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*Working Paper 554*

August 2000

**The Migration of Railway Freight Transport from Command  
Economy to Market Economy: The Case of China**

By

Ruhu Xie, Haibo Chen and Chris Nash

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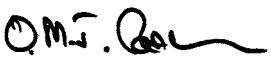
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**INSTITUTE FOR TRANSPORT STUDIES  
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# **The Migration of Railway Freight Transport from Command Economy to Market Economy: The Case of China**

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## **ABSTRACT**

In recent years, the Chinese railways freight transport has been facing great challenges from the transport market and economic expansion. The total freight volume has been increasing. But the market share of railway freight has decreased greatly, especially since the beginning of migration from command economy to market economy.

In this paper, we make some insight into five aspects. Firstly, the historical and current situation of freight transport in China and the relationship between economic development and freight transport is analysed. Secondly, the market structure of freight. Thirdly, the causes resulting in the loss of market share of Chinese Railways are discussed in detail. Fourthly, the current measures taken by the railway to restore its capability of competition and their effects are introduced. Finally, the future prospect of Chinese Railways is put forward. It is concluded that Chinese Railways has not yet adapted sufficiently to new economic conditions; although in recent years progress has been made, further change will be needed.

## ***Glossary***

BR	British Rail
CR	Chinese Railways
COFC	Container on Flat Car
DMIS	Dispatching Management Information System
GDP	Gross Domestic Product
IR	Indian Railways
JIT	Just-in-Time
MOR	Ministry of Railways
SNCF	French Railways
TOFC	Trailer on Flat Car
TMIS	Transport Management Information System



## INTRODUCTION

“As planning regulations which were carried out mainly in the form of guidance plans constantly improved, and as the control over prices further relaxed, prices of an overwhelming majority of consumer goods and means of production are now being set by the market. As a result, the market is playing an increasing evident role in augmenting supply, regulating demand and enriching the people’s life” (Report on the Work of the Government, Li Peng, 1998).

After taking the policies of reform and open door, particularly, after implementing the market economy system, Chinese transportation has changed significantly as have other economic departments. With the rapid development of the economy, the construction of transport infrastructure has achieved great success, the comprehensive transport capacity has raised significantly, and the growth of transport volume has been very high. An integrated transport network, which is composed of railway, highway, water, civil aviation and pipeline, has been established. The conditions of transport, which had been a bottleneck of the national economy, have been improved greatly, but are still a weak sector. In recent years, with the migration from command economy to market economy, the pattern of transport has been changed.

Railway transport has played an important role in the economic development of China. The railway has being called the artery of the national economy. Before the early 1990’s, Chinese railway freight transportation was the main goods transport means. But there had been 20 bottlenecks or so on main trunk lines by 1995, with more than 20% suppressed demand during the economic boom period. The railway had become a constraint on national economic development.

However, in recent years, railway freight transport has been facing great challenges from the transport market and economic expansion. The total freight volume has been increasing. But the market share of railway freight has decreased greatly. From 1990 to 1998, the average annual growth rate of national total freight lifted was 3.8%, but that of railways was only 0.7%. Furthermore, freight lifted by railways decreased by 5.3% from 1997 to 1998. In terms of freight moved, there was almost the same story as freight lifted.

Since 1990, the railway has lost market share, which in terms of tonnes was 15.5% in 1990 and decreased to 12.8% in 1998. By contrast, the market share of highway increased from 74.6% in 1990 to 77.2% in 1998.

Why and how did the Chinese Railways lose business? What part will Chinese Railways play in Chinese economic development in the future? What has been and will be done in order to restore the competitiveness of railway? This paper will give an answer to these questions.

The purpose of this paper is to provide some insight into five aspects: (1) the past and current role of railway freight transportation in China; (2) the relationship between freight transport and relevant factors; (3) the causes resulted in the loss of market share of Chinese Railways; (4) the current measures taken by railway to restore its capability of competition; (5) the future of railway freight transport.

## 2. HISTORICAL REVIEW AND CURRENT SITUATION

### 2.1 Introduction to Chinese railway transport

The railway plays a dominant role in the transport system and has an important effect on the economic development of China. We can find from table 1 that although the route length of railways is less than 5% of that of highways, its passenger traffic is about 8%, passenger-kilometres about 60%, freight traffic about 16% and freight ton-kilometres about 220% of those of highways.

Comparing with other countries, Chinese railway ranks very high in terms of traffic route, volume and density in the world. But, in terms of route-km per unit area and route-km per capita, China ranks very low.

Take freight transport for example. From table 2, we find that the Chinese Railways (CR) carries vastly more freight with less track than Indian Railways (IR). The differences with Britain (BR) and France (SNCF) are vast. The values of freight tonnes per line-km, freight tonnes-km per line-km, mean train loads and freight average transport distance are many times those at BR or SNCF. This difference represents the two railway freight types in the world. One is in big countries, and the scale of rail network is small relative to country size. One is in smaller countries, and the scale of rail network is bigger.

**Table 1. Basic conditions of transportation (1998)**

Modes	Length (10 000km)	Passenger traffic (10 000 persons)	Passenger- kilometres (100 million)	Freight traffic (m tonnes)	Freight ton- kilometres (100 million)
Railways in operation	5.76	93620	3696	16124	12312
Highways	127.85	1257332	5943	9760	5483
Water (Navigable inland)	11.03	20545	120	1095	19406
Civil aviation	150.58	5755	800	140	33.5
Pipelines	2.31	/	/	174	606

Source: Chinese statistics yearbook, 1999

**Table 2. International railway scale, traffic and density**

Items	CR(98)	IR(94)	BR(95)	SNCF(93)
Route-km	57 584	62 461	16 536	32 731
Double track (%)	34.2	24.1	70.1	49
% of route electrified	22.5	18.3	30.7	41.5
Tonnes (million)	1 612.43	358.7	101	123.4
Tonnes-km(million)	1 231 200	252 411	13 100	48 136
Market share of freight in tonnes (%)	12.75	40(1992)	6	14.9(1994)
Freight % of traffic units	77.0	44	30	46.5
Freight tonnes per line-km	28 000	5 700	6 100	3 770
Freight tonnes-km per line-km (million)	21.37	4.04	0.792	1.47
Mean train load (tonnes)	1634(1995)	1158(1990)	343.2(1990)	303.7
Freight average transport distance (km)	763.8	703.6	126.7	390.1
Route-km per 1000km <sup>2</sup>	6.0	19.0	67.61	59.3
Route-km per million population	50	69	286	570

Sources: 1. Chinese Statistics Yearbook 1999; 2. World Bank's Railway Database 1999.

Also in China, the majority of freight traffic is concentrated on some principal trunk railways. For example, in 1998, about 41% of freight lifted and 72% of freight moved were

accomplished by 24 principal trunk routes (such as Beijing-Shenyang, Beijing-Guangzhou, Beijing-Kowloon, Tianjin-Shanghai, etc.) among about 150 rail main lines in the country.

