Infrastructure and GDP Growth: A Cyclic Effect

Final Year Project (2018-19)

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CERTIFICATION

This is to certify that thesis entitled

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Has been accepted towards fulfillment of the requirements

For Bachelors in Civil Engineering

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DEDICATED

TO

OUR FAMILIES, TEACHERS AND FRIENDS

ACKNOWLEDGEMENT

In the name of Allah the merciful and beneficent, he who guided us in our pursuit of knowledge and bestowed upon us the strength to complete this project.

This thesis is dedicated to our parents because they have provided us with moral and emotional support throughout our life, hence we owe it all to them.

We are grateful to our supervisor and mentor; Lec. M. Hasnain for his continuous support and encouragement which helped u make through our project. We are also grateful to our HOD CE&M Dr. Jamal Thaheem for his valuable guidance, without whom this project would have been very difficult.

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Table of Contents

List of Figures

ABSTRACT

Infrastructure development plays a significant role in the economic state of a country, but not enough emphasis has been laid to study the impact of infrastructure spending on the GDP of Pakistan. Hence, the aim of this study is to determine the relationship between the expenditure on infrastructure and GDP. Further, to evaluate the degree of impact specific components of infrastructure have on the economic growth of Pakistan.

Data was collected that was in scattered form and analysed numerically which lead to the conclusion that both, Hard and Soft infrastructure directly affect the GDP of Pakistan. Among different trends that were studied, the regression tests show that Buildings and Utilities play a greater role in the GDP of Pakistan and on a broader scale it was concluded that the government should invest more in hard infrastructure and in the sub sectors of waterways and transport specifically.

Chapter # 1

INTRODUCTION

1.1 BACKGROUND

The aim of this research is to examine the degree of influence, infrastructure has on the economic growth of Pakistan. Sufficient infrastructure is basically a significant determinant of a nation's successful attempt to integrate its economy. Which is accomplished by diversifying production base, expanding trade and making the existing resources useful. Infrastructure development, both economic and social, is one of the key determinants of economic growth, particularly in developing countries. Furthermore, it is one of the major contributors in the Gross Domestic Product (GDP) of a country. An increase in infrastructure development ascends to an increase in the overall GDP of a country. Whereas a decrease, results in the contrary. Similarly, a higher GDP promotes improved infrastructure and vice versa.

For a developing country these findings can contribute a great deal in identifying the key factors that determine its economic growth. Which in-turn can help to classify and explain the factors associated with infrastructure that can potentially be a source of raising income levels. While offering policymakers and business leaders an edge, in the constitution of improved economic policies and institutional reforms.

Despite the importance of infrastructure development on the economic state of a country, unfortunately, Pakistan lacks substantial data necessary to allow economists, study the impact and relation of infrastructure and GDP growth in Pakistan. It is largely due to scattered, available data and inability to efficiently allocate and outsource budget in different developmental domains within Pakistan. Hence, the expenditure on infrastructure remains unquantified and obscure. Thus, it is an absolute necessity for future development, to collect authentic data from credible sources and converge it in a single data storage facility from where it is accessible for future studies.

1.2 OBJECTIVES OF THE STUDY

The main objective of the thesis is to determine the relationship between infrastructure expenditure and the GDP of Pakistan. Further, analyse the degree of impact, specific components of infrastructure development have on the growth and proliferation of GDP in Pakistan.

1.3 STRUCTURE OF THE STUDY

The thesis is structured as follow. In section II we discuss about the existing literature. Section III in detail, reflects on the Methodology and procedure opted to carry out this study. Section IV includes results estimation and empirical analysis. Finally, the last section of discusses conclusion and correlations dependability of obtained results.

Chapter # 2

LITERATURE REVIEW

2.1 INFRASTRUCTURE AND OUTPUT (GDP)

Existing literature has been found to exhibit a positive correlation between investment in infrastructure and significant impact on economic growth.

Devarajan, Swaroop, and Zou (Shantayanan Devarajan, 1996) use regression model and annual data from 43 countries to determine the link between the components of central government expenditures and economic growth. These central components include defence education, health, transport and communication.

Furthermore, Esfahani and Ramirez (Hadi Salehi Esfahania, 2003) explored the relation between infrastructure spending and economic growth in 75 countries using the structural growth model. The study has considered variables such as population growth rate, growth rate of per capita telephones, private ownership in the telecoms sector, growth rate of per capita power production, and average years of secondary education, terms of trade change, exchange rate black market premium, population density, and urbanizations share of industry in GDP. The findings of the study suggest that the long term relationship between investment in economic infrastructure, such as roads, air travels, electricity, telephones etc. long-run economic growth (GDP) in South Africa was investigated by Fedderke, Perkins, and Luiz (J.W.FedderkeP.PerkinsJ.M.Luiz, 2006). They used bounds analysis of Pesaran, Shin and Smith's (2000) F test, Co-integration test, and Vector Error-Correction Mechanism. The study discovers that investment in infrastructure leads to economic growth in South Africa. The findings also suggest that infrastructure have both direct and indirect influence on output; there is a causality effect running in both directions between infrastructural investment and economic growth. This study effectively concludes a forcing relationship moving from infrastructural fixed capital stock to GDP, indicating that infrastructure expenditure leads to economic growth.

Murty and Soumya (Soumya, 2006) discovered the macroeconomic effects of changes in public investment in infrastructure in India over the period of 1978-1979 and 2002-2003 by using the structural, macro-econometric model. The study indicates that public sector investment in infrastructure has the potential to provide accelerated growth process in Indian economy.

Moreover, Nannan and Jianing (Yu Nannan, 2012) examine the relationship between infrastructure investment and economic growth in China using a dataset for a 20-year period between 1988 and 2007 by using the OLS model. The results led to a positive correlation

between physical infrastructure development and Chinese economic growth. Further, the study concludes that there is a lack of infrastructure development which lags demands of the economy.

All these studies support and confirm the notion that infrastructure development has an influence on GDP growth. Furthermore, they also provide evidence regarding an existing relationship between economic growth, economic infrastructure investment, formal employment, exports and imports of goods and services. Thus, it is fair to claim that investment in infrastructure positively affects economic growth, therefore, investment in infrastructure can be employed as a leading indicator for future economic activities.

2.1.1 Gross Domestic Product (GDP)

The value of all the goods and services that are produced in a country is known as its GDP. It takes into account the value of all finished goods or services located within the boundaries of a country. By determining their final cost, rather than the cost implicated in their production. It is a measure of all public, private and governmental expenditures. Along with the investments, paid-in construction costs, additions to private inventories and the foreign balance of trade (exports additional, imports subtracted). Unlike the Gross National Product (GNP), which includes the overall production of all the citizens in an economy, which comprises of those living abroad and excludes the domestic production by foreigners. Concisely, GDP is a monetary value that gives an expansive depiction of a Nation's overall economic state and activity over a specific period of time. (Amadeo, 2019)

GDP can be calculated either through expenditures, productions, or incomes. The Basic components of GDP equation include personal consumption expenditures, business investment, government spending , exports and imports. The components are adjusted as follows:

$$\mathbf{C + I + G + (X - M)}$$

C = personal consumption expenditures
I = business investment
G = government spending
X = exports
M = imports

C is the personal consumption expenditures also regarded as the consumer spending.

Which is the expenditure of money for purchasing goods and services for personal needs, such as food, clothing and transport. Consumers are a viable component of GDP because they help to

provide an implicit picture of consumer behavior in terms of spending. Higher the consumer assurance level, higher the consumers willingness to spend. While a low confidence level reflects that the consumers are unwilling to spend in future.

I represents private domestic investment, which is the expenditure of businesses in order to invest in their own business activities such as buying material. These investments are very important sources of GDP because they bring growth to productive capacity and also boost employment opportunities.

G denotes government expenditure and gross investment. Focuses on the expenditures of Governments on equipment, infrastructure, and workforce. When consumer spending and business investment both decline rapidly, this component bears specific importance, for example, after a recession.

NX is net exports, calculated as total exports minus total imports (**NX = Exports - Imports**). The amount of goods and services that are produced by an economic country in order to be exported to other countries, minus the imports that are being transported in the country, are calculated as the net exports. An excess in the current account increases a country's GDP, whereas a severe shortage brings strains on a country's GDP.

Though GDP has its own limitations it can be a source for an insight to the magnitude of a country's economic state. Thus, it plays a very strategic role in guiding and decision making of country's policy makers, investors, and business men.

2.1.2 Nominal GDP vs. Real GDP

Since GDP is based on the financial value of the end product of goods and services, inflation or a drastic increase in price of goods will tend to portray a higher GDP whereas a decrease in prices will lower the GDP. Therefore, a mere look at the quantified GDP values is not sufficient to determine the actual economic state of the country. Which is why, economists have devised modification for inflation in order to obtain an economy's real GDP that justifies its increase or decrease.

By modifying the output in any given year for the price levels that prevailed in a base year, economists adjust for the effect of inflation. In this way the actual growth is studied by comparing a country's GDP from one year to another.
Real GDP is computed using a GDP price deflator. It is the difference in prices between the current year and the base year. Nominal GDP is divided by this deflator, resulting in real GDP. Nominal GDP is usually higher than real GDP because inflation is always positive.

Real GDP takes into account the change in market value, which narrows the difference between output figures from year to year with the effects of inflation removed. It is used to compare and analyze the difference between GDP of two or more years. However, Nominal GDP is a raw form of measurement that includes price increases and is used while comparing different quarters of output within a same year. A large discrepancy between a nation's real and nominal GDP signifies significant inflation (if the nominal is higher) or deflation (if the real is higher) in its economy (Jim Chappelow, 2019).

2.1.3 Gross value added (GVA)

GVA is a monetary measure of the contribution a single region or sector of economy makes in the overall GDP of the country. It revolves around the value of goods and services produced in a country, subtracted by all the input and raw material cost attributed to their production. This leaves behind the sale price value, also known as the intermediate consumption. Therefore, GVA gives an explicit picture of how and to what extent a corporate subsidiary or a municipality is contributing to the state's economy, producer, sector or region. Hence, it is used as a productivity metric to measure gross regional domestic product.

GVA is the difference between gross and net output. GVA is an important economic term because it is used in the calculation of gross domestic product (GDP), which is a prime indicator of the economy of the state. GVA is employed to estimate the value added (or lost) in terms of contribution to the GDP by a particular region, sector or province. GVA is indirectly related to GDP through taxes and subsidies on products, that a government apply on certain sectors of the economy while subtracting taxes imposed on others.

At the level of a firm and organization, GVA can be used to measure the amount of money a product or service has contributed toward meeting a company's goal. While at a national level, GVA favors, as a means to quantify the total economic output and growth compared to GDP or gross national product (GNP) (Will Kenton, 2019).

2.2 HARD AND SOFT INFRASTRUCTURE OUTPUT IN CONTEXT OF PAKISTAN

Since our research is based upon the relationship between infrastructure and the effect it has on the GDP, it is important to understand what infrastructure consists of. Firstly, infrastructure can be divided into two main categories; hard infrastructure and soft infrastructure.

Hard infrastructure is attributed to physical substances and supporting information technologies that provide basic services, essential for economic activity and providing quality

life. These include constructible materials such as bridges, roads, solar panels, buildings etc. Whereas, **Soft infrastructure** constitute institutions and court of laws that are essential to the economy and quality of life because of the services they provide. Such as government, healthcare, education, financial and legal systems (Spacey, 2017)

2.2.1 Hard Infrastructure

"Hard" infrastructure is focused on the provision of basic physical utilities i.e. water, gas and electricity, waste, transport provision (roads, rail, air) etc. These provide with a basic framework for a community or society to function in, accounting for its social, economic and environmental activities. Further, hard infrastructure also includes community facilities and public buildings that support community life by tending to the developmental, recreational, social and cultural needs of people. Local government plays a key role by providing such facilities for instance libraries, town halls, recreation and cultural facilities, meeting rooms, child care, and office spaces, centers for young and older people etc. Yet, what remains indistinguishable in hard infrastructure is the physical nature that provokes a need for its design and construction.

2.2.2 Construction

According to the UN studies in methods, Construction activities are defined as following:
"Construction, repair and demolition of buildings, highways, streets and culverts; heavy construction of such projects as sewers and water mains, railway roadbeds, railroads, piers, tunnels, subways, elevated highways, bridges, viaducts, dams drainage projects, sanitations projects, gas mains, pipe-lines and all other types of heavy construction; marines construction such as dredging, under-water rock removal, pile driving land draining and reclamation, construction of harbors and water-ways; water wells; airports; athletic fields, gold courses; swimming pools; tennis courts; parking areas, communication systems such as telephone and telegraph lines; and all other construction weather undertaken by private bodies or governmental authorities. Special trade contractors in the field of construction, such as carpenters, plumber, plasters and electricians, are also included in this group" (United Nations Studies in Methods, SeriesFNo13)[i]

The construction domain in Pakistan, is overlooked by the Pakistan Standard Industrial Classification (PSIC). Which follows standards set by the International Standard Industrial Classification of all economic activities (ISIS). In division 45 of section F set by PSIS in 2007, general as well as specialized activities of construction, related to buildings and civil engineering as a whole are covered. In detail these activities include new additions, repair, alteration, construction of pre-fabricated buildings or structures on site and construction of temporary nature. Individual activities were incorporated in PSIC 2010, in the same section. Which consist

of set standards for the complete construction of: buildings (division 41), civil engineering works (division 42), and specialized activities carried out s part of a construction process (division 43). Furthermore, to address the construction activities, a commodity flow approach is used based on the expenditure incurred by the establishments. These establishments either undertake the construction or the contractors or sub-contractors purchasing the construction material. The expenditure data is obtained from data set of GFCF in all sectors of the economy. Broadly these construction activities constitute land improvement and construction of all type of buildings, roads, bridges, railway lines, utility lines (telecommunication lines, power lines, pipe lines) waterways, dams as well as repairs and maintenance of such infrastructure.[ii]

2.2.3 Soft Infrastructure

Soft infrastructure accounts for the nonmaterial requirements of a community that form the basis, apart from physical framework. It is the provision of skills, knowledge and access to a range of services and responses a community or a society needs to flourish while responding to their current as well as the future necessities. The term 'Soft infrastructure' is often referred to as the social and community infrastructure that not only enhances quality of life but promotes law and order, stability and social well-being. This type of infrastructure can be widely classified as following: health, individual, family and community support, education, employment and training, public and community transport, housing, emergency services, arts and culture etc. (Casey, 2005)

To build and promote a socially sustainable community it is immensely important to efficiently incorporate and make available both, the hard and soft infrastructure. For example, a developer uses capital resources to build a school (hard infrastructure) for the main purpose of education (soft infrastructure). However, that would only be possible in the presence of teaching staff as well as the assistance of operating staff that will run the school and maintain the building. Thus, both these infrastructures are significant yet, incomplete without the other.

2.2.4 General Government Services

As mentioned before, in Pakistan the area of construction and civil engineering works comes under the PSIC, which also classifies government sectors that acquire, and sort data obtained from construction activities. This classification and division of work are done according to the specific job description of each government sectors either dealing in the market or non-market domains. According to PSIC 2007 and PSIC 2010, the most important government sectors involved in construction data processing include defense, public administration, education and health.

