THE ANALYSIS ON TRANSPORTATION STRUCTURE OF CHINA

(The Relevance Analysis on freight Transportation among Various Transportation Means of China)

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abstract: In this paper, by means of the "relative degree" relevance analysis model and the" relative coefficient " model of gray system theory, the relevance among various transportation means of freight transportation in Chinese comprehensive transportation system are quantitatively analysis, based on the practical statistic data of the total freight transportation turnovers, developing speed of turnovers and turnovers of different freight transportation mode. Meanwhile, several basic analysis results concerning with our transportation structure characteristics are presented: 1. Among various transport means, they are series--connected (high relevant, positive relative) in general; 2. The independent and complement relationships are being strengthened; 3. The parallel-connection composition phases are not formed yet; 4. The comprehensive transportation in our country should be developed in accordance with the basic national transportation conditions that among various transport means, work is shared out properly and development is taken coordinate.

1. INTRODUCTION

Along with China economy developing rapidly and continuously, the problem of Chinese transportation became serious recent years, this problem also limited the development of national economic. In this case, the development of transportation industry is not only the development of various transportation meanings themselves, but also need us to establish corresponding policy of transportation and make reasonable planning based on the nation detail situation, so that to build the best integrated transporting capacity, only by this way the requirements of economy development can be satisfied. Therefore, based on the national situation, how to set up the relevance analysis model of various transportation meaning and analysis the China transportation system structure is a important research field.

2. THE MEANING AND MODEL OF RELEVANCE ANALYSIS

The relevance analysis is a statistical method which can be used to study and analysis the relationship among two or more variables. When two or more variables are influenced by implicated factors, the relevance analysis is a powerful tool of data analysis. The transportation structure of China is mainly composed of 5 kinds of transportation means which named railway, road, water, pipeline and air transportation. The organic uniting of various transport means forms the transport system of China, the sharing out of work, operation and continuous development of various transport means accomplish passenger and freight transportation, therefore there are complicated relationship among various transport means, such as the promoting and leading relation of developing speed with the conditions of national conditions, social, economy the competition overlapping relation of superiority scope and coordination of transportation. So that to analysis the complicated relationship among various transportation means is very important, to study transportation system rational and the internal relationship of various means which is developing clarifying the characters of transport system and the position of various means in whole system.

There are different rational describing model which applied in many case. This paper mainly used the "relative degree" relevance analysis model and "relative coefficient" model. "Relevance degree" describing such model: the relative degree model is bring about with the creation of gray system theory. The relative degree of two relative variables described the mutual approaching level with the trendation based on time changing, this represent the level of geometric figure. Assuming there are two variables X, Y with relationship, In a specified period, N corresponding observations X_1, X_2 ,..., Xn and Y_1, Y_2 ,....., Y_n are received, then the calculation formula is:

$$r = \frac{1}{n-1}\sum \zeta_t$$

$$\zeta_t = 1/(1+|{}_\Delta X_t/X_t - {}_\Delta Y_t/Y_t|) \qquad t = 1,2,\ldots,n-1$$

$${}_\Delta X_t = X_{t+1} - X_t, \qquad {}_\Delta Y_t = Y_{t+1} - Y_t$$

here: n is the number of statistic data, ζ_t stand for the relation coefficient in the period from t to $t+1$, it reflects the approaching level of X and Y in this period, r is the relative degree of X and Y, within (0,1), for a specified variable, the relative degree itself equal 1. If relative changing ration between two variables more closely, and relevant ration is high, it represent that there are more relevant relation of developing status with two variables. Therefore, to deal with the mutual relation of various meaning in system with relative degree analysis, r stand for the mutual close level among various meanings with time changing. "Relative coefficient" used to describe such model: relative coefficient is a statistic analysis quantity which used to describe the close level of relative relation and relative quality of two variables with the condition of straight linear relation. The calculation formula of relative coefficient is:

$$R = \sum (X_i - \mu)\bullet(Y_i - \nu) \Big/ \sqrt{\sum (X_i - \mu)\bullet(X_i - \mu)} \bullet \sqrt{\sum (Y_i - \nu)\bullet(Y_i - \nu)}$$