## 2.2 The freight volume over the past decade in China

### 2.2.1 The market share of freight traffic by mode

It can be seen from table 3 that the national total freight lifted had been increasing from 1990 to 1997 and had a slight downturn in 1998. It can also be seen that, the average annual growth rate of total freight lifted by railways was only 0.7%. This growth rate is much less than that by other transport modes and that of national freight lifted. The fastest growth of freight lifted was by air; its average annual growth rate was high as 34.8% but it remains very small in total.

From table 4, we can conclude almost the same story as table 3 in respect of tonne kilometres moved.

**Table 3. National total freight traffic by mode (m tonnes)**

Year	National Total	Railways		Highways		Water		Air	pipeline
		National	Local	total	Of which A*	total	Of which B*		
1990	9706	1462	44	7240	572	800	538	.37	157
1991	9857	1478	49	7339	666	833	572	.45	155
1992	10458	1523	53	7809	674	924	623	.58	147
1993	11157	1566	60	8402	616	979	642	.69	148
1994	11802	1571	59	8949	561	1070	632	.83	150
1995	12348	1593	65	9403	518	1131	633	1.01	152
1996	12962	1616	71	9838	506	1274	623	1.15	159
1997	12758	1618	78	9765	495	1134	619	1.25	160
1998	12643	1532	80	9760	470	1095	591	1.40	174
C** (%)	3.8	0.6	10	4.3	-2.2	4.6	1.2	34.8	1.3

\* A, B—transport enterprises directly under the departments of highways and water respectively.

\*\* C—average annual growth rate from 1990-1998.

Source: Chinese traffic and communication yearbook, 1999.

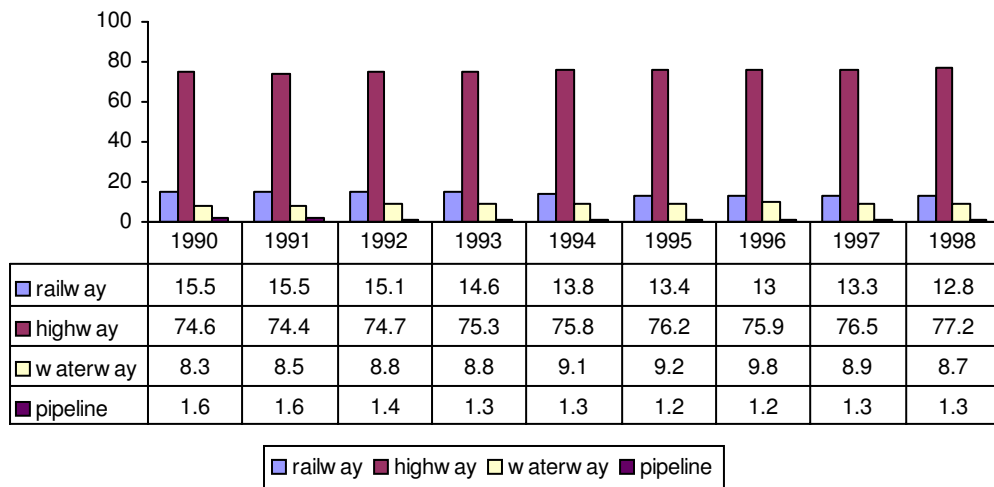
**Table 4. National total freight moved by mode (100 million tonne-kilometres)**

Year	Total	Railways		Highways		Water		Air	pipeline
		National	Local	total	Of which A*	total	Of which B*		
1990	26207.6	10601.2	21.2	3358.1	359.8	11591.9	11385.0	8.2	627.0
1991	27986.6	10948.1	23.9	3428.0	365.5	12955.5	12725.4	10.1	621.0
1992	29217.5	11548.5	27.0	3755.4	366.4	13256.2	12981.8	13.4	617.0
1993	30510.3	11923.4	31.2	4070.5	311.4	13860.8	13408.8	16.6	608.0
1994	33261.0	12426.0	31.4	4486.3	297.4	15686.6	14935.6	18.6	612.0
1995	35729.6	12836.0	34.2	4694.9	274.7	17552.2	16602.2	22.3	590.0
1996	36454.1	12922.0	48.6	5011.2	276.3	17862.5	16341.7	24.9	585.0
1997	38211.8	13046.4	50.7	5271.5	276.4	19235.0	17833.0	29.1	579.1
1998	37840.7	12261.5	50.7	5483.4	269.4	19405.8	17975.4	33.5	605.8
C** (%)	5.5	2.0	17.4	7.9	-3.1	8.4	7.2	38.6	-0.4

\* A, B—transport enterprises directly under the departments of highways and water respectively

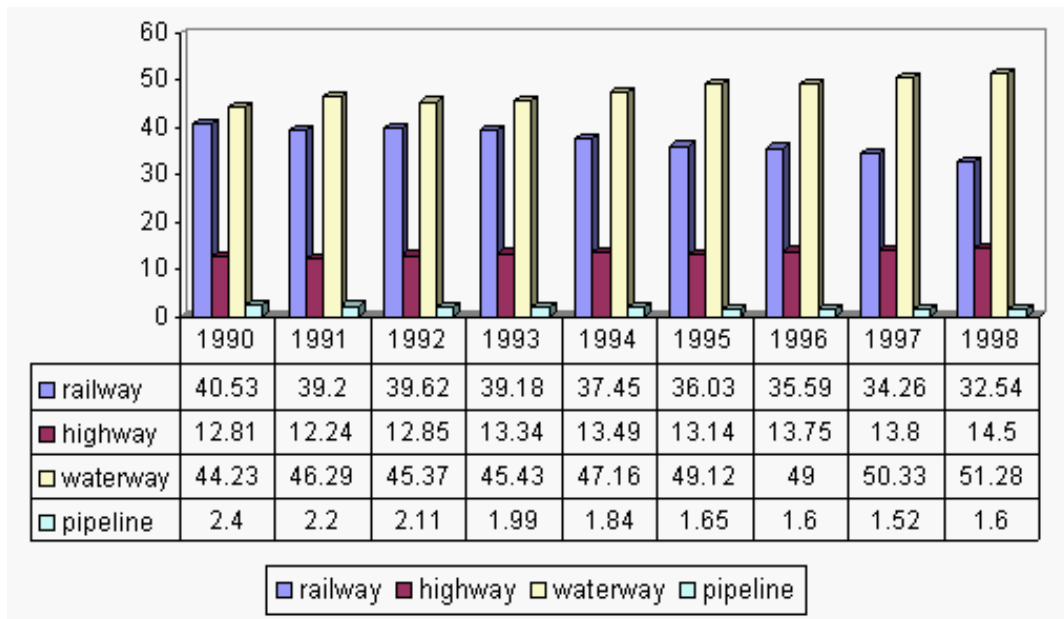
\*\* C— average annual growth rate.

