
Chinese Railway Transportation: Opportunity and Challenge

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ABSTRACT

China's Railway Transportation (CRT) is enjoying a time of unprecedented development thanks to huge government investment and a series of aggressive favorable policies. Understanding the opportunities and challenges facing the CRT affords the practitioners and policy makers a better perception of development regarding this important transportation mode. This paper attempts to comprehensively assess this industry using force field analysis, taking into consideration "driving forces" such as energy conservation, urgent social demands supplemented by a big market for container transportation due to a soaring economy, and the central government's policies that have supported corporate transformation in the past three decades. However, key "resisting forces" are likewise identified: fierce competition from other modes of transportation, especially from the road sector, a lagging financing strategy, a low profit rate, and strict government controls, all of which could lead to low productivity. After these factors are documented and analyzed, our study shows that the overall forces are deemed favorable for CRT development, although the resisting forces may create a very large impact since they also represent urgent issues, and thus need to be tackled accordingly.

INTRODUCTION

China's railway transportation (CRT) has long served as the country's primary mode of transportation; almost every person in China has traveled using the CRT, especially for long-distance commuting. The CRT also carries about 30% of the total market share in transportation of goods. With rapid economic development in recent decades, China, not unexpectedly, has witnessed soaring demands for better mobility. In 2007 alone, nearly 1.4 billion passengers and 3.2 billion tons of goods were shipped through the CRT network.

To compete with other modes of transportation, and to regain losses in market share, the government implemented six large-scale railway speed upgrades between 1997 and 2007. Billions of US dollars have also been invested in network expansion (see Fig. 1). One of these upgrades is the construction of the Qinghai-Tibet railway, which indicates that each province in China is to be connected by the railway network. In the next five years, approximately \$300 billion will be invested in Chinese railways to expand capacity, to introduce and test new technology and to enhance the productivity of railway transportation. The leverage of building and updating the railway system to national macro economics has also been taken into account by policy makers in terms of the current financial crisis. Therefore, understanding the influencing forces for growth of the CRT is important in also understanding the political, social and economic forces that could determine its future.

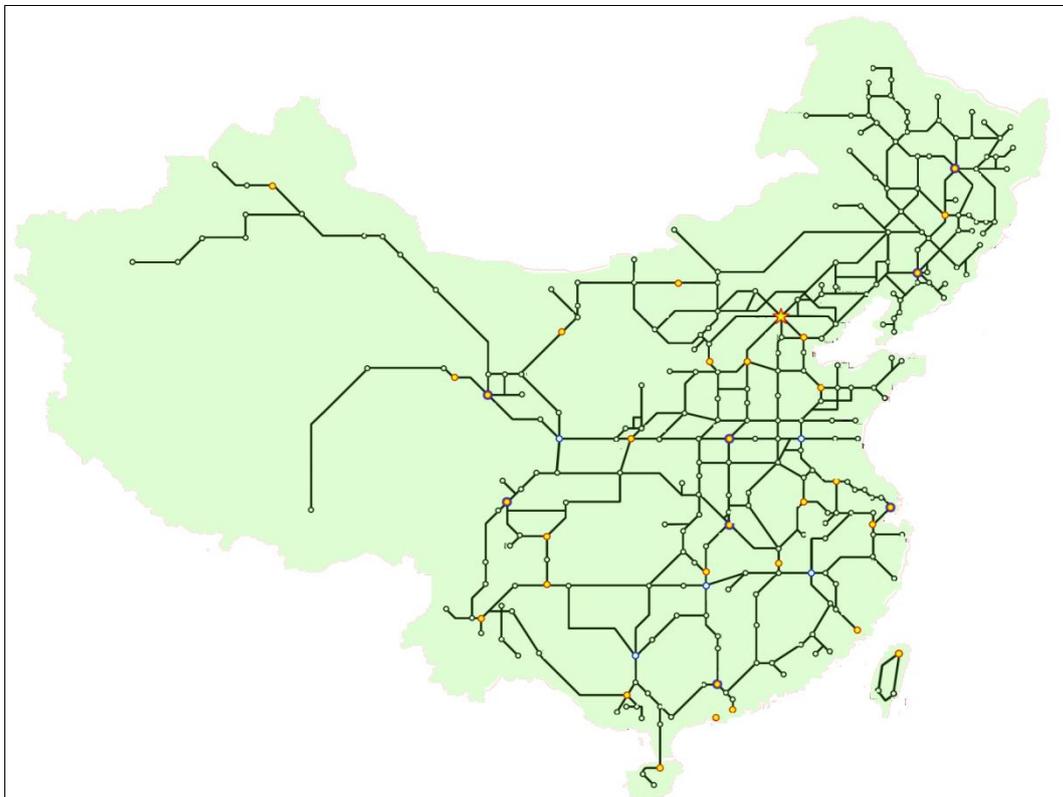


FIGURE 1 China's railway network

METHODOLOGY

Questions are now being raised concerning the ways in which the CRT be developed and what key factors will impact and even shape its future. To examine these questions, the authors applied force field analysis to determine the key driving and resisting forces of a CRT system. This type of analysis was developed by (3) and is widely used in decision-making; it is a powerful tool for gaining a comprehensive view of the different influencing forces (including their strengths) that affect a given industry. The key steps are:

- Step 1: Identify driving forces
- Step 2: Identify restraining forces
- Step 3: Quantify the forces to check the balance of the system
- Step 4: Integrate all the forces into FFA Graph
- Step 5: Consider the implications of FFA regarding decision making

IDENTIFICATION OF THE DRIVING FORCES

The key forces that support the development of the CRT include:

- Energy savings potential
- Urgent social demand
- The strong container transportation market
- Central government's supportive policies

Driving force 1: Energy savings potential

Among the major transportation modes in China, railway transportation is the one of most energy-efficient modes, second only to water transportation. For every 10,000 tons km¹ of goods transported, energy consumed via water, railway, road, and air modes are 6, 58, 80, and 340 Kg standard coal, respectively. In addition, compared with developed countries like Japan (see Table 2), the CRT is achieving increases in energy usage by updating its equipment and fully utilizing its existing operational capacities.

TABLE 1 General energy consumption of the National Railway Freight for selected years (1980-2007) (in Kg standard coal/10000 tons km)

Country	1980	1985	1990	1995	2000	2007
China	147.4	118.7	84.2	74.0	72.5	57.8
Japan	122.9	125.7	85.7	87.1	90.0	88.5

¹ This number includes both passenger transport and freight transport. In china, CRT considers 10 pers ons = 1ton.

The ongoing electrification process has also helped significantly in energy conservation. In 2007, energy consumed by railway transport enterprises was equivalent to 16,760,000 tons of standard coal, an increase of 1.8% compared to the previous year. Meanwhile, the gross converted turnover rose to 7.8% compared to the previous years; the general energy consumption increase was far slower than was that in transport load. In addition, emissions were reduced in both chemical oxygen demand and in sulfur dioxide discharge for several years following the gradual electrification of the railway system. However, the CRT has yet to reveal in detail its energy sources, making this only a partial calculation. The industry could be better evaluated with a full life cycle analysis.

In 2007, the CRT published the “Railway Environmental Protection Program of the 2006-2010 Five-Year Plan”, which requested that each railway department strengthen its examination of environmental protection targets, increase production without increasing pollution, and even increase production while reducing pollution. The purpose is to achieve a 10% drop in the discharge of main pollutants compared to the targets identified in the 2002-2006 Year Plan. Since the 2006-2010 Year Plan aimed at achieving a 20% drop in unit energy consumption, the Ministry of Railways (MOR) determined its energy saving goals for the corresponding period as: (a) a drop of 20% is realized in the income-energy consumption ratio of unit transport compared with that at the end of the 10th Five-Year Plan; and (b) general energy consumption of unit transport is to be controlled under 7.75 tons standard coals/million tons km by 2010, a 5% drop compared to Year 2005.

Driving force 2: Urgent social demand

China is characterized by its large area and its high population, coupled with accelerated industrialization and urbanization. All of these factors lead to a vast exchange of materials and personnel across the country. The CRT covers the transport of all key resources, including coal, steel, and food from the northern and western regions to the northern and southern areas of the country. Incidentally, many of China’s developed industrial areas badly need huge quantities of raw materials and energy, which has led to an increased demand for rail transport. These demands have put a tremendous strain on China’s currently limited railway infrastructure and capacity. From 1978 to 2005, development in infrastructure allowed for a mere 3.5% yearly average growth in railway freight volume, while freight volume in all modes of transport achieved an average annual growth of 8%. During this period, the railway system experienced a yearly average growth of 1% in passenger transport volume, while the volume in all modes of transport achieved a similar yearly average growth of 8%.

The present railway transport volume cannot completely accommodate domestic demands because of its insufficient capacity. In fact, China’s railway system has

operated with an overload for the greater part of its existence. Being cheap and convenient, the railway has always maintained a certain attraction for the transport of passengers and freight. While the development of the railway network structure is only at its preliminary stage, the existing system already bears the heaviest load in the world as measured by transport density (7). A comparison with its international counterparts is illustrated in Fig. 3.