$$i = 1,2,\ldots,m$$

here: X_i and Y_i are statistic variable quantities, μ and ν to describe the average quantities of X_i and Y_i separately. N is the number of statistic data. R is relative coefficient which used to describe the close level of linear relation and relative quality. The scope of R is (-1,1) $(-1 \le R \le 1)$, the sign behalf the relative quality between variables, "-" means negative relative, "+" means positive relative, which means when positive relative, the increase (decrease) of X will lead to the linear increase (decrease) of Y, when negative relative, the increase (decrease) of X will lead to the linear decrease (increase) of Y. The closer the quantity of R approach 1(+1 or -1), the stronger the relative relation is, the closer the quantity of R approach 0, the weaker the relative relation is. If $R=1$ or $R=-1$, the two variables is relative completely. If $R=0$, The two variables is not relative at all. Therefore, by means of relative coefficient analysis method to process the relationship, we can draw a conclusion of the relative quality and characters of different transportation means with the assumption of linear relation. It can be learned from the conception and definition of " relative degree " and "relative coefficient" that the character of relative degree describing is would not be limited by linear relation of variables. The relative degree can reflect the strangeness and weakness of moving relation between two variables, The relative coefficient can give the relative quality information of two variables effective as well as strong and weak of linear relation with assuming that there is linear relation between two variables, It is more concrete and directly compared with relative degree under linear relation.

3. THE RELEVANCE ANALYSIS OF FREIGHT TRANSPORTATION AMONG VARIOUS TRANSPORT MEANS

The portion of freight traffic of each transportation means in the system show the contribution of this kind of transportation means. The relation of freight traffic (turnovers) among different means reflect the function of coordination development and relation of them. Since that, the relevance analysis of various meanings of system is the procedure analysis which reflect the characters and relative relation by the freight traffic (turnovers) of various meanings.

3.1 Relative Degree Analysis of Various Transport Meanings

Based on our statistic data of China transportation and relative degree analysis model, the result of relative relation analysis of transport turnovers meanings in China is listed as table 1 and table 2.

The transportation turnovers relative degree matrix of various meanings (1952----1978) **table 1**

air	*air transportation*	*water transportation*	*road transportation*	*railway transportation*
air	1			
water	0.8368	1		
road	0.8511	0.9146	1	
railway	0.8323	0.9308	0.9287	1

annotation: turnovers of road not including non-traffic department
water transportation not including ocean transportation
(The following is same)

The transport turnovers relative degree matrix of various meanings (1978------1995) table 2

	air	*pipeline*	*water*	*road*	*railway*
air	1				
pipeline	0.8485	1			
water	0.8880	0.9432	1		
road	0.8497	0.9422	0.9381	1	
railway	0.8636	0.9635	0.9628	0.9502	1

From the calculation result of the tables, it can be known that in general, the transportation turnovers relative degree of various meaning tend to increase with time going on. That means of freight relations of various meanings is closer and trend to coordinate development. In China transportation market, mutual depending and complementing relation is strengthened continuously with the development of transport system itself meanwhile, from the high relevant of various meanings (especially the relative degrees between railway and pipeline, water transport, road, road and pipeline, water transport are oeuvre 0.9), it can be drawn out that various meanings are not developed at same speed, but almost all meanings are developing with high speed at the same time. As whole, the transport system can not meet the requirement of freight transport. only by developing various means the long-term planning between transport and economical development can be solved effectively.

3.2 Relative Coefficient Analysis of Freight Transport Turnovers Developing Speed of Various Meaning

With relative coefficient analysis model, the result of relative relation analysis of freight transport turnovers developing speed (table3) of various meaning in China is listed as table 4.

The freight transport turnovers share of various meanings table 3

Time	*1949-1960*	*1961-1975*	*1976-1985*	*1986*	*1987*	*1988-1995*
railway transportation	21.22%	6.436%	6.827%	7.87%	8.07%	4.29%
road traffic department	26.23%	8.295%	5.150%	4.22%	5.91%	7.72%
inland river transportation	22.21%	5.494%	11.01%	13.88%	7.01%	7.45%
ocean transportation	18.92%	20.21%	11.35%	11.62%	10.59%	9.93%

Based on relative coefficient, it can be shown that freight transport developing speed of railway is in apparent positive relative with road, inland water transportation. The relative coefficient are 0.9301% and 0.8911%, road and inland river are also in positive relative too, whose relative is 0.7749%, between ocean transportation and

other meanings there are not apparent relative relation.

