

# Multiple Regression Forecast Analysis of Pakistan Railway Freight Volume under the Background of China-Pakistan Economic Corridor Construction

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**Abstract**—The construction of the China-Pakistan Economic Corridor is the a development strategy of China and Pakistan, and it is also an important part of the ‘Belt and Road’. For better construction the Corridor, this article systematically forecasts Pakistan’s railway freight demands. Considering GDP, total population, food production, and fixed asset investment and FDI respectively as influencing factors, this article carries out a multiple regression forecast analysis on Pakistan’s railway freight volume in 2020, 2025 and 2030. The study found that Pakistan’s railway freight volume is positively correlated with Total Fixed Asset Investment and FDI, but the positive correlation between FDI is stronger, and Pakistan’s railway freight volume will have a steady and rapid growth in the next decade. If FDI increases, the growth of railway freight volume will be stronger, which also demonstrates the importance of China’s investment on the Corridor and the impact on the increasing of railway freight volume.

**Index Terms**—China-Pakistan Economic Corridor, railway freight volume, multiple regression forecast, FDI

## I. INTRODUCTION

Railway is an important transportation infrastructure of the country, and it is also one of the resource-based and environment-friendly modes of transportation. Accelerating the development of railways has become a consensus in all aspects of society and the main artery of national economic development. In 2013, President Xi clearly stated in an important speech at the Indonesian National Assembly that China is committed to strengthening connectivity with ASEAN countries and is willing to develop maritime partnerships with them to jointly build the "21st World Maritime Silk Road". Under the framework of the ‘Belt and Road’, connectivity with countries along the route is not only embodied in politics, economy and culture, but also the connectivity of transportation. Chinese Foreign Minister Wang Yi described the ‘China-Pakistan Economic Corridor’ as the ‘first movement’ in the ‘Belt and Road’ symphony, and the China-Pakistan Railway from Kashgar to Puerto Gwadar is exactly the aorta of ‘China-Pakistan Economic Corridor’. Gao Bai believes that the China-Pakistan Railway is the outline of China's land rights strategy, which in turn affects the international political and economic structure of the entire region. At the same time, for Pakistan, the construction of the China-Pakistan Railway will

directly provide local people with lots of jobs, effectively improving Pakistan's lagging infrastructure, and promote Pakistan's export trade. Pakistan, as the main route country of the China-Pakistan Railway, is indispensable for the prediction and research of Pakistan's railway demand, and provides suggestions for the future development of the China-Pakistan Economic Corridor.

There are a lot of literature on the forecast of railway freight volume at home and abroad. Deng Julong (1986) proposed the Grey System Theory, which belongs to the continuous type, using a small amount of data for modeling and the GM (1,1) model to predict the development of system behavior characteristic values, which can accurately describe the state and behavior of the social economic system; Gregory A. Godfrey and Warren B. Powell (2000) constructed an exponential smoothing prediction model. After comparing the model with the ARIMA method, they found that the error of exponential smoothing prediction is lower and the actual operation is easier to grasp; Ping Hai (2005) Established a Grey Forecasting Series Topology forecasting model to predict China's railway freight demand, and got a better fitting effect; Paulo S A. Freitas and Antonio JL Rodrigues (2006) constructed a variety of joint forecasts of neural network forecasting models In this method, the Gaussian radial function network is considered, and the framework of the commonly used linear combination estimation model is constructed through the exploration of various models; He Haijun (2007) applies the econometric model to analyze the factors affecting the logistics and freight volume, and obtains the social Factors such as fixed asset investment, total energy production, total social retail sales, total import and export trade volume have become the main factors affecting the current volume of logistics and freight in China; Zhao Weiyan and Gu Xuesong (2007) performed a curve model based on a linear regression model. Modifications were made and a combined forecasting model was obtained to predict the total amount of freight at the city level, and an ideal forecasting effect was obtained; Yu Chunrong, Zhang Zhiwen (2008) used OLS regression to obtain GDP as an inducement for railway freight transportation demand, and believed that Can predict the future freight volume based on GDP.

## II. FORECAST OF PAKISTAN RAILWAY FREIGHT VOLUME DEMAND

### A. Current status of Pakistan's railway transportation

In the past decade, Pakistan’s domestic railway operating

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mileage has been 7,791 mileage, and there are 559 stations nationwide. Except for 33 stations that realize computer networking operations, the rest are still operated manually, which is extremely inefficient. Pakistan's railway layout is unbalanced, mainly based on north-south lines, and railway operating mileage accounts for about three-quarters of the country. And the east is densely sparse, and the road network density in the east of Punjab and Sindh is relatively high.