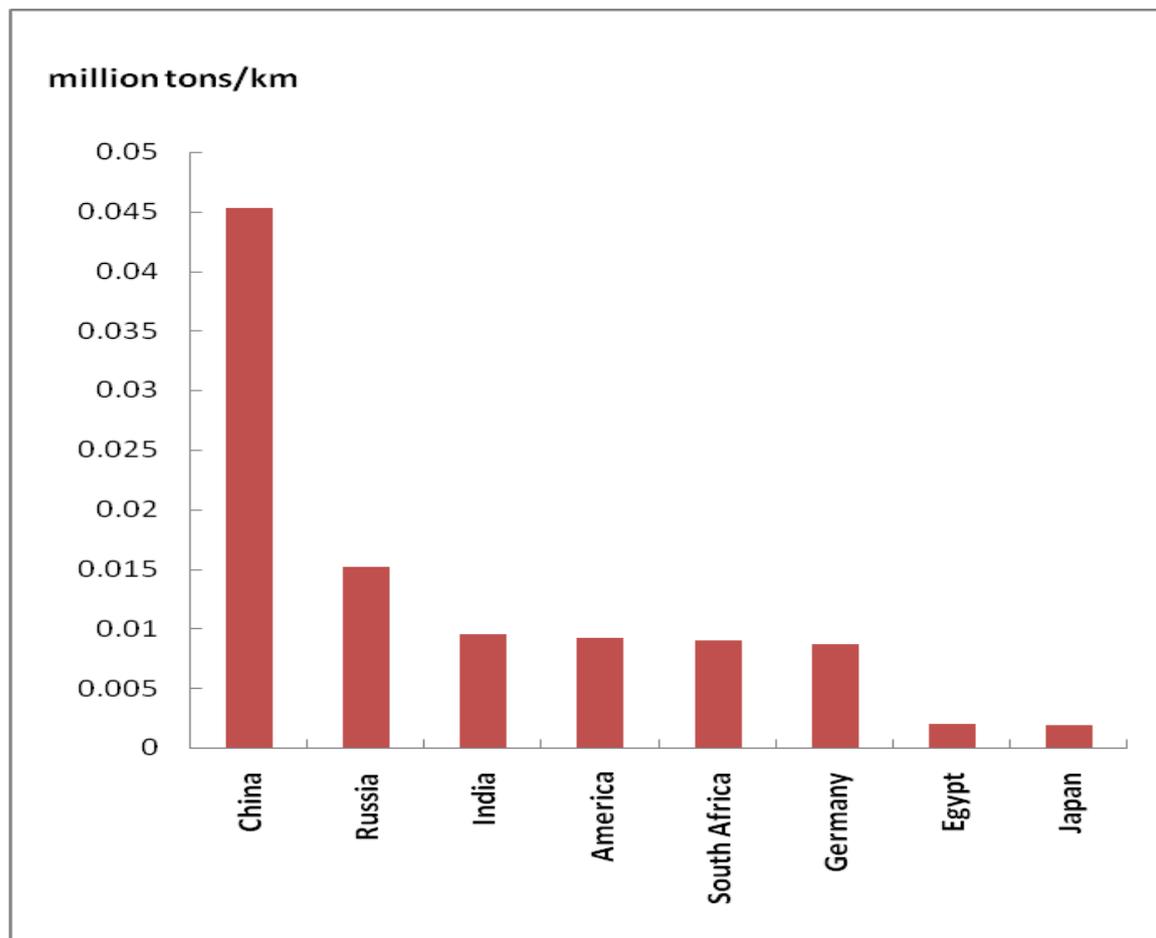


FIGURE 2 Rail transport density in different countries

To address the sparse infrastructure problem, China plans to construct more than 12,000 kilometers of new high-speed tracks for passenger transportation as well as to separate the passenger transportation line from the freight line. The authors regard the supply-demand contradiction as one main impetus for the future growth of the CRT. Above all, a common feature in China's railway transportation depends on the MOR to support its demand for larger passenger and cargo transportation; otherwise, the MOR will not only cause the loss of the target market, but will also fail in its political commitment. The gap between demand and supply indicates that there is much expected from the CRT in terms of its future performance. New investments and more construction work are crucial elements in the development of the CRT.

Driving force 3: The strong container transportation market

Over the past 30 years, rapid economic growth has resulted from an export-oriented economy driven by the speedy development of the coastal economy. However, production costs have risen appreciably with the advancement of the coastal economy. As a result, the logistics chain of export-oriented trade is extending ever further inland, and logistics channels are now required to bridge the structural discrepancy between coastal and inland economies. As this inland growth continues, container lorries are now finding difficulty in supporting this development due to a limited transport radius, thus signaling the arrival of the railway container era.

The continuous development of the coastal economy extension will promote the further development of railway container transport in China. The construction of a railway container system will in turn propel the development of the inland economy. The construction of a railway container passage has been raised to a strategic status in the “2006-2010 Plan and the Medium and Long-Term Railway Development Plan”, in effect, giving priority to the development of railway container transport. Railway containers presently remain in an initial development stage, with impetus coming primarily from two aspects: (a) under the current economic frame, railway containers will account for an increasingly higher proportion of the present logistics system as the railway infrastructure improves; and (b) as the domestic economy extends, the logistics system supported by railway containers will further accelerate its development.

In the past, responsibilities concerning container transport were shared by 14 railway bureaus. This was changed in December 2003 when the China Railway Container Transport Corp., Ltd. was created to oversee the entire railway container transport system. Thus, a container transport network was formed to cover the entire railway system. Meanwhile, the container transport market also became standardized and unified² in China.

With the rapid growth of container transportation, the midwest region has begun to show its potential. Due to geographical limitations, this region was previously unfavorable for development of waterway and highway container transportation systems, whereas railway container transportation has experienced rapid development. Since 2000, the midwest region has surpassed the coastal area in terms of container freight volume; in fact, almost 70% of railway containers now originate from the midwest area. At present, China is only in its earliest stages of fully utilizing a wide railway network in covering the soaring demand for container transportation. Consequently, this vast market will act to motivate the railways to accelerate their modernization, aiding the rail industry in achieving rapid and sustainable development.

