THE ECONOMIC COST OF THE STATE-OWNED ENTERPRISES (SOEs): A MARKET BASED SOLUTION

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CERTIFICATE

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I, Muhammad Kashif Aakash hereby state that my MPhil thesis titled **"The Economic Cost of State-Owned Enterprises (SOEs): A Market Based Solution"** is my own work and has not been submitted previously by me for taking any degree from Pakistan Institute of Development Economics or anywhere else in the country/world.

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Dedication

I dedicate this dissertation to my father Islam Gul and my mother Misri Jana.

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ABSTRACT

This study shows the economic efficiency in a State-Owned Enterprise of Pakistan, the Pakistan Railway. The study is based on the fundamentals of CCR-BCC Data Envelopment Analysis (DEA) by Charnes et al. (1978). The model is extended to the time series data from 1970-2019. The Pakistan Railway is product inefficient except 1970, 1980 and 208-19 due to the change in policies, which resulted a decline in inputs and as a result reduced the outputs. The PR is earnings inefficient except 2017 and 2018 due to the product inefficiency. The PR is financially efficient with the inputs and outputs used in the analysis but the increase in the operational cost is shrinking business and the closure of trains has reduced the competition of Pakistan Railway in freight market which resulted a decline in the revenue of freight. This research suggests that Pakistan Railway needs investment in the product efficiency to upgrade infrastructure and the usage of trains in a right direction. A policy turn-around is needed with autonomous and dedicated management.

Keywords: State-Owned Enterprises, SOEs, Pakistan Railway, Data Envelopment Analysis, DEA.

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LIST OF ABBREVIATIONS

CCI Council of Common Interest

DEA Data Envelopment Analysis

DMU Decision Making Units

FY Financial Year NHA, PESCO, PIA

GDP Gross Domestic Product

GOE Government Owned Enterprises

GOP Government of Pakistan

HQ Headquarter

HSR High Speed Railways

ML-1 Main Lane 1

NHA National Highway Authority

NWR North Western Railways

PER Pakistan Eastern Railway

PESCO Peshawar Electric and Supply Company

PIA Pakistan International Airlines

PR Pakistan Railways

SFA Stochastic Frontier Analysis

SOE State-Owned Enterprises

SP&DR Scinde, Punjab and Delhi Railway

CHAPTER 1

INTRODUCTION

1.1 Background of the study

A state-owned enterprise (SOE) or government-owned enterprise (GOE) is a business enterprise where the government or state has significant control through full, majority, or significant minority ownership. Defining characteristics of SOEs are their distinct legal form and operation in commercial affairs and activities.

State-owned enterprises (SOEs) is contributing substantial share to the employment, market capitalization and gross domestic product (GDP) of developing economies. The state ownership is mostly common in sectors as infrastructure and utilities, but they are also apart of high-tech areas as shipbuilding, aerospace, automotive industries and sectors closely linked to military industrial complex. In many other cases, SOEs are playing a dominant role, or even have (natural) monopoly positions, in their respective fields. Moreover, they can also appear as diversified industrial groups, whose activities are partially or totally funded and controlled by the government Meissner et al. (2019).

The state-owned enterprises (SOEs) have grown so fast with the SOEs assets, in the world 2,000 largest firms has double its value with the 20 percent. The current value of the SOEs in the world is $45 trillion by 2018, which is the 50 percent of the world GDP. In the chin economic growth SOEs play a tremendous role in the local economy (IMF, 2020).

This study is mainly a focus on a State-Owned Enterprise in Pakistan. The Pakistan Railway is adopted for the study locale. Because of its huge losses in the past decades caused by various management and policy issues. This area lacks the research and development, this will be an addition to the existing literature and research. This study is based on a quantitative methodological approach to evaluate the efficiency of Pakistan Railway using the Data Envelopment Analysis (DEA) methodology.

The importance of railways has grown so fast during the period of post-World War 2 in the twentieth century. In the beginning of the twentieth century, British had 21,000 miles track, China had 370 miles where America had 182,000 miles track (Smith & Zhou, 2018).

The motivation for this study is to analyze the deteriorating condition of Pakistan Railways and investigate that why a profit-making public railway declined over the years. After the

independence, Pakistan inherited a railway system developed by British which was considered as a symbol of strategic connectivity and economic power. At was developed and built against all argument's harsh geographical conditions, impassable territory and low demand (Tahir & Tahir, 2020). Initially, Pakistan Railway had to bear with problems resulting from the partition of British India, for instance, financial debts, return of skilled labor and the maintenance and manufacturing facilities were left in Kolkata, the HQ in India.

According to Malik (1962) the 8,863 km track along the equipment was in a very worse condition. There was no supply line for the replacement or repairing the equipment's of railway. In such conditions, the management revived the enterprise and made it functional for the next three decades.

At the time of the initial three decades, Pakistan Railway have experienced various issues. The key issues were the labor issues, government policy and Pakistan Railway management. All these issues are related to the service efficiency and effectiveness. With coordinating these three dimensions it is not possible to run railways (Beyer JR, 1919).

According to Bruinsma et al. (2008) in the end of 1950 the rail has lost the pre-eminence in the transportation in the world. Roads and cars have become the source of transportation, and revenue (Sperling & Gordon, 2010). The large bulk of rail traffic shifted to highways (Jitsuzumi & Nakamura, 2010). Due to the rising prices of oil and envirnment benefits of railways the world is now witnessing a renewed interest in the railways (Jitsuzumi & Nakamura, 2010).

The first study in analyzing the efficiency in the railway sector was used by (Perelman & Pestieau, 1988). They have used the deterministic frontier, which require the priori imposition of a fundamental form for the frontier. Oum and Yu (1994) estimated the productive efficiency of railways using the non-parametric techniques (DEA, Data Envelopment Analysis). Their analysis estimated the efficiency and determined the financial and management autonomy. The efficiency of European railways was analyzed by Cowie and Riddington (1996) in 1992. The main focus in the analysis was to compare the results obtained from different approaches of frontier. Though, continuously changing were not analyzed. The results concluded that the good and bad performers can be obtained but the accurate efficiency is not possible. Cantos et al. (1999) estimated the efficiency in the European railways using the frontier approach to analyze the productivity. The total Factor Productivity was measured using the Malmquist Productivity Index through the non-parametric approach (DEA).

1.2 Railway in Pakistan

Pakistan Railway is a very important SOE in Pakistan because it is giving a huge employment to the people of Pakistan. Initially in 1950-55 PR was giving employment to 100,734 citizens which was later increased to 137,730 in 1975-80 where currently, the total employees of PR are 67,627 in the year 2018-19 (Railways, 2019). The governance failure has declined the efficiency of Pakistan Railway and the railway had to burden huge losses on the Pakistan economy.

According to (Ahmed, 2021) PR has suffered Rs. 1.19 trillion losses in the last three years. In the year 2018-19 Pakistan Railway has suffered a loss of Rs. 32.7 billion, Rs. 50.15 billion in 2019-20 and 36.28 billion in the initial eight months of the fiscal year 2020-21.

Pakistan Railways importance and expectations are rising and the organization efficiency of service and quality is declining (Nayak, 2021). The deteriorating conditions of Pakistan Railways have started after the Independence of Pakistan in 1947 (Malik, 1962). The transport policy of Pakistan was favored as a pro-road in the Second Five Year Plan (Planning Comission, 1960). The amount which was allocated to the PR was very low as compared to the amount allocated for the roads (Imran, 2009). This policy of preferring roads over the railways have declined the performance of PR. Because of the lack of investment, the railway lost to compete in passengers' traffic and freight traffic (GOP G. , 2013-14).

Pakistan have been to various IMF programs since the late 1980s. A policy of deregulation, liberalization and privatization was adopted. Pakistan Railways was added to the list of Privatization Commission in the year 1993. PR was privatized after a decision in 1997 (Tahir, 2013). After privatization a World Bank program was initiated to restructure or corporatize Pakistan Railways eventually (World Bank, 1998). While in result no privatization took place, the investment in Pakistan Railway was placed on hold by the government. The privatization policy was changed in 2010 from strategic sale majority of shares of the enterprise were given to public private partnership mode.

Pakistan Railway was included along 23 other enterprises chosen for privatization. PR was also included to be restructured (GOP, Year Book 2005-06, 2006). Railway was considered as fuel efficient and environment friendly have raise its competition and revival worldwide. The light rail transit has attracted more investment in the rolling stock. Railway was built for facilitating the people, it was considered as a product not for the purpose of financial efficiency. It was a considered as symbol of modernity and industry. The policy of overcoming the losses and

closing down the railway lines has neglected the issues of social connectivity, harmony and deprivation Collins (2001) and (Meunier, 2002).

Insufficient investment is the main reason for deterioration. The rising passenger and the employees of railway shows a generalized issue of over-employment and corruption, which have burdened the enterprise and become worse in an era in doing business. When the state itself is financially inefficient with the declining tax/GDP ratio have arose the issues of financial efficiency. In the first five-year plan, Pakistan prepared a strategy to recover track first and the rolling stock later (GOP, 1957). This plan was never followed. Both the rehabilitation of rolling stock and the Track length was declining. The strategy didn't match at the time with the state findings, which was declined in the macroeconomic difficulties in the recent years.

Pakistan Railways can be summed up as a system of utilized and superfluous capacity. The demand for railways is deprived. The population is increasing by 2 percent annually and the Gross Domestic Product (GDP) by 4-5 percent. The environment degradation and energy deficit are increasing. Petroleum imports are the one-third of the total imports. About 35 percent fuel mix for power generation is based on oil. The cost of generation of oil is increased due to the increased in the prices of oil (SBP, 2013). Environmental degradation cost in Pakistan is around 6 percent of the GDP and to the airborne lead pollution the contribution is 0.7 percentage points (Bank, 2006). For environmental sustainability and economic productivity, the intermodal transport policy is very important.

1.3 Research Question

1. To determine how the economic efficiency is affected by historical reforms and deteriorating conditions of Pakistan Railway?

1.4 Research Objective

1. To examine the economic efficiency in Pakistan Railway.

CHAPTER 2

OVERVIEW OF SOES IN PAKISTAN

2.1 SOEs in Pakistan

Currently, in Pakistan there are 212 State Owned Entities (SOEs) in Pakistan with its operations in various sectors as follows.

- 85 commercial SOEs,
- 44 Non-Commercial SOEs (Not-for profit, as well as trusts, universities, trainings institution and welfare funds).
- 83 subsidiaries of the commercial SOEs

The commercial SOEs mainly operate in 7 sectors: Power; Oil and Gas; Manufacturing, Finance; Infrastructure Transport and Communication; Industrial Estate Development and Management; Mining and Engineering and Wholesale, Retail and Marketing.

The below table shows the classifications of sectors in which SOEs operate.

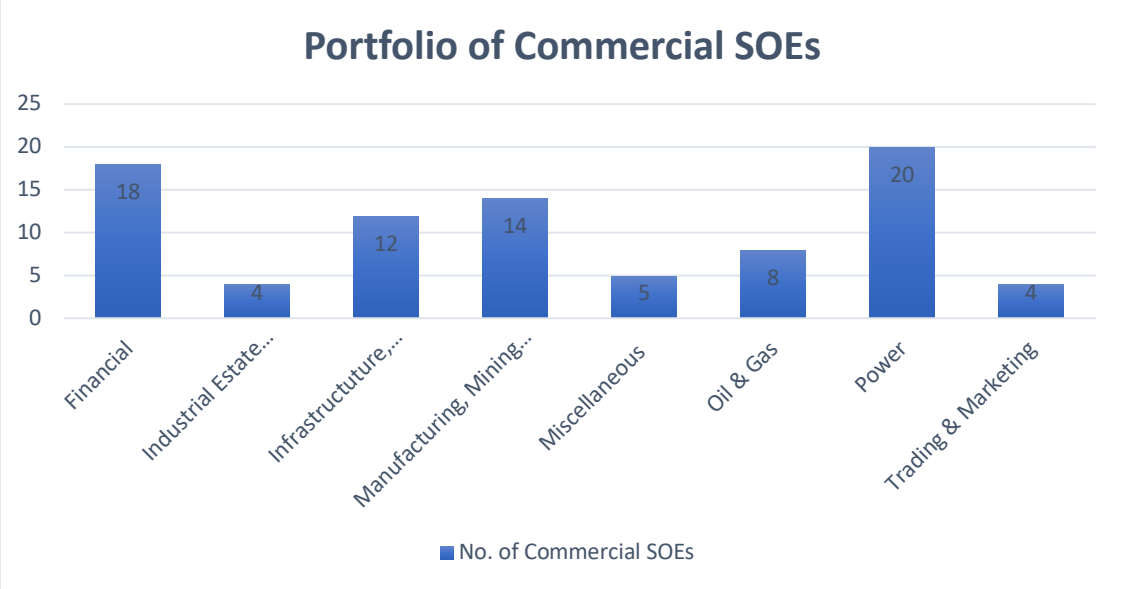

Fig 2. 1: Portfolio of Commercial SOEs

Source: (GOP, 2021)

2.1.1 Revenue of SOEs: Profit and (Losses)

SOEs in Pakistan contribute the total revenue from all sectors collectively for the year 2018-19 was Rs. 4 trillion (approx.) while the total value asset was 19 trillion. They contribute roughly 10% to the nominal GDP. Moreover, SOEs provide employment to more than 450,000 people which is around 0.8% of the total workforce. The commercial SOEs collectively recorded Rs. 143 billion net losses for the year 2018-19. Where the estimated losses for the year 2017-18 were around Rs 287 billion, a slight improvement is recorded with in the fiscal year 2018-19. (GOP, 2021).

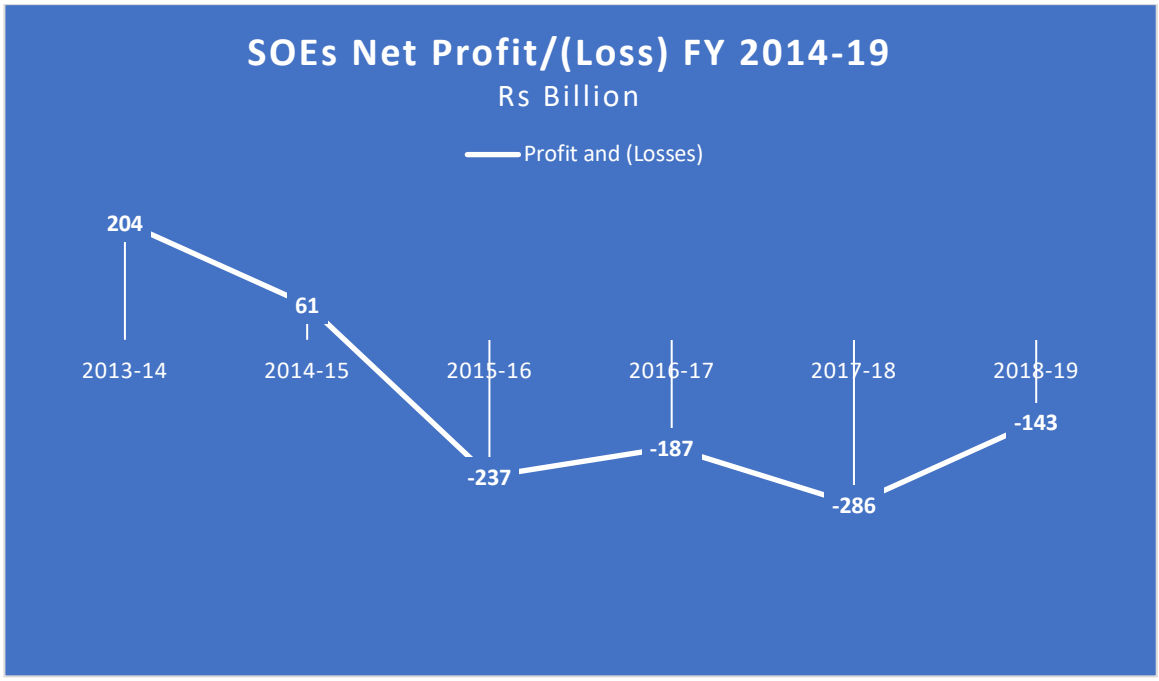

Fig 2. 2: SOEs Net Profit/(Loss) FY 2014-19

Source: (GOP, 2021)

Above table shows the Net Profit and Losses of SOEs from Financial Year 2014 till financial year 2019. The SOEs in Pakistan were performing better in financial year 2013-14 with the total profit of Rs. 204 Billion. A massive decline was recorded in the financial year 2014-15 with the total profit of Rs. 61 Billion accumulatively low from the previous year. A negative performance with tremendous decline from profit making entities to loss making enterprise is recorded in the FY 2015-16 with Rs. -237 Billion. Again, in the FY 2016-17 performance is negative with Rs. -187 Billion losses but relatively better than the previous year. Again, a massive increase in the losses for the FY 2017-18 with Rs. -286 Billion, followed with Rs. -143 Billion in the FY 2018-19.

2.1.2 Contribution of Loss Making SOEs

According to the (GOP, 2021) performance of SOEs in the past six years shows that, intermittently losses has been experienced by the commercial SOEs. Furthermore, the sum of the losses of the top 10 loss-making state-owned entities contributes around 90% to the total losses of SOEs portfolio each year. Pakistan Railways, NHA, PESCO, PIA, are among the top 10 loss makings state owned enterprises.