The finance sector is separately dealt, as it constitutes social security funds, either as a single unit based on the institution or as part of central, state or local government. Public corporations are not included in this sector. Also, it does not include quasi-corporations that fall under government's control. The tasks allocated to this sector by the PSIC are classified based on the transactions. The classes are as following: defense, public order and safety, economic affairs, environmental protection housing and community amenities, health, recreation, culture and religion, education, and social protection.
The main sources of construction data processing in the financial sector are federal budgets and the ministry of finance data for the federal government. PSIC has allocated the non-market autonomous bodies directly involved in construction activities, to the government. Whereas, the non-market autonomous bodies directly involved in construction activities are allocated to their respective corporation and industries. The output of market bodies for the government is measured based on revenues generated. Which are further tallied with receipts, inspection fees, museum tickets etc. This gives the over-all output of the finance sector therefore it can be used to calculate the value of market output as well. The Intermediate consumption includes the expenditures on utilities, stationary, repair and maintenance, fees, occupancy charges (excluding residential component), etc.

The expenditures of respective government units are utilized by following a pattern classified by the ministry of finance, the Finance Departments of the provinces or the local authorities responsible for the performance of the budget. This pattern identifies object code and then used accordingly. The value of market output is given by receipts, sales of market products, and output of own final use. Finally, this value is then made equivalent to own gross fixed capital formation. The data is obtained from the budget documents which also includes the object codes. Subsidies are not a part of intermediate consumption.

2.3 LITERATURE ON INFRASTRUCTURE OUTPUT OF OTHER COUNTRIES

2.3.1 China

China is one of the fastest growing countries of the world and the defining feature of their successful growth is their investment-led development. In the last couple of decades due to investment in infrastructure by both the public and private sector, sheer economic growth has been promoted within the country. This has led to advancements, creating opportunities like production facilities and stimulated economic activities; reduced transaction costs and trade costs and employment opportunities to the poor. Pravakar, Ranjan and Geethanjali's (Pravakar Sahoo, 2010) research, explores the defining factors behind the economic boom in China between 1975 to 2017. Owing to its large population, majority suffer from poor living standards. Thus, the policies encouraging investment-led growth in China not only improved the physical

infrastructure but also reduced unemployment in China from 60% in 1980 to 8% in 2003, which accounts for a drastic change portraying a high economic growth. Thus, to conclude, cheap labor and improved yet, adequate infrastructure both played a role in the export-led growth strategy opted by China. Due to large population and unemployment, cheap labor was easily available from the rural sector. However, the public investment in infrastructure became the key factor that led to the economic boom.

Moreover, other than China, countries like Japan, Malaysia, Singapore, and Korea, have underwent similar transformation, relatively in a short time span, owing to their large investments in the infrastructure sector (Gunjeet Kaur, 2010)

2.3.2 India

India is known for its largest population in the world. However, its economic growth suffers relative to its labor and employment ratio. One reason identified by (Naliniprava Tripathy, 2016) is the annual spending of India's GDP on infrastructure which is far less than to be ideally spent. An auto- Regressive Distributed Lag (ARDL) model and Error Correction Model were used to examine the long-run relationships and short-term dynamics of investment in infrastructure and economic growth to gain new insights in the subject for better policy making strategies. It was found, India annually spends 6% of its GDP on infrastructure compared to China who invests about 11% of its GDP on infrastructure development. The results suggest a lag in economic growth of India was primarily due to the insufficient expenditure on Infrastructure development.

Furthermore, another research, (Soumya, 2006) explores the macroeconomic effects as a result of changes in public investment on infrastructure in India, over the period of 1978-1979 and 2002-2003. This study employed the structural, macro-econometric model while considering the four broad sectors in macroeconomics - real, fiscal, monetary, and external sectors of the Indian economy, as variables. The real sector is further divided into four sub-sectors: agriculture, manufacturing, infrastructure, and services. The results show a significant crowding-in effect between private and public sector investment in all the four of the sub-sectors in real Indian economy. Further, it is also indicated that public sector investment in infrastructure has the potential to provide accelerated growth process in Indian economy.

2.3.3 Malaysia

Malaysian economy sets another example due to its rapid growth (5-9% a year) after independence. Two major influential factors have been identified by (Naidu, 2008) which justify the economic growth in Malaysia. First, accounts for the recognition of infrastructure as the key element for economic growth, by the Malaysian government. Second the development of infrastructure to serve socio-economic ends that promote development in rural and underdeveloped regions of the country. Maximum amount of money has been spent on infrastructure by the government, ranging between a low of 1.9 per cent in the Second Malaysia Plan and a high ratio of 9.4 in the Seventh Malaysia Plan. Hence the economic growth is inevitable and substantiate.

2.3.4 United Arab Emirates

The United Arab Emirates (UAE) gives immense importance to infrastructure construction, and regard it as the basis of economic and social development. Despite the infrastructure availability and adequacy in UAE, there are still many undergoing projects that are aimed to combine public and private sectors as a foundation to expand economic growth. These projects include residential, tourism, industrial and commercial facilities, education and health care, electricity, communications and ports and airports.

UAE has sufficiently reduced its dependence on oil, considering it as an opportunity to diversify its economy. Though, world-wide the prices of oil have declined as a result however, UAE has successfully managed to uphold its position in the international economy. Largely because of its extensive infrastructure development in the last decade. Petroleum, manufacturing, trade, construction and real estate is the highest share of the top five industry accounted for GDP in the Unit-ed Arab Emirates. (Zhang Ya Bing, 2018)

Thus, it is evident from these examples that Infrastructure development in fact, is one of the leading causes of economic growth, in a country. It is becoming more or less a universally recognized notion, that adequate supply of infrastructure services is an essential ingredient for productivity and growth of an economy.

2.3.5 SUMMARY

Existing literature and exemplary infrastructure policies of diriment countries across the globe manifest a positive relationship between infrastructure development and economic growth of a country. Gross domestic product (GDP) is a key determinant of the economic state of a country. It is total value of all the goods produced within the boundaries of a country including its sale as well as the production cost. Therefore, GDP provides an implicit view of the economy of a country by giving an estimate, final value of all the goods produced within. Furthermore, GDP is often not accurate when a country is suffering from inflation. The high GDP or contrary cannot be justified in terms of price increase or economic boom. Thus, economist have devised a solution where effects of inflation are removed and a 'Nominal GDP' is calculated. Further, a relative value to GDP is the Gross value added (GVA) is a monetary measure of the contribution a single region or sector of economy makes in the overall GDP of the country. Hence, it is a means to measure individual output contribution of each sector. The infrastructural development has a significant effect on the growth of an economy. There are namely two types of infrastructure, Hard infrastructure and soft infrastructure. Hard, constitutes the physical utilities that are necessary for community to function, such as roads, buildings, water, gas and electricity supply, etc. Whereas, Soft is accounts for the nonmaterial requirements of a community such as education, healthcare services, law and order, employment, training etc. The provision of each of the infrastructure types, falls assorted government sectors in Pakistan. However, Pakistan still lacks organized data to determine the impact for infrastructure growth on its economy. Therefore, the main objective of this thesis is to collect this data from various credible sources. Then organize it for analysis to determine the relationship between infrastructure expenditure and the GDP of Pakistan.

Chapter # 3

RESEARCH METHODOLOGY

3.1. THEORETICAL BACKGROUND

This study involves the collection of various data sets to perform multilinear regression analysis on how infrastructure spending may have an impact on the overall GDP of Pakistan. Mainly emphasizing on the construction sector (hard infrastructure) and its various sub-heads.

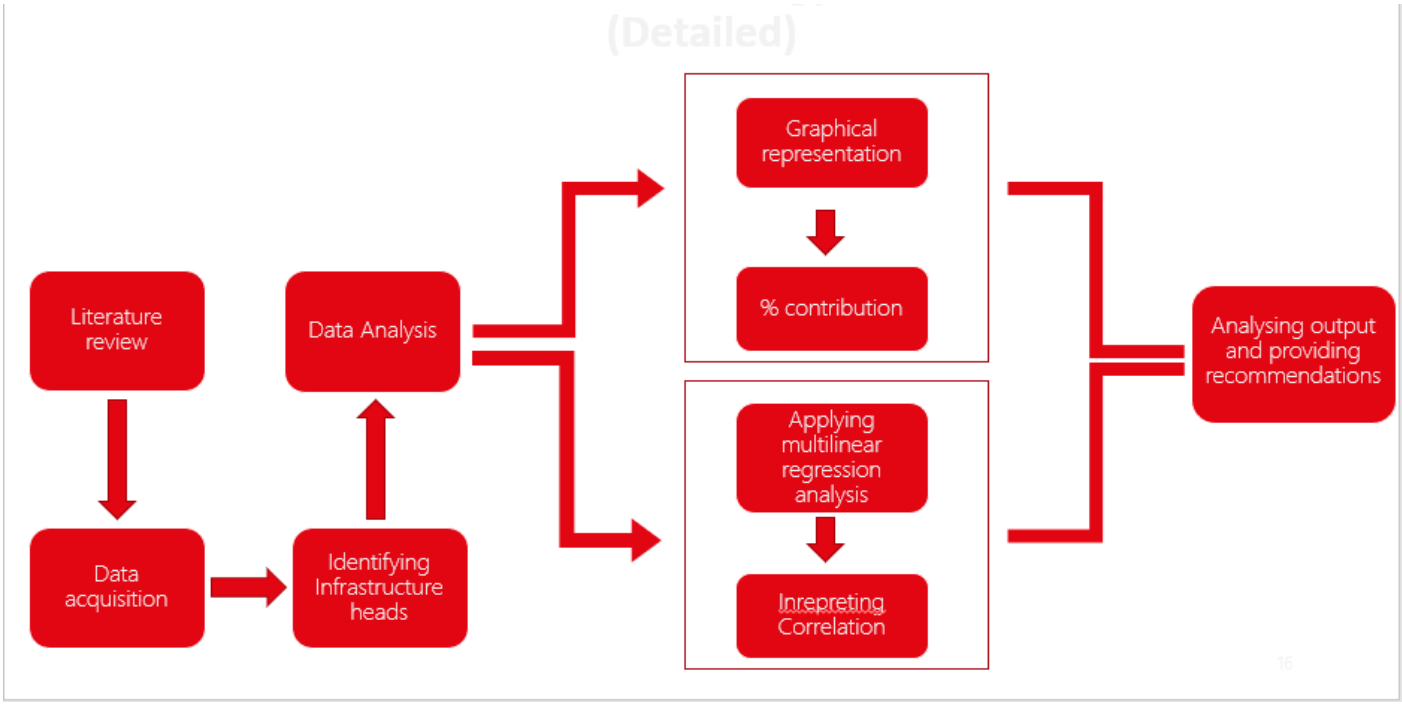


Figure 3.1 Research Methodology Flow Chart

3.1.2 Data collection for Various other countries

Relevant data for various other countries such as Malaysia, China, India and United Arab Emirates were readily available on their official bureau of statistics website. However, the data set belonged to variable time periods and different base years.

3.2 Developing data sets for analysis

Extensive data of Gross domestic product of Pakistan along with gross value added, which comprise of various heads such as; construction, services, manufacturing etc. were extracted from the source and compiled onto excel sheets in tabular format for comparison between Gross domestic product and infrastructure to study its trend. Using graphical representation, we were able to study the correlation between the different domains of infrastructure and GDP.

3.2.1 Analyzing using Excel

The data acquired from Pakistan bureau of statistics was analysed and the heads that were contributing to infrastructure were compiled and showcased in a tabular format. The analysis comprised of comparison charts such as; GDP vs infrastructure spending, contribution in construction with regard to GDP of various countries, GDP of various countries with their respective time period (base year 2005). Further studies of construction sector were analysed, and graphs were plotted to interpret the correlation with respect to Gross domestic product of Pakistan.

3.2.2. Analyzing using Minitab

Minitab software is a complete statistical software package that provides its users with comprehensive methods, tools and graphs to assort and analyse their data. It constitutes all basic as well as complex statistical tools from optimization models, control charts and graphs to regression model and ANOVA.

Our research is based on a descriptive study on the analysis of a dependent variable and various other independent variables using a multilinear regression analysis model an inbuilt tool of the Minitab software which demonstrates the correlation between two or more variables presenting a cause-effect relationship. The multilinear regression analysis gives an output in the form as follows;

P value:

P-value ≤ α: The relationship is statistically significant

It can be concluded that there is a statistically significant association between the respondent variable and the term if the p-value is less than or equal to the significance level

P-value > α: The relationship is not statistically significant

It cannot be concluded that there is a statistically significant relationship between the response variable and the term if the p-value is greater than the significance level. The model is refitted excluding the term.

R-sq:

R^2 is the percentage of variation in the result that is explained by the model. If the value of R^2 is higher, the model fits the data more accurately. R^2 is always between 0% and 100%. It measures how much the variation in the response (Y) is explained by the X variables in the regression model.

Coefficients:

A regression coefficient explains the size and the relationship between a predictor and the response variable. Coefficients are the numbers by which the values of the term are multiplied in a regression equation.

The coefficient for a term represents the change in the mean response associated with a change in that term, while the other terms in the model are held constant. The sign of the coefficient indicates the direction of the relationship between the term and the response. The size of the coefficient is usually a good way to assess the practical impact of the effect that a term has on the response variable.

Chapter # 4

RESULTS AND DISCUSSIONS

4.1. Infrastructure and GDP Growth of Pakistan

We are analyzing the impact of spending on hard and soft infrastructure on the GDP of Pakistan. For that we collected data from the Pakistan Bureau of Statistics. The following graph depicts the results of the data analyzed.