²A detailed standard can be retrieved at <http://www.chinact.com/newsDetail.do?id=327&categoryid=10>.

Driving force 4: The central government's supportive policies

The authors have created a database³ to describe the historical policies and reforms of domestic railways in the past 30 years vis-à-vis the various support policies from the central government. Since the introduction of the reform and open policy, the railway system has undergone three phases: (1) decentralization of power and transfer of profits, (2) all-round contract system, and (3) corporatized transformation. In particular, the MOR has initiated and instituted diverse programs of reform since 1998, implying sufficient preparation for further reorganization of the entire railway industry.

TABLE 2 Key events of the CRT industry

Stage	Period	Key events
Initiation of Reform And Open Policy	1982-1985	The railway bureaus acquired greater autonomy in management. Profit retention system was practiced.
All-round Contract System	1986-1992	The Ministry of Railway adopted a contract system within the entire industry. The state took measures to stop direct investments in railway undertakings (e.g., deduction and exemption of business tax). The operators had to undertake all costs for maintenance and expanded reproduction, such as railway construction and purchase of locomotives. Such costs would come from the gross profit.
Corporatized Transformation	1993	The former Guangzhou Railway Bureau was reorganized and renamed the Guangzhou Railway Group, and became an experimental unit for the railway bureaus' corporatized transformation.
	1995	The Dalian Railway Company Limited was founded, becoming an experimental unit for corporatized transformation of the railway sub-bureau.
	1996	The Guangzhou Railway Group created a new mode of parent-subsidiary structure and founded the Guangshen Railway Company Limited, the first joint-stock transportation enterprise in China. In 2006, the company successfully issued H shares in Hong Kong and New York. That same year, it also issued shares in the Shanghai Stock Exchange.

³ For a detailed account, refer to the Renmin Ribao Database (1949-2008), which contains a full collection of CPC's mouthpiece, Renmin Ribao (People's Daily). Its policy coverage is very helpful for exploring China's policies.

1998	The MOR reformed the organizational structure, effectively realizing the separation of enterprise from administration.
1999	The responsibility system of assets management was adopted throughout the railway industry. The MOR transferred power to the bureaus and allowed them to conduct autonomous management. In return, the bureaus had to achieve a series of targets aiming at preserving and increasing the value of state properties, turning losses into profit, and maintaining the safety of state properties.
2001	Railway transportation enterprises adopted a new financial system, implementing a separate accounting for passenger transport, freight transport, and railway network.
2005	All sub-bureaus were removed. The bureaus now directly manage the stations and sections. Large bureaus were split into several smaller ones.
2005	An open policy was adopted to attract foreign capital in some fields.

The CRT system conducted reforms to remove substations in 2005. At present, there are 18 railway bureaus/companies nationwide⁴, as well as three specialized transport companies⁵ that are responsible for the transportation of goods. Whether it is the reform in business structure of CRT or the introduction of new marketing strategy, these reflect the determination of central government in developing the railway system as a whole. The ongoing cooperative transformation is heavily dependent on the government's policies; in fact, the transformation processes are largely carried out at the political level. The Chinese government's approval of the "Medium- and Long-Term Railway Network Plan in 2005" could guarantee the development of CRT in strategic and operational detail within a mandatory administrative framework.

IDENTIFICATION OF THE RESTRAINING FORCES

The four key restraining forces against the development of CRT in the future include:

- Fierce competition from other modes of transportation
- A lagging financing strategy

⁴ These include 16 bureaus in Harbin, Shenyang, Beijing, Hohhot Municipality, Zhengzhou, Jinan, Shanghai, Nanchang, Liuzhou, Chengdu, Kunming, Lanzhou, Urumchi, Xi'an, Wuhan, and Taiyuan; and two companies (Guangzhou Railway (Group) Corporation and Qingzang Railway Group Company). They own the properties of most domestic railways.

⁵ These are China Railway Container Transport Corp., Ltd., China Railway Special Goods Transport Co., Ltd., and China Railway Express Co., Ltd. MOR plans to merge the former China Railway Parcel Express and the China Railway Express.

- Low profit rate
- Military management and low productivity

Restraining force 1: Fierce competition from other modes of transportation

Figure 3 shows the market shares in terms of passenger transportation and freight turnover for each of the four transportation modes in 1986-2007. The CRT's market share continues to shrink with regard to passenger transportation or freight transportation. For passenger transportation, the market share has declined from over 50% to less than 40% in the past 20 years. This market loss can be attributed to an increase in air transportation due to the rising income of the population, who can now afford this once "elite-oriented" service. In addition, the expansion of the regional airway networks means that the CRT is no longer the only choice for travel between second tier cities. At this time, several budget airlines operate their businesses in China under a competitive pricing strategy. Air fares could be far cheaper for the same route offered by the CRT and travel time via air transport is only a fraction of the travel hours via the CRT. With regards to freight transportation, the market share has declined from over 45% to less than 30% in the past 20 years, with the majority of this market loss being taken by water transportation, which is deemed as a clean mode of transportation. Since freight transportation contributes two-thirds of the revenues to the CRT, a change in any shipper's preference could affect the expansion plans of the CRT, leading to a resisting force against growth.

