

ASEAN REGIONAL LOGISTICS DEMAND FORECAST

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Abstract: *The prediction of ASEAN logistics development demand is to carry out an efficient allocation of logistics resource, create an important prerequisite of highly effective logistics system. Each country of ASEAN area has widely different characteristic, only one prediction method cannot accurately predict the volume of goods, comprehensively consider the development level of each ASEAN country, fundamental facilities and logistics level of ASEAN will be divided into four groups. Based on the different application scale of each prediction method, triple exponential smoothing method is applied to predict the volume of goods in groups 1 and 2, the improved multilayer bid regression algorithm is used to predict the volume of goods in groups 3 and 4. At the end, suggestion for ASEAN logistic development is considered based on prediction of goods volume in the whole ASEAN area.*

Keywords: ASEAN; logistics development, demand forecast

I. INTRODUCTION

Nowadays, regional economic integration is developing rapidly, ASEAN countries accelerate, ASEAN regional integration and promote sustained growth of ASEAN regional economy, but economic cooperation and development cannot be separated from the logistics support. At present, the ASEAN countries, the level of economic and logistics development is uneven, to strengthen the regional logistics cooperation among ASEAN countries, promote the development of trade between ASEAN countries and enhance the level of logistics service, it is of great practical significance to analyze and forecast the logistics development needs of ASEAN countries.

From the domestic and foreign scholar's documents, there are a wide variety of forecasting methods for logistics demand, can be divided into qualitative prediction and quantitative prediction method. Qualitative prediction is based on the predictors of their own experience and knowledge of the future development of things to make a comprehensive analysis, make estimates of future changes in logistics requirements. Quantitative forecasting is based on existing data and related information, select the appropriate mathematical model or method to study the development trend of logistics, and then according to the mathematical model to predict the future demand for logistics. For cargo forecasts generally fall into two categories, one category is only from the time series of freight to find out the law, the other is the use of

cargo factors to analyze the changes in the trend, and both of them give a more accurate prediction of the volume of freight traffic. Silva ^[1] using nonparametric time series and singularity, forecasting technology to forecast freight volume and the prediction model of the economic recession in 2008. Wang Ying ^[2] uses the core idea and basic principle of support vector machines to establish the forecasting model of highway freight volume, predicts the data of Beijing city, and the results show that the model is effective and feasible. Jia Xue Feng ^[3] used gray model to forecast the highway freight volume. Xu Zhao ^[4] was predicted by multiple regression prediction. Zheng Chun Wei ^[5] used the regression analysis model and the GM (1, 1) model to predict the highway freight volume. However, the above literature research on the regional economic level and development speed is similar, and the ASEAN countries have a wide gap in logistics levels, so the ASEAN as a whole to select the forecast method will cause a greater error. Forecast ASEAN logistics development needs the ASEAN countries hierarchical division before. ASEAN economic development, trade development and national logistics development more similar to the same cluster. It is possible to reduce the prediction error by selecting the applicable forecasting method for different cluster countries. Finally, have prediction results of the three clusters and the future of ASEAN logistics development needs to provide advice. At present, ASEAN regional logistics research field is very small, therefore, ASEAN regional logistics efficiency evaluation research, the logistics resources investment, rational allocation, in order to improve the operational efficiency of logistics on the ASEAN regional economic development to help.

II. THE MAIN FACTORS AFFECTING THE ASEAN LOGISTICS DEMAND

2.1 Economic development level

ASEAN logistics demand is closely related to the economic development level of ASEAN, and the rapid development of ASEAN economy is the driving force to promote the rapid growth of regional logistics demand. At present, ASEAN countries are the new open economies and the economic development level of the ten ASEAN countries (Fig. 1). The economic development of ASEAN region has developed rapidly on the whole, but the gap of economic development in different countries is relatively large, in terms of total GDP, Indonesia and Thailand have the largest GDP, Malaysia, Singapore, followed by Philippines, Vietnam is the mediate, Laos, Burma, Kampuchea and Brunei are the smallest. In general, the total economic performance is the level of regional economic development is the most direct, the greater the amount of area economy, production logistics service circulation function needs more and more strong, economic growth; the higher the level of development, the logistics demand growth is strong. Therefore, the level of regional economic development not only determines the quantity of logistics demand, but also determines the level and content of logistics demand.