The relevance analysis matrix of the freight transport turnovers developing speed of various meanings table 4

	railway	*road*	*inland river*	*ocean*
railway	1			
road	0.9301	1		
inland river	0.8911	0.7749	1	
ocean	0.5722	0.5597	0.3406	1

The above positive relevance show that the various transportation means developing procedure is cooperated and prompting each other since new China foundation. The strong positive relevance between railway and road, water transportation indicates that the development of railway will promote and speed the development of road and water freight transport. It also proved the result of relative degree analysis is right, it represent that in China, each transportation means need developing and the competition phase of transportation market has not formed.

3.3 The Relative Coefficient Analysis of Classified Freight Transportation Turnovers of Various meanings

By means of relative coefficient analysis model, the result of relevance analysis of classified freight turnovers of various meanings is listed from table 5-1 to 5-12.

1980--1995 the relevance matrix of coal transport turnovers of various meanings table 5-1

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.6365	1		
total water	0.9607	0.5395	1	
inland & ocean	0.9876	0.6920	0.9604	1

1980--1995 the relevance matrix of oil transport turnovers of various meanings table 5-2

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.9499	1		
total water	0.9242	0.8599	1	
inland & ocean	0.9765	0.9754	0.9402	1

1980--1995 the relevance matrix of metal coal transport turnovers of various meanings table 5-3

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.9215	1		

total water	0.9449	0.8096	1	
inland & ocean	0.9487	0.9426	0.9027	1

1980--1995 the relevance matrix of steel transport turnovers of various meanings table 5-4

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.9308	1		
total water	0.8693	0.7625	1	
inland & ocean	0.8166	0.6528	0.9411	1

1980--1995 the relevance matrix of building materials transport turnovers of various meanings table 5-5

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	-0.8169	1		
total water	0.8986	-0.8845	1	
inland & ocean	0.9129	-0.8864	0.9975	1

1980--1995 the relevance matrix of cement transport turnovers of various meanings table 5-6

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.5465	1		
total water	-0.7608	-0.6106	1	
inland & ocean	-0.8014	-0.5682	0.7450	1

1980--1995 the relevance matrix of timber transport turnovers of various meanings table 5-7

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.8633	1		
total water	0.5602	0.6535	1	
inland & ocean	-0.0295	-0.073	0.1573	1

1980--1995 the relevance matrix of non-metal ore transport turnovers of various meanings table 5-8

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	-0.2682	1		
total water	0.7305	-0.4070	1	
inland & ocean	0.6865	-0.1089	0.4895	1

1980--1995 the relevance matrix of fertilicy and farm chemical

transport turnovers of various meanings table 5-9

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.5978	1		
total water	0.5189	-0.1726	1	
inland & ocean	0.9235	0.4348	0.6841	1

1980--1995 the relevance matrix of salt transport turnovers of various meanings table 5-10

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.9098	1		
total water	0.1046	0.2844	1	
inland & ocean	0.0420	0.1801	0.9833	1

1980--1995 the relevance matrix of grain transport turnovers of various meanings table 5-11

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.8961	1		
total water	0.6601	0.4907	1	
inland & ocean	-0.6247	-0.6328	-0.1450	1

1980--1995 the relevance matrix of others transport turnovers of various meanings table 5-12

	railway	*road*	*total water*	*inland & ocean*
railway	1			
road	0.9872	1		
total water	0.9557	0.9391	1	
inland & ocean	0.9930	0.8673	0.8018	1

Based on the result of table 5-1~5-12, according to the regulation that if the absolute relative coefficient equal or more than 0.8, the relation is strong relative, if little than 0.8 or more than and equal 0.5, the relation is general relative, if little than 0.5 and more than 0.4 the relation is weak relative, if little than 0.4, the relation is non-relative. The result of generalizing the relative relation among railway, road, water transport according to classified cargo is listed as table 6.

classified freight reliance analysis of various transportation mode table 6

non-relative	***strong positive relative***	***general positive relative***	***strong negative relative***	***general negative relative***	***general negative relative***
railway and road	oil, metal ore, timber, salt, steel, grain, others	coal, cement fertilizer and farm chemical	ore of building material		non-metal ore
railway and water	coal, oil, steel metal ore, ore	non-metal ore, grain	cement	grain	timer, salt

	of building material, fertilizer and farm chemical, others				
water and road	oil, metal ore and others	coal, steel, fertilizer and farm chemical	ore of building material	cement, grain	timber, non-metal ore, salt