Source: *Chinese traffic and communication yearbook, 1999.*



**Figure 1: The market shares of freight traffic by mode in tonnes, excluding the traffic by civil aviation.**

### 2.2.2 The market share of freight by modes in tonne-kilometres



**Figure 2: The market shares of freight traffic by mode in tonne-kilometres, excluding the traffic by civil aviation.**

It can be seen from figure 1 and figure 2 that the market share (in tonnes and in tonne-kilometres) of Chinese Railways had been decreasing since 1992. In contrast, the market share of highway had been increasing since the same year.

We can also see from figure 2 that the market share (in tonne-kilometres) of Chinese Railways has been declining since 1993. And those of highway and water have been growing. It was the year that the Chinese economic system was beginning the migration from a command one to a market one.

According to Taylor (1996), the change of transport market share is faster in EU than that in China. For example, the market share of railways had been decreased from 23.7% in 1985 to 14.9% in 1994. That of road had been raised from 61.3% in 1985 to 71.7% in 1994. Many of the developments that have taken place within the transport industry during this period have favoured the growth of highway transport as opposed to competing modes.

## **2.3 The worldwide background**

In recent years, the pattern of freight transport has changed significantly in worldwide scope. The changes are mainly resulted from the following aspects.

### ***2.3.1 New logistic concept***

As the economy develops, just-in-time (JIT) inventory systems are becoming more and more popular in the world. “ Under this system, all elements in the value chain, from raw material acquisition to delivered finished products, are synchronised to substantially cut sourcing, production and delivery cycles and substantially reduced, or even eliminate, inventories”(Kasarda, 1996). JIT has many advantages over traditional systems. For example, less warehouse space is needed, less money is tied up in inventory-related costs and the input product rises. The use of JIT techniques has put great pressure on the transport systems and has demanded a more flexible approach to the movement of freight. JIT was first introduced in Japan, and now it is widely used in the USA and EU.

### ***2.3.2 Increasing demand for “door-to-door” transport***

Most consumers and companies wish their goods to be transported “door-to-door”. Road transport can satisfy this requirement because road can reach almost every place whereas railway transport would have to use another form of transport to delivery the goods from a railway station to the door or pick the goods up from a shipper’s door to the railway station.

### ***2.3.3 New transport techniques***

Since 1970s, changes in trade mix and technology have brought a global increase in the volume of container traffic. There has been a fast increase in international container traffic since 1990s, especially in Asia. This expansion is mainly attributable to the growth of exports and imports of manufactured commodities (which are very suitable for container transport). In USA, the numbers of containers and piggyback semitrailers carried by the railroad doubled between 1983 and 1994. Growth has slowed down since then but has remained strong. (National Research Council of U.S.A, 1998).

The availability of intermodal services is one of the elements of the wave of technological change affecting logistics, one more option increasing flexibility for shippers and offering opportunities for cost savings. Containers transported via intermodal services save handling costs when freight must be transferred from one mode to another; also a truck-rail container movement can yield savings compared with truck alone if the cost of transfer is offset by rail’s lower cost per tonne kilometre. “The shift away from the use of a single mode of transportation for a shipment in favour of an intermodal approach is an important trend in contemporary freight transportation” (Clarke, Chatterjee et al, 1996).

Piggyback traffic involves two types of railway service. One is trailer on flat car (TOFC), which involves loading two or three highway trailers on a railway flatcar. The other is

container on flat car (COFC), which means containers are transported on a rail flatcar. Pickup and delivery service is performed by motor carriers (Wood and Johnson, 1995). With the development of intermodal transportation, piggyback will be playing a more and more important role.

### ***2.3.4 New structure of economy and production***

With the development of the economy, the structures of products, goods and market have been changed significantly. This generates new requirements for transport departments. These new requirements are mainly safer, faster, simpler and more flexible transport.

### ***2.3.5 Pressure from environment***

The increasing congestion and pollution in other transport modes are leading to politicians to favour railways. The external costs of transport take a number of forms, such as air pollution, global warming, accidents, traffic congestion and so on. Road transport is generally considered as an overwhelming cause of these problems. However, the railway has a reputation of environmentally friendly credentials compared with highway and air.

### ***2.3.6 Economic globalisation***

Since the early 1980s there has been a market growth and integration of world markets resulting in huge volumes of raw materials, components and finished products, information, and capital flowing across international borders every day. For example, U.S. exports and imports more doubled during the past decade reaching \$ 1.5 trillion in 1994 (Kasard, 1996). In China, the total exports and imports also doubled during the period of 1990 to 1997 reaching \$237 billion. Today, global sourcing is so commonplace that it is difficult to find assembled goods in one country made entirely of that country's parts and components.

## **2.4 The causes resulting in the changes of market share by mode**

### ***2.4.1 Water transport***

Chinese water transport is predominantly long distance international traffic. From figure 1 and figure 2, we can see that the market share in tonnes of water (including international transport by sea) had been increasing from 1990 to 1996 but decreasing slightly then to 1998. The market share in tonne-kilometres had a steady increase and played a main part in transport market during the past decade. The goods lifted and moved by water had an average annual growth of 1.2% and 7.2% respectively from 1990-1998.

The main cause of this phenomenon is the increase of volume of international trade, both in exports and in imports. According to the Chinese Statistics Yearbook (1999), from 1990 to 1997, the imports and exports increased by 106% (trade), 93.1% and 122.6% respectively. There had been some changes of the composition of export and imports. For example, in the sector of exports, the percentage of agricultural products, processed agricultural products and industrial products were 0.64%, 3.84%, and 95.52% respectively in 1990. Those in 1997 were 0.31%, 1.78%, 97.71%. The exports of industrial products increased very quickly, for instance, by 86.17% from 1990 to 1997. In the sector of imports, the percentage of agricultural raw materials, capital goods and consumer goods are 70.44%, 17.52% and 12.04% respectively in 1990. Those in 1997 are 67.41%, 18.99% and 13.06%. For the last decade or more, port handling of international containers has been growing at an annual rate of around 27% and the handling volume amounted to 10.77

million standard units in 1997, up 31% (Source: People's Republic of China Yearbook, 1998/99).

As to the increase of the market share of goods moved by water, as well as the increase in volumes of goods lifted the main cause is the increase of transport distance. The percentages of exports by destination have had a great change. For example, in 1990, the percentage of commodities exported to Europe, America and Asia were 9.89%, 5.53%, and 83.07% respectively. Those in 1997 were 12.1%, 6.38% and 74.22%. The commodities exported to Europe and America increased quickly, by 74.53% and 64.71%.

#### **2.4.2 Highways**

The enormous growth of road freight transport is reflected in the rapid development of all elements of road transport supply:

##### **(1) Rapid development of road infrastructure**

Because of the opening of the market of investment and capital, highway transport has been attracting vast capital sources. The development of infrastructure is therefore very fast during the past two decades. For example, the length of highways increased by about 44% from 1978 to 1998. In contrast, the length of railways has only increased by 18.5% in the same period. In addition, the quality and the level of highways has been raised greatly, especially, the development of freeways has been very swift since the middle of 1980s. There are more than 10 000 kilometres of motorway in China at the end of 1999.