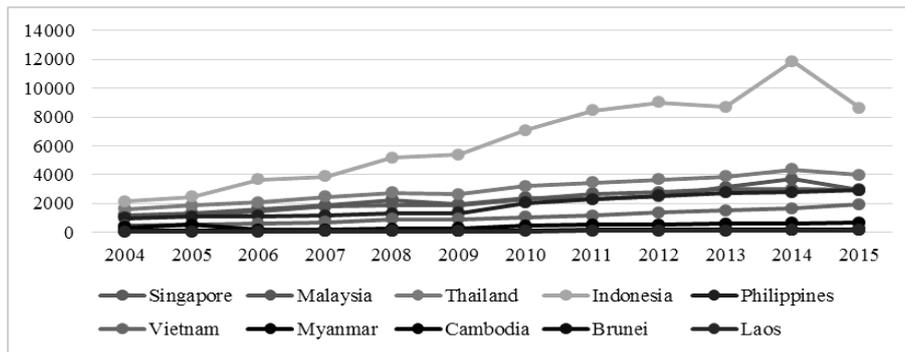


Figure 1. 2004-2015 total GDP of ASEAN countries (millions of dollars)

2.2. Industrial structure

The structure of the ASEAN regional economic industry by the first and the second industry and the third industry structure, unbalance of the three kinds of industrial development caused by the differences in the structure of ASEAN regional economic industry, thus forming different regional logistics demand structure. In the three ASEAN countries in the industrial structure, the first industry output value accounted for the largest, logistics demand to transportation and warehousing needs. For other high value-added logistics demand is less; when the second industrial output value accounted for the largest, in addition to transportation and storage requirements, regional logistics demand has also increased the distribution, packaging and distribution the processing of value-added services, logistics needs are obviously increased; when the third industrial output value accounted for the largest, logistics demand to logistics service demand based, complete logistics network and logistics management system can fully meet the demand for logistics services, through the information and automation of logistics management to improve the level of logistics services, reduce logistics costs, create more value added. Therefore, the development and change of industrial structure has an important impact on logistics demand. The ASEAN countries in recent years, the total economy continues to grow, in addition to Kampuchea, Burma and Laos, although rapid economic growth but mainly on agriculture, other ASEAN countries economic growth brings the industrial structure conversion from agriculture to industry especially the manufacturing industry and service industry.

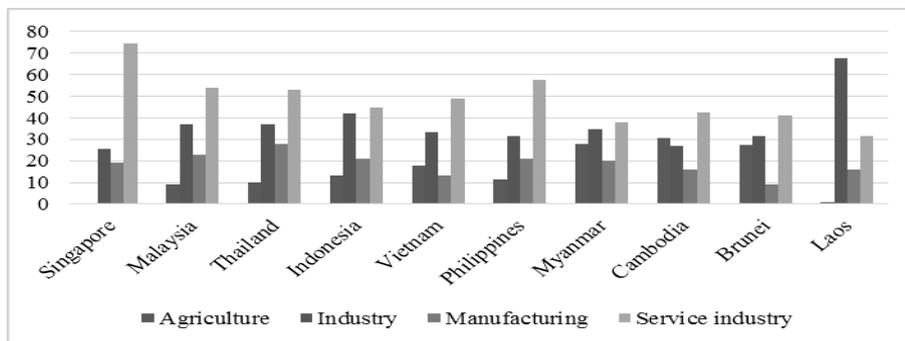


Figure 2. 2015 the industrial structure of the ten ASEAN countries (the proportion of GDP)

2.3. Total resident consumption

The total consumption of residents is the quantitative index of the residents' consumption level, and the residents' consumption level reflects the residents' purchasing ability and purchase preference, as well as the demand for material products and services. With the income level of the country city residents to improve the rapid escalation of ASEAN, the residents' consumption structure, consumption gradually tend to diversification and individuation, so as to drive the ability to purchase goods increased to a great extent, especially the third industry service consumption, increase the social logistics demand.

