, this paper selects nine typical container cargos as the research object.

Table 2 Import and Export annual quantity of part of commodities disclosed in 2017

Type	tons	10000RMB
Dairy Products Import	896069.03	1914457.93
Pork Import	316441.71	418297.496
Daily Necessities Import	430181.98	3036823.063
Flat Glass Export	75308.589	229124.8361
Mechanical and Electrical Products Export	272754393.5	133051040.3
Electrical and Electronic Products Export	330833227.8	83463023.83
Clothing Export	20002541.56	35101682.33
Furniture Export	789887.307	7166473.341
Toy Export	2616824.737	1530288.105

Source：Annual Data of Shanghai Customs, 2018

For reasons of confidentiality, the customs are unable to disclose the number of containers for each commodity. But on the official website, the customs still posted the net weight and value of these goods. Therefore, this paper introduces the stowage factor of the goods to convert the weight of the cargo into the volume. Based on the standard volume of the TEU, which is 38.3m^3. The approximate container volume TEU can be deduced from the net weight of the cargo.

Table 3 Import and Export annual quantity of part of commodities adjusted by stowage factor

Type	Tons	Stowage Factor	Volume	TEU
Dairy Products Import	896069.03	2.12	1899666.344	49599.64344
Pork Import	316441.71	1.6	506306.736	13219.49702
Daily Necessities Import	430181.98	2.8	1204509.544	31449.33535
Flat Glass Export	75308.589	1.4	105432.0246	2752.794376
Mechanical and Electrical Products Export	272754393.5	1.9	518233347.6	13530896.8
Electrical and Electronic Products	330833227.8	2	661666455.5	17275886.57
Clothing Export	20002541.56	4.5	90011437.02	2350168.069
Furniture Export	789887.307	5	3949436.535	103118.4474
Toy Export	2616824.737	5	13084123.69	341622.0283

Source：Annual Data of Shanghai Customs, 2018

Table 4 Annual Throughput of Related Regions In 2017

Region	1, 000 tons
Shanghai	883240
Beijing	207340
Zhejiang	2155580
Fujian	1203520
Tianjin	505060
Shandong	2853860
Jiangsu	2020700
Anhui	3645670
Liaoning	2070640
Henan	2060870
Hebei	2105860
Jiangxi	1381180

Source：China's National Bureau of Statistics, 2018

As mentioned above, the exploration of container source involves trade secrets, and it is not feasible for individuals to sample. The author of this paper has made contact with YITONG single window, and they have made relevant secret measures for the existing sampled data, and given the modified sampling data of corresponding categories to the author for use in the paper.

Table 5 Sampling Data from YITONG System in cargo flow source exploration (part1/2)[2]

Type	Shanghai	Beijing	Zhejiang	Fujian	Tianjin	Shandon g
Dairy Products Import	27	15	8	6	6	6
Pork Import	5	2	0	0	4	4
Daily Necessities Import	0	0	0	0	0	2
Flat Glass Export	4820	1784	2429	1025	1290	1518
Mechanical and Electrical Products Export	3095	0	4373	2287	1346	2826
Electrical and Electronic Products	368	0	1345	434	0	434
Clothing Export	17	0	62	19	5	16
Furniture Export	59	0	231	31	0	31
Toy Export	18	15	2	1	3	2

Source：An online questionnaire data from YITONG, 2017

Table 6 Sampling Data from YITONG System in cargo flow source exploration (part2/2)[2]

Type	Jiangsu	Anhui	Liaoning	Henan	Hebei	Jiangxi
Dairy Products Import	3	3	0	0	0	0
Pork Import	1	2	1	0	0	0
Daily Necessities Import	0	0	1	0	1	0
Flat Glass Export	6186	0	0	1025	0	0
Mechanical and Electrical Products Export	7535	2758	1009	0	0	404
Electrical and Electronic Products	906	0	0	0	0	0
Clothing Export	22	0	3	0	5	5
Furniture Export	102	23	0	0	0	29
Toy Export	3	0	2	0	0	0

Source：An online questionnaire data from YITONG, 2017

[2] The data come from a cooperation project organized by Yitong Company and Shanghai Maritime University in 2017. After confidential information has been hidden, the data is permitted to be used for this paper.

4.1.2 Analysis

a) Sets, Parameters, and Decision variable

Sets and Parameters

i is the cargo type number $i \in N, \ N=\{1, 2, \cdots, n\}$, in this example let

Table 7 Table for *i* in container cargo flow source exploration

Cargo Type	i
Dairy Products Import	1
Pork Import	2
Daily Necessities Import	3
Flat Glass Export	4
Mechanical and Electrical Products Export	5
Electrical and Electronic Products	6
Clothing Export	7
Furniture Export	8
Toy Export	9

j is the cargo hinterland number $j \in M, \ M=\{1, 2, \cdots, m\}$, in this example let

Table 8 Table for *j* in container cargo flow source exploration

Source	Shanghai	Beijing	Zhejiang	Fujian	Tianjin	Shandong
j	1	2	3	4	5	6
Source	Jiangsu	Anhui	Liaoning	Henan	Hebei	Jiangxi
j	7	8	9	10	11	12

Parameters

According to Set *M* and *N* determined before, then the Parameters can be input as follow:

a_{ij} is the sample result of cargo flow *i* from hinterland *j* (TEU)

Table 9 Table for a_{ij} in container cargo flow source exploration

i	1	2	3	4	5	6	7	8	9	10	11	12
1	27	15	8	6	6	6	3	3	0	0	0	0
2	5	2	0	0	4	4	1	2	1	0	0	0
3	0	0	0	0	0	2	0	0	1	0	1	0
4	4820	1784	2429	1025	1290	1518	6186	0	0	1025	0	0
5	3095	0	4373	2287	1346	2826	7535	2758	1009	0	0	404
6	368	0	1345	434	0	434	906	0	0	0	0	0
7	17	0	62	19	5	16	22	0	3	0	5	5
8	59	0	231	31	0	31	102	23	0	0	0	29
9	18	15	2	1	3	2	3	0	2	0	0	0

b_i is the total type *i* cargo flow in/out of Shanghai

Table 10 Table for b_i in container cargo flow source exploration

Type	i	b_i
Dairy Products Import	1	49599
Pork Import	2	13219
Daily Necessities Import	3	31449
Flat Glass Export	4	2752
Mechanical and Electrical Products Export	5	13530897
Electrical and Electronic Products	6	17275887
Clothing Export	7	2350168
Furniture Export	8	103118
Toy Export	9	341622

c_j is the total cargo flow from hinterland *j*

Table 11 Table for c_j in container cargo flow source exploration

j	1	2	3	4	5	6
c_j	883240	207340	2155580	1203520	505060	2853860
j	7	8	9	10	11	12
c_j	2020700	3645670	2070640	2060870	2105860	1381180

d_i is the weight of 1 TEU cargo type *i*

Table 12 Table for d_i in container cargo flow source exploration

i	Stowage Factor	m/TEU	d_i
1	2.12	38.3	0.018066
2	1.6	38.3	0.023938
3	2.8	38.3	0.013679
4	1.4	38.3	0.027357
5	1.9	38.3	0.020158
6	2	38.3	0.01915
7	4.5	38.3	0.008511
8	5	38.3	0.00766
9	5	38.3	0.00766

Decision variable

x_{ij} is the estimated cargo flow *i* from/to hinterland *j* (TEU)

b) Objective Functions and Constraints

Objective Functions

Let

$$\begin{aligned} A = 27 &+ 15 + 8 + 6 + \cdots + 0 \\ 5 &+ 2 + 0 + 0 + \cdots + 0 \\ &\cdots\cdots\cdots\cdots\cdots\cdots \\ 18 &+ 15 + 2 + 1 + \cdots + 0 = 50000 \end{aligned} \qquad \text{(Equation 4-1)}$$