##### **(2) Rapid increase of civil motor trucks numbers**

The number of civil motor trucks increased by 123% from 2 812 100 in 1987 to 6 278 900 in 1998. And the total loading capacities increased by 95% from 12.37 million tonnes in 1987 to 24.09 million tonnes in 1998. But the number of railway freight cars only increased by 46% from 300 886 in 1985 to 439 326 in 1998. The total loading capacities of freight cars also just increased by 62%.

##### **(3) Deregulation of transport market**

Because of the widening access to the transport market, the transport market of highways has become flourishing. The most important development was the huge rise in the number of firms in road freight business. Unlike state-owned firms, particularly railways, which normally have high overheads, small and mainly private-owned firms can offer lower prices and provide better services. The more competitive the private hauliers became, the more of the market share the state haulier lost. For example, the market share of freight lifted by own account trucks and privately owned trucks grew very fast, accounting for 62%, 68%, 73% of total national freight lifted in 1985, 1990 and 1998 respectively. But that by transport enterprises directly under the departments of highways owned trucks decreased from 10% in 1985 to 3.7% in 1998.

#### **2.4.3 Civil aviation**

The growth rate of civil aviation has been very high both in passenger and freight transport since 1978. The length of civil aviation routes increased by 10 times from 1978 to 1998. Air transport is a main means for long distance passenger transport. But in the sector of freight transport, the market share of civil aviation is very small, only 0.01% and 0.09 % in terms of freight lifted and moved respectively in 1998. Nevertheless, freight lifted and moved by air increased quickly, by 278% and 308% respectively from 1990 to 1998. The

main cause is the increasing transport demands of airmail and parcels, emergency goods and time-sensitive goods travelling long distances.

#### **2.4.4 Pipelines**

Pipeline is mainly used as the best transport mode for liquids, especially for crude oil, refined oil and gas. The length of pipeline has been increasing steadily at 5% annual growth rate. But the market share declined from 1.6% and 2.4% to 1.3% and 1.6% in terms of freight lifted and moved respectively in the past decade, because of freight shifting from pipeline to water with the increase of oil export and import traffic.

#### **2.4.5 Railways**

There is a detailed analysis of the causes of the change in railway's freight market share in section 4.

### **2.5 The relationship between economic development and freight transport**

In recent years, the Chinese economy has been getting rapid growth. Its GDP annual growth rate is more than 7%; the fastest in the world.

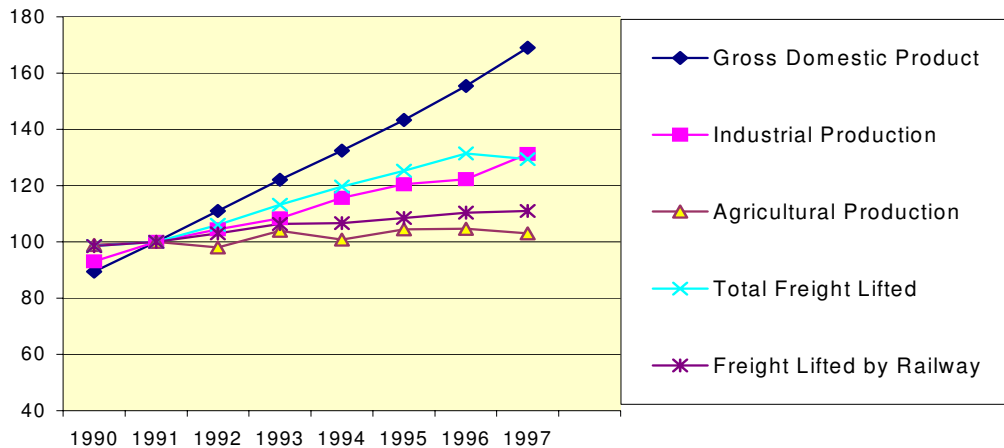
We can see from table 5 and figure 3 that the national economy has had a constant and rapid growth since 1990. The growth rate of industrial production was also very high. Consequently, there must be a great demand for freight transportation. In fact, the annual growth rate of total freight lifted was around 3.9%; the indexes of industrial production and total freight lifted were much in line. The index of railway freight lifted was much less than the former two indexes.

**Table 5. The growth rate of GDP, etc. (1991=100.)**

Year	Gross Domestic Product	Index of Industrial Production	Index of Agricultural Production	Index of Freight lifted	
				Total	Railways
1990	89.5	93.06	98.9	98.5	98.5
1991	100	100.0	100	100	100
1992	111.0	104.48	98.0	106.1	103.1
1993	122.1	108.34	104.0	113.2	106.4
1994	132.5	115.61	100.8	119.7	106.7
1995	143.3	120.46	104.5	125.3	108.5
1996	155.4	122.29	104.7	131.5	110.4
1997	169.0	131.30	103.1	129.4	111.0

Source: 1. Chinese statistics yearbook, 1999; 2. Chinese traffic and communication yearbook, 1999.





**Figure 3: The growth rate of GDP, etc (1991 = 100)**

In China, the structure of GDP by kind of economic activity has been changed greatly. For instance, the percentage of agriculture, forestry, hunting and fishery has decreased from 4.9% to 2.73%. The percentage of industry (include manufacturing, electricity, gas, water and construction) has declined from 42.31% to 34.93%. But the percentage of services has raised from 52.79% to 62.34%. Therefore, this is one reason why the annual growth rate of GDP is very high, but that of freight is so low.

Information on the structure of the overall freight market in China is limited by the lack of data on account of private road haulage. However, Table 6 shows the commodity structure of railway freight traffic.

We can conclude that bulk goods and raw material movements (especially coal movement), which have been railway's core business, account for around 75% of its total goods lifted. These include coal and coke, petroleum, iron and steel and other ores, and building materials.

**Table 6. Classified goods lifted by railway<sup>a</sup> (%)**

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total(m tonnes)	146	147	152	156	157	159	161	161	153
Coal	44.72 <sup>b</sup>	42.34 <sup>b</sup>	42.10	41.71	41.96	42.25	44.55	43.51	41.83
Petroleum	4.47	4.43	4.40	4.69	4.40	4.63	4.52	4.78	5.14
Coke			1.65	1.97	2.34	2.36	2.37	2.47	2.61
Metal Ores	5.93	6.00	6.14	6.27	6.48	6.70	6.95	7.25	7.77
Steel and Iron	5.67	5.62	5.58	6.29	6.20	5.89	5.87	6.12	6.58
Non-metal Ores	5.38	5.28	5.36	6.28	6.00	5.90	5.86	5.54	5.48
Phosphorus Ores			0.94	0.75	0.90	1.06	0.97	0.89	0.98
Mineral Building material	8.53	8.09	7.83	8.25	7.16	6.60	6.11	6.19	6.61
Cement	2.38	2.51	2.68	3.10	3.10	3.00	2.63	2.41	2.42
Timber	2.50	2.35	2.23	2.25	2.20	2.50	2.44	2.39	2.31
Grain	3.72	4.20	4.21	4.22	4.80	4.21	3.73	4.38	3.62
Cotton			0.10	0.08	0.07	0.08	0.08	0.09	0.10
Chemical fertiliser	2.30	2.54	2.51	1.87	2.35	2.65	2.56	2.59	3.20
Salt	0.80	0.75	0.73	0.79	0.64	0.63	0.72	0.68	0.71
Others	13.60 <sup>c</sup>	15.89 <sup>c</sup>	13.54	11.48	11.40	11.54	10.64	10.71	10.64

*a. Excluding local railway; b. Including coke; c. Including phosphorus ores and cotton.*

*Source: Chinese Railway Annual Statistics, 1990-1999*

In contrast with the development of the economy as a whole, the proportion of freight traffic of Chinese Railways comprising non bulk goods has actually declined over this period.