2.4. Total imports and exports

The total import and export volume is an intuitive reflection of foreign trade. The development of foreign trade has made great contributions to the prosperity of the regional economy, not only the material circulation becomes a bridge between internal and external economic subject, more mining the potential inherent in the logistics market, promote cross regional development of logistics industry. The continuous growth of foreign trade, promote the complementary advantages of regional resources and the outside world, the output of goods at the same time, also attracted a large number of overseas investment, accelerate the construction of logistics infrastructure and logistics service level, expand the logistics of the main market. Therefore, the development of trade is closely related to the demand for logistics. Import and export situation of ASEAN countries in recent years (figure 3).

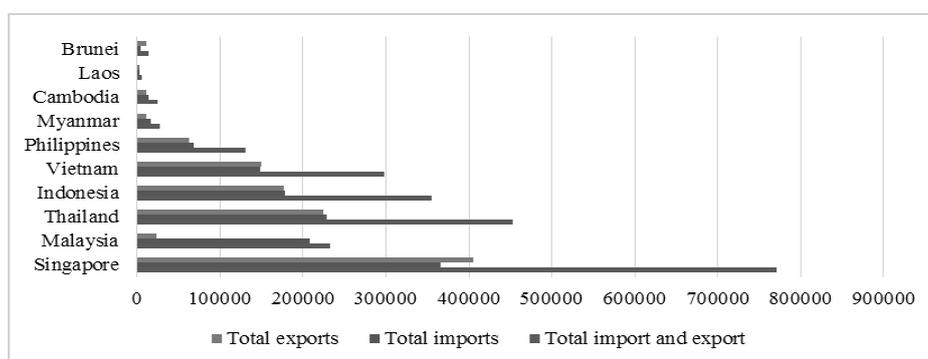


Figure 3. 2015 trade in ASEAN countries (millions of dollars)

2.5. Logistics infrastructure

The attraction of regional logistics infrastructure to goods and the degree of adaptation to demand depend largely on the level of logistics infrastructure and logistics services in different countries. Perfect logistics infrastructure can speed up the turnover of goods circulation, promote the logistics demand growth. Logistics infrastructure, infrastructure in the ASEAN countries, Singapore is the most perfect, the more developed infrastructure in Malaysia, Thailand, Vietnam, Indonesia, Philippines, the construction of infrastructure, the infrastructure is still lagging behind other countries. The level of logistics development in ASEAN countries is uneven, and there are differences between countries.

III. STRATIFICATION IN ASEAN COUNTRIES

3.1. According to the ASEAN economy, infrastructure and logistics level

ASEAN is the Association of Southeast Asian Nations the economic development level, infrastructure quality level and logistics development level of ASEAN countries are unbalanced, therefore, the study of ASEAN logistics development should first be divided into different levels. According to the World Bank (WTO) in 2015: ASEAN countries' total GDP, GDP growth rate, per capita GDP and per capita gross national income (GNI) are divided into economic development indicators; the ranking of ASEAN countries is based on the quality level; and ASEAN's Logistics Performance Index (LPI) is divided into a country's trade logistics development level.

The ASEAN countries are divided, divided into content, the basis for classification, as shown in table 1.

Table 1. ASEAN countries economic level, infrastructure level, logistics level (unit: billion,%, dollars)

ASEAN	Economic development level					Infrastructure level		Logistics level	
	GDP	Growth Rate	GDP per capita	GNI per capita	Level	Index	Ranking	Index	Level
Singapore	2927.39	2.0	52888	52090	high income	6.50	4	4.14	high income
Malaysia	2962.83	5.0	9768	10570	middle and higher	5.42	16	3.43	middle and higher
Thailand	3951.68	2.8	5814	5720	middle and higher	4.39	71	3.26	middle and higher
Indonesia	8619.33	4.8	3346	3440	middle and bottom	4.06	81	2.98	middle and bottom
Vietnam	1935.99	6.7	2111	1990	middle and bottom	3.78	99	2.98	middle and bottom
Philippines	2924.51	5.9	2904	3550	middle and bottom	3.37	106	2.86	middle and bottom
Myanmar	626.00	7.3	1161	1160	low income	2.10	135	2.46	low income
Cambodia	180.49	7	1158	1070	low income	3.22	102	2.80	low income
Laos	123.69	7.4	1818	1740	low income	3.08	108	2.07	low income
Brunei	129.30	-0.6	30554	38010	high income	3.88	89	2.87	middle and bottom

Source: 2015 World Bank (WTO), World Bank World Development Indicators (WDI) and UNCATD STAT.