Let

$$B = 49599 + 13219 + 31449 + \cdots + 341622 = 33698711 \quad \text{(Equation 4-2)}$$

Turn the objective function into this way:

$$MinZ = \frac{1}{B}\sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{B}{A}a_{ij} - x_{ij}\right|$$
$$= \frac{1}{33698711} * \left|\frac{33698711}{50000} * 27 - x_{11}\right| + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 15 - x_{12}\right| + \cdots + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 0 - x_{112}\right|$$
$$+ \frac{1}{33698711} * \left|\frac{33698711}{50000} * 5 - x_{21}\right| + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 2 - x_{22}\right| + \cdots + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 0 - x_{212}\right|$$
$$+ \cdots\cdots\cdots\cdots\cdots\cdots + $$
$$+ \frac{1}{33698711} * \left|\frac{33698711}{50000} * 18 - x_{91}\right| + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 15 - x_{92}\right| + \cdots + \frac{1}{33698711} * \left|\frac{33698711}{50000} * 0 - x_{912}\right|$$

(Equation 4-3)

The objective function is to minimize the sum of the absolute deviations between the ratio of the estimated volume and of the sampled volume.

Constraints

$$\begin{cases} x_{11} + x_{12} + \cdots + x_{112} = 49599 \\ x_{21} + x_{22} + \cdots + x_{212} = 13219 \\ \cdots\cdots\cdots \\ x_{91} + x_{92} + \cdots + x_{912} = 341622 \end{cases} \quad \text{(Equation 4-4)}$$

Constraint 4-4: the sum of the total quantity of goods of type I in each place of the source is equal to that of all goods exported through Shanghai Port.

$$\begin{cases} 0.018066 * (x_{11} + x_{21} + \cdots + x_{91}) \le 883240 \\ 0.023938 * (x_{12} + x_{22} + \cdots + x_{92}) \le 207340 \\ \cdots\cdots\cdots \\ 0.00766 * (x_{112} + x_{212} + \cdots + x_{912}) \le 1381180 \end{cases} \quad \text{(Equation 4-5)}$$

Constraint 4-5: the sum of the total volume of the goods from the j source cannot exceed the total volume of the export of the source j (as there is no guarantee that all the goods from this source are going from Shanghai, so this condition is chosen as < = "instead of strictly" = ")

$x_{11}, x_{12}, \cdots, x_{912} \ge 0$ (Equation 4-6)

Constraint 4-6: Non-negative decision variables

4.1.3 Results

The results obtained by the MATLAB program are as follows：

MinZ=1.827, $\frac{1.827}{9\times12}=0.0169\ll0.05$ .Therefore, this estimate result is acceptable.

Table 13 Table for results x_{ij} in container cargo flow source exploration

	1	2	3	4	5	6
1	18401	9969	5059	4315	4117	3819
2	3133	1282	251	159	2472	2842
3	132208	107953	13323	8199	24597	18106
4	0	0	598	786	1950	13177
5	660	245	333	140	176	209
6	1637239	0	2313783	1204250	703607	1488399
7	1831244	0	6668492	2142210	0	2142210
8	260869	0	949468	289071	70505	244417
9	11962	0	47022	6290	0	6290
	7	8	9	10	11	12
1	2034	1984	0	0	0	0
2	965	1481	489	145	0	0
3	23230	0	14348	0	0	0
4	1887	598	5472	0	5158	1824
5	848	0	0	140	0	0
6	3978084	1461337	527705	0	0	216494
7	4491731	0	0	0	0	0
8	336074	0	44653	0	70505	84606
9	20830	4743	0	0	0	5981

For convenience, a proportional calculation is carried out for each category, a better result on the hinterland of some of the goods in the port of Shanghai.

Table 14 Percentage distribution of partial container cargo flow source in Shanghai Port

Type	Shanghai	Beijing	Zhejiang	Fujian	Tianjin	Shandong
Dairy Products Import	37.10%	20.10%	10.20%	8.70%	8.30%	7.70%
Pork Import	23.70%	9.70%	1.90%	1.20%	18.70%	21.50%
Daily Necessities Import	38.70%	31.60%	3.90%	2.40%	7.20%	5.30%
Flat Glass Export	0.00%	0.00%	1.90%	2.50%	6.20%	41.90%
Mechanical and Electrical Products Export	24.00%	8.90%	12.10%	5.10%	6.40%	7.60%
Electrical and Electronic Products	12.10%	0.00%	17.10%	8.90%	5.20%	11.00%
Clothing Export	10.60%	0.00%	38.60%	12.40%	0.00%	12.40%
Furniture Export	11.10%	0.00%	40.40%	12.30%	3.00%	10.40%
Toy Export	11.60%	0.00%	45.60%	6.10%	0.00%	6.10%
Type	Jiangsu	Anhui	Liaoning	Henan	Hebei	Jiangxi
Dairy Products Import	4.10%	4.00%	0.00%	0.00%	0.00%	0.00%
Pork Import	7.30%	11.20%	3.70%	1.10%	0.00%	0.00%
Daily Necessities Import	6.80%	0.00%	4.20%	0.00%	0.00%	0.00%
Flat Glass Export	6.00%	1.90%	17.40%	0.00%	16.40%	5.80%
Mechanical and Electrical Products Export	30.80%	0.00%	0.00%	5.10%	0.00%	0.00%
Electrical and Electronic Products	29.40%	10.80%	3.90%	0.00%	0.00%	1.60%
Clothing Export	26.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Furniture Export	14.30%	0.00%	1.90%	0.00%	3.00%	3.60%
Toy Export	20.20%	4.60%	0.00%	0.00%	0.00%	5.80%

According to the table above we can get the following results:

a) Dairy Products Import

As the result shows in Figure 4, 37% of the destination of imported dairy products is Shanghai itself, followed by Beijing 20%, Zhejiang 10%. According to the import data in value published by China General Administration of Customs on the national dairy imports, the import value of dairy products in Shanghai accounts for 28.1 % of the whole country, while Beijing 15.2% and Zhejiang 7.7%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

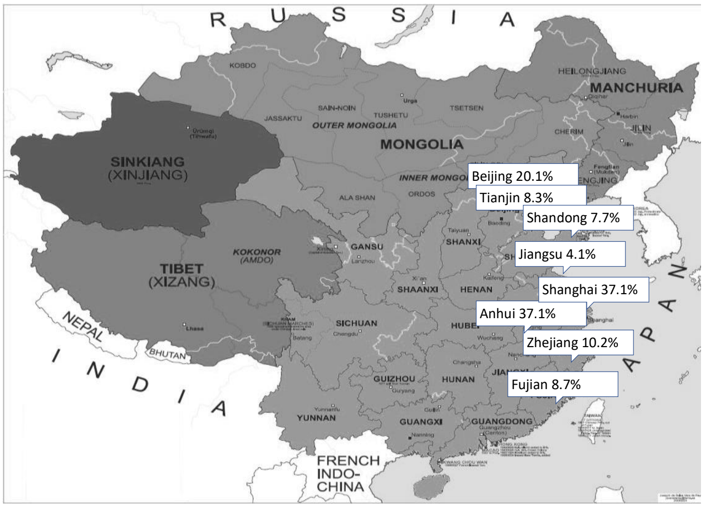

Figure 4 Destination Distribution of Dairy Products Import

b) Pork Import

As the result shows in Figure 5, 23.7% of the destination of imported Pork is Shanghai itself, followed by Shandong 21.5%, Tianjin 18.7%. According to the import data in value published by China General Administration of Customs on the national pork import, the import value of pork in Shanghai accounts for 17.3 % of the whole country, while Shandong 15.7% and Tianjin 13.7%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