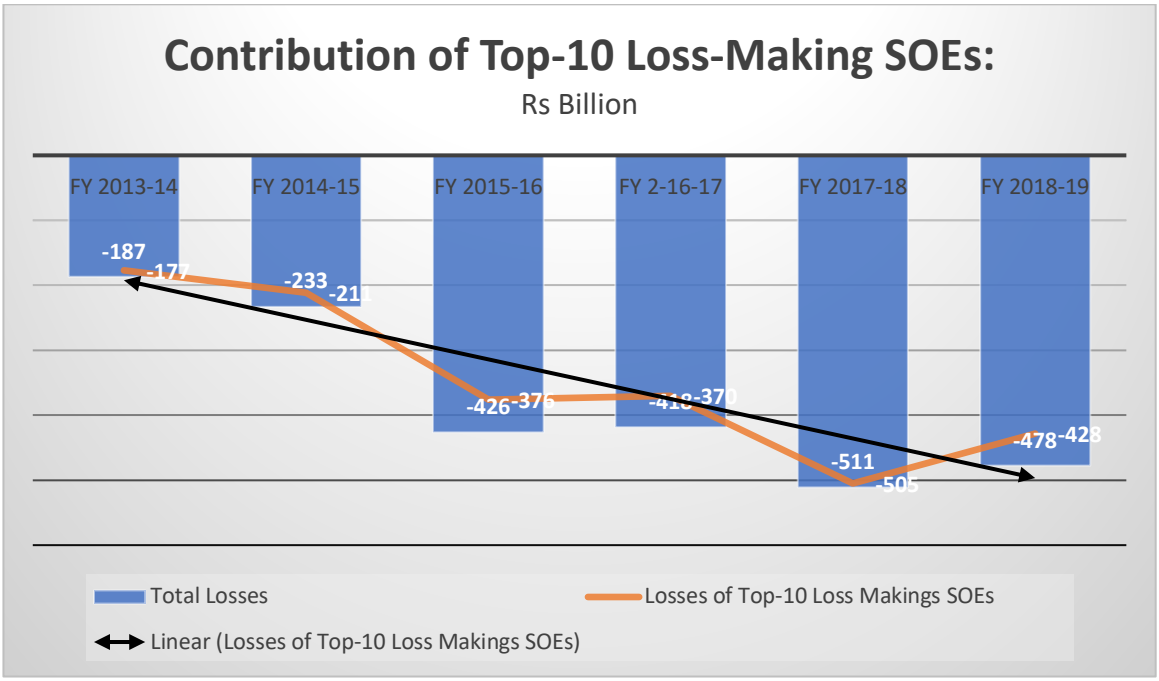

Fig 2. 3: Contribution of Top-10 Loss-Making SOEs

Source: (GOP, 2021)

Above graph shows the contribution of top 10 loss making SOEs and the total losses. In the financial year 2013-14 the total losses recorded were 187 Billion rupees, where the contribution of top 10 loss making enterprises are recorded 177 Billion rupees. Followed with the increase in the total losses in the financial year 2014-15 the total losses were recorded 233 Billion rupees and the top 10 loss making entities contribution was 211 Billion rupees. In the FY 2015-16 the total losses reached 426 Billion rupees and the contribution of loss-making entities recorded Rs. 376 Billion. A little decline is recorded in the losses for the financial year 2016-17, where the total losses were recorded Rs. 418 Billion and the top 10 loss making enterprises showed a little decline from the previous financial year with contribution of Rs. 370 Billion. In the financial year 2017-18 a massive increase in the losses with the total losses of Rs. 511 Billion and top 10 loss making enterprises contribution is Rs. 505 Billion. Again, in financial year 2018-19 a massive decline is recorded from the previous year, where the total losses were Rs. 478 Billion and the contribution of top 10 loss making firms recorded with Rs. 428 Billion.

Pakistan Railway is the only SOE stands along PIA and NHA which are also contributing losses consecutively from the financial year 2014 to 2019. Pakistan Railway losses in financial year 2018-19 are Rs. 32,769 Million.

2.2 History of Pakistan Railways

The story of Pakistan Railways (PR) is full of hope and expectations for the people of Pakistan but the service is declining with safety precautions. The government of Pakistan never priorities railways in the transportation policy. According to Imran (2009) the government have not priorities railways transportation, rather failed to invest in it. The amount allocated as a whole for railways transportation is less than the amount spending on roads sector. The false policy of roads sector brings a disaster in the competition of transportation sector. The railways lost its ability to compete with the roads sector because the approach of government investment has shifted from railways to roads. The profitable freight traffic lost its ability to sustain its expenses rather shifted to the crisis in the railways sector. The net results appeared to be burden on the public taxpayers in form of subsidies and losses. It is also taken as a sign and indicator of government failure, that generalized issues have aroused in the transportation sector like corruption, over-employment a burden in times of shrinking business. The contraction of railways business has made it even more hard to overcome the corruption and the losses.

According to Malik (1962) the gloom of Pakistan Railways has started after the colonial era and the beginning of the Independence of the country in 1947. It had to face a very uncomplimentary conditions at the times of the partition. Railway had evolved a complete culture of its own like military. They were self-reeling in health, education, housing, police and its own accounting system and the lifetime employment. The railway organization was not just a mode of transportation, but it was a complete way of life which had to change suddenly. According to Malik (1962) Pakistan had received 8,863 km, railways line in inheritance after the partition. With the deteriorating conditions of the railways track and equipment. The rival of the railways was solely considered as the measure of the enterprise determination and dedication to survive as a new nation. In the first three decades, the Pakistan Railways performed well. Today, PR system can be described in way that it is totally collapsed, and the deteriorating conditions have no alternative with the increasing and huge population size. But to travel in a train which never reaches on time and the unsafe trains are always at risk. According to Tahir (2013) the railway is not performing worse in the service delivery but it is declining in its operations and revenue as well. The contraction is in every indicator from

freight services to passenger, passenger services to route kilometers and from number of locomotives to revenue. The track in 1950-55 was 12000 which was reduced to 11,881 km in 2018-19. In the same year a huge declined was also recorded in the reduction of locomotives from 862 to 472, followed with the couching vehicles from 2,585 to 1638 and the freight wagons from 24,251 to 14327. In 1950-55 the operating expenses of Pakistan Railways were 67 percent of its revenue and the enterprise was making profits. But in the year 2011-12, the operating expenses rose to 194 percent of the revenue (Year Book 2018-19). The enterprise resulted in a crisis in public transportation and a burden in form of losses and subsidies on public exchequer.

The struggle of Pakistan Railways to survive in a country where the income per capita was $1,254 in 2013-14 and the population growth was 2 percent. The shares of Transport and communication sector in GDP was 13 percent and the growth rate for the year 2005-6 to 2013-14 was 4 percent.

2.2.1 Pre-Independence

According to Imran and Ahmed (2021) the railway construction was started in 1850 after a heated debate for 15 years in the British India. The debate was won in the circumstances of security and commercial benefits of railways. Military measures with less outlay and better security measure was the first objective of developing railways at the time. The second objective was to build railways for commercial purposes to the nearest shipping ports of the country and to bring back the good produced in the Great Britain (Thorner, 1950).

The third motive was to uplift the status of the people of India through technological transfer (Macpherson, 1955). The first train travelled from Bombay to Thane in 1854 which was followed by a passenger train from Howrah to Hooghly in the same year.

Railway was introduced in the region which later became the territory of Pakistan in 1861, when a railway track line was built between Karachi and Kotri. The Lahore-Multan and Lahore-Amritsar railway line started in 1862. The Scinde Railway Company which built and developed these railway lines was renamed as Scinde, Punjab and Delhi Railway (SP&DR) in 1862 (Malik, 1962). In the 1857 the uprising of Indian had convinced the government to link Delhi and Calcutta with Karachi through 2,200 miles. The Bay of Bengal was connecting with Arabian Sea on the purpose of security (Kerr, 2007). Moreover, various government officials have argued and questioned the logic of commercialization and profits of the railway extension

in Scinde (Sind) and Punjab. Because the railway route line passed through deserts and villages in Scinde, and the Lahore to Multan line was going through the jungles. These routes were not profitable because these were occupied by ;goats and their attendants' (Imran & Ahmed, 2021). After a debate which have led to the state ownership of the SP&DR and new the North Western Railway was established in 1886. The SP&DR, the frontier lines and the northern Punjab were included in NWR, which was owned by the state but operated in the Headquarter of the North Lahore. This has opened new opportunities in the expansion of the railways and Lahore was the center of extensive network of the Indian Railway Workshop (Khan et al., 2013).

2.2.1.1 Frontier Railways

Due to the Anglo-Afghan wars and the danger from the Russian imperialism on the Indian boarder strategically the north-western part of Pakistan was very important. To ensure the quick movements of the troops constructing railways in these hilly areas was a supreme priority at the time.

Firstly, the focus was given to construct Kandahar State Railway, which was completed in 1880 from Sukkur to Quetta through Sibi the total route was 134 miles (Kerr, 2007). The Sibi to Quetta line was completed in 1887 because it passed through high mountains and ravines, it was nearly 6000 ft above the sea level. So many workers and engineers sacrificed their lives in the construction of the route. Later the route was extended to Chaman through Khwaja Arman Mountains from 1 to 40 step gradient. The Chaman extension included a very famous 3.9 km Khojak Tunnel, which was one of the longest tunnels in India in 1891 at the time of its completion. Due to its difficult terrain, the total 65 Welsh miners with highly expertise were brought from England along with workers from Arab and Persian Gulf countries, Afghanistan and throughout India. The 800 workers died in the construction of this railway line (Berridge, 1969). The Lansdowne Bridge at Sukkar on the Indus River completed in 1889.

The railway network in Pakistan was extended to Afghanistan, the International border in three phases. The first phase the Khyber Railway was built in 1883 which was from Peshawar to Rawalpindi. In the second phase the railway line was extended from Peshawar to Jamrud in 1901. Due to the Afghan war the third phase was delayed for two decades but extended from Jamrud to Landikotal in 1925. The Landikotal is the last line of the Khyber Railway in Pakistan. In this line ninety-two bridges and thirty-four tunnels were built.

Another railway line linked Quetta with Zahidan in Iran was built in 1918 which was named as a Nushki Extension Railway.

2.2.2 Post-Independence

Railways was developed in the colonial period of British Raj. There was no significant development after the independence in 1947. The railways lost its abilities to road sector in both freight and passenger not because the road sector was more efficient, and the railways were not doing well but the government policies favored road sector instead of railways. Where the railways success story in the colonial period was the rise of railways and after the independence period, the government policies favored roads have declines the railways as a whole.

After the independence in 1947, 8,122 route kilometers of the North Western Railways was inherited by Pakistan, while 3,133 route kilometers was inherited by India. The inherited railway route was 6,880 kilometers broad gauge, 736 kilometers were narrow gauge and 506 km were meter gauge (Year Book 2018-19). The different types of railway gauges were a very challenging part in ensuring the availability of equipment's to continue the railways operations. In the early days, railways played a tremendous role in the migration of the people between the two countries, Pakistan and India. Railways were playing a considerable role and was a symbol of the national unity. A policy was adopted in building railways as a symbol of national unity and connectivity in the line of national defense. The railway was extended to Charsadda and Mardan in 1954, and the narrow-gauge line of Jacobabad-Kashmore was converted into broad gauge in 1956. The railway of Pakistani portion was renamed as Pakistan Railways from Western Railways in 1961. An alternative route was built to connect Karachi to Northern Pakistan, the Kot Adu-Kashmore line was constructed from 1969-1973 (50 YEARS OF PAKISTAN, 1998).

2.2.2.1 Issues of Governance

A variety of issues have contributed to the disasters of Pakistan Railways. But the major one could be the governance problem.

How should we manage railways is an answered and unresolved riddle in Pakistan? Should it be run by civil servants as a department of government or professional managers and autonomous board be given this task? Should it be the provincial government or the federal government? Should we privatize it or public private partnership? A variety of other questions could possibly be raised but are not answered in the debate.

According to (Nayak, 2021) historically, the railways were under the complete control of British. Through the terms of contract, the control was exercised. British order, British origin, the British shareholders financing British model and the British railway lines and engines. Initially the private sector give birth to the railways but due to the shortage of funds and risk factors in the investment the British Indian State role of influence was increased. Railways has a very significant strategic role and importance; this argument have influenced that railways should be run by state and bear its strategic and social risks.

There were variety of ownership structures and different types of state controls in the colonial period Kerr (2007) (Sanyal, 1930). But, the state was in regulatory control nature. The railways companies board of directors were in Britain. The directors were mostly the retired ex-Indian officials with diverse experience. Many employees of public sector joined the private sector railway after their retirement from the government sector. The British control was contractual, legislative and executive. The Indian Railway Act IX of 1890 was passed. The Indian Railway Act, 1890 has restricted the role of the government to regulation, coordination, claims settlements between railway administration.

Pakistan continued to follow Indian Railway Act 1980 after the Independence. There were various important issues to be addressed was a very challenging situation for the new state, likewise the issue of autonomy, the organization of railway. Initially the railway was considered as a symbol of unity and integration and its strategic importance of defense line. A unified railway board was established by central government at the time after assuming the control of Pakistan Eastern Railway (PER) and North Western Railways (NWR). For a long time, the board was a part of the railways working and was also a division for the Ministry of Communications. According to Malik (1962) (1998) the railway finances were merged and combined in general finances, the losses and interest charges in the working of strategic lines and the railway budget was bearing the interest rate charges. The railway budget was also included in the general budget. The net receipts of the railways accrued to the country general revenue and money was allocated for the development for the prevailing position of the government. This system has repercussion on the railways and prevented any orderly scheme expansion (Pakistan, 1957). At the end of financial year, the funds were lapsed. With the passage of the time the mismanagement became a major issue. The PR was not having powers to take any step. They had to take various ministries in consideration for appointments, funds and expenditures. The appointment inside the PR was not on meritocracy, such restriction had disrupted the governance system of PR. The political and bureaucratic interference has a very

bad impression on the governance system. Resultantly, in time, this organization became a loss-making entity from a profit-making enterprise.

A team of world bank studied the mode of governance system of PR in 1956, the governance was unsatisfactory at the time, and the World Bank suggested a replacement body to exercise a modicum autonomy in the organization. The creation of Railway Board was passed in 1959. It consisted of a three members body drawn from Finance (F), Traffic and Commercial Department (T&C), Engineering (E). Financial Commissioner was the member of finance. The ex-officio secretary of the GOP was the member/secretary, where the board functioned as a ministry. The member of finance was exercising all the powers of the GOP in the expenditure and a general control of the ministry of finance. Ministry of Finance had a direct representative in the board as a financial commissioner. His induction in the position had ensured the linkages between the budget of the railways and overall budget of the government. For both railways general managers were appointed to deal with the day-to-day operational task of the railway including fares, personal and procurement. The board had only supervisor role. The decisions were to be made autonomously. The financial administration continued to be the same as the government department. The railway finance was not in the jurisdictions of the board and was working autonomously (Malik, 1962).

The decision-making process was affected adversely with the delays in the arrangements of central government and the affairs of railways, as the constitution of the Railway Board have given a less direct role to the central government. The central government was remained with the power of policy making, transfer of property and financial powers. This has caused a disconnection between the day-to-day affairs and long-term planning, affected the managerial development, technical know-how and the engineering capacity. Again, in 1982, the Railway Board was merged with presidential order in the Ministry of Railways. This status remains till today. The ex-officio Chairman of the Railway Board is the Secretary of the Ministry of Railways, and Pakistan Railways is also the department of the Ministry of Railway. Railway Board was once again put on the overall reform agenda in 2014 (Malik, 1962).

2.2.2.2 Provincialization of Pakistan Railway

Like governance issues, important political issues and concerns were raised about the ownership of railways. The provinces demanded that the ownership shall be transfer to them. Resultantly, due to this demand the railways were made the provincial subject. In the Chapter V of the Constitution Bill 1956 the fifth schedule and provision were made for their transfer in

the provinces. For recommendations on railways provincialization a committee was appointed in 1958. The committee recommended that the administration shall be given to a board and the railway shall remain with the center. A presidential order issued to transfer the PER and PWR to the provincial governments of East Pakistan and West Pakistan respectively, on June 1962. The Ordinance of Railway Board 1959 was repealed. Concurrent Railway Board for East Pakistan and West Pakistan were established. Provinces were given the financial autonomy. Still, the powers of dealing and interacting with foreign countries and international organization, implementing relevant agreement were remained with the Central Railway Division. There were certain restrictions on the provincial governments on the defense traffic, closing any railway line or its modification without the approval of the Central Railway Division. After the separation of East Pakistan, the PWR was renamed as a Pakistan Railways and its managerial and operational controls were reverted to the Central governments. The policymaking, service and management and technical advisory is now in the jurisdiction of ministry of railways. Many are still suggesting that railways shall move to the provinces.

A demand of transferring railways to the provinces was made in the eighteenth amendments to the 1973 constitution. In the constitution of 1962, the railway was a provincial subject and in 1956 the railway was a central subject. It was in the Part II of the Federal Legislative List in the constitution of 1973. In the Part II Federal Legislative List, the federal government, not the Council of Common Interest (CCI) had the power to regulate and formulate policies. The eighteenth amendments didn't change the status of railways.

2.2.2.3 Restructuring and Privatization

According to Tahir in 1997, the process of restructuring was initiated in Pakistan Railways. After a report published to convert the organization into a profit-making entity. The report includes the short, medium- and long-term strategies. The report suggested to close down the non-profitable lines and split the Pakistan Railway in a core and non-core activities. They proposed to sell or lease the ancillary services like sports center, schools, hospitals, hostels and clubs. To educate on restructuring and reform a workshop was arranged on various deliberate issues. The important discussion on labor issues was not discussed which would arose in the restructuring process.

The restructuring plan was followed, and the railway was divided into three public limited companies—freight business unit, passenger business unit and infrastructure business unit. In this reform a strategy of cost cutting was used to reduce the employees and the workforce was

reduced from 1,13,000 in 1997 to the total of 95,000 in 2001. The hospitals and schools were leased or sold, and medical education facilities were minimized.

As a result of restructuring, there was increase in the contractual labor while reduction in the permanent workforce. Benefits to workers like housing allowance, health facilities and education were cut off. High paid consultants were hired to increase the efficiency. The restructuring of Pakistan Railways has not improved but the workers have suffered various consequences in their job security.

A second restructuring effort of PR was undertaken from 2008-13. Which was also resulted as a failed privatization effort Tahir .

2.2.2.4 Transport Policy

Historically, after the Second World War the strategy of transport policy was emerged. In Pakistan after the Independence the First Five Year Plane in 1955-60 was pro rail transportation where the allocation of funding was splatted with the ration of 75:25, the fund was allocated very higher for railways. But in the Second Five Year Plan in 1960-65 the pro road policy emerged and creates a challenging time for Pakistan Railways. The railway lost to compete at the time because National Logistic Cell, a military controlled organization was in direct competition to the railways. In 1955-60 the road kilometers were 62000 which have now reached to 264,000 km. Where in railway routes we have reduced from 8,561 to 7,791 km (Tahir & Tahir, 2020).

