

# Study on Factors Affecting the Freight Volume Index in Equal Part Linear Regression Model

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**Abstract**—The volume of freight is an important reference for measuring the results of a country's or region's transport production, reflecting the number of services the transport industry serves a country or region. This article will study the influencing factors of the freight index through a bifurcation linear regression model and conduct linear regression modeling by dividing the data into several equal parts to study the GDP index, fixed assets investment, industrial added value index, and society in Guangdong Province. The relationship between total retail sales of consumer goods and freight index. After using the R language to perform bisection linear regression simulations, it was found that the GDP index had a significant impact on the freight volume index at low division; fixed asset investment had a significant impact on freight volume at higher sub-divisions; industrial added value index and consumer goods Retail sales have a significant impact on medium-high scores. Therefore, Guangdong Province should ensure the normal growth of GDP, vigorously strengthen investment in fixed assets, appropriately strengthen industrial development, and appropriately promote retail sales of consumer goods.

**Index Terms**—freight volume index, GDP Index, Investment of Fixed Assets, Industrial Added Value Index, Total Retail Sales of Social Consumer Goods; Equal Linear Regression, Guangdong Province

## I. INTRODUCTION

In the past, when researchers studied freight volume, it was more about how to forecast freight volume in order to make transportation planning, and there were few literatures that directly studied the factors affecting the size of freight volume. In the study of the factors affecting freight volume, the former used the standard regression analysis and grey relational analysis method to analyze the freight volume and the relative independent variables directly through the model, and draw the conclusion. As one of the important indicators of national power, freight volume can reflect the economic service of this country or region. Quantity, and then become one of the important indicators to measure the production result of the transportation industry in this country and region. This article will take the author's Guangdong province as the research object, through the equal linear regression model studies the freight volume

index influence factor, We hope to find a way to improve the freight volume of Guangdong province and promote the economic development of Guangdong Province.

Linear regression, as an important prediction method, has been widely used in various research fields, but because of the existence of the linear regression model, the average value can be generalized to the extremes, which sometimes leads to the distortion of the research results. To remedy this shortcoming, the paper uses Pan (2017) professor of the equal part linear regression model, by dividing the data into several equal parts to model the linear regression, can avoid the extreme value being averaged a summary of the value of the case, in order to study the Guangdong province GDP Index, fixed asset investment, industrial value added index, and the relationship between total retail sales of social consumer goods and freight volume index.

## II. LITERATURE REVIEW

Song (2012) By the method of multiple linear regression to Harbin1990Years to2006The annual freight volume of logistics system in the past year has carried on the demonstration analysis, studies the freight volume and the gross national product, the fixed Assets investment total, the social consumer goods retail total and the transportation posts and Telecommunications Department fixed assets Investment total to the correlation, the result found that the Harbin Gross national product enhancement to increase Harbin freight The total fixed assets investment and the transport and postal departments of fixed assets investment in the weak influence, while social consumption A positive correlation between total retail sales and annual freight volume.

Albert (2015)Based on the grey system theory, the data of Chongqing freight volume and relative index are modeled and analyzed, and the regional GDP, the first industry output value, the second industry output value, the third industry production value, the whole society fixed Assets Investment, highway line mileage, the total value of import and export, social consumer goods retail amount, per capita GDP and the relationship between the freight volume, the road line mileage and the second industry and freight volume of the relationship between

the larger.

Meixiaoling (2015) by qualitative analysis to select 9A factor affecting railway freight volume, which is carried out by grey correlation and projection algorithm. 9A quantitative analysis of the influencing factors, the result found 9The influence of a factor on the freight volume of railway is from small to large: the sum of freight volume of waterway and highway, volume of goods, first industry, tertiary industry, gross domestic product, national railway business mileage, secondary, railway industry workers, total import and export trade.

Elegant (2017) by building Copula Model to study the relationship between regional logistics and local economic development, and found that the overall presentation is positively correlated. Shou and Sun are expected (2009) to forecast freight volume and solve traffic planning, the paper qualitatively analyzes the influence of each industry development on freight volume, and concludes that the development of one or two industry will have great influence on freight volume.

Liu Yan (2016) in order to study GDP and the relationship between freight volume, which is divided into water transport, highway, civil aviation and railway, through the establishment of grey relational analysis model, analysis of water transport, highway, civil aviation and railway four modes of transportation and GDP the correlation between the results found that water transport on GDP the impact is the most, the road is the second, the impact of civil aviation ranked third, the railway is the smallest.