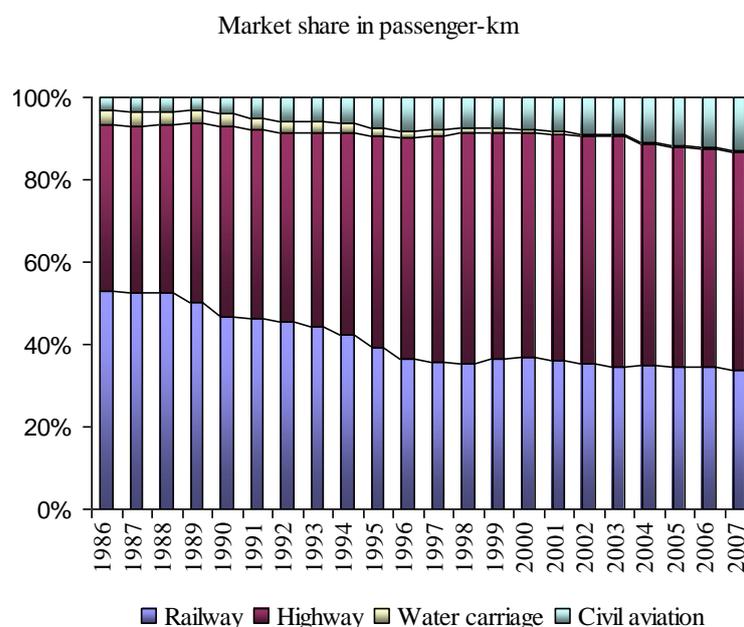


FIGURE 3a Market share percentage of railways, highways, and waterways in terms of passenger transportation turnover from 1986 to 2007

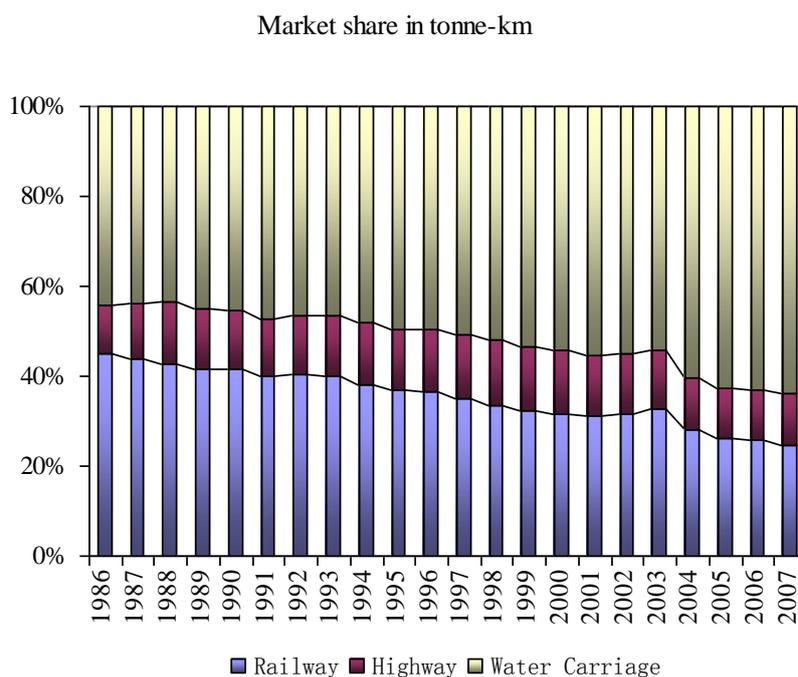


FIGURE 3b Market share percentage of railways, highways, and waterways in terms of freight transportation turnover from 1986 to 2007⁶

Restraining force 2: A lagging financing strategy

From 1978 to 2007, China's gross domestic product (GDP) rose from 364.5 billion yuan to 183,000 billion, a yearly average growth of 9.8%. Meanwhile, the railway network increased from 51,700 km to 75,400 km in length, showing a yearly average growth of only 1.4%. This is not only far lower than the speed of economic development, but is also substantially lower than the growth rate of other transport trades such as highways (Fig. 4). The reason for this may be an overly high threshold for railway projects borne out of huge costs and long-term completions. A project often involves more than 10 billion yuan, which raises the networking requirement and demands for integration of the different sections of the transport system.

⁶ The market shares of pipelines and civil aviation in freight transportation turnover are excluded from the figure since both transportation modes take up less than two percent of the total freight traffic.