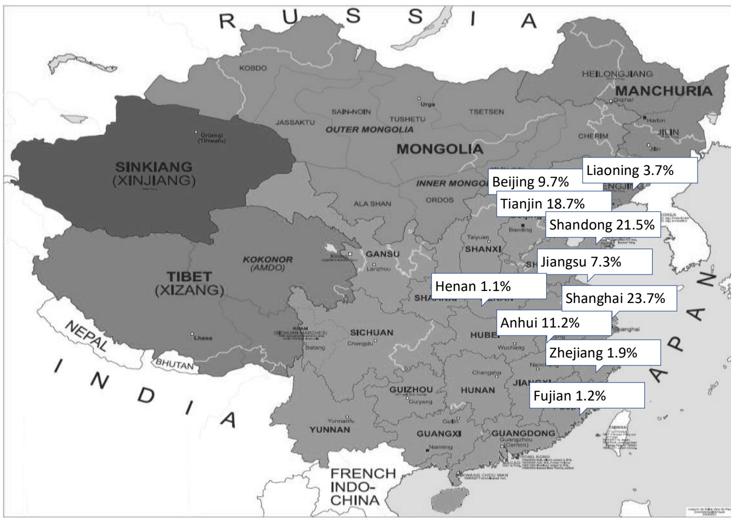

Figure 5 Destination Distribution of Pork Import

c) Daily Necessities Import

As the result shows in Figure 6, 38.7% of the destination of imported daily necessities is Shanghai itself, followed by Beijing 31.6%, Tianjin 7.2%. According to the import data in value published by China General Administration of Customs on the national daily necessities imports, the import value of daily necessities in Shanghai accounts for 32% of the whole country, while Beijing 26% and Tianjin 6%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

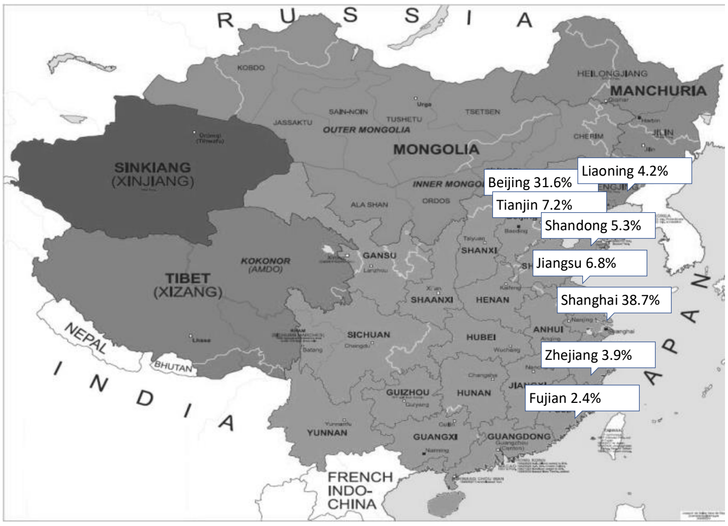

Figure 6 Destination Distribution of Daily Necessities Import

d) Flat Glass Export

As the result shows in Figure 7, 37% of the cargo flow of exported flat glass is Shandong Province, followed by Liaoning 17.4%, Hebei 16.4%. According to the export data in value published by China General Administration of Customs on the flat glass export, the export value of flat glass from Shandong accounts for 33.3 % of the whole country, while Liaoning 13.8% and Hebei 13%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

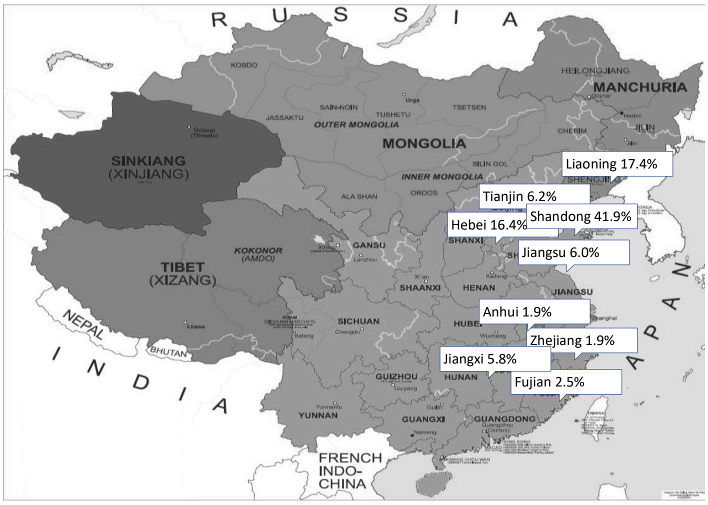

Figure 7 Origin Distribution of Flat Glass Export

e) Mechanical and Electrical Products Export

As the result shows in Figure 8, 30.8% of the cargo flow of exported mechanical and electrical products is Jiangsu Province, followed by Shanghai 24%, Zhejiang 12.1%. According to the export data in value published by China General Administration of Customs on the mechanical and electrical products export, the export value of mechanical and electrical products from Jiangsu accounts for 16.3 % of the whole country, while Shanghai 12.7% and Zhejiang 6.4%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

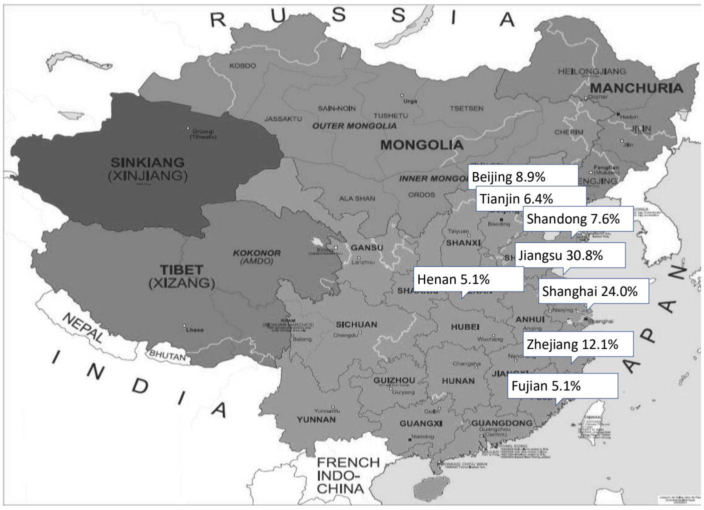

Figure 8 Origin Distribution of Mechanical and Electrical Products Export

f) Electrical and Electronic Products

As the result shows in Figure 9, 29.4% of the cargo flow of exported electrical and electronic products is Jiangsu Province, followed by Zhejiang 17.1%, Shanghai 12.1%. According to the export data in value published by China General Administration of Customs on the electrical and electronic products export, the export value of electrical and electronic products from Jiangsu accounts for 11.2 % of the whole country, while Zhejiang 6.5% and Shanghai 4.6%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