To study this 5 Effect of factors on railway freight volume, the author evaluates the forecast result by time

series forecasting model, multivariate linear regression model and neural network model, finds that the national total revenue has positive effect on railway freight volume, the national kerosene production has positive effect on railway freight volume, and the national steel production has positive effect on railway freight volume, The road freight volume has negative effect on the quantity of railway cargo, and the waterway freight has negative effect on the railway cargo volume.

### III. SAMPLE DATA

The research data used in this paper come from the statistic data of Chinese knowledge net, remove some incomplete data, and finally choose Guangdong Province 1985 to 2014 data from 30 years of the year as empirical information. Data is divided into 5 Class, the selected variables are Guangdong Province Freight volume index, Guangdong Province GDP Index, investment amount of fixed assets in Guangdong Province, industrial value index of Guangdong province, total retail sales of consumer goods in Guangdong Province, and finally get valid data altogether 150 row.

The data selected from the research object in this paper is taken 1985 Year to 2014 Year, due to industrial value added index valid data only to 2014 Years GDP Index, fixed asset investment, and the total retail sales of social consumer goods also only to 2015, so the relative time is selected Model analysis was carried out in the near 30-year data.

The following table is the sample data selected in the empirical analysis.

TABLE I.  
SAMPLE DATA

Year	X1: GDP index	X2: fixed investments	X3: industrial value-added	X4: Total Retail Sales of Consumer Goods	Y: Keqiang Index
2014	107.8	262,940,000	108.0	284,712,000	107.6
2013	108.5	223,084,000	107.9	254,539,000	114.8
2012	108.2	182,501,300	107.4	226,771,000	111.5
2011	110.0	165,991,600	110.5	202,467,000	114.6
2010	112.4	125,992,600	114.6	174,584,000	114.1
2009	109.7	102,300,500	108.4	148,918,000	117.3
2008	110.4	86,408,700	112.4	129,866,000	109.9
2007	116.3	92,943,000	117.8	107,313,000	113.4
2006	116.8	81,323,700	119.6	91,943,000	108.9
2005	115.7	69,779,000	119.0	79,155,100	101.5
2004	116.8	60,255,300	121.4	68,520,300	108.4
2003	116.9	50,305,700	122.7	60,298,600	105.1
2002	114.4	39,706,900	116.5	53,926,400	104.1
2001	113.3	35,364,100	114.5	48,565,500	110.4
2000	113.7	32,337,000	115.1	43,798,100	106.0
1999	110.1	30,275,600	110.9	39,324,400	104.3
1998	110.8	26,681,300	112.9	35,670,100	102.2
1997	111.2	22,981,400	114.4	31,393,200	104.4
1996	111.3	23,276,400	113.9	27,728,300	86.1
1995	120.4	23,272,200	124.6	24,783,500	92.6
1994	119.7	21,411,500	127.2	19,913,300	95.7
1993	123.0	16,298,700	139.8	15,183,100	110.7
1992	122.1	9,217,500	130.8	11,095,500	120.2
1991	117.7	4,782,000	123.0	7,866,400	109.7
1990	117.5	3,814,700	121.5	6,673,600	100.9

1989	107.2	3,473,400	110.8	6,361,500	106.6
1988	115.8	3,525,900	128.0	5,680,700	107.0
1987	119.6	2,510,100	131.6	4,051,900	114.6
1986	112.7	2,165,000	108.8	3,270,200	110.8
1985	118.0	1,845,900	120.9	2,892,300	177.1

The above data should be properly processed and the following table is obtained.

TABLE II.  
SAMPLE NARRATIVE STATISTICS OF GUANGDONG PROVINCE

Variable	Average	Standard deviation	Minimum value	Maximum Value
Freight index	109.68	14.64	86.1	177.1
GdpIndex	114.27	4.43	107.2	123
Investment amount of fixed assets	60225833.33	69241244.41	1845900	262940000
Industrial Value Added Index	117.83	8.11	107.4	139.8
Total retail sales of consumer goods	73908866.67	81329047.12	2892300	284712000

IV. RESEARCH METHODS

A. Equal Part Linear Regression

Linear regression, as an important prediction method, has been widely used in various research fields, but due to the existence of the linear regression model, the average value can be generalized to extremes, which leads to the distortion of the research results. To address this problem, Pan (2017) Professor proposed the equal part linear regression model, by dividing the data into several equal parts to model the linear regression, to some extent, to avoid extreme values are flat A summary of the average.