ASEAN economic development level is similar to the same level, ASEAN countries can be divided into four levels: high-income countries, high-income countries, low-income countries and low-income countries. Among them, Singapore and Brunei are high-income countries; Malaysia and Thailand are middle and higher income countries; Indonesia, Vietnam and Philippines are middle and low income countries; Cambodia, Brunei and Laos are low income countries. According to the ASEAN countries, the level of infrastructure quality, can be divided

into three levels: Singapore, Malaysia for the first level, Thailand, Vietnam, Indonesia and Brunei for the second level, while the Philippines, Cambodia, Laos and Myanmar for the third level. According to the level of development of ASEAN countries, Singapore is a high-level country; Malaysia and Thailand are high-level countries; Indonesia, Vietnam and Brunei are low-level countries; Myanmar, Cambodia and Laos are low-level countries.

3.2. According to the volume export between ASEAN countries

The export volume of ASEAN countries in recent five years (Figure 4)

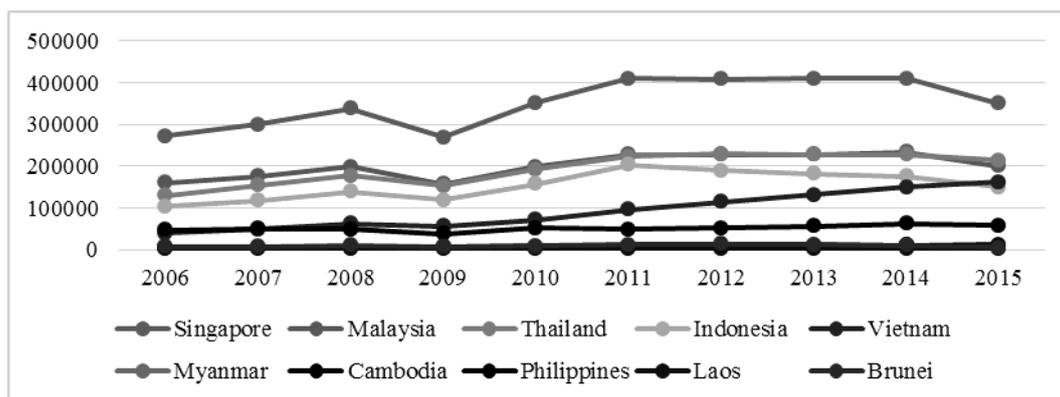


Figure 4. 2010-2015 ASEAN countries exports (millions of dollars)

Among the ASEAN countries, the export volume of Singapore is far more than that of other countries; the Thailand, Vietnam and Indonesia are the second clusters; Philippines, Brunei, Laos, Kampuchea and Burma are the third clusters.

3.3. ASEAN countries stratified results

Taking into account the level of economic development of ASEAN countries, ASEAN countries' trade development and logistics development level will ASEAN countries divided into four national clusters. Singapore is the only developed country in ASEAN countries, in all aspects is leading, therefore, Singapore is the first country; Malaysia, Thailand for the second cluster of countries; Indonesia, Vietnam, the Philippines and Brunei for the third cluster of countries; Cambodia, Laos and Myanmar for the fourth cluster of countries.