Before the 1980s, the average annual passenger volume of Pakistan Railways exceeded 120 million passengers and the average annual freight volume was 12 million tons. It once occupied an important position in the country's land transportation. However, due to the lack of maintenance and upgrading, the transportation speed and capacity continued to decline. In addition to the rapid development of highway network construction, the passenger and freight volume decreased year by year, and fell to the bottom in 1999. Passenger volume is less than 10% of the total passenger volume. The freight volume only accounts for about 3% of the total freight volume (except ocean transportation). In 2018, Pakistan's railway freight volume was 8.3 million tons, the freight turnover was 8,304 million tons-kilometers, and the passenger volume was 60.4 million people.

Now, in order to promote exchanges and cooperation in the fields of transportation, energy, ocean and other fields between China and Pakistan, the China-Pakistan Economic Corridor Belt has been proposed. Among them, a three-phase plan for Pakistan's railway construction is proposed. The phase is expected to complete the construction of the dry cargo terminal and the ML-1 railway upgrade in Havilian in 2020; The second phase includes the completion of the ML-2 railway upgrade (Godri-Atak) and expansion, connecting Quetta, Gwadar, Bisima, etc. Land, this phase will be completed in 2025; the third phase is expected to be completed in 2020, including the completion of the Haweilian to Hongqi Lafu railway, a total length of 682 kilometers. Next, in the "2030 Vision Plan" Pakistan has established the goal of "making railways become the country's main form of transportation", the transportation system is gradually profitable, and is conducive to promoting the country's economic development. The main contents include the gradual upgrading of existing track and signal systems, and new sections of roads. Increase the mileage of double tracks and build a railway connecting the Gwadar region. According to the current railway development policy, Pakistan's railway transportation will have a qualitative leap in the future.

### B. Railway demand forecast

#### 1) Research methods

From a comprehensive literature perspective, there are many methods for predicting railway demand, including time series, multiple regression, grey forecasting, and BP neural model. This article mainly uses multiple regression models to predict Pakistan's railway freight volume.

#### 2) Sample selection and data sources

Comparing on past historical data, qualitative and quantitative are combined, we choose the multiple freight regression method as our main forecasting method.

According to previous literature, four indicators of GDP, total population, investment in fixed assets, and grain output are selected as independent variables, and railway freight volume is used as the dependent variable for model setting. In addition, this article also selects FDI (China is the largest direct investment country in Pakistan) as an indicator, replaces fixed asset investment, and conducts multiple regression analysis to make a clearer analysis of Pakistan in the context of the construction of the China-Pakistan Economic Corridor. The demand for railway freight volume changes.

The main research method is based on the historical data of GDP, total population, fixed asset investment, and food production. The data interval is from 1996 to 2018. First, predict the predicted values of these indicators in 2020, 2025, and 2030. According to its predicted value, the freight volume of the railway is predicted, effectively eliminating the unstable factors in the model, and combining expert's opinions to put forward the actual freight volume of Pakistan.

The following are the main data of Pakistan's GDP X1, total fixed assets X2, total population X3, food production X4 and FDI X5 from 1996 to 2018.

Table 1 Forecast parameter table

Year	Railway freight volume Y (million tons)	GDPX1 (100 million US dollars)	Total fixed capital formation X2 (100 million US dollars)	Population X3 (million people)	Grain production X4 (million tons)	FDI X5 (100 million US dollars)	Railway mileage X6 (km)
1996	6.36	633.2	110.03	127.35	22.96	6.82	8775
1997	6	624.3	102.03	131.06	25.16	6.01	8775
1998	5.5	621.9	93.57	134.84	24.77	4.72	7791
1999	4.8	629.7	87.73	138.62	28.38	4.72	7791
2000	5.89	820.2	131.05	142.34	25.99	3.23	7791
2001	5.9	794.8	125.59	145.98	24.31	4.85	7791
2002	6.18	799.1	115.98	149.55	25.89	7.98	7791
2003	6.14	917.6	138.29	153.09	26.86	9.51	7791
2004	6.41	1077.6	159.85	156.66	29.91	15.25	7791
2005	6.03	1200.6	193.56	160.30	30.4	35.21	7791
2006	6.42	1372.6	243.40	164.02	32.34	51.4	7791
2007	7.23	1523.9	261.91	167.81	31.2	54.1	7791
2008	6.94	1700.8	299.44	171.65	35.12	37.2	7791
2009	5.84	1681.5	268.19	175.53	33.97	21.51	7791
2010	2.62	1771.7	251.66	179.42	34.3	16.35	7791
2011	1.32	2135.8	267.42	183.34	34.48	8.21	7791
2012	1.02	2243.8	302.38	187.28	34.47	14.56	7791