2.3 Inputs Conditions

Pakistan Railways passenger operations services are divided in following classes.

Table 2. 1: Pakistan Railways classification of Passenger Classes

S. No.	Class Code	Class Name
1	ACSL	AC Sleeper
2	PC	AC Parlour Car
3	ACLZ	AC Business
4	ACL	AC Standard
5	ISL	First Class Sleeper
6	EC	Economy Class
7	SEC	Second Class

Source: (PR, 2020).

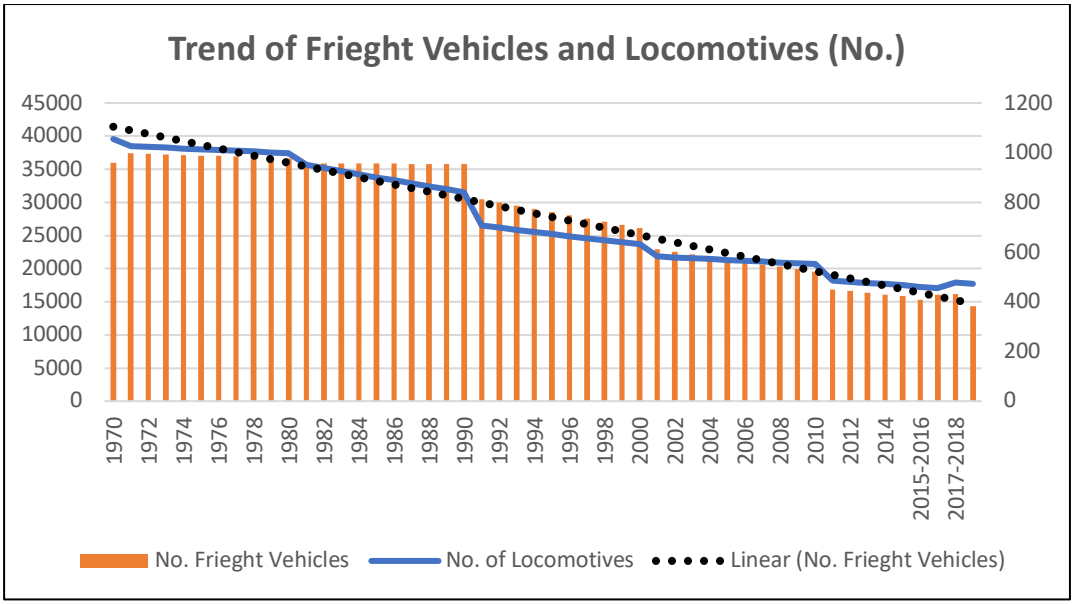

Fig 2. 4: Trend of Freight Vehicles and Locomotives (No.)

Source: (Year Book 2018-19).

The above graphs shows the No. of Freight Vehicles and the No. of Locomotives from the year 1970 to 2019. The Pakistan Railways own 37,395 freight vehicles in the year of 1971, which was relatively stable for few years, but a decline is recorded in the year 1991 with the total vehicles 30,492, followed with 22,888 in 2001. The present statistics of freight vehicles owned by Pakistan Railways are 14,327. The number of freight vehicles has been decreasing over the year.

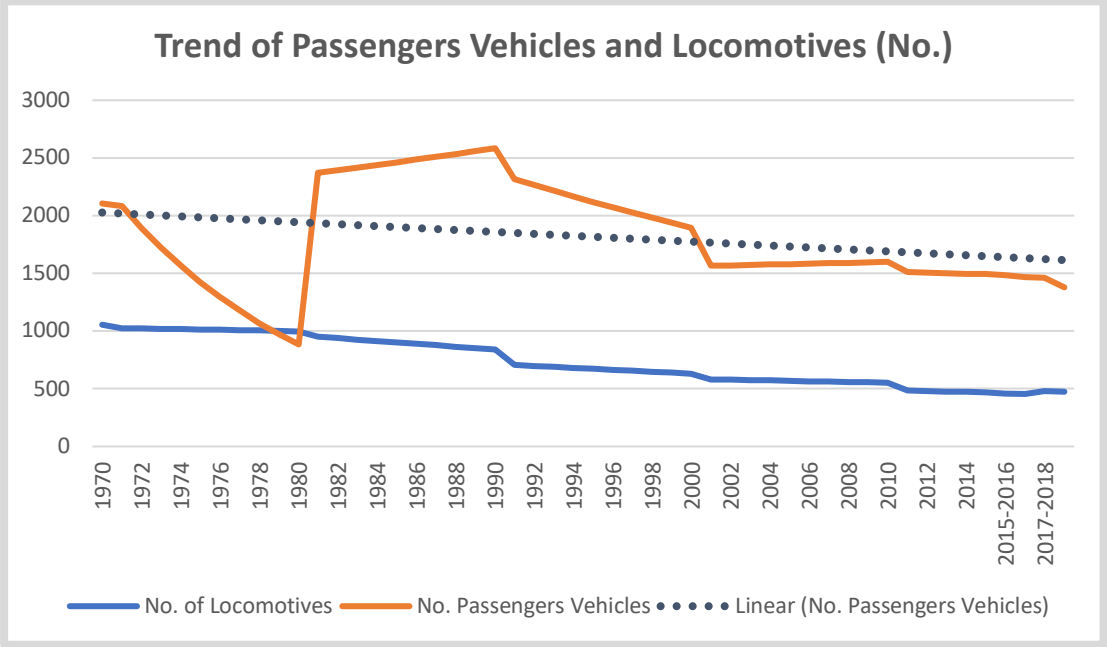

Fig 2. 5: Trend of Passenger Vehicles and Locomotives (No.)

Source: (Year Book 2018-19) .

The above graph indicates the Trend of Passengers Vehicles and Locomotives No. where we can see that the Passengers Vehicles were 2,103 in the year 1970 with 1,026 locomotives. After a decade in the year 1980 a decline is recorded with 884 vehicles and again in the following year in 1981 an increase is recorded with 2,370 vehicles. where the peak is recorded in 1990 with 2,584 vehicles followed with the continued declines for three decades. The total number of passenger's vehicles in 2019 are 1378.

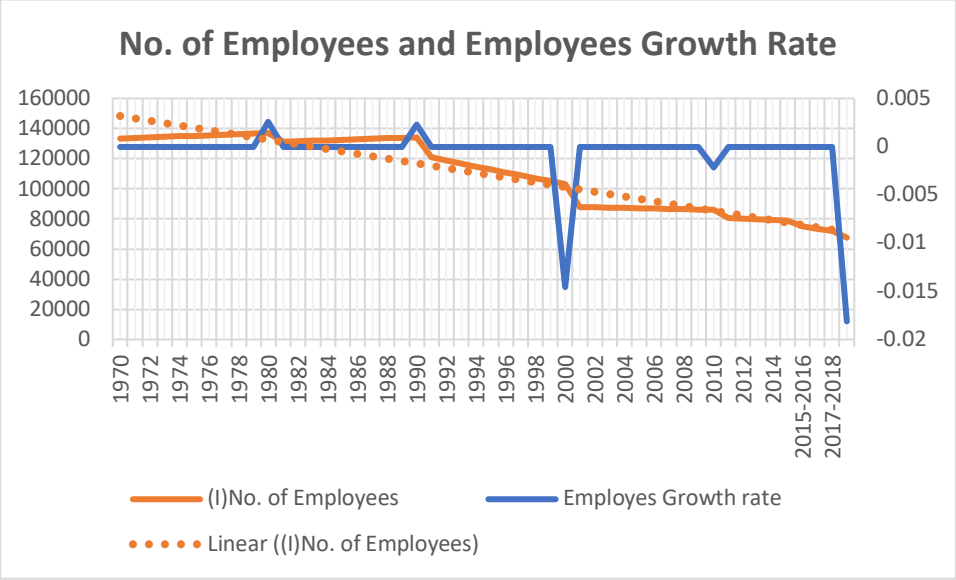

Fig 2. 6: Trend of the No. of Employees and Employees Growth Rate

Source: (Year Book 2018-19).

The above graph shows the number of employees and the employees growth rate where we can see that the employees of Pakistan Railways are constantly reduced over the years. The peak of the number of employees is in the year 1970 with total employees 133,269 and the employees serving in PR in 2018-19 are 67,627. The growth rate shows the decline in the No. of Employees over the years.

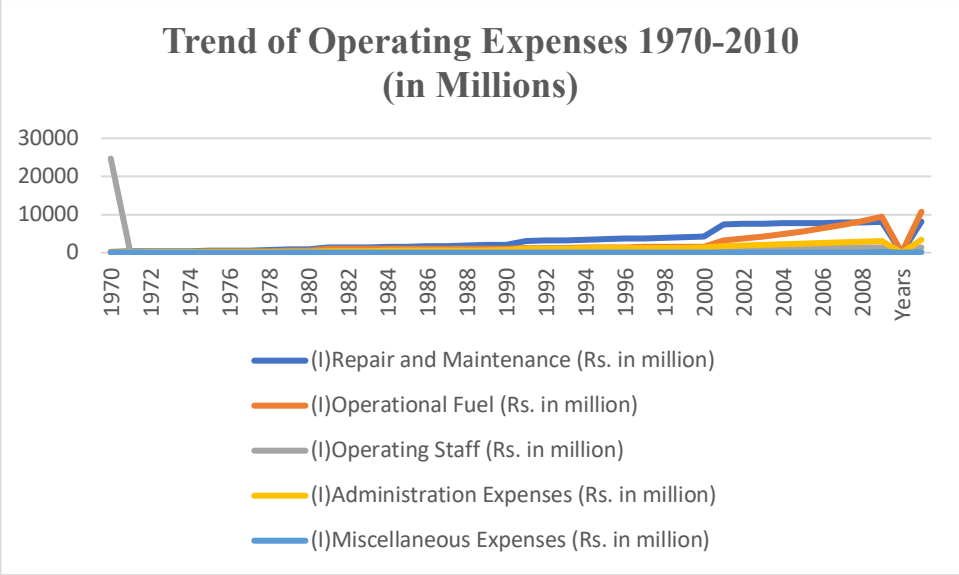

Fig 2. 7: Trend of Operating Expenses 1970-2010

Source: (Year Book 2018-19).

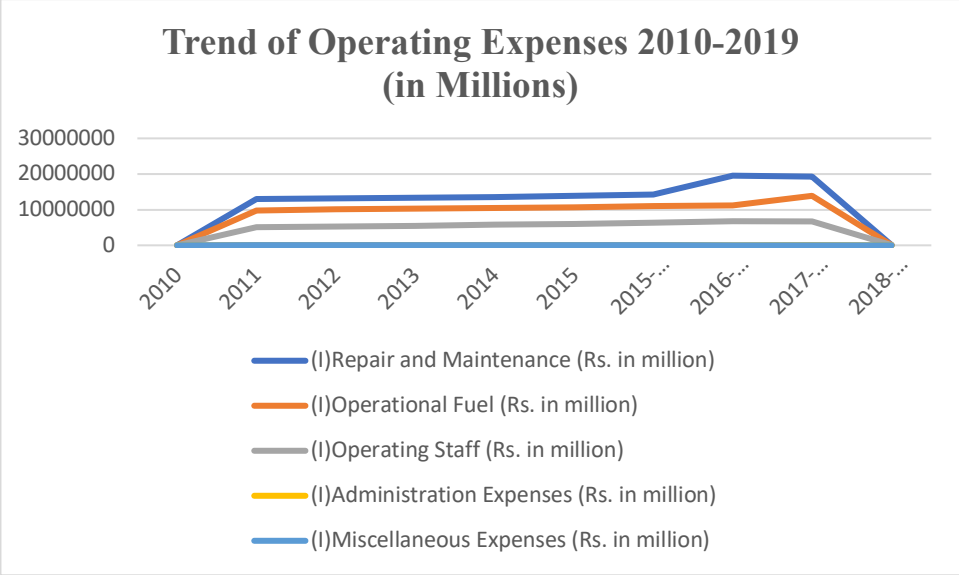

Fig 2. 8: Trend of Operating Expenses 2010-2019

Source: (Year Book 2018-19).

The Fig 2.7 shows the operating expenses of Pakistan Railways for Repair and Maintenance, Operating staff, Administration Expenses, Miscellaneous Expenses and Operational Fuel. From the year 1970 to 2009 in Fig 2.7 the Operational Fuel expenses were relatively higher than other expenses. In 1990 the Operation other than staff and fuel expenses were in the peak. The increase in the expenses had started from the year 2010 onwards showed in Fig 2.8 where the Operating Staff has recorded a highest peak in 2015 followed by Repair and Maintenance and Operational Fuel in the same year. The expenses of Operational Fuel, Repair and

Maintenance and Operating Staff higher from the remaining Administration Expenses, Miscellaneous Expenses from the year 2010 to 2018-19.

2.4 Output Conditions

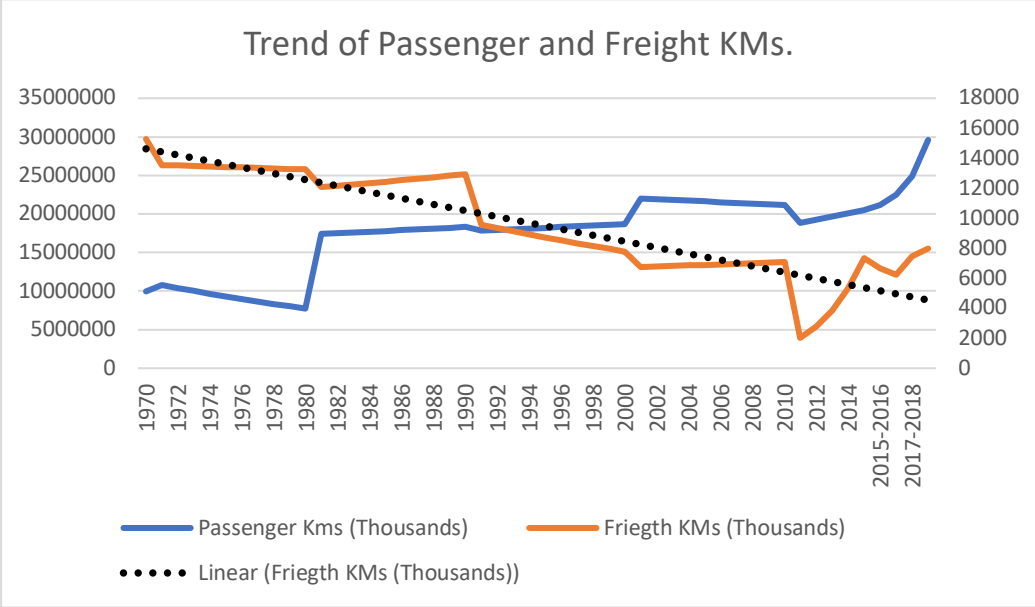

Fig 2. 9: Trend of Passenger and Freight KMs

Source: (Year Book 2018-19).

In the output condition of Pakistan Railways, the trend of passenger and freight kilometers shows that the freight was relatively doing better in the beginning years from 1970 but had started declining at the year 1990. And is still coming downfall. The passenger kilometers are increasing upwards with more attraction from the passenger's side. As in Pakistan we have only railways for long distance transport with minimum and cheap fares. The passenger kilometers were around 9,943,443 (thousands) in 1970 and at the same year the freight ton kilometers were 15,278 (thousands). The freight kilometers started downfall and the passenger's kilometers were still increasing. The peak was recorded for passenger's kilometer in 2018-19 with around 29,595,246 (thousands). While the freight kilometers were the highest in 1970 and there was no further improvement in the five decades. The lowest downfall in passenger kilometers was in 1980s and in the freight kilometers it was in the 2011.

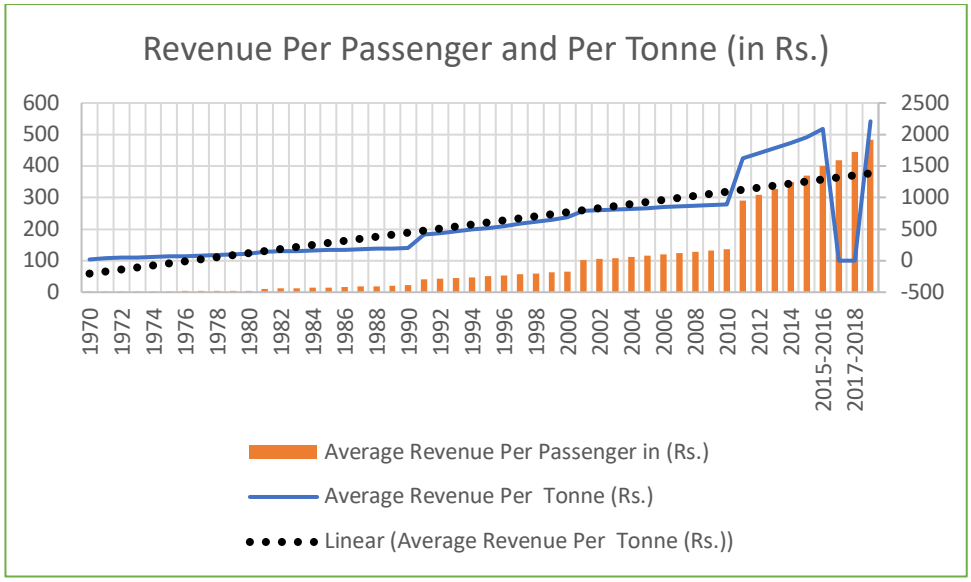

Fig 2. 10: Trend of Revenue per Passenger and Per Ton

Source: (Year Book 2018-19).

The above graph shows the average revenue per passenger and per ton. The revenue per ton is doing relatively better than revenue per passenger from 1970-2000. Where the least for average per passenger revenue was Rs. 1.7 and for average per Ton was Rs. 22.92. The peak for both per passenger and per ton revenue was recorded at the year 2018-19, where the revenue for per ton was Rs. 2209 and revenue for per passenger was Rs. 483.47.