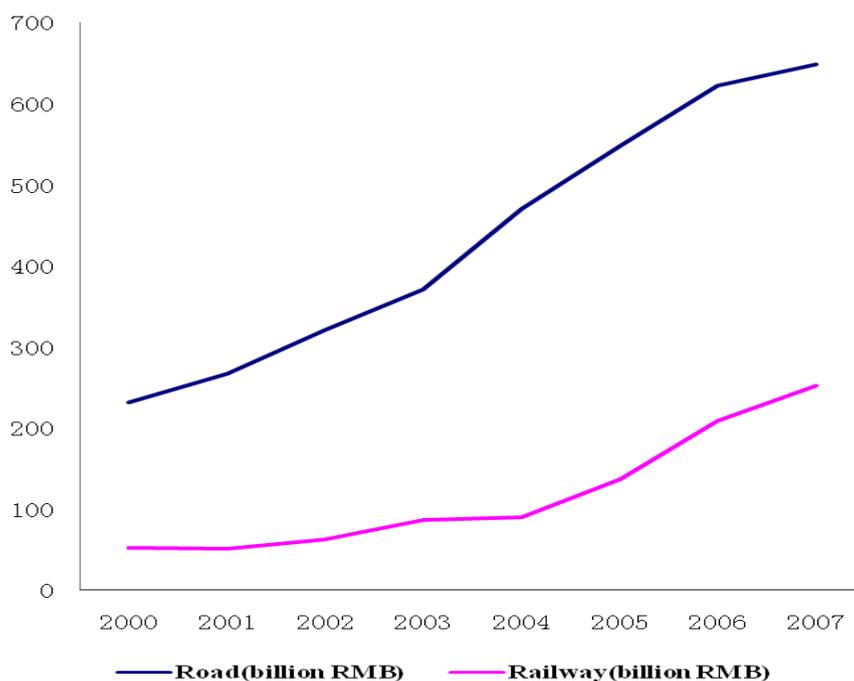


FIGURE 4 Growth difference between road and railway transport from 2000 to 2007

According to the “Medium- and Long-Term Railway Network Plan”, the operating mileage of domestic railways will reach 100,000 km by 2020. By this date, passenger transport will be separated from freight transport in the busy trunk lines. Multi-track lines will also be electrified for major passages, while multi-track railways and electrification rates will reach a 50% increase. Transportation will thus meet economic and social development needs in both capacity and quality, and the main technical equipment will catch up with or draw near the advanced level. By this date, the investment scale will exceed 2,000 billion yuan. Incidentally, there is a huge financial gap in the railway construction under the 2006-2010 Plan.

In the past, financing channels mainly consisted of the railway construction fund and the government’s financial support (Table 4). The railway construction fund is, in fact, a form of taxation collected by the MOR on the state’s behalf. The MOR is the entity for debt financing (bank and foreign loans), while the government guarantees its credit. By nature, debt financing for railway construction is covered by government financing; therefore, the government has to assume appropriate risks regardless of the issuing entity.

TABLE 3 Funding Source of Railway Investment (in %)

Year	Railway Construction Fund	Special Fund of Fiscal Budget	Domestic Loan	Foreign Bond	Capital Issuance	Corporate Financing
1998	36.8	6.5	35.4	1.7	9.9	9.7
1999	41.5	9.8	35.9	2.5	5	9.7
2000	38.8	10.1	35.3	4.7	0	11
2001	45.4	8.2	25.6	2.8	2.9	15.1
2002	43.1	10.3	21.6	6	3.2	15.9
2003	42.7	11.5	27.5	4.5	2.2	11.6
2005	44.7	11	26.5	5.5	3.2	13.1

Source: Xinhua Financial service

Under the government-source financing framework, domestic railway operators have attempted to finance capital market by issuing shares and bonds. However, these tools only raised about 20 billion yuan for the railway corporations⁷. Although the financing system has become slightly more flexible in China, the shares and bonds issued are simply insufficient to meet the financial needs of railway construction. The government remains the main entity or agent that should provide funds for further railway construction.

In addition, prices for withdrawal also remain extremely high because the dedicated assets of railway transport involve huge investments and high costs in transfer and conversion. Therefore, investors prefer projects with high profits, such as highway construction and real estate. Compared with other businesses, the railway undertaking is distinct in its network completeness and distribution of interests. It has natural monopolistic characteristics more common to power and water utility networks (8). Moreover, as an important infrastructure for the national economy, the railway undertaking plays a supportive role in society, economics, culture, and national defense. All governments, including China's, set clear restrictions for access to their railway transport industry. China has taken cautious attitudes towards any type of foreign railway investment. In the meantime, foreign investors for the railway industry have also cast their own doubts and uncertainties. Therefore, it can be concluded that the semi-military management of the CRT will not be fully eliminated in the following years because of fundamental realities and special characteristics of the CRT. Therefore, the problems resulting from this type of management will remain for a longer period than expected, which could impose incidental obstacles to the growth of the CRT.

⁷ These are the Guangshen Railway Company Limited, Beiya Group, Nanfang Huitong Company Limited, Dalian Tielong Company Limited, Second Railway Bureau Company Limited, and Daqin Railway. The data can be retrieved from the yearly reports.