2013	1.61	2312.2	308.85	191.26	38.21	17	7791
2014	3.6	2443.6	318.53	195.31	37.5	9.88	7791
2015	5	2705.6	381.67	199.43	38.23	23.05	7791
2016	5.63	2786.6	392.52	203.63	40.17	27.49	7791
2017	8.4	3045.7	443.16	207.90	39.18	34.71	7791
2018	8.3	3145.7	495.21	212.22	39.25	16.66	7791

(Data source: Pakistan Statistical Yearbook and World Bank; GDP, fixed asset investment and FDI use current US dollars)

3) Demand forecast

Using curve fitting based on the above data, select the most suitable model to predict GDP (X1), total fixed assets (X2), total population (X3), grain output (X4) and FDI (X5), and then pass A suitable multiple regression model predicts the railway freight volume. As shown in the table below.

Table2 Multiple Forecast Model Tables

Predictive model	Function	R2
GDP model	$Y1=487.27+38.90X_1+3.48X_1^2$	0.992
Total investment in fixed assets model	$Y2=82.66+5.83X_2+0.46X_2^2$	0.949
Population prediction model	$Y3=124.40+3.43X_3+0.016X_3^2$	0.999
Food production forecast model	$Y4=23.92+0.097X_4+0.071X_4^2-0.002X_4^3$	0.945
FDI Model	$Y5=5.82* (1.074) X5$	0.350
Multiple linear regression results of freight volume	$Y1=12.39-0.007X_1+0.065X_2-0.011X_3-0.289X_4$	0.65
Multiple linear regression results of freight volume	$Y2=21.205+0.004X_1-0.055X_3-0.436X_4+0.084X_5$	0.335

Table 3 Forecast result table

Forecast year	2020	Growth rate	2025	Growth rate	2030	Growth rate
GDP (100 million US dollars)	3634.8	6.11%	4825.3	5.38%	6187.3	4.78%
Total investment in fixed assets (100 million US dollars)	515.9	5.82%	671.6	5.16%	850.2	4.62%
Population (million people)	220.2	1.95%	241.7	1.84%	264.1	1.75%
Food production (million tons)	39.5	0	36.7	-2.48%	28.5	-7%
FDI (100 million US dollars)	34.7	7.4%	49.6	7.4%	70.8	7.4%
National railway freight volume Y <sub>1</sub> freight volume (million tons)	6.7	5.37%	9.3	7.62%	13.7	8.37%
National railway freight volume Y <sub>2</sub> freight volume (million tons)	9.3	9.6%	15.2	10.39%	24.6	9.87%

It can be seen from the above prediction results:

Firstly, the total investment in fixed assets is positively correlated with the volume of railway transportation. Taking the factors affecting GDP (X1), total fixed assets (X2), total population (X3), and food production (X4) into account, Pakistan's railway freight volume will be in the future In the next decade, there will be a steady growth; second, FDI is positively correlated with the volume of railway freight, and the impact is greater than the total investment in fixed assets. FDI will be replaced by fixed asset investment, considering GDP (X1), total population (X3), grain production (X4) and FDI (X5), Pakistan's railway freight volume will have a rapid growth in the next ten years. This also demonstrates the important role of China's investment in Pakistan in the construction of the China-Pakistan Economic Corridor and its impact on the increase in railway freight volume.

III. CONCLUSION

In summary, this article considers GDP, total population, food production, and Fixed Asset Investment and FDI as the influencing factor indicators, and carries out a multiple regression forecast analysis on Pakistan's future railway freight volume, and finds that Pakistan's railway freight volume It is positively correlated with the total fixed asset investment and FDI, but the positive correlation between FDI is stronger. In the next decade, Pakistan's railway freight volume will have a steady and rapid growth. If FDI increases, the growth of railway freight volume will be even stronger. In the context of 'Belt and Road', the construction of the China-Pakistan Economic Corridor will complete Pakistan's railway network and increase foreign investment in Pakistan. Pakistan's railway and freight volume will have a qualitative and quantitative leap in the next decade.

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