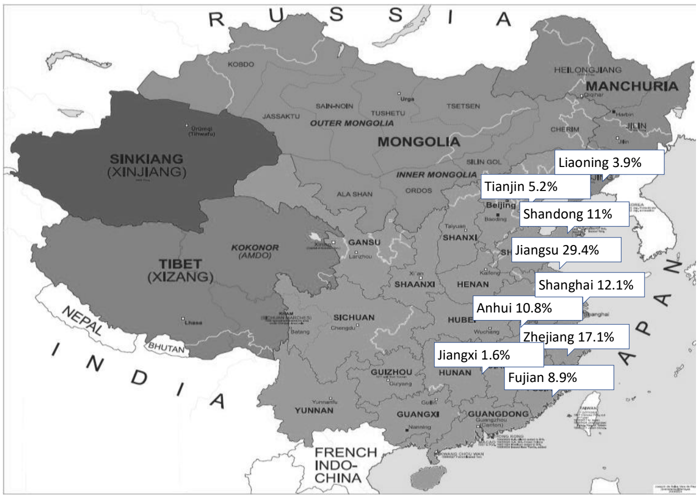

Figure 9 Origin Distribution of Electrical and Electronic Products

g) Clothing Export

As the result shows in Figure 10, 38.6% of the cargo flow of exported clothing is Zhejiang Province, followed by Jiangsu 26%, Fujian 12.4%. According to the export data in value published by China General Administration of Customs on the clothing export, the export value of clothing from Zhejiang accounts for 24.5 % of the whole country, while Jiangsu 16.5% and Fujian 7.9%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

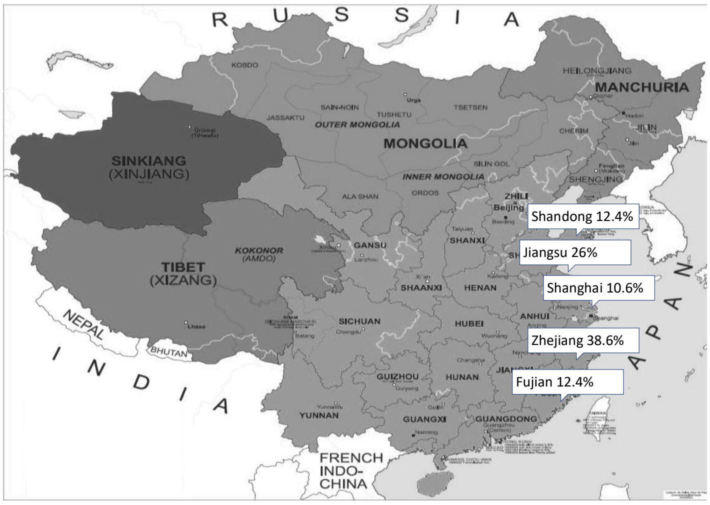

Figure 10 Origin Distribution of Clothing Export

h) Furniture Export

As the result shows in Figure 11, 40.4% of the cargo flow of exported furniture is Zhejiang Province, followed by Jiangsu 14.3%, Fujian 12.3%. According to the export data in value published by China General Administration of Customs on the furniture export, the export value of furniture from Zhejiang accounts for 21.4 % of the whole country, while Jiangsu 7.6% and Fujian 6.5%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

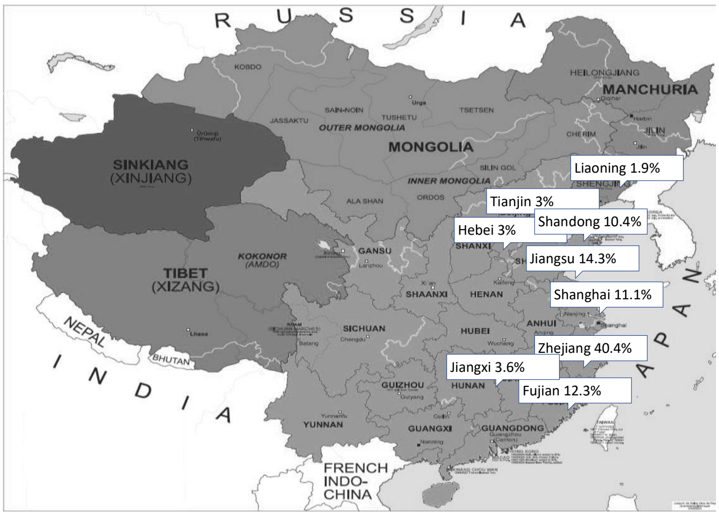

Figure 11 Origin Distribution of Furniture Export

i) Toy Export

As the result shows in Figure 12, 37% of the source of the exported toy is Zhejiang Province, followed by Jiangsu 17.4%, Shanghai 16.4%. According to the export data in value published by China General Administration of Customs on the toy export, the export value of the toy from Zhejiang accounts for 14.9 % of the whole country, while Jiangsu 6.6% and Shanghai 3.8%. From the perspective of proportion, it is worthy of credit to agree with the calculation results of this model.

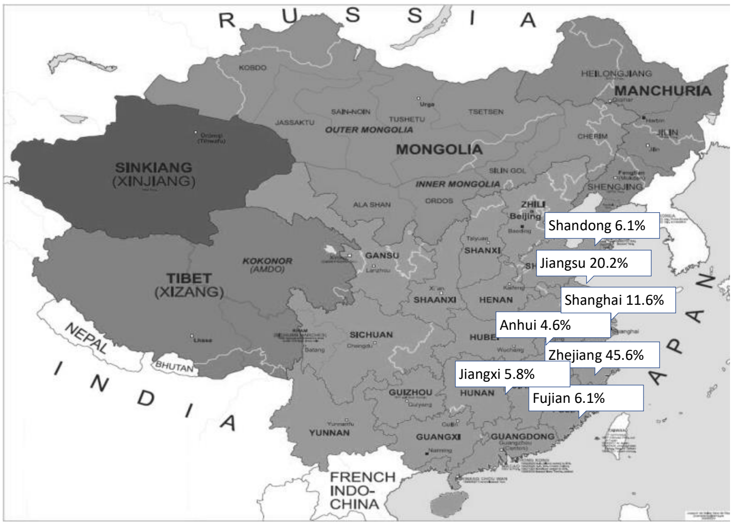

Figure 12 Origin Distribution of Toy Export

4.2 Exploring the Source of Passenger Flow in Shanghai Port

4.2.1 Data Collection

With the development of many years, Shanghai's two cruise ports have developed rapidly, and the cruises are gradually fixed. According to Annual Report on China's Cruise Industry. The list of ships stably linked to the two ports in Shanghai is shown in the Table below.

Table 15 Home Port Cruise Ships Operated by Cruise Lines in Shanghai

Home Port	Fleet	Tonnage (t)	Capacity (person)	Lease Time
Shanghai Wusongkou International Cruise Terminal	"Serena" of Costa Cruises	114000	3780	2015.4
	"Fortuna" of Costa Cruises	103000	3470	2016.4
	"Atlantica" of Costa Cruises	85619	2680	2013.7
	"Sapphire Princess" of Princess Cruises	116000	2670	2014.5
	"Majestic Princess"of Princess Cruises	143700	3560	2017.7
	"Golden Era" of Skysea Cruises	71545	2114	2015.5
	"Quantum of the Seas"of Royal Caribbean	167800	4180	2015.6
	"Mariner of the Seas"of Royal Caribbean	138279	3114	2013.6
	"Voyager of the Seas" of Royal Caribbean	138000	3114	2013.3
	"Joy" of Norwegian Cruise Line	168800	3850	2017.6
	"Virgo" of Star Cruise	75338	1870	2017.7
	"Serena" of MSC Cruise	65591	2069	2016.5
SIPG	"Brilliant of the Seas"of Diamond Cruise	45000	1300	2016.7

Source：Integrated information from Annual China's Cruise Market Development report, 2017

Table 15 indicates that cruise ships including "Fortuna" and "Atlantica" of Costa Cruises, "Sapphire Princess" of Princess Cruises, "Golden Era" of SkySea Cruises and "Voyager of the Seas" of Royal Caribbean are operated at double home ports. It can be thus seen that the competition in China's cruise market is getting fiercer and fiercer. Especially, many cruise lines are starting double home port operation mode affected the uncertainty of North Asian Market and the potentiality of emerging South China market, in order to avoid route operation risks and occupy the South China Market that is developing quickly.