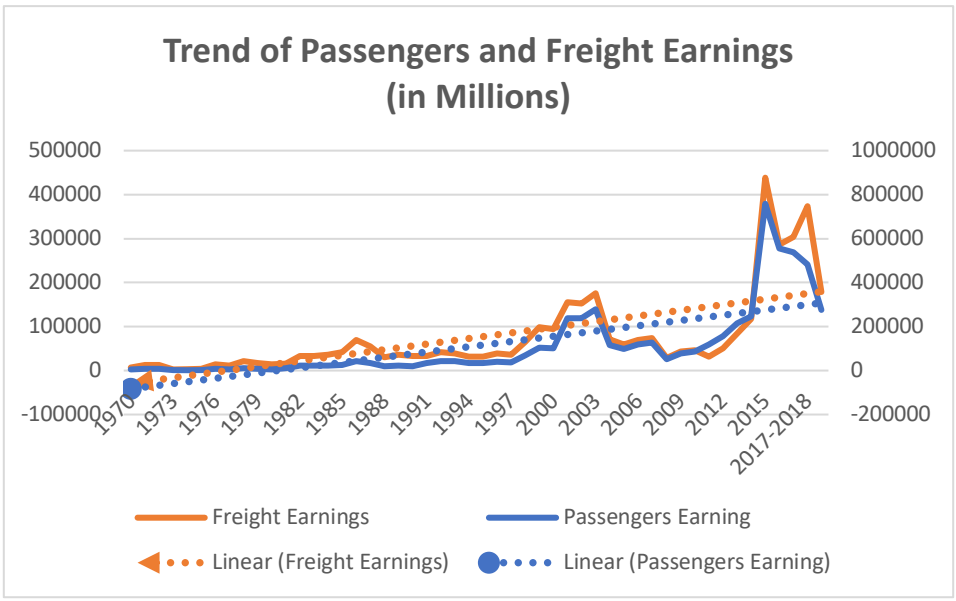

Fig 2. 11: Trend of Passengers and Freight Earnings

Source: (Year Book 2018-19).

The above graph shows the passengers and freight revenue from the year 1970 to 2018-19. We can see that the freight earnings are performing relatively better than the passenger's revenue. The freight performed well in 2015, 2017-18 and the performance of passenger is good in 2015.

But from the beginning the revenue of freight is doing better than passengers as Pakistan Railways is dependent on freight revenue. On the passenger side, it is not commercialized rather the railway is providing cheap long-distance services to the general public.

2.5 Input and Output Conditions

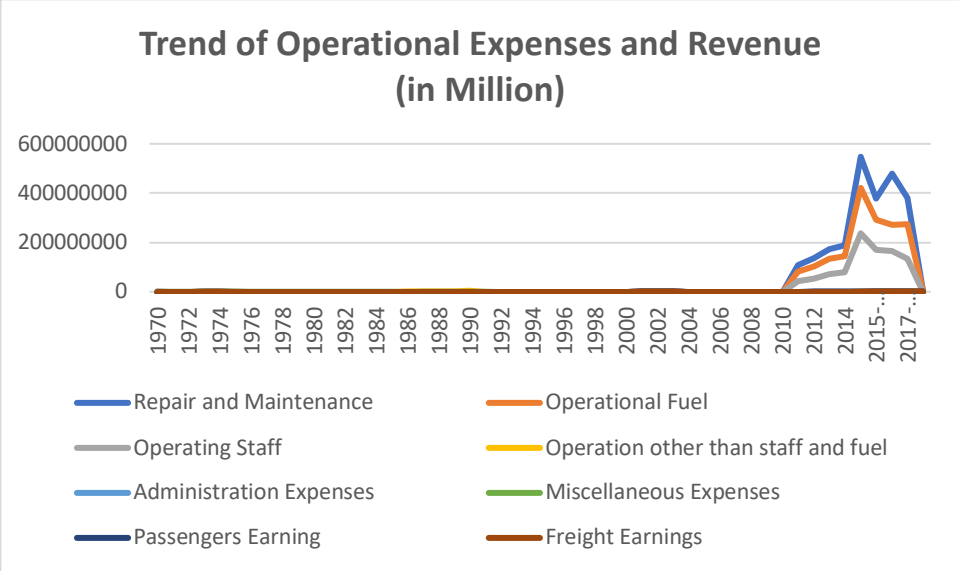

Fig 2. 12: Trend of Input and Output Conditions

Source: (Year Book 2018-19).

The above graph shows the operational expenses of Repair and Maintenance, Operational Fuel, Operating Staff, Operation other than staff and fuel, Administration Expenses, Miscellaneous Expenses and the revenue for Passengers Earnings and Freight Earnings. From the year 1970 to 2010 the railway is relatively doing stable, but the situation is very pathetic after 2010. Where the operating expenses of Repair and Maintenance is higher than the Passengers or Freight Earnings. The Repair and Maintenance peak in 2015 is Rs. 547469201 Million, the Operation Fuel is Rs. 421220866.8 Million followed by Operating Staff Rs. 237151929 while the revenue of Freight in the same year 2015 is Rs. 438497 Million.

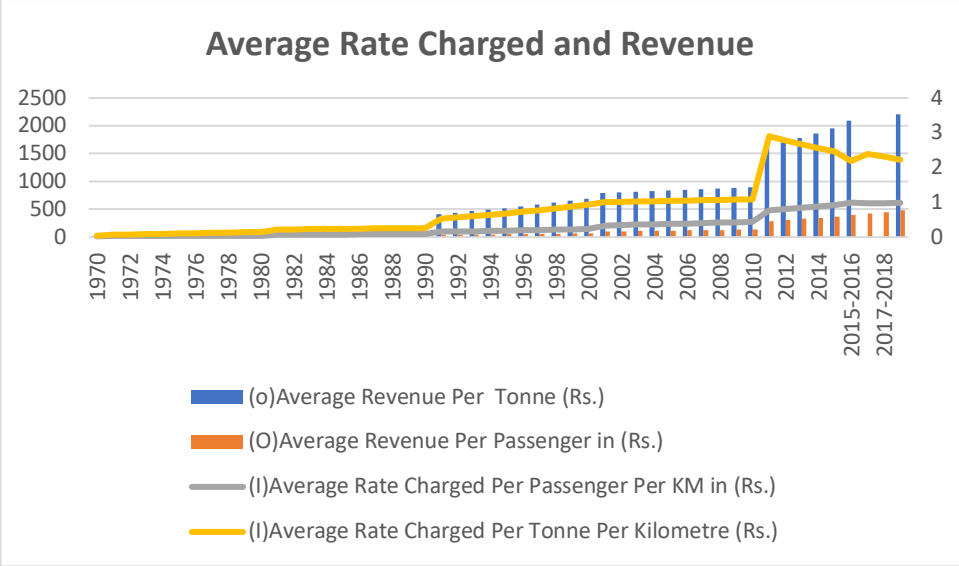

Fig 2. 13: Average Rate Charged and Average Revenue

Source: (Year Book 2018-19).

The above graph shows the Average Rate charged and the Average Revenue produce. We can see that the Average Rate Charged per Passenger km wasn't doing well from the year 1970 to 1990 later it is doing better in the year 2018-19. The Average Revenue Per Passenger has a peak in 2018-19. As compared to passenger the freight is doing better with its charged rate and its revenue. The peak for Average Rate Charger per Ton was in 2018-19.

2.6 Fresh Debates on Pakistan Railways

The journey of railways downfall started around 1970, when we started a romance with the cars. The Nawaz shareef government have come up with the highways and roads. And now is the time that there is road everywhere which has a very disastrous environmental problem. The railway holds a huge no. of land which is mostly used for colonies, houses but that is not used for the capital.

If the railways are operating in a right way, it must produce a good revenue. There are issues in the operational side, the governance system is the major reason for the collapsed and deficit of Pakistan Railways. 7,600 km of track is mostly in a bad shape, due to aging infrastructure in variety of bridges. This aging infrastructure is not replaced with time and creates problems like accidents. There are multiple outdated maintenance and repair equipment's for the track and PR is bearing a very huge amount of cost due to repair and maintenance. The advance technological machinery is not available with the railways organization to facilitate in the repair and maintenance. The speed in railways track is average at 15-30 km/hr. In some areas it is

running relatively faster at 110 km/hr. Upgradation of rail speed is one of the major policy issues.

Moreover, various reforms and restructures were initiated by different agencies, like in 1997 World Bank sponsored a restructuring into three companies, namely infrastructure, Passenger and Freight. A corporatization was initiated but the reforms were made outside the railway's organization. The Military CEO took charge in 2007. The railway revenue come up with a policy of new passenger trains for political gains. This has nosedived the whole revenue of the railways and the deficit increase to Rs. 30 Billion. One of the worst times in the railway's history was in 2011-2013 when railway was in completely bad shape. Because the freight traffic was extremely low.

There is a week policy formulation in the railways from the political side. Around more than 70% budget is used on the pay and pensions. Government have reduced the development budget. If I compare the pattern of expenditures with 1970s and the 2020. The operating expenditure were 62%, pay and allowances were 2.6% and operational fuel was carrying the remaining expenditures. In the current situation there is 13% of operating expenditure. The amount allocated for the operating expenditure is drastically reduced and a huge amount is allocated for pay and pensions.

The PR carries less than 4% of the traffic. The losses are increasing because of the losses from the passenger trains. Instead of passenger trains the freight trains can make good amount of revenue. The no. of passenger carried is declining and the no of passenger train km is increasing. There was time that 300 trains were running in a single day this has caused huge losses.

A discourse is arising in the air that PR has huge acres of land, but railway is all about trains. There are two types of trains the passengers and the freight, the efficiency in the revenue has to be coming from these two areas. Commercializing the land in the stations could be a success story but that is not the major revenue generation part of railways.

Historically, after merging the Railway Board into a Ministry in 1989, the secretary of the Railways became the Chairman Railways. The post of Secretary (Chairman) was open to everyone. The chairman railways have been appointed various times from the Accounts Groups, Customs, District Management, Army Generals etc. There was no professional of railways heading the organization due to which a historical decline was recorded in the whole revenue. The railway professional become the Chairman after 27 years in 2017.

The Railway Board changed into an unwieldly body with the number of Federal Secretaries and few private members have corrupted the board in general. There were no executive powers remaining with the board. They rarely meet on the meeting. The policy and executive role were taken over by the political leadership and Ministers.

In 1997 the world bank restructuring program of dividing railways into three companies, namely Infrastructure, Passenger and Freight was a very productive program but that was disrupted by the Military government which came into power after two years in 1999.

2.6.1 Track Access Regime

Track access was started back in 1993, 94 and 95. The policy was initially to bring private sector to the track of Pakistan Railways and run their freight trains. Private sector has to bring their own locomotives, freight wagons and run their train on Pakistan Railways infrastructure by paying track access charge on per ton kilometers. It's been more than two and a half decades, but this policy has not been implemented and private sector haven't been authorized to run their trains. With this policy the freight revenue will increase, and the private sector will contribute to Pakistan Railways. The policy was formulated but not implemented by Pakistan Railways and the Government of Pakistan.

Again in 2007 and 2010, the situation of railway was very bad, and they had agreed to open track access to the private sector. The policy was formulated, the third-party regulator was needed to connect the private sector with the government. The official bidding process was done but till 2021 the private sector has not received any authority to run their trains on the infrastructure of Pakistan Railways.

The infrastructure is in a very bad condition and it is getting worst. In the year 1993 it was in a bad condition and in 2021 it is also in a bad condition but still the private sector wants to come in and run their own trains in track access policy. The political influence has a very negative role in this policy.

2.6.2 Learning from Chinese Railways

In the 1990 the reforms in Chinese railways took place. There were 58,000 kilometers of track. There was the need of 3.4 million staff in 1990. The change happened in 2000 when the Chinese set a goal of long term and medium-term planning for the Chinese Railways. The planning includes multiple things but the major one was to separate the tracks for passengers which led to the high-speed trains in 2008. In 2019, there were140,000 track kilometers, 3.3 billion

passengers travelled, and 2.2 billion passengers travelled in high-speed rails, 4 billion tons freight, each ton took 700 kilometers. The railways in china have developed a system where highly professional people run the railway where no train gets late for many years. The financing mechanism was historically funded from development funds.

China has set a strategy of goal with long term planning of 15 years in 2001 which was revised in 2008 after achieving the goal of the High-Speed Railways. They have achieved their goals and developed their railways. The research and development have helped them with good findings. The have equipped the modern technologies which advanced the Chinese railways. The new strategic goal for railways in 2035 is the total track will be 200,000 km in terms of length and in 70,000 km in terms of High-Speed Railways.

In the period from 1997 to 2007 china have upgrade their railway track with 22,000 km running at the speed of 120 km/h, 16,000 km running at the speed of 160 km/h, 6,227 km with the speed of 200 km/h. 1,019 km track was the speed of 250 km/h. After this upgradation period in 2008 the HSR started in china. The relationship between railways freight volume and GDP is in a way where the trajectory of railway freight volume basically coincides with that of GDP growth, and most of the time they are synchronized. The driving effect of railway freight on China's economy is greater than the promotion effect of the national economy on railway freight.

There are five indicators which have made the railway of china a successful enterprise.

1. There is a good governance system.
2. Fast Decision-Making Process.
3. Source of financing is from government, enterprise investment and private capital.
4. Construction Period: Early completion brings early benefits.
5. Safety Management: Safety first is their major priority in the construction of a new project.
6. Technical Standards
7. Railway Affiliated Industries

2.6.3 Main Lane (ML)-1

Main Lane 1 or ML-1 initiative is to connect the various areas with each other and upgrade the track of PR. It is connecting Karachi-Rohri-Khanewal-Lahore-Rawalphindi-Peshawar-Taxila-Havelian. It is a total of 1872 kilometers track. Where the ML-2 will connect the PR with

Baluchistan province and ML-3 will connect us to Iran. The completion of the whole project estimated time is 8.5 years with the estimated cost of US$ 6.806 billion. With the ML-1 the main lane will be doubled with improved new track of 160km/h. The construction and rehabilitation of bridges. The technological advancement in Signaling & Telecom Systems. This will increase in line capacity from 34 to 134 trains each way per day. This will also increase the freight volumes from 8 to 35 million tons per year. The passenger trains pairs will be increased from 40 to 80 per day. The shares of railway freight will be increased from 4% to 20%.

Moreover, with the ML-1 in function the travel time will be reduced. The estimated time from Karachi-Lahore will be reduced from 18 hours to 10 hours, from Lahore-Multan the time will be reduced from 5 hours to 3 hours. The travel time from Islamabad to Lahore was 4 and half hours will be reduced to 2 and a half hours. From Peshawar to Islamabad, it will be reduced from 3 hours 45 minutes to 1 hour 45 minutes and the fastest route would be Karachi to Hyderabad where the time will be reduced from 2 hours to 1 hour 20 minutes.

Furthermore, this will add more opportunities for the youth of our country with 20,000 local labour and 4000 Chinese technical experts. The indirect job opportunities could possibly be 150,000.

2.6.4 How Railways are being Financed in the 21st Century

There could be variety of financing in the railways.

1. **Sovereign Financing:** The enterprise has been funded directly by the government.
2. **Corporate Financing:** Debt borrowing from the corporate sector.
3. **Project Financing:** A case study of Mexico Concessions has used this approach to finance a single project to improve the performance. Project financing can be done at a very small amount.
4. **Public Private Partnership:** PPP is based on projects. The private sector deals with risks and skills. Relatively, PPP is expensive.
5. **Typical Financing Instruments:** Typical financing includes loans, bods, stocks or leases. Investment must be profitable enough to pay back financing over time.

2.7 Summary of Emerging Crisis in Pakistan Railway

The crisis in Pakistan Railway emerged after 1980s when Pakistan Railway have adopted a policy of increasing the passenger trains and reducing the freight trains. This have increased the operating cost. As railway is the cheapest mode of transportation for long

routes in Pakistan, the passenger trains didn't contribute well. Due to this the freight trains lost its competition to the private sector and the revenue from the freight trains started declining. On the other side after 2010 (Fig 2.11) the operating and maintenance cost of Pakistan Railway is increased which have emerged financial crisis.

CHAPTER 3

LITERATURE REVIEW

3.1 Literature on Efficiency Analysis

The economic theory of efficiency analysis is based on the work of Koopmans (1951) and (Debreu, 1951). Farrell (1957) analyzed efficiencies in his first empirical work for a set of observed production units. A modern economic formulation was provided to the problem by (Shephard, 2015).

Efficiency and productivity in a converting resource (inputs) into (outputs), the goods and services, have been key issues in public and private sectors. There have been many efficiency analysis approaches in the literature Haksever (1996) Seiford and Thrall (1990) and in econometrics (Bauer, 1990) . There are two school of thoughts in the efficiency analysis for public and private organization which are competing with each other (Wang, 2003). One approach is Data Envelopment Analysis (DEA) Charnes et al. (1978) Ac et al. (1981) which is a non-parametric and mathematical approach and the other is an econometric regression theory, the estimation of (SFF) Stochastic Frontier Functions (Aigner et al., 1977).

In the two-competing paradigm on efficiency analysis, the DEA approach have been popular in the research field. The SFF employs the regression approach which is widely used and accepted in econometric field (Wang, 2003).

According to the (Charnes et al., 1978) original study of DEA. In DEA the production possibility surface is obtained by empirical estimation which a mathematical programing model. DEA directs to the top envelop of observational data set, which is a piecewise linear surface instead of trying to fit a regression surface passing through the center of observational set. With mathematical programing it analyzes relative efficiency represented by any other data point. In compare to the SFF approach other than the concavity of the frontier functions DEA requires no assumptions about the functional form (Wang, 2003).