IV. ASEAN LOGISTICS DEVELOPMENT DEMAND FORECASTING MODEL SELECTION

This paper we need to study the logistics demand forecast of ASEAN countries. The demand forecasting index can reflect the scale of regional logistics demand, and use no flow as a measure of the scale of logistics demand. At present, considering the availability of data, Indicators to reflect the situation of logistics needs of countries. By the ASEAN countries, the gap between the levels of logistics, so ASEAN as a whole selection of forecasting methods will cause greater error. Before the ASEAN logistics development needs are forecasted, the ASEAN countries will be divided into the same cluster, and the forecasting errors can be reduced for the

countries with different economic development, trade development and logistics development. In addition, the ASEAN regional logistics forecast and the ASEAN countries cluster forecasting methods for comparison, analysis, in order to get accurate predictions, reduce the forecast error. To accurately predict the future flow of ASEAN countries, that is, cargo volume, mainly based on the impact of logistics needs related to a strong impact factors, combined with the ASEAN countries to select ASEAN countries, the total GDP as an indicator of the level of economic development and the current ASEAN countries Freight volume as an indicator of the development of national logistics. ASEAN countries, the level of economic development and the development of freight and logistics needs are closely related. Under normal circumstances, the rapid economic development, trade, developed goods circulation of the higher degree of activity, the greater the demand for logistics. From 2006 to 2015, ASEAN countries' total GDP and freight trends, rational analysis, selection of convenient, scientific and accurate and applicable to each cluster country method. Through the analysis of historical data from 2006 to 2015, it is found that the global financial crisis, the GDP and exports of ASEAN countries at the end of 2008, have been badly impacted, leading to a severe decline in global trade in 2009, 2009 event was a small probability event, to this year's data reflect the future will have a greater error, so the 2009 data as abnormal values, in the analysis of data will be removed. In recent years, ASEAN countries, the freight volume of each cluster shown in Figure5.

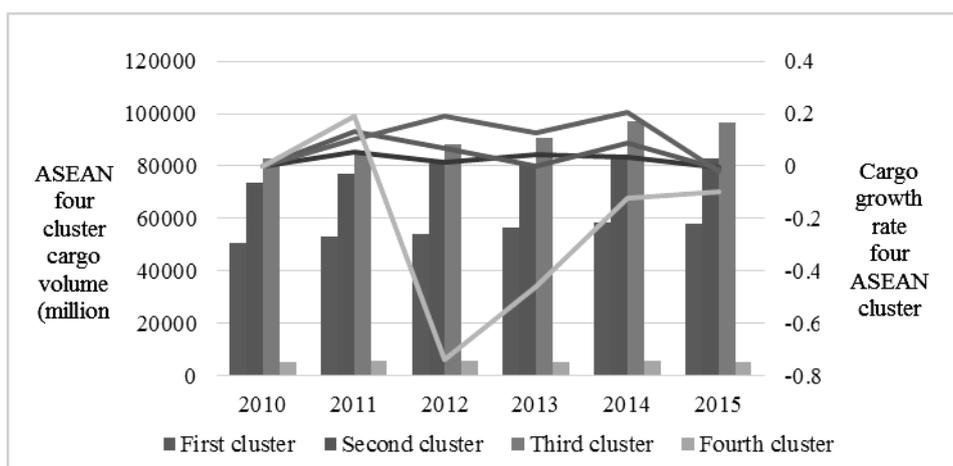


Figure 5. 2010-2015 China - ASEAN total import and export trade and the difference (unit: billion)

From figure 5, before 2014, ASEAN countries continue to increase cargo volume, ASEAN fourth cluster of countries, and the growth rate of freight volume fluctuations. In view of the development trend of GDP and freight volume of ASEAN countries, this paper chooses different models to calculate ASEAN's cargo demand in the next five years, that is, ASEAN's demand for logistics in the next five years. For the historical data of the first and second cluster countries in ASEAN, it is obviously inappropriate to use straight line fitting, so the exponential smoothing method is more applicable, and the exponential smoothing method is more complicated than other forecasting methods and requires a large number of data, taking into account the availability of data and other factors, select the operation is simple, the calculation

of a small amount of index smoothing method for cargo forecast. The growth rate of freight volume in the third and fourth cluster countries of ASEAN fluctuated greatly, and the freight volume between them was different. The previous forecast models were static model, the model parameters were fixed and the freight volume was dynamic, time variation affects the degree of

correlation of each factor to the predicted quantity, and the difference between them is large. Therefore, the improved multi-level hierarchical regression method can better reflect the application of high correlation factor in the forecasting model. Considering the time-varying characteristics of the dynamic system, it can eliminate the prediction error caused by the difference between the factors. Therefore, the improved multi-level hierarchical regression analysis and prediction model is more suitable to predict the ASEAN's third and fourth clusters freight volume.