In 2016, Costa Cruises, Royal Caribbean and Princess and Princess Cruises launched totally 11 home port cruise ships at Wusongkou International Cruise Terminal, operated accumulatively 400 voyages and served 1, 500, 000 outbound tourists. And the share of them are shows in Table 16, 17.

Table 16 Cruise Line Operated in Home Port Mode at Wusongkou International Cruise Terminal in 2016

Brand	Cruise ship name	Ships	Persons
Costa Cruises	Victoria	10	29800
	Atlantica	17	85800
	Serena	92	646800
	Fortuna	64	378900
	Total	183	1141300
Princess Cruises	Sapphire Princess	48	272300
	Golden Princess	1	2200
	Diamond Princess	39	216700
	Total	71	491200
Royal Caribbean International	Quantum of the Seas	53	477000
	Ovation of the Seas	1	9000
	Voyager of the Seas	36	144000
	Mariner of the Seas	65	260000
	Total	155	890000

Source：Annual Data collected from the annual report of Costa Cruises, Princess Cruises, and Royal Caribbean International, 2017

Table 17 Cruise Line Operated in Home Port Mode at Wusongkou International Cruise Terminal in 2016 (foreigner)

Brand	Persons (Foreign)
Costa Cruises	68478
Princess Cruises	24560
Royal Caribbean International	62300

Source：Annual Data collected from the annual report of Costa Cruises, Princess Cruises, and Royal Caribbean International, 2017

Since the statistics of domestic tourists and foreign tourists are different, this paper divides the total number of tourists into two parts: domestic tourists and foreign tourists (Table 18).

Table 18 Adjusted passenger situation of Wusongkou Cruise Terminal

Brand	Persons (Foreign)	Persons (Domestic)
Costa Cruises	68478	1072822
Princess Cruises	24560	466640
Royal Caribbean International	62300	827700

As mentioned above, the exploration of customer source involves commercial confidential, and it is not feasible for individuals to sample. The author of this paper has made contact with YITONG single window, and they have made relevant secret measures for the existing sampled data and given the modified sampling data of corresponding categories to the author for use in the paper.

Table 19 Sampling Data from YITONG System in passenger flow source exploration (Domestic)[3]

	Costa Cruises	Princess Cruises	Royal Caribbean International
Shanghai	10	5	28
Jiangsu	63	21	28
Zhejiang	48	27	41
Fujian	24	3	11
Jiangxi	19	7	9
Anhui	17	11	11
Liaoning	14	12	13
Heilongjiang	24	10	28
Others	7	1	4

[3] The data come from a cooperation project organized by Yitong Company and Shanghai Maritime University in 2017. After confidential information has been hidden, the data is permitted to be used for this paper.

Table 20 Sampling Data from YITONG System in passenger flow source exploration (Foreign)[3]

	Costa Cruises	Princess Cruises	Royal Caribbean International
Asia	29	10	25
America	5	2	5
Europe	8	3	8
Oceania	1	0	1
Africa	1	0	1
Other Countries	1	0	0

Table 21 Distribution of foreign passengers on Chinese cruise ships in 2016 (Foreign)

Region	persons
Asia	16620000
America	3115400
Europe	4891400
Oceania	776400
Africa	580200
Other Countries	2000

Source：Integrated information of 2017 Annual China's Cruise Market Development report, 2017

4.2.2 Analysis

a) Sets, Parameters, and Decision variable

Sets and Parameters

i is the brand number $i \in N$, $N = \{1, 2, \cdots, n\}$, in this example let

Table 22 Table for *i* in passenger flow source exploration

Brand	i
Costa Cruises	1
Princess Cruises	2
Royal Caribbean International	3

j is the cargo hinterland number $j \in M$, $M = \{1, 2, \cdots, m\}$, in this example let

Table 23 Table for *j* in passenger flow source exploration

Source	Shanghai	Jiangsu	Zhejiang	Fujian	Jiangxi	Anhui	Liaoning	Heilongjiang
j	1	2	3	4	5	6	7	8

Source	Others[4]	Asia	America	Europe	Oceania	Africa	Other Countries[5]
j	9	10	11	12	13	14	15

Parameters

Domestic Part:

According to Set M and N determined before, then the Parameters can be input as follow:

a_{ij} is the sample result of domestic passenger flow i from city j (person).

Table 24 Table for a_{ij} in domestic passenger flow source exploration

i \ j	1	2	3	4	5	6	7	8	9
1	10	63	48	24	19	17	14	24	7
2	5	21	27	3	7	11	12	10	1
3	28	28	41	11	9	11	13	28	4

b_i is the total domestic passenger take the service of brand i in Shanghai.

Table 25 Table for b_i in domestic passenger flow source exploration

Brand	i	b_i
Costa Cruises	1	1072822
Princess Cruises	2	466640
Royal Caribbean International	3	827700

c_j is the total domestic passenger flow from city j.

Table 26 Table for c_j in domestic passenger flow source exploration

City	j	c_j
Shanghai	1	305568
Jiangsu	2	792717
Zhejiang	3	827658
Fujian	4	273399
Jiangxi	5	255282
Anhui	6	280985
Liaoning	7	284583
Heilongjiang	8	445125
Others	9	85427

[4] ‘Others’ refers to the rest cities of the domestic market in China
[5] ‘Other Countries’ refers to the rest region of the global market, except Chinese market

Foreign Part:

a_{ij} is sample results of foreign passenger flow i from city j (person).

Table 27 Table for a_{ij} in foreign passenger flow source exploration

i \ j	10	11	12	13	14	15
1	29	5	8	1	1	1
2	10	2	3	0	0	0
3	25	5	8	1	1	0

b_i is the total foreign passenger take the service of brand i in Shanghai.

Table 28 Table for b_i in foreign passenger flow source exploration

Brand	i	b_i
Costa Cruises	1	68478
Princess Cruises	2	24560
Royal Caribbean International	3	62300

c_j is the total foreign passenger flow from region j.

Table 29 Table for c_j in foreign passenger flow source exploration

region	j	c_j
Asia	10	16620000
America	11	3115400
Europe	12	4891400
Oceania	13	776400
Africa	14	580200
Other Countries	15	2000

Decision variable

x_{ij} is the estimated passengers (person) take brand i from the city (region) j.

b) Objective Functions and Constraints

Objective Functions

Domestic Part:

Let

$$A = 10 + 63 + \cdots + 7$$
$$+5 \; + 21 + \cdots + 1 \qquad \text{(Equation 4-7)}$$
$$+28 + 28 + \cdots + 4 = 500$$

Let

$B = 1072822 + 466640 + 827700 = 2367162$ (Equation 4-8)

Turn the objective function into this way:

$$MinZ = \frac{1}{B}\sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{B}{A}a_{ij} - x_{ij}\right|$$
$$= \frac{1}{2367162}*\left|\frac{2367162}{500}*10 - x_{11}\right| + \frac{1}{2367162}*\left|\frac{2367162}{500}*63 - x_{12}\right| + \cdots + \frac{1}{2367162}*\left|\frac{2367162}{500}*7 - x_{19}\right|$$
$$+ \frac{1}{2367162}*\left|\frac{2367162}{500}*5 - x_{21}\right| + \frac{1}{2367162}*\left|\frac{2367162}{500}*21 - x_{22}\right| + \cdots + \frac{1}{2367162}*\left|\frac{2367162}{500}*1 - x_{29}\right|$$
$$+ \frac{1}{2367162}*\left|\frac{2367162}{500}*28 - x_{31}\right| + \frac{1}{2367162}*\left|\frac{2367162}{500}*28 - x_{32}\right| + \cdots + \frac{1}{2367162}*\left|\frac{33698711}{500}*4 - x_{39}\right|$$

(Equation 4-9)

The objective function is to minimize the sum of the absolute deviations between the ratio of the estimated volume and the sampled volume.