Jacobs (2001) conducted a study in estimating the efficiency of hospitals with employing the two approaches of efficiency analysis, the DEA and Stochastic Frontier Analysis (SFA). According to Ferrier and Lovell (1990) DEA may estimate more indistinct targets than SFA because only the distance is covered from input-output levels in the efficiency score. DEA has the advantage that multiple inputs and outputs technologies with complex production environment can be managed. But due to its non-statistical approach it doesn't produce the

standard diagnostic tools to judge the goodness of fit of the model. While SFA has the ability to discriminate between the efficient units, DEA has limited ability to do so. Although both methods are able to discriminate between the inefficient hospitals. Jacobs (2001) argued that the accuracy of efficiency is purely based on the nature of both methods. As DEA efficiency score is based on the comparison of the inputs and outputs levels on an individual hospital or (DMU), with the small amount of subset of the efficient units in the hospitals. They can prove to be highly sensitive to the data swings at the individual hospital levels or (DMU). SFA efficiencies are estimated on average values in the regression model which is not sensitive on the individual hospital (DMU) for the data swings (Jacobs, 2001).

Jacobs (2001) argued that DEA cannot assume the statistical noise which is a disadvantage but on the other side it is a non-parametric approach which is taking the advantage of minimal assumptions in the production frontier. The SFA approach takes the advantage of assuming the statistical noise but due to its parametric approach SFA needs strong assumption for the production frontier.

3.2 Data Envelopment Analysis (DEA) Literature

According to Fielding et al. (1985) efficiency in railways is service effectiveness and profitability. Where effectiveness is service produced which includes the operations with safety. Efficiency also meaning to be safe and reliable. Efficiency is denoted in three senses. When we talk about, maximum level of output with a given level of inputs that is Productive efficiency. In the context of railway, the maximum number of freight and passenger carrying capacity is the productive efficiency. When we refer to profitability, it means not only how spending is deployed on functions performed but allocative efficiency of service produced. According to Yu and Lin (2008) the production is totally different from the allocative efficiency of railway services that's why railway services are non-storable.

According to Talluri (2000a) firm take benchmarking as the initial step which is further involved in the business process reengineering (BPR) which is also considered as a continuous process-improvement (CPI) efforts. This process defines the best industrial practices and can also be used as source of guidance to improve practices of organizations. Techniques of benchmarking can identify both productive and effective processes in business which can also be used as a good way to improve processes that inefficient.

In the last two decades a wide variety of estimation techniques such as DEA data envelopment analysis and other such application have been explored, alongside its new methodological and conceptual modifications. Research efforts like this have been compiled in the (Seiford, 1996). Other than these recent modifications in DEA, we found out that DEA was originally developed for the evaluation of public sector entities such as schools and hospitals which is now also used for private sectors like banks airline companies and other industries in the manufacturing business. Furthermore, the scope of the DEA have spread across the countries, not specific to the United States but also in the Japan and European Countries. (Charnes et al., 1985).

In the input-based DEA model structure, each DMU reduce its inputs with the same number of outputs, till it reaches the efficiency frontier. In the output-based DEA structure, each DMU provide such information that how much a DMU has to increase its output maintaining the same amount of inputs (Sueyoshi & Goto, 2001).

In DEA non-parametric method, inputs and outputs data set is empirically enveloped on a production possibility set, without assuming the transformation of parametric functions. The DMU is distinguish that weather it is located on the efficient frontier or it is located inside the production set. If a DMU is located on the efficient frontier that DMU would be efficient. if the DMU is located inside the production set, that DMU would be inefficient. The efficiency score indicates that where the DMU stands, and how far a DMU is from the efficient frontier (Sueyoshi & Goto, 2001).

The efficiency score is determined with (theta) and the slack is the distance the DMU has to reach the efficiency frontier from its position at the production set. If there is no slack that DMU is efficient. If there is slack, the slack tells the amount of improvement a DMU needs. To evaluate the performance of certain DMUs the inputs and outputs needs to be selected appropriately. (Sueyoshi & Goto, 2001).

According to Talluri (2000b) the benchmarking is used to identify a set of efficient units for each DMU that can be used as benchmarking for the improvement. Benchmarking in DEA has certain limitations, but it identifies the targets of improvements. There is a discussion in the literature on the difficulty addressed that the process of inefficient units in the benchmarking may not be similar in their operating. This is a fact due to the composite DMU which dominates all other DMU doesn't exist in reality. To avoid this problems the research community have identified a technique which avoids such problems that is to utilized the performance-based clustering methods in identifying the appropriated benchmarking (Doyle & Green, 1994).

Traditionally the concept of DEA model doesn't allow to rank the DMU and specifically the ranking of efficient DMU. It is also possible that some inefficient DMU might perform better than overall performers of the few efficient DMU. This problem exists because for the unrestricted weight flexibility in the DEA model (Doyle & Green, 1994).

To determine relative efficiency problem allows for the unrestricted weight. In such circumstances a DMU involved in unreasonable weight can achieve a higher relative efficiency score (Dyson & Thanassoulis, 1988).

To visualize the efficiencies which are obtained from the DEA model, all the units should be placed on the horizontal axis, in a particular order and the efficiency score shall be plotted on the vertical axes (El-Mahgary & Lahdelma, 1995).

3.3 Literature on State Owned Enterprises

State-owned enterprises (SOEs) play a key role in the economy of many countries. They are usually thought to be in charge of increasing social welfare. At the same time, they are relatively low performance poses several problems, including slowing down economic growth. This effect is especially pronounced in countries where such firms represent a large share of the economy. Therefore, it is crucial for central governments to implement a comprehensive evaluation method to assess the performance of SOEs. Previous studies have offered many ways to evaluate their performance. By employing the principal component analysis technique and using data of 1,148 SOEs, mostly from European countries, our study aims at providing a more comprehensive framework for assessing SOE performance that includes various factors. We selected five factors: profitability, per capita productivity, per capita costs, debt due days, and solvency. The results of our empirical study show that solvency, per capita costs, and per employee productivity have more deterministic power over the success or failure of SOEs, compared to profitability. While profit making of SOEs is important, focusing on profitability as the solve assessment criterion will mislead policy makers, keeping in mind also that the nature of many SOEs is to generate social welfare and not profit (Taghizadeh-Hesary et al., 2019).

SOEs play a key role in the economy of many countries, especially in developing Asia, including the PRC and Central Asian countries where they represent a large share of the economy. Because SOEs use public funding, these types of firms are usually thought to be charged with increasing social welfare. At the same time, SOEs' economic performance is generally seen as rather mediocre, as their priority remains social welfare enhancement. Such

poor performance may slow down economic growth and even negatively affect other private firms, making it harder for them to access credit. This effect is especially pronounced in countries where SOEs figure largely in the economy. Therefore, it is crucial for central governments to implement a comprehensive evaluation method to assess the performance of such firms.

Many authors have addressed the role of SOEs in the economy, emphasizing their impact on social welfare and economic growth. A study conducted by Putterman and Dong (2000) explored the evolution of the role played by SOEs in the PRC from the 1950s. SOEs improved social welfare in many ways: by increasing the savings rate and by providing employment as well as reasonable wages and benefits compared to their rural counterparts, thereby encouraging the country's industrialization. However, SOEs gradually developed into high-wage enclaves, which eventually led to their demise (Putterman & Dong, 2000). Accentuating this effect were difficulties in laying off workers and the need to keep wages increasing constantly (Taghizadeh-Hesary et al., 2019).

The literature has enlightened innovation governance in developing economy state-owned enterprises (SOEs). Only in recent years there has been the more interest of bringing innovation governance to address the state and SOEs role in taking innovation risks. In particular, Chinese SOEs, got more attention with respect to its contribution to the innovation, growth and industrial diversification. Other countries, including brazil and several European economies are also influenced with an are attracted to innovation.

This difference between developing and developed economies, on one side, and between private sector companies and SOEs, on the other side, deserves more attention. One vital reason is the co-evolution of SOEs importance and the stage of economic development of a country. The gap between the developing and developed economies can be filled up with the changing role of SOEs in a national economy. The exemplary cases are the large SOEs in Russia, China, India, Indonesia, Brazil and the role of the chaebol in the Republic of Korea, to name just a few countries (Vonortas et al., 2016).

Ahuja and Majumdar (1998) examined 68 Indian SOEs determinants of performance with focus on manufacturing sector for the period of five years:1987 to 1991. Data envelopment analysis technique was used to determine the relative performance and variation in performance patterns was subsequently explained using regression analysis in the study. The performance is noted in Indian State-Owned Enterprises both, low performance and significant and systematic variations in the parameters of performance. According to Ahuja and Majumdar (1998) a unit of firm level analysis could identify the performance differentials between firms

in the state-owned sector with a solution to low performance of state-owned enterprises in India, however, analysis at firm level may give additional insights.

Simpson (2014) elaborated that at the micro level in the State-Owned Enterprises, the issues of governance have been given very less attention despite the evidence the collapse of SOEs and its poor performance are traceable to corporate governance.

3.4 Literature on Railways Globally

Takagi (2011) enlighten that the Development of High-Speed Railways in China has played a significant role and surpassed Japan's high-speed rail operations. In 2004 the Chinese government started the High-speed railway construction plan with a mid-to-long term rail network plan. The plan consists of more than 13,000 km track by 2012, and 20,000 km or more by 2020. The high-speed ranges from 200 km/hr. to 380 km/hr. on different routes and tracks. The main objective of the fastest rail system was to transport freight and passengers over long distances.

In china the policy evolution was adopted in 1949-1982. With a rigid planning and low prices. There was very less autonomy with the local railway bureaus and the Ministry of Railways. As a whole the function of governance and business activities including the prices were set by the central authority. In 1982-1985, some autonomy was given to the local bureaus of railways with retaining some profit according to mathematical formula after the payment of tax. A financial independence came into being in 1986-1992 where the State Council gave greater responsibility and financial autonomy to railway system. An exemption from income taxes and few other taxes was given to the railway system. The paid tax revenue and profit to the State Treasury were retained to the Ministry of Railways to reinvest in the railway system. It was also separated from the state finance. The approach of Corporatization was adopted in 1993-2002 in the railway system. It was restructured into a corporate group. After this approach, from 2002 onwards the railways are delivering a good performance with flexible prices (Bai & Qian, 2010).

According to Cantos et al. (1999) the evolution of productivity was analyzed in the European Railways from the period 1970-95. A non-parametric approach was used to enable the changes in productivity and to broke it down into variations in technical change and efficiency. The results show that in the last period (1985-95) there was productivity growth. Because the majority companies had passed through a process of reforms.

Purba et al. (2017) explained that High Speed Railways are one of the significant breakthroughs in transportation system of the 20th century. There were 10,000 kilometers of high-speed railways track in 2008 which was facilitating the people of Asia and Europe. This new technological advancement was attracted and in 2010 a great attention for High-Speed Railways was received in Indonesia.

Japan was the pioneer in the building of HSR in 1964. The construction was financed with loans from Japanese government and World Bank. In the period of seven years, the loan was repaid by the railway. Where than the operating profits were used to cross subsidize local trains. This success story has encouraged the motivation for building high speed trains in Japan (Purba et al., 2017).

According to (Giannakos) analyzed the situation in the Hellenic Railways where the railways are restructured. His study explained that the company will continue to be in losses rather suggested an alternative for restructuring where the ownership and maintenance of the rolling stock and infrastructure goes to two corresponding sisters' organizations for the infrastructure and exploitation. At the same time, all current debts and social provision is given to another company. Seems to produce the best net results.

3.5 Literature on Pakistan Railways

Khalid et al. (2016) has worked on the passenger perspectives of the Pakistan Railways and his findings says that in railways a good infrastructure exists, but the railway organization is deteriorating another day. There could be variety of factors but with a great focus corruption is the major issue followed with political interference and lack of resources (Khalid et al., 2016).

Irfan et al. (2012) analyzed the service quality of railways in Pakistan. Due to the population growth in Pakistan, the demand for traveling is also increasing. Pakistan Railways is playing a major role in transport services. Where in Pakistan the railways transportation is the cheapest transport service for long distances. A passenger perception study explored the service quality of railways in Pakistan while traveling among the major cities, Lahore, Multan, Rawalpindi, Peshawar and Karachi. Where the results analyzed that passengers are not satisfied with the service quality (Irfan et al., 2012).

Tahir (2013) analyzed the performance of Pakistan Railways with a multistage framework with four dimensions – input condition, output, government policy and earnings. In comparison with China and India using the Data Envelopment Analysis (DEA) technique the product efficiency, financial efficiency and earning effectiveness was estimated to understand the reasons behind

the decline of Pakistan Railways. The results show that Pakistan Railways has not utilize input in a better way and is found product inefficient which led to financial inefficiency as a cost. With fewer inputs the same service could be performed. Likewise, the Chinese railways is product and financial efficient which is performing with efficient earning. Where, the Indian railway is product efficient but is struggling with earning and financial efficiency. The lesson drawn in the context of Pakistan are that the product efficiency leads to railway development and other efficiencies and it can be sustained with managerial autonomy and the stable public investment.

3.6 Research Gap

Earlier studies of Tahir (2013) and Tahir and Tahir (2020) have estimated the efficiency analysis of Pakistan Railway for the time series data. This study is further investigating the efficiency analysis with different data description. As, in the literature of efficiency analysis and the method of (DEA) Data Envelopment Analysis, it is the (inputs) which produce (outputs). Those studies have not captured the efficiency of Pakistan Railway in a broader way. I have used the different set of inputs and outputs in the study and estimated the efficiency of Pakistan Railway for the time series data of 50 years from 1970-2019.

CHAPTER 4

METHODOLOGY

4.1 Economic Efficiency Analysis

In the study a methodology is developed to estimate the performance of Pakistan Railway. Following the methodology of Tahir and Tahir (2020), Window analysis is used to analyze the efficiency change in the efficient unites by tracking them over time. This study is based on the basic CCR-BCC DEA Output Maximization Model for estimation of productive, financial and earnings efficiency. The Years of the periods are treated as a DMUs (Decision Making Units) from 1970-2019. If there are 'n' units and 'k' periods of time, 'nk' units need to be assessed simultaneously. It is the moving average method of measuring efficiency in each DMU over the period of estimation. Each time period is a single DMU which is compared with another DMU in the same year (Ramanathan & Ramanathan, 2011).

The basic model of DEA was introduced by Charnes et al. (1978) to measure technical efficiency which assumed constant returns to scale. It calculates total technical efficiency as a single value which is also the combination of scale and technical efficiency. Consequently, BCC (1984) calculated efficiency subject to variable returns to scale. It enables the division of efficiency into technical and scale efficiencies. Efficiency is always relative in these models. Technical efficiency indicates the least amount of input for a given level of output; where technical inefficiency relates to the outcome of unwarranted use of inputs. We can also call it allocative efficiency. Allocative efficiency is the results of a wrong proportion of inputs, given the prices. A limitation of CCR model confuses overall technical efficiency with scale effect.

The pure technical efficiency estimates can be obtained from the BCC model. It assumes variable returns. CCR-BCC model is widely used as an alternative to the regression approach to efficiency (Ray, 2004) . It enables us to estimate technical efficiency, pure technical efficiency and scale effect.

$$\text{Scale Effiecny} = \frac{\text{Technical Efficiency}}{\text{Pure Technical Efficiency}} \tag{4.1}$$

4.2 Research Model

For analyzing operational efficiency of PR, an output oriented CCR- BCC DEA model is used. It focuses on the maximization of the output for a given level of inputs without suggesting reduction in inputs. This means expanding output instead of minimization of inputs. The linear programming problem is solved as follows:

$$\max W = \sum_{r=1}^{s} u_r \, y_{rp}$$

$$\text{S.T: } \sum_{i=1}^{m} v_i \, x_{ip} = 1 \, \sum_{r=1}^{s} u_r \, y_{rj} - \sum_{i=1}^{m} v_i \, x_{ip} \leq 0 \, j = 1,2 \ldots, n_{ur}, vi \geq \epsilon$$

$$r = 1, \ldots \ldots s, i = 1, \ldots \ldots, m \qquad (4.2)$$

In DEA model each DMU can be used to benchmark efficient units in comparison with inefficient units. It is a diagnostic tool and reengineering strategies can be prescribed on the basis of efficient units. It may be that these units are simply not comparable as they differ in operating practices (Farrell, 1957). In measuring relative efficiency, it is possible that an efficient unit turns out inefficient just because of unrestricted weight flexibility. This problem can be overcome by using cross efficiencies Talluri (2000a) which help identify good overall performers, besides effectively ranking DMUs. An efficient DMU must have high cross efficiency score along its column in cross efficiency matrix Talluri (2000b) suggested cross evaluation on the basis of a combination of qualitative and quantitative factors for effective ranking of DMUs.

To find the frontier of inputs and outputs, DEA uses linear programming. Value of 1 is assigned as efficiency score when comparing it with other units and value of less than 1 represents an inefficient unit. Inefficient units show deviations from the production frontier. After estimating the efficiency scores, cross-evaluation matrix introduced by Sexton et al. (1986) was used for complete ranking in DEA. This matrix calculates efficiency of each DMU n times by using optimal weights. It uses the concept of peer evaluation method to rank efficiency scores (Sueyoshi & Goto, 2001).

4.3 Data

The data collection includes the Quantitative methods, where the quantitative data is collected from the (Year Book 2018-19) of Pakistan Railways. The data includes two type of variables

for the analysis. First are the Inputs variables and second are the Output variables. Both the Input and Output variables are collected for the product, financial and earnings efficiency analysis.

The time series data includes the total 50 years from 1970-2019. Firstly, the data available in the book year report was the five-year average data. Which was then converted into annual time series data with the formula of growth rate. The formula was used for each variable.