According to the need of the actual problem, the linear regression is similar to the research method of the classification regression, and the linearity data is cut into "τ" The division, respectively, to model the regression, so that the different parts of the N Individual adaptive linear regression model of group data points.

This paper The data is divided into three equal parts in chronological order. 10 Group data, in three different parts, different data have different trends, the three sets of data to fit the linear regression model, can be expressed as the following linear regression:

$$y_i^c = \beta_0^c + \beta_1^c x_i^c + \epsilon_i^c$$

The least square estimator can be expressed as:

$$\hat{\beta}_0^c = \frac{\sum_{i=1}^n (x_i^c - \bar{x}^c)(y_i^c - \bar{y}^c)}{\sum_{i=1}^n (x_i^c - \bar{x}^c)^2}$$

$$\hat{\beta}_1^c = \bar{y}^c - \bar{\beta}_0^c \bar{x}^c$$

The judgment coefficient and the trust interval can be expressed as:

$$(\hat{\beta}_i^c - t_{\alpha/2} \times s_{\hat{\beta}_i^c}, \hat{\beta}_i^c + t_{\alpha/2} \times s_{\hat{\beta}_i^c}), i = 0,1$$

You can add a symbol to a specific position in the equation "c".

B. R Language software

The author of this paper adopts R Language as a case data analysis of the main analysis software. R Language is a kind of language and operating environment which is mainly applied in the field of cartography and statistical analysis. it in1980 Year or so by belonging to S The development of a branch of language is widely used in the field of statistical analysis. As a complete set of data processing, computing and mapping software systems, R The language is simple, easy to use and powerful, and can be applied to the establishment, simulation, operation, analysis and drawing of the regression model perfectly.

V. EMPIRICAL ANALYSIS

Empirical analysis of the collection of Guangdong province 1985 to 2014 Statistical data of the year as sample, freight volume index (Y) as a dependent variable to GDP Index (X1), Fixed Assets investment (X2), industrial growth Added Value index (X3) and the total retail sales of consumer goods (X4) are divided into linear regression analysis for the independent variable.

Table III.

STATISTICAL ANALYSIS OF LINEAR REGRESSION SAMPLES

Standard regression R2=0.07	linear	First Division R2=0.82	Second Division R2=0.69	Third quarter R2=0.46
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Variable	Coefficient	T	Significant	Coefficient	T	Significant	Coefficient	T	Significant	Coefficient	T	Significant
Constant	-3.12	-0.27	-	-1.28	-1.38	-	7.22	0.82	-	-9.89	-0.39	-
X1	1.92	1.10	-	4.73	3.36	**	3.63	0.15	-	3.02	0.89	-
X2	-2.25	-0.68	-	-2.76	-3.15	**	-1.07	-1.11	-	6.28	0.94	-
X3	-6.88	-0.73	-	-2.70	-3.02	**	-2.49	-0.12	-	-8.21	-0.50	-
X4	2.18	0.75	-	3.17	3.00	**	1.26	1.63	-	-9.81	-1.22	-

From table 3, it was found that the first equal part of the EPLRM, and the four variables were less than 95% significant levels. It showed that the four variables had significant explanatory power to Y at the low level. In the standard linear regression model, the four variables are not significant, indicating that the standard linear regression model is not strong enough to explain the sample. In the second and third equal part of the EPLRM, the four variables are not significant, indicating that the equal part linear regression model is not strong in the interpretation ability of the data in second equal part and

third equal part.

“Fig. 1” is the trajectory of the coefficient of equal part linear regression and the confidence interval, in which the red dotted line is a standard linear regression line, and the upper and lower two black dotted lines are the upper and lower confidence intervals of the standard linear regression lines, the irregular rough lines are equal part linear regression lines, and the upper and lower grey areas are the upper and lower confidence intervals of the equal part linear regression lines.