Based on table 6, it is indicated that between railway and road, railway and water transport there is apparent positive relative (include strong and general positive relative) for main variety of freight transport in China such as oil, steel, coal, metal ore, fertilizer and farm chemical and other manufactured goods for daily requirement. It shows that for the purpose of Chinese freight transportation general demand, there is not competition relation but strong depending on relative among various meanings, concrete expression of the relation is mutual coordination, mutual complementing, mutual promoting and through transportation the separate superiority scope of various meanings. It can be known from the transport characters of various meanings and Chinese situation: railway transportation which has the characters of long distance, economic, and it is national bone line transport meaning, road is surface meaning which deal with short distance and collecting and distributing cargo. Water transport would not be powerful. unless it cooperated with other meanings because it is limited by geography location of shipping line. The result of these mutual depending and coordination function in fact is the essence of positive relative, the reason of the negative relation between railway and road, for the ore of building materials is transport distance of this matter is short enough in transport superior scope of both two meanings. for cement, the negative relation between railway and water transport is account to the transport distance and economic transportation, time value etc. is all in the superior scope of these two meanings ,another reason is that origin and end of traffic flow largely located near the coast. For different transportation objects, there is different relative relation between road and water transportation, the relation as to oil, metal ore, coal, steel, fertilizer and farm chemical is positive while ore of building materials, cement, grain are main committal matter.

Based on above analysis. We can think that Chinese main freight transportation require various transportation meaning cooperated in accomplishing the transportation procedure, within these transportation means, railway is the master transportation mode, road and water transportation are slavery, that is to say road and water transportation mode which concerned with integrated transportation and also collected distributed transportation mean to the railway. These three transportation means coordinated accomplish the freight transportation requirements of national economy development. For some specified matter, because of its own special transportation requirements and characters, there exist possibility of competition of various transportation meaning, but from table 6, it can be seen that these kinds of material is very few. Besides theses, the table 6 also indicated the general conclusion drawn from previous analysis of freight turnovers transportation relative degree and relative coefficient analysis of freight tumors developing speed: Chinese various transportation meaning developing speed and level can not satisfied (strong positive relative) the main body transportation requirement which need by the development

of national economy, transportation industry need to be developed fast.

4. GENERAL CONCLUSION

a. The freight transportation relationship between various transportation meaning in Chinese transport system become closer and tend to coordinate in the future. in another word, in Chinese transportation market, this kind of co-dependent relation between various meaning need to be stronger, then along with the transportation system developing and perfecting. in general, high relevance and strong relative both indicated Chinese freight transportation market has not entered competition phrase.

b. The result of high relevance and strong positive relevance of various meaning in Chinese freight transportation system show that national transportation system can not meet the requirements of national economy development in hand of qualities, the reason is that all meaning are in high-speed synchronous increasing period, transportation capacity can not meet the transportation requirements, each transportation meanings need vigorous developing.

c. Based on Chinese situation, to analysis the high-relevance and strong positive relevance relation between main freight and various transportation meaning, we can see that the reason of this kind relation is that besides various transportation being not developed, this relation concerned with that China is a wide land country, national resource distribution is not balanced. This natural condition forced the structure of China transportation system represented serial-connected character, in another word, the relation between various transportation is high relevance and strong positive relative. This is just the character of Chinese transport system. Since this, the serial-connected union transportation characters must be taken care of when development planning and corresponding policy of China transportation industry established.

d. It is can be known that since railway transportation mode is the key of Chinese transportation system, the high relevance and strong positive relation between railway and other transportation meanings indicate that the development of railway will prompt and driven the other transportation meaning to develop faster. But recent years, for the reason of investment and policy, railway development fall into a critical situation with prerequision of equipment, it also limited the development of the other transportation meanings. Therefore, the basic way of solving the difficult situation of China transportation is to develop railway as thread to drive the other meaning coordinately.

e. As to different cargo (transport object) the relative relation among various meanings is varied, which properly is mutual depending and competital relation, as a main transportation objective matter in China, the relation among various transportation meanings is fairly strong mutual depending relation. To individual transportation objective matter relation is fairly strong competital relation which is not Chinese freight transport main body.

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