Formula is as follows.

$$\frac{Latest\ Year}{Previous\ Year} - 1 \qquad (4.3)$$

4.4 Data Description

A framework for the study is developed to analyze the economic efficiency of the deteriorating conditions of Pakistan Railways using the DEA (Data Envelopment Analysis) model. The study is divided in three types of efficiency analysis. The Product Efficiency, Financial Efficiency and Earnings Efficiency. For measuring Product Efficiency, the inputs comprised of number of employees, number of locomotives, number of freight vehicles and number of passenger vehicles. The service output indicators are the Passengers (kilometers) and Freight (kilometers). After estimating the product efficiency, the Earnings efficiency is focused. The earning efficiency comprised of two inputs which are average revenue per passenger (rupees) and average revenue per ton (rupees) and the output indicators are average revenue per passenger (rupees) and average revenue per ton (rupees). After calculating the earnings efficiency, the financial efficiency is focuses with the following input indicators, operational fuel, repair and maintenance, operating staff, operation other than staff and fuel, administration expenses and miscellaneous expenses. The output indicators for the financial efficiency are freight earnings and passenger earnings. All variables of financial efficiency are in unit (million) with constant prices. The actual values are converted to constant terms with the formula of indexation. Where the actual value was divided by the inflation rate and multiplied by 100, resulted in the conversion of the values from actual to constant terms. The scheme of analysis is shown in table 4.1.

Table 4. 1: Pakistan Railways: Performance Analysis

	Product Efficiency	**Earnings Efficiency**	**Financial Efficiency**
Inputs	• No. of Employees • No. of Locomotives • No. of Freight Vehicles • No. of Passengers Vehicles	• Average Rate Charged Per Passenger KM in (Rs.) • Average Rate Charged Per Ton per KM (Rs.)	• Operational Fuel (in Millions) • Repair and Maintenance (in Millions) • Operating Staff (in Millions) • Operation other than staff and fuel (in Millions) • Administration expenses (in Millions) • Miscellaneous expenses (in Millions)
Outputs	• Passenger KM (in thousands) • Fright KM (in thousands)	• Average Revenue per Passenger in (Rs.) • Average Revenue per Ton (Rs.)	• Fright Earnings (in Millions) • Passenger Earnings (in Millions)

CHAPTER 5

DATA ANALYSIS AND RESULTS

5.1 Product Efficiency

The Product efficiency analysis is estimated with DEA CCR-BCC Output Maximization Model to estimate the product efficiency of PR. There are four Inputs used in the analysis which are No. of Locomotives, No. of Employees, No. of Freight Vehicles and No. of Passengers Vehicles. There were two Output used in the analysis which includes Passenger Kilometers (in thousands) and Freight Kilometers (in thousands).

Table 5. 1: Product Efficiency Statistics of Input and Output Data

	No. of Employees	No. of Locomotives	No. Freight Vehicles	No. Passengers Vehicles	Passenger KMs (Thousands)	Freight KMs (Thousands)
Max	137041	1054.84	37395	2584.34	29595246	15278.9
Min	67627	455	14327	884.211	7730850	2021
Average	109831	734.621	28065.5	1821.03	17500376	9586.14
SD	23729.3	204.966	8120.38	451.134	4893953	3265.39

Source: Authors estimation.

Table 5. 2: Correlation of Product Efficiency

	No. of Employees	No. of Locomotives	No. Freight Vehicles	No. Passengers Vehicles	Passenger KMs (Thousands)	Freight KMs (Thousands)
No. of Employees	1	0.95604	0.99398	0.41197	-0.788702	0.91851
No. of Locomotives	0.95604	1	0.96696	0.23169	-0.849414	0.94922
No. of Freight Vehicles	0.99398	0.96696	1	0.40042	-0.776564	0.93071
No. of Passengers Vehicles	0.41197	0.23169	0.40042	1	0.143635	0.2993
Passenger KMs. (Thousands)	-0.7887	-0.84941	-0.77656	0.14364	1	-0.72622
Freight KMs (Thousands)	0.91851	0.94922	0.93071	0.2993	-0.726223	1

Source: Authors estimation.

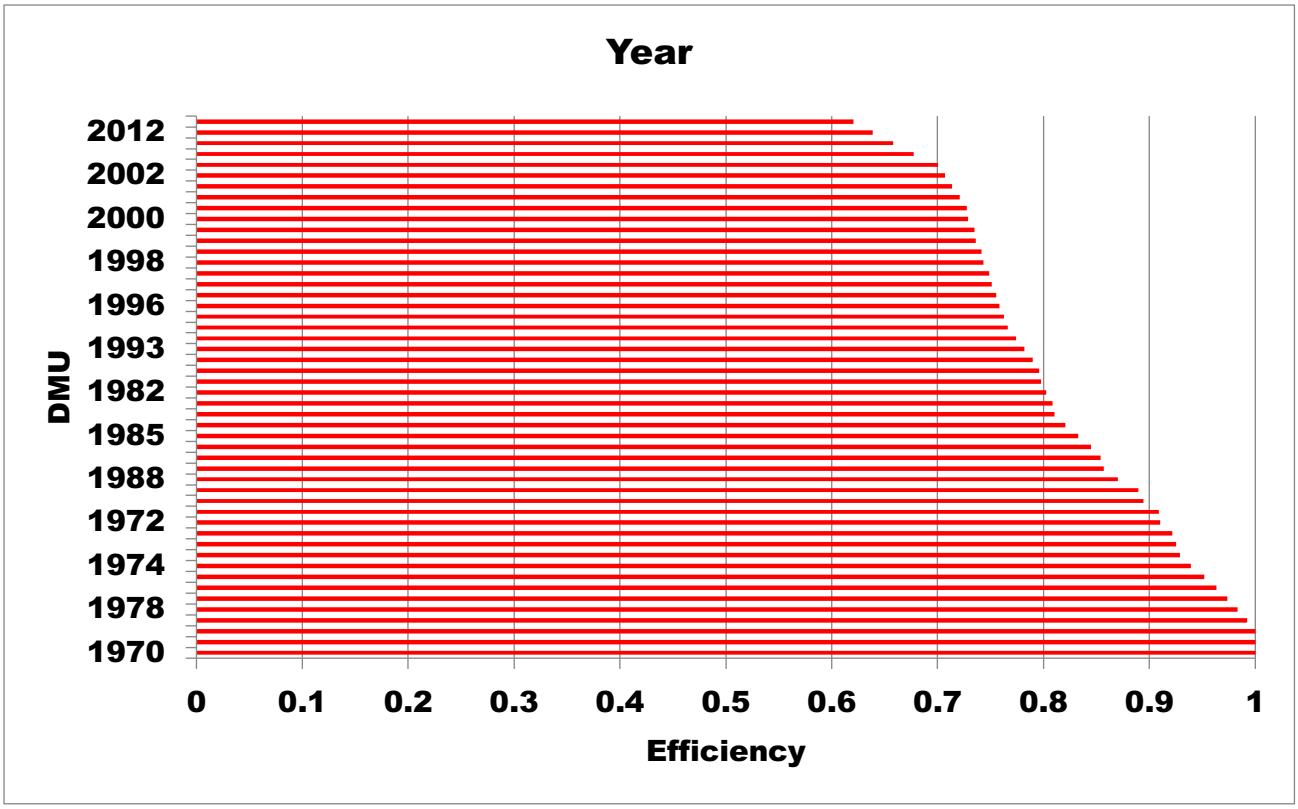

Fig 5. 1: Product Efficiency Scores

Source: Authors estimation.

The above graph shows that the efficiency scores (theta) of Decision Making Unites (DMUs). Where three DMUs are efficient, 1970, 1980 and 2018-19. The remaining 47 DMUs are inefficient with the given inputs. If we compare the efficiency DMUs with the inefficiency DMUs the railway was not doing well. because of the political influence the number of passengers (kilometers) started increasing from 1980 which have badly declined the efficiency of freight trains. PR was initially not built for commercial purposes, so the earnings from passenger trains are very low as compared to the freight trains. The increase in the passenger kilometers have declined the freight kilometers. Due to the change in the policy, the freight vehicles were reduced, and the passenger vehicles were increased to increase the passenger trains and kilometers. The change in the policy have made PR product inefficiency.

Table 5. 3: Statistical Summary of Product Efficiency

Average	0.8202
Max	1
Min	0.6206
St Dev	0.1045

Source: Authors Estimation.

The above table shows the average score of the DMUs, the maximum and minimum score of the DMUs and the standard deviation.

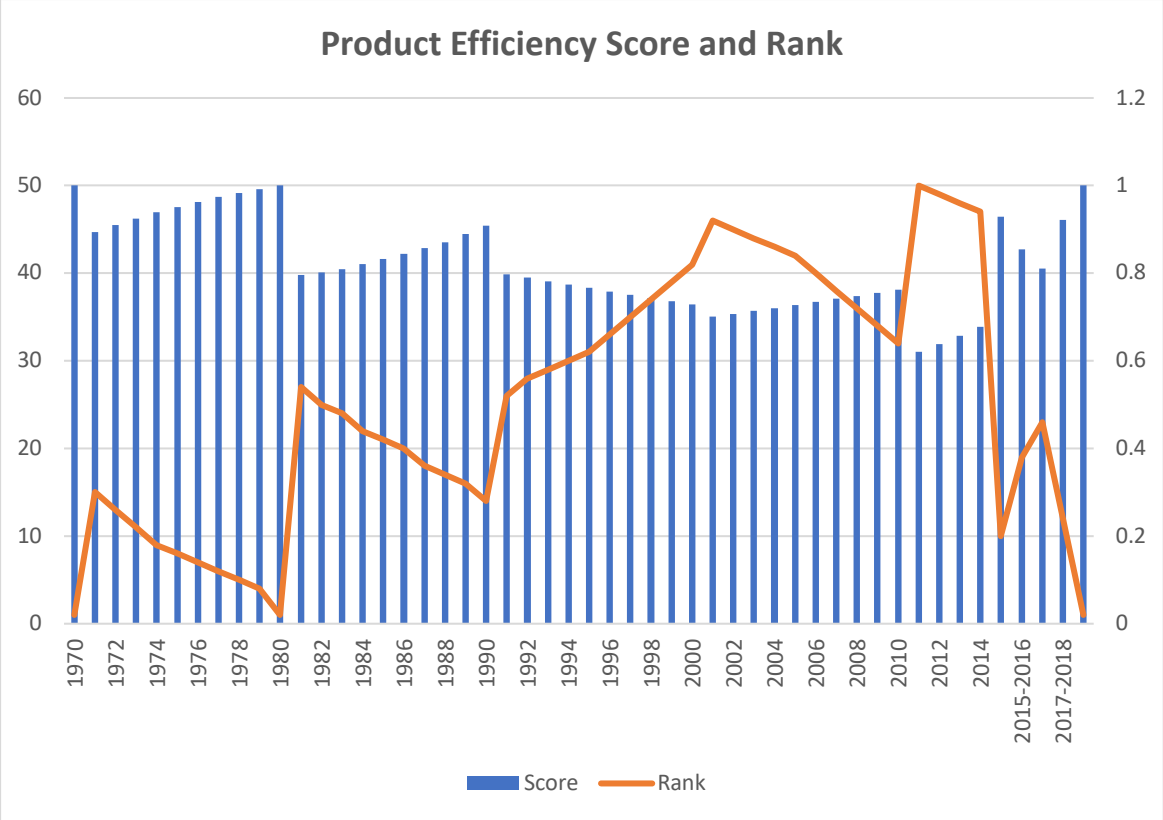

Fig 5. 2: Product Efficiency Score and Rank

Source: Authors estimation.

The above graph shows the efficiency scores (theta) and ranks for the given DMUs. The year time period are the DMUs, the ranks are from 0-50, as there is total 50 DMUs. The efficiency score is from 0-1, where the efficient DMU score is equal to 1 and those DMUs with the score below 1 are inefficient DMUs. The efficient DMU can be seen while touching the efficiency score 1 at the right. These DMUs are also ranking at the No. 1 position. While the most inefficient DMU is 2011 with the score of 0.6206, ranking at the 50th position, followed with 2012 and 2013 ranking on 49th and 48th position respectively with the efficiency score of 0.6389 and 0.6577. When we see the slack there are only 3 years (1970, 1980 and 2018-19) when slack inputs and outputs are zero. This means that the slack level of output has no effect on the efficiency evaluation. (See the appendix table 1).

5.2 Earnings Efficiency

The Earnings Efficiency analysis is estimated with DEA CCR-BCC Output Maximization Model with two Inputs; Average Rate Charged Per Passenger KM in rupees, Average Rate Charged Per Ton Per KM in rupees. There are two Output which includes; Average Revenue

Per Ton in rupees and Average Revenue Per Passenger in rupees. The Average Rate Charged Per Passenger Per KM was in Paisa which was converted to rupees with the formula of currency converter.

Table 5. 4: Earnings Efficiency Statistics on Input and Output Data

	Average Rate Charged Per Passenger Per KM in (Rs.)	Average Rate Charged Per Ton Per Kilometer (Rs.)	Average Revenue Per Ton (Rs.)	Average Revenue Per Passenger in (Rs.)
Max	0.9863	2.9	223266	483.37
Min	0.02246045	0.04	22.9227804	1.79473079
Average	0.30223166	0.87358426	9320.41481	106.029304
SD	0.3103298	0.84289491	42665.5758	135.899014

Source: Authors Estimation.

Table 5. 5: Correlation of Earnings Efficiency

	Average Rate Charged Per Passenger Per KM in (Rs.)	Average Rate Charged Per Ton Per KM (Rs.)	Average Revenue Per Ton (Rs.)	Average Revenue Per Passenger in (Rs.)
Average Rate Charged Per Passenger Per KM in (Rs.)	1	0.96956802	0.45784637	0.99021625
Average Rate Charged Per Ton Per KM (Rs.)	0.96956802	1	0.36976741	0.94318507
Average Revenue Per Ton (Rs.)	0.45784637	0.36976741	1	0.50230637
Average Revenue Per Passenger in (Rs.)	0.99021625	0.94318507	0.50230637	1

Source: Authors Estimation.

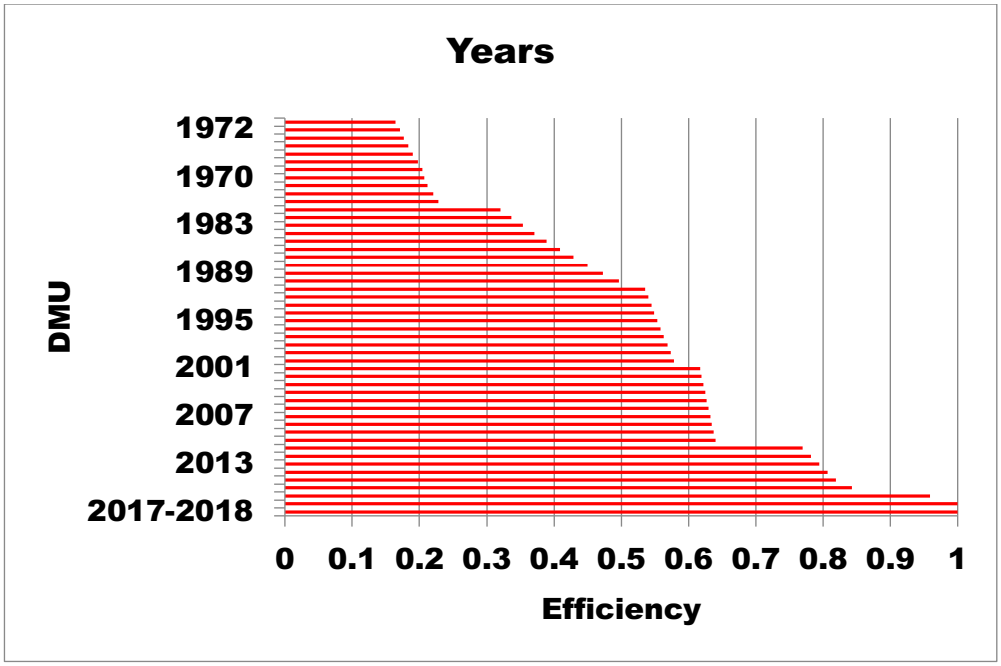

Fig 5. 3: Earnings Efficiency Scores

The above graph shows the Earnings Efficiency of Pakistan Railways. Years are treated as a DMUs from 1970 to 2018-19. There is total 50 Decision Making Units (DMUs). In the analysis only 2 DMUs are efficient and the remaining 48 DMUs are inefficient with the given inputs and outputs. The reason behind the earnings inefficiency of PR is connected with product efficiency. Because of product inefficiency PR was not able to produce good revenue with passengers' trains. The contribution of freight revenue is much higher than the revenue produced by passengers. Because Pakistan Railway is the only cheap transport service in Pakistan for long distance. The fares charged per passenger are relatively very low. The amount charged per passenger in the year 1970 is Rs. 0.22460 and the amount charged per ton is Rs. 0.04. The revenue produced in 1970 by per passenger is Rs. 1.7947 and the revenue produced by per ton is Rs. 22.092. This clearly shows that the product efficiency has reduced the performance of Pakistan Railway which made PR earnings inefficient.

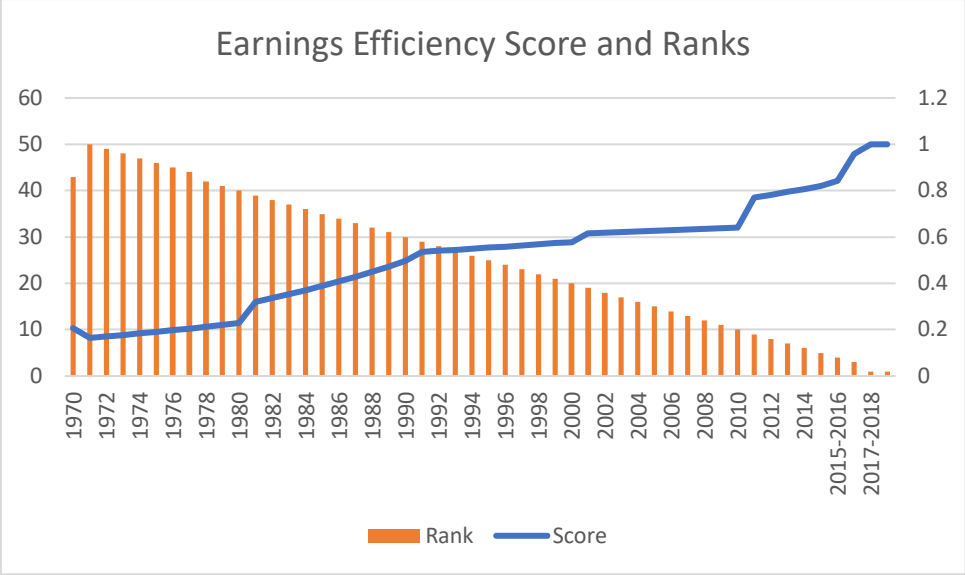

Fig 5. 4: Earnings Efficiency Score and Ranks

Source: Authors estimation.