It can be seen from table 7 that, the total average transport distance for rail freight has increased by 8.1%.

The pattern varies between commodities, however, for instance for coal the average length of haul is low and not increasing because larger loads are handled by water. Consequently the percentage of tonne kilometers accounted for by coal traffic is declining (Table 8).

**Table 7. Average transport distance of classified goods by Chinese Railway<sup>a</sup> (km)**

Item	1991	1992	1993	1994	1995	1996	1997	1998
Total average	740	758	761	791	806	799	806	800
Coal	545	558	549	561	561	562	554	553
Petroleum	668	689	708	753	831	872	851	862
Coke	746	771	797	800	779	791	792	804
Metal ores	484	481	479	470	478	493	483	458
Steel and Iron	970	960	1 001	1 014	1 085	1 081	1 077	1 066
Non-metal Ores	513	538	572	568	595	596	581	566
Phosphorus Ores	/	/	1 141	1 101	1 010	1 037	952	
Mineral Building material	365	391	473	512	546	568	581	546
Cement	442	479	512	500	478	444	429	420
Timber	1 473	1 501	1 524	1 592	1 613	1 597	1 654	1 695
Grain	1 076	1 119	1 176	1 338	1 340	1 385	1 444	1 429
Cotton	2 030	1 910	2 598	2 917	2 896	2 855	2 848	2 822
Chemical fertiliser	859	847	813	979	994	1 005	1 064	1 155
Salt	1 201	1 048	910	810	801	832	820	776
Others	1 438 <sup>b</sup>	1 575 <sup>b</sup>	1 600	1 618	1 637	1 657	1 675	1 588

*a. Excluding local railways. b. Including phosphorus ores.*

*Source: Chinese Railway Annual Statistics, 1990-1999*

**Table 8. Classified goods moved by Chinese Railway<sup>a</sup> (%)**

Item	1991	1992	1993	1994	1995	1996	1997	1998
Total (100 million tonne-km)	1 094 807	1 154 851	1 192 342	1 242 602	1 283 601	1 292 185	1 304 641	1 226 152
Coal	31.19	30.97	30.10	29.77	29.43	31.32	29.86	28.90
Petroleum	4.00	4.00	4.18	4.19	4.77	4.93	5.03	5.53
Coke	1.68	1.56	2.07	2.35	2.28	2.34	2.42	2.62
Metal ores	3.92	3.89	3.95	3.85	3.97	4.29	4.34	4.45
Steel and Iron	7.36	7.07	8.27	7.95	7.93	7.94	8.17	8.77
Non-metal Ores	3.66	3.81	4.72	4.32	4.38	4.34	3.99	3.88 <sup>b</sup>
Phosphorus Ores	/	/	1.12	1.26	1.32	1.26	1.05	
Mineral Building material	4.00	4.04	5.13	4.64	4.47	4.50	4.46	4.51
Cement	1.50	1.69	2.08	1.96	1.75	1.46	1.28	1.27
Timber	4.71	4.42	4.51	4.45	5.00	4.88	4.90	4.89
Grain	6.11	6.38	6.52	8.13	7.01	6.46	7.84	6.46
Cotton	0.26	0.28	0.28	0.25	0.28	0.27	0.31	0.35
Chemical Fertiliser	2.94	2.65	2.00	2.91	3.27	3.22	3.41	4.62
Salt	1.22	1.05	0.94	0.66	0.63	0.74	0.69	0.69
Others	27.45 <sup>c</sup>	28.19 <sup>c</sup>	24.13	23.31	23.51	22.05	22.25	23.05

*a. Excluding local railways; b. Including phosphorus ores; c. Including phosphorus ores.*

*Source: Chinese Railway Annual Statistics, 1990-1999*

### **3. THE CAUSES RESULTING IN THE LOSS OF MARKET SHARE OF CHINESE RAILWAYS**

After reform and the open-door policy, China has achieved great success in economic development. The economic system has been undergoing a huge migration from the central command approach to mostly a market one since 1990. The influences on transport from this migration in China are much the same as those in most east European countries (Hall, 1993).

Because of the rapid development of the economy, the old transport system no longer suits the needs of the market. Before 1995, because of the capacity constraints from railway freight, the government had set up some policies to relieve demand on Chinese Railways, such as restricting short-distance (normally less than 100km) transport by railways; raising freight price especially for short distance freight; and shifting freight flow from railway to highway and water; etc. This had made some effects but the capacity constraints from railway freight were not released much eased. After 1995, the change of transport market is mainly due to the market demands. The freight market is in favour of road but not rail. Railway has lost its monopoly position and has been losing its freight share and profits.

The reasons for this are:

#### **3.1 Rail goods transport is slow and information is poor**

In China, after consigning a batch of goods to a railway freight station, the consignor would not know when and how this batch of goods could arrive at its destination. A visual word “black hole” is used to describe Chinese Railway. Normally, consignors often inquire the arrival time of goods at the destination station. In many cases, goods delivery is overdue. Thus, many kinds of goods, for example, time-sensitive goods like perishable goods (which decreased radically by 38% from 1992 to 1998 in terms of freight carried), high-value-added goods and urgent goods, have been shifted to other modes such as road and air.

#### **3.2 The development of railway container transport is slow**

From an estimation by Ocean Shipping Consultants, the annual growth rates of container traffic in the lines of Intra-Asia, Asia/North America and Asia/Europe were 30.5%, 5.5% 10.0% respectively from 1986-1993. And they will continue this rapid growth trend at annual growth rates of 16.3%, 9.2% and 8.8%.

But in China, container traffic is only 1.3% -1.5% of all traffic lifted by railway, and the annual growth rate was 5.3% from 1992 to 1997. There are not sufficient special flat cars for container, craning facilities and related infrastructure. As a result, Chinese Railways has not enough capacity to satisfy the requirements of container transport, not only in the sector of international trade, but also in that of domestic trade. This circumstance has partly led to the loss of freight flow and brought some constraints to international and domestic trade, especially manufactured and agricultural goods trade. For example, the business of refrigerated container transport remains almost entirely on road.

In addition, technical constraints and system incompatibility have prevented the Chinese Railways from being a successful organisation for international railway business, especially in inter-modal freight transportation.

### **3.3 Failure to adapt to the change of product structure and market demand**

As described above, the structures of products, goods and market have been changed significantly. For example, with the increase of high value-added goods, for the sake of safety, more and more closed-wagons are needed. But the railway transport department failed to supply enough closed wagons in time. So, a lot of this kind of goods has shifted to highway.