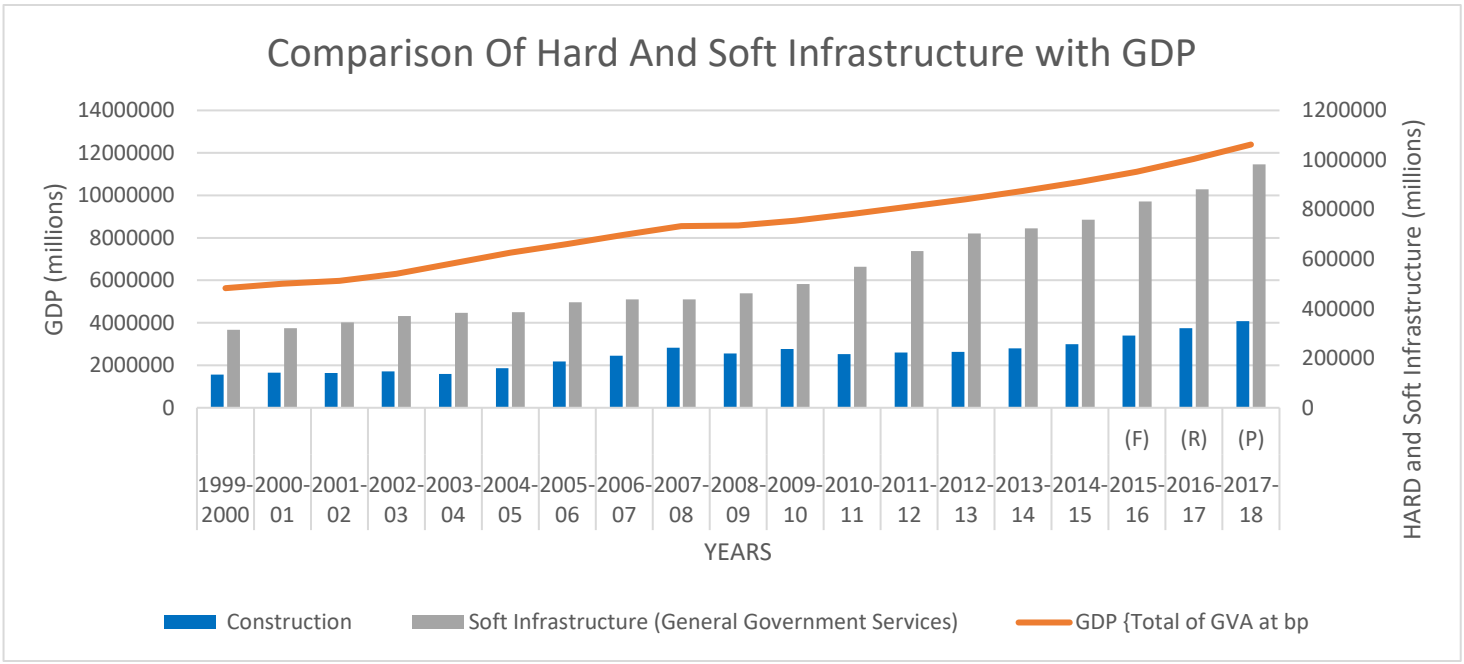
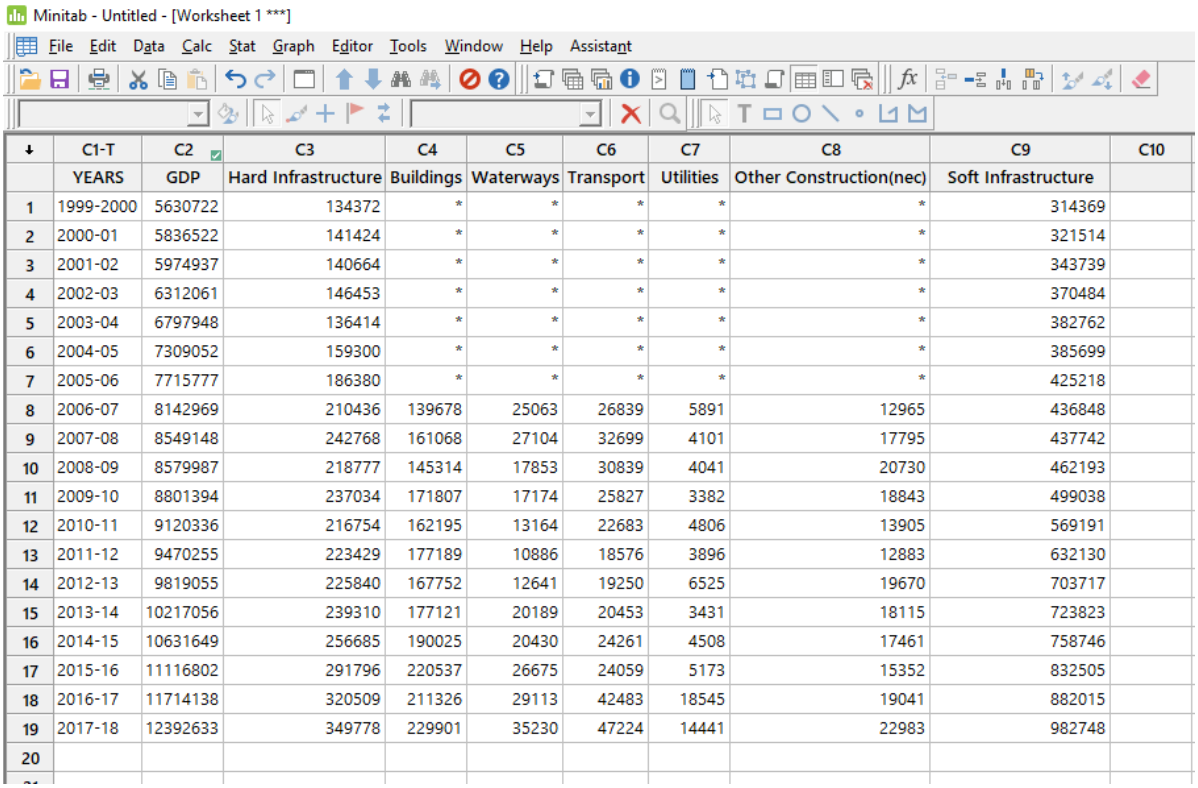


Figure 4.1 Comparison of Hard And Soft Infrastructure with GDP

It is quite evident from the data that there has been more expenditure on the Soft Infrastructure in comparison to the Hard Infrastructure and both have a positive impact on the GDP of Pakistan.

4.2. Regression Analysis: GDP versus Hard Infrastructure, Soft Infrastructure

To further verify our interpretation, we ran multilinear regression analysis using the software MINITAB.



	C1-T	C2	C3	C4	C5	C6	C7	C8	C9	C10
	YEARS	GDP	Hard Infrastructure	Buildings	Waterways	Transport	Utilities	Other Construction(nec)	Soft Infrastructure	
1	1999-2000	5630722	134372	*	*	*	*	*	314369	
2	2000-01	5836522	141424	*	*	*	*	*	321514	
3	2001-02	5974937	140664	*	*	*	*	*	343739	
4	2002-03	6312061	146453	*	*	*	*	*	370484	
5	2003-04	6797948	136414	*	*	*	*	*	382762	
6	2004-05	7309052	159300	*	*	*	*	*	385699	
7	2005-06	7715777	186380	*	*	*	*	*	425218	
8	2006-07	8142969	210436	139678	25063	26839	5891	12965	436848	
9	2007-08	8549148	242768	161068	27104	32699	4101	17795	437742	
10	2008-09	8579987	218777	145314	17853	30839	4041	20730	462193	
11	2009-10	8801394	237034	171807	17174	25827	3382	18843	499038	
12	2010-11	9120336	216754	162195	13164	22683	4806	13905	569191	
13	2011-12	9470255	223429	177189	10886	18576	3896	12883	632130	
14	2012-13	9819055	225840	167752	12641	19250	6525	19670	703717	
15	2013-14	10217056	239310	177121	20189	20453	3431	18115	723823	
16	2014-15	10631649	256685	190025	20430	24261	4508	17461	758746	
17	2015-16	11116802	291796	220537	26675	24059	5173	15352	832505	
18	2016-17	11714138	320509	211326	29113	42483	18545	19041	882015	
19	2017-18	12392633	349778	229901	35230	47224	14441	22983	982748	
20										

Figure 4.2 Data Worksheet

4.2.1. Results:

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	7.21088E+13	3.60544E+13	279.61	0.000
Hard Infrastructure	1	2.65624E+12	2.65624E+12	20.60	0.000
Soft Infrastructure	1	3.09681E+12	3.09681E+12	24.02	0.000
Error	16	2.06313E+12	1.28945E+11		
Total	18	7.41719E+13			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
359090	97.22%	96.87%	95.96%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2465044	317605	7.76	0.000	
Hard Infrastructure	15.61	3.44	4.54	0.000	6.54
Soft Infrastructure	5.13	1.05	4.90	0.000	6.54

Regression Equation

GDP = 2465044 + 15.61 Hard Infrastructure + 5.13 Soft Infrastructure

4.2.2. Interpretation:

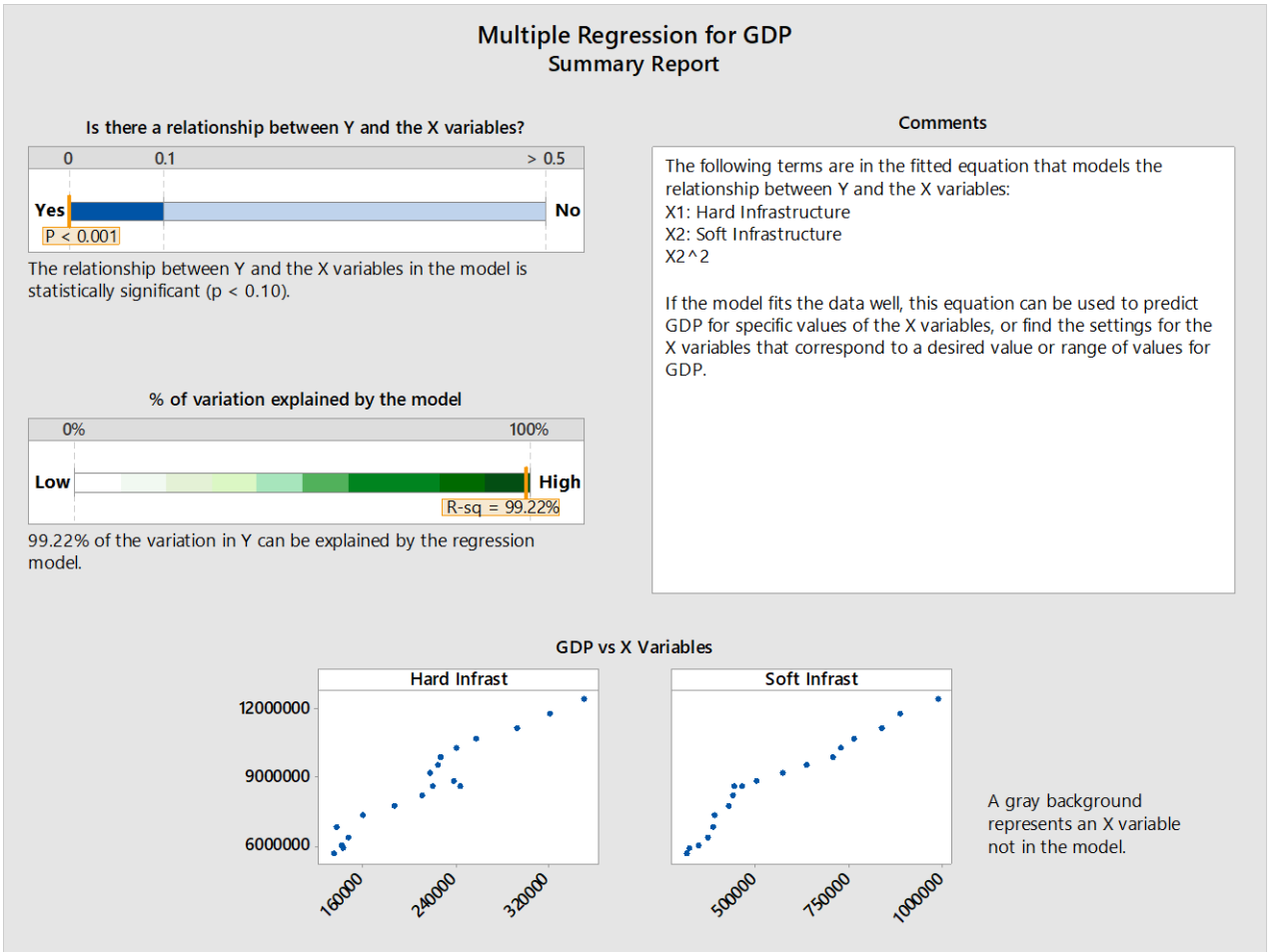


Figure 4.3 Minitab Results

P value:
The P values are less than 0.5 hence we can justify that our independent variables i.e. hard and soft infrastructure have a significant effect on the GDP of Pakistan and a direct positive relationship exists with an acceptable level of risk.

R-sq:
R-sq= 97.22%

Model fits well. We can use the model for prediction of our GDP.

Coefficients:

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2465044	317605	7.76	0.000	
Hard Infrastructure	15.61	3.44	4.54	0.000	6.54
Soft Infrastructure	5.13	1.05	4.90	0.000	6.54

If there is 1 unit increase in Hard Infrastructure (1 million) then there is a positive increment of 15.61 units (15.61 million) in the GDP.

If there is 1 unit increase in Soft Infrastructure (1 million) then there is a positive increment of 5.13 units (5.13million) in the GDP.

The Positive signs show a direct relation between GDP and Hard Infrastructure, GDP and Soft Infrastructure. We can interpret that if we spend more on infrastructure then our GDP is going to have a positive impact of that. And if we spend less on infrastructure then our GDP is going to be less.

The regression model can be used for predicting future GDPs.

4.3. Comparison with Other Countries

For comparison of our GDP with other countries we chose the following countries.

1. China
2. India
3. Malaysia
4. UAE

4.3.1 Comparison of GDP:

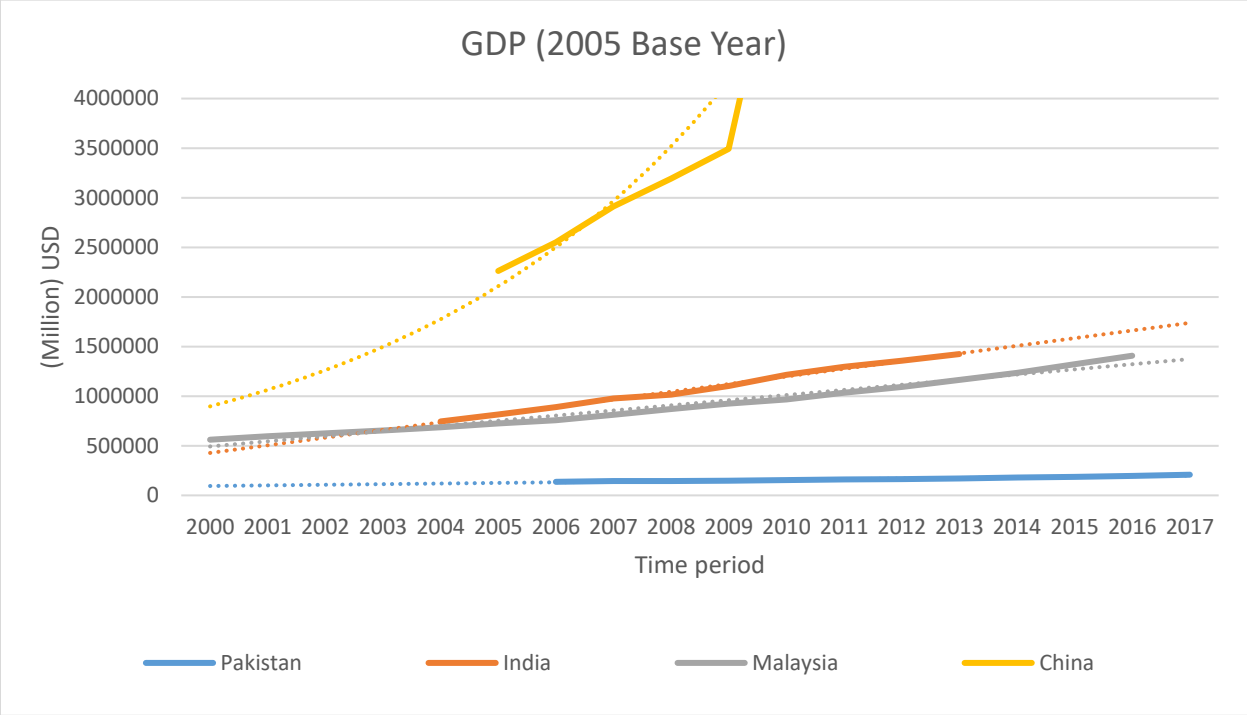


Figure 4.4 Comparison of GDP of different Countries

It is quite evident from the graph that in comparison to these countries our GDP is the lowest, reason being that we are a developing country and our economy is not stable.