The above graph shows the Earnings Efficiency scores (theta) and ranks for the given Decision-Making Units (DMUs). The year time periods are the DMUs, the ranks are ranking from 0-50 because the total number of DMUs are 50. The efficiency score is from 0-1, where the DMU score with 1 is the efficient DMU and the DMU scores below 1 are the inefficient DMU. The rank is denoted on the left vertical axes and the score is denoted on the right secondary axes of the graph. There are only two efficient DMUs which are 2018-19 and 2017-18 ranking 1 with the efficiency score 1. There are total 48 inefficient DMUs and the most inefficient DMU is 1971 ranking at 50th position with the efficiency score 0.164 followed with 1972 and 1973 with 49th and 48 positions respectively with score 0.1708 and 0.1771. If we see the slack system in the earnings efficiency there are only 2 years (2017-18 and 2018-19) when slack inputs and outputs is zero. This means there is no effect on the efficiency evaluation because of slack level of output.

Table 5. 6: Statistical Summary of Earnings Efficiency

Average	0.5161
Max	1
Min	0.1647
St Dev	0.2301

Source: Authors estimation.

The above table shows the average score of the DMUs, the maximum and minimum score of the DMUs and the standard deviation.

5.3 Financial Efficiency

The Financial Efficiency analysis is estimated with DEA CCR-BCC Output Maximization Model with six input and two outputs. The inputs include Repair and Maintenance, Operational Fuel, Operating Staff, Operations other than staff and fuel, Administration Expenses, and Miscellaneous Expenses. The outputs include Passengers Earnings and Freight Earnings. The unit of both Inputs and Outputs is Million Rupees. The values of the data were converted to constant terms with the indexation formula of

$$\frac{Current\ Values}{Iflation\ Rate} \times 100 \qquad (5.1)$$

Table 5. 7: Financial Efficiency Statistics on Input and Output Data

	Repair and Maintenance (Rs. in million)	Operational Fuel (Rs. in million)	Operating Staff (Rs. in million)	Operation other than staff and fuel (Rs. in million)	Administration Expenses (Rs. in million)	Miscellaneous Expenses (Rs. in million)	Passengers Earnings (Rs. in millions)	Freight Earnings (Rs.in millions)
Max	547469201	421320866.8	237151929.1	4215362.719	306306.2082	6612.103948	758474.0418	438497.2408
Min	1575.065065	1022.191335	489.8024909	173.9546542	525.3106416	63.89102484	1579.598475	3051.076556
Average	47914682.26	34518133.06	19088874.21	174191.6566	39292.0361	1170.340148	112106.7392	75075.60273
SD	126388407.6	90436034.59	50596235.34	655504.2261	64346.96415	1511.818232	161170.9539	93070.212

Source: Authors estimation.

Table 5. 8: Correlation of Financial Efficiency

	Repair and Maintenance (Rs. in million)	Operational Fuel (Rs. in million)	Operating Staff (Rs. in million)	Operation other than staff and fuel (Rs. in million)	Administration Expenses (Rs. in million)	Miscellaneous Expenses (Rs. in million)	Passengers Earnings (Rs. in millions)	Freight Earnings (Rs.in millions)
Repair and Maintenance (Rs. in million)	1	0.99	1	-0.07	0.954	0.91	0.899	0.86
Operational Fuel (Rs. in million)	0.992	1	1	-0.07	0.953	0.89	0.902	0.86
Operating Staff (Rs. in million)	0.9933	1	1	-0.07	0.957	0.9	0.903	0.85
Operation other than staff and fuel (Rs. in million)	-0.072	-0.07	-0.1	1	-0.097	-0.13	-0.11	-0.08
Administration Expenses (Rs. in million)	0.9543	0.95	1	-0.1	1	0.97	0.986	0.95
Miscellaneous Expenses (Rs. in million)	0.9109	0.89	0.9	-0.13	0.974	1	0.981	0.96
Passengers Earnings (Rs. in millions)	0.8991	0.9	0.9	-0.11	0.986	0.98	1	0.97
Freight Earnings (Rs.in millions)	0.8569	0.86	0.9	-0.08	0.948	0.96	0.972	1

Source: Authors estimation.

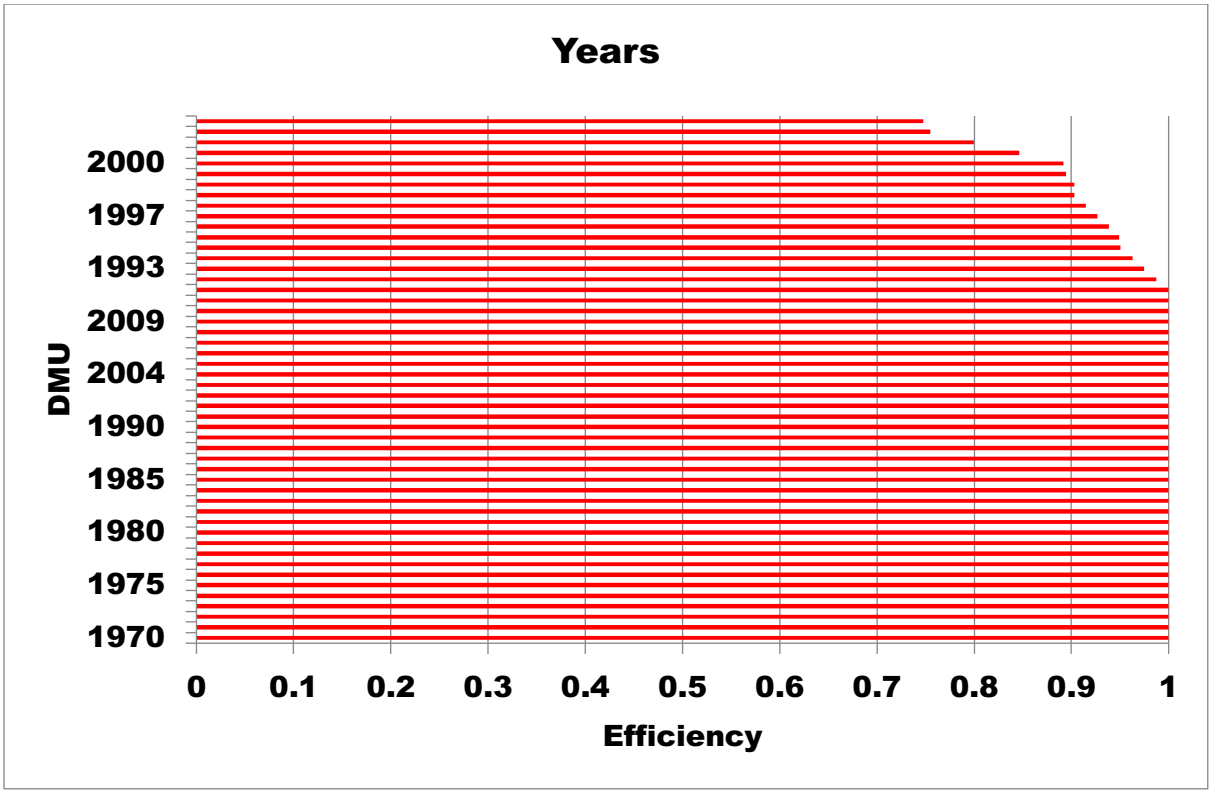

Fig 5. 5: Financial Efficiency Scores

Source: Authors estimation.

The above graph shows the Financial Efficiency of Pakistan Railways. Years are treated as a DMUs from 1970 to 2018-19. There is total 50 Decision Making Units (DMUs). In the analysis 34 DMUs are efficient and the remaining 16 DMUs are inefficient with the given inputs and outputs. PR is financially efficient but the inefficient DMU show that the repair and maintenance cost is increasing because the rolling stock is in a bad condition due to which the amount of repair and maintenance is increasing. PR needs investment to upgrade its rolling stock and equip new technologies. PR is running on the infrastructure built by British in 1800s and 1990s. The fuel amount is also increasing which shows the increase in the operational cost. The operating cost is increasing which becomes the source of inefficiency. From 2001 the revenue produce by passenger is increasing and the revenue produced by freight is declining which is due to the product inefficiency of PR. The policy of increasing passenger trains has reduced the competition of freight trains in the market. The freight has shifted to the trucks and roads instead of PR. to attract the freight market PR and GOP has to increase the capacity of freight trains.

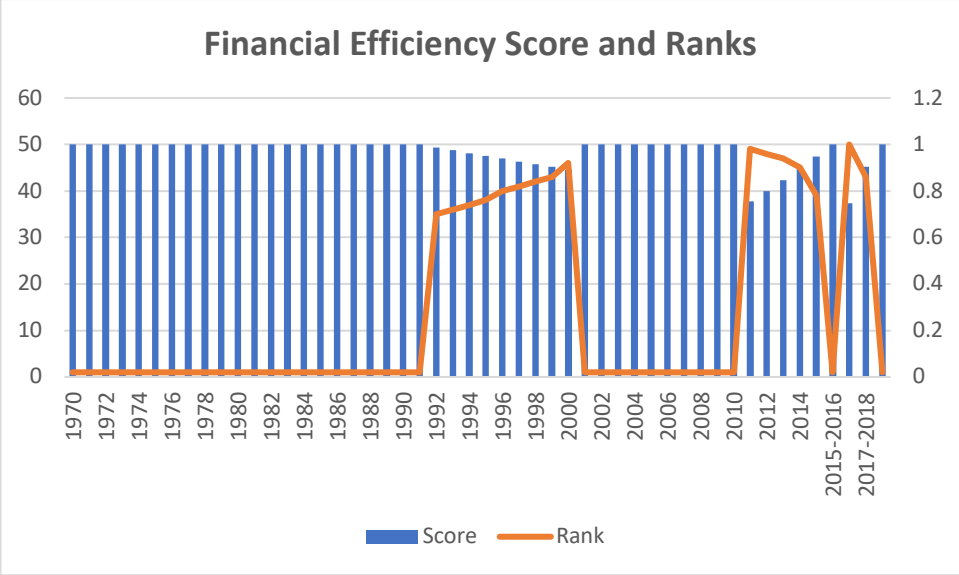

Fig 5. 6: Financial Efficiency Scores and Ranks

Source: Author estimation.

The above graphs show the Financial Efficiency scores (theta) and ranks for the DMUs. the year time periods are the DMUs, the ranks are ranking from 0-50 as the number of DMUs are 50. The efficiency scores 1 are the efficient DMU and below 1 are the inefficient DMUs. The vertical axes on the graph shows the ranks and the horizontal axes shows the scores of the DMUs. there are total 34 efficient DMUs with the efficiency score 1 and ranking in the 1st position. The remaining 16 DMUs are the inefficient DMUs, where the most inefficient DMU is 2016-17 with rank 50 and the efficiency score 0.7473 followed by DMU 2011 and 2012 with the ranks 49 and 48 respectively, with the efficiency score of 0.755 and 0.7998. As the number of efficient DMUs are higher in the financial efficiency. The slack is zero in 34 years from (1970 to 1991, from 2001 to 2010 and 2015-16 and 2018-19). This means that there is no effect of slack level of output on the efficiency evaluation.

Table 5. 9: Statistical Summary of Financial Efficiency

Average	0.9669
Max	1
Min	0.7473
St Dev	0.0636

Source: Authors estimation.

The above table shows the average score of the DMUs, the maximum and minimum score of the DMUs and the standard deviation.

5.4 Efficiency of Pakistan Railway

After estimating the performance of Pakistan Railways as a whole. The product, earnings and financial analysis have resulted that Pakistan Railway is product and earnings inefficient and is financial efficient. The performance of Pakistan Railway in product efficiency is only impressive in 1970 and 2018-19 where the inefficiency in the remaining years is because of the poor inputs deriving outputs. The freight km had declined from the year 1970 till 2018 which can be seen in (figure 5.5). The worst performance of freight km was in 2012. On the other side the passenger km started increasing from 1981 with the peak in 2018-19. But the passenger trains km was increasing but the passenger carried didn't showed increased in the number. The political influence has increased the number of passenger trains and reduced the number or freight trains resulted in the inefficient performance. The freight trains can make good earnings rather than passengers trains. This is the reason behind the product inefficiency of Pakistan Railways.

The product inefficiency has resulted inefficiency in the earnings efficiency. The policy of increasing the number of passenger trains and reducing the number of freight trains have showed a very negative performance and made Pakistan Railway earnings inefficient. The earnings we have produced from passengers' trains is relatively very low as compared to the earnings we have produced from the freight trains. Pakistan Railway is not a commercialized company to generate revenue through higher rates from passenger, but we can increase out revenue from increasing the number of passenger trains. The peak of the earning efficiency was at the year 2018-19 and 2017-18 and the lowest performance was in 1972.

The financial efficiency is estimated efficient in 34 years and is estimated the worst in 2011, 2012 and 2013 where in 2008 the government tried to privatize the Pakistan Railways which was resulted is a failed experience. The privatization had a very negative role in the financial efficiency of PR. The worst performance time was the period when PR was privatized and later in 2013 it was again removed from the list of privatized enterprises. Institution like PR need high investment from government where privatization would not be the solution. Rather to improve the product efficiency and increase investment can produce relatively better earnings and financial output.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATION

6.1 Conclusion

This study applies the DEA Data Envelopment Analysis on a State-Owned Enterprise of Pakistan, the Pakistan Railways to compare the efficiency in a multi-stage framework. The operational performance is estimated separately in the product efficiency, and the earnings and financial efficiency shows the efficiency as a whole.

The results estimated that Pakistan railways has lost the product and earnings efficiency over the years. Various studies validate that the importance of maximizing the revenue is important, but the structure of cost and the cost effectiveness needs to be considered. This study estimated that the product inefficiency leads to the earnings and financial inefficiency also estimated by Tahir and Tahir (2020) . The outputs Pakistan railway is producing can be produced with fewer inputs. The product inefficiency leads to the earnings inefficiency. Pakistan Railway needs investment to improve its rolling stock because the repair and maintenance cost is increasing every year and the route track is in a very bad condition. With investment in Pakistan Railway the enterprise can improve the quality of route track in specific to improve the product efficiency of Pakistan Railway. The repair and maintenance cost will be reduced to the normal condition. This shows the mismanagement and political interference in the context of policy formulation which resulted the inefficiency.

6.2 Policy Recommendation

After analyzing the performance of Pakistan Railway, the policy recommendation to improve its performance would be to adopt a market-based approach. The market-based approach could be demand oriented.

Firstly, the government shall refine its policy of increasing passengers' trains and reducing the freight trains. The passenger's trains had travelled thousands of kilometers without the good number of passengers carried. This policy had lost the competition of freight trains with private logistic companies. Because freight trains have not shown significant improvement in the past.

Secondly, the government shall focus on the inputs which produce outputs, for instance, the infrastructure and the rolling stock are the inputs which produce the outputs of track kilometers for both passenger and freight. The infrastructure is in a very bad condition which is eating the highest amount of repair and maintenance cost and increase the operation cost. A dire need of investment is needed to improve the infrastructure.

Thirdly, PR should increase the electrification capacity. The electric locomotives are very rarely used in PR. While our neighboring country India have increased significantly their electric locomotives.

Fourthly, Pakistan Railway shall be autonomous in their decisions. The Track Access Policy was initiated in 1993 and in 2021 the policy is not in developed. This shows the lack of incompetency and political interference in the decisions of PR. Various years the enterprise was run by not a railway personal but was run by various groups of civil servants and Army Generals. Such inductions bring barriers in the policy formulation which needs to be adjusted in a positive manner.

Fifthly, Pakistan government shall invest in Pakistan Railway because railway is environmentally friendly transportation. Adopting road policy in 1960 have increase the roads everywhere and polluted the environment of every city. Investing in railways will protect the environment from pollution.

Last but not the least, PR shall start ML-1 as soon as it possible because with the ML-1 the PR infrastructure will be developed. The private sector will be given the opportunity to take benefit of the PR track.

REFERENCES

Ac, C., Cooper, W., & Rhodes, E. (1981). Evaluating Program and Managerial Efficiency: An Application of Data Envelopment Analysis to Program Follow Through. *Management Science, 27*, 668-697. doi:10.1287/mnsc.27.6.668

Ahuja, G., & Majumdar, S. K. (1998). An assessment of the performance of Indian state-owned enterprises. *Journal of productivity analysis, 9*(2), 113-132.

Aigner, D., Lovell, C. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of econometrics, 6*(1), 21-37.

Bai, C.-E., & Qian, Y. (2010). Infrastructure development in China: the cases of electricity, highways, and railways. *Journal of Comparative Economics, 38*(1), 34-51.

Bank, W. (2006). Pakistan strategic country environmental assessment. In: World Bank.

Bauer, P. W. (1990). Recent developments in the econometric estimation of frontiers. *Journal of econometrics, 46*(1-2), 39-56.

Berridge, P. S. A. (1969). *Couplings to the Khyber: The Story of the North Western Railway*: David & Charles.

Beyer JR, C. O. (1919). Railway efficiency and labor. *The ANNALS of the American Academy of Political and Social Science, 86*(1), 227-243.

Bruinsma, F., Pels, E., Priemus, H., Rietveld, P., & Van Wee, B. (2008). Railway development. *Impact on urban dynamics*.

Cantos, P., Pastor, J. M., & Serrano, L. (1999). Productivity, efficiency and technical change in the European railways: a non-parametric approach. *Transportation, 26*(4), 337-357.

Charnes, A., Cooper, W. W., Golany, B., Seiford, L., & Stutz, J. (1985). Foundations of data envelopment analysis for Pareto-Koopmans efficient empirical production functions. *Journal of econometrics, 30*(1-2), 91-107.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444.

Collins, M. (2001). Rail versus Road in Ireland, 1900-2000. *Newtownards: Colourpoint*.