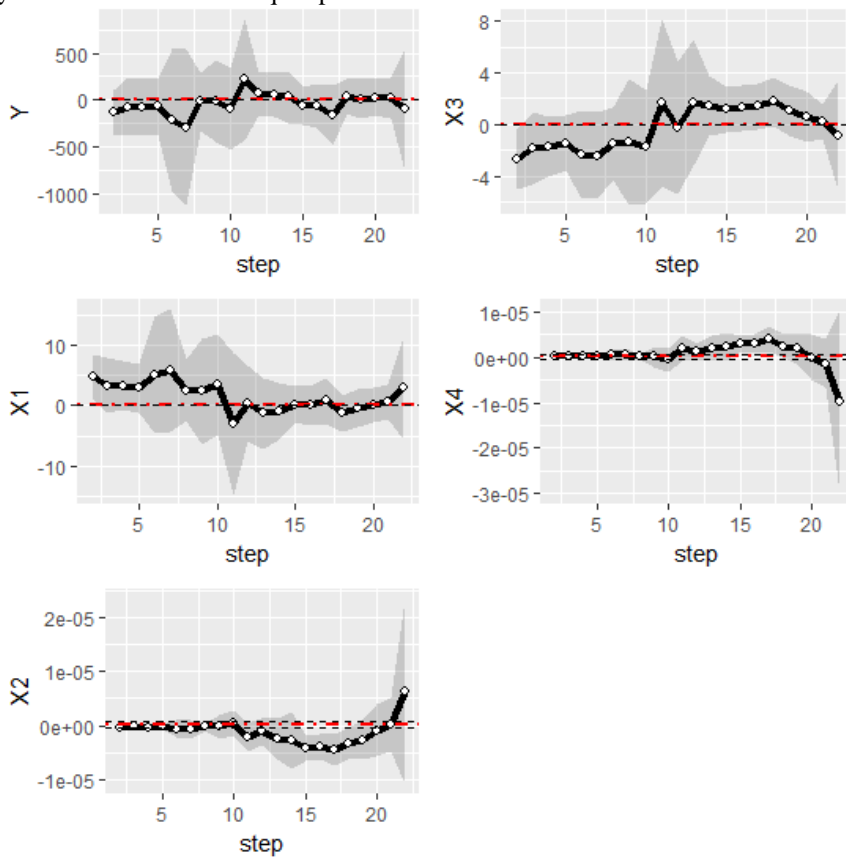


Figure 1. Linear regression trend chart of freight volume index

According to the “fig. 1”, we can see that in the variable (X1) Guangdong Province GDP In the correlation between index and freight volume index, the conclusion of the standard linear regression model is underestimated in the lower branch, and there is an underestimation trend at the high point. If the standard linear regression model is used to GDP The correlation

between index and freight volume index may lead to insufficient investment. In other words, for the impact on the freight index, GDP Index this variable to keep enough GDP Growth has a particularly significant effect on the increase in freight volume indices, and when GDP When the index exceeds a certain level, its influence on the freight index will become less obvious, but after the

higher level, the significant trend is increasing.

Therefore, if the volume of freight is to be increased Number can be considered to improve GDP, thereby improving GDP Index to promote the growth of the freight index. In the variable X2. The relationship between the investment amount of fixed assets and the freight index in Guangdong province, in the lower division, the influence of fixed assets investment amount on the Freight volume index the conclusion of the standard linear regression model is basically consistent, at the middle point, the standard linear regression model There is an overestimation of the impact, and in the high score, the impact is underestimated, that is to say, fixed asset investment in a certain range of increase will not have a particularly significant impact on freight volume, so it is good to maintain appropriate investment quotas.

However, if higher than a certain level, the impact of fixed asset investment on the freight volume index significantly increased, so from the point of view of increasing the freight index, it is necessary to ensure that the appropriate investment in fixed assets, on the basis of economic capacity can consider a substantial increase in investment, To develop the potential of the impact of fixed asset investment on freight index. In the

variableX3In the correlation between the industrial value Index and the freight volume index, the conclusion of the standard linear regression model is that there is an overestimation in the lower division, and there is an underestimation in the middle and high points, and the overestimation trend in the higher score, the small increase of the industrial value index will not have much effect on the freight volume index, But once a lower level is exceeded, the freight index will have a significant, and when the industrial value index reaches a certain level, the impact on the freight volume index will become insignificant, so a significant increase in the value of the wage index before exceeding a larger value can greatly boost the volume index. In the variable X4 The relationship between total retail sales of consumer goods and freight volume index, in low division, the standard linear regression model and the linear regression model are in accord with the conclusion that the median linear regression model is overvalued and the higher score continues to underestimate, so if we want to increase the freight index by increasing the total retail sales of consumer goods, we should vigorously strengthen the retail sales of consumer goods and promote the substantial increase in freight volume.