V. ON THE FIRST AND SECOND CLUSTER COUNTRIES LOGISTICS DEMAND FORECAST

5.1. Forecasting model

The third-order exponential smoothing method is a kind of time series forecasting method. The prediction model is:

$$Y(t+1)=\alpha X(t)+(1-\alpha)Y(t) \quad (1)$$

Among them, (t) initial data for phase t , $Y(t)$ exponential smoothing predictive value for t period set the time series to $X_1, X_2, X_3, \dots, X_t$. The forecast period is T year, the base year is the index of the year $Y(t+T)$, and the mathematical model of the cubic exponential smoothing method is:

$$Y(t+T)=a_t + b_t T + c_t T^2 \quad (2)$$

Among them, a, b, c are smoothing coefficients.

5.2. The smoothing coefficient α is worth determining

When applying the exponential smoothing method for trend prediction, it is also necessary to reasonably determine the value of the smoothing coefficient α . From the exponential smoothing value calculation formula we can see, the next exponential smoothing value is the appropriate adjustment of the error between the actual value of the next period (or the previous exponential smoothing value) and the current exponential smoothing value (multiplied by the coefficient α). At this time α take a larger value (0.7 ~ 0.9). The 2014, 2015 forecast and the actual value of the error analysis, after calculating the root mean square error, the first batch of ASEAN countries to obtain the amount of cargo $\alpha = 0.8$, ASEAN second cluster country $\alpha = 0.7$, the prediction results are better.

5.3. Forecast result

According to the above formula, the prediction model of the third exponential smoothing method of the first cluster and the second cluster of ASEAN is:

$$Y_{t+T} = 58315.8 + 2224.7T + 227.1T^2$$

$$Y_{t+T} = 83197.4 + 1933.9T - 40.5T^2$$

This paper chooses the cargo volume of ASEAN countries from 2006 to 2015 as sample data (the data are derived from the World Bank database and ASEAN countries). Can be the first cluster of ASEAN, ASEAN second cluster 2016-2025 cargo forecast value of the calculation results shown in figure 6:

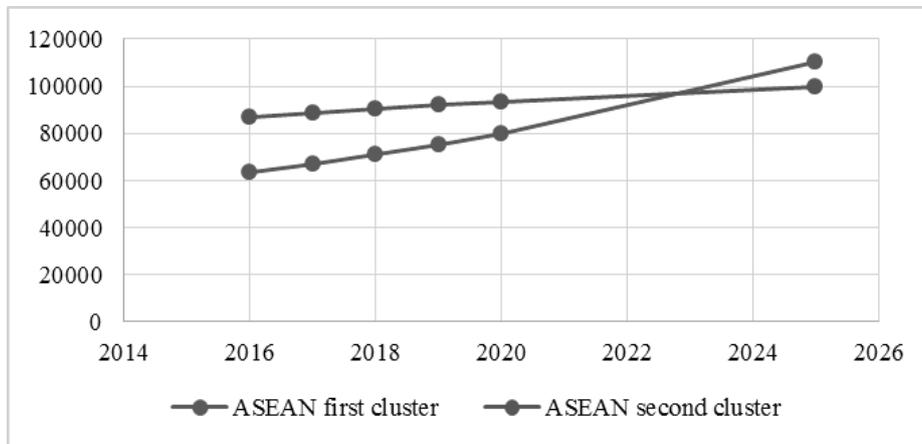


Figure 6. 2016-2025 ASEAN first cluster, the second cluster of cargo (unit: million tons)