4.3.2 Comparison of % Contribution of Construction in GDP:

Figure 4.5 Comparison of % Contribution of Construction of different countries in GDP

This graph shows the comparison of percentage contribution of Construction (Hard Infrastructure).
Pakistan falls in the lowest category, with an average expenditure of 2.5% of its GDP on construction. Malaysia lies slightly higher with an average of 3.65%.

Then there is China which is the rising economy that spends 6.5%.

India spends 7.25% of GDP on construction.

Whereas UAE spends 8.9% of its GDP on construction.

Country	% Contribution of Construction
Pakistan	2.5%
India	7.25%
Malaysia	3.65%
China	6.5%
UAE	8.9%

4.3.3 Global Competitive Index:

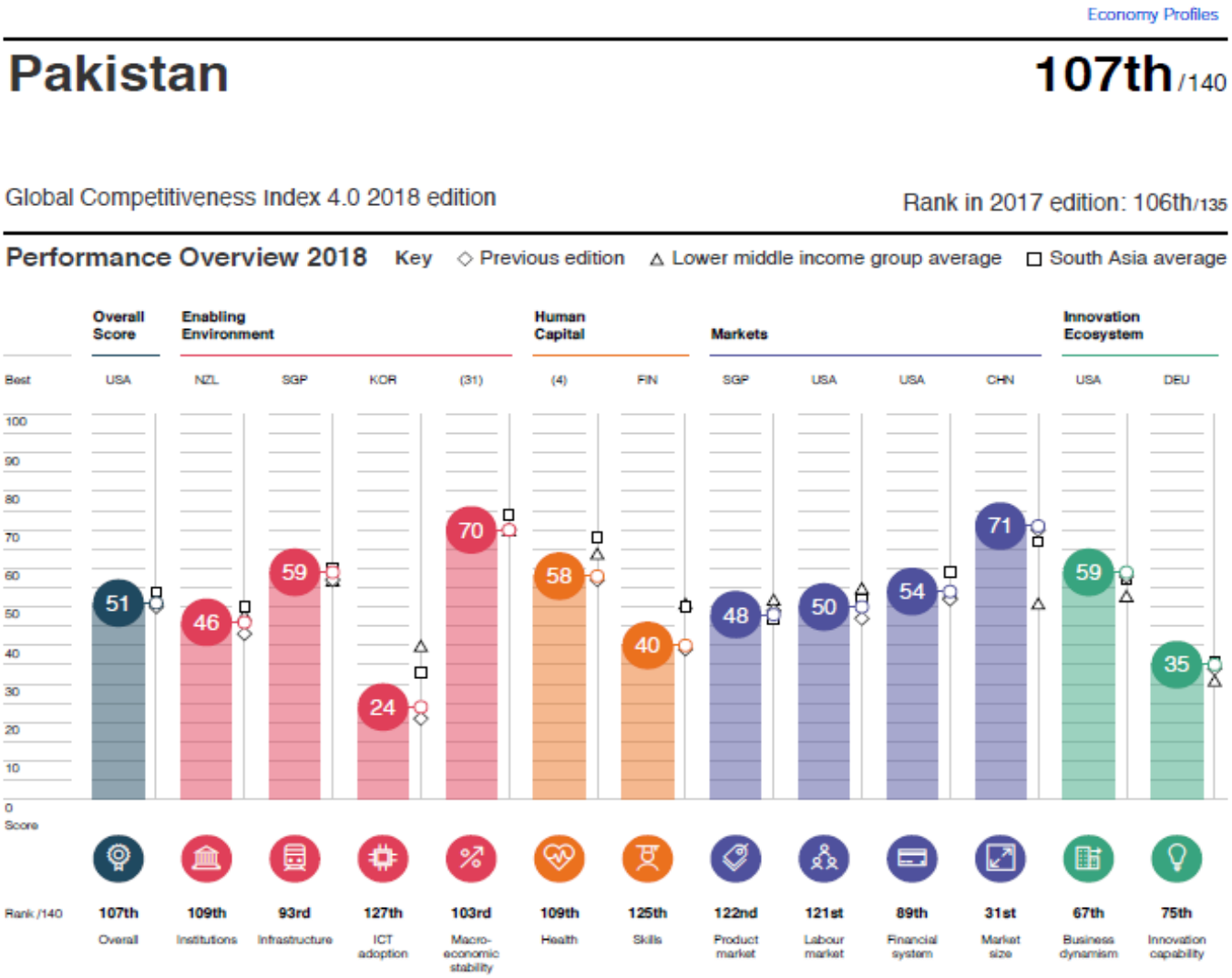


Figure 4.6 The Global Competitiveness Report 2018-World Economic Forum

Pillar 2: Infrastructure 0-100 (best)	-	**59.0** ↑	**93**	**Singapore**
2.01 Road connectivity index 0-100 (best)	66.9	66.9 =	62	United States
2.02 Quality of roads 1-7 (best)	3.9	49.1 ↓	69	Singapore
2.03 Railroad density km of roads/square km	11.6	29.1 =	52	Multiple (20)
2.04 Efficiency of train services 1-7 (best)	3.8	46.4 ↑	52	Switzerland
2.05 Airport connectivity score	98,082.1	62.2 ↓	41	Multiple (8)
2.06 Efficiency of air transport services 1-7 (best)	4.1	52.3 ↑	89	Singapore
2.07 Liner Shipping Connectivity Index 0–157.1 (best)	33.4	33.4 ↓	49	Multiple (4)
2.08 Efficiency of seaport services 1-7 (best)	4.1	51.3 ↑	69	Singapore
2.09 Electrification rate % pop.	73.6	73.6 ↑	109	Multiple (66)
2.10 Electric power transmission and distribution losses % output	17.1	86.3 ↑	105	Multiple (9)
2.11 Exposure to unsafe drinking water % pop.	34.3	67.0 ↑	112	Multiple (23)
2.12 Reliability of water supply 1-7 (best)	4.0	49.7 ↑	102	Switzerland

The Global Competitiveness Report 2018- World Economic Forum

According to the Global Competitive Index Pakistan is ranked 107th out of 140 countries.

In the infrastructure sector Pakistan lies 93rd out of 140 countries. This rank is really low.

Bangladesh is on 103rd whereas India is on 58th.

4.4. Hard Infrastructure and GDP Growth of Pakistan:

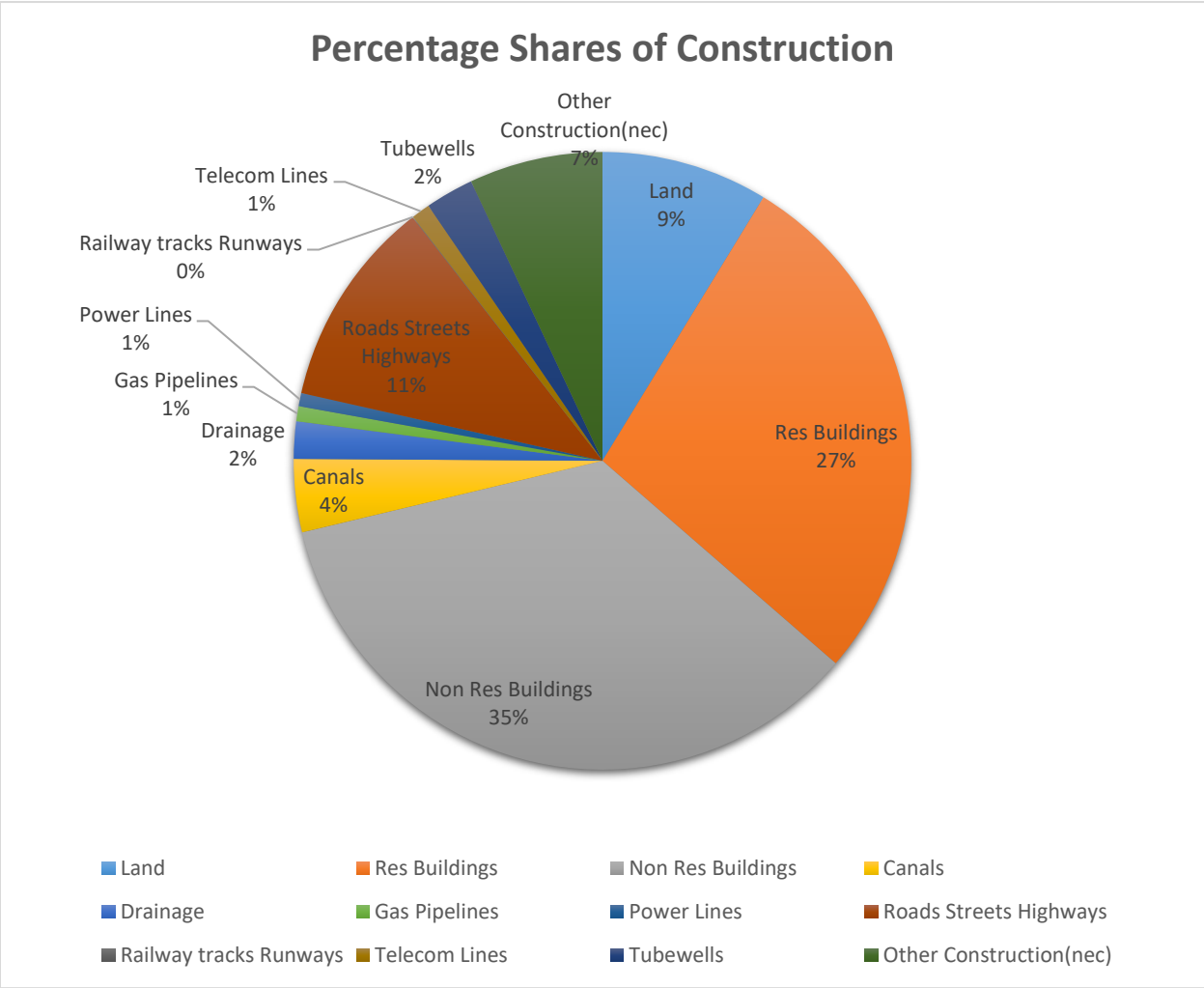


Figure 4.7 Percentage Shares of Construction

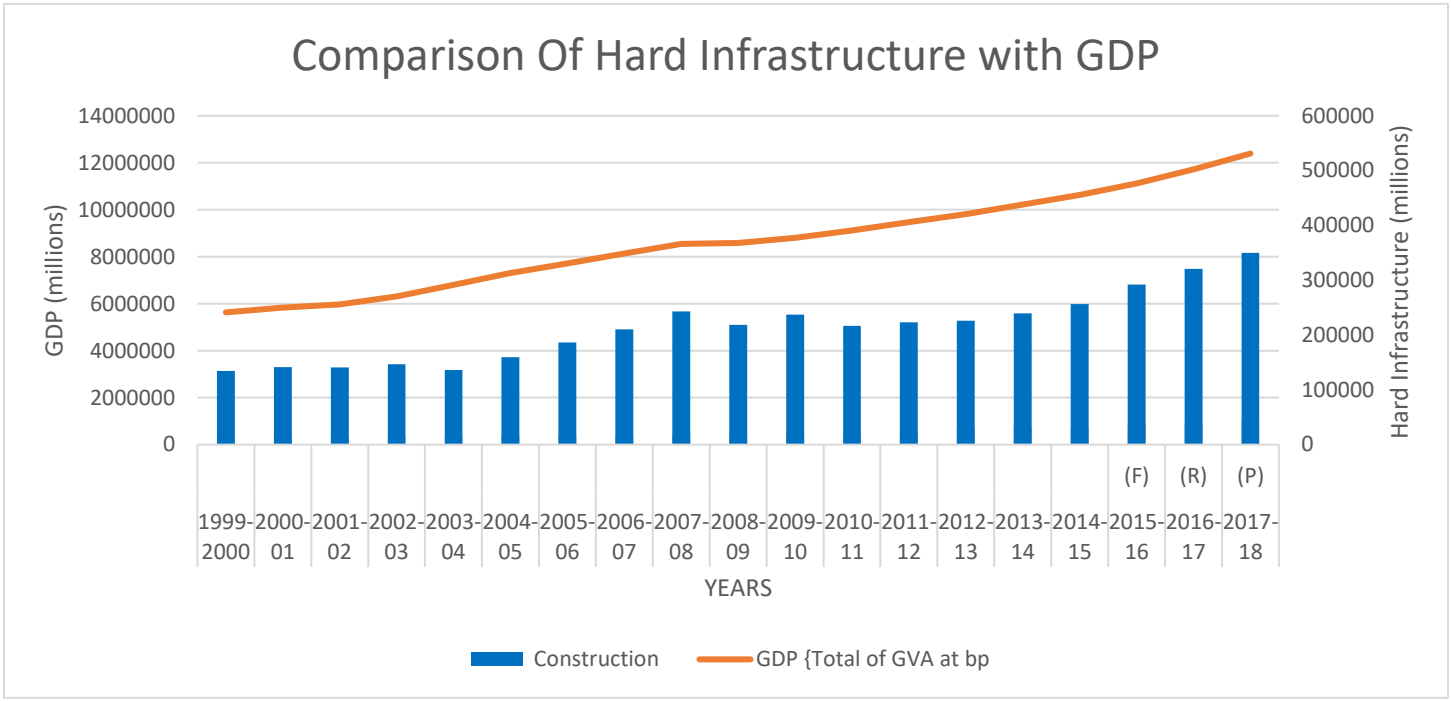


Figure 4.8 Comparison Of Hard Infrastructure with GDP

The trend of GDP and Construction is almost similar as discussed above, but to further study which heads contribute most to GDP we individually compare each head with GDP.