In addition, the competition from other transport modes is very intensive, especially from highway transport.

### **3.4 The rigid management system and ideological barrier of Chinese Railways**

Transport, as well as the whole national economy, has been undergoing intensive impact from the reform of economy system since 1990s. But, the ideology of railway management has not been changed from a command one to a market one. The railway reform progress has lagged much behind the economic reform.

The financial performance of Chinese Railways is not good. There was a great loss of more than 10 000 million Yuan in the period of 1995-1998. The causes were mainly from three aspects: low prices, highly increased costs and competition from other modes, especially from road transport. All of these stem from the rigid regulatory regime and management.

For instance, before 1998, a shipper had to order shipment one month or more in advance. The railway operators have adopted a 'take-it-or-leave-it' attitude to potential customers. There has been lack of incentive mechanism. The attitude and action an employee takes and the efficiency of his/her work are seldom connected with his/her salary.

Outdated and ill-maintained railways transport facilities and equipment are still in use. The consigning procedures are very complicated and inconvenient, and long consigning time would be expected. It has been said that "the door of railways is hard to enter, the face of railway staff is unhappy to see and the business with railways is difficult to do." Goods are often damaged, lost or stolen, etc. This is partly due to the poor facilities, partly due to the inefficient operation and partly due to the poor management.

Setting the prices of railway transport services was controlled by the central government. On the one hand, the prices of commodities and the structure of market are getting more and more flexible. On the other hand, the price of railway is relatively fixed. As a consequence, railway transport can not follow the demands from market. Railway freight price is normally settled and raised every 3-5 years. Even so, at present, the freight price is about 6-7 times that of road transport. But in fact, customers, especially small shippers have to pay two times normal freight fares, if they want to get a plan via bottlenecks. There are many types of charges in railway freight transport. Some of them are illegal and overcharging often occurs.

Finally, because of the characteristics of its state and public ownership, Chinese railway must serve the public, social welfare and national defense. Micro-decisions and policies are made by central government. Investments and budgets, insufficient far from the need, are also mainly from central government. The central government uses railways as a political means to control inflation and to provide employment and so on. The developments of

transport market and economy are largely beyond the control of railway itself. Railways have suffered from lack of independence. Many of these factors are the main reasons of railway's unfavorable situation. Chinese Railways is a labor-intensive industry. Its productivity is very low. For example, in 1998, the whole transport employee productivity was only 1 055 000 traffic units (Source: Information branch of the Statistics Centre of the Railway Ministry, 2000) which is one tenth of that of USA class I railways in 1996. The number of staff per kilometer route is 61.74 in 1996, ranked first position in the world. (The second is India, the number is 25.25 in 1995. The number in USA class I railways is 1.07 in 1996. The number in UK is 6.33 in 1994) (Source: World Bank Database, 1999).

### 3.5 The low operation efficiency of railway freight

Generally, we use indicators such as turnround time, travel speed, delivery speed of goods and percentage of overdue goods delivery, etc. to assess the efficiency and quality of freight transport.

**Table 9. The indicators of railway freight operation**

Item	1991	1992	1993	1994	1995	1996	1997	1998
$\theta$ (day)	4.2	4.15	4.18	4.48	4.50	4.48	4.57	5.48
T (hour)	17.3	17.1	17.3	17.9	17.9	17.8	18.1	22.8
$V_1$ (km/hour)	29.5	29.9	30.3	29.9	30.2	30.4	31.4	31.8

$\theta$ ---Turnround time of freight cars; T---Handling time of freight in freight station;  
 $V_1$ --- Commercial speed of freight trains.

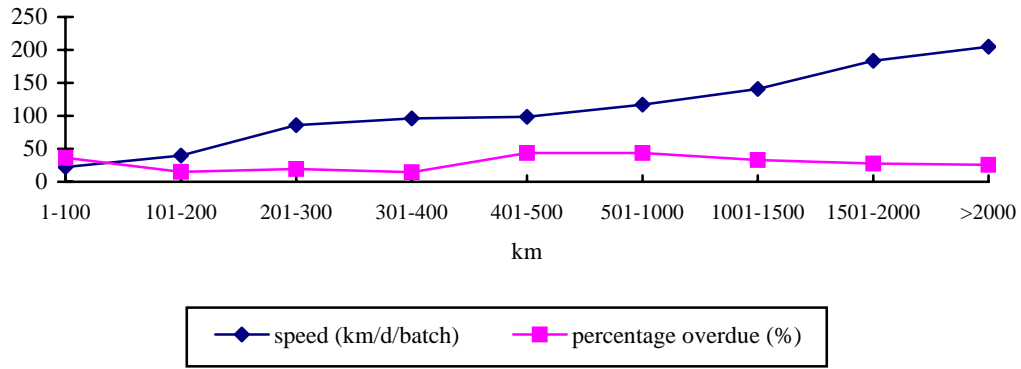
The turnround time of freight cars may be expressed as follows:

$$\theta = (T_1 + T_2 + T_3) / 24 \text{ (day)}$$

Where:  $T_1$ ---total running time in one turnround of car, hours;  
 $T_2$ ---total transfer time in one turnround of car, hours;  
 $T_3$ ---total loading and unloading time in one turnround of car, hours.

According to the analyses in an investigation (X.M Li and R.H Xie et al, 2000), the travel time ( $T_1$ ) of cars makes up only 34.1%, the transfer time ( $T_2$ ) in transfer stations makes up 27.1% of the average transport time of goods, and the time ( $T_3$ ) at freight stations makes up to 38.8%. Sampling statistics also indicate that the average transport speed is very slow. So, in order to speed up the goods transport, some measure must be taken to cut down the time taken in transfer and freight stations.

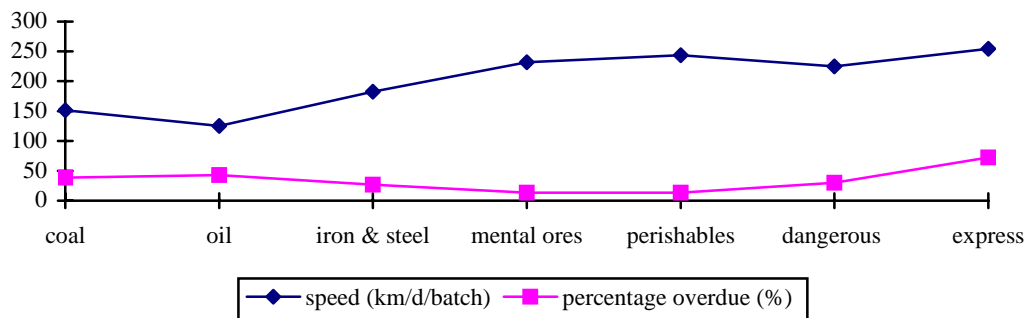
Table 9 shows that turnround of railway cars ( $\theta$ ) has been becoming longer and longer in recent years. The value for 1998 had a significant increase because the transport data of cars owned by enterprises are included from this year. The longer the  $\theta$  is, the worse the railway freight transport operation efficiency becomes.