VI. THE DEMAND FORECAST OF LOGISTICS IN THE THIRD AND FOURTH CLUSTER COUNTRIES

6.1. The principle and method of improved multilevel bidding regression algorithm

At present, the research on freight traffic mainly focuses on the improvement of freight forecasting method, while the impact of cargo volume analysis. Cui Shu-hua ^[9] analysis of road freight volume factors are mainly a region of the total population, fixed asset investment, energy production, total amount of entry and exit, the length of the highway line and the gross domestic product and other factors. Chen Shi ^[10] from the economic factors, logistics service factors and policy factors to analyze. Song Cai-ping ^[11] that the impact of cargo factors, including five indicators. It can be seen that there are many indicators that affect the freight volume. For the prediction model selection, the correlation of each index is combined with the study of the ASEAN region to select the four factors related to the cargo volume to predict the large value of the freight volume, including the ASEAN third cluster, The total GDP of the fourth cluster country, the total import and export trade, the exchange rate and the number of unemployed.

6.2. Prediction model

Select the third cluster of ASEAN, the fourth cluster of countries 2006 - 2015 cargo volume is $y(k)$, GDP total is $\mu_1(k)$, the third cluster, the fourth cluster of countries exchange rate of change $\mu_2(k)$, ASEAN third cluster, fourth cluster country exchange rate $\mu_3(k)$, the third cluster, the fourth cluster of countries the number of unemployed $\mu_4(k)$. To establish an improved multi-level hierarchical regression model, we must first use the standardized data $[\mu_1'(k), \mu_2'(k), \mu_3'(k), \mu_4'(k)]$. The least squares method is used to establish the multivariate linear regression equations. The equations are obtained by using the column principal element method or the Gaussian elimination method. The information on the freight volume and the third cluster, the total amount of the fourth cluster country, the total import and export trade volume, the exchange rate and the regression equation and the regression coefficient of the number of unemployed. The significance of the regression equation test can be seen:

$$\frac{S_{\text{back}} / k}{S_{\text{gap}} / (n - k - 1)} > F_{0.05(4,5)} \quad (3)$$

So the significance level is 0.05, the regression equation is conspicuous. This shows that there is a linear relationship between the volume of freight and the third cluster, the total GDP of the fourth cluster country, the total import and export trade volume, the rate of exchange rate change and the number of unemployed persons. According to the time-varying parameter tracking recursive algorithm formula:

$$\beta_i' = \beta_i'(k-1) + \frac{1}{\sum_{i=1}^m [\mu_i'(k)]^2} a_i \mu_i'(k) \left[y'(k) - \sum_{i=1}^m \mu_i'(k) \beta_i'(k-1) \right] \quad (4)$$

The β_i' -valued sequence can be obtained, and the multi-layer AR model is used to predict the time-varying parameters. The model is as follows:

$$\beta_i'(k) = a_1(k) \beta_i'(k-1) + a_2(k) \beta_i'(k-2) + a_3(k) \beta_i'(k-3) + a_4(k) \beta_i'(k-4) + e(k) \quad (5)$$

Use the following time-varying parameters to track the formula for the time-varying parameter $\hat{a}(i, k)$:

$$\hat{a}(i, k) = \hat{a}(i, k-1) + \frac{1}{\sum_{i=1}^4 \beta_i'(k-1)} \left\{ \beta_i'(k) - \sum_{i=1}^4 \beta_i'(k-1) \hat{a}(i, k-1) \right\} \quad (6)$$

From (6), we can get the evaluation sequence of $\hat{a}(i, k)$, and then the predicted value of $\hat{a}(i, k)$ is obtained by mean approximation, thus, the forward prediction value of the time-varying parameter $\beta_i'(k)$ can be obtained according to equation (5):

$$\beta_i^* = a_1^*(11)\beta_i(11) + a_2^*(11)\beta_i(10) + a_3^*(11)\beta_i(9) + a_4^*(11)\beta_i(8)$$

2015 may be obtained when varying parameter prediction value, re-use:

$$y_i = \sum_{i=1}^m a_i \beta_i^*(k) u_i(k) + a_0 \quad (7)$$

According to the above formula, the third cluster of ASEAN, the fourth cluster forecast model is:

$$y(k) = 836229.1 + 0.31\beta_1'(k)\mu_1'(k) + 2.41\beta_2'(k)\mu_2'(k) + 27.54\beta_3'(k)\mu_3'(k) + 9.13\beta_4'(k)\mu_4'(k)$$

$$y(k) = 52112.91 + 8.06\beta_1'(k)\mu_1'(k) + 18.41\beta_2'(k)\mu_2'(k) + 1.19\beta_3'(k)\mu_3'(k) + 8.74\beta_4'(k)\mu_4'(k)$$