LAND:

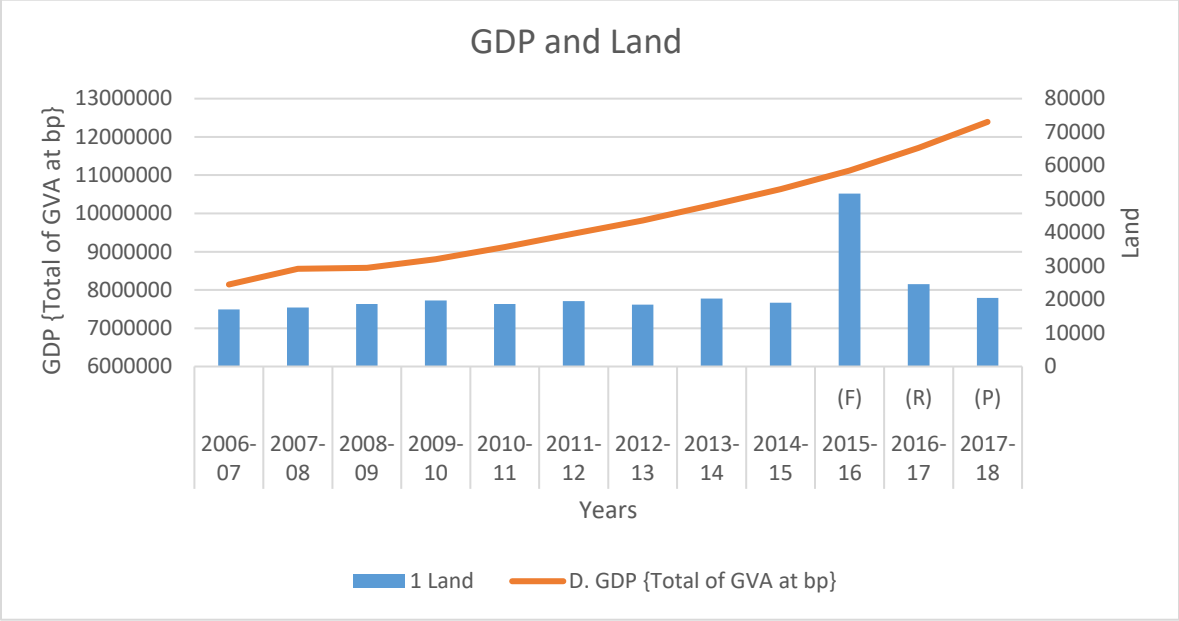


Figure 4.9 Comparison of Land and GDP

Apart from 2015-16 the trend is almost constant. Construction on average contributes 2.5% to the GDP of Pakistan. And Land on average contributes 9% to Construction sector.

Residential Buildings:

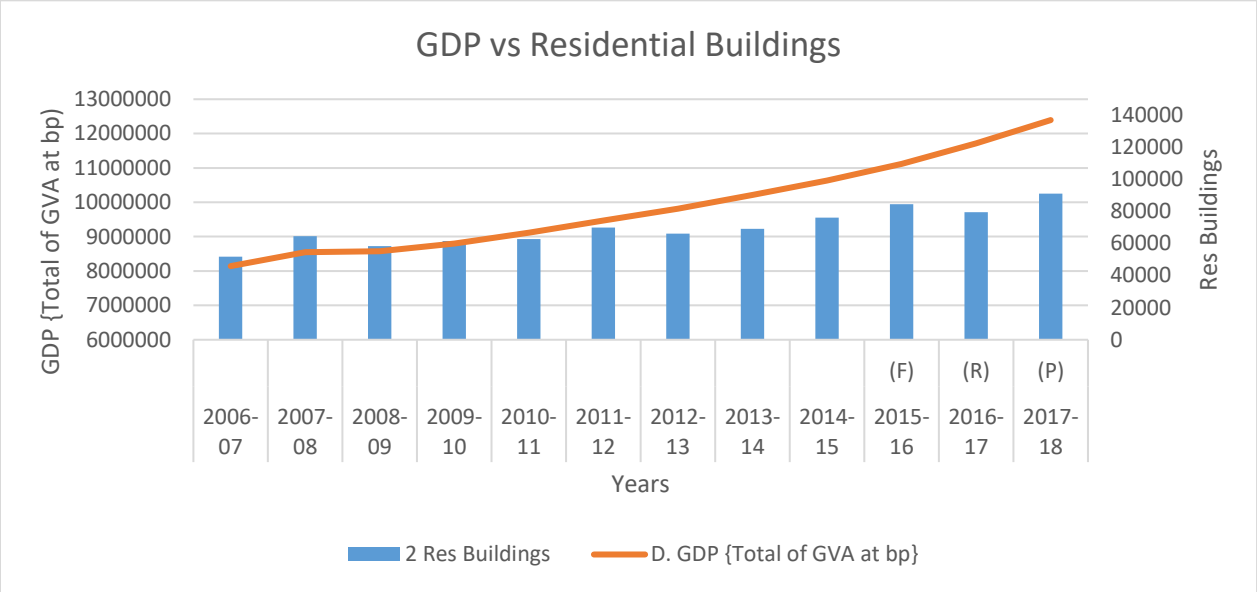


Figure 4.10 Comparison of Residential Buildings and GDP

The trend between Residential Buildings and GDP shows similarity. With time the spending on residential buildings has increased. Construction on average contributes 2.5% to the GDP of Pakistan. And Residential Buildings on average contributes 27% to Construction sector.

Non-Residential Buildings:

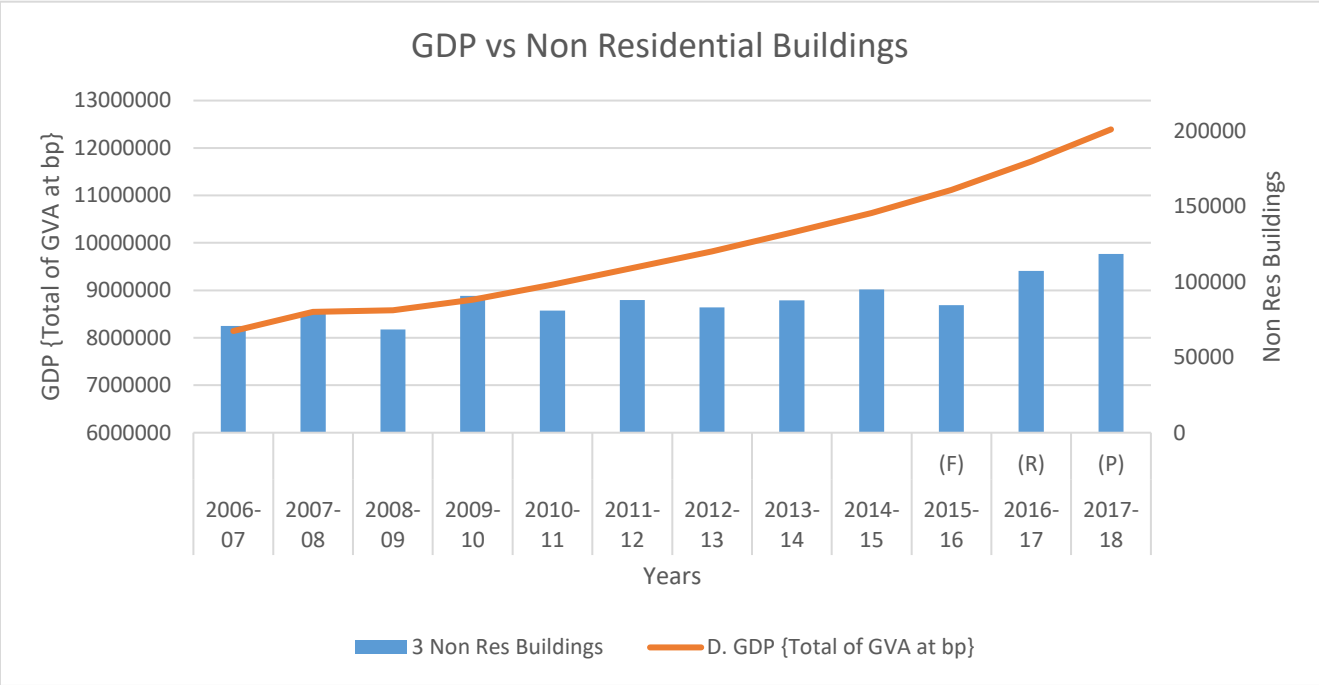


Figure 4.11 Comparison of Non-Residential Buildings and GDP

The trend between Non-Residential Buildings and GDP is like the previous comparison. With time the spending on Non-Residential buildings has increased. Construction on average contributes 2.5% to the GDP of Pakistan. And Non-Residential Buildings on average contributes 35% to Construction sector. Which is the largest contribution to the construction sector as of yet.

Canals:

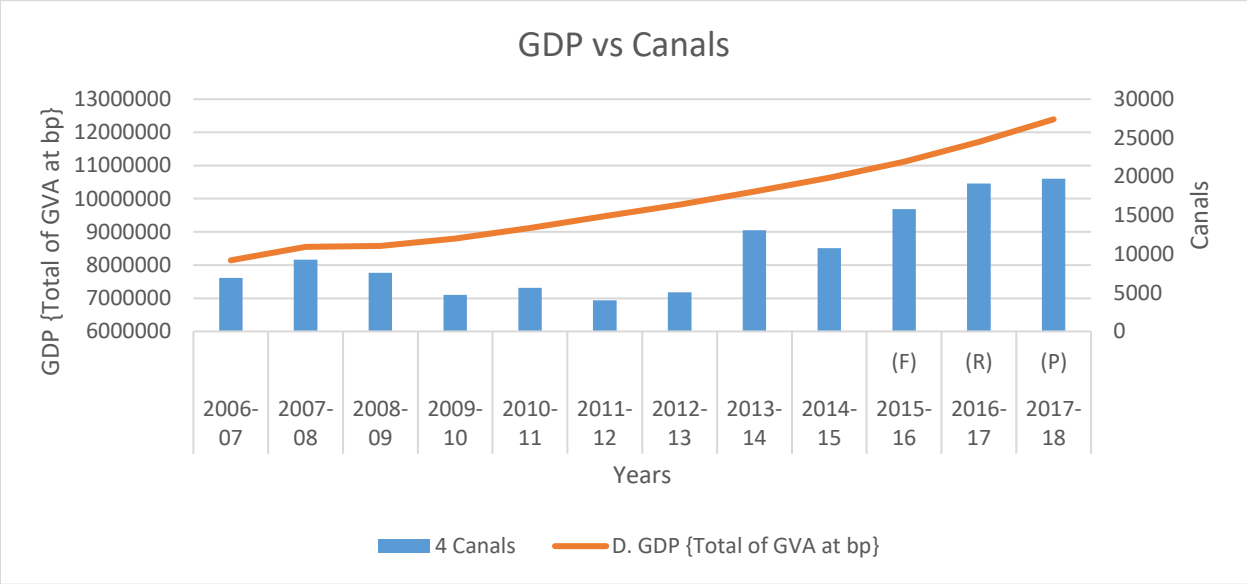


Figure 4.12 Comparison of Canals and GDP

Drainage:

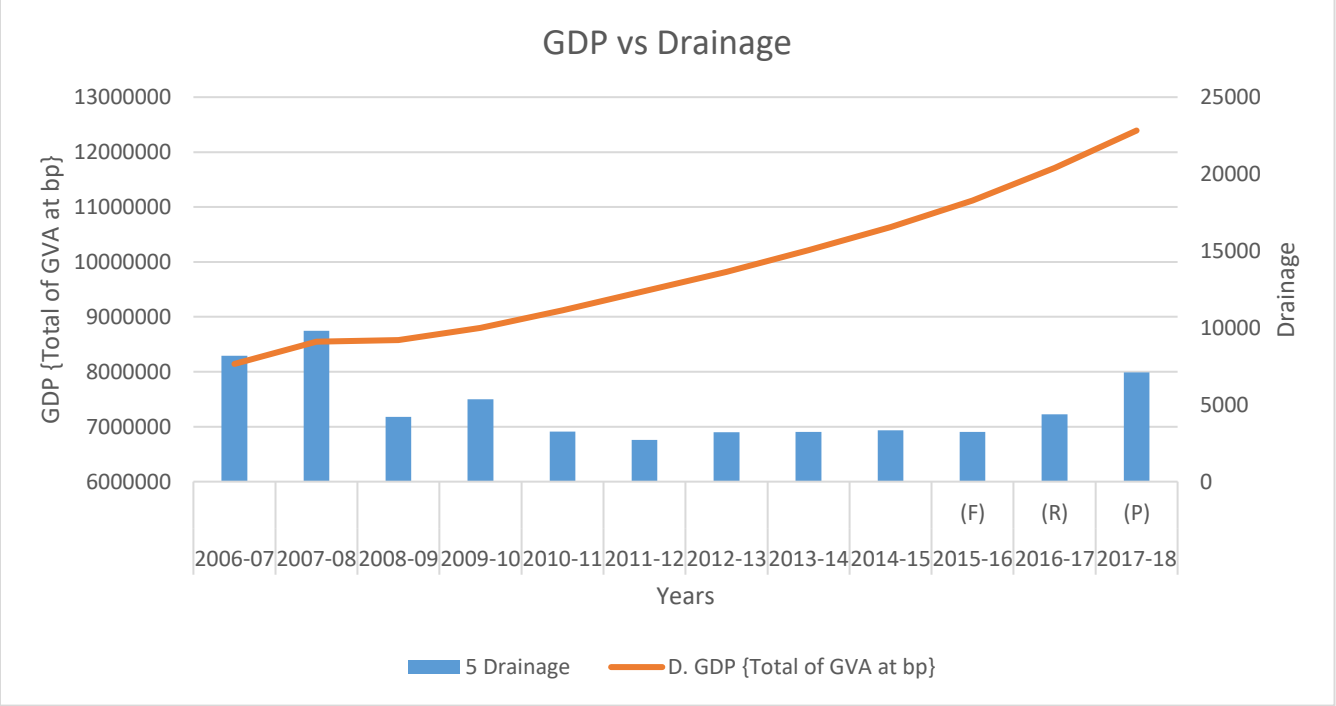


Figure 4.13 Comparison of Drainage and GDP

Power lines:

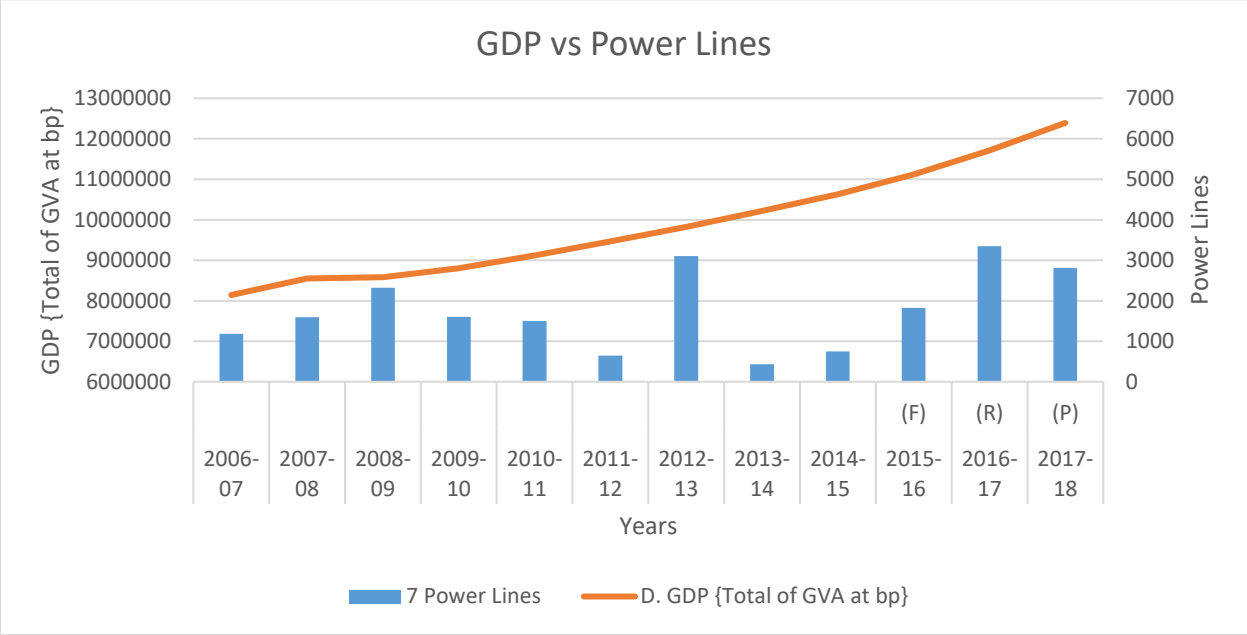


Figure 4.14 Comparison of Power Lines and GDP

Gas Pipelines:

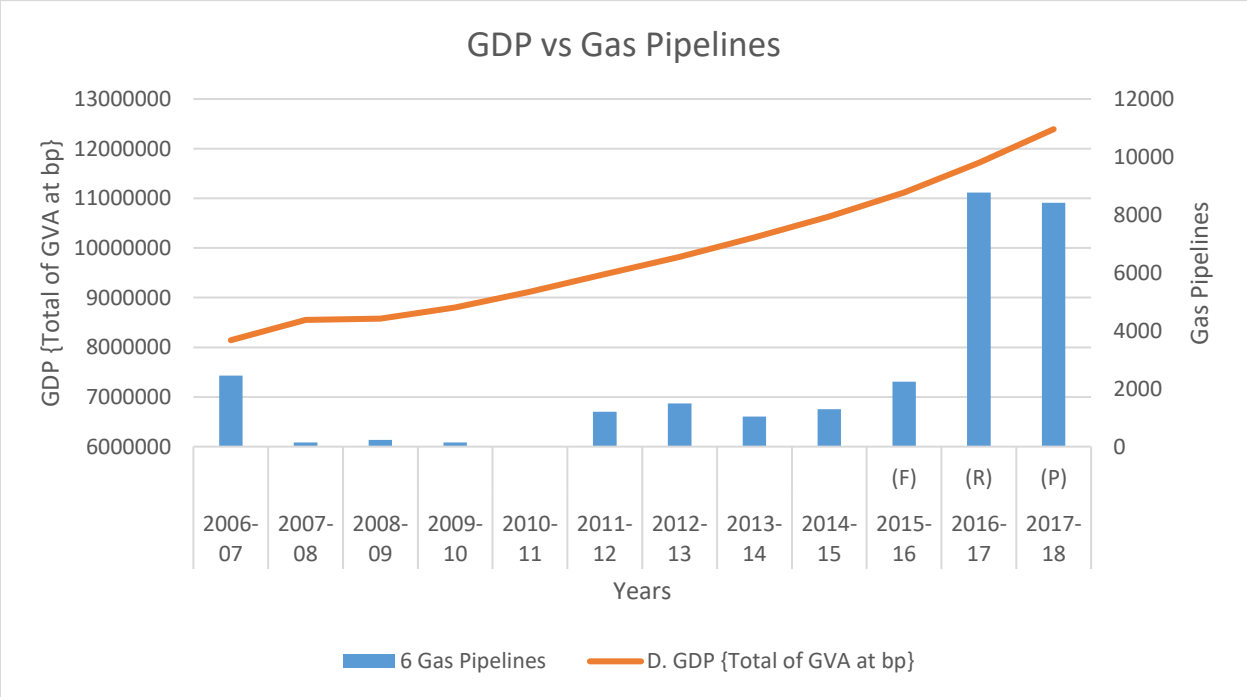


Figure 4.15 Comparison of Gas Pipelines and GDP

Roads Streets Highways:

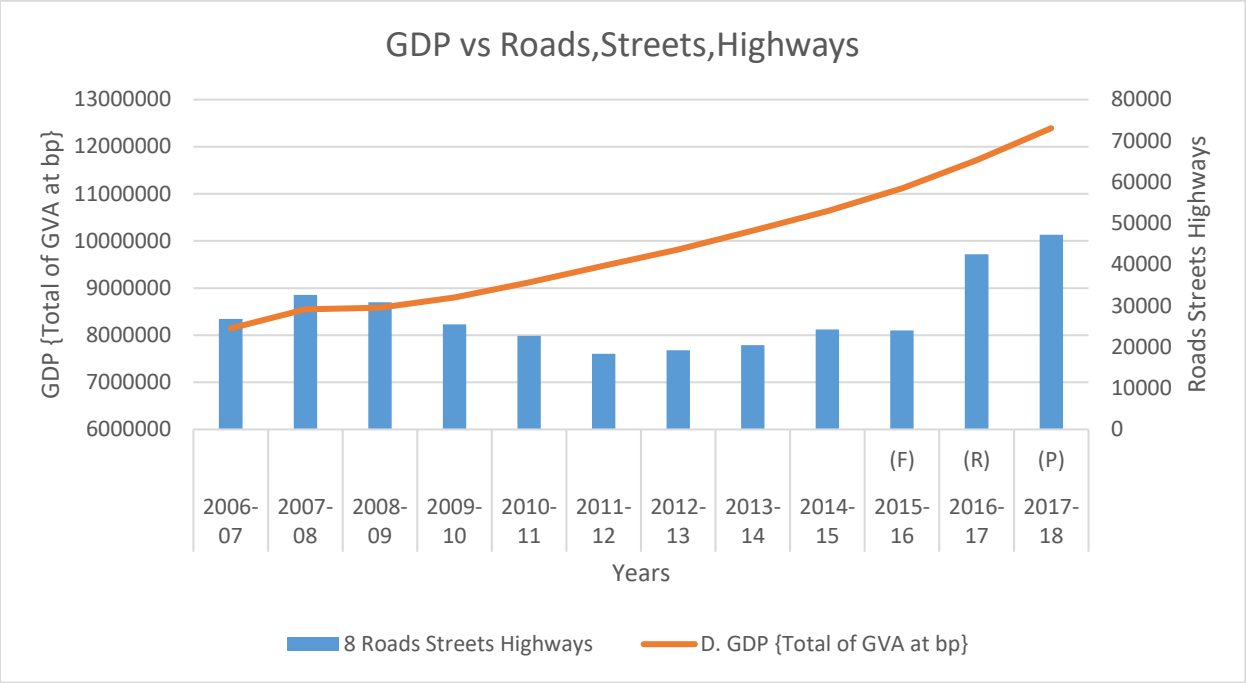


Figure 4.16 Comparison of Roads, Streets, Highways and GDP

The comparison between roads, streets, highways and GDP shows that there was a decline in spending on the said sector from 2007 till 2012 and things took a great turn. Spending on roads, streets and highways increased as the GDP of Pakistan also rose.

Railway Track, Runways:

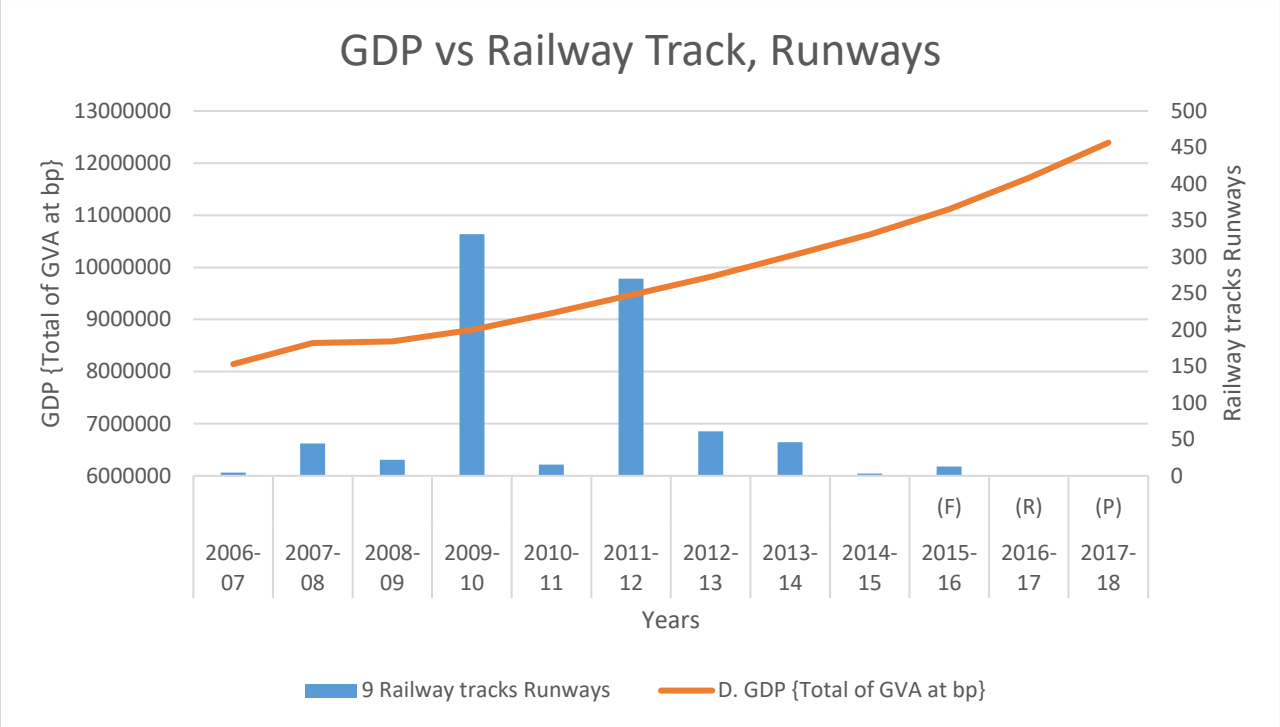


Figure 4.17 Comparison of Railway Track, Runways and GDP

The relationship shows that there has been minimal to zero investment in the railway tracks and runways sector of Pakistan except the years 2009-2010 and 2011-2012. Since the formation of Pakistan, no new railway tracks have been laid and in 10 years only one new airport has been constructed.

Telecom Lines:

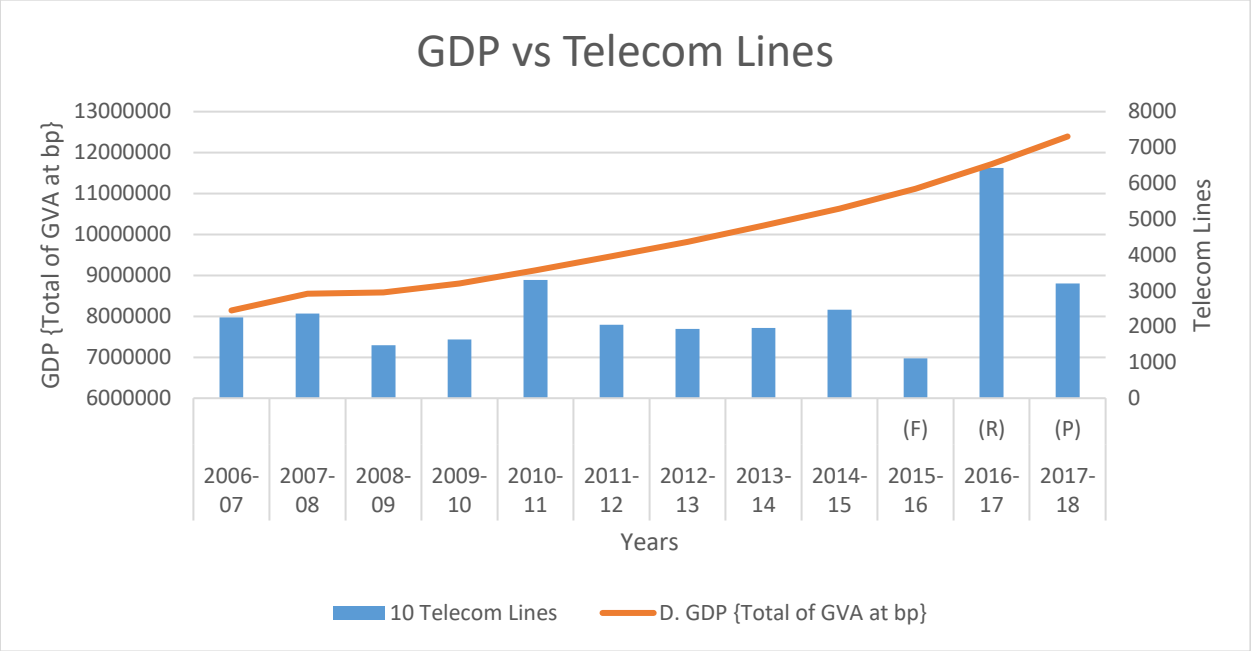


Figure 4.18 Comparison of Telecom Lines and GDP

Tube wells:

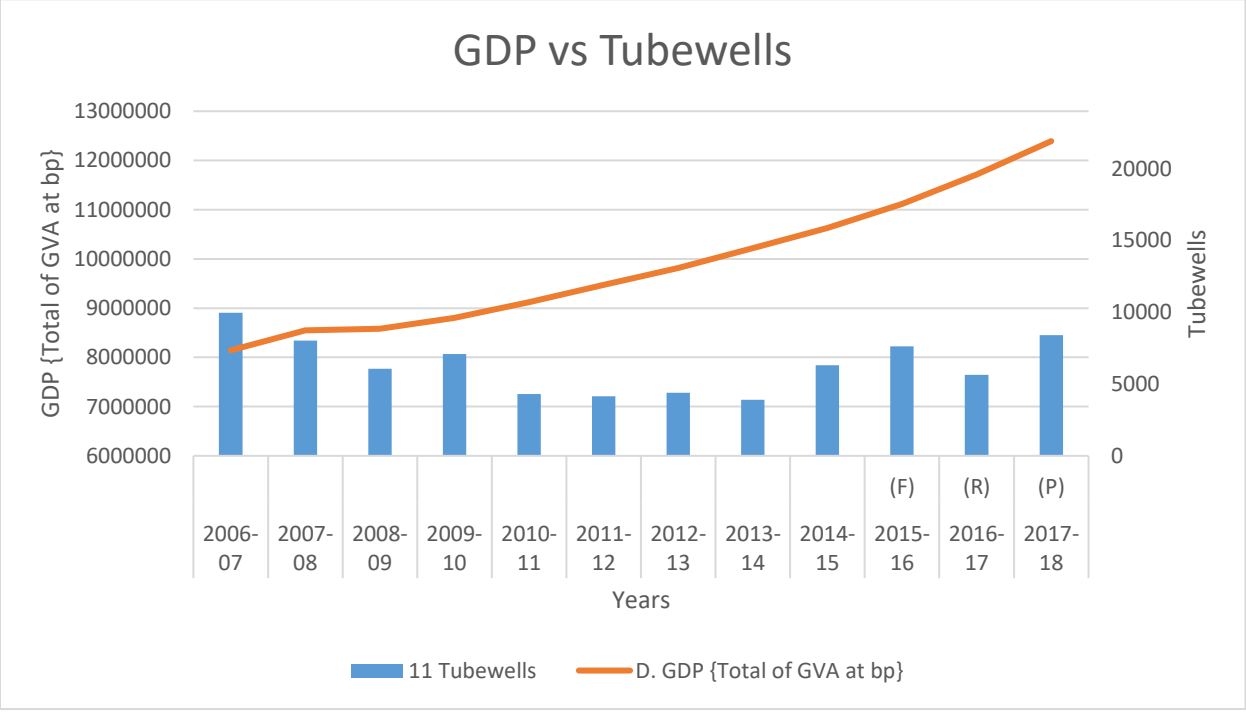


Figure 4.19 Comparison of Tube Wells and GDP

GDP vs Other Construction:

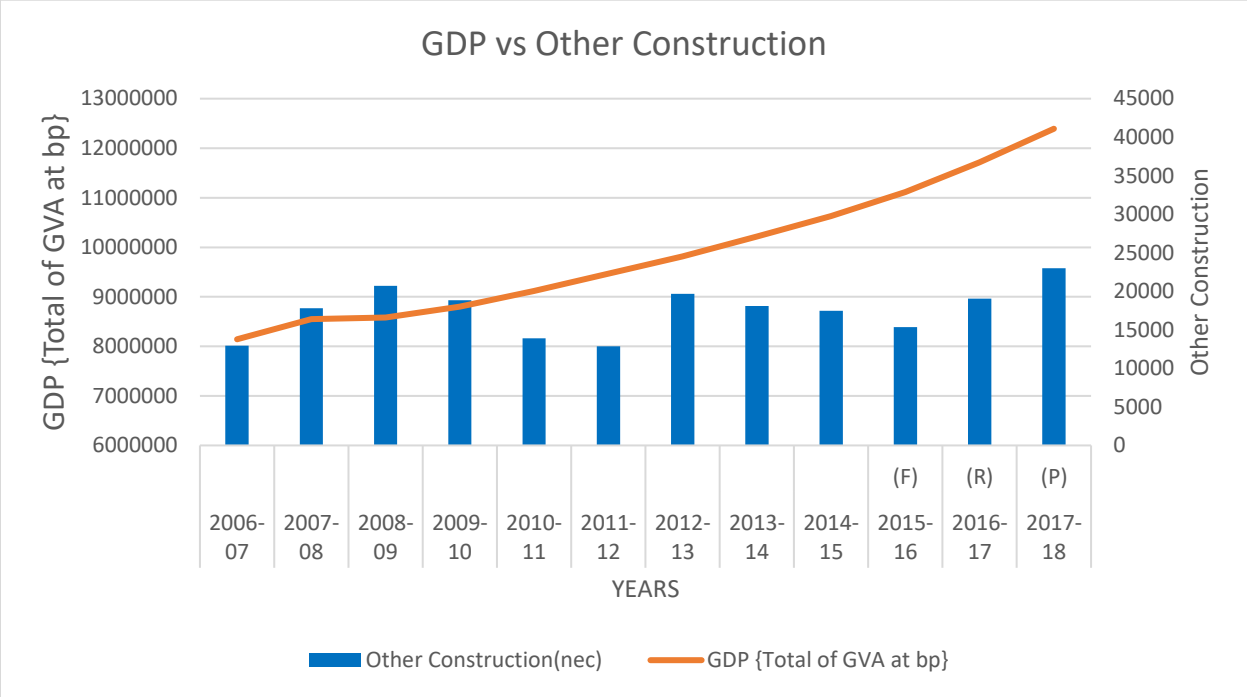


Figure 4.20 Comparison of Other Construction and GDP

4.5. Regression Analysis: GDP versus Components of Hard Infrastructure:

Regrouping:

Since our variables were 12, we regroup our heads into 5 categories.

We group the heads into 5 major categories for ease of analysis and running the test. The grouping is as follows.

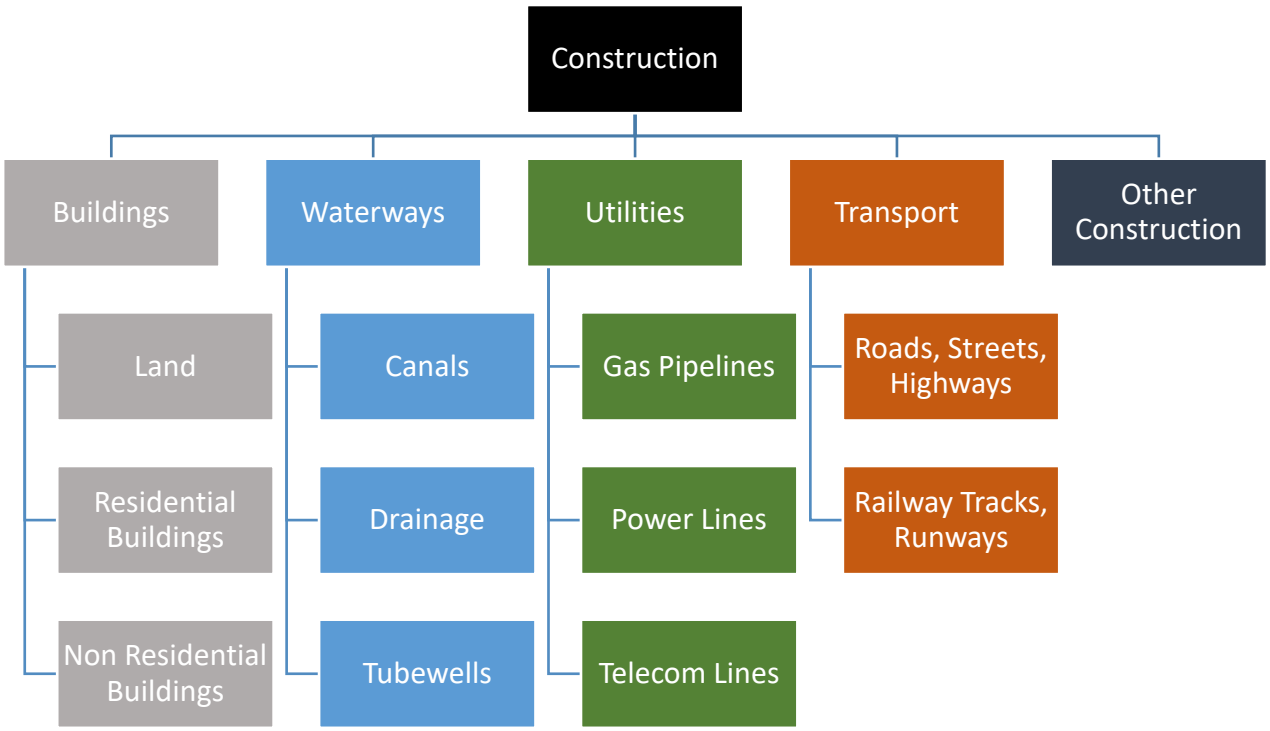


Figure 4.21 Regrouping of heads

Graphical Comparison:

GDP vs Buildings:

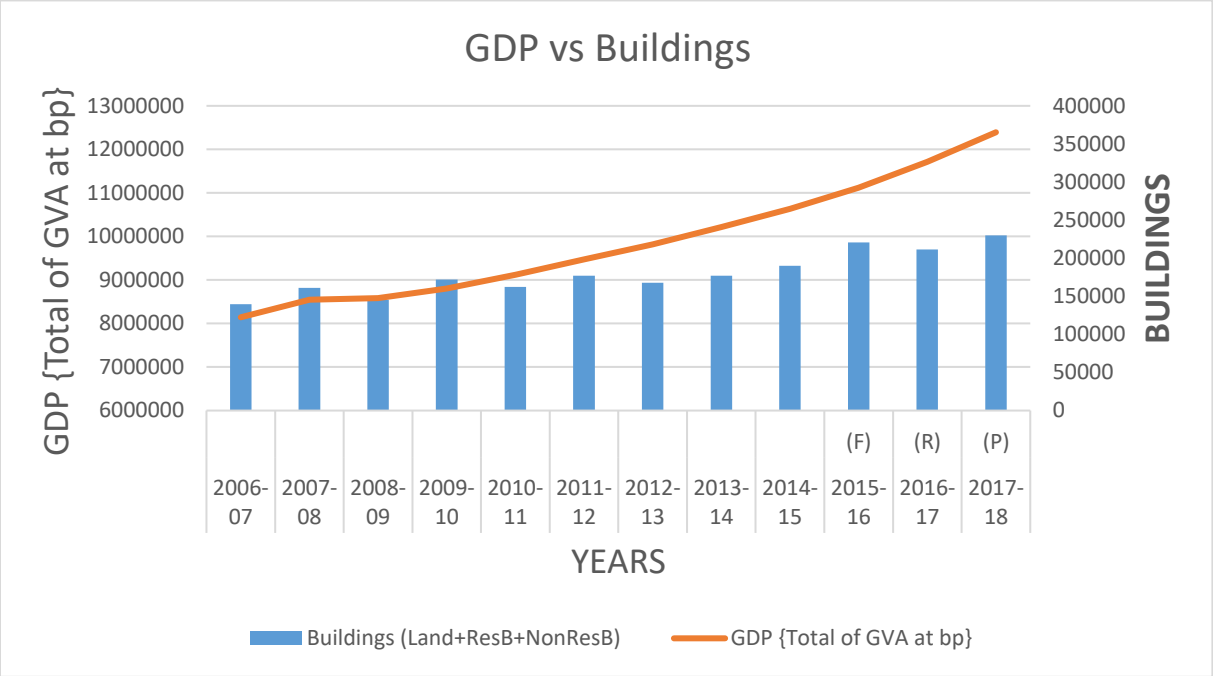


Figure 4.22 Comparison of Buildings and GDP

The trend between Residential Buildings and GDP shows similarity. With time the spending on buildings has increased. The trend is almost constant for 10 years. If we boost our investments in the buildings sector, our GDP will benefit from it substantially.

GDP vs Waterways:

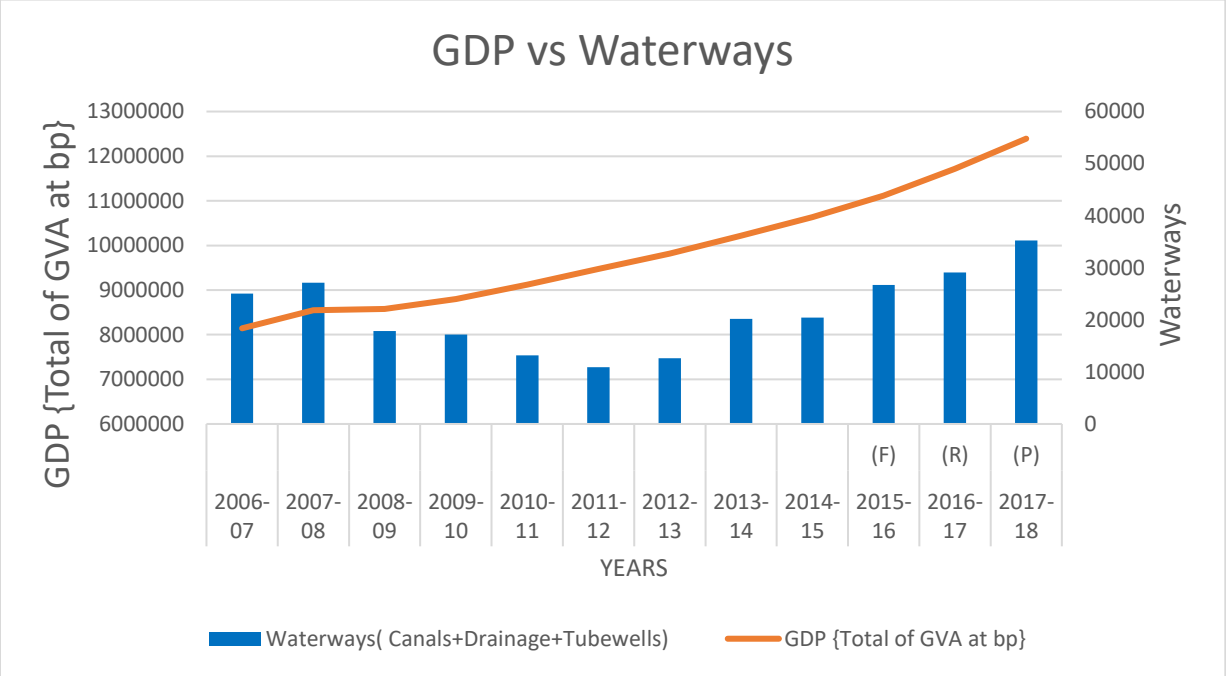


Figure 4.23 Comparison of Waterways and GDP

The waterways include the canals, drainage systems and the tube wells. Analyzing them individually didn't give a satisfactory relationship. We can see that from the year 2008 till 2012 there has been a drop in the value added by waterways. Where as after 2012 the trend has been similar to that of GDP. Both increased.

GDP vs Transport:

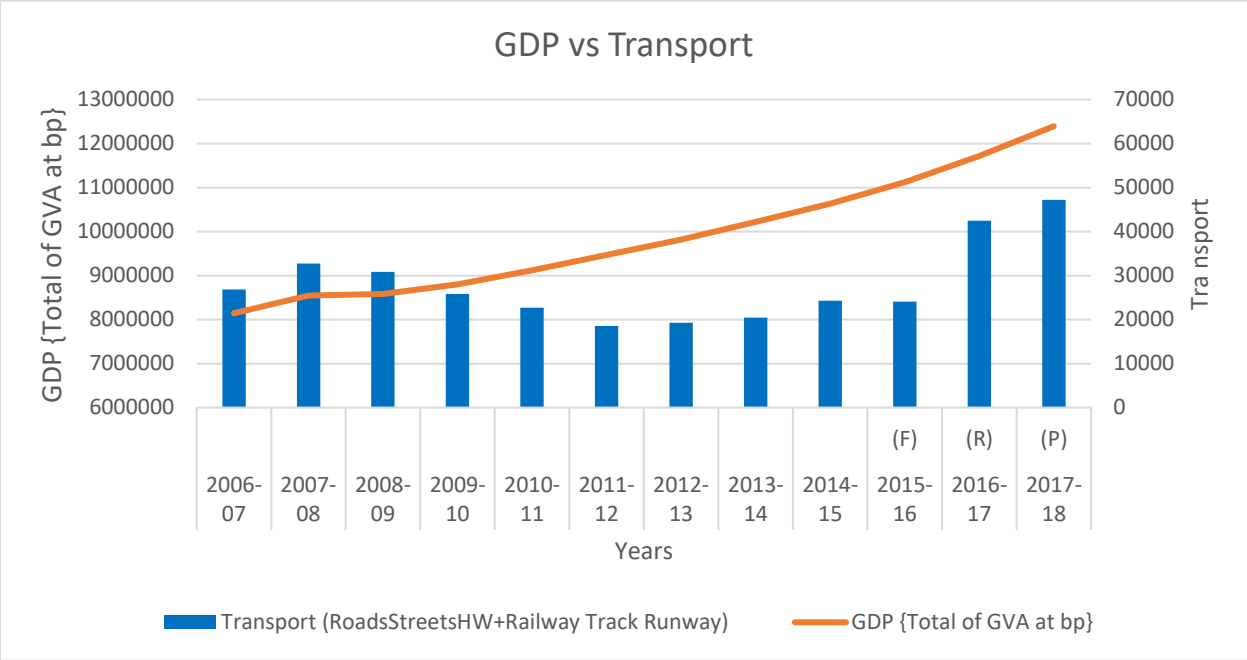


Figure 4.24 Comparison of Transport and GDP

Transport includes the roads, streets, highways, railway tracks and runways. Transportation is the backbone of the economy but in Pakistan the spending on transportation sector is very less. From 2008 till 2012 there has been a slight decrease in expenditure on transport but otherwise the trend is similar to that of GDP.