Table IV.

DIFFERENCE BETWEEN THREE EQUAL REGRESSION COEFFICIENTS FINSPECTION

Variable	$\tau_1 - \tau_2$		$\tau_1 - \tau_3$		$\tau_2 - \tau_3$	
	F	Significant	F	Significant	F	Significant
Constant	0.289513989	-	0.522886751	-	1.806084577	-
GdpIndex	0.140170124	*	1.815741539	-	12.953841244	**
Investment amount of fixed assets	0.017502097	***	0.012336658	***	0.704867402	-
Industrial Value Added Index	0.105203475	*	1.591714229	-	15.129863636	**
Total retail sales of consumer goods	0.008747563	***	0.005023510	***	0.574275358	-

It can be seen from the table 5 that there are significant differences in the GDP index (X1) and the industrial added value index (X3) in the first and second equal part coefficients. There are very significant differences between the fixed assets investment (X2) and the total retail sales volume (X4) of the social consumer goods (X4). There are very significant differences between fixed assets investment (X2) and total retail sales of social consumer goods (X4) at the first and third equal part. However, there is a significant difference between the GDP index (X1) and the industrial added value index (X3) at second equal part and third equal part. This result is consistent with the expectation of the equal linear regression model. The above differences can be judged by all equal part linear regression lines.

VI. CONCLUSIONS

The Statistical Yearbook of Guangdong Province in China 1985 to 2014 30 Years of data, using the method

of dividing linear regression R Language software, research and analysis of freight index and Gdp The relationship between index, fixed assets investment amount, industrial added value Index and total retail sales of social goods, according to the conclusion of empirical analysis, the following conclusions are drawn and relevant suggestions are put forward.

First, in Guangdong province Gdp In the correlation between index and freight volume index, the conclusion of the standard linear regression model is underestimated in the lower branch, and there is an underestimation trend at the high point. If the standard linear regression model is used to Gdp The correlation between index and freight volume index may lead to insufficient investment. In other words, for the impact on the freight index, Gdp Index this variable to keep enough Gdp Growth has a particularly significant effect on the increase in freight volume indices, and when Gdp When the index exceeds a certain level, its influence on the freight index will become less obvious, but after the higher level, the

significant trend is increasing.

Therefore, if we want to increase the freight index, we can consider raising Gdp, thereby improving Gdp Index to promote the growth of the freight index. In the relationship between the amount of fixed assets investment in Guangdong province and the freight index, in the lower division, the impact of fixed assets investment on freight volume index the conclusion of the standard linear regression model is basically consistent, in the middle point, the standard linear regression model has an overestimation on the relative influence of fixed assets investment on freight volume, and in high grade, The influence is also underestimated, that is to say, the increase in fixed assets investment will not have a particularly significant impact on freight volume, so it is good to keep the appropriate investment quota. However, if higher than a certain level, the impact of fixed asset investment on the freight volume index significantly increased, so from the point of view of increasing the freight index, we need to ensure that the appropriate Investment in fixed assets, on the basis of economic capacity can consider a substantial increase in investment in order to develop investment in fixed assets on the impact of freight index potential. In the industrial added value index and freight volume refers In the correlation of number, the conclusion of the standard linear regression model is overrated in the lower branch. There is an underestimation in the medium and high places, and in higher points there is an overvalued trend, and a small increase in the industrial value index will not have much effect on the freight volume index, but once it exceeds a certain low level, will have a significant impact on the freight volume index, and when the industrial value index reaches a certain level, the impact on the freight index will become insignificant, so before a large value, the increase in the value of the wage index can greatly Promote the increase of freight volume index. In the relationship between the total retail sales of consumer goods and the Freight volume index, the standard linear regression model and the linear regression model are generally in line with the conclusion that the standard linear regression model has an overestimation and the higher score continues to be underestimated. If we want to increase the freight index by increasing the total retail sales of consumer goods, we should vigorously strengthen the retail sales of consumer goods and promote the substantial increase of freight volume.

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