Can be the third cluster of ASEAN, ASEAN fourth cluster 2016-2025 forecast of freight volume calculation results shown in figure 7:

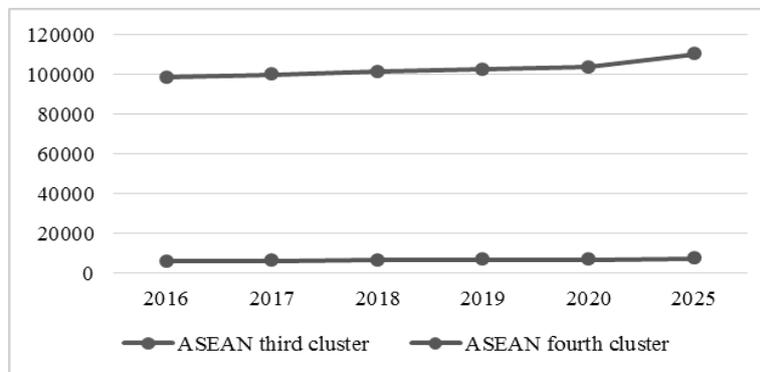


Figure 7 2016-2025 ASEAN third cluster, the fourth cluster of cargo (unit: million tons)

VII. CONCLUSION

In this paper, by forecasting the freight volume of the four ASEAN countries, we can see that the growth rate of freight volume in the next five years shows different trends, and the future growth trend and the annual increase are shown in fig. 8 and table 2 respectively.

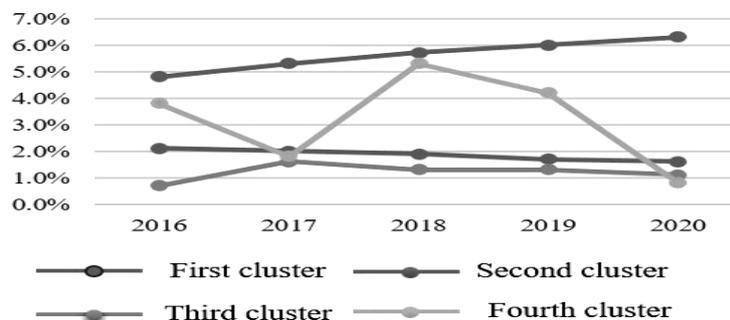


Figure 8. Growth rate of freight volume for four ASEAN countries in 2015-2020 (unit :%)

Table 2. Average annual growth rate of freight volume for the four ASEAN countries in 2015-2020

Category	Annual increase (unit :%)
ASEAN first cluster country	5.62%
ASEAN second cluster country	1.86%
ASEAN third cluster country	1.20%
ASEAN fourth cluster country	3.18%

From figure 8 and table 2, in the next five years of goods volume growth speed in four ASEAN groups, the goods volume of group 1 is stronger in increasing rate tendency, bigger and higher in scale than that of other three groups, in the next five years the goods volume of group 1 will continuously increase, claiming number 1 in the ranking table of ASEAN area; goods volume in groups 2 and 3 will be in stable condition however in a small scale, in the next five the goods volume will maintain in a moderate level; years goods volume in group 4 is still increasing however not stable, in 2017 and 2018 there will be changes, after 2018 the growth rate will go down, however development scale will go up. Based on the prediction and analysis of logistic demand in ASEAN, the development tendency of ASEAN logistics in the next five year is confirmed, the instructions for ASEAN logistics development plan is provided. Logistics development in each ASEAN country has its own different characteristic, Logistics development of Singapore always ranks number 1, level of logistics service is high, transportation is highly effective and the information network is completed. Logistics development in Cambodia, Laos and Myanmar rank very low, obstacles exist in every aspect, having bad impact to Logistics development. In recent years, Logistics development has been highly paid attention by the governments of other ASEAN countries, logistics service and other related aspects are also increasing.

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