**Figure 4: The speed and percentage of overdue of goods delivery at different distance**

The speed and overdue percentage of goods delivery at different transport distance have great difference (Figure 4). We can find out that the speed in shorter distance is less than that in longer distance, and the overdue percentage fluctuates at different distance. The highest overdue percentage is 43.78%.

There is much difference of the speed and the overdue percentage among different kinds of goods. This is shown in the figure 5. We can see that the speed of express goods is the highest, but its overdue percentage is also the highest.



**Figure 5: The delivery speed and percentage of overdue of different kind of goods**

The main causes that resulted in the low operation efficiency are the lengthening of distance, the transfer time in transfer stations and the time for loading or unloading in freight stations. Other causes are from the fluctuation of train flow (which is affected by goods flow and the changes of market), the delay of maintenance for cars, the difficulty of hitching up to a train in small intermediate stations, the violation to rules and regulations in dispatching, the overtime of cars staying at industrial siding and problems of transport facilities (X.M Li and R.H Xie et al, 2000).

## **4. CURRENT MEASUREMENTS FOR THE RESURGENCE OF RAILWAY**

### **4.1 The current attitude of central government to the railways**

Government has been considering railways as a national means. It is difficult to regard railways as an organisation that is independent of the state. But now, like most European countries (Taylor, 1996), state interference in the railways is much more subdued than it was before 1997 in China.

#### ***4.1.1 Investment in infrastructure***

Chinese government has invested huge capital in transport infrastructure from national budget since 1997. For example, the total value of rail fixed assets has been increasing at a rate of more than 80 000 million Yuan per year. More than 50 000 million Yuan per year is invested in rail infrastructure. Numerous major projects are under way. 2 000 kilometres of new rail lines have been built and put into use during the period of 1998-1999. The annual growth rate of new lines has reached a high level, about 10%, since 1998. The construction of double track routes and electrified routes has also achieved great progress.

Since 1999, in line with the national strategy, the central government of China has given a high priority to railway investment in the West of China. The on-going projects in the West made up one half of total railway projects in 1999.

#### ***4.1.2 Decentralisation and deregulation***

As early as the 1980s, Chinese railway had taken a measure called the Economic Contract Responsibility System between the central government and the Ministry of Railways to improve railway management. According to this system, railway obtained some power of operation and management, and succeeded in raising productivity, profitability and investment. At the same time, a degree of railway deregulation has been introduced, particularly in the fields of the mix of ownership, price and entry control. But this system was not maintained after 1990 due to the political environment and some problems with it (Wu and Nash, 2000).

Since 1997, Chinese railway has taken a step in the so-called Property Operating Responsibility System between the MOR and regional railway administrations. In this system, regional railway administrations (14 at present) have, at some degrees, gained the power of management of projects, profits, pricing, production and personnel to improve their productivity and accountability.

### **4.2 The recent reform in Chinese Railways**

Meligrana (1999) put forward that there are many components to an effective and efficient transportation system, including both the supply of transportation facilities and the organisation of the transportation system. And when public transportation is inadequate or is organised ineffectively, personal (or goods) mobility, economic activity and the environment all suffer.

In order to cope with the competition and meet the demands from transport market, Chinese Railways has taken many reform measure since 1997. The main contents are briefly summarised below.

#### ***4.2.1 Reforming transport plan and train organisation***

Chinese Railways planning is composed of a monthly freight plan, locomotive utilisation plan, train scheduling plan and car organising plan, etc. In the past, shippers normally must put their transport demand forward to railway freight stations one month or more in advance. Once the monthly freight plan is made out and the demand is permitted, they could get a loading plan. This kind of plan is far from the needs from the market. So, since 1998, the departments of railways have taken an important reform step, i.e., shippers can now get a wagon in one or two days after ordering. Since 1997, there has been a new method of freight train organisation called “five-fixed regular train”, which means the departure and arrival time, the departure and arrival station, the train number, the number of cars and the freight fares are all fixed in the freight train timetable and plan. And there has been a kind of train so-called “parcels express train” since 1997. These trains are run on the basis of contracts between the railway and firms.

#### ***4.2.2 Improving service quality***

The most important step is to improve the work responsibility and attitude of employees. The system of performance-related payment has been implemented. The work responsibility and attitude of employee has been related to their salary and subsidy. There has been a movement to so-called “smiling service” and “civilised service”. The second step is to raise transport quality especially freight security. For example, there has been so-called “goods value-guaranteed” transport after the implementing of Railway Act since 1992. In this system, the goods value loss that results from the causes of railways will be refunded unconditionally and quickly. The third step is to simplify the consigning procedures and provide various conveniences for shippers. The fourth step is to change the marketing of freight service so that railways contact consumers on their own initiative.

#### ***4.2.3 Improving service facilities and equipment***

In recent years, the railway freight yard and related facilities has been improved and updated greatly. For example, the quantities, the capacities, the maximum lift weight and the technical properties of loading and unloading machinery in freight yards have been improved. Almost every freight station has installed computers to deal with consignments, to provide information about goods delivery for consignee and to transmit to and receive data from central management system. The freight plans and train scheduling can be worked out by computer. The Transportation management information system (TMIS) and Dispatching management information system (DMIS) have been put into use. Most freight cars can be traced through their car numbers in these systems.

#### ***4.2.4 Raising train speed***

Since 1996, the speed of passenger train has been raising significantly in some principle lines like Beijing-Guangzhou, Beijing-Shanghai, Beijing-Haerbing, etc. The speed of freight train began to be raised in 1997. In order to speed up the train, the Ministry of Railways has been investing very much on projects, such as the reconstructing of present rail tracks, the updating of locomotives and wagons, the replacing of rail switches, the updating of communication equipment and signals. For example, the number of electric locomotives increased by 32.9% from 2517 in 1995 to 3344 in 1999. The length of continuous welded rail increased by 18.9% from 1995 to 1998. And the automatic blocking length increased by 63% in the same period.



#### ***4.2.5 Cutting down over-staffing***

At the Chinese Ninth People's Congress, when questioned on the overstaffing problems in the state-owned enterprises in China, a representative of the State Council put forward: "The enterprises can be operated as well as usual if one third of staff were removed. Furthermore, it will be even better for some enterprises if half the employees are removed". After the Congress, most state-owned enterprises have begun the process of cutting down staff. The Chinese railways have begun this project since 1996 and planned to cut its staff down by half. The measure included: (1) shifting staff from transport units to non-transport units and closing some small railway stations (every year, about 100 small stations were closed); (2) getting rid of some companies and factories; (3) removing cultural and educational institutions, hygiene organisations and some related departments from railway to society.