Restraining force 3: Limited profitability

Railway sector profitability has been poor for the past decade. During this time, an average 87% of railway revenue has come from passenger and freight transportation; the latter being almost double that of passenger transportation. The gradual increase in revenue seems to indicate that the CRT is heading towards a better business operation. However, as the CRT continuously upgrades its locomotives and improves its service, higher investment also takes place, the consequence of which is an extremely low profit rate, which has only been around 1-2% in recent years. In addition, the calculation on profit rate for the CRT can be quite misleading since the significantly high fixed investments costs are not included in the operation cost⁸. This results in serious financing issues, since the low return rate of railway investment may discourage international financing for the CRT. In China, the government still regards rail transportation as a public service, and therefore sets extremely low fares. This makes the profit-making for the MOR very difficult. In addition, the semi-military management within the MOR prevents the rail industry from being more sensitive to the market, thus limiting the return of investments of railway transportation.

Restraining force 4: Strict government control

In 2008, the former Ministry of Traffic, Civil Aviation Administration, State Post Bureau, and the “urban passenger transport direction” function of the Ministry of Construction will be merged into the newly formed Ministry of Communications. However, MOR, an agency created specifically for the transportation system, will be “retained”, implying its semi-militarized⁹ features. The reasons for putting the railway system under tight management seem complicated, although it may be partially due to the industry’s strategic position as well as the inertial power structure within the office. It has been openly admitted that the semi-military management of the State-owned CRT brings forth great significance in national emergencies, such as in the recent relief efforts in the aftermath of the Sichuan earthquake. Nonetheless, there is unease with the semi-military control of the CRT in terms of accommodating market-oriented development (9). Limited by insufficient network capacity, low tariffs, and few financing sources, the CRT has to first function as a public carrier, and raising profits becomes secondary. Since the power of the MOR is affiliated with the political will of the Central Government, the advancement of such ideals may be quite difficult.

Some of the common flaws of state-owned enterprises are low efficiency and vague policy, industrial abuses of non-transparent policies, unsound legislation, and unclear

⁸ If such costs are considered, the profit rate would be below 0% for CRT in most years. Generally, the railways’ operation cost in this study’s calculation only involves salaries, materials and energy cost, depreciation and taxes based on CRT’s accounting rules.

⁹ It will be interesting to notice how the 2008 earthquake disaster might greatly impact the way of the official thinking for future operations of CRT. We think that officials will insist on a state-guided priority more than ever before.

property rights, which limit the access of social capital (10). In China, the government's control of the railway system brings about two main drawbacks: low tariffs and fixed transportation schedules. From the previous statement, low tariffs disallow the growth of CRT with the MOR putting tariffs under tight control because of its relationship to public benefits. A large majority of railway goods have relatively low value per ton, such as coal, due in part to fixed transportation schedules. The MOR, owner, and constructor of railway infrastructure, should be responsible for the operations of the rail system. The dual identity of MOR, which may have been unclear under China's ambition of elevating the status of railway transportation in the macro economy, may pose contrasting initiatives: the MOR has to make its railway operations market-driven, while inherently, the policies continue to be designed by the central government.

FORCES QUANTIFICATION

In this step, a score is assigned to each force, ranging from 1 (weak) to 5 (strong) according to its "magnitude" in supporting or resisting the growth of CRT. It is admitted that these ratings are based on the understanding of each force described in previous statements, so the ranking could be largely subjective. An improvement to this method is to survey a large sample of the experts and officials in CRT and to compile their opinions and suggestions.

Figure 6 shows that the driving forces for CRT growth outweigh the resisting forces, indicating that CRT could embrace a good development in the upcoming years. The authors regard lagging management and low profit-making capabilities as the main forces restraining the CRT, while the contradiction between current limited infrastructure and rail transportation demand aids CRT in becoming more prosperous.