Foreign Part:

Let

$$A^{'} = 29 + 5 + \cdots + 1$$
$$+10 \; + 2 + \cdots + 0 \qquad \text{(Equation 4-10)}$$
$$+25 + 5 + \cdots + 0 = 100$$

Let

$B^{'} = 68478 + 24560 + 62300 = 155338$ (Equation 4-11)

Turn the objective function into this way:

$$MinZ^{'} = \frac{1}{B}\sum_{i=1}^{n}\sum_{j=1}^{m}\left|\frac{B}{A}a_{ij} - x_{ij}\right|$$
$$= \frac{1}{155338}*\left|\frac{155338}{500}*29 - x_{110}\right| + \frac{1}{2367162}*\left|\frac{155338}{500}*5 - x_{111}\right| + \cdots + \frac{1}{2367162}*\left|\frac{155338}{500}*1 - x_{115}\right|$$
$$+ \frac{1}{155338}*\left|\frac{155338}{500}*10 - x_{210}\right| + \frac{1}{2367162}*\left|\frac{155338}{500}*2 - x_{211}\right| + \cdots + \frac{1}{2367162}*\left|\frac{155338}{500}*0 - x_{215}\right|$$
$$+ \frac{1}{155338}*\left|\frac{155338}{500}*25 - x_{310}\right| + \frac{1}{2367162}*\left|\frac{155338}{500}*5 - x_{311}\right| + \cdots + \frac{1}{2367162}*\left|\frac{155338}{500}*0 - x_{315}\right|$$

(Equation 4-12)

The objective function is to minimize the sum of the absolute deviations between the ratio of the estimated volume and the sampled volume.

Constraints

Domestic Part:

$$\begin{cases} x_{11}+x_{12}+\cdots+x_{19}=1072822 \\ x_{21}+x_{22}+\cdots+x_{29}=466640 \\ x_{31}+x_{32}+\cdots+x_{39}=827700 \end{cases} \quad \text{(Equation 4-13)}$$

Constraint 4-13: the sum of the total number of a passenger taking brand i in each place of the source is equal to a whole number of brand *i*.

$$\begin{cases} x_{11}+x_{21}+x_{31} \le 305568 \\ x_{12}+x_{22}+x_{32} \le 792717 \\ \cdots\cdots\cdots \\ x_{19}+x_{29}+x_{39} \le 85427 \end{cases} \quad \text{(Equation 4-14)}$$

Constraint 4-14: the sum of the total volume of the passengers from place j cannot exceed the total volume of the place *j*.

$$x_{11}, x_{12}, \cdots, x_{39} \ge 0 \quad \text{(Equation 4-15)}$$

Constraint 4-15: Non-negative decision variables.

Foreign Part:

$$\begin{cases} x_{110}+x_{111}+\cdots+x_{115}=68478 \\ x_{210}+x_{211}+\cdots+x_{215}=24560 \\ x_{310}+x_{311}+\cdots+x_{315}=62300 \end{cases} \quad \text{(Equation 4-16)}$$

Constraint 4-16: the sum of the total number of a passenger taking brand i in each place of the source is equal to a whole number of brand *i*.

$$\begin{cases} x_{110}+x_{210}+x_{310} \le 16620000 \\ x_{111}+x_{211}+x_{311} \le 3115400 \\ \cdots\cdots\cdots\cdots \\ x_{115}+x_{215}+x_{315} \le 2000 \end{cases} \quad \text{(Equation 4-17)}$$

Constraint 4-17: the sum of the total volume of the passengers from place j cannot exceed the total volume of the place *j*.

$$x_{110}, x_{111}, \cdots, x_{315} \ge 0 \quad \text{(Equation 4-18)}$$

Constraint 4-18: Non-negative decision variables.

4.2.3 Results

The results obtained by the MATLAB program are as follows：

MinZ= 0.013272988, $\frac{0.013272988}{3\times 9}=0.000491592 \ll 0.05$ .Therefore, this estimate result is acceptable.

MinZ'= 2.75528E-05, $\frac{2.76E-05}{3\times 6}=1.53071E-06 \ll 0.05$ .Therefore, this estimate result is acceptable.

Table 30 Table for results x_{ij} in domestic passenger flow source exploration

	1	2	3	4	5	6	7	8	9
1	45652	296738	228260	114130	91304	79891	68478	114130	34239
2	24560	98240	127712	14736	34384	54032	58944	49120	4912
3	133500	133500	195800	53400	44500	53400	62300	133500	17800

Table 31 Table for results x_{ij} in foreign passenger flow source exploration

	10	11	12	13	14	15
1	45048	7768	12427	1553	1553	1553
2	15534	3107	4660	0	0	0
3	38835	7767	12427	1553	1553	0

For convenience, a proportional calculation is carried out for each category, a better result on the distribution of Shanghai cruise port as follow Table 32, 33.

Table 32 Percentage distribution of partial domestic passenger source in Shanghai Port

	Costa Cruises	Princess Cruises	Royal Caribbean International
Shanghai	4.26%	5.26%	16.13%
Jiangsu	27.66%	21.05%	16.13%
Zhejiang	21.28%	27.37%	23.66%
Fujian	10.64%	3.16%	6.45%
Jiangxi	8.51%	7.37%	5.38%
Anhui	7.45%	11.58%	6.45%
Liaoning	6.38%	12.63%	7.53%
Heilongjiang	10.64%	10.53%	16.13%
Others	3.19%	1.05%	2.15%

Table 33 Percentage distribution of partial foreign passenger source in Shanghai Port

	Costa Cruises	Princess Cruises	Royal Caribbean International
Asia	64.44%	66.67%	62.50%
America	11.11%	13.33%	12.50%
Europe	17.78%	20.00%	20.00%
Oceania	2.22%	0.00%	2.50%
Africa	2.22%	0.00%	2.50%
Other Countries	2.22%	0.00%	0.00%

According to the Table s above we can get the following results:

a) Costa Cruises

According to the result of the model, we can work out the general situation of Costa Cruises in Shanghai. In the domestic market, the largest part of the passenger flow is from Jiangsu 27.66%, Zhejiang 21.28%, Fujian and Heilongjiang also accounted for about 10% of the market share. From the foreign market, main passenger flow source of Costa Cruises Shanghai is from Asia 65%, and then 18% in Europe, America 11%.