GDP vs Utilities:

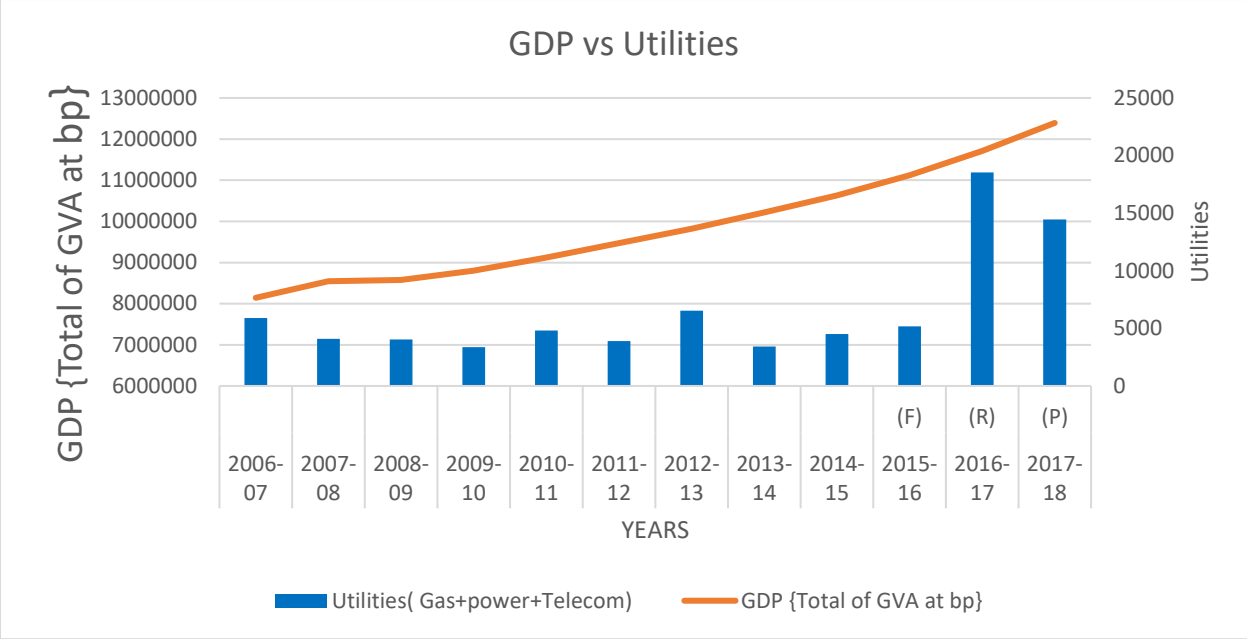


Figure 4.25 Comparison of Utilities and GDP

Utilities that include the Gas, power and telecom lines have shown a constant trend from 2006 to 2015 but during the fiscal years of 2015-2016 and 2017-2018 the investment in the utilities increased. It shows a similar relation with the GDP of Pakistan.

GDP vs Other Construction:

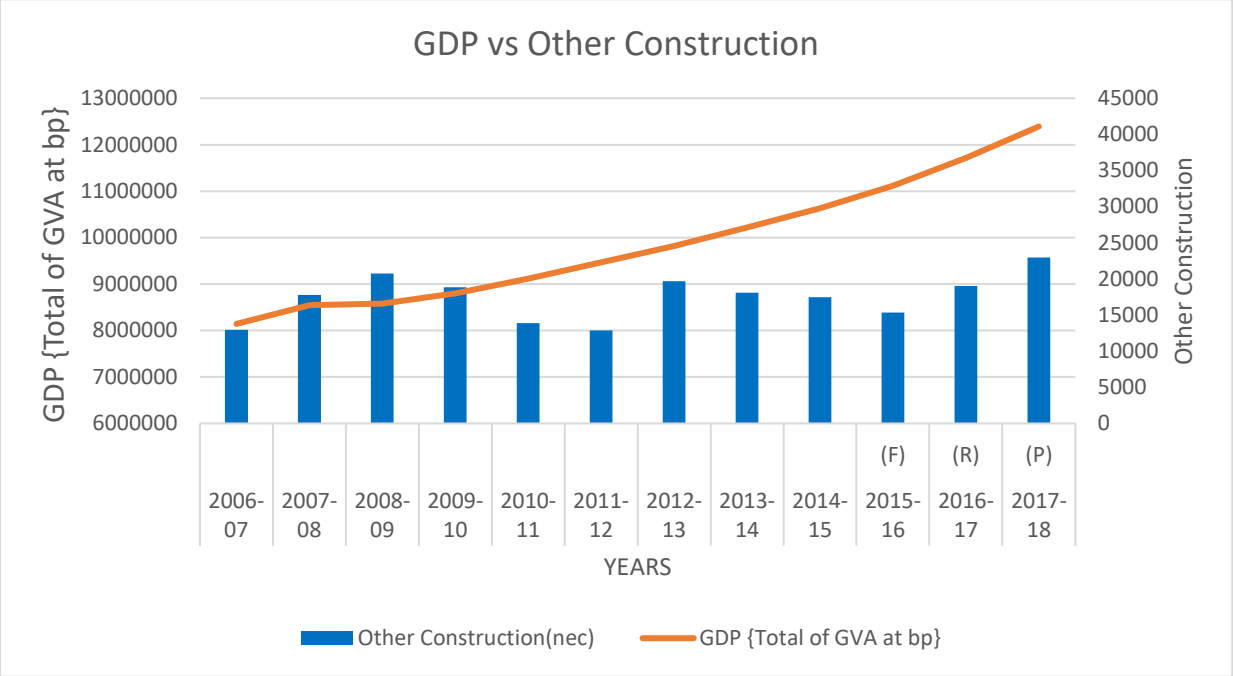
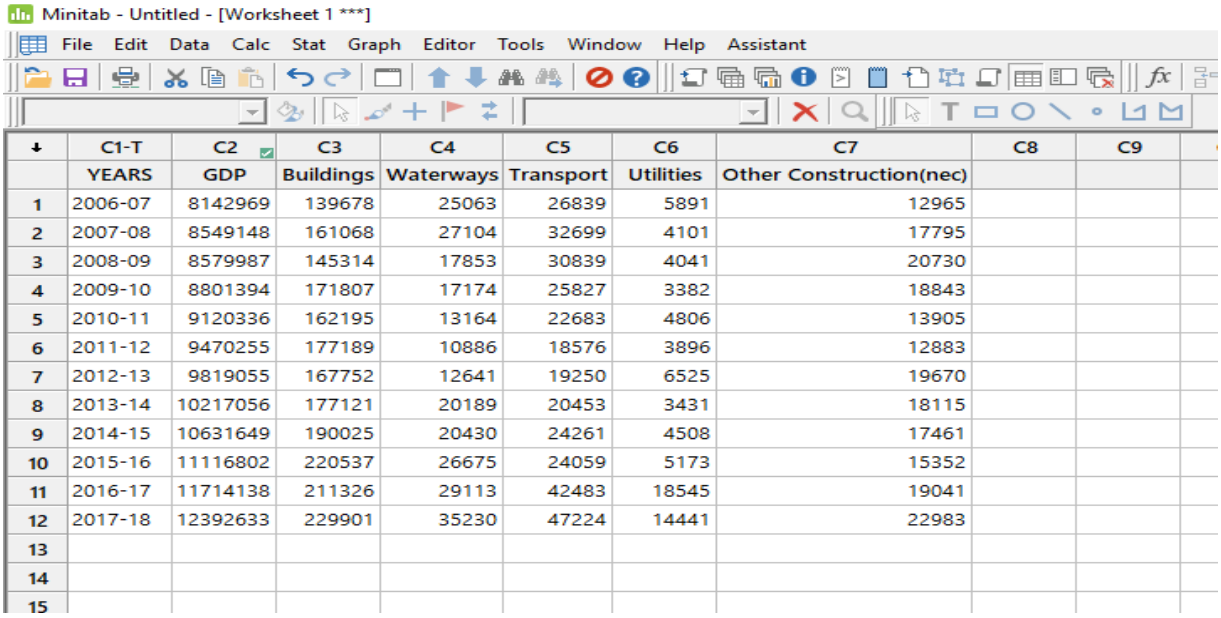


Figure 4.26 Comparison of Other Construction and GDP

All other activities related to construction that do not fall in specific heads are studied as 'other construction'. Other construction has shown a dissimilar trend with the GDP as the values are increasing, decreasing and then increasing again.

Data:


Minitab - Untitled - [Worksheet 1 ***]

File Edit Data Calc Stat Graph Editor Tools Window Help Assistant

	C1-T	C2	C3	C4	C5	C6	C7	C8	C9
	YEARS	GDP	Buildings	Waterways	Transport	Utilities	Other Construction(nec)		
1	2006-07	8142969	139678	25063	26839	5891	12965		
2	2007-08	8549148	161068	27104	32699	4101	17795		
3	2008-09	8579987	145314	17853	30839	4041	20730		
4	2009-10	8801394	171807	17174	25827	3382	18843		
5	2010-11	9120336	162195	13164	22683	4806	13905		
6	2011-12	9470255	177189	10886	18576	3896	12883		
7	2012-13	9819055	167752	12641	19250	6525	19670		
8	2013-14	10217056	177121	20189	20453	3431	18115		
9	2014-15	10631649	190025	20430	24261	4508	17461		
10	2015-16	11116802	220537	26675	24059	5173	15352		
11	2016-17	11714138	211326	29113	42483	18545	19041		
12	2017-18	12392633	229901	35230	47224	14441	22983		
13									
14									
15									

Regression Test Results:

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	5	1.93864E+13	3.87728E+12	26.14	0.001
Buildings	1	5.21681E+12	5.21681E+12	35.18	0.001
Waterways	1	52123529739	52123529739	0.35	0.575
Transport	1	3.64730E+11	3.64730E+11	2.46	0.168
Utilities	1	8.37147E+11	8.37147E+11	5.64	0.055
Other Construction(nec)	1	4.32904E+11	4.32904E+11	2.92	0.138
Error	6	8.89814E+11	1.48302E+11		
Total	11	2.02762E+13			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
385101	95.61%	91.95%	86.74%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2456211	1040160	2.36	0.056	
Buildings	35.84	6.04	5.93	0.001	2.20
Waterways	19.5	33.0	0.59	0.575	4.48
Transport	-61.0	38.9	-1.57	0.168	9.14
Utilities	119.2	50.2	2.38	0.055	4.33
Other Construction(nec)	85.5	50.1	1.71	0.138	1.85

Regression Equation

GDP = 2456211 + 35.84 Buildings + 19.5 Waterways - 61.0 Transport + 119.2 Utilities + 85.5 Other Construction(nec)

Interpretation:

P value:

The P value for buildings is less than 0.5 hence we can justify that our independent variable i.e. BUILDINGS has a significant effect on the GDP of Pakistan and a relationship exists with an acceptable level of risk. Which was also shown in the graph,

The P value for utilities is close to 0.5 hence we conclude that Utilities has a significant impact on the GDP.

Whereas we cannot conclude about the rest of the variables if they play a significant role in the GDP of Pakistan or not, i.e. waterways, transport, other construction.

R-sq:

The higher the R square value, the better the model explains your data.
R-sq=95.61%
According to the R-sq value of our results, the model fits well and can be used for predicting future values.

Coefficients:

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2456211	1040160	2.36	0.056	
Buildings	35.84	6.04	5.93	0.001	2.20
Waterways	19.5	33.0	0.59	0.575	4.48
Transport	-61.0	38.9	-1.57	0.168	9.14
Utilities	119.2	50.2	2.38	0.055	4.33
Other Construction(nec)	85.5	50.1	1.71	0.138	1.85

The variables Buildings and Utilities are significant. Hence, If there is 1 unit increase in Buildings (1 million) then there is a positive increment of 35.84 units (35.84 million) in the GDP.

If there is 1 unit increase in utilities (1 million) then there is an increment of 119.2 units (119.2 million) in the GDP.

If there is 1 unit increase in waterways (1 million) then there is a positive increment of 19.5 units (19.5 million) in the GDP.

If there is 1 unit increase in transport (1 million) then there is a decrement of 61 units (61 million) in the GDP.

If there is 1 unit increase in ‘other construction’ (1 million) then there is an increment of 85.5 units (85.5 million) in the GDP.

The Positive signs show a direct relation between: -
1. GDP and Buildings
2. GDP and Water ways
3. GDP and Other Construction.
4. GDP and Utilities

and an inverse relation between GDP and Transport.

The P values for Water ways, transport and other construction are not less than 0.5 hence they are not significant. In the data set that we acquired, the results of the analysis infer that Transport, waterways and other construction don't play a significant role. The regression model can be used for future prediction if the same trend is continued in the next years.

We can conclude from the results that in Pakistan a significant role in the GDP is being played by Building construction and Utilities. And also, it can be concluded that rest of the sectors are being neglected. There would be a great impact if those are increased.

Chapter # 5

CONCLUSIONS

5.1 Conclusion

5.1.1 Hard and Soft infrastructure and GDP:

Hard and soft infrastructure directly affect the GDP of Pakistan. It is clear through the regression test that they play a significant role. There has been more expenditure on the soft infrastructure (General Government Services) in Pakistan even though its effect on the GDP is less as compared to Hard Infrastructure as shown by the regression tests.

5.1.2 Comparison with Other Countries (Hard Infrastructure):

Comparison with other countries of interest i.e. China, India, Malaysia and UAE.

Through graphical analysis shows that Pakistan lacks a great deal in its GDP from these countries. Also the percentage share of construction in the GDP is way less than these countries. Pakistan has an average share of 2.5% in its GDP for construction whereas for India it is 7.25%.

According to the global competitiveness index by the world economic forum Pakistan lies on 107^{th} rank and in infrastructure it lies on 93^{rd}. The reason being that in comparison to other countries Pakistan spends less on infrastructure.

5.1.3 Hard Infrastructure and GDP:

The components of hard infrastructure were analyzed individually and then in the form of groups. Different trends were shown but the regression tests show that buildings and utilities play a greater role in the GDP of Pakistan. This is because over the years there has been emphasis on the buildings only, no new railway tracks have been laid, neither a large number of airports have been constructed. There is little emphasis on the drainage, construction of canals and tube wells which is thought provoking as well.

The results show that the government should invest more in construction and in sub sectors of waterways and transport in particular.

5.2 Recommendations:

1. Using interpolation on the data provided by Pakistan bureau of statistics determine the previous trends and determine the more accurate relationship between GDP and infrastructure spending.
2. Conduct more tests to study the correlation of different subsectors of construction on the GDP of Pakistan.
3. Extensive analysis could be performed by comparing our results with a developing country that has an economy similar to that of Pakistan.
4. Determine a correlation of sectors that contribute to GDP like agriculture, services etc and compare it with that of infrastructure.
5. Validate the study and present it to the ministry of finance with potential infrastructure policies that could yield economic growth in Pakistan.

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[i] https://unstats.un.org/unsd/publication/seriesf/seriesf_67e.pdf
[ii] http://www.pbs.gov.pk/content/methodology-new-base-2005-06