Cowie, J., & Riddington, G. (1996). Measuring the efficiency of European railways. *Applied Economics, 28*(8), 1027-1035.

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica: Journal of the Econometric Society*, 273-292.

Doyle, J., & Green, R. (1994). Efficiency and cross-efficiency in DEA: Derivations, meanings and uses. *Journal of the operational research society, 45*(5), 567-578.

Dyson, R. G., & Thanassoulis, E. (1988). Reducing weight flexibility in data envelopment analysis. *Journal of the operational research society, 39*(6), 563-576.

El-Mahgary, S., & Lahdelma, R. (1995). Data envelopment analysis: visualizing the results. *European Journal of Operational Research, 83*(3), 700-710.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society: Series A (General), 120*(3), 253-281.

Ferrier, G. D., & Lovell, C. K. (1990). Measuring cost efficiency in banking: Econometric and linear programming evidence. *Journal of econometrics, 46*(1-2), 229-245.

Fielding, G. J., Babitsky, T. T., & Brenner, M. E. (1985). Performance evaluation for bus transit. *Transportation Research Part A: General, 19*(1), 73-82. doi:https://doi.org/10.1016/0191-2607(85)90009-3

Giannakos, K. A restructuring model applied in Hellenic Railways during the period 2002-2006 according to European legislation.

Haksever, C. (1996). Data envelopment analysis-Foreword. In: PERGAMON-ELSEVIER SCIENCE LTD THE BOULEVARD, LANGFORD LANE, KIDLINGTON ….

Imran, M. (2009). Public transport in Pakistan: a critical overview. *Journal of Public Transportation, 12*(2), 4.
Imran, M., & Ahmed, W. (2021). Pakistan's Railways: A Painful History? In *The Railways in Colonial South Asia* (pp. 115-140): Routledge.
Irfan, S. M., Kee, D. M. H., & Shahbaz, S. (2012). Service quality and rail transport in Pakistan: A passenger perspective. *World Applied Sciences Journal, 18*(3), 361-369.
Jacobs, R. (2001). Alternative methods to examine hospital efficiency: data envelopment analysis and stochastic frontier analysis. *Health care management science, 4*(2), 103-115.
Jitsuzumi, T., & Nakamura, A. (2010). Causes of inefficiency in Japanese railways: Application of DEA for managers and policymakers. *Socio-Economic Planning Sciences, 44*(3), 161-173.
Kerr, I. J. (2007). *Engines of change: the railroads that made India*: Greenwood Publishing Group.
Khalid, A., Nasir, M., & Mohsin, M. R. (2016). Why Pakistan railways has failed to perform: A special focus on passenger perspective. *Journal of the Research Society of Pakistan, 53*(2).
Khan, A., Arif, S., Nadeem, O., & Anwer, A. (2013). BRITISH RAILWAY ARCHITECTURAL LEGACY IN LAHORE: HISTORY, IMPORTANCE AND BUILDINGS'PRIORITIES FOR CONSERVATION. *Pakistan Journal of Science, 65*(3).
Koopmans, T. C. (1951). An analysis of production as an efficient combination of activities. *Activity analysis of production and allocation*.
Macpherson, W. (1955). Investment in Indian railways, 1845-1875. *The Economic History Review, 8*(2), 177-186.
Malik, M. (1962). Hundred years of Pakistan railways. *Ministry of Railways Communication, Government of Pakistan, Karachi, 1*, 68-84.
Meissner, D., Sarpong, D., & Vonortas, N. S. (2019). Introduction to the special issue on "innovation in state owned enterprises: implications for technology management and industrial development" guest editors. In: Taylor & Francis.
Meunier, J. (2002). *On the fast track: French railway modernization and the origins of the TGV, 1944-1983*: Greenwood Publishing Group.
Nayak, G. (2021). *The Railways in Colonial South Asia: Economy, Ecology and Culture*: Routledge.
Oum, T. H., & Yu, C. (1994). Economic efficiency of railways and implications for public policy: a comparative study of the OECD countries' railways. *Journal of transport Economics and Policy*, 121-138.
Perelman, S., & Pestieau, P. (1988). Technical performance in public enterprises: A comparative study of railways and postal services. *European Economic Review, 32*(2-3), 432-441.
Purba, A., Nakamura, F., Dwsbu, C. N., Jafri, M., & Pratomo, P. (2017). *A current review of high speed railways experiences in Asia and Europe.* Paper presented at the AIP Conference Proceedings.
Putterman, L., & Dong, X.-Y. (2000). China's state-owned enterprises: their role, job creation, and efficiency in long-term perspective. *Modern China, 26*(4), 403-447.
Ramanathan, R., & Ramanathan, U. (2011). A performance measurement framework combining DEA and balanced scorecard for the UK health sector. *International Journal of Operational Research, 12*(3), 257-278.
Ray, S. C. (2004). *Data envelopment analysis: theory and techniques for economics and operations research*: Cambridge university press.

Sanyal, N. (1930). *development of Indian Railways*: University of Calcutta, Calcutta.
Seiford, L. M. (1996). Data envelopment analysis: the evolution of the state of the art (1978–1995). *Journal of productivity analysis, 7*(2), 99-137.
Seiford, L. M., & Thrall, R. M. (1990). Recent developments in DEA: the mathematical programming approach to frontier analysis. *Journal of econometrics, 46*(1-2), 7-38.
Sexton, T. R., Silkman, R. H., & Hogan, A. J. (1986). Data envelopment analysis: Critique and extensions. *New Directions for Program Evaluation, 1986*(32), 73-105.
Shephard, R. W. (2015). *Theory of cost and production functions*: Princeton University Press.
Simpson, S. N. Y. (2014). Boards and governance of state-owned enterprises. *Corporate Governance*.
Smith, R. A., & Zhou, J. (2018). Background of recent developments of passenger railways in China, the UK and other European countries. *China's High-Speed Rail Technology*, 47-65.
Sperling, D., & Gordon, D. (2010). *Two billion cars: driving toward sustainability*: Oxford University Press.
Sueyoshi, T., & Goto, M. (2001). Slack-adjusted DEA for time series analysis: Performance measurement of Japanese electric power generation industry in 1984–1993. *European Journal of Operational Research, 133*(2), 232-259.
Taghizadeh-Hesary, F., Yoshino, N., Kim, C. J., & Mortha, A. (2019). A comprehensive evaluation framework on the economic performance of state-owned enterprises.
Tahir, N. The Rise and Fall of Pakistan Railways, 1849–2013. In *The Railways in Colonial South Asia* (pp. 191-247): Routledge.
Tahir, N. (2013). Efficiency analysis of Pakistan Railway in comparison with China and India. *Efficiency Analysis of Pakistan Railway in Comparison with China and India*, 71-98.
Tahir, N., & Tahir, P. (2020). Empirical Analysis of Railway Efficiency in Pakistan. *Abasyn University Journal of Social Sciences, 13*(2).
Takagi, K. (2011). Development of high-speed railways in China. *Japan railway and transport review, 57*, 36-41.
Talluri, S. (2000a). A benchmarking method for business-process reengineering and improvement. *International Journal of Flexible Manufacturing Systems, 12*(4), 291-304.
Talluri, S. (2000b). Data envelopment analysis: models and extensions. *Decision Line, 31*(3), 8-11.
Thorner, D. (1950). *Investment in empire*: University of Pennsylvania Press.
Vonortas, N., Sarpong, D., & Meissner, D. (2016). Special Issue: Innovation in State Owned Enterprises - Implications for Technology Management and Industrial Development. *Industry and Innovation, 26*. doi:10.1080/13662716.2019.1551838
Wang, S. (2003). Adaptive non-parametric efficiency frontier analysis: a neural-network-based model. *Computers & Operations Research, 30*(2), 279-295.
Yu, M.-M., & Lin, E. T. (2008). Efficiency and effectiveness in railway performance using a multi-activity network DEA model. *Omega, 36*(6), 1005-1017.

Appendix

Appendix A: Efficient years

Product Efficiency			
Years	**Theta**	Reference Sum (Lambda)	Sum of Slack
dmu:1970	1.00	1	0
dmu:1980	1.00	1	0
dmu:2018-19	1.00	1	0
Earnings Efficiency			
dmu:2017-18	1.00	1	0
dmu:2018-19	1.00	1	0
Financial Efficiency			
dmu:1970	1.00	1	0
dmu:1971	1.00	1	0
dmu:1972	1.00	1	0
dmu:1973	1.00	1	0
dmu:1974	1.00	1	0
dmu:1975	1.00	1	0
dmu:1976	1.00	1	0
dmu:1977	1.00	1	0
dmu:1978	1.00	1	0
dmu:1979	1.00	1	0
dmu:1980	1.00	1	0
dmu:1981	1.00	1	0
dmu:1982	1.00	1	0
dmu:1983	1.00	1	0

dmu:1984	1.00	1	0
dmu:1985	1.00	1	0
dmu:1986	1.00	1	0
dmu:1987	1.00	1	0
dmu:1988	1.00	1	0
dmu:1989	1.00	1	0
dmu:1990	1.00	1	0
dmu:1991	1.00	1	0
dmu:2001	1.00	1	0
dmu:2002	1.00	1	0
dmu:2003	1.00	1	0
dmu:2004	1.00	1	0
dmu:2005	1.00	1	0
dmu:2006	1.00	1	0
dmu:2007	1.00	1	0
dmu:2008	1.00	1	0
dmu:2009	1.00	1	0
dmu:2010	1.00	1	0
dmu:2018-19	1.00	1	0

Source: Authors estimation.

Appendix B: Inefficient years

	Product Efficiency			Earnings Efficiency			Financial Efficiency		
DMUs	**Theta**	**Reference Lambda**	**Product Sum of Slack**	**Theta**	**Reference Lambda**	**Product Sum of Slack**	**Theta**	**Reference Lambda**	**Product Sum of Slack**
1970				0.2074	0.018	0.005			
1971	0.8943	0.705	6592726.222	0.1647	0.029	0.004			
1972	0.9102	0.615	4842528.678	0.1708	0.03	0.007			
1973	0.9251	0.529	3403659.991	0.1771	0.001	0.011			
1974	0.9389	0.446	2248435.965	0.1837	0.001	0.016			
1975	0.9516	0.366	1351556.916	0.1905	0.001	0.021			
1976	0.9632	0.289	689908.849	0.1975	0.001	0.026			
1977	0.9738	0.213	242380.459	0.2048	0.001	0.033			
1978	0.9835	0.14	375.602	0.2124	0.001	0.04			
1979	0.9923	0.067	188.504	0.2202	0.002	0.048			
1980				0.2284	0.002	0.056			
1981	0.7961	0.264	18888826.65	0.3208	0.001	0.057			
1982	0.8023	0.13	23777312.02	0.3367	0.001	0.057			
1983	0.8086	0.142	28534215.26	0.3534	0.001	0.057			
1984	0.8206	0.112	29569152.71	0.3709	0.001	0.057			

1985	0.8326	0.083	30603182.91	0.3893	0.001	0.057			
1986	0.8448	0.053	31636460.66	0.4087	0.001	0.057			
1987	0.857	0.024	32669139.86	0.4289	0.001	0.056			
1988	0.8704	1.832	33437844.73	0.4502	0.088	0.056			
1989	0.8893	1.807	33026101.9	0.4726	0.09	0.056			
1990	0.9086	1.782	32619326.01	0.496	0.093	0.056			
1991	0.7977	1.498	22009267.45	0.5353	0.002	0.188			
1992	0.7897	1.479	21110695.87	0.5399	0.002	0.206	0.9875	0.018	673.356
1993	0.7818	1.461	20213735.48	0.5446	0.002	0.225	0.9751	0.035	1326.345
1994	0.7739	1.443	19318217.81	0.5492	0.002	0.245	0.9628	0.043	1657.553
1995	0.7662	1.425	18423974.24	0.5539	0.002	0.267	0.9506	0.06	2288.275
1996	0.7585	1.407	17530835.91	0.5587	0.002	0.291	0.9386	0.091	3517.454
1997	0.7509	1.389	16638633.72	0.5635	0.003	0.316	0.9266	0.103	3978.801
1998	0.7433	1.372	15747198.3	0.5683	0.003	0.344	0.9148	0.226	8765.294
1999	0.7359	1.355	14856359.97	0.5732	0.003	0.373	0.9031	0.399	15572.223
2000	0.7285	1.338	13965948.69	0.5781	0.003	0.405	0.8915	0.438	17187.442
2001	0.7005	0.066	1483074.286	0.6171	0.002	0.248			
2002	0.7072	0.059	2067738.71	0.6196	0.002	0.234			
2003	0.7139	0.052	2646039.004	0.6221	0.002	0.219			
2004	0.7207	0.046	3218073.665	0.6246	0.002	0.204			

2005	0.7276	0.039	3783939.675	0.6272	0.002	0.188			
2006	0.7345	0.032	4343732.53	0.6297	0.002	0.172			
2007	0.7414	0.026	4897546.258	0.6323	0.002	0.155			
2008	0.7484	0.019	5445473.447	0.6348	0.002	0.137			
2009	0.7555	0.012	5987605.261	0.6374	0.002	0.118			
2010	0.7626	0.006	6524031.472	0.64	0.002	0.099			
2011	0.6206	1.025	18663.79	0.7697	0.002	1.163	0.755	0.661	219820329.4
2012	0.6389	1.017	17421.852	0.7817	0.002	0.963	0.7998	0.678	225441267.7
2013	0.6577	1.009	15801.465	0.794	0.002	0.764	0.8463	0.674	223969662.6
2014	0.6771	1	13672.637	0.8065	0.002	0.566	0.8945	0.518	172187915.8
2015	0.9288	0.992	7340787.152	0.8191	0.001	0.368	0.9491	5.592	263590634.3
2015-2016	0.8539	0.975	4024546.104	0.8425	0.001	0.016			
2016-2017	0.8104	0.964	804864.217	0.9593	0.996	6.275	0.7473	2.704	913651158.5
2017-2018	0.9217	1.013	2955924.289				0.9031	9.921	618179218.9

Source: Authors estimation.

Appendix C

The below table shows the top ten SOEs with the highest losses in figures.

S. No.	Sector	SOEs	Losses (in Rupees)	Financial Year
1.	Roads & Highways	National Highway Authority (NHA)	133.48 Billion	2016-17
2.	Railways	Pakistan Railways	40.702 Billion	2016-17
3.	Aviation	Pakistan International Airlines (PIA)	39.4 Billion	2016-17
4.	Power	Lahore Electric Supply Company (LESCO)	37.4 Billion	2016-17
5.	Power	Hyderabad Electric Supply Company (HESCO)	27.3 Billion	2016-17
6.	Power	Peshawar Electric Supply Company (PESCO)	19.372 Billion	2016-17
7.	Industrial & Engineering	Sindh Engineering	19.305 Billion	2016-17
8.	Power	Quetta Electric Supply Company (QESCO)	18.703 Billion	2016-17
9.	Power	Multan Electric Power Company (MEPC)	17.935 Billion	2016-17
10.	Industrial & Engineering	Pakistan Steel Mill (PSM)	14.852 Billion	2016-17

Source: (Haider, 2019).

Appendix D

The below table shows the top eleven profit making SOEs with their employment, expenditures, revenue and losses in figures for the fiscal year 2016-17. All figures in Rs million.

S. No.	Type of SOE	Name of SOE	Revenue	Expenditure	Operating Profit	Net Profit
1.	Energy	Central Power Purchase Agency (Guarantee) Limited (PPAL)	822	546	276	136
2.	Energy	Water and Power Development Authority (WAPDA)	65,235	1,888	34,362	17,014
3.	Hydrocarbons	Oil and Gas Development Company Limited (OGDCL)	171,829	17,509	72,804	63,802
4.	Hydrocarbons	Pakistan Petroleum Limited (PPL)	116,986	7,137	43,786	35,679
5.	Hydrocarbons	Pakistan State Oil Company Limited (PSO)	878,147	37,199	13,282	23,917

6.	Agriculture	Livestock & Dairy Development Board (LDDB)	49	9	40	40
7.	Textiles	Faisalabad Garments City Company (FGGC)	46	15	8	2
8.	Textiles	Lahore Garments City Company	55	41	14	14
9.	Services	Pakistan Tourism Development Corporation (PTDC)	148	13	(28)	9
10.	Banks	National Bank of Pakistan	209,278	335,671	127,957	80,027
11.	Insurance	State Life Insurance Corporation	1,112	6,664	6,646	4,435

Source: (Ministry of Finance, 2017).

Appendix E

The below table shows the top twelve loss making SOEs with their employment, expenditures, revenue and profit in figures for the fiscal year 2016-17. All figures in Rs million.

SS. No.	Type of SOE	Name of SOE	Short Form	Revenue	Expenditure	Operating Profit/Loss	Net (Loss)
1.	Power	Peshawar Electric Supply Company	PESCO	110,136	23,742	(21,659)	(19,372)
2.	Power	Islamabad Electric Supply Company Limited	IESCL	86,664	14,490	(12,134)	(11,860)
3.	Power	Quetta Electric Supply Company	QESCO	66,480	33,807	(20,037)	(18,703)
4.	Power	Lahore Electric Supply Company Limited	LESCL	171,821	34,811	(42,268)	(37,370)
5.	Power	Hyderabad Electric Supply Company Limited	HESCL	40,492	8,559	(28,722)	(27,310)
6.	Industrial and Engineering	Pakistan Steel Mills Corporation (Private) Limited	PSM	425	2,551	(10,057)	(14,852)

7.	Services	Pakistan Broadcasting Corporation	PBC	4,382	3,874	(643)	(607)
8.	Services	Pakistan Post Office	PO	11,226	20,533	(9,307)	(9,307)
9.	Services	Pakistan Television Corporation Limited	PTCL	10,161	10,807	(646)	(649)
10.	Aviation	Pakistan International Airlines Corporation	PIA	95,992	9,139	(23,910)	(39,559)
11.	Railways	Pakistan Railways	PR	40,065	50,192	(40,317)	(40,702)
12.	Roads & Highways	National Highway Authority	NHA	29,296	14,361	(86,814)	(133,488)

Source: (Ministry of Finance, 2017).