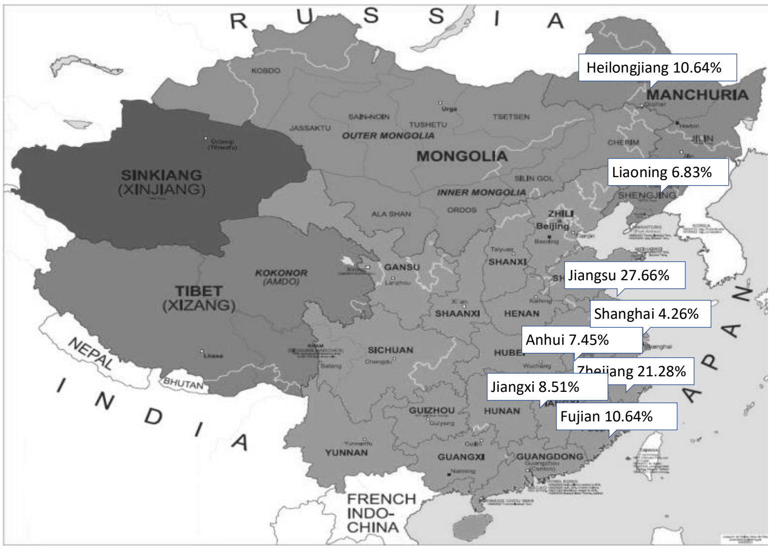

Figure 13 Percentage distribution of partial domestic passenger source for Costa Cruises

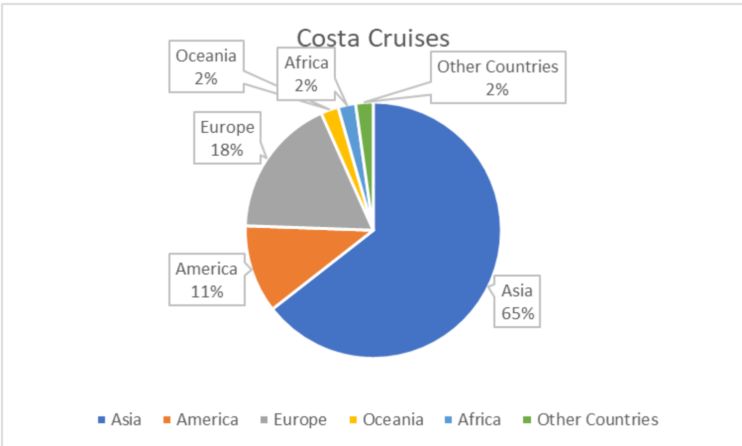

Figure 14 Percentage distribution of partial foreign passenger source for Costa Cruises

b) Princess Cruises

According to the result of the model, we can work out the general situation of Princess Cruises Shanghai. In the domestic market, the largest part of the passenger flow is from Zhejiang 27.37%, Jiangsu 21.05%, Anhui, Liaoning, and Heilongjiang also accounted for around 10% of the market share. From the foreign market, main passenger flow source of Princess Cruises Shanghai is from Asia 67%, and then 20%

in Europe, America 13%.

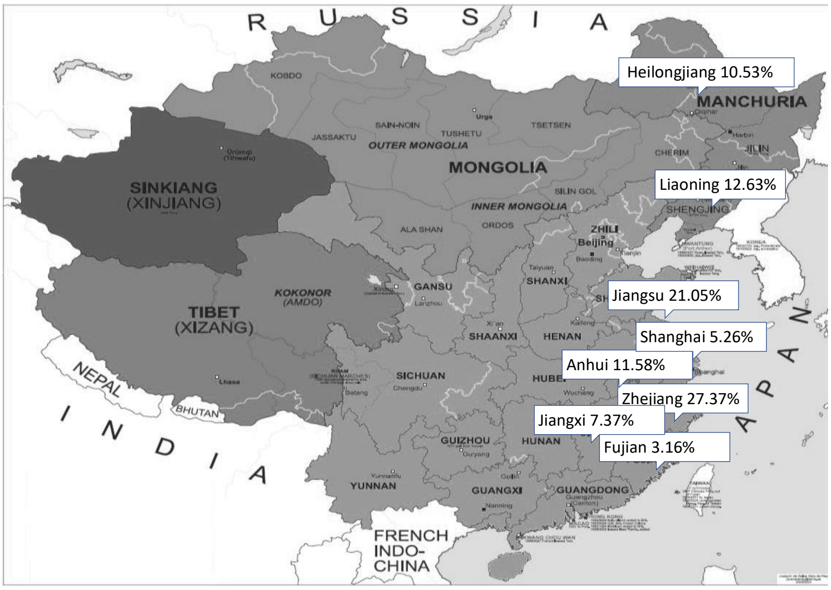

Figure 15 Percentage distribution of partial domestic passenger source for Princess Cruises

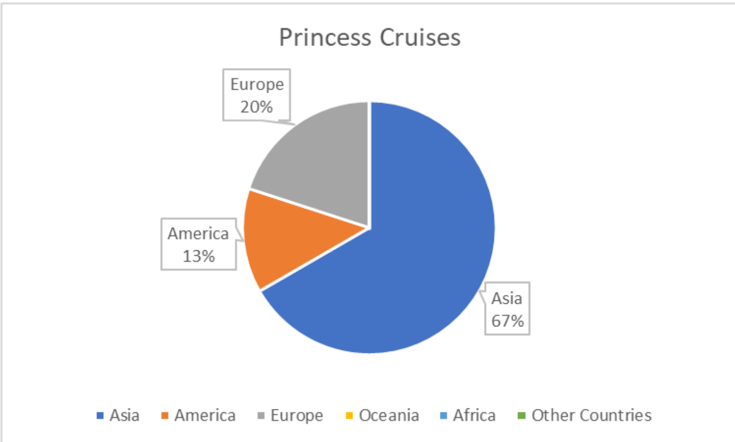

Figure 16 Percentage distribution of partial foreign passenger source for Princess Cruises

c) Royal Caribbean International

According to the result of the model, we can work out the general situation of Princess Cruises Shanghai. In the domestic market, the largest part of the passenger flow is from Zhejiang 23.66%, Jiangsu, Shanghai, Heilongjiang all accounted for 16.13% of the market share. From the foreign market, main passenger flow source of Princess Cruises Shanghai is from Asia 63%, and then 20% in Europe, America 13%.

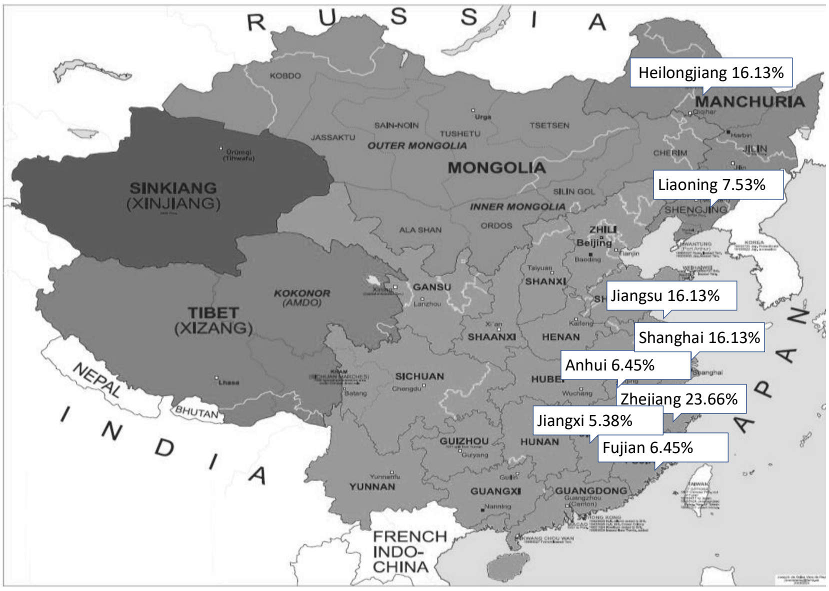

Figure 17 Percentage distribution of partial domestic passenger source for Royal Caribbean International