#### ***4.2.6 Restructuring price***

In 1998, railway has restructured the freight tariff and cancelled all illegal charges and over charges. The tariff is more transparent and simple than before. The central government and the Ministry of Railways have begun the project of decentralisation and deregulation to some degree since 1998. The regional railway administrations now have power to charge substantial premiums up to more than 30% above the normal fare at peak time or on congested lines, or discount up to 30% below the normal fare at downturn time or in lines with spare capacity. Negotiated prices between railways and shippers have been implemented at some degrees on the principle of willingness of both sides.

### **4.3 Effects of reform**

#### ***4.3.1 The railway traffic volume and market share began to increase***

In 1999, railway passenger and freight transport has shifted its falling trend to raising trend. For example, the freight lifted and moved has increased by 2.4% and 2.6% comparing with 1998. Obviously, a longer time period is needed to be sure the trend has changed, but this year's results are encouraging.

#### ***4.3.2 The railway productivity raised significantly***

The measure of cutting down staff has achieved great success. The total number of staff has been cut down from 3 372 000 in 1995 to 1 934 000 in 1998. The employee productivity raised by 117% from 1995 to 1998. The employees per kilometre of line decreased nearly 50% from 61.74 to 33.6. The parcel express trains have attracted a great deal of parcel business and achieved excellent economic results. The revenue from parcels increased by 60% from 1995 to 1998. The average distance between every two stations increased by 5% from 1995 to 1999.

#### ***4.3.3 Train speed is raised***

The average annual growth rate of freight train commercial speed is 2.2%, from 30.4 km/h in 1996 to 32.4km/h in 1999. This growth rate is much higher than before. The increasing trend of turnround time of freight cars has been controlled at the level of 1998.

#### ***4.3.4 The economic effects are significant***

The financial status of railway transport has been switched from loss to surplus since 1998. The transportation revenue increased by 18.5% from 1997 to 1999. Revenue from freight traffic increased significantly by 46% from 1995 to 1999 and made up more than 50% of total transportation revenue.

## **5. THE FUTURE**

### **5.1 Introduction**

The problems discussed in this paper are by no means confined to Chinese Railways. As a means of dealing with them, privatisation is a major trend in railway transport industry. The overall advantages and disadvantages of railway privatisation have been discussed by some authors (e.g. Harris et al, 1997, 1999). In Japan, the very beginning of rail privatisation was from 1987, and the real implementation of privatisation was in 1992. According to the research of Mizutani. (1999), railway's overall productive efficiency has been improved since the beginning of railway reform in 1987 due to many factors: a flatter and more decentralised organisation, labour-saving option, a private railway type incentive wage scheme and improvement in the management-labour relationship. According to Tilsley (2000), EU Council of Transport Ministers suggests that in order to reinforce the policy, Member states should undertake to achieve specific outcomes in terms of liberalisation. For example, they should lend organisational and financial support to new private railway undertakings operating on their networks, until these reach a 20% market share.

### **5.2 Further Measurements which must be taken by Chinese Railways**

According to the research of Cantos et al (1999), the degree of autonomy and professionalism in management seems to be a key element in explaining companies' levels of efficiency and their degree of technological evolution. The more productive conduct of companies with less government control lies in the fact that companies with more freedom to choose their prices, quality of service, etc., have greater incentives to behave efficiently and to become involved in investment processes that give rise to technological advances. The greater the degree of autonomy and financial independence, the higher the efficiency levels and technical change.

The new management system of Chinese Railways can be discussed from three aspects. In the first, it is extremely important to define the role and power of the Ministry of Railways. The Ministry of Railways should only be a government executive department not an enterprise. It should only be in charge of macro management, making policies and dealing with coordination. In the second, reorganisation of Chinese Railways faces multiple choices. There are three options, i.e. regions, sectorisation or vertical separation (Wu and Nash, 2000). Whichever option is chosen, the railway sub-organisations must be like real enterprises that have a considerable degree of autonomy in terms of management and with their own objectives and accounts. But unlike USA and some European countries, Chinese railways could not be privatised for in a quite long time.

At present, the preponderant markets of railways are long distance transport, low-value-added goods (e.g., raw materials) and large quantity transport (e.g., bulk goods). The potential markets that have been lost much by railways are short and medium distance transport, high-value-added goods and sporadic goods, etc. The key to retaining and increasing traffic is these sectors in service quality.

Although the quality of service has been improved, there are various aspects of service still needing attention. Especially, the procedure of consigning must be further simplified, the reliability, safety and quality of goods in transport must be raised.

Because rail networks just connect fixed points, it is inflexible to every place and inconvenient to small shippers, especially, after some small railway stations are closed. Thus, a great deal of small batches of goods has been shifted to highways. In this circumstance, it is very necessary to develop the railway freight agent business. By means of freight agencies, small batches of goods can be collected into big batches and can be transported by containers. In the short run, freight agent business will attract goods sources and goods flow for railway. In the long run, it will reform the system of goods flow.

In order to meet the new demands from economic development, especially from international trade, railway freight must speed up the step of using new technologies, such as intermodal and piggyback.

The success of intermodal depends on information technology application. Information technology has allowed freight carriers to mitigate intermodal's reliability problems, which stem from extra handlings and involvement of more parties in movement.

Piggyback traffic needs more special flat cars to carry trailers and containers, and need more motor carriers to engage in the service of pickup and delivery.

## CONCLUSIONS

Some conclusions can be drawn from this paper, as shown as below.

- (1) The freight transport pattern in China has changed significantly. and the situation which railway played a monopoly role has ended.
- (2) The average annual growth rate of freight lifted and moved by railways is much less than that of total freight lifted and those by other modes. The freight market shares of railways and pipeline have decreased, and those of highways have increased. In the sector of water, although the share of freight lifted has been decreased slightly, the share of freight moved has been raised significantly because of the rapid development of international trade.
- (3) The causes resulting in these changes are two. One is exogenous, such as the change of product structure, the change of productivity distribution, the change of GDP structure, the new demands from market, and so on. Another is internal to the railways, such as the ideology of reform, the attitude toward the new demands from market, the national transport policy, and so on.
- (4) The Chinese railway has been playing a very important role in the whole transport system, although its market share of freight traffic has decreased in the past decade, especially after having begun the migration from command economy to market economy. It is still a main mode for bulk goods and long distance transport at present and in the future.
- (5) The main causes that resulted in the loss of market share of Chinese Railways are that they failed to satisfy the new demands from economic development; there has been an intensive competition from highway transport and there have been internal causes in railways, which mainly stemmed from the rigid management system and ideological barrier.
- (6) After enduring the throes resulting from reform of the economic system, Chinese railways has taken a series of measures. Firstly, the attitude of central government is in favour of railways. The Chinese government has invested huge capital on railway infrastructure. The Ministry of Railways and regional railway administrations have gained more power to run their business. Secondly, Chinese Railways has been taking many reform steps to cope with the competition from other modes and meet the demands from transport market since 1997. Of these measurements have achieved preliminary success.
- (7) Chinese Railways must take further steps to strengthen and expand the results of reformation. These steps include: to set up a new management system, to hold present and seek new markets and customers, to further improve service quality, to reform freight train organisation methods, to develop freight agent business and to use new technologies.

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