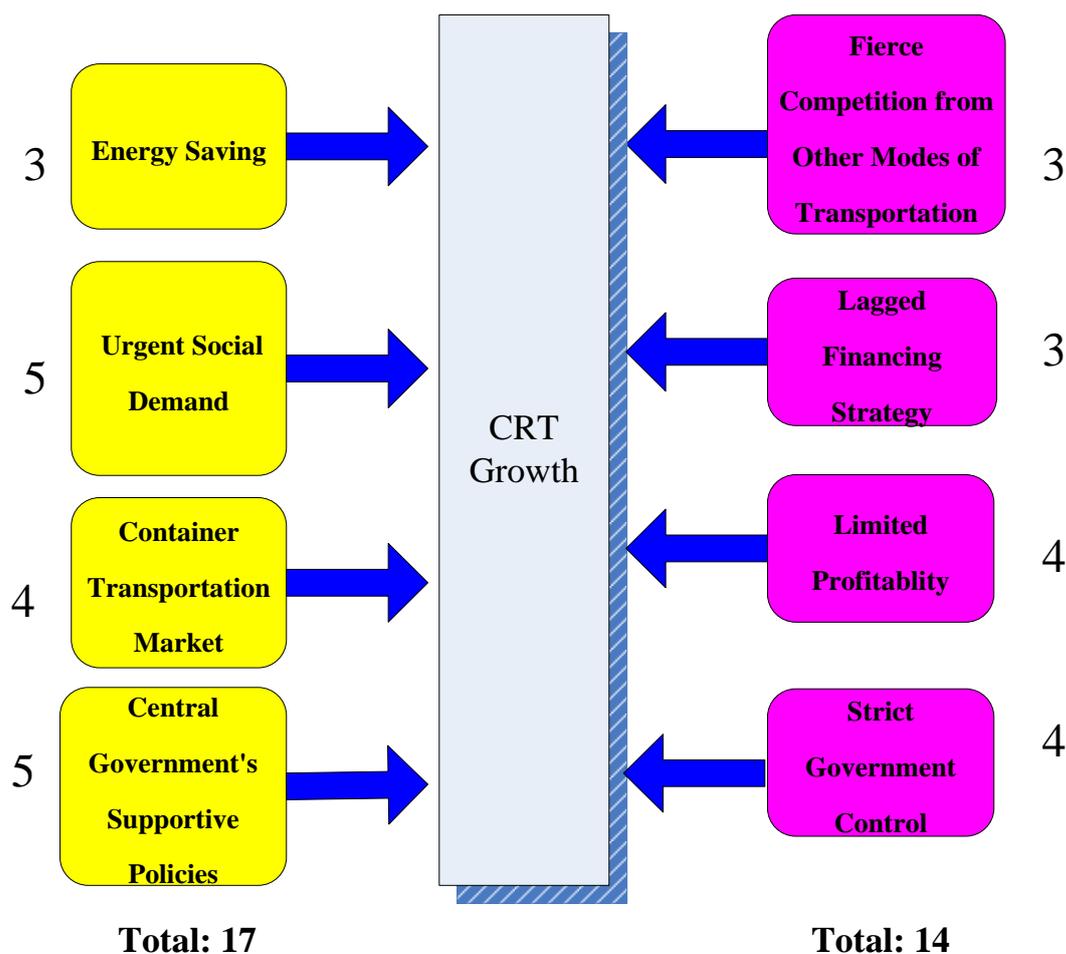


FIGURE 5 Force field analysis of driving and resisting forces for CRT growth

Discussion

The FFA diagram visualizes the key influencing forces supporting/restraining CRT growth, and it also provides Chinese policy makers a means for considering the impact of policy changes on railway development. By and large, the Chinese government has two ways to accelerate CRT development: it can add more driving forces and/or reduce constraining forces. Seen from FFA graph, most driving forces come from the conflict between a continually increasing rail transport demand and a limited railway capacity as well as a promising intermodal transport market. As for restraining forces, strict regulation seems to be responsible for the unsatisfactory performance of CRT in the passenger and freight markets. Therefore, deregulating the Chinese railways seems to be the appropriate attempt. Indeed, voices for railway deregulation have emerged recently. This paper does not attempt to give a definite Yes or No answer to the privatization issue because the effectiveness of this kind of policy change may not be evident within a short period. Moreover, a host of uncertainties that accompany possible deregulation complicate this issue. It is interesting to note that regulation or deregulation is still a controversial issue facing even American

railroads.

The benefit conflicts between carriers, shippers and relevant third parties pose to the government a hard choice between interfering with the railway transportation market and encouraging free market competition. The authors view compromises in deregulation, such as transferring operational functions to market driven entities or increasing the proportion of foreign capital in railway construction as the better decisions. China's unique socio-economic status may require that railways to achieve higher return while retaining their role as common carrier. In the 2008 Sichuan Earthquake, the CRT was able to provide a quick response and played the role of national hero in conveying injured and medical materials, which could not have happened had it been under complete deregulation or privatization. As a result, the Chinese government needs to stay cautious and aware of any negative outcomes that could arise from rail policy changes.

CONCLUSIONS AND FUTURE RESEARCH

The CRT's development not only reflects a shift in China's economy -- from a central-planned economy to a market-based economy -- but also reveals the unique problems and challenges that this nation has undergone in the past decades. The force field analysis can help us to comprehensively understand this industry by examining and comparing the driving forces and resisting forces. The root causes for our driving forces can be attributed to several aspects, such as the soaring economy, rising income, and unbalanced allocation of natural resources, which may lead to increased personal and material exchanges. These root causes raise an urgent social demand on their own. In addition, the people's demand for high speed travel and the energy goals of the nation are speeding up the electrification process. At the same time, the government's administrative supportive policies have also paved way for further positive development of the CRT. In contrast, the resisting forces including fierce competition, a lagging financing strategy, low profit rate, and semi-military management, all of which could drag down the growth of the industry, remain in place. State monopoly and tight regulations could likewise lead to inefficiency of the operation, affecting potential profits and thus the overall financing decision-making. Although the effects of these forces, overall, appear to favor CRT development, the resisting forces should be taken in consideration for their significant and potentially negative impacts, and should thereby be properly addressed.

More forces (e.g. new railway technology, the change of economic policies) need to be taken into account in addition to the forces applied in the analysis in this study. Furthermore, deregulation is an important research topic that requires its own detailed analysis when applied to the understanding of the sustainability of CRT development.

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