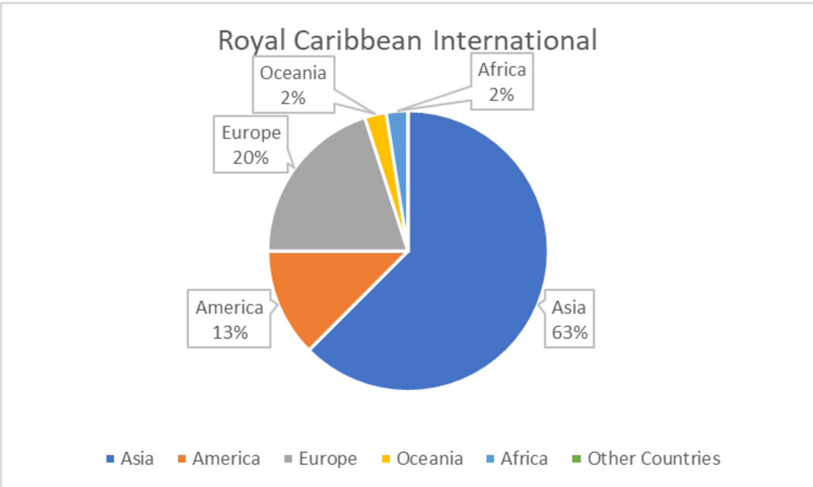

Figure 18 Percentage distribution of partial foreign passenger source for Royal Caribbean International

5 Conclusion

Nowadays, the development of a port is no longer the same as that of the original one that only competes in service level. Hinterland is of increasing significance in the competition instead. As shipping service industry has been booming, and under the integration of shipping and tourism, the cruise industry is progressively critical for the competitiveness of a port. In this era, the source of container cargo and passenger flow are being rapidly changed. Only the ports fully understanding their own source of tourists and container cargo flow are able to seize the opportunity in the market. Thus, the exploration method for the source of container cargo and passenger flow is of great importance.

At present, the methods for investigating passenger and cargo sources are primarily limited to static and long-period statistics, and unsuitable for applying to the current high speed changing the market. Most ports have made informatization reform, but most of such reforms are only used to reduce the mistakes in port operation and improve operational efficiency. Such data were rarely systematized by ports, and few authorities can use big data technology to process these data. As a result, the exploration of the source of container cargos and cruise passenger flow is a blank area. In the chapter 3, two frameworks of are proposed to solve the sources of these two aspects. In these two frameworks, the MADE mathematical method is employed to bridge the small sampling and the estimation of the source of goods and passengers. Then, the Shanghai port is taken as an case in the fourth chapters of this paper. The annual data published by Shanghai Port Customs and relevant cruise enterprises in 2016 and 2017 are input to do the verification. According to the results, the results yielded are comparatively reliable. It can also be referenced by the further application of the MADE method in big data technology.

Of course, there are still some inevitable shortcomings worth further studying in this dissertation. The two research frameworks proposed in this paper are still theoretical. In addition, a series of difficulties still need to be solved, such as data cleaning, when we can combine them with big data. In addition, the verification of the model is based on static data in this paper, while the data in a frequent short period of times cannot be verified because of the problem of confidentiality, which needs further study.

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Appendix A: MATLAB Code for MADE Method

```
imax (1)=length (i);%Determine the number of i
jmax (1)=length (j);%Determine the number of j
A1=zeros (1)
B1=zeros (1)
For i=1:imax (1);%Calculation of A
For j=1:jmax (1)
A1=A1+a (i, j)
end
end
For i=1:imax (1);%Calculation of B
B1=B1+b1 (i)
end
function f=fun1 (x);%Establishment of objective function
f=zeros (1)
For i=1:imax (1)
For j=1:jmax (1)
f=f+abs (B1/A1*a (i, j)-x (i, j))
end
end
f=f/B1

Aeq=[];%Constraint condition 1
For i=1:imax (1);
aeq1=[];
For j=1:jmax (1);
aeq1=[aeq 1];
end;
Aeq=[Aeq;aeq1];
end
Beq=[];
For i=1:imax (1);
Beq=[Beq;b1 (i)]
end

A=[];%Constraint condition 2
For j=1:jmax (1);
a1=[];
```

```
For i=1:imax (1);
a1=[a1 1];
end;
a1=d (j)*a1;
A=[A;a1];
end
b=[];
For j=1:jmax (1);
b=[b;c (j)]
end

x0=[];%Constraint condition 3
For i=1:imax (1)
For j=1:jmax (1)
x0=[x0;0]
end
end

VLB=[];
VUB=[];
[x, fval]=fmincon ('fun1', x0, A, b, Aeq, Beq, VLB, VUB);%Solving function
```

Appendix B: Shanghai Yitong "SINGLE WINDOW" Platform Document (Main Data)

Table 34 Main Data Table of Shanghai Yitong "SINGLE WINDOW" Platform Document

Table No.	FIELD NAME
00	HEAD RECORD
10	VESSEL & VOYAGE INFORMATION
11	VESSEL & VOYAGE SUPPLEMENTARY INFORMATION
12	FIRST RECORD OF 1 B/L
13	LOCATION INFORMATION
14	COUNTRY (IES) OF ROUTING
16	SHIPPER INFORMATION
17	CONSIGNEE INFORMATION
19	CARRIER INFORMATION
20	SPECIFICATION OF THE POSTAL DELIVERY POINT
41	CARGO INFORMATION
42	CONTAINER NUMBER
43	DANGEROUS GOODS/REFRIGERATED CONTAINER INFORMATION
44	CARGO MARKS INFORMATION
47	DESCRIPTION OF CARGO INFORMATION
48	UNIQUE CONSIGNMENT REFERENCE NUMBER
51	CONTAINER INFORMATION
52	SEAL INFORMATION
60	AMENDMENT
90	MEMO

Appendix C: A Report of Shanghai Yitong “SINGLE WINDOW”

‘Single window’ system streamlines Chinese trade[6]

“Ahead of the two-day BRICS trade ministers meeting in Shanghai on Aug 2, China has proposed to establish an e-port network to promote trade businesses.

The so-called “single window” system is a key component of this network, which is designed to streamline trade and improve the business environment among Brazil, Russia, India, China and South Africa.

Working for a logistics company, Xu Jiajia sometimes handles up to 80 declarations a day. In the past, in order to get approvals from two government agencies, she had to prepare two sets of documents. But since 2014, her company has been using a new electronic processing system called “single window” to make things easier.

“The ‘single window’ combines two systems. Since some of the information required by the two departments is the same, we don’t need to submit them repeatedly as we did before. It saves labor and lowers the rate of mistakes, ” said Xu.

The “single window” system helps to simplify procedures, reduce foreign trade costs and improve the business environment.

“This is our customs declaration department. This department used to be the one with the longest working hours, and they needed to work overnight quite often, but now, they don’t need to stay late like that anymore. So, their work efficiency is very high, ” said Yu Xiongwei, a manager at Technology Development Department, at Shanghai

[6] A report of Shanghai Yitong “SINGLE WINDOW” retrieved from:
http://english.gov.cn/news/video/2017/08/02/content_281475767251986.htm

Origin International Logistics.

The new system not only saves when it comes to labor, but it speeds up the process.

Shanghai's "single window" system now serves more than 200, 000 companies every year, saving them more than two billion yuan. Analysts say the process should be expanded nationwide to deliver tangible results.

"Our vision for this network is showing here. When it's established, it can improve the transparency of information to prevent information imbalance and trading fraud. It can also strengthen the government's ability to supervise trade. It will enhance trade facilitation and efficiency, and upgrade the trading ability level," said Wei Xiaoming, Director of the Business Development Center at Shanghai E&P International."